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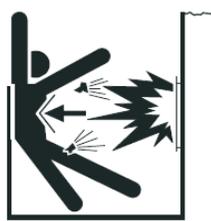


Instruction manual

Type SDV7-AR arc-resistant distribution circuit breaker

Installation operation maintenance E50001-F710-K379-V5-4A00

	<p style="text-align: center;">⚠ DANGER</p> <p>Hazardous voltages and high-speed moving parts.</p> <p>Will cause death, serious injury or property damage.</p> <p>Always de-energize and ground the equipment before maintenance. Read and understand this instruction manual before using equipment. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause death, severe injury or equipment damage. Follow all safety instructions contained herein.</p>
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	<p style="text-align: center;">⚠ DANGER</p> <p>Arc flash and explosion hazard.</p> <p>Will cause death, serious injury or property damage.</p> <p>No equipment can completely eliminate the risk of arc flash.</p> <p>This equipment is not arc-resistant unless all of the following conditions are met:</p> <ol style="list-style-type: none"> 1. All pressure relief devices are free to operate as designed. 2. The fault energy available to the equipment does not exceed the internal arcing short-circuit current rating and rated arcing duration of the equipment. 3. There are no obstructions around the equipment that could direct the arcing exhaust products into an area intended to be protected. 4. The equipment is installed in accordance with the information in the instruction manuals and drawings.
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Important

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

Qualified person

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

- **Is trained and authorized** to de-energize, clear, ground and tag circuits and equipment in accordance with established safety procedures.

- **Is trained** in the proper care and use of protective equipment, such as: rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

- **Is trained** in rendering first aid.

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

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

Note:

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise that are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office.

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

Table of contents

Introduction	04 – 05
General description	06 – 07
Receiving, handling and storage	08 – 10
Installation	11 – 13
Electrical connections	14
Instrument transformers	15 – 16
Installation of type SDV7-SE distribution circuit breaker with stored-energy operator	17 – 24
Installation of type SDV7-MA distribution circuit breaker with magnetic-actuator operator	25 – 34
Maintenance	35 – 42
Maintenance and troubleshooting	43 – 47
Appendix	48 – 55

	<p style="text-align: center;">⚠ DANGER</p> <p>Arc flash hazard and hazardous voltages.</p> <p>Will cause death, serious injury or property damage.</p> <p>Always de-energize and ground the equipment before maintenance. Read and understand this instruction manual before using equipment. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause death, severe injury or equipment damage. Follow all safety instructions contained herein.</p>
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	<p style="text-align: center;">⚠ DANGER</p> <p>Arc flash hazard, hazardous voltages and high-speed moving parts.</p> <p>Will cause death, serious injury or property damage.</p> <p>To avoid arc flash burns, electrical shock and entanglement in moving parts, only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all danger or warning notices, and procedures contained herein. Personnel must observe all applicable regulations (e.g., OSHA), follow all requirements of NFPA 70E and adhere to specific operating procedures applicable to the installation. Use appropriate personal protective equipment (PPE) for the voltage and arc flash incident energy exposure.</p>
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Introduction

The type SDV7-AR arc-resistant distribution circuit breaker is designed to meet all applicable ANSI, NEMA and IEEE standards.

This equipment is classified as an arc-resistant distribution circuit breaker and has been tested for resistance to internal arcing in accordance with ANSI/IEEE C37.20.7.

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.

This instruction manual applies to the type SDV7-AR distribution circuit breaker enclosure.

Refer to instruction manual E50001-F710-K376-X-XXXX for instructions applicable to the type 3AH35-SE stored-energy operator, used in the type SDV7-SE-AR circuit breakers.

Refer to instruction manual E50001-F710-K378-X-XXXX for instructions applicable to the type 3AH35-MA magnetic-actuator operator, used in the type SDV7-MA-AR circuit breakers.

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

Signal words

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

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

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

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

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

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.

General description



Figure 1: Typical type SDV7-AR distribution circuit breaker

Introduction

Siemens type SDV7-AR distribution circuit breaker is precision built equipment designed to function efficiently under normal operating conditions. It is designed and manufactured to operate within the parameters established in ANSI/IEEE C37 and NEMA standards for distribution circuit breakers. Performance requirements of these standards have been met or exceeded by these designs. Specific standards which apply include:

- ANSI/IEEE C37.04-1999 rating structure for ac high-voltage circuit breakers
- ANSI/IEEE C37.06-2009 preferred ratings ac high-voltage circuit breakers
- ANSI/IEEE C37.09-1999 test procedure for ac high-voltage circuit breakers
- ANSI/IEEE C37.20-7-2007 guide for testing metal-enclosed switchgear rated up to 38 kV for internal arcing faults
- NEMA SG4-2009 ac high-voltage circuit breakers.

The instructions included in this instruction manual are provided to aid you in obtaining longer and more economical service from your Siemens type SDV7-AR distribution circuit breaker. For proper installation and operation, this information should be distributed to your operators and engineers.

By carefully following these instructions, difficulties should be avoided. However, these instructions are not intended to cover all details of variations that may be encountered in connection with the installation, operation and maintenance of this equipment.

Should additional information be desired, including replacement instruction manuals, contact your local Siemens representative.

To provide additional personal protection in the event of an internal arcing fault, this equipment is also classified as arc-resistant switchgear and has been qualified to carry a type 2B accessibility rating per ANSI/IEEE C37.20.7.

Scope

These instructions cover the installation, operation and maintenance of a Siemens type SDV7-AR distribution circuit breaker using vacuum interrupters. The equipment designs described in this instruction manual consists of free-standing outdoor distribution circuit breakers for application up to 38 kV. A typical type SDV7-AR distribution circuit breaker is shown in Figure 1: Typical type SDV7-AR distribution circuit breaker. All diagrams, descriptions and instructions apply to all of the above classes and designs unless noted otherwise.

Standard construction details of the circuit breaker enclosure are given in appropriate sections of this instruction manual.

Standard construction details of the stored-energy operating mechanism of the circuit breaker are detailed in the type 3AH35-SE stored-energy operator instruction manual E50001-F710-K376-X-XXXX.

Standard construction details of the magnetic-actuator operating mechanism of the circuit breaker are detailed in the type 3AH35-MA magnetic-actuator operator instruction manual E50001-F710-K378-X-XXXX.

Special mechanical and electrical devices, furnished in accordance with purchase order requirements, are covered by supplementary instructions submitted with this instruction manual.

The equipment furnished has been designed to operate in a system having the circuit capacity specified by the purchaser. If for any reason the equipment is used in a different system or if the short-circuit capacity of the system is increased, the ratings of the equipment, including the momentary rating and the interrupting capacity of the type SDV7-AR distribution circuit breaker must be checked. Failure on the part of the user to receive approval of intended changes from Siemens may cause the warranty to be void.

This instruction manual applies to the type SDV7-AR distribution circuit breaker enclosure structure.

Refer to instruction manual E50001-F710-K376-X-XXXX for instructions applicable to the type 3AH35-SE stored-energy operator.

Refer to instruction manual E50001-F710-K378-X-XXXX for instructions applicable to the type 3AH35-MA magnetic-actuator operator.

General description

The distribution circuit breaker described in this instruction manual is of the ac high-voltage outdoor circuit breaker type, as defined in ANSI/IEEE C37 and NEMA SG4 standards. All high-voltage parts excluding roof bushings are completely enclosed within grounded barriers. The secondary control devices and primary circuits are isolated from each other by barriers.

Siemens type SDV7-AR distribution circuit breakers carry a type designation, as shown in Table 1: Type SDV7-AR distribution circuit breaker designations. This designation may appear on drawings and familiarity with them will simplify communications with the factory.

In this instruction manual, reference to type SDV7-AR distribution circuit breaker is used when the text applies to the circuit breaker with either type of operating mechanism. When relevant to the type of operator, the type SDV7-SE-AR (stored-energy) or type SDV7-MA-AR (magnetic-actuator) designations are used.

Additionally, this equipment is classified as arc-resistant, as defined in ANSI/IEEE C37.20.7, and has been qualified to carry a type 2B accessibility rating. The arc-resistant features are intended to provide an additional degree of protection to personnel in close proximity to the equipment in the event of an internal arcing fault while the equipment is operating under normal conditions.

Normal conditions include the "usual service conditions" defined in ANSI/IEEE C37.04, clause 4 and ANSI/IEEE C37.010, clause 4, as well as the following conditions intended to maintain the integrity of the equipment during an internal arcing fault event:

1. All doors and panels providing access to primary compartments must be closed and properly secured (All bolts installed and tightened. All latches in latched position.)
2. All pressure relief devices must be free to operate as designed.
3. The fault energy available to the equipment must not exceed the internal arcing short-circuit current rating and rated arcing duration of the equipment.
4. There must be no obstructions around the equipment that could direct the arcing exhaust products into an area intended to be protected.
5. The equipment must be properly grounded.
6. All equipment must be properly installed in accordance with information in instruction manuals and drawings.
7. The type SDV7-AR enclosure must be installed with the arc-exhaust vents at least 79" (2.0 m) above finished grade.

Operator	Type
Stored energy	SDV7-SE-AR
Magnetic actuator	SDV7-MA-AR

Table 1: Type SDV7 distribution circuit breaker designations

Receiving, handling and storage

Receiving

Each type SDV7-AR distribution circuit breaker is securely blocked and braced for shipment. It is crated, boxed or covered as required by shipping conditions. If special handling is required, it is so indicated. Relatively delicate instruments, protective relays and other devices are included, and the type SDV7-AR distribution circuit breaker must be handled carefully when unloading.

Inspection and unpacking

Inspect the equipment as soon as possible after receipt for any damage that may have occurred in transit. Before unpacking, examine the package itself, as a damaged package may indicate damage to the contents of the package. Be careful when unpacking equipment. The use of sledge hammers and crowbars may damage the finish, or the equipment itself. Use nail pullers. After unpacking, examine equipment for any possible damage. Check the shipping manifest to be certain that all items have been received.

Note: If there is a shortage, make certain it is noted on the freight bill and contact the carrier immediately. Notify Siemens medium-voltage customer service at +1 (800) 347-6659 (+1 (919) 365-2200 outside the U.S.) of any shortage or damage.

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 shipment arrives, note whether equipment is properly protected from the elements. Note trailer number on which the equipment arrived. Note blocking of equipment. During unloading, make sure to count the actual items unloaded to verify the contents as shown on 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.
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 delivery receipt. If the driver will not sign the delivery receipt with damage noted, the shipment should not be signed for by the consignee or their agent.
4. Notify Siemens 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 damage immediately.

Important: Do not move 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 equipment was damaged or further damaged on site after unloading.

6. **Be sure 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 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 of the carrier inspection report and forward it along with a copy of the noted delivery receipt to Siemens at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S. 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 above referenced documents. The carrier inspection report and/or driver's signature on the delivery receipt does not constitute approval to repair.

Note: 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. 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. 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.

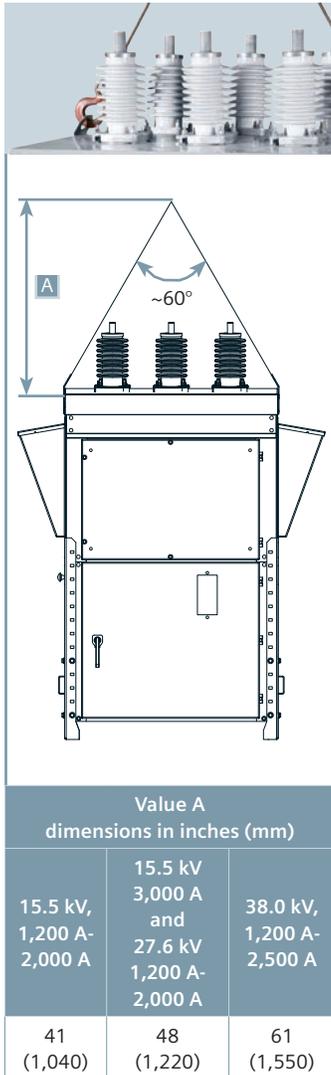


Figure 2: Lifting type SDV7-AR distribution circuit breaker with crane

Lifting and moving

There are a number of methods that can be used in handling the type SDV7-AR distribution circuit breaker that, when properly employed, will not damage the type SDV7-AR distribution circuit breaker. The handling method used will be determined by conditions and available equipment at the installation site. Lifting with a crane by the use of a sling and lifting lugs is the preferred method of handling; however, overhead obstructions often dictate that other methods must be used. Forklift trucks may be used prior to removal of wooden skids. Verify the forklift blades pass completely through the wooden skid under the circuit breaker.

Each type SDV7-AR distribution circuit breaker has provisions for attaching lifting cables. Lifting lugs are provided on two sides of the circuit breaker, which are designed for use with a lift sling or hooks of the proper size and a crane of adequate height and capacity. Refer to the type SDV7-AR distribution circuit breaker nameplate for the weight.

Lifting type SDV7-AR distribution circuit breaker with crane

Recommended lifting of type SDV7-AR distribution circuit breakers is by means of cables connected to an overhead crane. The cables are connected to the lifting lugs on the top of the type SDV7-AR distribution circuit breaker as illustrated in Figure 2: Lifting type SDV7-AR distribution circuit breaker with crane. A crane with sufficient height should be used so the load angle on the lifting cable will be approximately 60° when viewed from the front or rear.

Storage

When it is necessary to store a type SDV7-AR distribution circuit breaker in an area exposed to the weather or under humid conditions, energize the space heaters provided and make certain that any vents are uncovered to allow air to circulate. If at all possible, install the type SDV7-AR distribution circuit breaker at the permanent location even though it may be some time before the equipment is used. It is also recommended that the type SDV7-AR distribution circuit breaker receive periodic inspection during storage.

Access to the heater circuit is gained by opening the door to the relay and control compartment. Refer to the wiring diagram drawing for space heater circuit connections. Lubricate hinges and other moving parts.

	! WARNING
	<p>Heavy weight.</p> <p>Can result in death, serious injury or property damage.</p> <p>Observe all handling instructions in this instruction manual to prevent tipping or dropping of equipment.</p>

Installation

Preparation for installation

Prior to installation of the type SDV7-AR distribution circuit breaker, careful design, planning and construction of the foundation or base on which the circuit breaker will rest must be made. A thorough analysis and careful construction may alleviate many problems at the time of installation, and during operation. It is important that a relatively level surface be provided capable of supporting the weight of the type SDV7-AR distribution circuit breaker, and 0.75 inch diameter anchor bolts are recommended.

Figure 4: Anchoring type SDV7-AR distribution circuit breaker on page 13 illustrates typical locations for anchor bolts. No special leveling procedures are required.

Prior to installation of a type SDV7-AR distribution circuit breaker, study this instruction book and the circuit breaker drawings, such as general arrangement/outline drawing, schematic diagram, connection diagrams, current transformer connection diagram, electrical bill of material and nameplate engraving.

Special attention should be given to the foundation information contained in this instruction manual as well as the information provided on the equipment drawings. Verify the foundation conforms to the requirements described in this instruction manual and the general arrangement/outline drawing.

The type SDV7-AR distribution circuit breaker is shipped with the legs attached. The legs must be set to the desired height.

Setting leg height

The type SDV7-AR distribution circuit breaker is shipped with the legs set to a low level (and on some units, turned outward). The legs must be removed and installed correctly.

Remove the legs from the enclosure. Raise the enclosure, and install the legs at the desired height.

The legs must be installed and turned inward, so that the two sides of the each leg are adjacent to the enclosure sides and the hole at the bottom of the leg is inside the perimeter of the enclosure, as in Figure 3: Outline drawing on page 12.

Use anti-seize compound (Loctite* 77164 or 77124 nickel anti-seize) on the 1/2-13 SAE stainless steel cap screws used to secure the legs to facilitate removal of the legs should it be required in the future.

The height (as installed) between the mounting surface (foundation) and the bottom of the enclosure must be at least 4" (102 mm) and no higher than 28" (711 mm).

The type SDV7-AR enclosure must be installed with the arc-exhaust vents at least 79" (2.0 m) above finished grade.

High-seismic installations

Figure 3: Outline drawing on page 13 shows optional cross-braces installed for high-seismic requirements.

Cross braces can be installed if the bottom of the enclosure is at least 12" (330 mm) above the foundation.

The cross braces consist of steel links that are adaptable for all installation heights (from 13" (330 mm) to 28" (711 mm)). Install the cross braces as shown in the illustration. The end of the link with a single hole is bolted to the lowest hole on the leg. The opposite link is bolted with the single-hole end bolted to one of the two highest exposed holes in the leg below the enclosure. The highest hole or second highest hole is used, as necessary to allow alignment. Then, bolt the two links together towards the middle, using whichever set of holes align.

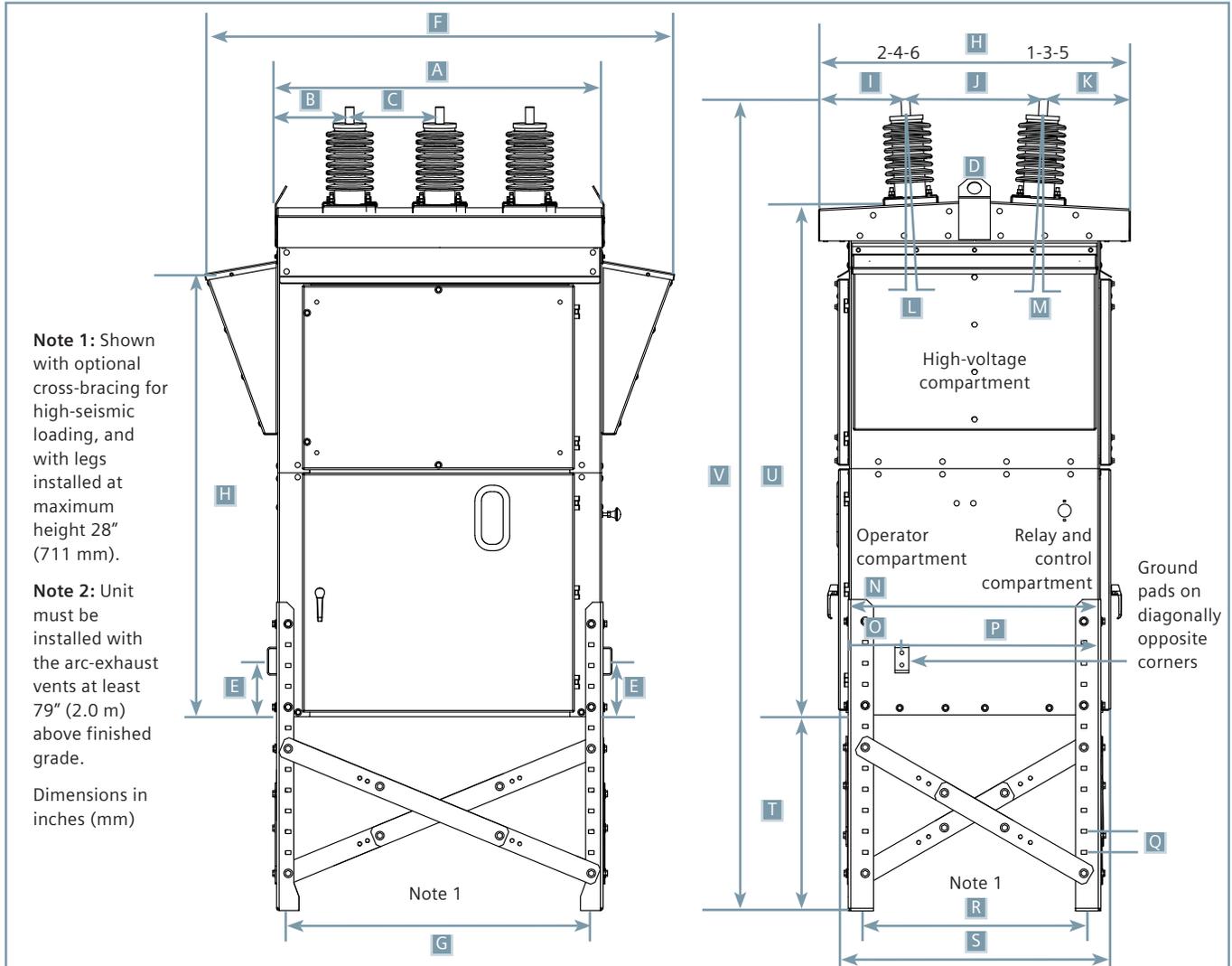
When optional cross braces are furnished, install all eight cross braces (four sets) to obtain the required seismic performance.

Location

The circuit breaker should be located so that it is readily accessible for manual operation and inspection. Ample clearance should be provided for doors and panels to swing open, or to be removed for servicing the circuit breaker.

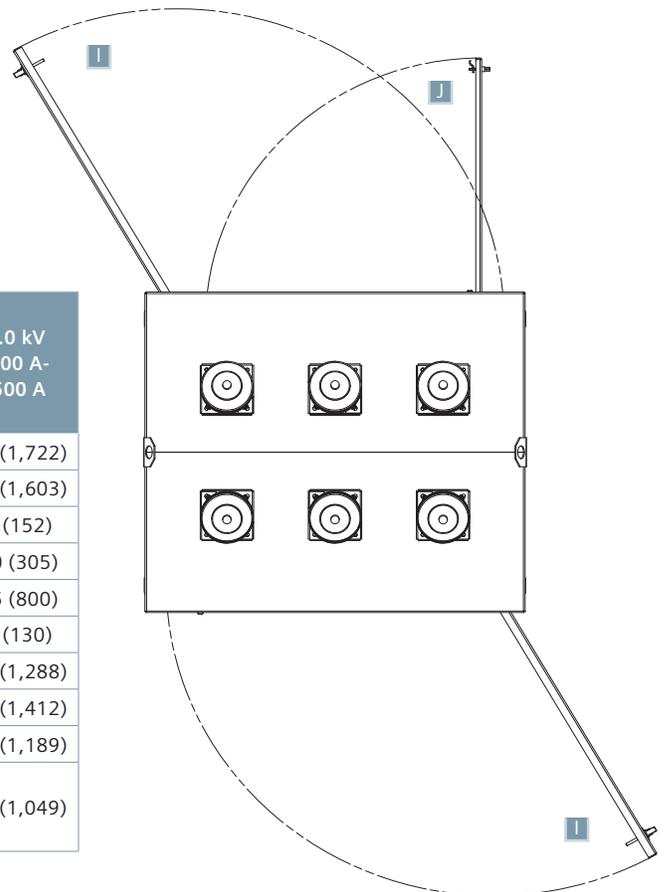
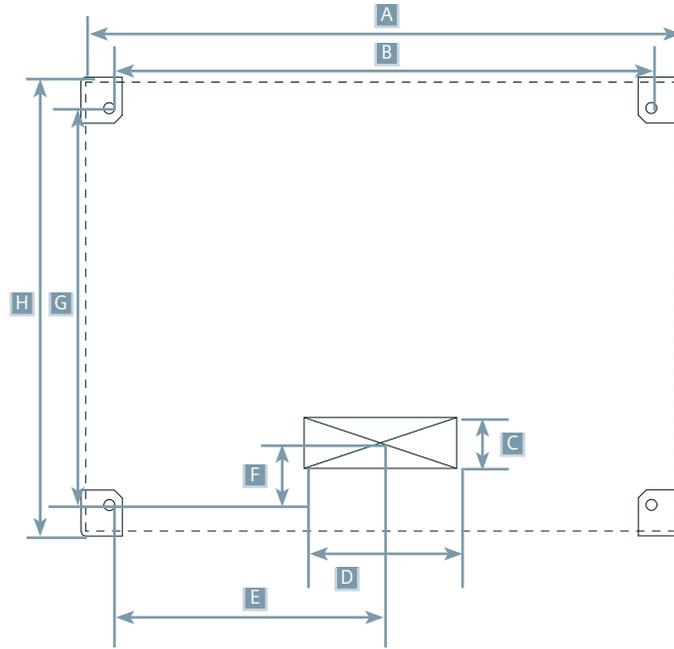
* Loctite is a registered trademark of Henkel Corporation.

Figure 3: Outline drawing¹



Item	15.5 kV 1,200 A- 2,000 A	15.5 kV 3,000 A	27.6 kV 1,200 A- 2,000 A	38.0 kV 1,200 A- 2,500 A	Item	15.5 kV 1,200 A- 2,000 A	15.5 kV 3,000 A	27.6 kV 1,200 A- 2,000 A	38.0 kV 1,200 A- 2,500 A
A	47.1 (1,196)	56.3 (1,430)	56.3 (1,430)	65.7 (1,669)	M	3.0°	3.0°	3.0°	3.0°
B	10.6 (269)	12.1 (307)	12.1 (307)	13.4 (340)	N	35.8 (909)	44.2 (1,123)	44.0 (1,118)	55.6 (1,412)
C	13.0 (330)	16.0 (406)	16.0 (406)	19.5 (495)	O	7.6 (193)	7.7 (196)	7.6 (193)	9.5 (241)
D	2.0 (51)	2.0 (51)	2.0 (51)	2.0 (51)	P	28.4 (721)	36.5 (927)	36.4 (925)	46.1 (1,171)
E	8.0 (203)	8.0 (203)	8.0 (203)	8.0 (203)	Q	3.0 (76)	3.0 (76)	3.0 (76)	3.0 (76)
F	67.6 (1,717)	79.1 (2,009)	79.1 (2,009)	99.1 (2,517)	R	31.3 (795)	39.4 (1,001)	39.4 (1,001)	50.9 (1,293)
G	42.7 (1,085)	52.0 (1,321)	52.0 (1,321)	63.1 (1,603)	S	38.8 (986)	47.0 (1,194)	46.8 (1,189)	58.4 (1,483)
H	44.5 (1,130)	57.8 (1,468)	49.6 (1,260)	63.2 (1,605)	T	4.0 (102)- 28.0 (711)	4.0 (102)- 28.0 (711)	4.0 (102)- 28.0 (711)	4.0 (102)- 28.0 (711)
I	8.0 (203)	18.4 (467)	11.5 (292)	20.4 (518)	U	73.5 (1,867)	77.2 (1,961)	77.6 (1,971)	93.5 (2,375)
J	19.8 (503)	21.0 (307)	21.0 (307)	22.2 (564)	V	92.0 (2,337)- 116.0 (2,945)	96.0 (2,337)- 120.0 (3,048)	96.0 (2,337)- 120.0 (3,048)	120.5 (3,061)- 144.5 (3,670)
K	8.0 (203)	18.4 (467)	11.5 (292)	20.4 (518)	W	63.9 (1,623)	65.5 (1,664)	65.5 (1,664)	80.2 (2,037)
L	3.0°	3.0°	3.0°	3.0°					

Figure 4: Anchoring type SDV7-AR distribution circuit breaker



Dimensions in inches (mm)

Item	15.5 kV 1,200 A- 2,000 A	15.5 kV 3,000 A	27.6 kV 1,200 A- 2,000 A	38.0 kV 1,200 A- 2,500 A
A	47.1 (1,196)	56.5 (1,435)	56.5 (1,435)	67.8 (1,722)
B	42.7 (1,085)	52.0 (1,321)	52.0 (1,321)	63.1 (1,603)
C	6.0 (152)	6.0 (152)	6.0 (152)	6.0 (152)
D	12.0 (305)	12.0 (305)	12.0 (305)	12.0 (305)
E	21.3 (541)	26.0 (660)	26.0 (660)	31.5 (800)
F	4.9 (124)	3.9 (99)	4.9 (124)	5.1 (130)
G	31.3 (795)	39.4 (1,001)	39.4 (1,001)	50.7 (1,288)
H	36.1 (917)	44.2 (1,123)	44.2 (1,123)	55.6 (1,412)
I (Outer door)	40.0 (1,016)	46.5 (1,181)	46.5 (1,181)	46.8 (1,189)
J (Inner relay panel, when supplied)	36.0 (914)	42.8 (1,087)	42.8 (1,087)	41.3 (1,049)

Electrical connections

	⚠ DANGER
	<p>Hazardous voltages and high speed moving parts.</p> <p>Will cause death, serious injury or property damage.</p> <p>Do not work on energized equipment. Always de-energize and ground high-voltage conductors before working on or near them. The user must adjust the circuit breaker height to ensure compliance with safety codes for electrical clearance, and to assure that the arc-exhaust vents are at least 79" (2.0 m) above finished grade.</p>

Primary lead connections

The primary leads must be routed to the bushing terminals so as to maintain adequate dielectric clearance between different phase conductors and to ground. Conductors must be supported so that the circuit breaker bushings are not subjected to excessive strains, both during normal service and in the event of a short-circuit condition. The leads should be sized to have a capacity at least equal to the maximum operating current of the circuit and within the rating of the type SDV7-AR distribution circuit breaker. Connections are to be made to the bolted terminals of the bushings and must be securely tightened to a clean, bright surface to assure good contact.

Ground connections

Grounding pads on diagonally opposite corners of the enclosure are provided for connecting the cabinet to ground. The grounding conductors should be at least 4/0 AWG conductor on each ground pad. A good low-resistance ground is essential for adequate protection and for proper functioning of electronic components such as protective relays. Connections to ground pads must be made in such a manner that a reliable ground connection is obtained. Consult latest National Electrical Code® or National Electric Safety Code® for ground connection standards.

Secondary control wiring

All secondary control wiring installed by the factory is neatly routed and secured in place. Complete all field connections in a similar manner. Check that the protective relay panel (if so equipped) clears any additional wiring installed.

A conduit panel opening is provided in the bottom of the relay and control compartment for the connection of control circuits. The control wires should be run separately from high-voltage wiring to prevent inductive coupling between them and should be sized for full operating current to avoid a drop in voltage below that specified on the nameplate. All conduits should be sealed off at their entrance to the relay and control compartment.

Terminal blocks are provided inside the relay and control compartment for the connections necessary for the control wiring and protective relay panel (if so equipped). Terminal blocks for current transformer wiring are located in the operator compartment and wires can easily be routed from the conduit panel opening in the relay and control compartment to the current transformer circuit terminal blocks in the operator compartment. Consult the connection diagrams for the location of connection terminal points for each circuit.

Connection diagrams are provided with each type SDV7-AR distribution circuit breaker and will be found in the pocket inside the relay and control compartment door.

Instrument transformers

	⚠ DANGER
	<p>Hazardous voltages.</p> <p>Will cause death, serious injury or property damage.</p> <p>Do not operate current transformers with the secondary open circuited. Current transformers must be either connected to a load or short circuited. Current transformer secondary circuits also must be grounded.</p>

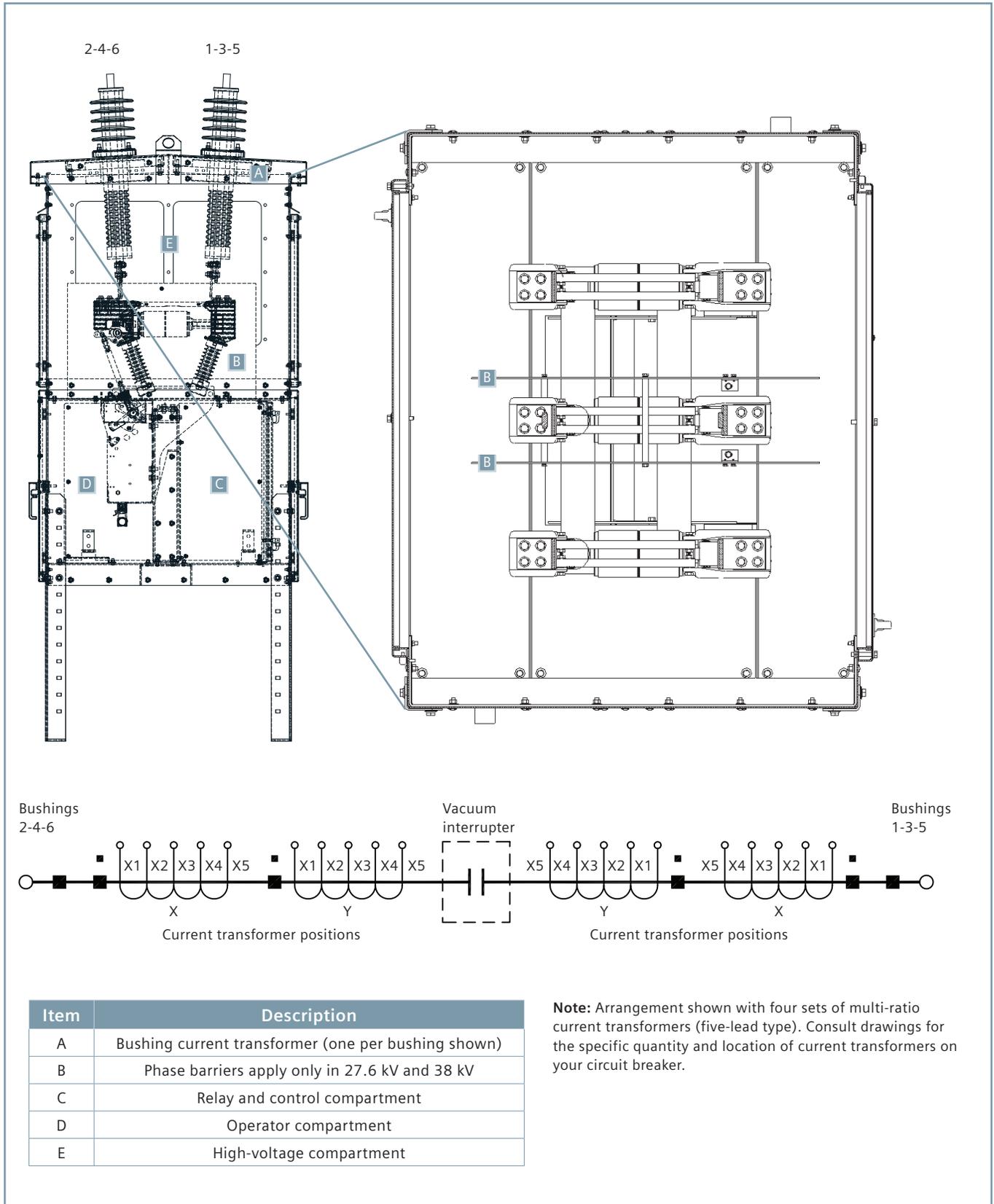
Current transformers (CTs)

Figure 5: Type SDV7-AR distribution circuit breaker with interphase barriers and bushing current transformers installed in primary compartment on page 16 illustrates bushing (toroidal) CTs installed in the primary compartment of a type SDV7-AR distribution circuit breaker. The roof bushings pass through the CTs. Up to two CTs may be mounted around each roof bushing. The bushing CT connections are wired to separate terminal blocks located in the low-voltage operator compartment.

Phase barriers

Phase barriers are provided on all 27.6 kV and 38 kV class type SDV7-AR distribution circuit breakers as shown in Type SDV7-AR distribution circuit breaker with interphase barriers and bushing current transformers installed in primary compartment on page 16. These plates of insulating material are attached to the circuit breaker housing and provide suitable electrical insulation between the vacuum interrupter primary circuits.

Figure 5: Type SDV7-AR distribution circuit breaker with interphase barriers and bushing current transformers installed in primary compartment



Installation of type SDV7-SE circuit breaker with stored-energy operator

	⚠ DANGER
	<p>Hazardous voltages and high speed moving parts.</p> <p>Will cause death, serious injury or property damage.</p> <p>Read instruction manuals, observe safety instructions and use qualified personnel.</p>

Introduction

This section provides a description of the inspections, checks and tests to perform on the type SDV7-SE-AR distribution circuit breaker prior to operation.

Inspections, checks and tests without control power

Type SDV7-SE-AR vacuum circuit breakers are normally shipped with the primary contacts open and the springs discharged. However, prior to starting the inspection process, it is critical to first verify that the control power is de-energized, the spring-loaded mechanisms are in the discharged condition and the circuit breaker main contacts are open.

De-energizing control power in a power circuit breaker

To de-energize the control power, open the disconnect device in the relay and control compartment. Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19 presents the location of this disconnect in a standard type SDV7-SE-AR distribution circuit breaker.

The disconnect means shown in the photo are knife switches with fuses. Molded-case circuit breakers or pullout type fuse holders can be furnished instead when specified.

The control power disconnect device is located on the control panel in the relay and control compartment.

Opening the knife switch de-energizes control power to the circuit breaker. In some circuit breakers, pullout type fuse holders or molded-case circuit breakers are used in lieu of knife switches. Removal of the fuse holder or opening the molded-case circuit breaker accomplishes the same result: control power is disconnected.

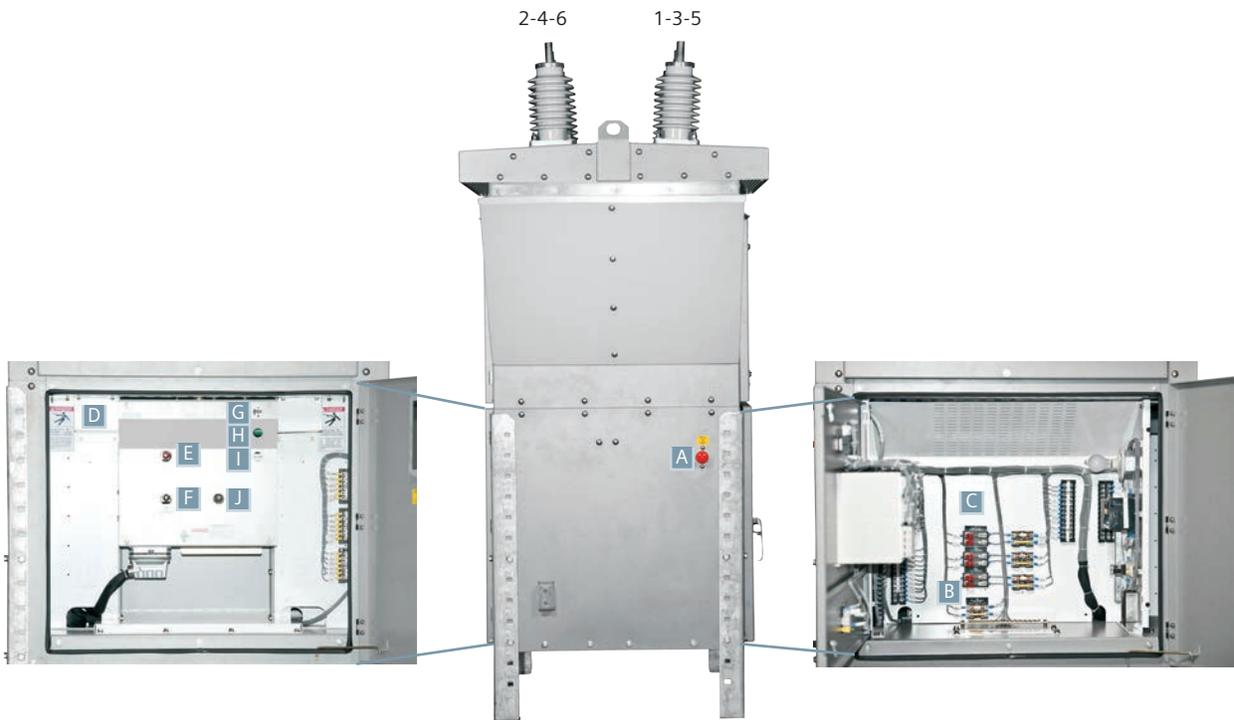
Spring discharge check (refer to Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19)

1. De-energize control power.
2. Press red open button on the operating mechanism.
3. Press black close button on the operating mechanism.
4. Again press red open button on the operating mechanism.
5. Verify spring condition indicator shows DISCHARGED.
6. Verify main contact status indicator shows OPEN.

Physical inspections

1. Verify the rating of the circuit breaker is compatible with the system.
2. Perform a visual shipping damage check. Clean the circuit breaker of all shipping dust, dirt and foreign material.

Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator



Item	Description
A	External manual trip
B	Control disconnect device
C	Relay and control compartment
D	Operator compartment
E	Push-to-trip pushbutton
F	Push-to-close pushbutton
G	Operations counter
H	OPEN/CLOSE indicator
I	CHARGED/DISCHARGED indicator
J	Opening for manual charging
K	Reset mechanism for external manual trip



Manual spring charging check

1. Insert the manual spring charging crank into the manual charge socket as shown in Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19. Turn the crank until the spring condition indicator shows the closing springs are charged, and remove the spring charging crank from the socket.
2. Repeat the spring discharge check presented on page 18.
3. Verify the springs are DISCHARGED and the circuit breaker primary contacts are OPEN by observing the indicator positions.

As-found and vacuum check tests

Perform and record the results of both the as-found insulation test and the vacuum check high-potential test. Procedures for these tests are described in the maintenance section of this instruction manual beginning on page 35.

Automatic spring charging check

Note: A temporary source of control power and test leads may be required if the control power source has not been connected to the circuit breaker. Refer to the specific wiring information and rating label for your circuit breaker to determine the voltage required and where the control voltage signal should be applied. When control power is connected to the circuit breaker, the closing springs should automatically charge if the control power disconnect (refer to Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19) is closed.

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

1. Use the manual close and open controls (refer to Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19) to first close and then open the circuit breaker contacts. Verify contact positions visually by observing the OPEN/CLOSED indicator on the circuit breaker.

2. Open control power circuit by opening knife switch shown in Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19.
3. Repeat the spring discharge check presented on page 18.
4. Verify the springs are DISCHARGED and the circuit breaker primary contacts are OPEN by observing the indicator positions.

External manual trip

1. Energize control power circuit by closing knife switch shown in Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19. The spring charging motor should charge the circuit breaker closing springs.
2. Use the manual close control (refer to Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19) to close the circuit breaker.
3. Pull the external manual trip (red knob on side of enclosure) to trip the circuit breaker, and maintain the external manual trip in the "pulled" condition.
4. Attempt to close the circuit breaker manually and electrically. The circuit breaker should not close.
5. Release the external manual trip knob, and reset the external manual trip mechanism by pushing on the black reset knob inside the relay and control compartment. The reset mechanism is to the left of the relay panel hinges.
6. After resetting the external manual trip mechanism, attempt to close the circuit breaker manually or electrically. The circuit breaker should close.
7. Open control power circuit by opening knife switch shown in Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19.

8. Repeat the spring discharge check presented on page 18.
9. Verify the springs are DISCHARGED and the circuit breaker primary contacts are OPEN by observing the indicator positions.

Final mechanical inspection and testing without control power

Before the circuit breaker is energized, it must be thoroughly inspected and tested. Correct any deviations before energization.

Inspection

Check the following points:

1. Make a final mechanical inspection of the circuit breaker. Verify the contacts are in the OPEN position, and the closing springs are DISCHARGED.
2. Confirm the circuit breaker is properly set up and reasonably level on its foundation and appropriately anchored to the foundation.
3. Check the tightness of all hardware on the cabinet, adjustable legs, bushings, bus bars and operator mechanism.
4. Verify that the operating mechanism has been properly lubricated.
5. Blocking, supports and other temporary ties remove from circuit breakers, instruments, protective relays, etc.
6. Proper fuses correctly placed.
7. Temporary wiring jumpers (used on the secondaries of current transformers wired to external devices, as shown on wiring diagrams) removed.
8. Ground connections properly made.
9. Incoming primary and secondary connections properly made and checked for shorts or undesired grounds.
10. Verify all covers, and bolted connectors are securely fastened.
11. Protective relays coordinated with other protective relays and protection devices on the system. Refer to protective relay instructions before making any adjustments.
12. Examine the vacuum interrupters for damage, and wipe the vacuum interrupters and other insulating parts with a clean, dry cloth.

13. All filters in vent areas are clean and free of shipping or construction material.
14. Arc-exhaust vents correctly secured, undamaged, and free to open in the event of an internal arcing fault.
15. Retouch any paint that has been damaged during installation.

NOTICE
<p>Shipping bracing and tag between phase barriers (on units so equipped) may damage circuit breaker.</p> <p>May result in damage to equipment.</p> <p>Remove bracing and tag (on units so equipped) before energizing circuit breaker with high voltage.</p>

	⚠ DANGER
	<p>High potential tests employ hazardous voltages.</p> <p>Will cause death or serious injury.</p> <p>Follow safe procedures, exclude unnecessary personnel and use safety barriers. Keep away from circuit breaker during application of test voltages. After test completion, ground both ends and the middle ring (if visible) of the vacuum interrupter to dissipate any static charges.</p>

	⚠ WARNING
	<p>Vacuum interrupters may emit X-ray radiation.</p> <p>Can result in serious injury.</p> <p>X-rays can be produced when a high voltage is placed across two circuit elements in a vacuum.</p> <p>Keep personnel more than six feet away from a circuit breaker under test. All normal metallic doors and panels must be installed during tests.</p>

Testing

Note: No hazardous X-radiation is produced with closed contacts, or with open contacts with rated operating voltage applied.

1. An insulation resistance test is advisable on the control circuit to verify that all connections made in the field are properly insulated.
2. A dielectric test, if possible, should be made on the high-voltage circuit for one minute at the voltages corresponding to the rated voltage of the equipment. The voltage should be raised gradually and the circuit under test should sustain the voltage for one minute.

NOTICE
<p>Excessive test voltages.</p> <p>May result in damage to equipment.</p> <p>Do not perform dielectric tests at test voltages exceeding the ratings of the tested equipment.</p>

When the test is performed with the circuit breaker open, the integrity of the vacuum interrupter will also be verified. If these levels cannot be sustained and there is no other source for the failure, the vacuum interrupter must be replaced.

Table 2: High-potential test voltages

Rated maximum voltage kV (rms)	Rated power-frequency withstand kV (rms)	Field-test voltage	
		kV (rms)	kV dc
15.5	50	37.5	53
27.6	60	45	64
38.0	80	60	85

Note: The dc test voltage is given as a reference only. It represents values believed to be appropriate and approximately equivalent to the corresponding power-frequency withstand test values specified for each voltage rating. The presence of this column in no way implies any requirement for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to ac withstand tests. When performing dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

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

These high voltages will produce X-ray radiation. Such devices also show erroneous readings of leakage current when testing vacuum circuit breakers.

Field dielectric tests are recommended when new units are installed, or after major field modifications. The equipment should be put in good condition prior to the field test. It is not expected that equipment shall be subjected to these tests after it has been stored for long periods of time or has accumulated a large amount of dust, moisture or other contaminants without being first restored to good condition.

A dielectric test on secondary and control circuits should be made for one minute at 1,125 volts ac or 1,590 volts dc. The above voltages are in accordance with NEMA Standards.

Note: Certain control devices, such as motors and motor circuits, should be tested at 675 volts ac. Electronic devices should be tested at the voltages specified in the instruction manual for the electronic device.

3. Charge the closing springs manually and push the close pushbutton to close the circuit breaker.
4. Verify main contact status indicator shows CLOSED. Press the trip pushbutton and verify the main contact status indicator shows OPEN. The spring condition indicator should also show DISCHARGED.
5. Energize the control circuits. The motor should run to charge the closing springs, and then automatically turn off.
6. Close the circuit breaker electrically (locally and remotely as applicable) and verify the circuit breaker shows CLOSE and remains closed by checking the main contact status indicator. Note that the motor will immediately run to recharge the closing springs.
7. Trip the circuit breaker electrically (locally and remotely as applicable).
8. Trip the circuit breaker by passing sufficient current (or voltage if applicable) through the coils of protective relays.
9. Repeat the close and trip operations several times to assure proper operation.
10. Check the tripping and closing times from coil energization to contact part or contact make.

Placing equipment into service

To place equipment in service for the first time proceed as follows:

1. Check that the circuit breaker is OPEN and all control circuits are energized.
2. Check torque of the bolts that secure the roof bushings to the top plate of the type SDV7-AR distribution circuit breaker. Torque should be in the range of 20-25 ft-lbs (27-34 Nm).
3. Connect primary incoming power source to circuit breaker.
4. Check all instruments, protective relays, meters, etc.
5. Connect as small a load as possible and observe instruments.
6. Gradually connect more load to the equipment while observing instruments until the full load is connected.
7. Check for signs of overheating of primary and secondary circuits and satisfactory operation of all instruments during the first week of operation.

Installation of type SDV7-MA circuit breaker with magnetic-actuator operator

	⚠ DANGER
	<p>Hazardous voltages and high speed moving parts.</p> <p>Will cause death, serious injury or property damage.</p> <p>Read instruction manuals, observe safety instructions and use qualified personnel.</p>

Introduction

This section provides a description of the inspections, checks and tests to perform on the type SDV7-MA-AR distribution circuit breaker prior to operation.

Inspections, checks and tests without control power

Type SDV7-MA-AR vacuum circuit breakers are normally shipped with the primary contacts open and the springs discharged. However, prior to starting the inspection process, it is critical to first verify that the control power is de-energized, the spring-loaded mechanisms and capacitors are in the discharged condition and the circuit breaker main contacts are open.

De-energizing control power in a power circuit breaker

To de-energize the control power, open the disconnect device in the relay and control compartment. Figure 8: Relay and control and operator compartments for type SDV7-MA-AR circuit breaker with magnetic-actuator operator presents the location of this disconnect in a standard type SDV7-MA-AR distribution circuit breaker on page 30.

The disconnect means shown in the photo are knife switches with fuses. Molded-case circuit breakers or pullout type fuse holders can be furnished instead when specified.

The control power disconnect device is located on the control panel in the relay and control compartment.

Opening the knife switch de-energizes control power to the circuit breaker. In some circuit breakers, pullout type fuse holders or molded-case circuit breakers are used in lieu of knife switches. Removal of the fuse holder or opening the molded-case circuit breaker accomplishes the same result: control power is disconnected.

If any maintenance is to be performed, discharge the capacitors.

NOTICE

Capacitor discharge plug (105.2)

Disconnect control power prior to removing or replacing the capacitor discharge plug. Refer to Figure 7.

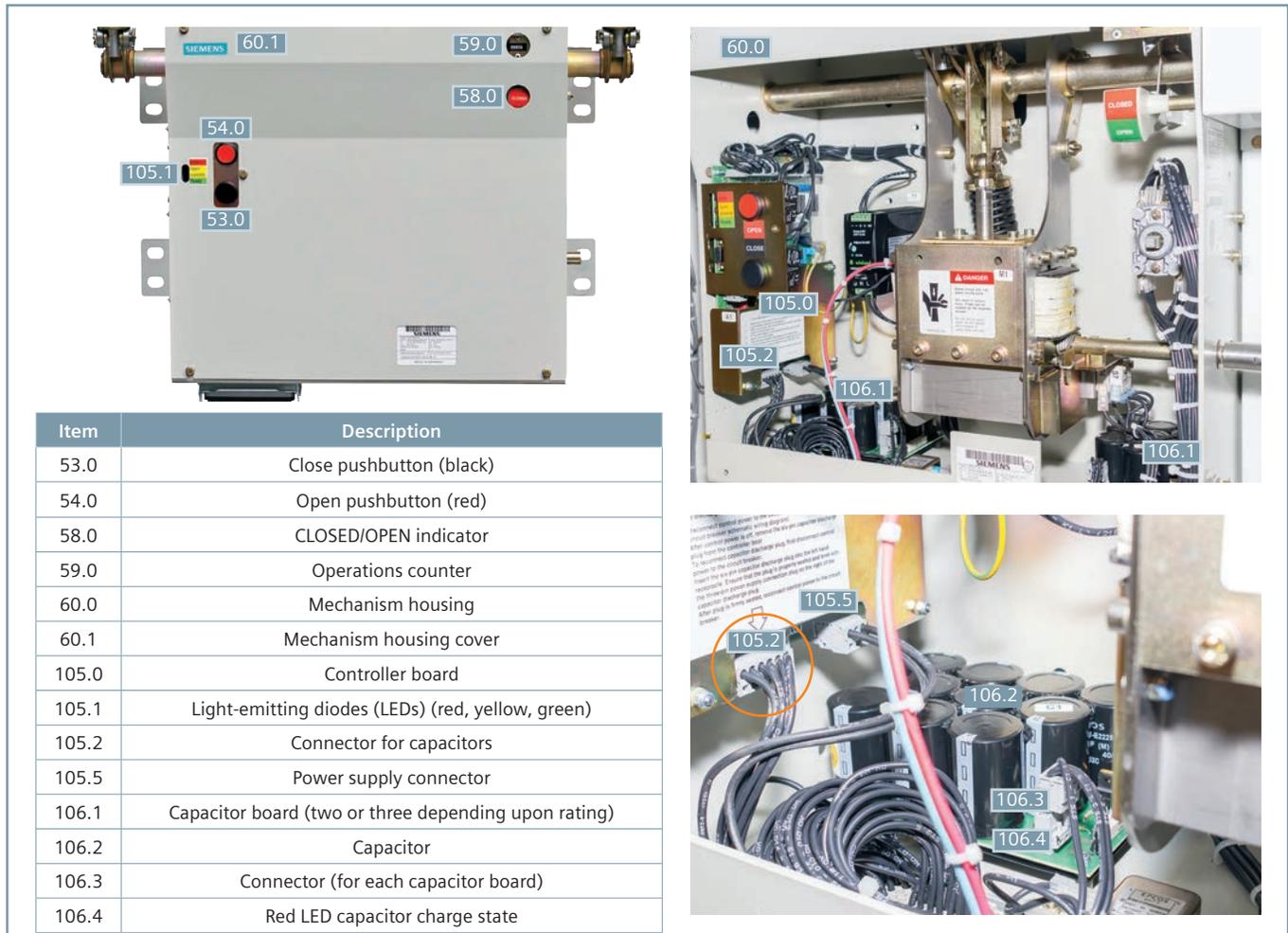
To discharge capacitors:

- Disconnect control power to the circuit breaker by opening the disconnect device (device 08 in the typical schematic in Figure 10 on page 51) located in the control compartment.
- After control power is off, disconnect the capacitor discharge plug (105.2) from the controller board (105.0) to discharge capacitors.

To reconnect capacitors:

- Disconnect control power to the circuit breaker by opening the disconnect (device 08 in the typical schematic in Figure 10 on page 51) located in the control compartment.
- Insert the capacitor discharge plug (105.2) (with six pins) into the left-hand receptacle on the controller board (105.0). Ensure that the plug is properly seated and the plug position is level with the power supply connection plug (105.5) that is located to the right of the capacitor discharge plug.
- After the capacitor discharge plug is firmly seated, reconnect control power to the circuit breaker (device 08 in the typical schematic in Figure 10 on page 51).

Figure 7: Operator controls and discharging capacitors



Discharging capacitors

After control power has been removed, discharge stored energy from the capacitors (refer to Figure 7: Operator controls and discharging capacitors).

1. Press red Open pushbutton (54.0).
2. Remove the mechanism housing cover sheet (60.1).
3. Discharge the capacitors (106.2) by unplugging the connector (105.2) from the controller board (105.0). The red LED (106.4) on each of the capacitor boards (106.1) indicates the state of charge of the capacitors (106.2). When the capacitors (106.2) are discharging, the red LEDs are flashing. This indicates a hazardous voltage. When the LEDs stop flashing, the capacitors (106.2) are discharged to a low voltage.

Automatic capacitor charging

The controller board (105.0) executes a self-test of the capacitors (106.2) and checks the status of the capacitors (106.2). This self-test runs automatically and regularly. The result of the self-test is stored in the memory of the controller board (105.0).

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

	⚠ DANGER
	<p>Stored energy and high speed moving parts.</p> <p>Will result in serious injury. Fingers can be crushed by the magnetic actuator.</p> <p>Do not remove guard panel. Do not operate circuit breaker if guard panel removed.</p>

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 35.

Capacitor charging check

The capacitor charging system of the circuit breaker must be checked. Control power is required for capacitor charging.

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

1. Close the control power disconnect device in the relay and control compartment to energize the circuit breaker control circuit. If not previously charged, the capacitors should charge automatically. When the capacitors are fully discharged and control power is then applied, the red LED lights, and the green LED lights after approximately 30-35 seconds. The red LED is off when the green LED lights.

If the capacitors have been fully discharged for a very long time, charging time may be significantly longer than indicated. If capacitor charging time is much longer than expected on initial energization, refer to "Capacitor charging after very long de-energization" of the "Maintenance" section of the type 3AH35-MA vacuum circuit breaker magnetic-actuator operator module instruction manual, E50001-F710-K378-X-XXXX.

2. Use the Close and Open pushbuttons on the circuit breaker operating mechanism (refer to Figure 7: Operator controls and discharging capacitors on page 26) to first close, and then open the circuit breaker contacts. Verify contact positions visually by observing the OPEN/CLOSED indicator on the circuit breaker.

3. In step 2, when the close pushbutton was pressed, the circuit breaker should have closed, and the capacitors should have recharged automatically. Upon closing, the yellow LED should be on, followed by the green LED when full capacitor charge has been obtained. The yellow LED is off when the green LED lights. The meaning of the LEDs (105.1) on the controller board:

- a) Green LED indicates ready (energy sufficient for OPEN-CLOSE-OPEN cycle).
- b) Yellow LED indicates open possible (energy sufficient for OPEN operation).
- c) Red LED indicates error.

NOTICE

Capacitor discharge plug (105.2)

Disconnect control power prior to removing or replacing the capacitor discharge plug. Refer to Figure 7 on page 26.

To discharge capacitors:

- Disconnect control power to the circuit breaker by opening the disconnect device (device 08 in the typical schematic in Figure 10 on page 51) located in the control compartment.
- After control power is off, disconnect the capacitor discharge plug (105.2) from the controller board (105.0) to discharge capacitors.

To reconnect capacitors:

- Disconnect control power to the circuit breaker by opening the disconnect (device 08 in the typical schematic in Figure 10 on page 51) located in the control compartment.
- Insert the capacitor discharge plug (105.2) (with six pins) into the left-hand receptacle on the controller board (105.0). Ensure that the plug is properly seated and the plug position is level with the power supply connection plug (105.5) that is located to the right of the capacitor discharge plug.
- After the capacitor discharge plug is firmly seated, reconnect control power to the circuit breaker (device 08 in the typical schematic in Figure 10 on page 51).

4. Perform the magnetic actuator-discharge check.
 - a) Initial status: circuit breaker open.
 - b) Press red Open pushbutton (54.0).

- c) Press black Close pushbutton (53.0).
 - d) Verify main contact status indicator shows CLOSED.
 - e) Press red Open pushbutton (54.0) again.
 - f) Verify main contact status indicator shows OPEN.
5. De-energize the control power by opening the control power disconnect device in the relay and control compartment. Remove the mechanism housing cover sheet (60.1). Do not unplug connector (106.3) from the capacitor boards, or damage to the capacitor board or the controller board may occur. Fast discharge the capacitors (106.2) by unplugging the connector (105.2) on the capacitor controller board (105.0). During fast discharge of the capacitors, a red LED on each capacitor board will flash, indicating that discharge is in process. The process is complete when the red LED stops blinking.
 6. After the discharging process is complete, plug in the connector (105.2) to the controller board (105.0).

External manual trip

1. Energize control power circuit by closing the control power disconnect device shown in Figure 8: Relay and control and operator compartments for type SDV7-MA-AR circuit breaker with magnetic-actuator operator on page 30. The LEDs (105.1) should show the progress of capacitor charging.
2. Use the Close pushbutton on the circuit breaker operating mechanism (refer to Figure 7: Operator controls and

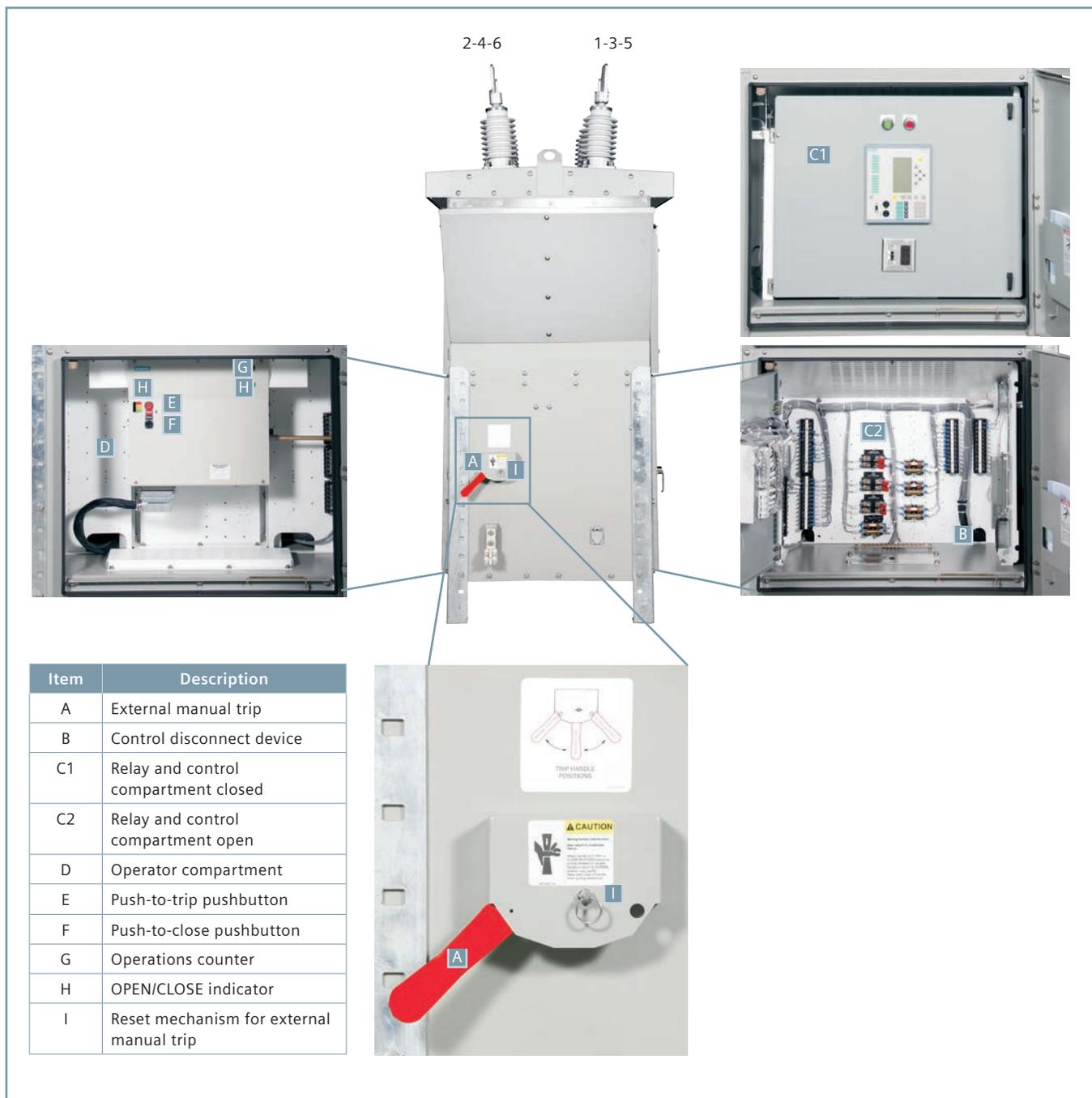
- discharging capacitors on page 26) to close the circuit breaker.
3. Use the manual opening handle on the right side of the enclosure (refer to Figure 8: Relay and control and operator compartments for type SDV7-MA-AR circuit breaker with magnetic-actuator operator on page 30) to open the circuit breaker.
 4. Attempt to close the circuit breaker using the pushbutton on the circuit breaker operating mechanism (refer to Figure 7: Operator controls and discharging capacitors on page 26). The circuit breaker should not close.
 5. Reset the manual opening handle to NORMAL position by pulling the retainer pin out.
 6. After resetting the manual opening handle to NORMAL position, attempt to close the circuit breaker using the pushbutton on the circuit breaker operating mechanism. The circuit breaker should close.
 7. Open the circuit breaker using the pushbutton on the circuit breaker operating mechanism.
 8. Open control power circuit by opening control power disconnect shown in Figure 8: Relay and control and operator compartments for type SDV7-MA-AR circuit breaker with magnetic-actuator operator on page 30.

Final mechanical inspection and testing without control power

Before the circuit breaker is energized, it must be thoroughly inspected and tested. Correct any deviations before energization.

	<p>⚠ CAUTION</p>
	<p>Spring-loaded mechanism.</p> <p>Can result in moderate injury.</p> <p>When handle is in TRIP or CLOSE BLOCKED positions, pulling release pin causes handle to return to NORMAL position very rapidly. Keep hand clear of handle when pulling release pin.</p>

Figure 8: Relay and control and operator compartments for type SDV7-MA-AR circuit breaker with magnetic-actuator operator



Inspection

Check the following points:

1. Make a final mechanical inspection of the circuit breaker. Verify the contacts are in the OPEN position.
2. Confirm the circuit breaker is properly set up and reasonably level on its foundation and appropriately anchored to the foundation.
3. Check the tightness of all hardware on the cabinet, adjustable legs, bushings, bus bars and operator mechanism.
4. Verify that the operating mechanism has been properly lubricated.
5. Blocking, supports and other temporary ties remove from circuit breakers, instruments, protective relays, etc.
6. Proper fuses correctly placed.
7. Temporary wiring jumpers (used on the secondaries of current transformers wired to external devices, as shown on wiring diagrams) removed.
8. Ground connections properly made.
9. Incoming primary and secondary connections properly made and checked for shorts or undesired grounds.
10. Verify all covers, and bolted connectors are securely fastened.
11. Protective relays coordinated with other protective relays and protection devices on the system. Refer to protective relay instructions before making any adjustments.
12. Examine the vacuum interrupters for damage, and wipe the vacuum interrupters and other insulating parts with a clean, dry cloth.
13. All filters in vent areas are clean and free of shipping or construction material.
14. Retouch any paint that has been damaged during installation.

NOTICE

Shipping bracing and tag between phase barriers (on units so equipped) may damage circuit breaker.

May result in damage to equipment.

Remove bracing and tag (on units so equipped) before energizing circuit breaker with high voltage.

	<h2 style="margin: 0;">⚠ DANGER</h2>
	<p>High-potential tests employ hazardous voltages.</p> <p>Will cause death or serious injury.</p> <p>Follow safe procedures, exclude unnecessary personnel and use safety barriers. Keep away from circuit breaker during application of test voltages. After test completion, ground both ends and the middle ring (if visible) of the vacuum interrupter to dissipate any static charges.</p>

	<h2 style="margin: 0;">⚠ WARNING</h2>
	<p>Vacuum interrupters may emit X-ray radiation.</p> <p>Can result in serious injury.</p> <p>X-rays can be produced when a high voltage is placed across two circuit elements in a vacuum.</p> <p>Keep personnel more than six feet away from a circuit breaker under test. All normal metallic doors and panels must be installed during tests.</p>

Testing

Note: No hazardous X-radiation is produced with closed contacts, or with open contacts with rated operating voltage applied.

1. An insulation resistance test is advisable on the control circuit to verify that all connections made in the field are properly insulated.
2. A dielectric test, if possible, should be made on the high-voltage circuit for one minute at the voltages corresponding to the rated voltage of the equipment. The voltage should be raised gradually and the circuit under test should sustain the voltage for one minute.

<h2 style="margin: 0;">NOTICE</h2>
<p>Excessive test voltages.</p> <p>May result in damage to equipment.</p> <p>Do not perform dielectric tests at test voltages exceeding the ratings of the tested equipment.</p>

When the test is performed with the circuit breaker open, the integrity of the vacuum interrupter will also be verified. If these levels cannot be sustained and there is no other source for the failure, the vacuum interrupter must be replaced.

Table 3: High-potential test voltages

Rated maximum voltage kV (rms)	Rated power-frequency withstand kV (rms)	Field-test voltage	
		kV (rms)	kV dc
15.5	50	37.5	53
27.6	60	45	64
38.0	80	60	85

Note: The dc test voltage is given as a reference only. It represents values believed to be appropriate and approximately equivalent to the corresponding power-frequency withstand test values specified for each voltage rating. The presence of this column in no way implies any requirement for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to ac withstand tests. When performing dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

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

These high voltages will produce X-ray radiation. Such devices also show erroneous readings of leakage current when testing vacuum circuit breakers.

Field dielectric tests are recommended when new units are installed, or after major field modifications. The equipment should be put in good condition prior to the field test. It is not expected that equipment shall be subjected to these tests after it has been stored for long periods of time or has accumulated a large amount of dust, moisture or other contaminants without being first restored to good condition.

A dielectric test on secondary and control circuits should be made for one minute at 1,125 volts ac or 1,590 volts dc. The above voltages are in accordance with NEMA Standards.

Note: Certain control devices, such as motors and motor circuits, should be tested at 675 volts ac. Electronic devices should be tested at the voltages specified in the instruction manual for the electronic device.

3. Energize the control circuits. For magnetic-actuator operators, the LEDs show capacitor charging status.
4. Close the circuit breaker electrically (locally and remotely as applicable) and verify the circuit breaker shows CLOSED and remains closed by checking the main contact status indicator. Note that the capacitors will recharge for magnetic-actuator operators.
5. Trip the circuit breaker electrically (locally and remotely as applicable).
6. Trip the circuit breaker by passing sufficient current (or voltage if applicable) through the coils of protective relays.
7. Repeat the close and trip operations several times to assure proper operation.
8. Check the tripping and closing times from coil energization to contact part or contact make.

Placing equipment into service

To place equipment in service for the first time proceed as follows:

1. Check that the circuit breaker is OPEN and all control circuits are energized.
2. Check torque of the bolts that secure the roof bushings to the top plate of the type SDV7-AR distribution circuit breaker. Torque should be in the range of 20-25 ft-lbs (27-34 Nm).
3. Connect primary incoming power source to circuit breaker.
4. Check all instruments, protective relays, meters, etc.
5. Connect as small a load as possible and observe instruments.
6. Gradually connect more load to the equipment while observing instruments until the full load is connected.
7. Check for signs of overheating of primary and secondary circuits and satisfactory operation of all instruments during the first week of operation.

Maintenance

Inspection and maintenance intervals

Periodic inspections and maintenance are essential to obtain safe and reliable operation of the type SDV7-AR distribution circuit breaker.

When type SDV7-AR distribution circuit breakers are operated under “usual service conditions,” maintenance and lubrication is recommended at five-year intervals or at the number of operations indicated in Table 5: Maintenance and lubrication intervals on page 39, whichever occurs first. “Usual” and “unusual” service conditions for ac high-voltage circuit breakers are defined in ANSI/IEEE C37.04, section 4 and ANSI/IEEE C37.010, section 4. Generally, “usual service conditions” are defined as an environment in which the equipment is not exposed to excessive dust, acid fumes, damaging chemicals, salt air, rapid or frequent changes in temperature, vibration, high humidity and extremes of temperature.

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 chapter 1) 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 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.

	⚠ DANGER
	<p>Hazardous voltages and high speed moving parts.</p> <p>Will cause death, serious injury or property damage.</p> <p>Read instruction manuals, observe safety instructions and use qualified personnel.</p>

Recommended hand tools

Type SDV7-AR distribution circuit breakers uses both standard SAE (U.S. customary) and metric fasteners. Metric fasteners are used for the vacuum interrupters and in the vacuum interrupter/operator module. SAE (U.S. customary) fasteners are used in most other locations. This list of hand tools describes those normally used in disassembly and re-assembly procedures.

SAE (U.S. customary):

- Socket and open-end wrenches: 5/16, 3/8, 7/16, 1/2, 9/16, 11/16, 3/4 and 7/8"; 7, 10, 13, 17 and 19 mm
- Hex keys: 3/16 and 1/4"; 8 mm
- Screwdrivers: 0.032 x 1/4" wide and 0.055 x 7/16" wide
- Pliers
- Light hammer
- Dental mirror
- Flashlight
- Torque wrench (0 to 150 ft-lbs (0 to 200 Nm)).

Recommended maintenance and lubrication

Periodic maintenance and lubrication should include all the tasks shown in Table 4: Maintenance tasks.

Recommended procedures for each of the listed tasks are provided in this section of the instruction manual or in the maintenance section of the operator manuals:

- Type 3AH35-SE stored-energy operator instruction manual, E50001-F710-K376-X-XXXX
- Type 3AH35-MA magnetic-actuator operator instruction manual, E50001-F710-K378-X-XXXX.

The list of tasks in Table 4: Maintenance tasks does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment.

Particular applications may require further procedures. Should further information be desired or should particular problems arise not covered sufficiently for the Purchaser's purposes, the matter should be referred to Siemens at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S.

For a quick reference to these tasks, refer to periodic maintenance and lubrication tasks in Table 8 on page 44.

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.

Inspection items and tests
Primary-power path checks <ul style="list-style-type: none"> ■ Cleanliness check ■ Inspection of flexible connectors
Magnetic-actuator operator-mechanism checks <ul style="list-style-type: none"> ■ Maintenance and lubrication ■ Fastener check ■ Capacitor charging check ■ Contact-erosion check
Stored-energy operator-mechanism checks <ul style="list-style-type: none"> ■ Maintenance and lubrication ■ Fastener check ■ Manual spring charging check ■ Contact-erosion check
Electrical-control checks <ul style="list-style-type: none"> ■ Wiring and terminals checks ■ Capacitor charging check ■ Electrical close and trip check
Vacuum-integrity check
High-potential test
Insulation test
Contact-resistance test
Inspection and cleaning of circuit breaker insulation
Functional tests

Table 4: Maintenance tasks



⚠ WARNING

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

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

The maintenance tasks described in Table 4: Maintenance tasks on page 37 and in the type 3AH35-SE stored-energy operator instruction manual, E50001-F710-K376-X-XXXX, or type 3AH35-MA magnetic-actuator operator instruction manual, E50001-F710-K378-X-XXXX, must be performed regularly.

De-energize the circuit breaker

Prior to performing any inspection or maintenance checks, the circuit breaker must be de-energized and grounded. Principal steps are outlined below for information and guidance.

Be sure that the circuit breaker and its mechanism are disconnected from all electric power, both high voltage and control voltage, before it is inspected or repaired.

After the circuit breaker has been disconnected (isolated) from power lines, attach the grounding leads properly before touching any of the circuit breaker parts.

De-energize the control power to the circuit breaker.

For the type SDV7-SE circuit breaker with stored-energy operator:

Review Figure 6: Relay and control and operator compartments for type SDV7-SE-AR circuit breaker with stored-energy operator on page 19. If the circuit breaker includes the optional capacitor trip unit, the capacitor must be discharged by grounding its terminals.

Perform the spring discharge check.

1. De-energize control power.
2. Press red open button on the operating mechanism.
3. Press black close button on the operating mechanism.
4. Again press red open button on the operating mechanism.
5. Verify spring condition indicator shows DISCHARGED.
6. Verify main contact status indicator shows OPEN.

For the type SDV7-MA circuit breaker with magnetic-actuator operator:

Review Figure 8: Relay and control and operator compartments for type SDV7-MA-AR circuit breaker with magnetic-actuator operator on page 30.

Discharging capacitors

After control power has been removed, discharge stored energy from the capacitors (refer to Figure 7: Operator controls and discharging capacitors on page 26).

1. Press red Open pushbutton (54.0).
2. Remove the mechanism housing cover sheet (60.1).

NOTICE

Capacitor discharge plug (105.2)

Disconnect control power prior to removing or replacing the capacitor discharge plug. Refer to Figure 7 on page 26.

To discharge capacitors:

- Disconnect control power to the circuit breaker by opening the disconnect device (device 08 in the typical schematic in Figure 10 on page 51) located in the control compartment.
- After control power is off, disconnect the capacitor discharge plug (105.2) from the controller board (105.0) to discharge capacitors.

To reconnect capacitors:

- Disconnect control power to the circuit breaker by opening the disconnect (device 08 in the typical schematic in Figure 10 on page 51) located in the control compartment.
- Insert the capacitor discharge plug (105.2) (with six pins) into the left-hand receptacle on the controller board (105.0). Ensure that the plug is properly seated and the plug position is level with the power supply connection plug (105.5) that is located to the right of the capacitor discharge plug.
- After the capacitor discharge plug is firmly seated, reconnect control power to the circuit breaker (device 08 in the typical schematic in Figure 10 on page 51).

3. Discharge the capacitors (106.2) by unplugging the connector (105.2) from the controller board (105.0). Do not unplug connector (106.3) from the capacitor boards, or damage to the capacitor board or to the controller board may occur. The red LED (106.4) on each of the capacitor boards (106.1) indicates the state of charge of the capacitors (106.2). When the capacitors (106.2) are discharging, the red LEDs are flashing. This indicates a hazardous voltage. When the LEDs stop flashing, the capacitors (106.2) are discharged.

Place the circuit breaker in the CLOSE BLOCKED position by moving the manual open handle on the right side of the circuit breaker (refer to Figure 8: Relay and control and operator compartments for type SDV7-MA-AR circuit breaker with magnetic-actuator operator on page 30.)

Checks of primary power path

The primary power path consists of the three vacuum interrupters, six bus connections to the bushings and the roof-mounted bushings. These components must be checked for cleanliness and condition. The vacuum interrupters must also be checked for vacuum integrity.

Check torque of the bolts that secure the roof bushings to the top plate of the circuit breaker. Torque should be in the range of 20-25 ft-lbs (27-34 Nm).

If a bushing has been removed or is being replaced, tighten bushing mounting bolts in a cross pattern, progressively increasing torque from one-third to two-thirds to full torque.

Use anti-seize compound (Loctite* 77164 or 77124 nickel anti-seize) on the threads of the roof studs to facilitate future removal of a bushing should it become necessary.

For connections between the bottom of the bushing and the bus bar, torque the 1/2-13 SAE grade 5 steel hardware to 50-75 ft-lbs (80-102 Nm).

For connections between the bus bars and the pole heads of the operator, torque M12 x 1.75 grade 8 bolts to 52 ft-lbs (70 Nm).

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

Also, the vacuum integrity check is usually performed in conjunction with the High Potential tests. These instructions follow the recommendation that these tests contact erosion/manual spring charging check, and vacuum integrity/high-potential tests) will be combined as described.

Cleanliness check

Figure 9 is a side view of the type SDV7-AR distribution circuit breaker showing the vacuum interrupter, bus connections and roof bushings.

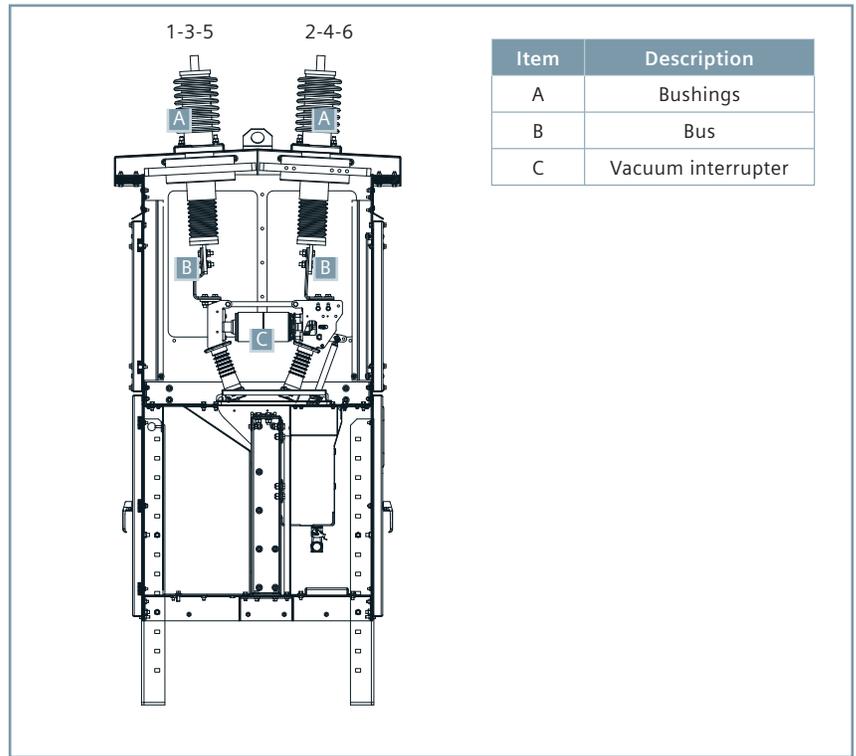


Figure 9: Side view of type SDV7-AR distribution circuit breaker

All of these components must be cleaned and free of dirt or any foreign objects. Use a dry lint-free cloth. For stubborn dirt, use a clean cloth saturated with denatured alcohol.

Also, inspect the bus work for any evidence of loose bolts, bushings for any evidence of damage, and flexible connectors for tightness and absence of mechanical damage, burning, or pitting.

Checks of the stored-energy operator mechanism

The stored-energy operator checks are divided into mechanical and electrical checks for simplicity and better organization. The 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 5 presents the recommended maintenance intervals for the type SDV7-AR distribution circuit breakers. These intervals assume that the circuit breaker is operated under "usual service conditions" as discussed in ANSI/IEEE C37.04, section 4, and elaborated in ANSI/IEEE C37.010, section 4. The maintenance and lubrication interval is the lesser of the number of closing operations or the time interval since last maintenance.

Item	Description
A	Bushings
B	Bus
C	Vacuum interrupter

Circuit breaker type	Number of years/closing operations (whichever comes first)
SDV7-SE-AR	Five years/ 10,000 operation
SDV7-MA-AR	

Table 5: Maintenance and lubrication intervals

* Loctite is a registered trademark of Henkel Corporation.

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

High-potential test voltages

The voltages for high-potential tests are shown in Table 2 (or 3): High-potential test voltages on page 23 (or 33).

Note: The dc test voltage is given as a reference only. It represents values believed to be appropriate and approximately equivalent to the corresponding power-frequency withstand test values specified for each voltage rating. The presence of this column in no way implies any requirement for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to ac withstand tests. When making dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

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

These high voltages will produce X-ray radiation. Such devices also show erroneous readings of leakage current when testing vacuum circuit breakers.

Vacuum integrity test procedure

1. Observe safety precautions listed in the danger and caution advisories. Construct the proper barrier and warning light system.
2. Ground each pole not under test.
3. Apply test voltage across each pole for one minute.
4. If the pole sustains the test voltage for that period, the vacuum integrity has been verified.

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

If dc high-potential tests are used, note the following:

- If a dc test indicates loss of vacuum, reverse the polarity of the test leads and retest.
- If the second test is successful, the vacuum interrupter has adequate vacuum integrity.
- If the second test also indicates loss of vacuum integrity, replace the vacuum interrupter.

As-found insulation and contact-resistance tests

As-found tests verify the integrity of the circuit breaker insulation system. Megger* or insulation-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 increase in contact resistance.

Insulation and contact-resistance test equipment

In addition to the high-potential test equipment capable of test voltages as listed in Table 2 (or 3): High-potential test voltages on page 23 (or 33), the following equipment is also required:

- AC high-potential tester with test voltage of 1,125 volts, 60 Hz.
- Micro-ohmmeter for contact-resistance tests.

Voltage kV	Interrupting kA	Continuous current			
		1,200 A	2,000 A	2,500 A	3,000 A
15.5	20/25/31.5/40	160	105	----	95
27.6	20/25	160	105	----	----
38.0	20/25/31.5/40	160	105	100	----

Table 6: Maximum contact resistance (micro-ohms)

Insulation and contact-resistance test procedure

1. Observe safety precautions listed in the danger and caution advisories for the vacuum integrity check tests.
2. Close the circuit breaker. Ground each pole not under test. Use manual charging, closing and tripping procedures.
3. Apply the proper high-potential test voltage (refer to Table 2 (or 3): High-potential test voltages on page 23 (or 33)) 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 completion, ground both ends and the middle arc chamber of the vacuum interrupter to dissipate any static charges.
6. Disconnect the leads to the spring-charging motor.
7. Test each individual wire, when they are connected to the operator 64-pin plug, connect the high-voltage tester to a particular pin and ground the circuit breaker housing. Starting with zero volts, gradually increase the test voltage to 1,125 volts, 60 Hz (750 volts, 60 Hz on pins A1 and D16 for motor circuit for stored-energy operator). Maintain test voltage for one minute.
8. If no disruptive discharge occurs, the secondary control insulation level is satisfactory.
9. Disconnect the shorting wire and reattach the leads to the spring-charging motor.
10. Perform contact-resistance tests of the primary contacts using a micro-ohmmeter. Contact resistance should not exceed the values listed in Table 6: Maximum contact resistance (micro-ohms). The contact resistance is measure across the phase terminals (outside terminals of roof bushings).
11. Make a permanent record of all tests performed.

Inspection and cleaning of circuit breaker insulation

- 1A. (For stored-energy operator) perform the spring discharge check.
 - A. De-energize control power.
 - B. Press red open button on the operating mechanism.
 - C. Press black close button on the operating mechanism.
 - D. Again press red open button on the operating mechanism.
 - E. Verify spring condition indicator shows DISCHARGED.
 - F. Verify main contact status indicator shows OPEN.
- 1B. (For magnetic-actuator operator) use the manual opening handle on the right side of the enclosure (refer to Figure 8: Relay and control and operator compartments for type SDV7-MA circuit breaker with magnetic-actuator operator on page 30 to open the circuit breaker.
2. Remove the phase barriers (if provided) as shown in Figure 5: Type SDV7-AR distribution circuit breaker with interphase barriers and bushing current transformers installed in primary compartment on page 16.

NOTICE

Risk of insulation damage with use of incorrect compounds.

May cause equipment dielectric failure.

Use only isopropyl alcohol to clean insulation. Do not use any cleaning compounds containing chlorinated hydrocarbons such as trichlorethylene, perchlorethylene or carbon tetrachloride. These compounds will damage the material used in the barriers and other insulation on the circuit breaker.

3. Clean barriers, post insulators and roof bushings using clean cloth and isopropyl alcohol.
4. Reinstall all barriers. Check all visible fasteners again for condition and tightness.

Functional tests

Refer to the installation checklist in the installation checks and initial functional tests section of this instruction manual. 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 fully discharged, all fasteners and connections are checked again for tightness and condition before placing the type SDV7-AR distribution circuit breaker back in service.

Protective relays and instruments

The type SDV7-AR distribution circuit breaker can be equipped with a protective relay panel when required. A protective relay package can be supplied on a hinged panel mounted in the front of the relay and control compartment.

To ensure satisfactory operation of protective relays and instruments do not leave device covers off longer than necessary.

When a cover has been broken, cover the device temporarily and replace broken cover as soon as possible.

Refer to the wiring and schematic diagrams, and other instruction literature shipped with the circuit breaker for additional specific protective relay requirements.

Equipment surfaces

Inspect the painted surfaces and touch up scratches as necessary. ANSI-61 touch-up paint is available from Siemens. This paint matches the unit and is thinned and ready for use in one pint (473 ml) spray cans.

Inspect interior of unit for entrance of moisture and repair as necessary.

Inspect ventilation filters, clean or replace as appropriate.

Maintenance and troubleshooting

	! WARNING
	<p>Hazardous voltages and high-speed moving parts.</p> <p>Can cause death, serious injury or property damage.</p> <p>All replacement of circuit breaker components must be performed with the circuit breaker completely de-energized and the springs discharged.</p>

Introduction

The following procedures along with the troubleshooting charts at the end of this section, provide maintenance personnel with a guide to identifying and correcting possible malfunctions of the type SDV7-AR distribution circuit breaker.

Type	Number of closing operations
SDV7-SE-AR	10,000
SDV7-MA-AR	

Table 7: Overhaul schedule ANSI/IEEE "usual conditions"

Circuit breaker overhaul

Table 7: lists the recommended overhaul schedule for type SDV7 distribution circuit breakers operating under ANSI/IEEE "usual service conditions." When actual operation conditions are more severe, overhaul periods should occur more frequently. The operations counter on the front panel of the circuit breaker records the number of operations.

For overhaul information and instructions, refer to the instruction manual for the type 3AH35-SE distribution circuit breaker stored-energy operator E50001-F710-K376-X-XXXX or the 3AH35-MA magnetic-actuator operator E50001-F710-K378-X-XXXX.

Table 8: Periodic maintenance and lubrication tasks

Sub-assembly	Item	Inspect for
Primary power path	Vacuum interrupter	<ol style="list-style-type: none"> Cleanliness. Contact erosion. Note: Perform with manual-spring checks. Vacuum integrity. Note: Perform with high-potential tests.
	Vacuum interrupter contact resistance	<ol style="list-style-type: none"> Record contact resistance with contacts closed and check at each maintenance interval to monitor condition.
Vacuum interrupter operator mechanism	Cleanliness	<ol style="list-style-type: none"> Dirt or foreign material.
	Fasteners	<ol style="list-style-type: none"> Tightness of nuts and other locking devices.
	(Stored-energy) manual-spring check	<ol style="list-style-type: none"> Smooth operation of manual charging, manual closing and manual tripping.
	Lubrication	<ol style="list-style-type: none"> Evidence of excessive wear. Lubrication of wear points.
Electrical controls	Wiring	<ol style="list-style-type: none"> Mechanical damage or abrasion.
	Terminals and connectors	<ol style="list-style-type: none"> Tightness and absence of mechanical damage.
	Close and trip solenoids, anti-pump relay and auxiliary switches	<ol style="list-style-type: none"> Automatic charging. Close and trip with control power.
High-potential test	Primary circuit-to-ground and between primary disconnects	<ol style="list-style-type: none"> 60-second withstand 37.5 kV, 45 kV or 60 kV, 60 Hz (53 kV, 64 kV or 85 kV dc).
	Control circuit-to-ground	<ol style="list-style-type: none"> 60-second withstand 1,125 V, 60 Hz.
Insulation	Barriers and all insulating components	<ol style="list-style-type: none"> Cleanliness. Cracking, crazing, tracking or other sign of deterioration.
Space heaters	Space heaters	<ol style="list-style-type: none"> Correct operation.

Table 9: Troubleshooting

Problem	Symptoms		Possible causes and remedies
	(Stored-energy) closing spring will not automatically charge.		<ol style="list-style-type: none"> 1. Secondary control circuit is de-energized or control circuit fuses are blown. Check and energize or replace if necessary. 2. Secondary multi-pin plug contacts A1 or D16 are not engaging. Check and replace if required. 3. Damage to wiring, terminals or connectors. Check and repair as necessary. 4. Failure of charging motor (88). Replace if required. 5. Motor cut-off switch LS21 or LS22 fails to operate. Replace if necessary. 6. Mechanical failure of operating mechanism. Check and contact the factory or Siemens field service at +1 (800) 347-6659 or +1 (919) 365-2200 outside the U.S.
Circuit breaker fails to close.	(Stored-energy) closing springs charge but circuit breaker does not close.	Closing coil or solenoid (52SRC) fails to energize. No sound of circuit breaker closing.	<ol style="list-style-type: none"> 1. Secondary control circuit de-energized or control circuit fuses blown. Correct as indicated. 2. No closing signal to multi-pin plug pin A2 or contacts A2 and B3 are not engaging. Check for continuity and correct protective relay logic. Replace contacts if required. 3. Failure of anti-pump relay (52Y) contacts 21 to 22, 31 to 32 or 13 to 14. Check and replace as required. 4. Failure of close coil (solenoid) (52SRC). Check and replace as required. 5. Auxiliary switch NC contacts 41 to 42 are open when circuit breaker contacts are open. Check linkage and switch. Replace or adjust as necessary.
		Closing coil energizes. Sound of circuit breaker closing is heard, but circuit breaker contacts do not close.	<ol style="list-style-type: none"> 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: Troubleshooting (continued)

Problem	Symptoms	Possible causes and remedies
Nuisance or false close	Electrical problem	<ol style="list-style-type: none"> 1. Nuisance or false closing signal to secondary disconnect multi-pin plug contact. Check protective relay logic. Correct as required. 2. (Stored-energy) closing coil (52SRC) terminal A2 is shorted-to-ground. Check to determine if problems are in wiring or coil. Correct as required.
	Mechanical problem	<ol style="list-style-type: none"> 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.
Circuit breaker will not trip	(Stored-energy) tripping coil or solenoid (52T) does not energize. There is no tripping sound.	<ol style="list-style-type: none"> 1. Secondary control power is de-energized or control power fuses are blown. Correct as indicated. 2. Damage to wiring, terminals or connectors. Check and repair as necessary. 3. No tripping signal to multi-pin plug contact C2. Check for continuity and correct protective relay logic. 4. Secondary multi-pin plug contacts C2 or D2 are not engaging. Check and replace if required. 5. Failure of trip coil (52T). Check and replace if necessary. 6. Auxiliary switch 52a NO contacts 23 to 24 or 33 to 34 are open when circuit breaker is closed. Check linkage and switch. Replace or adjust as necessary.
	(Stored-energy) tripping coil (52T) energizes. No tripping sound is heard, and circuit breaker contacts do not open. In other words, they remain closed.	<ol style="list-style-type: none"> 1. Failure of tripping spring or its mechanical linkage. Check and replace if required.
	(Stored-energy) tripping coil (52T) energizes. Tripping sound is heard, but circuit breaker contacts do not open.	<ol style="list-style-type: none"> 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. 2. One or more of the vacuum interrupters are held closed. Check and replace as necessary.
Nuisance or false trip	Electrical problem	<ol style="list-style-type: none"> 1. Tripping signal remains energized on secondary multi-pin plug contact C2. 2. Check for improper protective relay logic.
	Mechanical problem	<ol style="list-style-type: none"> 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.

Ordering replacement parts

When ordering replacement parts for a Siemens distribution circuit breaker, it is very important to give complete information. This information should include:

1. Type SDV7-AR distribution circuit breaker serial number listed on circuit breaker nameplate.
2. Type of operator listed on operator nameplate.
3. Type of circuit breaker.
4. Rated continuous current of circuit breaker.
5. Rated voltage of circuit breaker.
6. Description of part. Use instruction book description insofar as possible.
7. Instruction book number listed on circuit breaker nameplate.
8. Instruction book item number.
9. Number of pieces required.

While the circuit breaker can be identified by the serial number alone, all additional information that is given will serve as a check to be certain that the part or parts furnished are correct for the circuit breaker in question. Without this serial number, Siemens cannot be sure of the correct identity of the desired parts.

If any doubt exists as to the instruction book reference number or the description, a dimensional sketch of the desired part will help to properly identify it.

Siemens recommends that a supply of repair parts be kept on hand so that emergency repairs can be made without waiting for shipment of parts from the factory.

A list of recommended spare parts is sent with the circuit breaker. Before removing any part to be replaced, observe its function and adjustment. This usually saves adjustment time during installation.

Appendix

Table 10: Technical ratings

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

Footnotes:

¹ Standard 50 ms (3-cycle) with 48 Vdc, 125 Vdc or 250 Vdc trip voltage or capacitor trip with 83 ms (5-cycle) interrupting time optional (for stored-energy only).

² TRV values are in accord with IEEE C37.06-2009. TRV peak value u_c is roughly equal to historic E₂ value in ANSI C37.06-2000. Value t₃, time to voltage u_c, is approximately 1/1.138 times the T₂ value in ANSI C37.06-2000.

³ First value is full-wave impulse withstand circuit breaker open or closed. Second value is chopped-wave impulse withstand, applicable only with circuit breaker closed.

Table 11: Control data

Stored -energy operator						
Nominal	Range		Close coil	Trip coil ^{1,6}	Spring charging motor	
	Close	Trip	A	A	Amperes run (avg.)	Charging seconds
48 Vdc	36-56	28-56	11.4	30/11.4	8	10
125 Vdc	90-140	70-140	2.1	7.4/4.8	4	10
250 Vdc	180-280	140-280	2.1	9.6/4.2	2	10
120 Vac	104-127	104-127	2.0	---	6	10
240 Vac	208-254	208-254	2.0	---	3	10
Magnetic-actuator operator						
Electronic controller power supply	Input voltage range	Input power	Controller output		Capacitor voltage ^{2,3,4}	
			Close	Open		
	28-56 Vdc	80 W ⁵	40-55 A	10-15 A	160 Vdc	
	95-250 Vdc/ 100-254 Vac	60 W/60 VA ⁵	40-55 A	10-15 A	160 Vdc	
Binary inputs (close and open commands)	Low range model		≥ 17 Vdc or 17 Vac		Recommended duration ≥ 100 ms	
	High range model		≥ 69 Vdc or 53 Vac		Recommended duration ≥ 100 ms	

Table 12: Interrupting capacity auxiliary switch contacts

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

Table 13: Type SDV7 distribution circuit breaker weight in lbs (kg)³

Voltage	Interrupting	Continuous current					
		1,200 A ^{1,2}	2,000 A ^{1,2}	2,500 A ^{1,2}	3,000 A ^{1,2}	Pallet	Seismic cross braces
15.5 kV	20/25 kA	2,631 (1,193)	2,741 (1,243)	----	----	71 (32)	90 (41)
15.5 kV	31.5/40 kA	2,693 (1,222)	2,761 (1,252)	----	3,227 (1,486)	71 (32)	90 (41)
27.6 kV	20/25 kA	2,959 (1,342)	3,069 (1,392)	----	----	84 (38)	110 (50)
38.0 kV	20/25/31.5/40 kA	4,308 (1,954)	4,336 (1,967)	4,427 (2,008)	----	125 (57)	130 (59)

Table 14: Space heater data

Location	Heater wattage
High-voltage compartment 15.5 kV and 27.6 kV	500 ¹
High-voltage compartment 38.0 kV	750 ¹
Relay and control compartment	100 ¹
Operator compartment - stored-energy operator (for application below -30 °C down to -50 °C)	150 ²
Operator compartment - magnetic-actuator operator (for application below -25 °C down to -50 °C)	150 ²

Footnotes:

- ¹ First value is for standard 50 ms/ three-cycle interrupting time. Second value is for optional 83 ms/ five-cycle interrupting time (stored-energy operator only).
- ² If controller power fails, capacitors retain sufficient charge to open circuit breaker within 300 seconds, with minimum open command duration 100 ms.
- ³ Capacitors discharge to 10 V or less within five minutes after disconnecting plug.
- ⁴ Capacitor charging time approximately 30-35 seconds from complete discharge, approximately 12 seconds after OPEN-CLOSE-OPEN sequence.
- ⁵ On initial energization, power demand is approximately 100 W, declining to approximately 20 W when capacitors are fully charged. When the circuit breaker operates (open or close), power demand again increases to approximately 100 W, declining to approximately 20 W when capacitors are fully charged.
- ⁶ For stored-energy operator, power requirement for second trip coil is approximately 70 W (dc) or 50 VA (ac). Power requirement for undervoltage device is approximately 20 W (dc) or 20 VA (ac).

Footnotes:

- ¹ Weight does not include shipping pallet.
- ² Weight does not include seismic cross braces.

Footnotes:

- ¹ Thermostat controlled and set to turn off at 95 °F.
- ² Thermostat controlled and set to turn off at 10 °F.

Table 15: Technical ratings

Item	Unit	15.5 kV			27.6 kV	38.0 kV	
Lightning impulse withstand voltage	kV	110			150	200	
■ Full wave 1.2/50 μs		142			194	258	
■ Chopped wave 2 μs ¹		----			----	----	
■ Chopped wave 3 μs							
Power-frequency withstand voltage	kV	50			60	80	
Rated short-circuit current	kA	20/25/31.5/40			20/25	20/25/31.5/40	
%dc component	%	48			48	48	
Rated closing and latching current	kA peak	52/65/82/104			52/65	52/65/82/104	
Rated duty cycle	----	O-0.3 s-CO-3 min.-CO O-15 s-CO			O-0.3 s-CO-3 min.-CO O-15 s-CO	O-0.3 s-CO-3 min.-CO O-15 s-CO	
■ Reclosing duty							
■ Non-reclosing duty							
Minimum reclosing time ²	s	0.3			0.3	0.3	
Rated power frequency	Hz	60			60	60	
Capacitance switching	A	100			100	100	
■ Overhead line		400			400	250	
■ Isolated bank		400			400	250	
■ Back-to-back							
Phase spacing (bushing center-to-center)	inches (mm)	13.0 (330)			16.0 (406)	19.5 (495)	
■ 1,200 A		13.0 (330)			16.0 (406)	19.5 (495)	
■ 2,000 A		16.0 (406)			----	2,500 A 19.5 (495)	
■ 3,000 A							
External creep	inches (mm)	25.2 (640)			26.5 (673)	41.0 (1,040)	
External strike-to-ground	inches (mm)	10 (255)			10 (255)	17 (480)	
Operating temperature range	°C	-30 to +40			-30 to +40	-30 to +40	
■ Standard		-40 to +40 ³			-40 to +40 ³	-40 to +40 ³	
■ Optional							
Operating mechanism	----	Stored-energy/ magnetic-actuator			Stored-energy/ magnetic- actuator	Stored-energy/magnetic- actuator	
Closing time ⁴	ms	≤65/≤55			≤65/≤55	≤70/----	
Opening time by interrupting time ⁴	ms	≤38/≤33			≤38/≤33	≤38/≤----	
■ Three-cycle		≤56/----			≤56/----	≤56/----	
■ Five-cycle							
Dual trip coils (mechanically and electrically independent)	----	Optional (stored-energy)			Optional (stored-energy)	Optional (stored-energy)	
Auxiliary voltages (options)	----	See Table 11			See Table 11	See Table 11	
■ Close, trip and protection		120/240			120/240	120/240	
■ Space heaters, auxiliaries	Vac						
Contact gap (stroke)	mm	20/25	20/25	31.5/40	VS-25008	VS-30030	VS-30041
Vacuum interrupter type		VSS-17006	VS-25008	VS-15052			
1,200 A		7-9	13-15	7-9			
2,000 A		7-9	13-15	7-9			
3,000 A	----	----	7-9	----	(2,500) 18-22	18-22	
Radio influence voltage (RIV) 1,000 kHz	μV	≤500			≤650	≤650	
Seismic withstand (optional) (ANSI/IEEE 693-2005 high-response spectrum)	g	0.5			0.5	0.5	

Footnotes:

¹ Circuit breaker is in closed position.

² User must supply external time delay (typically using setting in reclosing relay) for the minimum reclose time interval of 0.3 s in accordance with ANSI/IEEE.

³ Consult factory for -50 °C.

⁴ First value is for stored-energy operator; value after slash is for magnetic-actuator operator. For magnetic-actuator operator, add 10 ms if command power is ac.

Figure 10: Typical control schematic for stored-energy operator

Legend

- 01/C Control switch close (remote)
- 01/T Control switch trip (remote)
- 08 Close and trip power disconnect
- 08M Motor power disconnect
- 52a Auxiliary switch, open when circuit breaker is open
- 52b Auxiliary switch, closed when circuit breaker is open
- 52SRC Closing spring release coil
- 52T Opening spring release coil
- 52Y Anti-pump relay
- 69 Closing cutout switch
- 88 Spring charge motor

- G Green indicating light (remote)
- R Red indicating light (remote)
- LS3 Closing spring position switch, closed when closing spring is discharged
- LS9 Closing spring position switch, open when closing spring is discharged
- LS21 Motor cutoff switch, closed when closing spring is discharged
- LS22 Motor cutoff switch, closed when closing spring is discharged
- LS41 Closing spring position switch, open open when closing spring is discharged
- W White indicating light (remote)
- XO Plug connector (operator connections)

Schematic shown with closing springs discharged and circuit breaker open.

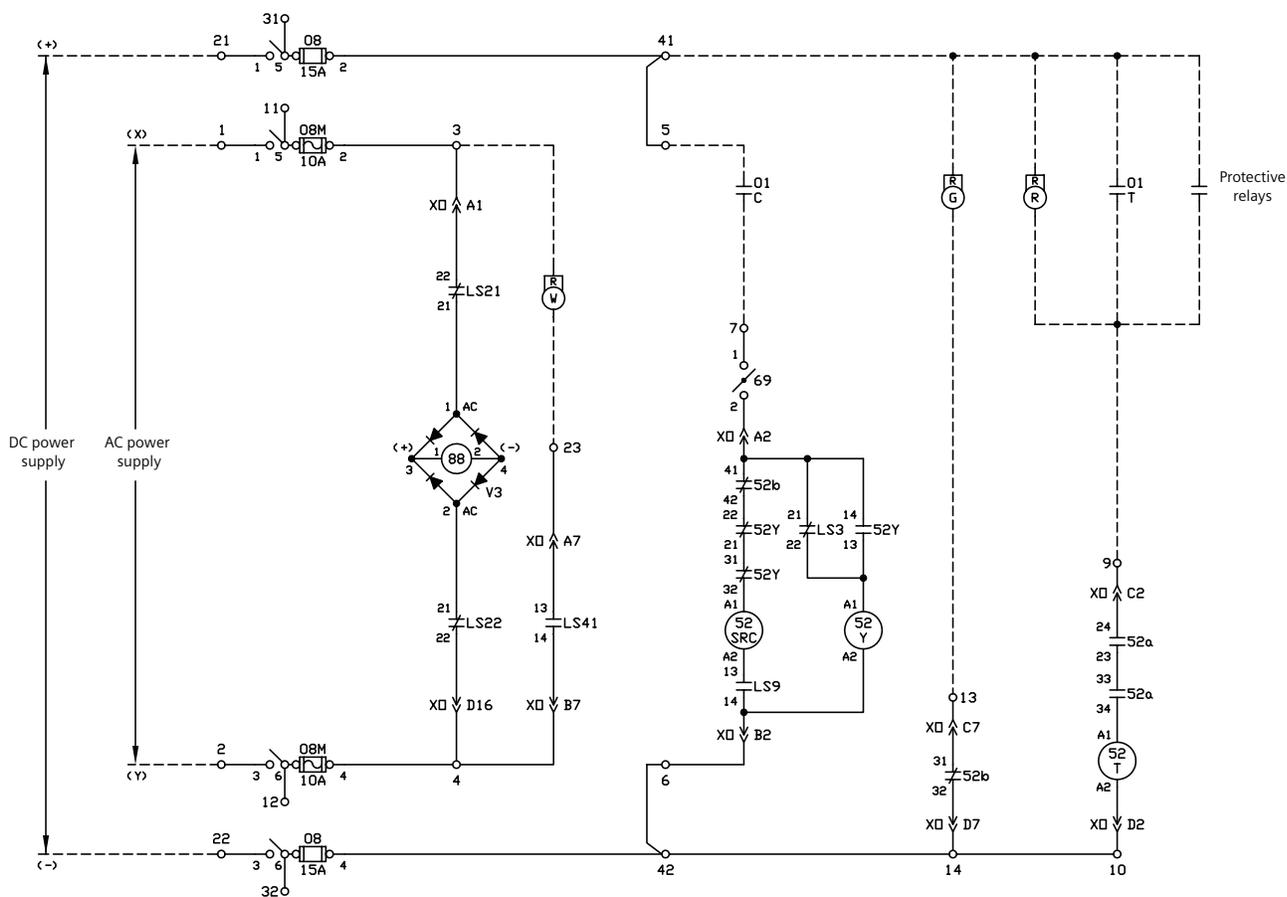
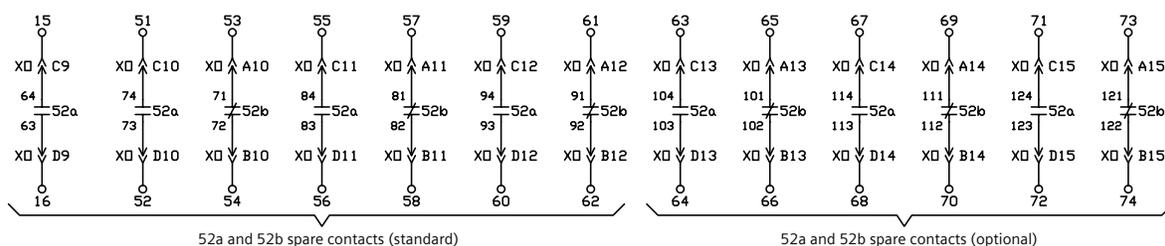


Figure 11: Typical control schematic for magnetic-actuator operator⁴

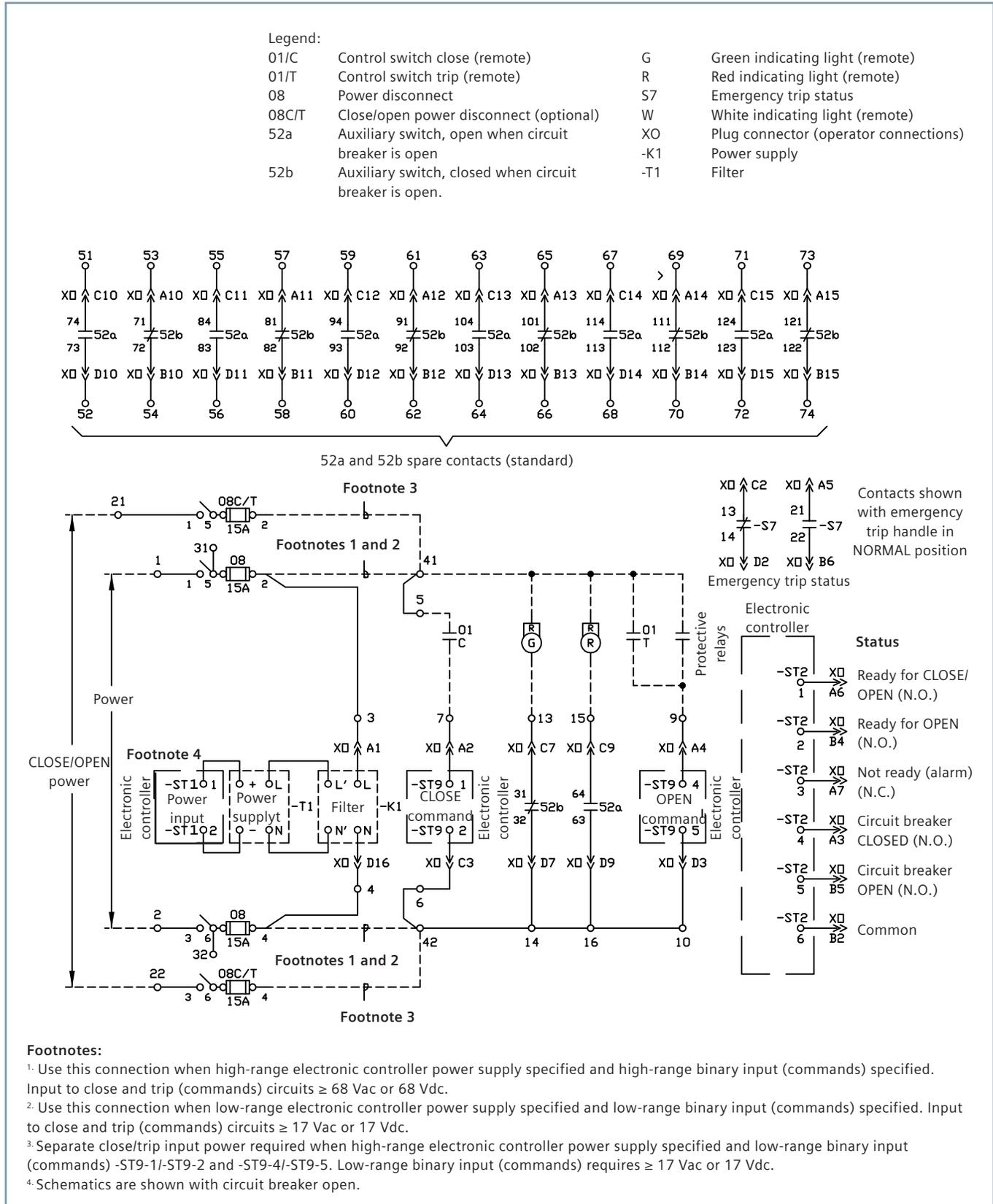
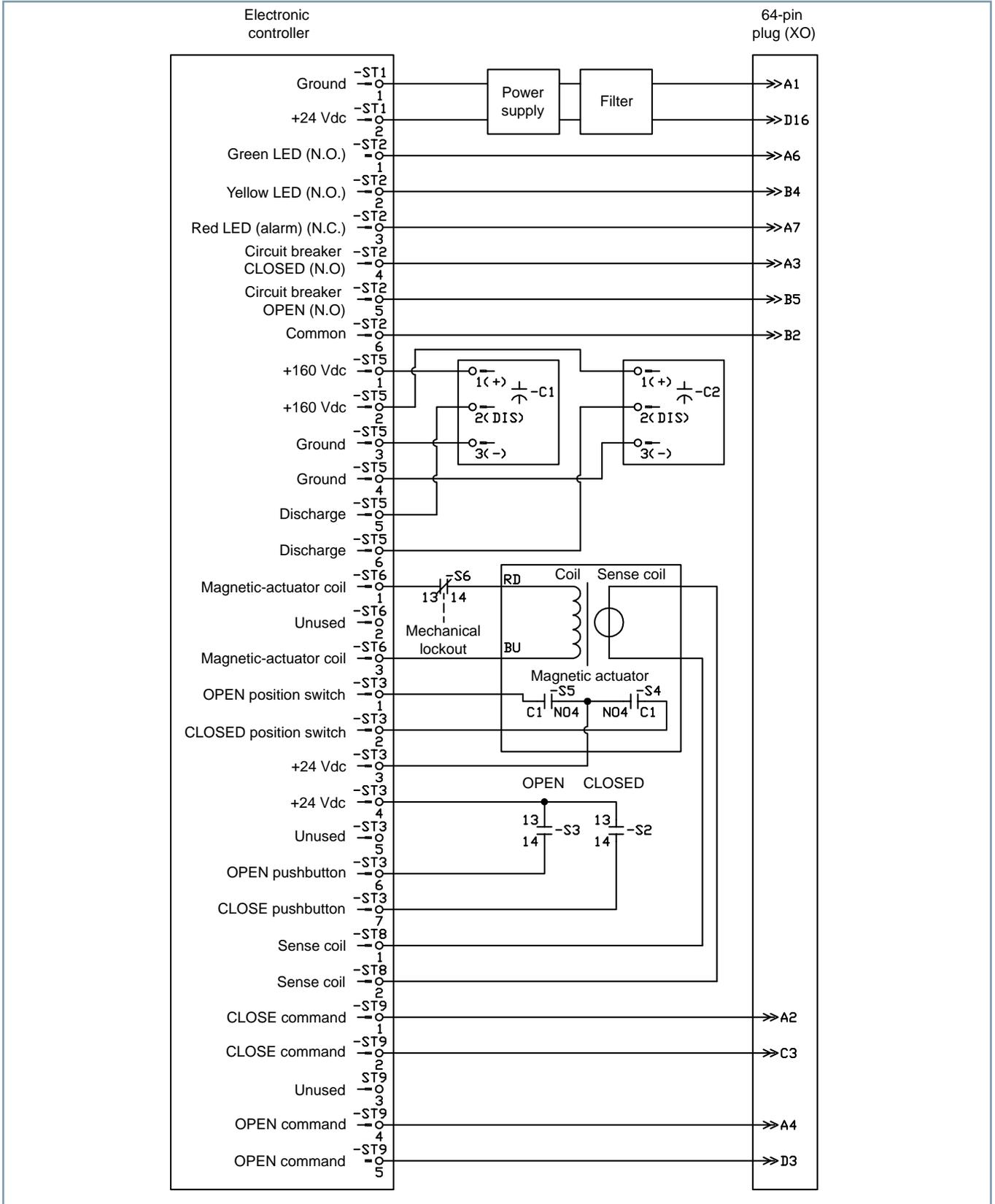


Figure 12: Controller schematic for magnetic-actuator operator



Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

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