Type 3AH 4.16 kV to 38 kV vacuum circuit breaker operator module instruction manual

Installation operation maintenance E50001-F710-A251-X-76US

Answers for energy.
**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 obligations. 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 manual a **qualified person** is one who is familiar with the installation, construction or 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 operating 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.
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**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 Energy, Inc. The warranty contained in the contract between the parties is the sole warranty of Siemens Energy, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.
Introduction

The type 3AH vacuum circuit breaker module is designed to meet all applicable ANSI, NEMA and IEEE 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 instruction manual indicate the degree of hazard that may be encountered by the user. These words are defined as:

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

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

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

**Caution (without safety alert symbol)** - Indicates a potentially hazardous situation which, if not avoided, may result in property damage.

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**DANGER**

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

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or by tampering by unqualified personnel will result in dangerous conditions that will cause death, severe injury or equipment damage. Follow all safety instructions contained herein.
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) 347-6659 or +1 (919) 365-2200 outside the U.S.

For medium-voltage customer service issues, contact Siemens at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S.
Receiving, handling and storage

Introduction
This portion of the instruction manual covers the receiving, handling and storage instructions for a type 3AH vacuum circuit breaker module. This section of the instruction manual is intended to help the user identify, inspect and protect the circuit breaker prior to its installation.

Receiving procedure
Make a physical inspection of the shipping container before removing or unpacking the circuit breaker.

Check for shipment damage or indications of rough handling by the carrier. Check each item against the manifest to identify any shortages.

Accessories (as applicable) such as the manual charging crank, racking crank or split-plug jumper are shipped separately.

Shipping damage claims

Important: The manner in which visible shipping damage is identified by consignee prior to signing the delivery receipt can determine the outcome of any damage claim to be filed.

Notification to carrier within 15 days for concealed damage is essential if loss resulting from unsettled claims is to be eliminated or minimized.

1. When the shipment arrives, note whether the equipment is properly protected from the elements. Note the trailer number the equipment arrived on. Note also any blocking of equipment. During unloading, check the actual equipment delivered to verify it agrees with the delivery receipt.

2. Make immediate inspection for visible damage upon arrival and prior to disturbing or removing packaging or wrapping material. This should be done prior to unloading when possible. When total inspection cannot be made on vehicle prior to unloading, close inspection during unloading must be performed and visible damage noted on the delivery receipt. Take pictures if possible.
Receiving, handling and storage

3. Any visible damage must be noted on the delivery receipt and acknowledged with the driver’s signature. The damage should be detailed as much as possible. It is essential that a notation “possible internal damage, subject to inspection” be included on the delivery receipt. If the driver will not sign the delivery receipt with the damage noted, the shipment should not be signed for by the consignee or their agent.

4. Notify Siemens medium-voltage customer service immediately of any damage, at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S.

5. Arrange for a carrier inspection of the damage immediately.

Important: Do not move the equipment from the place it was set when unloading. Also, do not remove or disturb packaging or wrapping material prior to carrier damage inspection. Equipment must be inspected by carrier prior to handling after receipt. This eliminates loss due to claims by carrier that the equipment was damaged or further damaged on site after unloading.

6. Be sure the equipment is properly protected from any further damage by covering it properly after unloading.

7. If practical, make further inspection for possible concealed damage while the carrier’s inspector is on site. If inspection for concealed damage is not practical at the time the carrier’s inspector is present, it must be done within 15 days of receipt of the equipment. If concealed damage is found, the carrier must again be notified and inspection made prior to taking any corrective action to repair. Also notify Siemens immediately at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S.

8. Obtain the original carrier inspection report and forward it with a copy of the noted delivery receipt to Siemens. Approval must be obtained by Siemens from the carrier before any repair work can be performed.

Before approval can be obtained, Siemens must have the documents referenced in the paragraph above. The carrier inspection report and/or driver’s signature on the delivery receipt does not constitute approval to repair.

Note: Any determination as to whether the equipment was properly loaded or properly prepared by shipper for over-the-road travel cannot be made at the destination. Shipments are not released from the factory without a clear bill of lading. Approved methods are employed for preparation, loading, blocking and tarping of the equipment before it leaves the Siemens factory. If the equipment is received in a damaged condition, this damage to the equipment has to have occurred while en route due to conditions beyond Siemens’ control. If the procedure outlined above is not followed by the consignee, purchaser or their agent, Siemens cannot be held liable for repairs. Siemens will not be held liable for repairs in any case where repair work was performed prior to authorization from Siemens.
Receiving, handling and storage

Handling procedure
1. Carefully remove the shipping carton from the circuit breaker. Keep the shipping pallet for later use if the circuit breaker is to be stored prior to its installation.
2. Inspect for concealed damage. Notification to carrier must take place within 15 days to assure prompt claim resolution.
3. Each circuit breaker should be lifted appropriately to avoid crushing the side panels of the circuit breaker, or damaging the primary disconnect assemblies. Refer to Table 13 for circuit breaker weights.
4. The palleted circuit breaker can be moved using a properly rated fork-lift vehicle. The pallets are designed for movement by a standard fork-lift vehicle.

Storage procedure
1. Whenever possible, install the circuit breaker in its assigned switchgear enclosure or end location for storage.
2. When the circuit breaker needs to be placed on its pallet for storage, be sure the unit is securely bolted to the pallet and covered with polyethylene film at least 10 mils thick.

Indoor storage
Whenever possible, store the circuit breaker indoors. The storage environment must be clean, dry and free of such items as construction dust, corrosive atmosphere, mechanical abuse and rapid temperature variations.

Outdoor storage
Outdoor storage is not recommended. When no other option is available, the circuit breaker must be completely covered and protected from rain, snow, dirt and all other contaminants.

Space heating
Space heating must be used for both indoor and outdoor storage to prevent condensation and corrosion. When equipment is stored outdoors, 250 watts per circuit breaker of space heating is recommended. If the circuit breaker is stored inside the switchgear enclosure and the switchgear is equipped with space heaters, energize the space heaters.
Installation checks and functional tests

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

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 in switchgear
When the circuit breaker is mounted in switchgear, open the control-power disconnect device in the metal-clad switchgear cubicle, outdoor circuit breaker housing or other location.

In metal-clad switchgear, the control-power disconnect device is normally located on the secondary-device panel in the upper cell of the vertical section. The normal control-power disconnect device is a pullout-type fuse holder. Removal of the fuse holder de-energizes control power to the circuit breaker in the associated switchgear cell. In some switchgear assemblies, a molded-case circuit breaker or knife switch is used in lieu of the pullout-type fuse holder. Opening this circuit breaker or switch accomplishes the same result: control power is disconnected.

Spring-discharge check (refer to Figure 1)
Perform the spring-discharge check before removing the circuit breaker from the pallet or removing it from the switchgear.

The spring discharge check should be performed after de-energizing control power. This check assures both the tripping and closing springs are fully discharged.

Note: Do not perform the spring-discharge check if the circuit breaker is in the CONNECT position. Open the circuit breaker and rack to the DISCONNECT position, and then perform the spring-discharge check. For fixed-mounted circuit breaker applications, open the isolator switches on the line side and on the load side of the circuit breaker before performing the spring-discharge check.

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.

DANGER
Hazardous voltage and high-speed moving parts.
Will cause death, serious injury and property damage.
Read instruction manuals, observe safety instructions and use qualified personnel.
Installation checks and functional tests

**Manual-spring charging check**
1. Insert the manual-spring charging crank into the manual-charge handle socket (refer to Figure 1). 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 on page 29.

**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.

1. Open control-power circuit by opening the control power-disconnect device.
2. Energize (close) the control power-circuit disconnect.
3. Use the Close and Open controls (refer to Figure 1) to first Close and then Open the circuit breaker contacts. Verify contact positions visually by observing the OPEN/CLOSED indicator on the circuit breaker.
4. De-energize control power by repeating Step 1. If a split-plug jumper was used for temporary control-power connections, disconnect the split-plug jumper from the switchgear first and next from the circuit breaker.
5. Perform the spring-discharge check again. Verify that the closing spring is discharged and the primary contacts of the circuit breaker are 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.

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**Note:** A temporary source of control power and test leads may be required if the control-power source has not been connected to the switchgear or 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.
Introduction
The type 3AH vacuum circuit-breaker operator is intended for application in a drawout truck for use in medium-voltage metal-clad switchgear and for stationary applications, such as the type SDV6 outdoor distribution circuit breaker. The type 3AH circuit breaker conforms to the requirements of ANSI/IEEE standards, including C37.20.2, C37.04, C37.06, C37.09 and C37.010.

The circuit breaker includes three vacuum interrupters, a stored-energy operating mechanism, necessary electrical controls and interlock devices, disconnect devices to connect the circuit breaker to both primary and control power (for drawout applications) and an operator housing. In a typical installation in a drawout truck, insulating barriers may be located between the vacuum interrupters and along the sides.

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

Vacuum interrupters
The operating principle of the vacuum interrupter is simple. Figure 3 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 pole head of the circuit breaker. The vacuum interrupter movable contact is connected to the pole bottom and driving mechanism of the circuit breaker. The metal bellows provide a secure seal around the movable contact, preventing loss of vacuum while permitting vertical motion of the movable contact.
Vacuum interrupter/operator

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 (refer to Figure 2)
Figure 2 illustrates the pad provision to accept the primary connections. Each circuit breaker has three upper and three lower primary disconnect pad provisions, to allow connection to the switchgear. For stationary circuit breaker applications, bus conductors connect directly to these pads. Bolting hardware is M12 x 1.75 grade 8. Torque M12 bolts to 52 ft-lb (70 Nm).

Phase barriers (if applicable)
Plates of glass-polyester insulating material are attached to the circuit breaker and provide suitable electrical insulation between the vacuum interrupter and primary conductors and the cubicle.

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, 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 ANSI/IEEE C37.04-1999, clause 6.9.
Vacuum interrupter/operator module
The vacuum interrupter/operator module consists of the three poles, each with its vacuum interrupters and primary insulators, mounted on the common operating mechanism housing. This module is shown in Figure 4.

Construction (Refer to Figures 1, 2, 5, 6 and 7)
Each of the circuit breaker poles are fixed to the rear of the operating mechanism housing by two cast-resin insulators. The insulators also connect to the upper and lower pole supports that in turn support the ends of the vacuum interrupter. The pole supports are aluminum castings (most 1,200 A, all 2,000 A and some 3,000 A), copper castings (some 3,000 A) or sheet steel (some 1,200 A). Primary disconnect stud extensions may be attached directly to the upper and lower pole connection pads.

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 in most designs, although direct connection to the switchgear is used for certain products.

Circuit breaker pole (refer to Figure 5)
The vacuum interrupter is bolted to the upper pole head and the upper pole head is rigidly connected to the operator housing by the post insulator. The lower part of the vacuum interrupter is stabilized against lateral forces by a centering ring on the pole bottom. The external forces due to switching operations and the contact pressure are absorbed by the struts.

Current-path assembly (refer to Figure 5)
The current-path assembly consists of the pole head, the stationary contact and the moving contact, that is connected to the pole bottom by a terminal clamp and a flexible connector.

Vacuum interrupter (refer to Figure 5)
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 Figures 5 and 6)
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, contact pressure spring (49.0), insulating coupler (48.0) and angled lever.

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

During closing, the opening spring (64.0) (refer to Figure 6) and the contact pressure springs (49.0) are charged and latched by pawl (64.2) (refer to Figure 7). The closing spring (62.0) (refer to Figure 6) 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) (refer to Figure 7). The opening sequence is similar to the closing sequence. The residual force of the opening spring 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.
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 Figures 6 and 7. The control and sequence of operation of the mechanism is described in Figure 8.

Motor-operating mechanism (refer to Figure 6)
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.

Mode of operation
The operating mechanism is of the stored-energy trip-free type. For example, 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. The charging shaft is supported in the charging mechanism (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.
Figure 6: Stored-energy operating mechanism (circuit breaker shown in OPEN position) (straight linkage shown)

50.2 - Charging mechanism gear box
50.3 - Charging flange
50.3.1 - Driver (not visible)
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 52SRC
54.0 - Open pushbutton
54.1 - Trip coil 52T
55.0 - Closing spring-charge indicator
55.1 - Linkage
55.2 - Control lever
55.2 - CLOSE/OPEN indicator
58.0 - Opening spring
58.1 - Auxiliary switch
60.0 - Jack shaft
61.8 - Shock absorber
62.0 - Closing spring
62.1 - Charging shaft
62.2 - Crank
62.3 - Cam disc
62.5 - Lever
62.5.1 - Pawl roller (not visible)
62.5.2 - Close latch pawl
62.6 - Driver lever
62.8 - Trip-free coupling lever*
62.8.1 - Spring return latch (not shown)*
62.8.2 - Trip-free coupling system
63.0 - Auxiliary spring
63.1 - Lever - phase C
63.5 - Lever - phase B
63.7 - Lever - phase A
64.0 - Opening spring
68.0 - Auxiliary switch
68.1 - Auxiliary switch link

* For certain applications, the straight trip coupling rod (62.8) is replaced by a collapsible trip-free coupling system, illustrated in Figures 7-11.
When the charging mechanism is actuated by hand with a hand crank (refer to Figures 13 and 14) or by a motor (50.4), the flange (50.3) turns until the driver (50.3.1) locates itself in the cutaway part of the cam disc (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 cam disc (62.3) follows along, and it is brought into position for closing when the closing spring is fully charged.

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) switch in the control supply to cause the closing spring to recharge immediately.

Closing (refer to Figures 6-11)
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 cam disc (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), (63.5) and (63.7) fixed on the jack shaft operate the three insulating couplers (48.0) (refer to Figure 5) 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 (63.1) actuates the auxiliary switch (68.0) through the linkage (68.1).
Vacuum interrupter/operator

Trip-free operation
(refer to Figures 6 and 7)

Trip-free for all drawout circuit breakers and some fixed-mounted circuit breakers
The trip coupling rod (62.8 together with 62.8.1 and 62.8.2) permits the immediate de-coupling of the drive lever (62.6) and the jack shaft (63.0) to override closing action by trip command or by means of the racking interlocks. The trip-free coupling rod (62.8) forms a link between the drive lever (62.6) and the jack shaft (63.0). The rigidity of this link depends upon a spring-return latch (62.8.1) carried within the coupling rod. The latch pivots within the coupling rod and is normally positioned to ensure the rigidity of the coupling rod. Trip-free coupling link (62.8.2) and trip-free coupling lever (62.8.3) cause the spring-return latch position to be dependent upon the normal tripping components and the racking interlock. Thus, whenever a trip command is applied or the circuit breaker is not in the fully CONNECT or TEST position, the trip-free coupling rod is no longer rigid, effectively decoupling the drive lever and jack shaft. Under these conditions the vacuum interrupter contacts cannot be closed.

Trip-free for the type SDV6 outdoor distribution circuit breaker and some fixed-mounted circuit breakers
For the type SDV6 outdoor distribution circuit breaker and some other fixed-mounted circuit breakers, the drawout trip-free linkage (refer to Figures 7-11) is replaced with simplified linkage. The trip-free coupling rod (62.8) is replaced with a straight coupling rod (refer to Figure 6), and other parts associated with drawout interlocking are eliminated. The parts modified or eliminated are noted in the relevant figures. In these circuit breakers, 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.

Opening (refer to Figure 6)
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 C37.06-2009.

Manual operation
Electrically operated vacuum circuit breakers can be operated manually if the control supply should fail.
Figure 8: Operating mechanism section diagram (drawout trip-free linkage shown) mechanism OPEN, closing spring DISCHARGED

48.0  - Insulating coupler
50.3  - Charging flange
50.3.1 - Driver
53.0  - Close pushbutton
53.1  - Close coil 52SRC
54.0  - Open pushbutton
54.1  - Trip coil 52T
62.1  - Charging shaft
62.2  - Crank
62.2.2 - Closing-spring mounting
62.3  - Cam disc
62.5  - Lever
62.5.1 - Pawl roller
62.5.2 - Close latch-pawl
62.6  - Drive lever
62.8  - Trip-free coupling rod*
62.8.1 - Spring-return latch*
62.8.2 - Trip-free coupling link (draw bar)*
62.8.3 - Trip-free coupling lever*
62.8.5 - Push rod and cam assembly*
62.8.6 - Interlock lever push rod*
62.8.7 - Interlock lever actuator*
62.8.8 - Trip-free actuator*
63.0  - Jack shaft
63.1  - Lever - phase C
63.5  - Lever - phase B
63.7  - Lever - phase A
64.0  - Opening spring
64.2  - Trip-latch pawl
64.2.1 - Trip-latch pin
64.2.2 - Latching pawl-release lever
64.3  - Lever
64.3.1 - Jack-shaft pawl
64.5  - Opening-spring shaft

*  For the type SDV6 outdoor circuit breaker and some fixed-mounted circuit breakers, trip-free coupling rod (62.8) and other parts associated with drawout interlocking are eliminated.

**  Items moved from position shown in Figure 10 on trip operation. Underlined items moved from position shown in Figure 9 on closed spring-discharge operation.
Vacuum interrupter/operator

Figure 9: Operating mechanism section diagram (drawout trip-free linkage shown) mechanism OPEN, closing spring DISCHARGED.

- Insulating coupler
- Charging flange
- Driver
- Close pushbutton
- Close coil 52SRC
- Open pushbutton
- Trip coil 52T
- Charging shaft
- Crank
- Closing-spring mounting
- Cam disc
- Lever
- Pawl roller
- Close-latch pawl
- Drive lever
- Trip-free coupling rod*
- Spring return-latch*
- Trip-free coupling link (draw bar)*
- Trip-free coupling lever*
- Push rod and cam assembly*
- Interlock lever push rod*
- Interlock lever actuator*
- Trip-free actuator*
- Jack shaft
- Lever - phase C
- Lever - phase B
- Lever - phase A
- Opening spring
- Trip-latch pawl
- Trip-latch pin
- Latching pawl-release lever
- Lever
- Jack-shaft pawl
- Opening-spring shaft

* For a type SDV6 outdoor circuit breaker and some fixed-mounted circuit breakers, trip-free coupling rod (62.8) and other parts associated with drawout interlocking are eliminated.

** Items moved from position shown in Figure 11 on trip operation. Underlined items moved from position shown in Figure 8 on closed spring-discharge operation.
Vacuum interrupter/operator

Figure 10: Operating mechanism section diagram (drawout trip-free linkage shown) mechanism CLOSED, closing spring DISCHARGED

62.5.2 - Close latch-pawl
62.8.1 - Spring-return latch*
62.8.2 - Trip-free coupling link (draw bar)*
62.8.3 - Trip-free coupling lever*
62.8.5 - Push rod and cam assembly*
62.8.6 - Interlock lever push rod*
62.8.7 - Interlock lever actuator*
62.8.8 - Trip-free actuator*
63.1 - Lever - phase C
63.5 - Lever - phase B
63.7 - Lever - phase A
64.0 - Opening spring
64.2.1 - Trip-latch pin
64.2.2 - Latching pawl-release lever
64.3 - Lever
64.3.1 - Jack-shaft pawl
64.5 - Opening spring-shaft

* For the type SDV6 outdoor circuit breaker and some fixed-mounted circuit breakers, trip-free coupling rod (62.8) and other parts associated with drawout interlocking are eliminated.

** Numbered items moved from position shown in Figure 9.
Figure 11: Operating mechanism section diagram (drawout trip-free linkage shown) mechanism CLOSED, closing spring CHARGED

62.5.2 - Close latch pawl
62.8.1 - Spring return latch*
62.8.2 - Trip-free coupling link (draw bar)*
62.8.3 - Trip-free coupling lever*
62.8.5 - Push rod and cam assembly*
62.8.6 - Interlock lever push rod*
62.8.7 - Interlock lever actuator*
62.8.8 - Trip-free actuator*
63.1 - Lever - phase C
63.5 - Lever - phase B
63.7 - Lever - phase A
64.0 - Opening spring
64.2.1 - Trip-latch pin
64.2.2 - Latching pawl release lever
64.3 - Lever
64.3.1 - Jack shaft pawl
64.5 - Opening spring shaft

* For type SDV6 outdoor circuit breakers and some fixed-mounted circuit breakers, trip-free coupling rod (62.8), and other parts associated with drawout interlocking are eliminated.

** Numbered items moved from position shown in Figure 10.
Manually charging the closing spring (refer to Figures 13 and 14)
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)
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)
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).

CAUTION
The special hand crank automatically disengages if the spring-charging motor operates. In order to avoid injuries as a result of the motor suddenly starting up, the circuit breaker spring must only be charged manually with the special hand crank (50.0).
Vacuum interrupter/operator

Figure 12: Operator sequential operation diagram

Closing

Control voltage applied.

Anti-pumping feature (52Y) assures a continuously applied closing command does not cause the circuit breaker to reclose automatically after it has tripped out on a fault.

Undervoltage device 27 picks up.¹

Spring-charge motor (88.0) energized.

Closing spring fully charged.

LS21 and LS22 operate to de-energize spring-charging motor (88.0).

LS3 opens in series with anti-pump relay (52Y).

LS41 closes to signal closing spring is charged.

LS9 closes close circuit only when closing spring is fully charged.

Continuous closing command.

Close coil (52SRC) unlashes closing spring and circuit breaker closes.

Motor cutoff switches LS21, LS22 and LS3 are closed because the closing spring is discharged.

Before the spring-charge motor has recharged the closing spring and opened LS3, anti-pump relay (52Y) picks up and seals in.

The anti-pump relay (52Y) opens two contacts in series with the close coil (52SRC).

The close coil (52SRC) is now blocked and cannot be activated until springs are fully-charged and close command is removed.

Rapid auto-reclosing. The closing spring is automatically recharged as described above. Therefore, when the circuit breaker is closed both of its springs are charged. The closing spring charges the opening spring during closing. As a result, the circuit breaker is capable of an O-0.3s-CO-3 min-CD operating cycle. The dashed line shows the operating sequence initiated by the closing command.

No action! Open 52b in series with close coil (52SRC) blocks closing spring-release.

No action! Anti-pump relay (52Y) picks up through the closed LS3 contact and opens.

Circuit breaker auxiliary contacts 52a and 52b change state.

The circuit breaker closes.

The opening spring is charged.

The closing spring is unlatched.

52a contacts in series with the trip coil (52T) close to enable a trip operation.

Circuit breaker contacts 52a and 52b change state.

The circuit breaker closes.

LS21 and LS22 close to energize motor. LS3 closes and LS4 opens to cancel closing spring signal.

Trip coil (52T) can only be activated when series connected 52a contact is closed.

Trip coil (52T) unlashes the opening spring.

Footnote:
1 Optional items.

Secondary shunt-release (dual-trip) function activated by remote trip command contact NO.¹

Secondary release unlashes the opening spring.¹

Trip coil (52T) unlashes the opening spring.

Undervoltage device (27) is activated by closing NO contact, shorting the 27 coil. The NO contact is only effective with the circuit breaker closed. Resistor required.¹

Undervoltage device (27) is activated by closing a NC contact in series with 27 or by loss or reduction of tripping voltage.¹

Secondary shunt-release (dual-trip) function activated by remote trip command contact NO.¹

Undervoltage device 27 unlashes the opening spring.¹

Circuit breaker trips.
The schematic shown in Figure 15 is intended to aid in understanding the mechanism operation discussed in this instruction manual. It shows a drawout circuit breaker as an example. Refer to the schematic diagram furnished with your circuit breaker for specific information.

**Close coil (52SRC)**

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.
Vacuum interrupter/operator

Figure 15: Typical elementary diagram

88.0  - Spring-charging motor
52a   - Auxiliary switch is open when circuit breaker is open
52b   - Auxiliary switch is closed when circuit breaker is closed
52SRC - Spring-release coil (CLOSE)
52T   - Shunt trip coil
52Y   - Closing relay (anti-pump)
G     - Green indicating light (TRIP)

LS    - Spring-charged switch
MI1, MI2 - Mechanical interlock
01/C  - Control switch (CLOSE)
01/T  - Control switch (TRIP)
R     - Red indicating light (CLOSED)
W     - White indicating light (spring-charged)

Standard:
Fuses in close circuit. Slugs in trip circuit (fuses optional).
Shown with springs discharged, trip-latch reset, circuit breaker open, connect or withdrawn position.
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 Figures 16, 17 and 18).

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

Secondary shunt-release (52T1) (refer to Figure 16)

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.

Undervoltage release (27.0) (refer to Figures 17 and 18)

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. 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 control voltages.
Vacuum interrupter/operator

Construction and mode of operation of secondary shunt-release and undervoltage release (refer to Figures 16, 17 and 18)

The release consists of a spring-power stored-energy mechanism, a latching device and an electromagnet.

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.

Figure 18: Undervoltage lock/operate selection

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

23.0 - Striker pin
29.0 - Screw

Figure 19: Capacitor-trip device

120 or 240 Vac supply

Capacitor
Resistor
Rectifier
Capacitor trip
Vacuum interrupter/operator

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 on the drawout truck or in the stationary circuit breaker enclosure, as space is not available inside the type 3AH 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 19).

**Shock absorber**

Circuit breakers are equipped with a hydraulic shock absorber (61.8) (refer to Figure 6). 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 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 (88.0)**

Spring-charging motors (50.4) (refer to Figure 6) are available for either ac or dc operation. If operated with ac voltage, a rectifier is installed in the circuit breaker.
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 ten-year intervals (five-year intervals for the type SDV6 outdoor distribution circuit breaker) or at the number of operations indicated in Table 2. "Usual" and "unusual" service conditions for medium-voltage metal-clad switchgear (includes circuit breaker module) are defined in ANSI/IEEE C37.20.2, sections 4 and 8.1, ANSI/IEEE C37.04, section 4 and ANSI/IEEE C37.010, section 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.

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.
Maintenance

Hazardous voltage and high-speed moving parts.
Will cause death, serious injury and 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
- Dental 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 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 upper and the three lower primary disconnects (drawout only) or bus connections (stationary only). 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.
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.

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 is a side view of the circuit breaker with the insulating barriers removed (if furnished) to show the vacuum interrupter, and the upper and lower 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 bottom movable contacts of the vacuum interrupters to the lower connection pad for tightness and absence of mechanical damage, burning or pitting.

### Inspection items and tests

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<td>High-potential test</td>
</tr>
<tr>
<td>Insulation test</td>
</tr>
<tr>
<td>Contact-resistance test</td>
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<tr>
<td>Inspection and cleaning of circuit-breaker insulation</td>
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<tr>
<td>Functional tests</td>
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Table 1: Maintenance tasks
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.

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 ANSI/IEEE C37.20.2, section 4 (for drawout circuit breakers) or ANSI/IEEE C37.04, section 4 and elaborated in ANSI/IEEE C37.010, section 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

<table>
<thead>
<tr>
<th>Circuit breaker type</th>
<th>Number of years/closing operations (whichever comes first)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDV6</td>
<td>5-years/10,000 operations</td>
</tr>
<tr>
<td>All others</td>
<td>10-years/10,000 operations</td>
</tr>
</tbody>
</table>

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

- Klüber Isoflex Topas L32 (part 3AX11333H)

Source:


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.

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 9-10). 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.
Maintenance

Figure 20: Operator mechanism lubrication

Klüber L32 or Klüber L32N
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 21. 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.

b) Observe the white contact-erosion mark (refer to Figure 21) of each pole. When any part of the white contact-erosion mark is visible, contact wear is within acceptable limits.

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.

---

**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.

---

**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.
Maintenance

**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 check and initial functional tests (refer to pages 9-10).

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 switchgear or 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 circuit breaker energized by control power either from the switchgear or an external control-power source.

1. Once the circuit breaker springs are charged, move the switchgear-mounted Close/Trip switch to the Close position. 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, move the switchgear-mounted Close/Trip switch to the Trip position. 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 3: Typical vacuum interrupter contact life expectancy

<table>
<thead>
<tr>
<th>Rated maximum voltage kV</th>
<th>Interrupting class MVA</th>
<th>Rated short-circuit current</th>
<th>Vacuum interrupter type</th>
<th>Graph</th>
<th>Right hand limit of curve (refer to Figure 22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.76</td>
<td>250</td>
<td>29 kA @ 4.76 kV; 36 kA @ 3.85 kV</td>
<td>VS-17006 VS-17040</td>
<td>A</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td>36</td>
</tr>
<tr>
<td>4.76</td>
<td>350</td>
<td>41 kA @ 4.76 kV; 49 kA @ 4.0 kV</td>
<td>VS-15052 VS-17040</td>
<td>B</td>
<td>49</td>
</tr>
<tr>
<td>8.25</td>
<td>500</td>
<td>33 kA @ 8.25 kV; 41 kA @ 6.6 kV</td>
<td>VS-15052</td>
<td>B</td>
<td>41</td>
</tr>
<tr>
<td>15.0</td>
<td>500</td>
<td>18 kA @ 15.0 kV; 23 kA @ 11.5 kV</td>
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<td>23</td>
</tr>
<tr>
<td>15.0</td>
<td>750</td>
<td>28 kA @ 15.0 kV; 36 kA @ 11.5 kV</td>
<td>VS-15052 VS-17040</td>
<td>B</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td>36</td>
</tr>
<tr>
<td>15.0</td>
<td>1,000</td>
<td>37 kA @ 15.0 kV; 48 kA @ 11.5 kV</td>
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<td>B</td>
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<td>38.0</td>
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<td>21 kA @ 38.0 kV; 35 kA @ 23.0 kV</td>
<td>VS-30030</td>
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<table>
<thead>
<tr>
<th>Rated maximum voltage kV</th>
<th>Interrupting class kA</th>
<th>Rated short-circuit current</th>
<th>Vacuum interrupter type</th>
<th>Graph</th>
<th>Right hand limit of curve (refer to Figure 22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.76</td>
<td>31.5</td>
<td>31.5</td>
<td>VS-17006 VS-17040</td>
<td>A</td>
<td>31.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td>31.5</td>
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<tr>
<td>4.76</td>
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<td>VS-15052 VS-17040</td>
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<td>50</td>
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<td>B</td>
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<td>4.76</td>
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<td>VS-17085</td>
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<td>8.25</td>
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<td></td>
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<td></td>
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<td>E</td>
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<tr>
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<td>40</td>
<td>VS-15052 VS-17040</td>
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<tr>
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<td>63</td>
<td>VS-17085</td>
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<td>20</td>
<td>VS-25008</td>
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<td>20</td>
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<tr>
<td>15.5</td>
<td>25</td>
<td>25</td>
<td>VS-25008</td>
<td>C</td>
<td>25</td>
</tr>
<tr>
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<td>31.5</td>
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<td>VS-15052</td>
<td>B</td>
<td>31.5</td>
</tr>
<tr>
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<td>40</td>
<td>40</td>
<td>VS-15052</td>
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</tr>
<tr>
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<td>VS-25008</td>
<td>C</td>
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<tr>
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<td>20</td>
<td>VS-30030</td>
<td>D</td>
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<td>25</td>
<td>VS-30030</td>
<td>D</td>
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<td>31.5</td>
<td>VS-30041</td>
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<td>40</td>
<td>40</td>
<td>VS-30041</td>
<td>D</td>
<td>40</td>
</tr>
</tbody>
</table>

**Footnote:**

1. Maximum symmetrical interrupting current rating of circuit breaker (refer to Tables 11 and 12).
Figure 22: Typical vacuum interrupter contact life curves

Load graph "A" vacuum interrupter type VS-17006
Load graph "C" vacuum interrupter type VS-25008
Load graph "E" vacuum interrupter type VS-17040

Permissible operating cycles

Breaking current (symmetrical value)

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.
Appendix

Figure 22: Typical vacuum interrupter contact life curves (continued)

Load graph "B" vacuum interrupter type VS-15052
Load graph "D" vacuum interrupter types VS-30030 and VS-30041
Load graph "F" vacuum interrupter type VS-17085

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.
Checks of the spring-charging motor (88.0)
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 and Figure 22).

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 22) are offered as a guide to expected life.

Vacuum-integrity check (using mechanical test) (refer to Figure 23)
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) (refer to Figure 23).

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 23.

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 (refer to Figure 23);

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) (refer to Figure 23).

**DANGER**
High-potential tests employ hazardous voltages.
Will cause death and serious injury.
Follow safe procedures, exclude unnecessary personnel and use safety barriers. Keep away from the circuit breaker during application of test voltages. Disconnect the split plug jumper from between the circuit breaker and switchgear before conducting high-potential tests.
Maintenance

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) 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.

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.
### Table 4: High-potential test voltages

<table>
<thead>
<tr>
<th>Equipment maximum voltage rating kV</th>
<th>Equipment rated power-frequency withstand kV (rms)</th>
<th>Maximum ac rms test voltage kV</th>
<th>Maximum dc average test voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.76</td>
<td>19</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>8.25</td>
<td>36</td>
<td>27</td>
<td>38</td>
</tr>
<tr>
<td>15.0</td>
<td>36</td>
<td>27</td>
<td>38</td>
</tr>
<tr>
<td>15.5</td>
<td>50</td>
<td>38</td>
<td>53</td>
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<td>27.6</td>
<td>60</td>
<td>45</td>
<td>64</td>
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<tr>
<td>38</td>
<td>80</td>
<td>60</td>
<td>85</td>
</tr>
</tbody>
</table>

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. 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.

* Megger is a registered trademark of Megger Group, Ltd.

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.
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 38-39).

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 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. For drawout applications, connect all points of the secondary disconnect with a shorting wire. For stationary applications, disconnect secondary circuits for the operating mechanism by disconnecting the multiple pin-plug at the upper right 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 (if applicable) and reattach the leads to the spring-charging motor.

10. Perform contact-resistance tests of the primary contacts. The resistance should be read between the lower and upper connection pads (refer to Figure 23). Contact resistance should not exceed the values listed in Table 5.
Inspection and cleaning of circuit breaker insulation

1. Perform the spring-discharge check (refer to page 9) 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 again the red Open pushbutton.

   All of these controls are on the circuit breaker front panel (refer to Figure 1). Visually verify the Discharged condition of the springs.

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

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

4. Replace 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.

Functional tests

Refer to the installation checklist in the installation checks and initial functional tests section of this instruction manual (refer to pages 9-10). 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.

<table>
<thead>
<tr>
<th>Current rating A</th>
<th>Contact resistance Micro-Ohms</th>
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</thead>
<tbody>
<tr>
<td>1,200</td>
<td>35</td>
</tr>
<tr>
<td>2,000</td>
<td>30</td>
</tr>
<tr>
<td>3,000</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 5: Maximum contact-resistance
Overhaul

Introduction

The following procedures along with the troubleshooting charts in this instruction manual (refer to pages 47-51), provide maintenance personnel with a guide to identifying and correcting possible malfunctions of the circuit breaker.

Circuit breaker overhaul

Table 6 gives the recommended overhaul schedule type 3AH operating mechanisms. These intervals assume that the circuit breaker is operated under "usual service conditions" as discussed in ANSI/IEEE C37.20.2 section 4 (for drawout circuit breakers) or ANSI/IEEE C37.04 section 4 and elaborated in C37.010 section 4 (for outdoor distribution circuit breakers). If the circuit breaker is operated frequently, the overhaul interval in Table 6 may coincide with the maintenance interval in Table 2.

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
- Trip-free drive bar mechanism (if applicable).

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 32).
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 Figures 24 and 25.

Table 6: Overhaul schedule

<table>
<thead>
<tr>
<th>Circuit breaker type</th>
<th>Closing operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDV6 outdoor distribution circuit breaker</td>
<td>10,000</td>
</tr>
<tr>
<td>All others</td>
<td>10,000</td>
</tr>
</tbody>
</table>
Instructions herein apply for replacement of all vacuum interrupters except type VS-17085 vacuum interrupters, and interrupters on 3,000 A circuit breakers having the flexible connector (refer to 29.1 in Figure 24) electron-beam welded to the moving terminal (refer to 36.1 in Figure 24) of the vacuum interrupter. These interrupters must be replaced by factory-trained personnel. Contact Siemens medium-voltage customer service at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S.

1. Removing the vacuum interrupter

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

The movable contact uses a metal bellows to maintain the vacuum seal while still permitting up and down motion of the contact. The bellows is rugged and reliable, and is designed to withstand years of vertical 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 outer-phase and inter-phase barriers.

1.2 Loosen the lateral bolt(s) on terminal clamp (29.2). Employ the illustrated procedure to loosen clamp hardware (refer to Figure 25).

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 pole bottom (40.0) and swing the struts forward and downward.

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 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 pole head to the post insulator. Completely remove the pole head and set aside.

1.9 Grasp the vacuum interrupter (30.0) and withdraw vertically. Assistance may be required to work the terminal clamp off the movable stem of the vacuum interrupter. **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 lower pole-support (40.0). Slip terminal clamp (29.2) into position on the movable stem.

2.3 Align vacuum interrupter and fasten “finger tight” using heavy flat washer, lock washer and bolt (31.2).
20.0 - Upper pole-support (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 - Upper terminal-bolt
36.1 - Moving terminal
36.3 - Eye bolt (or adapter)
40.0 - Lower pole-support (pole-bottom)
48.0 - Insulating coupler
48.5 - Pin
48.6 - Angled lever
48.9 - Drive link
2.4 Fasten the pole head to the post insulator (16.1) “finger tight” using hex-head bolt, lock washer and flat washer.

2.5 Attach struts (28.0) to the upper pole-support (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 Raise 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 25). 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.

2.8 Align 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).

2.9 Tighten vacuum interrupter fastening bolt (31.2) on the pole head (20.0) holding the vacuum interrupter firmly by its upper 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 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).

2.10 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 vertically without binding, and then tighten the hardware which secures the centering ring. Recheck that the movable contact is free to move vertically without binding.
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 pole bottom (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). 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.
## Maintenance and Troubleshooting

### Rated maximum voltage

<table>
<thead>
<tr>
<th>Rated maximum voltage (kV)</th>
<th>Interrupting class (kA)</th>
<th>Rated short-circuit current (kA)</th>
<th>Vacuum interrupter Type</th>
<th>Continuous current (kA)</th>
<th>Stroke (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.76</td>
<td>250</td>
<td>29 kA@4.76 kV; 36 kA@3.85 kV</td>
<td>VS-17006; VS-17040</td>
<td>1,200, 2,000; 1,200, 2,000</td>
<td>7-9</td>
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<td>4.76</td>
<td>350</td>
<td>41 kA@4.76 kV; 49 kA@4.0 kV</td>
<td>VS-15052</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>8.25</td>
<td>500</td>
<td>33 kA@8.25 kV; 41 kA@6.6 kV</td>
<td>VS-15052</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>15.0</td>
<td>500</td>
<td>18 kA@15.0 kV; 23 kA@11.5 kV</td>
<td>VS-17006</td>
<td>1,200, 2,000</td>
<td>7-9</td>
</tr>
<tr>
<td>15.0</td>
<td>750</td>
<td>28 kA@15.0 kV; 36 kA@11.5 kV</td>
<td>VS-15052; VS-17040</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>15.0</td>
<td>1,000</td>
<td>37 kA@15.0 kV; 48 kA@11.5 kV</td>
<td>VS-15052</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>38.0</td>
<td>1,500</td>
<td>21 kA@38.0 kV; 25 kA@23.0 kV</td>
<td>VS-30030</td>
<td>1,200, 2,000, 3,000</td>
<td>18-22</td>
</tr>
</tbody>
</table>

### 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.

### Table 7: Vacuum interrupter stroke

<table>
<thead>
<tr>
<th>Rated maximum voltage (kV)</th>
<th>Interrupting class (kA)</th>
<th>Rated short-circuit current (kA)</th>
<th>Vacuum interrupter Type</th>
<th>Continuous current (kA)</th>
<th>Stroke (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.76</td>
<td>31.5</td>
<td>31.5 kA@4.76 kV</td>
<td>VS-17006; VS-17040</td>
<td>1,200, 2,000; 1,200, 2,000</td>
<td>7-9</td>
</tr>
<tr>
<td>4.76</td>
<td>40</td>
<td>40 kA@4.76 kV</td>
<td>VS-15052; VS-17040</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>4.76</td>
<td>50</td>
<td>50 kA@4.76 kV</td>
<td>VS-15052</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>8.25</td>
<td>40</td>
<td>40 kA@8.25 kV</td>
<td>VS-15052; VS-17040</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>15.0</td>
<td>20</td>
<td>20 kA@15.0 kV</td>
<td>VS-17006</td>
<td>1,200, 2,000</td>
<td>7-9</td>
</tr>
<tr>
<td>15.0</td>
<td>25</td>
<td>25 kA@15.0 kV</td>
<td>VS-17006</td>
<td>1,200, 2,000</td>
<td>7-9</td>
</tr>
<tr>
<td>15.0</td>
<td>31.5</td>
<td>31.5 kA@15.0 kV</td>
<td>VS-17006; VS-17040</td>
<td>1,200, 2,000; 1,200, 2,000</td>
<td>7-9</td>
</tr>
<tr>
<td>15.0</td>
<td>40</td>
<td>40 kA@15.0 kV</td>
<td>VS-15052; VS-17040</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>15.0</td>
<td>50</td>
<td>50 kA@15.0 kV</td>
<td>VS-15052</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>15.0</td>
<td>63</td>
<td>63 kA@15.0 kV</td>
<td>VS-17085</td>
<td>1,200, 2,000, 3,000</td>
<td>10-11</td>
</tr>
<tr>
<td>15.5</td>
<td>20</td>
<td>20 kA@15.5 kV</td>
<td>VS-25008</td>
<td>1,200, 2,000</td>
<td>15-16</td>
</tr>
<tr>
<td>15.5</td>
<td>25</td>
<td>25 kA@15.5 kV</td>
<td>VS-25008</td>
<td>1,200, 2,000</td>
<td>15-16</td>
</tr>
<tr>
<td>15.5</td>
<td>31.5</td>
<td>31.5 kA@15.5 kV</td>
<td>VS-15052</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>15.5</td>
<td>40</td>
<td>40 kA@15.5 kV</td>
<td>VS-15052</td>
<td>1,200, 2,000, 3,000</td>
<td>8.5-9.5</td>
</tr>
<tr>
<td>27.6</td>
<td>20</td>
<td>20 kA@27.6 kV</td>
<td>VS-25008</td>
<td>1,200, 2,000</td>
<td>15-16</td>
</tr>
<tr>
<td>27.6</td>
<td>25</td>
<td>25 kA@27.6 kV</td>
<td>VS-25008</td>
<td>1,200, 2,000</td>
<td>15-16</td>
</tr>
<tr>
<td>38.0</td>
<td>20</td>
<td>20 kA@38.0 kV</td>
<td>VS-30030</td>
<td>1,200, 2,000, 3,000</td>
<td>18-22</td>
</tr>
<tr>
<td>38.0</td>
<td>25</td>
<td>25 kA@38.0 kV</td>
<td>VS-30030</td>
<td>1,200, 2,000, 3,000</td>
<td>18-22</td>
</tr>
<tr>
<td>38.0</td>
<td>31.5</td>
<td>31.5 kA@38.0 kV</td>
<td>VS-30041</td>
<td>1,200, 2,000, 3,000</td>
<td>18-22</td>
</tr>
<tr>
<td>38.0</td>
<td>40</td>
<td>40 kA@38.0 kV</td>
<td>VS-30041</td>
<td>1,200, 2,000, 3,000</td>
<td>18-22</td>
</tr>
</tbody>
</table>
## Maintenance and troubleshooting

### Table 8: Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Symptoms</th>
<th>Possible causes and remedies</th>
</tr>
</thead>
</table>
| 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 (88.0). 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) 347-6659 or +1 (919) 365-2200 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 secondary disconnect pin A2. Check for continuity and correct protective relay logic.  
3. Secondary disconnect contacts 13 or 15 are not engaging. Check and correct as required.  
4. Failure of anti-pump relay (52Y) contacts 21 to 22, 31 to 32 or 13 to 14. Check and replace as required.  
5. Failure of close coil (solenoid) (52SRC). Check and replace as required.  
6. 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) 347-6659 or +1 (919) 365-2200 outside the U.S. |
## Table 8: Troubleshooting (continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Symptoms</th>
<th>Possible causes and remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuisance or false close</td>
<td>Electrical problem</td>
<td>1. Nuisance or false closing signal to secondary disconnect multi-pin plug contact. Check protective relay logic. Correct as required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Closing coil (52SRC) terminal A2 is shorted-to-ground. Check to determine if problems are in wiring or coil. Correct as required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical problem</td>
<td></td>
<td>1. Mechanical failure of operating mechanism. Check and contact the factory or Siemens field service at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuit breaker will not trip</td>
<td>Tripping coil or solenoid (52T) does not energize. There is no tripping sound.</td>
<td>1. Secondary control power is de-energized or control power fuses are blown. Correct as indicated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Damage to wiring, terminals or connectors. Check and repair as necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. No tripping signal to secondary disconnect contact C2. Check for continuity and correct protective relay logic.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Secondary multi-pin plug contacts C1 or D2 are not engaging. Check and replace if required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Failure of trip coil (52T). Check and replace if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tripping coil (52T) energizes. No tripping sound is heard, and circuit breaker contacts do not open. In other words, they remain closed.</td>
<td>1. Failure of tripping spring or its mechanical linkage. Check and replace if required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tripping coil (52T) energizes. Tripping sound is heard, but circuit breaker contacts do not open.</td>
<td>1. Mechanical failure of operating mechanism. Check and contact the factory or Siemens field service at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. One or more of the vacuum interrupters are held closed. Check and replace as necessary.</td>
</tr>
</tbody>
</table>
## Table 8: Troubleshooting (continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Symptoms</th>
<th>Possible causes and remedies</th>
</tr>
</thead>
</table>
| 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) 347-6659 or +1 (919) 365-2200 outside the U.S. |
Table 9: Circuit breaker control data

<table>
<thead>
<tr>
<th>ANSI/IEEE C37.06 control voltages</th>
<th>Close coil</th>
<th>Trip coil</th>
<th>Spring charging motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal</td>
<td>Range</td>
<td>Close</td>
<td>Trip</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>------</td>
<td>-----</td>
</tr>
<tr>
<td>24 Vdc</td>
<td>19-28</td>
<td>14-28</td>
<td>5.7</td>
</tr>
<tr>
<td>48 Vdc</td>
<td>36-56</td>
<td>28-56</td>
<td>11.4</td>
</tr>
<tr>
<td>125 Vdc</td>
<td>100-140</td>
<td>70-140</td>
<td>2.1</td>
</tr>
<tr>
<td>250 Vdc</td>
<td>200-280</td>
<td>140-280</td>
<td>2.1</td>
</tr>
<tr>
<td>120 Vac</td>
<td>104-127</td>
<td>104-127</td>
<td>2.0</td>
</tr>
<tr>
<td>240 Vac</td>
<td>208-254</td>
<td>208-254</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Footnotes:
¹ Current at nominal voltage
² Capacitor trip
³ Value preceding slash (/) is the current for the standard trip coil with standard rating interrupting time. Value following (/) is current for optional trip coil with three-cycle interrupting time.
⁴---- means this selection is not available at this voltage.

Table 10: Interrupting capacity auxiliary switch contacts

<table>
<thead>
<tr>
<th>Type of circuit</th>
<th>Continuous current amperes</th>
<th>Control circuit voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120 Vac</td>
<td>240 Vac</td>
</tr>
<tr>
<td>Non-inductive</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Inductive</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

Footnotes:
¹ Two contacts in series.
² All switches are non-convertible.
Appendix

These ratings are in accordance with:

- ANSI/IEEE C37.06-2009 AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities for Voltages Above 1,000 Volts

Footnotes:
1. Maximum design voltage for which the circuit breaker is designed and the upper limit for operation.
2. K is listed for information purposes only. For circuit breakers rated on a “constant kA” ratings basis, the voltage range factor is 1.0.
3. All values apply to polyphase and line-to-line faults.
4. Standard duty cycle is 0 - 0.3 s - CO - 3 min. - CO.
5. Standard rating interrupting time is five-cycles (83 ms). Optional rated interrupting time of three-cycles (50 ms) is available (except with 24 Vdc tripping).
6. 150 kV BIL is for drawout applications. 200 kV BIL is for type SDV6 with appropriate construction.
7. Continuous current capability may be increased by the use of forced-cooling (fan-cooling) in the switchgear together with increased bus bar capacity.

<table>
<thead>
<tr>
<th>Circuit breaker type</th>
<th>Maximum design voltage (V) (^1)</th>
<th>Voltage range factor (K) (^2)</th>
<th>Withstand voltage levels</th>
<th>Continuous current (^3)</th>
<th>Short-circuit (I) (^3,4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-3AH-31.5</td>
<td>4.76</td>
<td>1.0</td>
<td>19</td>
<td>60</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>5-3AH-40</td>
<td>4.76</td>
<td>1.0</td>
<td>19</td>
<td>60</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>5-3AH-50</td>
<td>4.76</td>
<td>1.0</td>
<td>19</td>
<td>60</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>5-3AH-63</td>
<td>4.76</td>
<td>1.0</td>
<td>19</td>
<td>60</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>7-3AH-40</td>
<td>8.25</td>
<td>1.0</td>
<td>36</td>
<td>95</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>15-3AH-20</td>
<td>15.0</td>
<td>1.0</td>
<td>36</td>
<td>95</td>
<td>1,200, 2,000</td>
</tr>
<tr>
<td>15-3AH-25</td>
<td>15.0</td>
<td>1.0</td>
<td>36</td>
<td>95</td>
<td>1,200, 2,000</td>
</tr>
<tr>
<td>15-3AH-31.5</td>
<td>15.0</td>
<td>1.0</td>
<td>36</td>
<td>95</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>15-3AH-40</td>
<td>15.0</td>
<td>1.0</td>
<td>36</td>
<td>95</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>15-3AH-50</td>
<td>15.0</td>
<td>1.0</td>
<td>36</td>
<td>95</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>15-3AH-63</td>
<td>15.0</td>
<td>1.0</td>
<td>36</td>
<td>95</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>15.5-3AH-20</td>
<td>15.5</td>
<td>1.0</td>
<td>50</td>
<td>110</td>
<td>1,200, 2,000</td>
</tr>
<tr>
<td>15.5-3AH-25</td>
<td>15.5</td>
<td>1.0</td>
<td>50</td>
<td>110</td>
<td>1,200, 2,000</td>
</tr>
<tr>
<td>15.5-3AH-31.5</td>
<td>15.5</td>
<td>1.0</td>
<td>50</td>
<td>110</td>
<td>1,200, 2,000, 3,000</td>
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<tr>
<td>15.5-3AH-40</td>
<td>15.5</td>
<td>1.0</td>
<td>50</td>
<td>110</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>27-3AH-20</td>
<td>27.6</td>
<td>1.0</td>
<td>60</td>
<td>150</td>
<td>1,200, 2,000</td>
</tr>
<tr>
<td>27-3AH-25</td>
<td>27.6</td>
<td>1.0</td>
<td>60</td>
<td>150</td>
<td>1,200, 2,000</td>
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<tr>
<td>38-3AH-20</td>
<td>38.0</td>
<td>1.0</td>
<td>80</td>
<td>150/200 (^6)</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>38-3AH-25</td>
<td>38.0</td>
<td>1.0</td>
<td>80</td>
<td>150/200 (^6)</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>38-3AH-31.5</td>
<td>38.0</td>
<td>1.0</td>
<td>80</td>
<td>150/200 (^6)</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>38-3AH-40</td>
<td>38.0</td>
<td>1.0</td>
<td>80</td>
<td>150/200 (^6)</td>
<td>1,200, 2,000, 3,000</td>
</tr>
<tr>
<td>Circuit breaker type</td>
<td>Interrupting time&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Permissible tripping delay (y)</td>
<td>Max. sym. interrupting (I)</td>
<td>% dc component</td>
<td>Short-time current (I) (3 s)</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>---------------------------</td>
<td>----------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>5-3AH-31.5</td>
<td>83/5</td>
<td>2</td>
<td>31.5</td>
<td>47</td>
<td>31.5</td>
</tr>
<tr>
<td>5-3AH-40</td>
<td>83/5</td>
<td>2</td>
<td>40</td>
<td>47</td>
<td>40</td>
</tr>
<tr>
<td>5-3AH-50</td>
<td>83/5</td>
<td>2</td>
<td>50</td>
<td>47</td>
<td>50</td>
</tr>
<tr>
<td>5-3AH-63</td>
<td>83/5</td>
<td>2</td>
<td>63</td>
<td>47</td>
<td>63</td>
</tr>
<tr>
<td>5-3AH-40</td>
<td>83/5</td>
<td>2</td>
<td>40</td>
<td>47</td>
<td>40</td>
</tr>
<tr>
<td>5-3AH-50</td>
<td>83/5</td>
<td>2</td>
<td>20</td>
<td>47</td>
<td>20</td>
</tr>
<tr>
<td>5-3AH-25</td>
<td>83/5</td>
<td>2</td>
<td>25</td>
<td>47</td>
<td>25</td>
</tr>
<tr>
<td>5-3AH-31.5</td>
<td>83/5</td>
<td>2</td>
<td>31.5</td>
<td>47</td>
<td>31.5</td>
</tr>
<tr>
<td>5-3AH-40</td>
<td>83/5</td>
<td>2</td>
<td>40</td>
<td>47</td>
<td>40</td>
</tr>
<tr>
<td>5-3AH-50</td>
<td>83/5</td>
<td>2</td>
<td>50</td>
<td>47</td>
<td>50</td>
</tr>
<tr>
<td>5-3AH-63</td>
<td>83/5</td>
<td>2</td>
<td>63</td>
<td>47</td>
<td>63</td>
</tr>
<tr>
<td>5-3AH-20</td>
<td>83/5</td>
<td>2</td>
<td>20</td>
<td>47</td>
<td>20</td>
</tr>
<tr>
<td>5-3AH-25</td>
<td>83/5</td>
<td>2</td>
<td>25</td>
<td>47</td>
<td>25</td>
</tr>
<tr>
<td>5-3AH-31.5</td>
<td>83/5</td>
<td>2</td>
<td>31.5</td>
<td>47</td>
<td>31.5</td>
</tr>
<tr>
<td>5-3AH-40</td>
<td>83/5</td>
<td>2</td>
<td>40</td>
<td>47</td>
<td>40</td>
</tr>
<tr>
<td>27-3AH-20</td>
<td>83/5</td>
<td>2</td>
<td>20</td>
<td>47</td>
<td>20</td>
</tr>
<tr>
<td>27-3AH-25</td>
<td>83/5</td>
<td>2</td>
<td>25</td>
<td>47</td>
<td>25</td>
</tr>
<tr>
<td>38-3AH-20</td>
<td>83/5</td>
<td>2</td>
<td>20</td>
<td>47</td>
<td>20</td>
</tr>
<tr>
<td>38-3AH-25</td>
<td>83/5</td>
<td>2</td>
<td>25</td>
<td>47</td>
<td>25</td>
</tr>
<tr>
<td>38-3AH-31.5</td>
<td>83/5</td>
<td>2</td>
<td>31.5</td>
<td>47</td>
<td>31.5</td>
</tr>
<tr>
<td>38-3AH-40</td>
<td>83/5</td>
<td>2</td>
<td>40</td>
<td>47</td>
<td>40</td>
</tr>
</tbody>
</table>
Appendix

Table 12: Type 3AH vacuum circuit breaker ratings (historic "constant MVA" ratings basis)

These ratings are in accordance with:

- **ANSI/IEEE C37.04-1979 Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis**
- **ANSI C37.06-1987 AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities**
- **ANSI/IEEE C37.09-1979 Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis**
- **ANSI/IEEE C37.010-1979 Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.**

<table>
<thead>
<tr>
<th>Circuit breaker type</th>
<th>Nominal voltage class</th>
<th>Nominal three-phase MVA class</th>
<th>Maximum design voltage (V)</th>
<th>Continuous current (I)</th>
<th>Voltage range factor (K)</th>
<th>Withstand voltage levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kV</td>
<td>MVA</td>
<td>kV rms</td>
<td>A rms</td>
<td>----</td>
<td>Power frequency kW rms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lightning impulse (BIL) kV crest</td>
</tr>
<tr>
<td>5-3AH-250</td>
<td>4.16</td>
<td>250</td>
<td>4.76</td>
<td>1,200, 2,000</td>
<td>1.24</td>
<td>19</td>
</tr>
<tr>
<td>5-3AH-350</td>
<td>4.16</td>
<td>350</td>
<td>4.76</td>
<td>1,200, 2,000, 3,000</td>
<td>1.19</td>
<td>19</td>
</tr>
<tr>
<td>7-3AH-500</td>
<td>7.2</td>
<td>500</td>
<td>8.25</td>
<td>1,200, 2,000, 3,000</td>
<td>1.25</td>
<td>36</td>
</tr>
<tr>
<td>15-3AH-500</td>
<td>13.8</td>
<td>500</td>
<td>15.0</td>
<td>1,200, 2,000, 3,000</td>
<td>1.30</td>
<td>36</td>
</tr>
<tr>
<td>15-3AH-750</td>
<td>13.8</td>
<td>750</td>
<td>15.0</td>
<td>1,200, 2,000, 3,000</td>
<td>1.30</td>
<td>36</td>
</tr>
<tr>
<td>15-3AH-1000</td>
<td>13.8</td>
<td>1000</td>
<td>15.0</td>
<td>1,200, 2,000, 3,000</td>
<td>1.30</td>
<td>36</td>
</tr>
<tr>
<td>38-3AH-1500</td>
<td>38.0</td>
<td>1,500</td>
<td>38.0</td>
<td>1,200, 2,000</td>
<td>1.65</td>
<td>80</td>
</tr>
</tbody>
</table>

Footnotes:

1. Maximum design voltage for which the circuit breaker is designed and the upper limit for operation.
2. K is the ratio of the rated maximum design voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical interrupting capabilities vary in inverse proportion to the operating voltage.
3. To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum design voltage and rated maximum design voltage, the following formula shall be used: Required symmetrical interrupting capability = (rated short-circuit current (I) x [rated maximum design voltage]/operating voltage]). For operating voltages below 1/K times maximum design voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short-circuit current.
4. Within the limitations stated in ANSI/IEEE C37.04-1979, all values apply to polyphase and line-to-line faults. For single phase-to-ground faults, the specific conditions stated in clause 5.10.2.3 of ANSI/IEEE C37.04-1979 apply.
## Appendix

<table>
<thead>
<tr>
<th>Circuit breaker type</th>
<th>Short-circuit (at rated maximum design voltage) ((I))</th>
<th>Interrupting time (\text{ms / cycles})</th>
<th>Permissible tripping delay ((y))</th>
<th>Rated maximum design voltage ((V)) divided by (K) ((= V/K))</th>
<th>Maximum symmetrical interrupting ((K \times I))</th>
<th>Short-time current ((I)) (three seconds)</th>
<th>Closing and latching (\text{momentary}))</th>
<th>Circuit breaker type</th>
</tr>
</thead>
<tbody>
<tr>
<td>kA rms sym</td>
<td>ms / cycles</td>
<td>Sec</td>
<td>kA rms</td>
<td>kA rms sym</td>
<td>kA rms</td>
<td>Asymmetrical ((1.6 \times K \times I)) kA rms</td>
<td>Peak ((2.7 \times K \times I)) kA peak</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>83 / 5</td>
<td>2</td>
<td>3.85</td>
<td>36</td>
<td>36</td>
<td>58/78(^{10})</td>
<td>97/132(^{10})</td>
<td>5-3AH-250</td>
</tr>
<tr>
<td>41</td>
<td>83 / 5</td>
<td>2</td>
<td>4.0</td>
<td>49</td>
<td>49</td>
<td>78</td>
<td>132</td>
<td>5-3AH-350</td>
</tr>
<tr>
<td>33</td>
<td>83 / 5</td>
<td>2</td>
<td>6.6</td>
<td>41</td>
<td>41</td>
<td>66/77(^{10})</td>
<td>111/130(^{10})</td>
<td>7-3AH-500</td>
</tr>
<tr>
<td>18</td>
<td>83 / 5</td>
<td>2</td>
<td>11.5</td>
<td>23</td>
<td>23</td>
<td>37/58(^{10})</td>
<td>62/97(^{10})</td>
<td>15-3AH-500</td>
</tr>
<tr>
<td>28</td>
<td>83 / 5</td>
<td>2</td>
<td>11.5</td>
<td>36</td>
<td>36</td>
<td>58/77(^{10})</td>
<td>97/130(^{10})</td>
<td>15-3AH-750</td>
</tr>
<tr>
<td>37</td>
<td>83 / 5</td>
<td>2</td>
<td>11.5</td>
<td>48</td>
<td>48</td>
<td>77</td>
<td>130</td>
<td>15-3AH-1000</td>
</tr>
<tr>
<td>21</td>
<td>83/5</td>
<td>2</td>
<td>23.0</td>
<td>35</td>
<td>35</td>
<td>56</td>
<td>95</td>
<td>38-3AH-1500</td>
</tr>
</tbody>
</table>

1. Current values in this row are not to be exceeded even for operating voltage below \(1/K\) times rated maximum design voltage. For operating voltages between rated maximum design voltage and \(1/K\) times rated maximum design voltage, follow Footnote 5.
2. Current values in this row are independent of operating voltage up to and including rated maximum voltage.
3. “Nominal three-phase MVA class” is included for reference only. This information is not listed in ANSI C37.06-1987.
4. Standard duty cycle is \(0 - 15\ s\) - CO.
5. Standard rating interrupting time is five-cycles (83 ms). Optional rated interrupting time of three-cycles (50 ms) is available (except with 24 Vdc tripping).
6. High close and latch (momentary) rating available for special application.
7. Continuous current may be increased by the use of forced-cooling (fan-cooling) in the switchgear, together with increased bus bar capacity.
Table 13: Type 3AH vacuum circuit breaker weight in lbs (kg) (circuit breaker operator only)

<table>
<thead>
<tr>
<th>Circuit breaker type</th>
<th>Weight in lbs (kg)</th>
<th>Continuous current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1,200 A</td>
</tr>
<tr>
<td>Maximum voltage kV</td>
<td>Interrupting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>capability kA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(MVA) symmetrical</td>
<td></td>
</tr>
<tr>
<td>4.76</td>
<td>31.5 (250)</td>
<td>242 (110)</td>
</tr>
<tr>
<td>4.76</td>
<td>40</td>
<td>246 (112)</td>
</tr>
<tr>
<td>4.76</td>
<td>50 (350)</td>
<td>330 (150)</td>
</tr>
<tr>
<td>8.25</td>
<td>40 (500)</td>
<td>246 (112)</td>
</tr>
<tr>
<td>15.0</td>
<td>20 (500)</td>
<td>165 (75)</td>
</tr>
<tr>
<td>15.0</td>
<td>25</td>
<td>165 (75)</td>
</tr>
<tr>
<td>15.0</td>
<td>31.5 (750)</td>
<td>242 (110)</td>
</tr>
<tr>
<td>15.0</td>
<td>40</td>
<td>246 (112)</td>
</tr>
<tr>
<td>15.0</td>
<td>50 (1,000)</td>
<td>330 (150)</td>
</tr>
<tr>
<td>15.5</td>
<td>20</td>
<td>262 (119)</td>
</tr>
<tr>
<td>15.5</td>
<td>25</td>
<td>273 (124)</td>
</tr>
<tr>
<td>15.5</td>
<td>31.5</td>
<td>298 (135)</td>
</tr>
<tr>
<td>15.5</td>
<td>40</td>
<td>309 (140)</td>
</tr>
<tr>
<td>27.6</td>
<td>20</td>
<td>276 (125)</td>
</tr>
<tr>
<td>27.6</td>
<td>25</td>
<td>287 (130)</td>
</tr>
<tr>
<td>38.0</td>
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<td>353 (160)</td>
</tr>
<tr>
<td>38.0</td>
<td>25</td>
<td>353 (160)</td>
</tr>
<tr>
<td>38.0</td>
<td>31.5</td>
<td>363 (165)</td>
</tr>
<tr>
<td>38.0</td>
<td>40</td>
<td>375 (170)</td>
</tr>
</tbody>
</table>

Footnote:
1. Add 100 lbs (45 kg) for packaging.
### Table 14: Circuit breaker operating times (type 3AH3 operator)

<table>
<thead>
<tr>
<th>Time Description</th>
<th>Voltage Range</th>
<th>≤ 10 s</th>
<th>≤ 55 ms</th>
<th>≤ 65 ms</th>
<th>≤ 70 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring charging time</td>
<td>Up to 15.5 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 15.5 kV up to 27.6 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 27.6 kV up to 38 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close time from energizing close coil at rated control voltage to contact touch (last pole)</td>
<td>Up to 15.5 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 15.5 kV up to 27.6 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 27.6 kV up to 38 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening time from energization trip coil at rated control voltage to contact part (last pole), not including arcing time</td>
<td>Up to 15.5 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-cycle interrupting time (83 ms)</td>
<td>Over 15.5 kV up to 27.6 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 27.6 kV up to 38 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5-cycle interrupting time (58 ms)</td>
<td>Up to 15.5 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 15.5 kV up to 27.6 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 27.6 kV up to 38 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-cycle interrupting time (50 ms)</td>
<td>Up to 15.5 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 15.5 kV up to 27.6 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Over 27.6 kV up to 38 kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>