SIEMENS

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Type 3AH35-SE

Vacuum circuit breaker stored-energy operator module instruction manual

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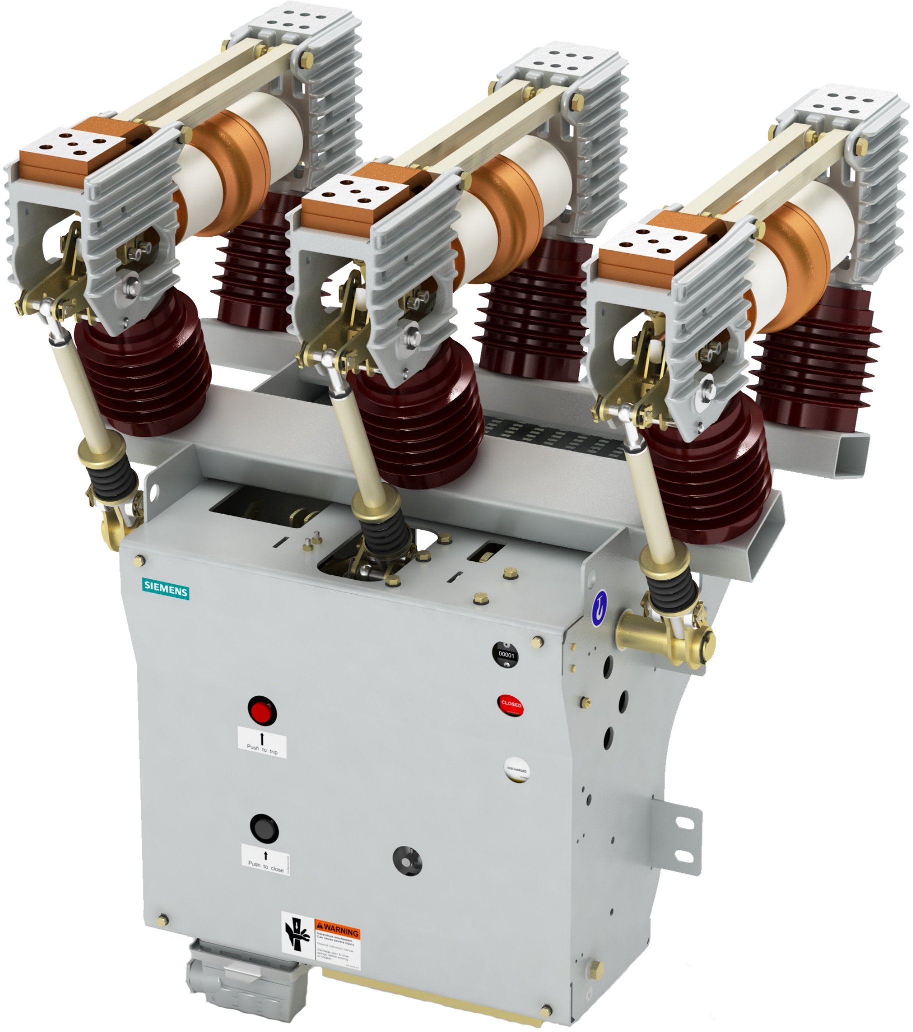

DANGER

Hazardous voltages and high speed moving parts. Will cause death, serious injury or property damage.

Even if the circuit breaker and control circuits have been de-energized for a long time, the power supply capacitors will maintain significant stored energy. Always discharge the capacitors before maintenance. Always de-energize and ground the equipment before maintenance.
Read and understand this instruction manual before using equipment. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause death, severe injury or equipment damage. Follow all safety instructions contained herein.

Important

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligation. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

Qualified person

For the purpose of this instruction manual a **qualified person** is one who has demonstrated skills and knowledge related to the installation, construction and operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

- **Is trained and authorized** to de-energize, clear, ground and tag circuits and equipment in accordance with established safety procedures.
- **Is trained** in the proper care and use of protective equipment, such as: rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- **Is trained** in rendering first aid.

Further, a qualified person shall also be familiar with the proper use of special precautionary techniques, personal protective equipment, insulation and shielding materials, and insulated tools and test equipment. Such persons are permitted to work within limited approach of exposed live parts operative at 50 volts or more, and shall, at a minimum, be additionally trained in all of the following:

- The skills and techniques necessary to distinguish exposed energized parts from other parts of electric equipment
- The skills and techniques necessary to determine the nominal voltage of exposed live parts
- The approach distances specified in NFPA 70E® and the corresponding voltages to which the qualified person will be exposed
- The decision-making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.

Index

Note:
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, operation or maintenance. Should further information be desired or should particular problems arise that are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office.

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 obligation of Siemens Industry, Inc. The warranty contained in the contract between the parties is the sole warranty of Siemens Industry, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

Introduction

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Introduction

The type 3AH35-SE vacuum circuit breaker stored-energy module is designed to meet all applicable ANSI, NEMA, IEEE, and IEC standards. Successful application and operation of this equipment depends as much upon proper installation and maintenance by the user as it does upon the proper design and fabrication by Siemens.

The purpose of this instruction manual is to assist the user in developing safe and efficient procedures for the installation, maintenance and use of the equipment.

Contact the nearest Siemens representative if any additional information is desired.

Signal words

The signal words “danger,” “warning” and “caution” used in this manual indicate the degree of hazard that may be encountered by the user. These words are defined as:

Danger – Indicates an imminently hazardous situation that, if not avoided, **will** result in death or serious injury.

Warning – Indicates a potentially hazardous situation that, if not avoided, **could** result in death or serious injury.

Caution – Indicates a potentially hazardous situation that, if not avoided, **may** result in minor or moderate injury.

Notice – Indicates a potentially hazardous situation that, if not avoided, **may** result in property damage.

Hazardous procedures

In addition to other procedures described in this instruction manual as dangerous, user personnel must adhere to the following:

1. Always work only on a de-energized circuit breaker. The circuit breaker should be isolated, grounded and have all control power removed before performing any tests, maintenance or repair.
2. Always perform maintenance on the circuit breaker after the spring-charged mechanisms are discharged (except for test of the charging mechanisms). Check to be certain that the indicator flags read OPEN and DISCHARGED.
3. Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

Field service operation and warranty issues

Siemens can provide competent, well-trained field service representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair and maintenance of Siemens equipment, processes and systems. Contact regional service centers, sales offices or the factory for details, or telephone Siemens field service at +1 (800) 333-7421 or +1 (423) 262-5700 outside the U.S.

For medium voltage customer service issues, contact Siemens at +1 (800) 333-7421 or +1 (423) 262-5700 outside the U.S.

Technical data and troubleshooting

Introduction

This section provides a description of the inspections, checks and tests to be performed on the circuit breaker stored-energy module only.

The inspections and checks in this section are to be performed with the circuit breaker disconnected and isolated from primary (high-voltage) power sources.

Inspections, checks and tests without control power

Inspections, checks and tests without control power

Vacuum circuit breakers are normally shipped with their primary contacts open and their springs discharged. However, it is critical to first verify the discharged condition of the spring-loaded mechanisms after de-energizing control power.

De-energizing control power

To de-energize control power in the outdoor circuit breaker, open the control power disconnect device in the relay and control compartment.

The control power disconnect device is normally a fused knife switch. Opening the knife de-energizes control power to the circuit breaker operating mechanism. In some outdoor circuit breakers, a molded-case circuit breaker or pullout-type fuse holder may be used in lieu of the fused knife switch. Opening the fused knife switch, or molded-case circuit breaker, or removing the pullout-type fuse holder accomplishes the desired result: control power is disconnected.

Spring-discharge check

Perform the spring-discharge check after de-energizing control power. This check assures both the tripping and closing springs are fully discharged. Refer to Figure 1: Operator panel controls of circuit breaker and manual charging of closing spring.

1. Press red Trip pushbutton.
2. Press black Close pushbutton.
3. Press red Trip pushbutton again.
4. Verify spring-condition indicator shows DISCHARGED.
5. Verify main contact status indicator shows OPEN.

Manual-spring charging check

1. Insert the manual-spring charging crank into the manual-charge handle socket (refer to Figure 1: Operator panel controls of circuit breaker and manual charging of closing spring). Turn the crank clockwise (about 48 revolutions) until the spring-condition indicator shows the closing spring is CHARGED.
2. Repeat the spring-discharge check.
3. Verify the springs are DISCHARGED and the circuit-breaker primary contacts are OPEN by indicator positions.

As-found and vacuum-integrity check tests

Perform and record the results of both the as-found insulation test and the vacuum-integrity check (dielectric) test. Procedures for these tests are described in the Maintenance section of this instruction manual beginning.

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Read instruction manuals, observe safety instructions and use qualified personnel.

Automatic spring-charging check

The automatic spring-charging features of the circuit breaker must be checked. Control power is required for automatic spring charging to take place.

Note: *A temporary source of control power and test leads may be required if the control-power source has not been connected to the circuit breaker. Refer to the specific wiring information and rating label for your circuit breaker to determine the voltage required and where the control-voltage signal should be applied. When control power is connected to the circuit breaker, the closing spring should automatically charge.*

1. Close the control power disconnect device to energize the circuit breaker control circuit. If not previously charged, the closing spring should charge automatically.

2. Use the manual close and open controls on the circuit breaker operating mechanism (refer to Figure 1: Operator panel controls of circuit breaker and manual charging of closing spring) to first close and then open the circuit breaker contacts. Verify contact positions visually by observing the OPEN/CLOSED indicator on the circuit breaker.

3. In step 2, when the close pushbutton was pressed, the circuit breaker should have closed, and the closing spring should have recharged automatically.

4. De-energize control power by opening the control power disconnect.

5. Perform the spring-discharge check.

A. Press red Trip pushbutton.

B. Press black Close pushbutton.

C. Press red Trip pushbutton again.

D. Verify spring-condition indicator shows DISCHARGED.

E. Verify main contact status indicator shows OPEN.

Final mechanical inspections without control power

1. Make a final mechanical inspection of the circuit breaker. Verify the contacts are in the open position, and the closing spring is discharged.

2. Verify mechanical condition of springs.

3. Check for loose hardware.

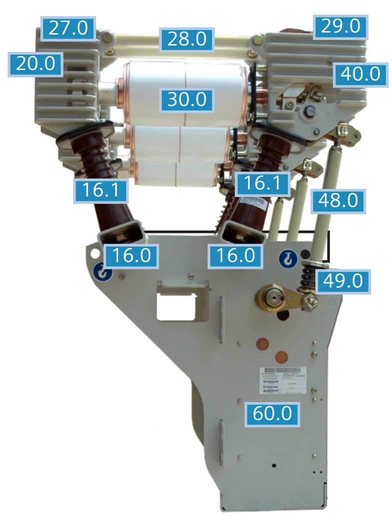
Vacuum interrupter/operator

Figure 1: Operator panel controls of circuit breaker and manual charging of closing spring

Item	Description
50.5	Manual spring charging port
53.0	Close pushbutton
54.0	Open pushbutton
55.0	CHARGED/DISCHARGED indicator
58.0	CLOSE/OPEN indicator
59.0	Operations counter

Figure 2: Vacuum circuit breaker operator module

Item	Description
16.0	Pole support channels
16.1	Post insulator
20.0	Fixed-end pole head
27.0	Fixed-end connection pad
28.0	Strut
29.0	Moving-end connection pad
30.0	Vacuum interrupter
40.0	Moving-end pole head
48.0	Insulating coupler
49.0	Contact pressure spring
60.0	Mechanism housing



Introduction

The type 3AH35-SE vacuum circuit-breaker operator is intended for stationary applications, such as the type SDV7-SE outdoor distribution circuit breaker. The type 3AH35-SE circuit breaker conforms to the requirements of IEC 62271-100 and ANSI/IEEE standards, including C37.04, C37.09, and C37.010.

The circuit breaker includes three vacuum interrupters, a stored-energy operating mechanism, necessary electrical controls and an operator housing. In a typical installation, insulating barriers may be located between the vacuum interrupters.

This section describes the operation of each major subassembly as an aid in the operation, maintenance and repair of the circuit breaker.

Vacuum interrupters

The operating principle of the vacuum interrupter is simple. Figure 3: Vacuum interrupter cutaway view is a section view of a typical vacuum interrupter. The entire assembly is sealed after a vacuum is established. The vacuum interrupter stationary contact is connected to the fixed-end pole head of the circuit breaker. The vacuum interrupter movable contact is connected to the flexible shunt associated with the other pole head and to the driving mechanism of the circuit breaker. The metal bellows provide a secure seal around the movable contact, preventing loss of vacuum while permitting motion of the movable contact along the axis of the vacuum interrupter.

When the two contacts separate, an arc is initiated that continues conduction up to the following current zero. At current zero, the arc extinguishes and any conductive metal vapor that has been created by and supported the arc condenses on the contacts and on the surrounding arc shield.

Contact materials and configuration are optimized to achieve arc motion and to minimize switching disturbances.

Primary connections

Figure 2: Vacuum circuit breaker operator module illustrates the pad provision to accept the primary connections. Each circuit breaker has three connection pads at the fixed end of the vacuum interrupter, and three connection pads on the flexible connectors that are associated with the movable contact of the vacuum interrupter. Interconnecting bus in the circuit breaker enclosure connects these connection pads to the roof bushing terminals. Bolting hardware is M12 x 1.75 grade 8. Torque M12 bolts to 52 ft-lb (70 Nm).

Phase barriers (if applicable)

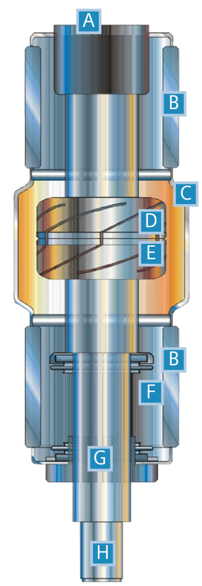
For certain ratings, insulating barriers are attached to the circuit breaker and provide suitable electrical insulation between the vacuum interrupter and primary conductors and the enclosure.

Stored-energy operating mechanism

The stored-energy operating mechanism of the circuit breaker is an integrated arrangement of springs, coils and mechanical devices designed to provide a number of critical functions. The energy necessary to close and open the contacts of the vacuum interrupters is stored in powerful opening and closing springs. The closing springs are normally charged automatically after a closing operation, but there are provisions for manual charging. The operating mechanism that controls charging, closing and tripping functions is fully trip-free. "Trip-free" requires that the tripping function prevail over the closing function as specified in IEEE C37.04 and IEC 62271-100.

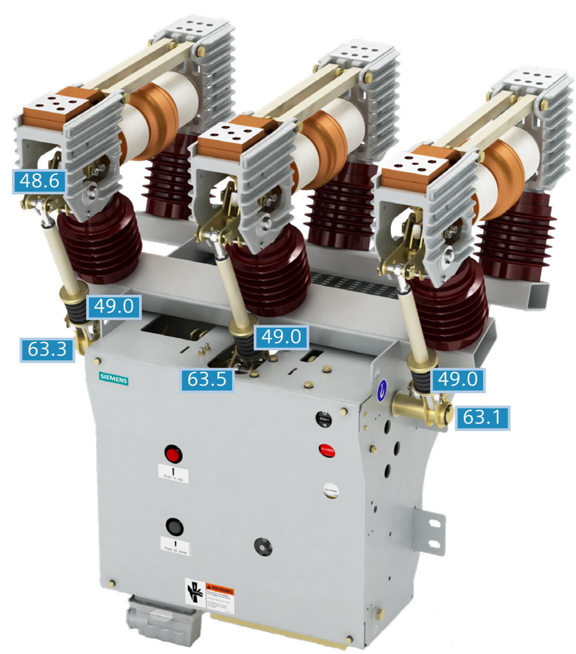
Vacuum interrupter/operator module

The vacuum interrupter/operator module consists of the three poles, each with its vacuum interrupter and primary insulators, mounted above the common operating mechanism housing. This module is shown in Figure 4: Vacuum circuit breaker operator module.



Item	Description
A	Fixed-contact current connection
B	Ceramic insulator
C	Arc shield
D	Fixed contact
E	Moving contact
F	Metal bellows
G	Guide
H	Moving-contact current connection

Figure 3: Vacuum interrupter cutaway view



Item	Description
48.6	Angled lever
49.0	Contact pressure spring
63.1	Lever - phase C
63.3	Lever - phase A
63.5	Lever - phase B

Figure 4: Vacuum circuit breaker operator module

Construction
Each of the circuit breaker poles are fixed to the pole support channel by two cast-resin insulators. The insulators also connect to the fixed- and moving-end pole heads that in turn support the ends of the vacuum interrupter. Refer to Figure 1: Operator panel controls of circuit breaker and manual charging of closing spring and Figure 2: Vacuum circuit breaker operator module, Figure 5: Pole assembly and Figure 6: Stored-enegy operating mechanism (circuit breaker shown in OPEN position).

The energy-storing mechanism and all the control and actuating devices are installed in the operator housing. The mechanism is of the spring stored-energy type and is mechanically and electrically trip free.

The close-open indicator, closing spring-charge indicator and the operation counter are located on the front of the operator housing.

The control connector for the control and signalling cables is a multi-contact plug. The mating control plug wiring connects to the terminal blocks in the relay and control compartment.

Circuit breaker pole (refer to Figure 5 Figure 5: Pole assembly)
The vacuum interrupter is bolted to the fixed-end pole head, which is rigidly connected to the pole support channel by the post insulator. The moving contact end of the vacuum interrupter is stabilized against lateral forces by a centering ring on the moving-end pole head. The external forces due to switching operations and the contact pressure are absorbed by the struts.

Current-path assembly (refer to Figure 5: Pole assembly)
The current-path assembly consists of the fixed-end pole head, the stationary contact and the moving contact, plus a flexible shunt between the moving contact terminal clamp and the moving-end connection pad.

Vacuum interrupter (refer to Figure 5: Pole assembly)
The moving-contact motion is aligned and stabilized by a guide bushing. The metal bellows follows the travel of the contact and seals the vacuum interrupter against the surrounding atmosphere.

Switching operation (refer to Figure 5: Pole assembly and Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position)

When a closing command is initiated, the closing spring (62.0), that was previously charged by hand or by the motor, actuates the moving contact through the jack shaft (63.0), lever (63.1, 63.3 and 63.5), contact pressure spring (49.0), insulating coupler (48.0) and angled lever (48.6).

The forces that occur when the action of the insulating coupler (48.0) is converted into the action of the moving contact along the axis of the vacuum interrupter are absorbed by the guide link (48.9), that pivots on the pole bottom and the eye bolt.

During closing, the opening spring (64.0) (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position) and the contact pressure springs (49.0) are charged and latched by pawl (64.2). The closing spring (62.0) (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position) of the motor-operated circuit breaker is recharged immediately after closing.

In the closed state, the necessary contact pressure is maintained by the contact pressure springs (49.0) and the atmospheric pressure. The contact pressure spring automatically compensates for arc erosion, which is very small.

When a opening command is given, the energy stored in the opening and contact pressure springs (49.0) is released by pawl (64.2). The residual force of the opening spring (64.0) maintains the moving contacts in the open position.

Operating mechanism

The operating mechanism is comprised of the mechanical and electrical components required to:

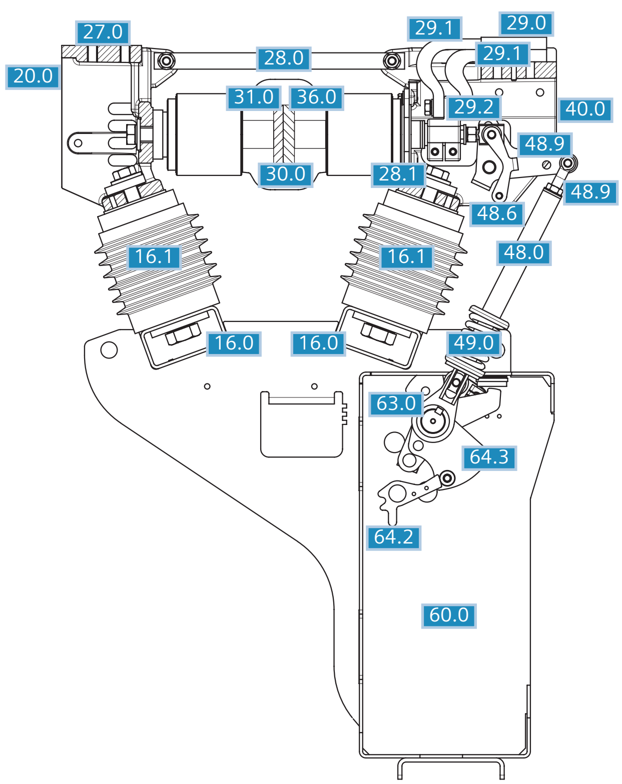
1. Charge the closing spring with sufficient potential energy to close the circuit breaker and to store opening energy in the opening and contact pressure springs.
2. Mechanisms to release closing and opening actions.
3. Means of transmitting force and motion to each of the three vacuum interrupters.
4. Operate all these functions automatically through an electrical charging motor, cutout switches, an anti-pump relay, a close coil, an open coil and an auxiliary switch.
5. Provide indication of the circuit breaker status (OPEN/CLOSED), spring condition (CHARGED/DISCHARGED) and number of operations.

Construction

The essential parts of the operating mechanism are shown in Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position). The control and sequence of operation of the mechanism is described in Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position).

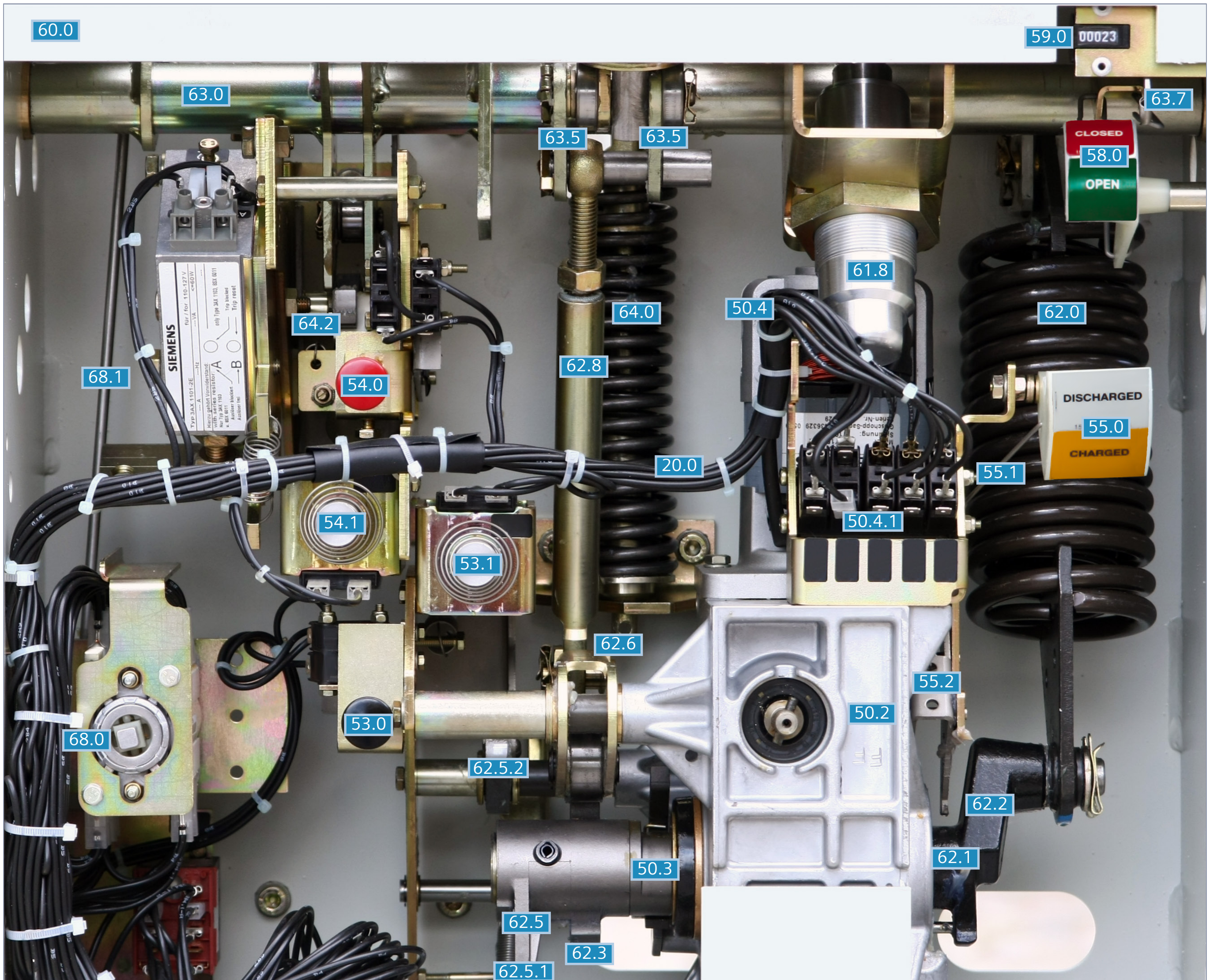
Motor-operating mechanism (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position)

The spring-charging motor (50.4) is bolted to the charging mechanism (50.2) gear box installed in the operator housing. Neither the charging mechanism nor the motor require any maintenance.



Item	Description
16.0	Pole support channels
16.1	Post insulator
20.0	Fixed-end pole head
27.0	Fixed-end connection pad
28.0	Strut
28.1	Centering piece
29.0	Moving-end connection pad
29.1	Flexible connector
29.2	Terminal clamp
30.0	Vacuum interrupter
31.0	Fixed contact
36.0	Moving contact
40.0	Moving-end pole head
48.0	Insulating coupler
48.6	Angled lever
48.9	Guide link
49.0	Contact pressure spring
60.0	Mechanism housing
63.0	Jack shaft
64.2	Trip-latch pawl
64.3	Lever - trip latch

Figure 5: Pole assembly



Item	Description	Item	Description	Item	Description
50.2	Charging mechanism gear box	55.2	Control lever	62.6	Driver lever
50.3	Charging flange	58.0	CLOSE/OPEN indicator	62.8	Straight coupling rod*
50.3.1	Driver (not visible)	59.0	Operations counter	63.0	Jack shaft
50.4	Spring-charging motor (88)	60.0	Operator housing	63.1	Lever phase C (to right of housing)
50.4.1	Limit switches	61.8	Shock absorber		
50.5	Manual spring-charging port	62.0	Closing spring	63.3	Lever phase A (to right of housing)
53.0	Close pushbutton	62.1	Charging shaft		
53.1	Close coil 52SRC	62.2	Crank	63.5	Lever phase B
54.0	Open pushbutton	62.3	Cam disc	63.7	Lever
54.1	Trip coil 52T	62.5	Lever	64.0	Opening spring
55.0	Closing spring-charge indicator	62.5.1	Pawl roller (not visible)	68.0	Auxiliary switch
55.1	Linkage	62.5.2	Close latch pawl	68.1	Auxiliary switch link

Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position)

Mode of operation

The operating mechanism is of the stored-energy trip-free type. The charging of the closing spring is not automatically followed by the contacts changing position, and tripping function prevails over the closing function.

When the stored-energy mechanism has been charged, the mechanism is ready for a closing operation at any time.

The mechanical energy for carrying out an "Open-Close-Open" sequence for auto-reclosing duty is stored in the closing and opening springs.

Charging

The details of the closing spring charging mechanism are shown in Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position). The charging shaft is supported in the charging mechanism gear box (50.2), but is not coupled mechanically with the charging mechanism. Fitted to it are the crank (62.2) at one end, and the cam (62.3), together with lever (62.5), at the other.

When the charging mechanism is actuated by hand with a hand crank (refer to Figure 9: Use of manual spring-operation crank and Figure 10: Manual spring-charging crank) or by a motor (50.4), the charging flange (cam) (62.3) turns until the driver (50.3.1) locates itself in the cutaway part of the charging flange (cam) (62.3), thus causing the charging shaft to follow. The crank (62.2) charges the closing spring (62.0). When the closing spring has been fully charged, the crank actuates the linkage (55.1) via the control lever (55.2) for the closing spring CHARGED indicator (55.0), and actuates the limit switches (50.4.1) for interrupting the motor supply. At the same time, the lever (62.5) at the other end of the charging shaft is securely locked by the close latch pawl (62.5.2). When the closing spring is being charged, the charging flange (cam) (62.3) follows along, and it is brought into position for closing when the closing spring is fully charged.

Closing (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position) and Figure 7: Operating mechanism section diagram mechanism OPEN, closing spring DISCHARGED)

If the circuit breaker is to be closed manually, the closing spring is released by pressing the Close button (53.0). In the case of remote electrical control, the close coil 52SRC (53.1) unlatches the closing spring (62.0).

As the closing spring discharges, the charging shaft (62.1) is turned by crank (62.2). The charging flange (cam) (62.3) at the other end of the charging shaft actuates the drive lever (62.6), with the result that jack shaft (63.0) is turned by lever (63.5) via the coupling rod (62.8). At the same time, the levers (63.1), (63.3) and (63.5) fixed on the jack shaft operate the three insulating couplers (48.0) (refer to Figure 5: Pole assembly) for the circuit breaker poles. Lever (63.7) changes the OPEN/CLOSE indicator (58.0) over to OPEN. Lever (63.5) charges the opening spring (64.0) during closing, and the circuit breaker is latched in the closed position by lever (64.3) with pawl roller (64.3.1) and by pawl (64.2). Lever (63.9) actuates the auxiliary switch (68.0) through the linkage (68.1).

The crank (62.2) on the charging shaft (62.1) moves the linkage (55.1) by acting on the control lever (55.2). The closing spring charged indication is thus canceled, and the limit switches (50.4.1) switch in the control supply to cause the closing spring to recharge immediately.

Trip-free function for the type SDV7-SE outdoor distribution circuit breaker

For the type SDV7-SE outdoor distribution circuit breaker, the trip-free function is accomplished by blocking the movement of the close latch pawl (62.5.2) when the manual trip pushbutton is actuated. The trip-free function is in accord with IEEE C37.04.

Opening (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position)

If the circuit breaker is to be opened manually, the opening spring (64.0) is released by pressing the OPEN pushbutton (54.0). In the case of an electrical command being given, the trip coil 52T (54.1) unlatches the opening spring (64.0).

The opening spring (64.0) turns the jack shaft (63.0) via lever (63.5); the sequence being similar to that for closing.

Rapid auto-reclosing

Since the closing spring is automatically recharged by the motor operating mechanism when the circuit breaker has closed, the operating mechanism is capable of an “Open-Close-Open” duty cycle as required for rapid auto-reclosing.

The circuit breaker is suitable for use in applications with a rated reclosing-time interval of 0.3 seconds, per ANSI/IEEE and IEC.

Manual operation

Electrically operated vacuum circuit breakers can be operated manually if the control supply should fail.

Manually charging the closing spring (Refer to Figure 9: Use of manual spring-operation crank and Figure 10: Manual spring-charging crank)

Insert the hand crank (50.0) with the over running coupling pushed forward (50.6) through the opening (50.1) onto hand crank coupling (50.5) and turn it clockwise (about 48 revolutions) until the closing-spring indicator (55.0) shows CHARGED. The hand crank is coupled with the charging mechanism via an over-running coupling; thus the operator is not exposed to any risk should the control supply be restored during manual charging.

Manual closing (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position)

Press the close button (53.0). The CLOSE/OPEN indicator (58.0) will then display CLOSED and the closing spring condition indicator (55.0) will now read DISCHARGED.

Manual opening (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position)

The opening spring (64.0) is charged during closing. To open the circuit breaker, press the Open pushbutton (54.0) and OPEN will be displayed by indicator (58.0).

The schematic shown in Figure 11: Typical elementary diagram is intended to aid in understanding the mechanism operation discussed in this instruction manual. Refer to the schematic diagram furnished with your circuit breaker for specific information.

Item	Description
48.0	Insulating coupler
49.0	Contact pressure spring
50.2	Charging mechanism gearbox
50.3.1	Driver
50.4	Spring charging motor (88)
50.4.1	Limit switches
50.5	Manual spring charging port
53.0	Close pushbutton
53.1	Close coil (spring-release coil) 52SRC
54.0	Open pushbutton
54.1	Trip coil (52T)
55.0	Closing spring-charge indicator
55.1	Linkage
55.2	Control lever
58.0	CLOSE/OPEN indicator
59.0	Operations counter
60.0	Mechanism housing
61.8	Shock absorber
62.0	Closing spring
62.1	Charging shaft
62.2	Crank
62.3	Charging flange (cam)
62.5	Lever
62.5.1	Pawl roller
62.5.2	Close latch pawl
62.6	Drive lever
62.8	Coupling rod
63.0	Jack shaft
63.1	Lever - phase C
63.3	Lever - phase A
63.5	Lever - phase B
63.7	Lever
64.0	Opening spring
64.2	Trip-latch pawl
64.3	Lever - trip latch
64.3.1	Trip-latch lever roller
68.0	Auxiliary switch
68.1	Auxiliary switch link

Circuit breaker OPEN, closing spring DISCHARGED

Circuit breaker OPEN, closing spring CHARGED

Circuit breaker CLOSED, closing spring DISCHARGED

Circuit breaker CLOSED, closing spring CHARGED

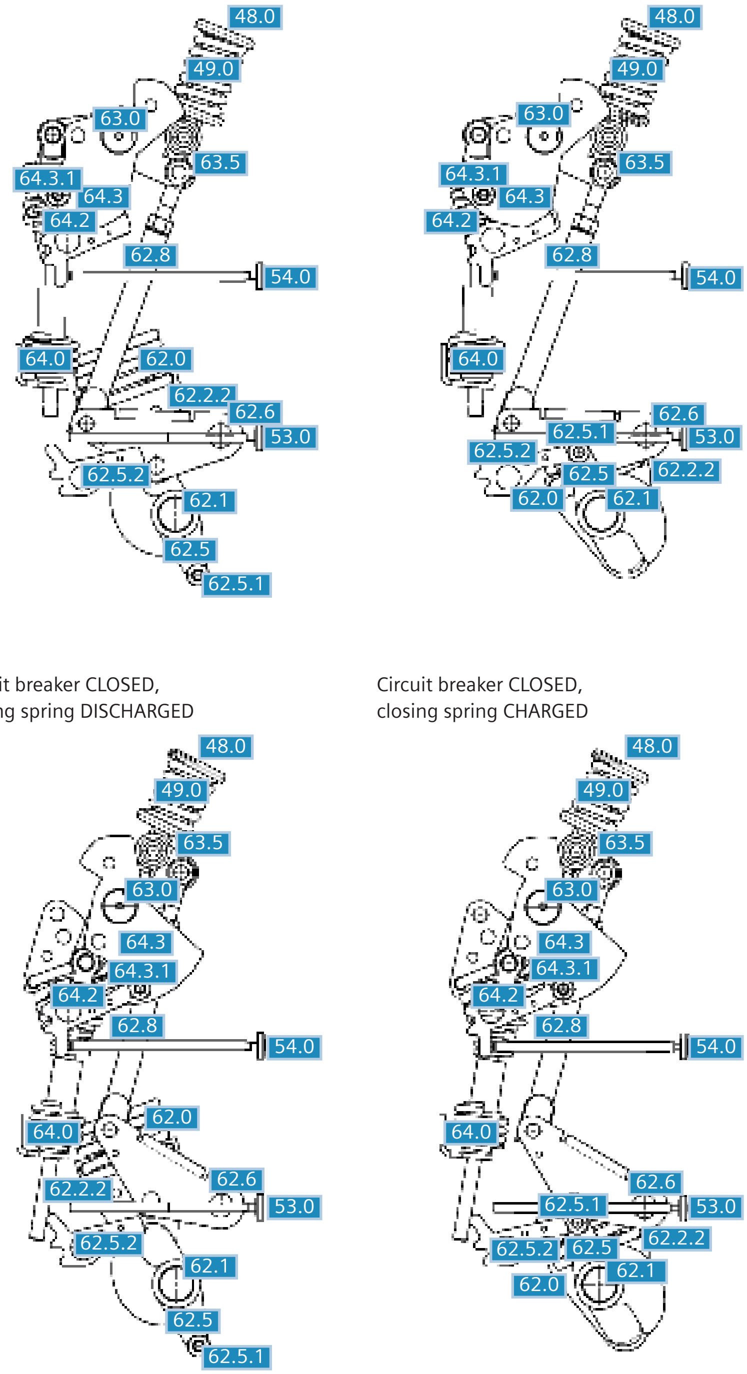


Figure 7: Operating mechanism section diagram mechanism OPEN, closing spring DISCHARGED

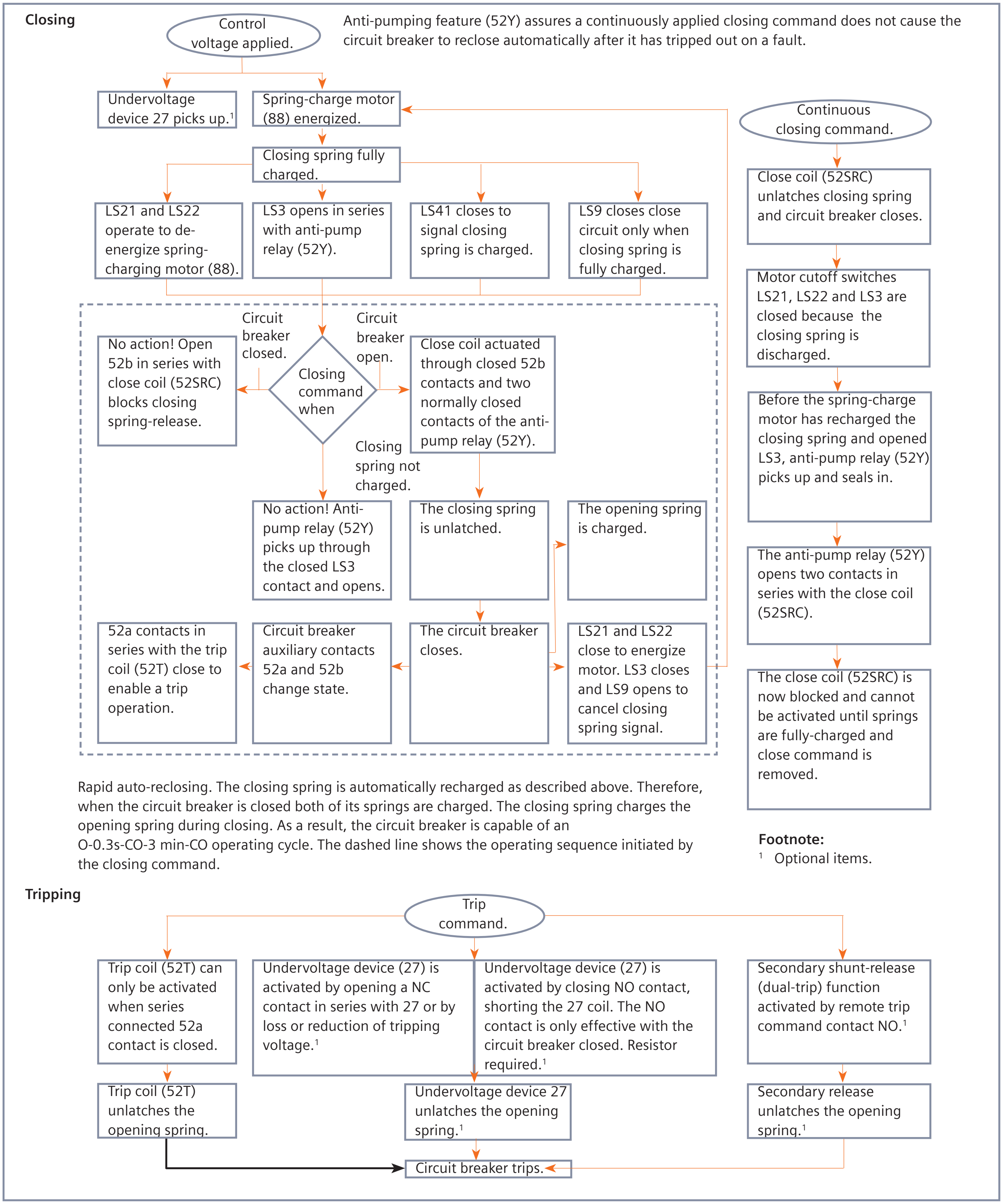
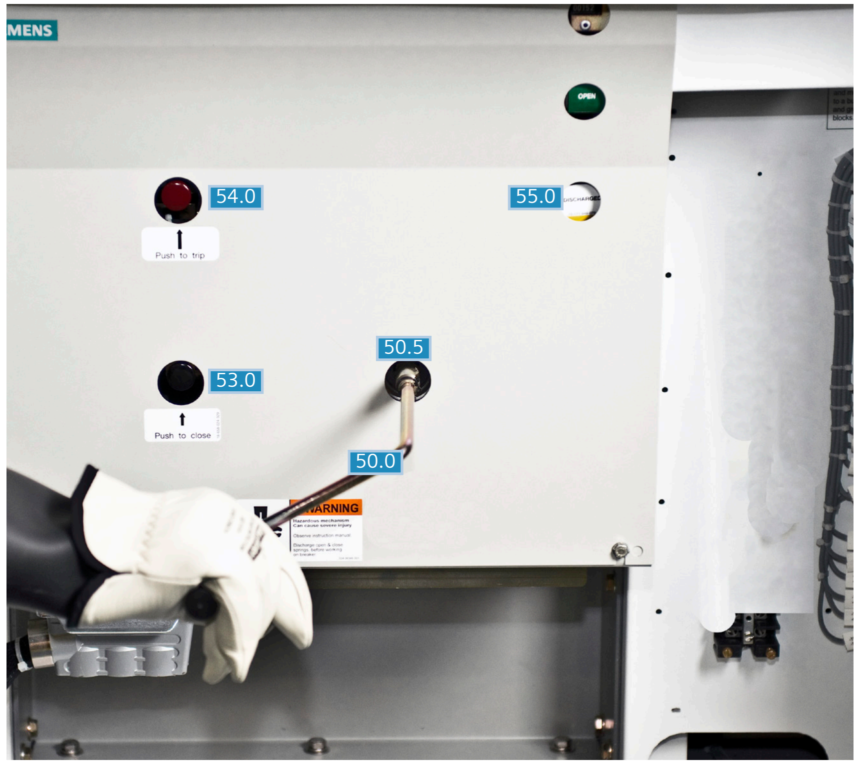


Figure 8: Operator sequential operation diagram

The close coil (3AY1510) is a standard component of the circuit breaker that is used to unlatch the stored energy of the closing spring and thus close the circuit breaker electrically. It is available for either ac or dc operation. After completion of a closing operation, the close coil is de-energized internally. If operated with ac voltage, a rectifier is installed in the circuit breaker.

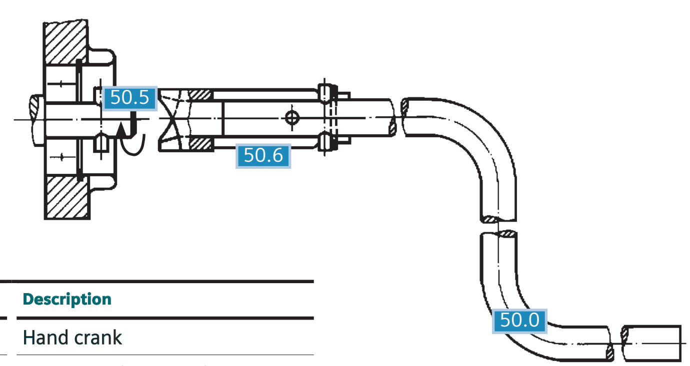
Trip coil (52T)

The trip coil (3AY1510) is a standard component of the circuit breaker. The electrically supplied tripping signal is passed on to the trip-latching mechanism by means of a direct action solenoid armature and the circuit breaker is thus opened. It is available for either ac or dc operation. After completion of an opening operation, the trip coil is de-energized internally. If operated with ac voltage, a rectifier is installed in the circuit breaker.



Item	Description
50.0	Hand crank
50.5	Manual spring-charging port
53.0	Close pushbutton
54.0	Open pushbutton
55.0	CHARGED/DISCHARGED indicator

Figure 9: Use of manual spring-operation crank



Item	Description
50.0	Hand crank
50.5	Manual spring-charging port
50.6	Over-running coupling

Figure 10: Manual spring-charging crank

Legend

01/C	Control switch close (remote)
01/T	Control switch trip (remote)
08	Close and trip power disconnect
08M	Motor power disconnect
52a	Auxiliary switch, open when circuit breaker is open
52b	Auxiliary switch, closed when circuit breaker is open
52SRC	Closing spring release coil
52T	Opening spring release coil
52Y	Anti-pump relay
69	Closing cutout switch
88	Spring charge motor
G	Green indicating light (remote)
R	Red indicating light (remote)
LS3	Closing spring position switch, closed when closing spring is discharged
LS9	Closing spring position switch, open when closing spring is discharged
LS21	Motor cutoff switch, closed when closing spring is discharged
LS22	Motor cutoff switch, closed when closing spring is discharged
LS41	Closing spring position switch, open open when closing spring is discharged
W	White indicating light (remote)
XO	Plug connector (operator connections)

Schematic shown with closing springs discharged and circuit breaker open.

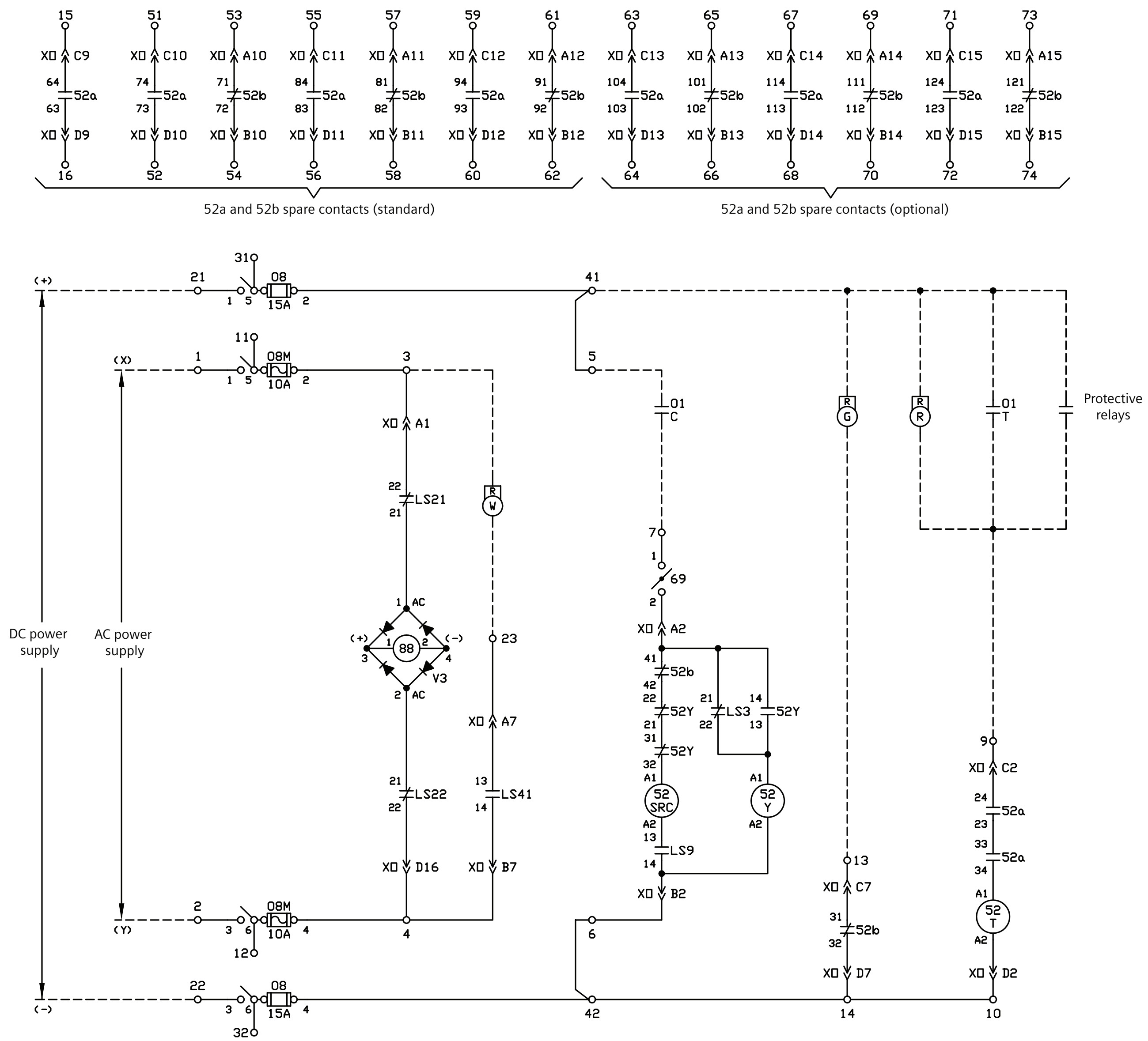


Figure 11: Typical elementary diagram

Indirect releases - secondary shunt release (dual trip) (52T1) or undervoltage (27.0)

The indirect release provides for the conversion of modest control signals into powerful mechanical-energy impulses. It is primarily used to open medium-voltage circuit breakers while functioning as a secondary shunt-release (dual trip) or undervoltage device.

These releases are mechanical energy-storage devices. Their internal springs are charged as a consequence of the circuit breaker mechanism operation. This energy is released upon application or removal (as appropriate) of applicable control voltages (refer to Figure 12: Construction of secondary shunt release (shown charged), Figure 13: Latch details (shown charged) and Figure 14: Undervoltage lock/operate selection).

The secondary shunt-release and undervoltage release mounts to the immediate left of the trip coil (54.1).

Secondary shunt-release (52T1) (refer to Figure 12: Construction of secondary shunt release (shown charged))

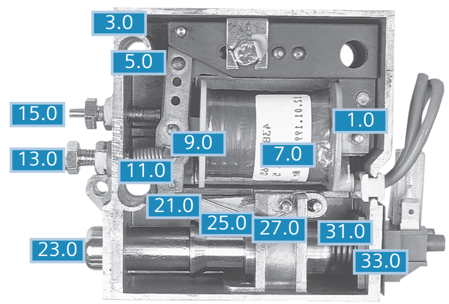
A secondary shunt-release (extra-trip coil) (3AX1101) is used for electrical opening of the circuit breaker by protective relays or manual control devices when more than one trip coil is required. The second trip coil is generally connected to a separate auxiliary supply (dc or ac) from the control supply used for the normal trip coil.

The power requirement for the second trip coil is approximately 70 W (for dc power) or 50 VA (for ac power).

Undervoltage release (27.0) (refer to Figure 13: Latch details (shown charged) and Figure 14: Undervoltage lock/operate selection)

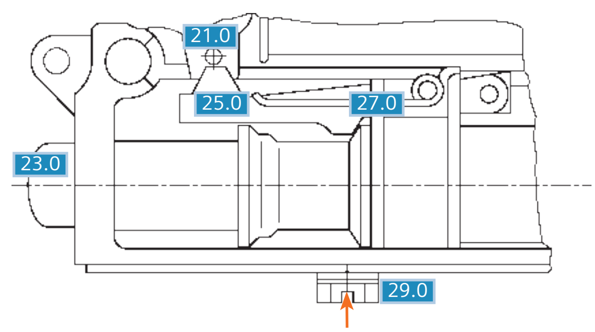
The undervoltage release (3AX1103) is used for continuous monitoring of the tripping supply voltage. If this supply voltage falls excessively, the undervoltage release will provide for automatic tripping of the circuit breaker.

The undervoltage device may be used for manual or relay tripping by employing a contact in series with undervoltage device holding coil. Relay tripping may also be achieved by employing a normally open contact in parallel with the holding coil.



Item	Description
1.0	Magnet core
3.0	Housing
5.0	Mounting holes
7.0	Magnet coil
9.0	Magnet armature
11.0	Tension spring
13.0	Adjusting screw (factory set) for 11.0
15.0	Tripping pin
21.0	Locking pin
23.0	Striker pin
25.0	Latch
27.0	Spring
31.0	Striker-pin spring
33.0	Terminal block

Figure 12: Construction of secondary shunt release (shown charged)



Item	Description
21.0	Locking pin
23.0	Striker pin
25.0	Latch
27.0	Spring
29.0	Locked/unlocked selection screw

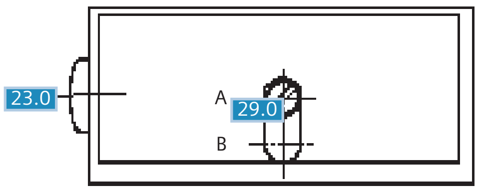
Figure 13: Latch details (shown charged)

The power requirement for the undervoltage device is approximately 20 W (for dc power) or 20 VA (for ac power).

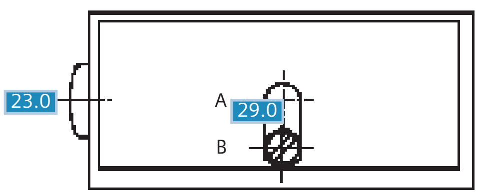
If this scheme is used, a resistor must be provided to limit current when the normally open contact is closed.

Secondary shunt and undervoltage releases are available for all standard ANSI/IEEE and IEC control voltages.

Cancel the lock for the undervoltage release by shifting the locking screw (29.0) from A to B.



Position A: locked



Position B: unlocked (operating position)

Item	Description
23.0	Striker pin
29.0	Locked/unlocked selection screw

Figure 14: Undervoltage lock/operate selection

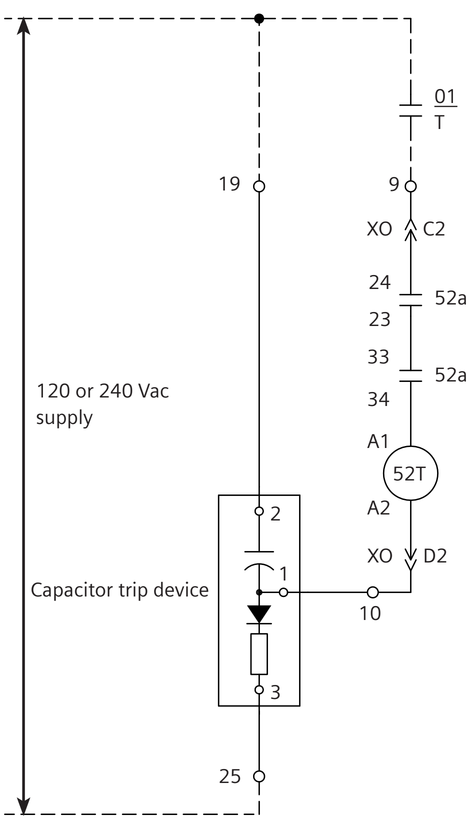


Figure 15: Capacitor-trip device

Construction and mode of operation of secondary shunt-release and undervoltage release

The release consists of a spring-power stored-energy mechanism, a latching device and an electromagnet. Refer to Figure 12: Construction of secondary shunt release (shown charged) and Figure 13: Latch details (shown charged) and Figure 14: Undervoltage lock/ operate selection.

These elements are accommodated side by side in a housing (3.0), with a detachable cover and three through-holes (5.0) for fastening screws. The supply leads for the trip coil are connected to a terminal block (33.0).

The energy-storing mechanism consists of the striker pin (23.0) and its operating spring (31.0), which is mostly located inside the striker pin (23.0). When the spring is compressed, the striker pin is held by a latch (25.0), whose sloping face is forced against the appropriately shaped striker pin (23.0) by spring (27.0). The other end of the latch (25.0) is supported by a partly milled locking pin (21.0), pivoted in the cover sheets of the magnet armature (9.0). The armature (9.0) is pivoted in front of the poles of the U-shaped magnet core, (1.0) and is pulled away from it by the tension spring (11.0).

If the magnet coil (7.0) of the secondary shunt release 3AX1101 is energized by a trip signal, or if the tripping pin (15.0) is mechanically actuated, magnet armature (9.0) is swung against the pole faces. When this happens, the latch (25.0) loses its support and releases the striker pin (23.0) that is forced out by the spring (31.0).

On the undervoltage release 3AX1103, the latch (25.0) is held by the locking pin (21.0) as long as the armature (9.0) is energized. If the circuit of the magnet coil (7.0) is interrupted, the armature (9.0) drops off, thus causing the latch (25.0) to lose its support and release the striker pin (23.0).

Following every tripping operation, the striker pin (23.0) must be reset to its normal position by loading the spring (31.0). This takes place automatically via the operating mechanism of the circuit breaker.

Since the striker pin of the undervoltage release 3AX1103 is latched only when the armature is energized, the undervoltage release is provided with a screw (29.0), for locking the striker pin (23.0) in the normal position for adjusting purposes or for carrying out trial operations during circuit breaker servicing. Position A (locked) disables the undervoltage release. Position B (unlocked) is the normal operating position.

Capacitor trip device

The capacitor trip device is an auxiliary tripping option providing a short-term means of storing adequate electrical energy to ensure circuit breaker tripping. If provided, a capacitor trip device must be located in the outdoor circuit breaker enclosure, as space is not available inside the type 3AH35-SE operator housing.

This device is applied in circuit breaker installations lacking independent auxiliary control power or station battery. In such installations, control power is usually derived from the primary source. In the event of a primary ac source fault or disturbance the capacitor trip device will provide short-term tripping energy for circuit breaker opening due to protective relay operation or operation of a circuit breaker control switch.

The capacitor trip converts 120 or 240 Vac control voltage to a dc full-wave voltage that is used to charge a large capacitor to the peak of the converted wave (refer to Figure 15: Capacitor-trip device).

Shock absorber

Circuit breakers are equipped with a hydraulic shock absorber (61.8) (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position). The purpose of this shock absorber is to limit overtravel and rebound of the vacuum interrupter movable contacts during the conclusion of an opening operation. The shock absorber action affects only the end of an opening operation.

Auxiliary switch (52a/b)

Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position) shows the circuit breaker mounted auxiliary switch (68.0). This switch provides auxiliary contacts for control of circuit breaker closing and opening functions. Contacts are available for use in relaying and external logic circuits. This switch is driven by linkage (68.1) connected to the jack shaft (63.0). The auxiliary switch contains both “b” (normally closed) and “a” (normally open) contacts. When the circuit breaker is open, the “b” contacts are closed and the “a” contacts are open.

Spring-charging motor (88)

Spring-charging motors (50.4) (refer to Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position) are available for either ac or dc operation. If operated with ac voltage, a rectifier is installed in the circuit breaker.

Maintenance

⚠ WARNING

Failure to maintain the equipment can result in death, serious injury, property damage or product failure, and can prevent successful functioning of connected apparatus.

The instructions contained herein should be carefully reviewed, understood and followed.

The maintenance tasks in Table 1 must be performed regularly.

Introduction and maintenance intervals

Periodic inspections and maintenance are essential to safe and reliable operation of the circuit breaker.

When circuit breakers are operated under "usual service conditions," maintenance and lubrication are recommended at five-year intervals for the type SDV7-SE outdoor distribution circuit breaker, or at the number of operations indicated in Table 2: Maintenance and lubrication schedule. "Usual" and "unusual" service conditions for outdoor medium-voltage circuit breakers are defined in IEEE C37.04 - clause 4, IEEE C37.010 - clause 3, and IEC 62271-100 - clause 10.4. Generally, "usual service conditions" are defined as an environment where the equipment is not exposed to excessive dust, acid fumes, damaging chemicals, salt air, rapid or frequent changes in temperature, vibration, high humidity and extreme temperatures.

The definition of "usual service conditions" is subject to a variety of interpretations. Because of this, you are best served by adjusting maintenance and lubrication intervals based on your experience with the equipment in the actual service environment.

Regardless of the length of the maintenance and lubrication interval, Siemens recommends that circuit breakers should be inspected and exercised annually.

For the safety of maintenance personnel as well as others who might be exposed to hazards associated with maintenance activities, the safety related work practices of NFPA 70E (especially chapters 1 and 2) should always be followed when working on electrical equipment.

Maintenance personnel should be trained in the safety practices, procedures and requirements that pertain to their respective job assignments.

This instruction manual should be reviewed and retained in a location readily accessible for reference during maintenance of this equipment.

The user must establish a periodic maintenance program to ensure trouble-free and safe operation. The frequency of inspection, periodic cleaning and a preventive maintenance schedule will depend upon the operation conditions. NFPA publication 70B, "Electrical equipment maintenance" may be used as a guide to establish such a program.

Note: *A preventive maintenance program is not intended to cover reconditioning or major repair, but should be designed to reveal, if possible, the need for such actions in time to prevent malfunctions during operation.*

DANGER

Hazardous voltages and stored energy.
Will cause death, serious injury or property damage.
De-energize before working on this equipment.

Read instruction manuals, observe safety instructions and use qualified personnel.

Recommended hand tools

Metric hardware is used on these circuit breakers.

The following list of hand tools describes those normally used in disassembly and re-assembly procedures:

- Open-end wrenches: 7, 8, 10, 13, 17, 19 and 24 mm
- Open-end wrench: 55 mm used to exchange shock absorber (Quantity: two pieces are required for the task)
- Sockets: 7, 8, 10, 13 and 17 mm
- Socket: 36 mm (used for replacing post insulators)
- Deep sockets: 19 and 24 mm
- Hex keys: 5, 6, 8 and 10 mm
- Torque wrench: 0-150 Nm (0-100 ft-lbs)
- Screwdrivers: 0.032 x 1/4 in wide and 0.055 x 7/16 in wide
- Pliers
- Light hammer
- Mechanic's mirror
- Flashlight
- Drift pins: 1/8, 3/16 and 1/4 in
- Retaining ring plier (external type, tip diameter 0.038 in).

Recommended maintenance and lubrication

Periodic maintenance and lubrication should include all the tasks shown in Table 1. Recommended procedures for each of the listed tasks are provided in this section of the instruction manual.

The list of tasks in Table 1: Maintenance tasks does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise that are not covered sufficiently for the user's purposes, the matter should be referred to the local Siemens sales office.

Checks of the primary power path

The primary power path consists of the three vacuum interrupters, the three fixed-end and three moving-end connections to the enclosure bus system. These components are checked for cleanliness and condition. The vacuum interrupters are also checked for vacuum integrity.

Some test engineers prefer to perform the contact-erosion check during the manual spring-charging check of the operator, since charging of the springs is necessary to place the contacts in the CLOSED position.

Also, the vacuum-integrity check is usually performed in conjunction with the high-potential tests.

These instructions assume these tests (contact-erosion/ manual spring-charging check and vacuum-integrity/ high-potential tests) will be combined as described.

Cleanliness check

Figure 2: Vacuum circuit breaker operator module is a side view of the circuit breaker with the insulating barriers removed (if furnished) to show the vacuum interrupter, and the fixed-end and moving-end connection pads.

All of these components must be clean and free of dirt or any foreign objects. Use a dry lint-free cloth. For stubborn dirt, use a clean cloth dipped in isopropyl alcohol (except for the vacuum interrupters). For stubborn dirt on a vacuum interrupter use a cloth and warm water and a small amount of mild liquid-household detergent as a cleaning agent. Dry thoroughly using a dry lint-free cloth.

Inspection of flexible connectors

Inspect the flexible connectors that connect the movable contacts of the vacuum interrupters to the moving-end connection pad for tightness and absence of mechanical damage, burning or pitting.

Checks of the stored-energy operator mechanism

The stored-energy operator checks are divided into mechanical and electrical checks for simplicity and better organization. This first series of checks determine if the basic mechanism is clean, lubricated and operates smoothly without control power. The contact-erosion check of the vacuum interrupter is also performed during these tasks.

Table 1: Maintenance tasks

Inspection items and tests
Primary-power path checks • Cleanliness check • Inspection of flexible connectors
Stored-energy operator mechanism checks • Maintenance and lubrication • Fastener check • Manual-spring charging check • Contact-erosion check
Electrical-control checks • Wiring and terminals checks • Automatic spring-charging check • Electrical close and trip check
Vacuum-integrity check
High-potential test
Insulation test
Contact-resistance test
Inspection and cleaning of circuit breaker insulation
Functional tests

⚠ WARNING

The use of unauthorized parts in the repair of the equipment, or tampering by unqualified personnel can result in hazardous conditions, that can result in death, serious injury or property damage.

Follow all safety instructions contained herein.

Maintenance and lubrication

Table 2 gives the recommended maintenance intervals for circuit breakers. These intervals assume that the circuit breaker is operated under "usual service conditions" as discussed in IEEE C37.04 - clause 4, IEEE C37.010 - clause 3, and IEC 62271-100 - clause 10.4 for outdoor distribution circuit breakers. The maintenance and lubrication interval is the lesser of the number of closing operations or the time interval since last maintenance.

The vacuum interrupter operator mechanism is shown in Figure 20, with the front cover removed to show construction details. Both the opening spring and the closing spring are shown. The movable end of the closing spring is connected to a crank arm. The movable end of the opening spring is connected to the jack shaft by a pull rod.

Clean the entire stored-energy operator mechanism with a dry, lint-free cloth.

Check all components for evidence of excessive wear. Place special attention upon the closing spring-crank and the insulating couplers and linkages.

Lubricate all non-electrical moving or sliding surfaces with a light coat of synthetic grease or oil. Lubricants composed of ester oils and lithium thickeners will be generally compatible.

Table 2: Maintenance and lubrication schedule

Circuit breaker type	Number of years/closing operations (whichever comes first)
SDV7-SE	10 years / 10,000 operations with space heater monitoring option

For all lubrication (except electrical moving or sliding surfaces), use one of the following:

- Klüber Isoflex Topas L32 (part 3AX11333H)
- Klüber Isoflex Topas L32N (spray) (part 15-172-879-201).

Source:

- Klüber Isoflex Topas L32 or L32N: Klüber Lubrication North America L.P. www.klueber.com.

Fastener check

Inspect all fasteners for tightness. Both locknuts and retaining rings are used. Replace any fasteners that appear to have been frequently removed and replaced.

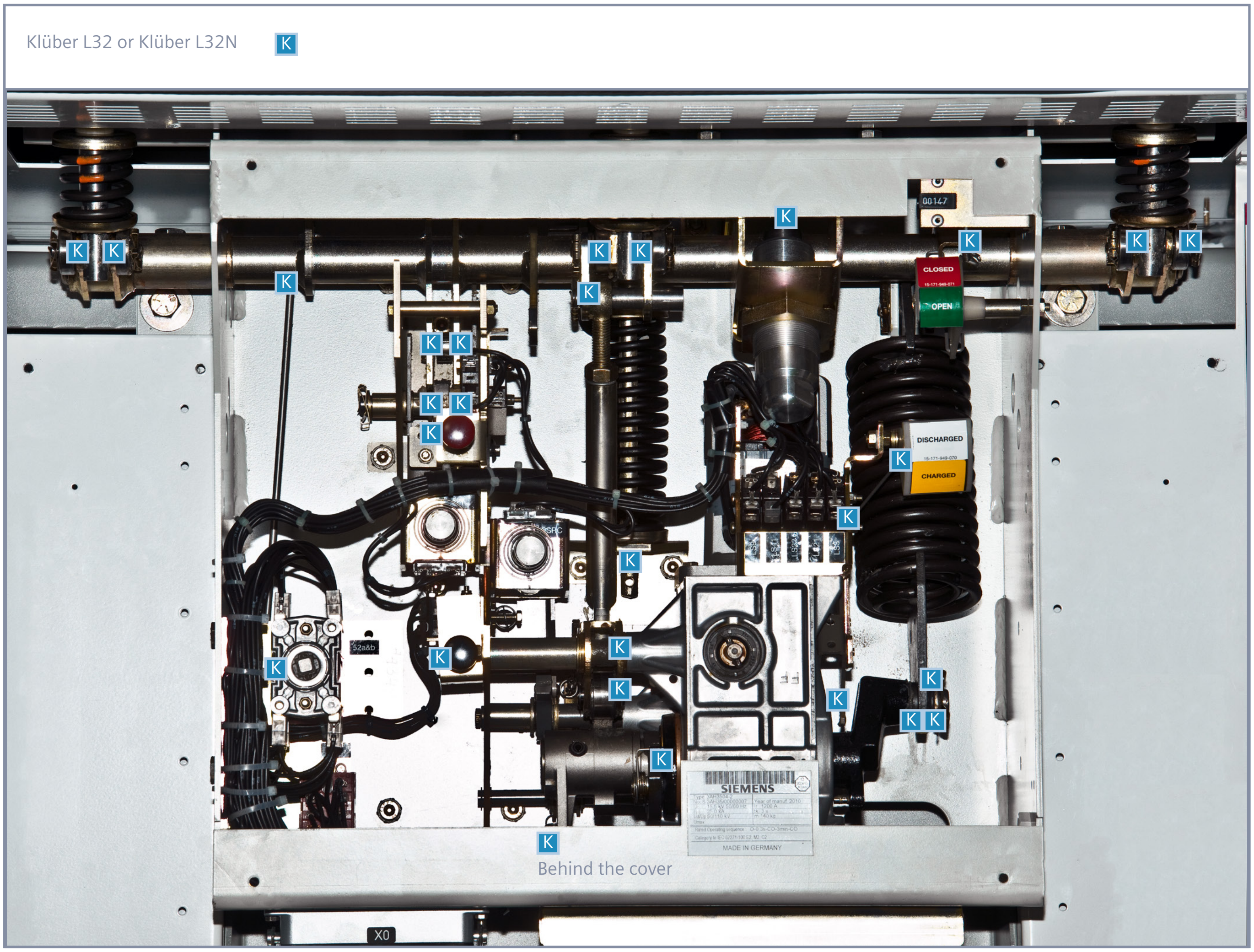


Figure 16: Operator mechanism lubrication

Manual spring-charging and contact-erosion checks

Perform the manual spring-charging check contained in the section describing the installation check and initial functional tests (refer to pages 6-7). The key steps of this procedure are repeated here:

1. Insert the hand-charging crank into the manual-charge socket at the front of the operator control panel. Turn the crank clockwise (about 48 revolutions) to charge the closing spring. Continue cranking until the CHARGED flag appears in the window of the spring indicator.

2. Press the Close (black) pushbutton. The contact-position indicator on the operator control-panel should indicate that the circuit breaker contacts are closed.

3. Perform the contact-erosion check. Contact erosion occurs when high fault-currents are interrupted. Determination of acceptable contact condition is checked by the visibility of the white contact-erosion mark shown in Figure 17: Contact-erosion check mark dot (circled in orange) (shown with circuit breaker OPEN). The white contact-erosion mark is located on the movable stem of the vacuum interrupter, near the plastic guide-bushing. The contact-erosion check procedure is:

   a) Be sure the circuit breaker primary contacts are closed.

⚠ WARNING

High-speed moving parts.
Can result in serious injury.

Tripping spring is charged. If trip latch is moved, the stored-energy springs will discharge rapidly.
Stay clear of circuit breaker components that are subject to sudden, high-speed movement.

Figure 17: Contact-erosion check mark dot (circled in orange) (shown with circuit breaker OPEN)

Figure 18: How to view contact erosion indicator between poles

b) Observe the white contact-erosion mark (refer to Figure 17) of each pole. When any part of the white contact-erosion mark is visible, contact wear is within acceptable limits. A mechanic's mirror is a convenient means for viewing the contact-erosion mark on each vacuum interrupter.

4. Press the red open pushbutton after completing the contact-erosion check. Visually verify the discharged condition of the closing spring and that the circuit breaker contacts are open.

5. Press the black close pushbutton. Nothing should happen. The manual-spring check should demonstrate smooth operation of the operating mechanism.

Electrical control checks

The electrical controls of the circuit breaker should be checked during inspections to verify absence of any mechanical damage, and proper operation of the automatic spring-charging and close and trip circuits.

Unless otherwise noted, all of these tests are performed without any control power applied to the circuit breaker.

Check of the wiring and terminals

1. Physically check all of the circuit breaker wiring for evidence of abrasion, cuts, burning or mechanical damage.

2. Check all terminals to be certain they are solidly attached to their respective device.

DANGER

Hazardous voltage and high-speed moving parts. Will cause death, serious injury and property damage.

Do not bypass interlocks or otherwise make interlocks inoperative. Interlocks must be in operation at all times.

Read instruction manuals, observe safety instructions and use qualified personnel.

Automatic spring-charging check (control power required)

Repeat the automatic spring-charging check described in the section describing the installation checks and initial functional tests (refer to pages 6-7).

Primary tasks of this check are:

1. The circuit breaker must be energized with control power for this check.
2. Energize the control-power source.
3. When control power is connected to the circuit breaker, the closing spring should automatically charge. Visually verify that the closing spring is charged.

Note: *A temporary source of control power and test leads may be required if the control-power source has not been connected to the circuit breaker. When control power is connected to the circuit breaker, the closing spring should automatically charge.*

Electrical close and trip check (control power required)

A check of the circuit breaker control circuits shall be performed. This check is made with the control circuit of the circuit breaker energized.

1. Once the circuit breaker springs are charged, operate the circuit breaker electrical close command (via pushbutton, control switch or equivalent means). Verify by both the sound of the circuit breaker closing and by the main contact status indicator that the circuit breaker contacts are closed.
2. As soon as the circuit breaker has closed, the automatic spring-charging process is repeated.
3. After a satisfactory close operation is verified, operate the circuit breaker electrical close command (via pushbutton, control switch or equivalent means). Verify by both the sound of the circuit breaker opening and by the main contact status indicator that the circuit breaker contacts are open.
4. After a satisfactory open operation is verified, hold the circuit breaker manual trip button and apply and maintain an electrical close signal. The circuit breaker should close, immediately trip, the close spring should charge, and the circuit breaker should not attempt to close again.

Completion of these checks demonstrates satisfactory operation of auxiliary switches, internal relays and open and close coils.

Table 3a: Typical vacuum interrupter contact expected life

Rated maximum voltage kV	Interrupting class kA	Rated short-circuit current	Vacuum interrupter type	Graph	Right hand limit of curve (refer to Figure 19)[1]
15.5 / 17.5	20	20	VS-25008	A	20
15.5 / 17.5	25	25	VS-25008	A	25
15.5 / 17.5	31.5	31.5	VS-15052	B	31.5
15.5 / 17.5	40	40	VS-15052	B	40
27.6	20	20	VS-25008	A	20
27.6	25	25	VS-25008	A	25
38.0	20	20	VS-30030	C	20
38.0	25	25	VS-30030	C	25
38.0	31.5	31.5	VS-30041	C	31.5
38.0	40	40	VS-30041	C	40

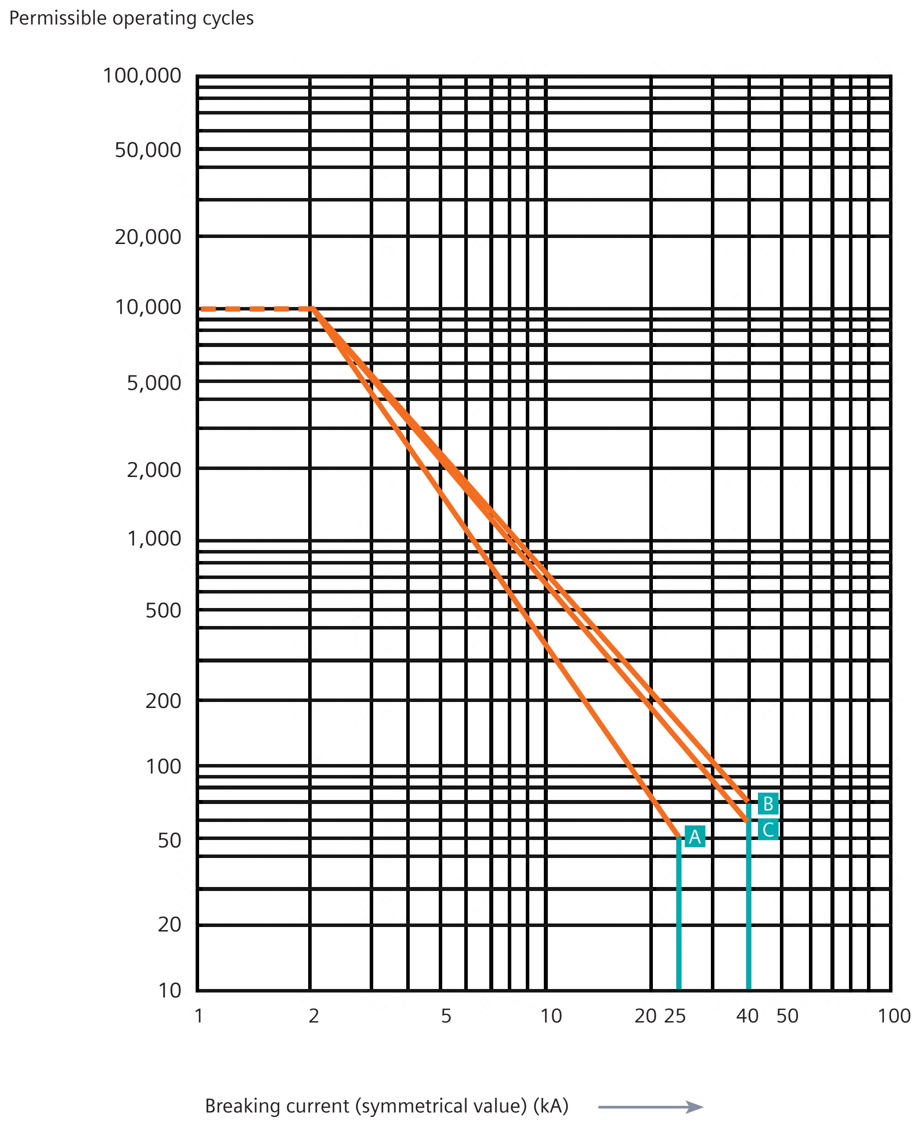
Table 3b: Typical vacuum interrupter contact expected life - additional vacuum interrupters

Rated maximum voltage kV	Interrupting class kA	Rated short-circuit current	Vacuum interrupter type	Graph	Right hand limit of curve (refer to Figure 19)[1]
15.5 / 17.5	20	20	VSA17-0-31	A	20
15.5 / 17.5	25	25	VSA17-0-31	A	25
15.5 / 17.5	31.5	31.5	VSA17-1-40	B	31.5
15.5 / 17.5	40	40	VSA17-1-40	B	40
27.6	20	20	VSS17-0-31	A	20
27.6	25	25	VSS17-0-31	A	25

Footnote:

1. *Rated short-circuit current. Refer to Table 9: Technical ratings.*

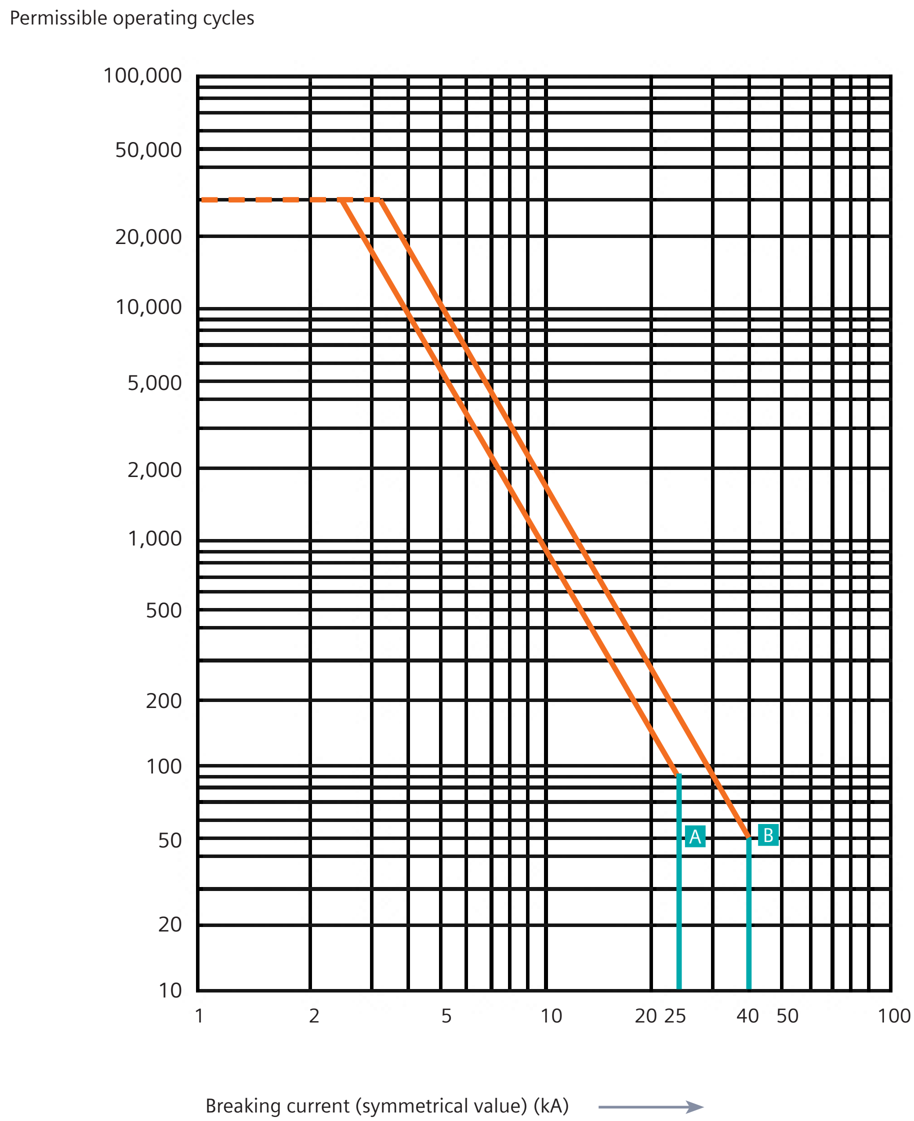
Load graph "A" vacuum interrupter type VS-25008
Load graph "B" vacuum interrupter type VS-15052
Load graph "C" vacuum interrupter types VS-30030 and VS-30041
All voltage classes



Note: *Right-hand vertical segment of curve is located at the maximum symmetrical interrupting current rating of the circuit breaker, as indicated in Table 3: Typical vacuum interrupter contact expected life.*

Figure 18a: Typical vacuum interrupter contact life curves

Load graph "A" vacuum interrupter type VSA/VSS-17-0-31
Load graph "B" vacuum interrupter type VSA-17-1-40
17.5 kV voltage class

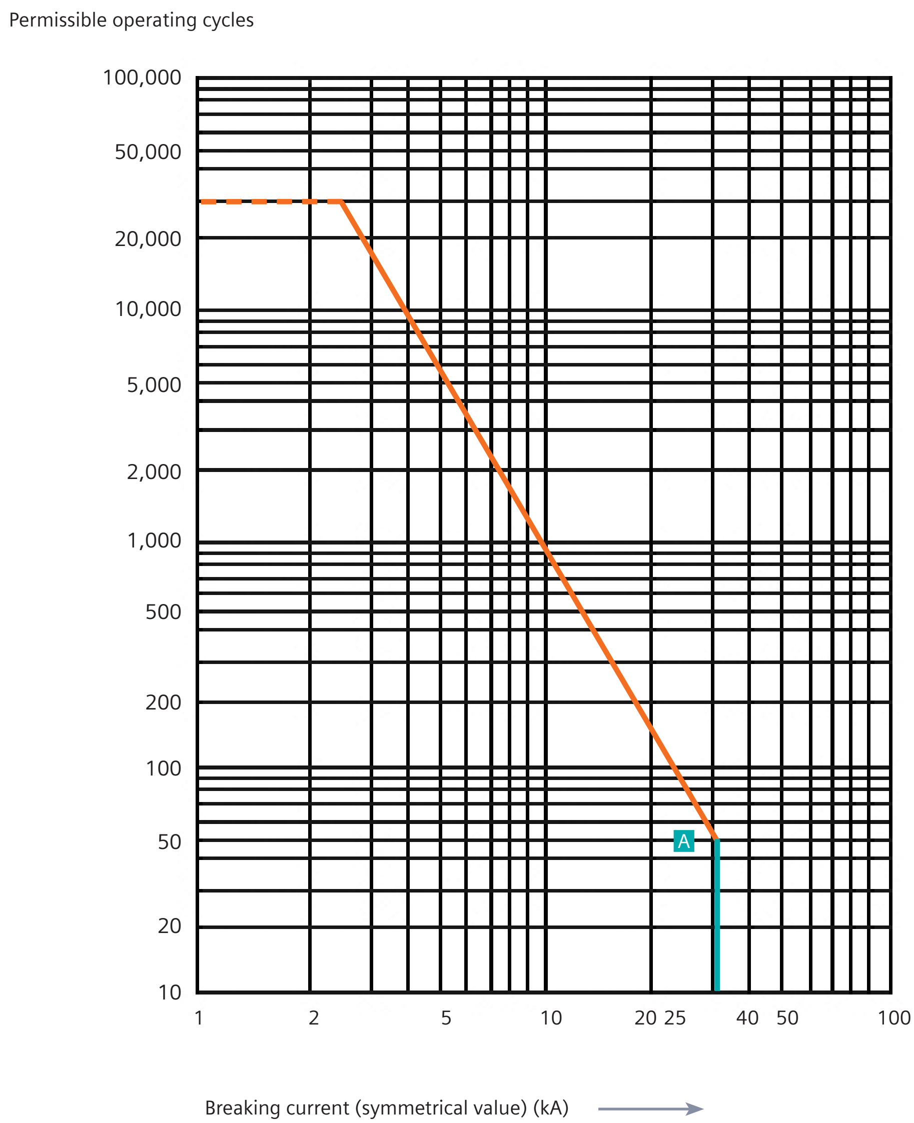


Note: *Right-hand vertical segment of curve is located at the maximum symmetrical interrupting current rating of the circuit breaker, as indicated in Table 3: Typical vacuum interrupter contact expected life.*

Figure 18b: Typical vacuum interrupter contact life curves

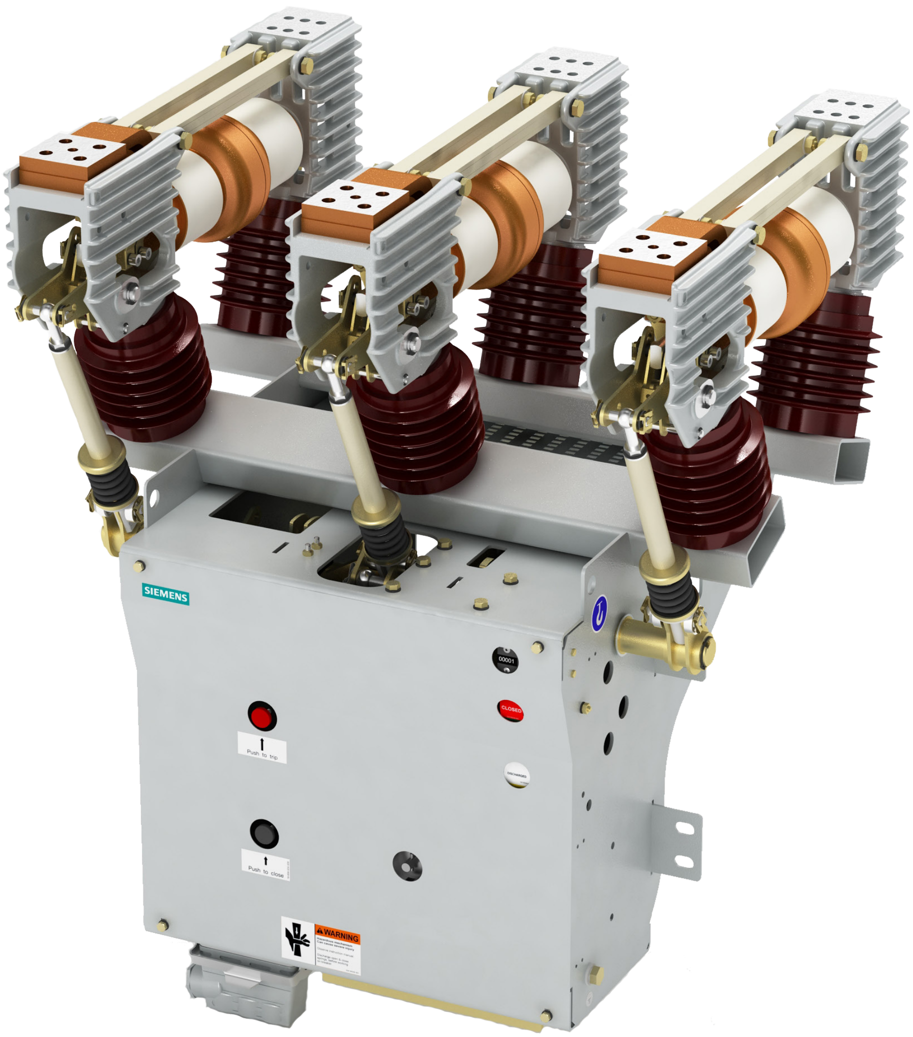
Load graph "A" vacuum interrupter type VSA/VSS-17-0-31

27 kV voltage class



Note: *Right-hand vertical segment of curve is located at the maximum symmetrical interrupting current rating of the circuit breaker, as indicated in Table 3: Typical vacuum interrupter contact expected life.*

Figure 18c: Typical vacuum interrupter contact life curves


SIEMENS
00001
CLOSED
Push to trip
Push to close
WARNING

Checks of the spring-charging motor (88)

No additional checks of the spring-charging motor are necessary. If it is necessary to remove or replace the spring-charging motor, torque motor-mounting hardware to 7.3-8 ft-lb (10-11 Nm).

Anti-pump relay

If it is necessary to remove the connections to the anti-pump relay, use care to avoid damaging the relay. Replace the relay if the relay terminals are damaged or loose in the relay body.

Vacuum interrupters

The life expectancy of vacuum interrupters is a function of the numbers of interruptions and magnitude of current interrupted (refer to Table 3: Typical vacuum interrupter contact life expectancy and Figure 18: Typical vacuum interrupter contact life curves).

The vacuum interrupters must be replaced before the number of mechanical operations (listed in Table 2) are reached, or when the contacts have been eroded beyond allowed limits. Vacuum interrupter replacement procedures are detailed in the following maintenance instructions.

The vacuum interrupter contact life curves (refer to Figure 18: Typical vacuum interrupter contact life curves) are offered as a guide to expected life.

Vacuum-integrity check (using mechanical test) (refer to Figure 19: Manual check of vacuum integrity)

Before putting the circuit breaker into service, or if a vacuum interrupter is suspected of leaking as a result of mechanical damage, check the vacuum integrity either mechanically as described in this section, or alternatively, electrically using a high-potential test set as described in the next section.

Open and isolate the circuit breaker and detach the insulating coupler (48.0) from lever (48.6).

The atmospheric pressure will force the moving contact of a hermetically sealed vacuum interrupter into the closed position, causing lever (48.6) to move into the position shown in Figure 19: Manual check of vacuum integrity).

A vacuum interrupter may be assumed to be intact if it shows the following characteristics:

1. An appreciable closing force has to be overcome when lever (48.6) is moved to the open position by hand;
2. When the lever is released, it must automatically return to the closed position with an audible sound as the contacts touch.

After checking the vacuum, reconnect the lever (48.6) to the insulating coupler (48.0).

⚠ DANGER

High potential tests employ hazardous voltages. Will cause death or serious injury.

Follow safe procedures, exclude unnecessary personnel and use safety barriers. Keep away from circuit breaker during application of test voltages.

⚠ WARNING

Vacuum interrupters may emit X-ray radiation.
Can result in serious injury.

Keep personnel more than six feet away from a circuit breaker under test.

High-potential tests

The next series of tests (vacuum-integrity test and insulation tests) involve use of high-voltage test equipment. The circuit breaker under test should be inside a suitable test barrier equipped with warning lights.

Vacuum-integrity check (using dielectric test)

A high-potential test is used to verify the vacuum integrity of the circuit breaker. The test is conducted on the circuit breaker with its primary contacts in the open position.

Vacuum integrity test procedure

1. Observe safety precautions listed in the danger and warning advisories. Construct the proper barrier and warning light system.
2. Ground the frame of the circuit breaker, and ground each pole not under test.
3. Apply test voltage (refer to Table 4: High-potential test voltages) across each pole for one minute (circuit breaker open).
4. If the pole sustains the test voltage for that period, its vacuum integrity has been verified.

Note: *Do not use dc high-potential testers incorporating half-wave rectification. These devices produce high peak voltages.*

High peak voltages will produce X-ray radiation. DC testers producing excessive peak voltages also show erroneous readings of leakage current when testing vacuum circuit breakers.

High-potential test voltages

The voltages for high-potential tests are shown in Table 4.

Note: *This test includes not only the vacuum interrupter, but also the other insulation components in parallel with the vacuum interrupter. These include the post insulators and the insulating coupler, as well as the insulating (tension) struts between the upper and lower vacuum interrupter supports. If these insulation components are contaminated or defective, the test voltage will not be sustained. If so, clean replace the affected components, and retest.*

Table 4: High-potential test voltages (values per IEEE standards)

Equipment maximum voltage rating kV	Equipment rated power-frequency withstand kV (rms)	Maximum ac rms test voltage kV	Maximum dc test voltage kV
15.5 / 17.5	50	38	53
27.6	60	45	64
38	80	60	85

As-found insulation and contact resistance tests

As-found tests verify the integrity of the circuit breaker insulation system. Megger* or insulation resistance tests and contact-resistance tests conducted on equipment prior to installation provide a basis of future comparison to detect changes in the protection afforded by the insulation system, and in the integrity of the current carrying path. A permanent record of periodic as-found tests enables the maintenance organization to determine when corrective actions are required by watching for significant deterioration in insulation resistance, or increases in contact resistance.

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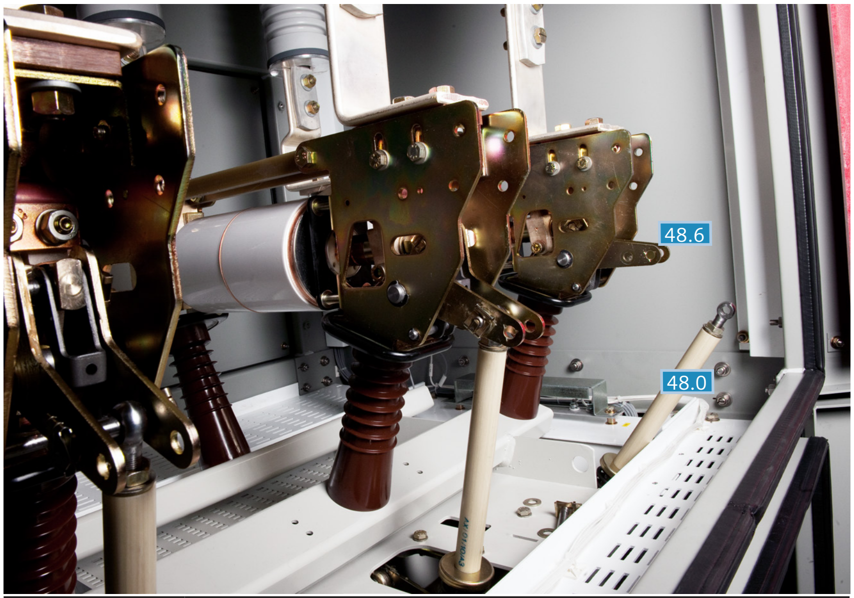
Insulation and contact-resistance test equipment

In addition to the high-potential test equipment capable of test voltages as listed in Table 4, the following equipment is also required:

- AC high-potential tester with test voltage of 1,500 volts, 60 Hz
- Test equipment for contact-resistance tests.



Identification	Description
48.0	Insulating coupler (shown disconnected on right pole for checking vacuum integrity)
48.6	Lever

Figure 19: Manual check of vacuum integrity

Insulation and contact-resistance test procedure

1. Observe safety precaution listed in the danger and warning advisories for the vacuum integrity check tests (refer to pages 31-32).
2. Close the circuit breaker. Ground the frame of the circuit breaker, and ground each pole not under test. Use manual charging, closing and tripping procedures.
3. Apply the proper ac or dc (refer to Table 4: High-potential test voltages) high-potential test voltage between a primary conductor of the pole and ground for one minute.
4. If no disruptive discharge occurs, the insulation system is satisfactory.
5. After test, ground both ends and the middle of each vacuum interrupter to dissipate any static charge.
6. Disconnect the leads to the spring-charging motor.
7. Disconnect secondary circuits for the operating mechanism by disconnecting the multiple pin-plug at the lower left corner of the operator, and connect all pins on the operator side with a shorting wire. Connect the shorting wire to the high-potential lead of the high-voltage tester, and ground the circuit breaker housing. Starting with zero voltage, gradually increase the test voltage to 1,500 volts rms, 60 Hz. Maintain test voltage for one minute.
8. If no disruptive discharge occurs, the secondary control insulation level is satisfactory.
9. Disconnect the shorting wire, reattach the multiple pin-plug and reattach the leads to the spring-charging motor.
10. Perform contact-resistance tests of the primary contacts. The resistance should be determined between the fixed-end connection pad and the moving-end connection pad (refer to Figure 5: Pole assembly). Contact resistance should not exceed the values listed in Table 5: Maximum contact resistance.

Inspection and cleaning of circuit breaker insulation

1. Perform the spring-discharge check (refer to page 6) on the circuit breaker after all control power is removed. The spring-discharge check consists of:

   a) Pressing the red open pushbutton

   b) Pressing the black close pushbutton

   c) Pressing the red open pushbutton again.

   All of these controls are on the circuit breaker front panel (refer to Figure 1: Operator panel controls of circuit breaker and manual charging of closing spring). Visually verify the discharged condition of the springs.

2. Remove any inter-phase barriers if furnished (applicable for certain types only).

3. Clean barriers and post insulators using clean cloth dipped in isopropyl alcohol.

4. Reinstall all barriers. Check all visible fasteners again for condition and tightness.

Note: *Do not use any cleaning compounds containing chlorinated hydrocarbons, such as: trichlorethylene, perchlorethylene or carbon tetrachloride.*

These compounds will damage the phenylene ether copolymer material used in the barriers and other insulation on the circuit breaker.

Table 5: Maximum contact resistance

Current rating A	Contact resistance Micro-Ohms
1,200 / 1,250	35
2,000	30
2,500	30
3,000	30

Functional tests

Refer to the installation checklist in the installation checks and initial functional tests section of this instruction manual (refer to pages 6-7). Functional tests consist of performing at least three manual spring-charging checks and three automatic spring-charging checks. After these tests are complete, and the springs are fully discharged, all fasteners and connections are checked again for tightness and condition.

Overhaul

Introduction

The following procedures along with the troubleshooting charts in this instruction manual (refer to pages 42-43), provide maintenance personnel with a guide to identifying and correcting possible malfunctions of the circuit breaker.

Table 6: Overhaul schedule

Circuit breaker type	Closing operations
SDV7-SE outdoor distribution circuit breaker	10,000

Circuit breaker overhaul

Table 6 gives the recommended overhaul schedule for the type 3AH35-SE operating mechanisms. These intervals assume that the circuit breaker is operated under “usual service conditions” as discussed in IEEE C37.04 - clause 4, C37.010 - clause 3, and IEC62271-100 - clause 6.107. If the circuit breaker is operated frequently, the overhaul interval in Table 6 may coincide with the maintenance interval in Table 2: Maintenance and lubrication schedule.

Replacement at overhaul

The following components are replaced during an overhaul of the circuit breaker, when required:

- Vacuum interrupters as determined by vacuum integrity test, contact erosion or according to overhaul schedule (refer to Table 6)
- Close coil, 52SRC
- Trip coil, 52T.

When these parts are changed, locking devices must also be removed and replaced. These include lock washers, retaining rings, retaining clips, spring pins, cotter pins, etc.

1. Replace vacuum interrupter; instructions follow.
2. Close coil (52SRC) and trip coil (52T).
   a) Remove two “push on” terminal connections
   b) Remove two M4 hex-head screws and remove solenoid.
   c) Install replacement coils with new M4 x 10 hex-head screws (Siemens part #00-000-443-820) and new lock washers for M4 (Siemens part # 00-000-288-316).
   d) The coil-mounting screws must be installed using thread locking adhesive (Loctite #222, Siemens part 15-133-281-007) and primer (Loctite primer T (#7471), Siemens part 15-133-281-005).
   e) Connect wires to coils with new wire terminals (Siemens part # 15-171-600-002).
3. Lubricate operating mechanism according to maintenance and lubrication information (refer to page 25).
4. When work is finished, operate circuit breaker and close and open several times, and check that all screw connections are tight.

Replacement of vacuum interrupters

Replacement vacuum interrupters are furnished as a complete assembly. They have been completely tested and dielectrically and mechanically conditioned.

It is recommended that one vacuum interrupter be removed and replaced completely rather than removing two or more vacuum interrupters at a time.

The following procedure in check list format describes the procedure for removing and replacing a vacuum interrupter. Components may be identified by reference to Figure 20: Vacuum interrupter replacement illustration and Figure 21: Illustration showing required technique for fastening terminal-clamp hardware.

Instructions herein apply for replacement of all vacuum interrupters except vacuum interrupters on 3,000 A circuit breakers having the flexible connector (refer to 29.1 in Figure 20: Vacuum interrupter replacement illustration) electron-beam welded to the moving terminal (refer to 36.1 in Figure 20: Vacuum interrupter replacement illustration) of the vacuum interrupter. These interrupters must be replaced by factory-trained personnel. Contact Siemens medium-voltage customer service at +1 (800) 333-7421 or +1 (423) 262-5700 outside the U.S.

1. Removing the vacuum interrupter

Note: *Special care needs to be exercised in removal or installation of hardware around the movable contact end of the vacuum interrupter.*

The movable contact uses a metal bellows to maintain the vacuum seal while still permitting motion of the contact along the axis of a vacuum interrupter. The bellows is rugged and reliable, and is designed to withstand years of axial movement. However, care should be exercised to avoid subjecting the bellows to excessive torque during removal and replacement. Twisting the bellows through careless bolt removal or tightening may damage the vacuum interrupter, resulting in loss of vacuum integrity.

1.1 Before starting work, the circuit breaker should be isolated from all primary and control-power sources and all stored energy discharged by opening, closing and opening the circuit breaker by hand. Discharge any static charge by grounding both ends and the middle of each vacuum interrupter. Carefully remove inter-phase barriers (if present).

1.2 Loosen the lateral bolt(s) on terminal clamp (29.2). Employ the illustrated procedure to loosen clamp hardware (refer to Figure 21: Illustration showing required technique for fastening terminal-clamp hardware).

1.3 Withdraw pin (48.5) from insulating coupler (48.0) and levers (48.6).

1.4 Remove coupling pin from the eye bolt (36.3).

1.5 Free struts (28.0) from the pole head (20.0). Loosen the strut hardware on the moving-end pole head and swing the struts away from the vacuum interrupter.

1.6 Loosen screws fastening the centering ring (28.1).

1.7 Remove bolt (31.2), lock washer and large washer at the stationary contact and of the vacuum interrupter (18 mm or 24 mm socket with extension).

1.8 Using a 24 mm socket with an extension, loosen and remove hex-cap screw fastening the fixed-end pole head to the post insulator. Completely remove the fixed-end pole head and set aside.

1.9 Grasp the vacuum interrupter (30.0) and withdraw horizontally. Assistance may be required to work the terminal clamp off the movable stem of the vacuum interrupter.

Note: *DO NOT USE UNDUE FORCE OR TWISTING MOTION. If the terminal clamp (29.2) cannot be easily removed, STOP!, check to be certain hardware is loose, and that the terminal clamp (29.2) is not binding.*

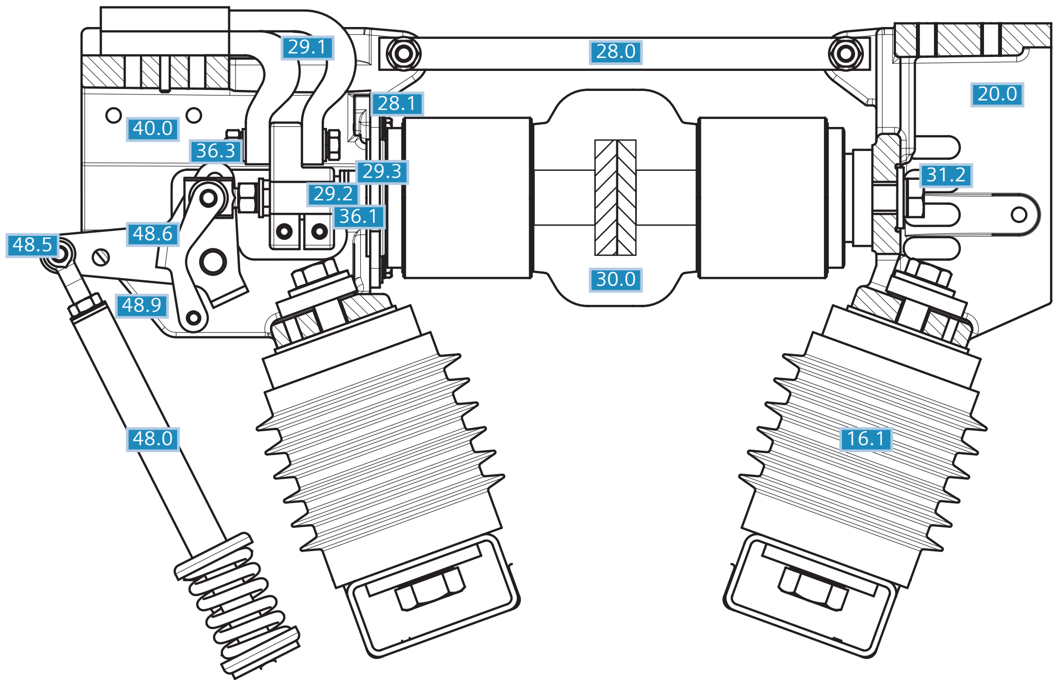
2. Installing a vacuum interrupter

Note: *Replacement vacuum interrupter (30.0) will be received from the factory with an eye bolt (36.3) in place, adjusted and torqued to specific requirements. DO NOT ALTER THE ADAPTER (EYE-BOLT)SETTING.*

2.1 Inspect all silver-plated connection surfaces for cleanliness. Clean only with a cloth and solvent. Do not abrade, as this will damage the silver plating.

2.2 Insert vacuum interrupter (30.0) into the moving-end pole head (40.0). Slip terminal clamp (29.2) into position on the movable stem.

2.3 Fasten the fixed-end pole head to the post insulator (16.1) “finger tight” using hex-head bolt, lock washer and flat washer.



Identification	Description
16.1	Post insulator
20.0	Fixed-end pole head
28.0	Strut
28.1	Centering ring
29.1	Flexible connector
29.2	Terminal clamp
29.3	Spacer (or shoulder)
30.0	Vacuum interrupter
31.2	Fixed-end terminal bolt
36.1	Moving terminal
36.3	Eye bolt (or adapter)
40.0	Moving-end pole head
48.0	Insulating coupler
48.5	Pin
48.6	Angled lever
48.9	Guide link

Figure 20: Vacuum interrupter replacement illustration

2.4 Align vacuum interrupter and fasten "finger tight" to the fixed-end pole head (20.0) using heavy flat washer, lock washer and bolt (31.2).

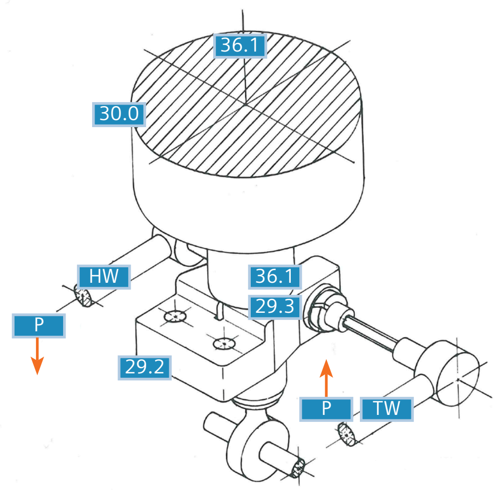
2.5 Attach struts (28.0) to the fixed-end pole head (20.0), replace hardware (M10), but do not tighten at this time.

2.6 Couple levers (48.6) and drive link (48.9) to the eye bolt (36.3), using the pin supplied. Apply retaining clips. Appropriate pin is modestly chamfered, not to be confused with pin for the insulating coupler.

2.7 Align fixed-end pole head (20.0) correctly and tighten bolt fastening it to the post insulator. Torque M16 bolt to 130 Nm (96 ft-lb). Fasten securely all bolts associated with struts (28.0).

2.8 Tighten vacuum interrupter fastening bolt (31.2) on the fixed-end pole head (20.0) holding the vacuum interrupter firmly by its fixed-end insulator and operate levers (48.6), by hand, to see whether the movable contact moves freely. If any binding or lack of freedom is noted, loosen bolt (31.2) and adjust the vacuum interrupter in the fixed-end pole head by turning and moving it slightly. Torque M12 bolt to 60 Nm (44 ft-lb) and M16 bolt to 130 Nm (96 ft-lb).

2.9 The centering ring (28.1) has been loose and "floating" during installation of the vacuum interrupter. Check that the movable contact is free to move axially without binding, and then tighten the hardware which secures the centering ring. Recheck that the movable contact is free to move axially without binding.



Identification	Description
29.2	Terminal clamp
29.3	Spacer (or shoulder)
30.0	Vacuum interrupter
36.1	Moving terminal
HW	Holding wrench
TW	Torque wrench
P	Direction of force (P)

Figure 21: Illustration showing required technique for fastening terminal-clamp hardware

2.10 Move the terminal clamp (29.2) against the step or the spacer (if applicable) of the moving contact (36.1) of the vacuum interrupter (30.0) so that the radius of the movable contact faces the connecting surface of the flexible connector (29.1). Employ technique illustrated to fasten terminal clamp (refer to Figure 21: Illustration showing required technique for fastening terminal-clamp hardware).
Note opposing wrenches. Tighten the bolt(s) of the terminal clamp to a torque of 40 Nm (30 ft-lb), taking care to see that the terminal of the vacuum interrupter is not subjected to excessive bending movement.

Note: *Excessive bending movement exerted while fastening the terminal clamp will damage the vacuum interrupter.*

2.11 Attach insulating coupler (48.0) and lever (48.6) together, using pin (48.5). Apply retaining clips. Correct pin has ends that have been generously chamfered.

2.12 Open and close circuit breaker several times and then check to see that all bolted joints and devices are tight.

3. Checking the contact stroke

3.1 Open the circuit breaker.

3.2 Free insulating coupler (48.0) by removing pin (48.5). The vacuum interrupter contacts must now close automatically as a consequence of atmospheric pressure.

3.3 Observe the terminal clamp (29.2) through the openings on each side of the moving-end pole head (40.0). Using vernier calipers, measure the distance from the bottom surface of the terminal clamp to the bottom edge of the cutout opening. Measure carefully and record your result.

3.4 Connect the insulating coupler (48.0) using pin (48.5) and the retaining clips provided.

3.5 Repeat the measurement described in step 3.3 again with care to maximize accuracy. Record your result.

3.6 Determine difference between the measurements made under steps 3.3 and 3.5. Your results should be per Table 7.

3.7 If you fail to achieve the listed results, carefully repeat the entire procedure making certain of your measurements.

3.8 Loosen eye bolt locking nut on insulating coupler (48.0), and retain position of the eye. Make adjustments in one-half turn increments. After adjustment is completed, tighten eye bolt locking nut to 26-34 ft-lb
(35-45 Nm).

4. After eye bolt is tightened to proper torque, repeat all measurement procedures, making certain they are in agreement with values indicated in step 3.6.

5. Complete all other maintenance procedures. Completely reassembled circuit breaker should pass the high-potential test before it is ready for service.

Hydraulic shock absorber

The mechanism is equipped with a hydraulic shock-absorber that functions when the circuit breaker opens (refer to item 61.8 in Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position). The shock absorber should require no adjustment. However, at maintenance checks, the shock absorber should be examined for evidence of leaking. If evidence of fluid leakage is found, the shock absorber must be replaced to prevent damage to the vacuum interrupter bellows.

Technical data and troubleshooting

Table 7a: Vacuum interrupter stroke

Rated maximum voltage	Interrupting class	Rated short-circuit current	Vacuum interrupter	Continuous current	Stroke[2]
kV	kA	kA	Type	A	mm
15.5 / 17.5	20	20 kA@15.5 kV / 17.5 kV	VS-25008	1,200, 2,000	13-15
15.5 / 17.5	25	25 kA@15.5 kV / 17.5 kV	VS-25008	1,200, 2,000	13-15
27.6	20	20 kA@27.6 kV	VS-25008	1,200, 2,000	13-15
27.6	25	25 kA@27.6 kV	VS-25008	1,200, 2,000	13-15
38.0	20	20 kA@38.0 kV	VS-30030	1,200, 2,000, 2,500	18-22
38.0	25	25 kA@38.0 kV	VS-30030	1,200, 2,000, 2,500	18-22
38.0	31.5	31.5 kA@38.0 kV	VS-30041	1,200, 2,000, 2,500	18-22
38.0	40	40 kA@38.0 kV	VS-30041	1,200, 2,000, 2,500	18-22

Note: the configuration covers 1,250 A as per IEC standard

Table 7b: Vacuum interrupter stroke - additional vacuum interrupters

Rated maximum voltage	Interrupting class	Rated short-circuit current	Vacuum interrupter	Continuous current	Stroke[2]
kV	kA	kA	Type	A	mm
15.5 / 17.5	20	20 kA@15.5 kV / 17.5 kV	VSA17-0-31	1,200, 2,000	10.5-12.5
15.5 / 17.5	25	25 kA@15.5 kV / 17.5 kV	VSA17-0-31	1,200, 2,000	10.5-12.5
15.5 / 17.5	31.5	31.5 kA@15.5 kV / 17.5 kV	VSA17-1-40	1,200, 2,000	6.5-8.5
15.5 / 17.5	40	40 kA@15.5 kV / 17.5 kV	VSA17-1-40	1,200, 2,000	6.5-8.5
27.6	20	20 kA@27.6 kV	VSS17-0-31	1,200, 2,000	10.5-12.5
27.6	25	25 kA@27.6 kV	VSS17-0-31	1,200, 2,000	10.5-12.5

Footnotes:

1. *The vacuum interrupter type designation is labeled on the vacuum interrupter. If the vacuum interrupter installed does not match that indicated in this table, contact the nearest Siemens representative.*
2. *If you need assistance achieving the indicated stroke setting, contact the nearest Siemens representative.*

Note: the configuration covers 1,250 A as per IEC standard

Table 8: Troubleshooting

Problem	Symptoms		Possible causes and remedies
Circuit breaker fails to close.	Closing spring will not automatically charge.		1. Secondary control circuit is de-energized or control circuit fuses are blown. Check and energize or replace if necessary. 2. Secondary multi-pin plug contacts A1 or D16 are not engaging. Check and replace if required. 3. Damage to wiring, terminals or connectors. Check and repair as necessary. 4. Failure of charging motor (88). Replace if required. 5. Motor cut-off switch LS21 or LS22 fails to operate. Replace if necessary. 6. Mechanical failure of operating mechanism. Check and contact the factory or Siemens field service at +1 (800) 333-7421 or +1 (423) 262-5700 outside the U.S.
	Closing springs charge but circuit breaker does not close.	Closing coil or solenoid (52SRC) fails to energize. No sound of circuit breaker closing.	1. Secondary control circuit de-energized or control circuit fuses blown. Correct as indicated. 2. No closing signal to multi-pin plug pin A2 or contacts A2 and B3 are not engaging. Check for continuity and correct protective relay logic. Replace contacts if required. 3. Failure of anti-pump relay (52Y) contacts 21 to 22, 31 to 32 or 13 to 14. Check and replace as required. 4. Failure of close coil (solenoid) (52SRC). Check and replace as required. 5. Auxiliary switch NC contacts 41 to 42 are open when circuit breaker contacts are open. Check linkage and switch. Replace or adjust as necessary.
		Closing coil energizes. Sound of circuit breaker closing is heard, but circuit breaker contacts do not close.	1. Mechanical failure of operating mechanism. Check and contact the factory or Siemens field service at +1 (800) 333-7421 or +1 (423) 262-5700 outside the U.S.

Table 8: Troubleshooting (continued)

Problem	Symptoms	Possible causes and remedies
Nuisance or false close	Electrical problem	1. Nuisance or false closing signal to secondary disconnect multi-pin plug contact. Check protective relay logic. Correct as required. 2. Closing coil (52SRC) terminal A2 is shorted-to-ground. Check to determine if problems are in wiring or coil. Correct as required.
	Mechanical problem	1. Mechanical failure of operating mechanism. Check and contact the factory or Siemens field service at +1 (800) 333-7421 or +1 (423) 262-5700 outside the U.S.
Circuit breaker will not trip	Tripping coil or solenoid (52T) does not energize. There is no tripping sound.	1. Secondary control power is de-energized or control power fuses are blown. Correct as indicated. 2. Damage to wiring, terminals or connectors. Check and repair as necessary. 3. No tripping signal to multi-pin plug contact C2. Check for continuity and correct protective relay logic. 4. Secondary multi-pin plug contacts C2 or D2 are not engaging. Check and replace if required. 5. Failure of trip coil (52T). Check and replace if necessary. 6. Auxiliary switch 52a NO contacts 23 to 24 or 33 to 34 are open when circuit breaker is closed. Check linkage and switch. Replace or adjust as necessary.
	Tripping coil (52T) energizes. No tripping sound is heard, and circuit breaker contacts do not open. In other words, they remain closed.	1. Failure of tripping spring or its mechanical linkage. Check and replace if required.
	Tripping coil (52T) energizes. Tripping sound is heard, but circuit breaker contacts do not open.	1. Mechanical failure of operating mechanism. Check and contact the factory or Siemens field service at +1 (800) 333-7421 or +1 (423) 262-5700 outside the U.S. 2. One or more of the vacuum interrupters are held closed. Check and replace as necessary.
Nuisance or false trip	Electrical problem	1. Tripping signal remains energized on secondary multi-pin plug contact C2. 2. Check for improper protective relay logic.
	Mechanical problem	1. Mechanical failure of operating mechanism. Check and contact the factory or Siemens field service at +1 (800) 333-7421 or +1 (423) 262-5700 outside the U.S.

Table 9: Technical ratings

Circuit breaker type SDV7-SE	Rated maximum voltage	Rated withstand voltages: Lightning impulse (BIL)	Rated withstand voltages: Power frequency	Rated short-circuit and short-time current	Rated interrupting time[2]	Rated continuous current[6]	Rated transient recovery voltage[3]: u_c TRV peak value	Rated transient recovery voltage[3]: t_3 time to voltage u_c	Rated permissible tripping delay time Y	Rated closing and latching current
	kV, rms	kV[1]	kV	kA, rms	ms/cycles	A, rms	kV	μs	sec	kA, peak
15.5 / 17.5-20	15.5 / 17.5	110/142	50	20	50/3	1,200, 2,000	29.2	32	2	52
15.5 / 17.5-25	15.5 / 17.5	110/142	50	25	50/3	1,200, 2,000	29.2	32	2	65
15.5 / 17.5-31.5	15.5 / 17.5	110/142	50	31.5	50/3	1,200, 2,000, 3,000	29.2	32	2	82
15.5 / 17.5-40	15.5 / 17.5	110/142	50	40	50/3	1,200, 2,000, 3,000	29.2	32	2	104
27.6-20	27.6	150/194	60	20	50/3	1,200, 2,000	52.1	45	2	52
27.6-25	27.6	150/194	60	25	50/3	1,200, 2,000	52.1	45	2	65
38.0-20	38.0	200/258	80	20	50/3	1,200, 2,000, 2,500	71.7	59	2	52
38.0-25	38.0	200/258	80	25	50/3	1,200, 2,000, 2,500	71.7	59	2	65
38.0-31.5	38.0	200/258	80	31.5	50/3	1,200, 2,000, 2,500	71.7	59	2	82
38.0-40	38.0	200/258	80	40	50/3	1,200, 2,000, 2,500	71.7	59	2	104

Table 10: Control data

	Range		Close coil	Trip coil[4, 5]	Spring charging motor	
Nominal	Close V	Trip V	A	A	Amperes run (avg.)	Charging seconds
48 Vdc	36-56	28-56	11.4	30/15	8	10
125 Vdc	90-140	70-140	2.1	7.4/4.8	4	10
250 Vdc	180-280	140-280	2.1	9.6/4.2	2	10
120 Vac	104-127	104-127	2.0	---	6	10
240 Vac	208-254	208-254	2.0	---	3	10

Footnotes:

1. *First value is full-wave impulse withstand circuit breaker open or closed. Second value is chopped-wave impulse withstand, applicable only with circuit breaker closed.*
2. *Standard 50 ms (3-cycle) with 48 Vdc, 125 Vdc or 250 Vdc trip voltage or capacitor trip with 83 ms (5-cycle) interrupting time optional.*
3. *TRV values are in accord with IEEE C37.06-2009. TRV peak value u_c is roughly equal to historic E_2 value in ANSI C37.06-2000. Value t_3, time to voltage u_c, is approximately 1/1.138 times the T_2 value in ANSI C37.06-2000.*
4. *First value is for standard 50 ms/3-cycle interrupting time. Second value is for optional 83 ms/5-cycle interrupting time (see note 1).*
5. *Power requirement for second trip coil is approximately 70 W (dc) or 50 VA (ac). Power requirement for undervoltage device is approximately 20 W (dc) or 20 VA (ac).*
6. *The configuration covers 1,250 A as per IEC standard.*

Table 11: Interrupting capacity auxiliary switch contacts

		Control circuit voltage				
Type auxiliary switch	Continuous current A	120 Vac	240 Vac	48 Vdc	125 Vdc	250 Vdc
Circuit breaker auxiliary switch	10	Non-inductive circuit interrupting capacity in A				
		10	5	10	9.6	4.8
		Inductive circuit interrupting capacity in A				
		6	3	10	6	3

Table 12: Technical ratings

Item	Unit	15.5 kV / 17.5 kV				27.6 kV		38.0 kV	
Lightning impulse withstand voltage • Full wave 1.2/50 µs • Chopped wave 2 µs[1] • Chopped wave 3 µs	kV	 110 142 ----				 150 194 ----		 200 258 ----	
Power-frequency withstand voltage[5]	kV	50				60		80	
Rated short-circuit current	kA	20/25/31.5/40				20/25		20/25/31.5/40	
%dc component	%	48				48		48	
Rated (making) closing and latching current	kA	52/65/82/104				52/65		52/65/82/104	
Rated duty cycle • Reclosing duty • Non-reclosing duty	----	O-0.3 s-CO-3 min.-CO O-15 s-CO				O-0.3 s-CO-3 min.- CO-O-15 s-CO		O-0.3 s-CO-3 min.-CO O-15 s-CO	
Minimum reclosing time[2]	s	0.3				0.3		0.3	
Rated power frequency	Hz	60				60		60	
Capacitance switching • Overhead line • Isolated bank • Back-to-back	A	 100 400 400				 100 400 400		 100 250 250	
Operating temperature range • Standard • Special	°C	 -30 to +40 -40 to +40[4]				 -30 to +40 -40 to +40[4]		 -30 to +40 -40 to +40[4]	
Operating mechanism	----	Stored-energy				Stored-energy		Stored-energy	
Closing time	ms	≤65				≤65		≤70	
Opening time by interrupting time • Three cycle • Five cycle	ms	 ≤38 ≤56				 ≤38 ≤56		 ≤38 ≤56	
Dual trip coils (mechanically and electrically independent)	----	Optional				Optional		Optional	
Emergency manual trip (externally operable)	----	Standard				Standard		Standard	
Auxiliary voltages (options) • Close, trip and protection	Vdc Vac	48/125/250 120/240[3]				48/125/250 120/240[3]		48/125/250 120/240[3]	
Interrupting medium	----	Vacuum				Vacuum		Vacuum	
Breaks per pole	----	1				1		1	
Contact gap (stroke) Vacuum interrupter type[6] 1,200 A 2,000 A 3,000 A	mm	20/25 VS-25008 13-15 13-15 ----	20/25 VSA17-0-31 10.5-12.5 10.5-12.5 ----	31.5/40 VS-15052 7-9 7-9 7-9	31.5/40 VSA17-1-40 6.5-8.5 6.5-8.5 -----	20/25 VS-25008 13-15 13-15 ----	20/25 VSS17-0-31 10.5-12.5 10.5-12.5 ---	20/25 VS-30030 18-22 18-22 (2,500) 18-22	31.5/40 VS-30041 18-22 18-22 18-22
Radio influence voltage (RIV) 1,000 kHz	µV	≤500				≤650		≤650	
Seismic withstand (optional) (IEEE 693 high-response spectrum)	g	0.5				0.5		0.5	

Footnotes:

1. *Circuit breaker is in closed position.*
2. *User must supply external time delay (typically using setting in reclosing relay) to assure the minimum reclose time interval of 0.3 s in accordance with IEEE C37.04.*
3. *Consult factory for -50 °C.*
4. *Add 10 ms if command power is ac.*
5. *The values in this table are per IEEE standard.*
6. *The configuration covers 1,250 A as per IEC standard.*

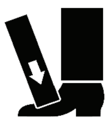
Disposal

⚠ WARNING

Stored energy.
Can cause death or serious injury.

Mechanisms contain stored energy, which may be released during disassembly.

Wear suitable protection and take appropriate precautions when disconnecting and removing moving parts.



⚠ WARNING

Heavy objects.
Can cause death or serious injury.

Disassembly may cause an unbalanced load, and could result in falling objects.

Take appropriate precautions in a properly designated workspace to maximize support and stability.

Siemens equipment is environmentally friendly product predominantly consisting of recyclable materials. For disposal, some disassembly, separation, and professional services handling may be required.

Materials to be handled include but are not limited to:

- *Metals:* Should be transferred and recycled as mixed scrap metals.
- *Plastics:* Plastic containing a recycle symbol should be recycled. Plastic lacking the recycle symbol should be discarded as industrial waste.
- *Small electronics, insulated cables, and motors:* Should be recycled via electronics scrap disposal companies specialized in separating and sorting as described above.
- *Batteries:* Should be recycled via a recycling company.

Disposal regulations vary from locality to locality and may be modified over time. Specific regulations and guidelines should be verified at the time of waste processing to ensure that current requirements are being fulfilled. For specific assistance in understanding and applying regional regulations and policies or manufacturer’s recommendations, refer to the local Siemens service representative for additional information.

Notes

Notes

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