Installation

Table of Contents

★ The instructions contained herein are also applicable to Mark IV Circuit-Switchers. For instructions for Mark II and Mark III Circuit-Switchers, contact the local S&C Sales Office

Febuary 2, 2026

Qualified Persons

⚠ WARNING

Only qualified persons knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution and transmission equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A qualified person is someone trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed
- The proper use of special precautionary techniques, personal protective equipment, insulated and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read This Instruction Sheet

NOTICE

Thoroughly and carefully read this instruction sheet and all materials included in the product's instruction handbook before installing or operating the S&C Mark V Circuit-Switcher. Become familiar with the Safety Information on page 3 and Safety Precautions on page 4. The latest version of this publication is available online in PDF format at **sandc.com/en/contact-us/product-literature/**.

Retain This Instruction Sheet

This instruction sheet is a permanent part of the S&C Mark V Circuit-Switchers. Designate a location where users can easily retrieve and refer to this publication.

Proper Application

⚠ WARNING

The equipment in this publication is only intended for application with S&C Mark V Circuit-Switchers. The application must be within the ratings furnished for the equipment. Ratings for the Mark V Circuit-Switcher are listed in the ratings table in S&C Specification Bulletin 711-31. The ratings are also on the nameplate affixed to the switch operator.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels and tags attached to the product. Become familiar with these types of messages and the importance of these signal words:

⚠ DANGER

"DANGER" identifies the most serious and immediate hazards that will likely result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ WARNING

"WARNING" identifies hazards or unsafe practices that can result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION

"CAUTION" identifies hazards or unsafe practices that can result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE

"NOTICE" identifies important procedures or requirements that can result in product or property damage if instructions are not followed.

Following Safety Instructions

If any portion of this instruction sheet is unclear and assistance is needed, contact the nearest S&C Sales Office or S&C Authorized Distributor, or call the S&C Global Support and Monitoring Center at 1-888-762-1100. Telephone numbers are also listed on S&C's website, sandc.com.

NOTICE

Read this instruction sheet thoroughly and carefully before installing the Mark V Circuit-Switcher shunt-trip device.

Replacement Instructions and Labels

If additional copies of this instruction sheet are required, contact the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

⚠ DANGER

S&C Mark V Circuit-Switchers operate at high voltage. Failure to observe the precautions below will result in serious personal injury or death. Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

1. **QUALIFIED PERSONS.** Access to Mark V Circuit-Switchers must be restricted only to qualified persons. See the "Qualified Persons" section on page 2.
2. **SAFETY PROCEDURES.** Always follow safe operating procedures and rules.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, and flash clothing, in accordance with safe operating procedures and rules.
4. **SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels.
5. **OPERATING MECHANISM AND BASE.** Mark V Circuit-Switchers contain fast-moving parts that can severely injure fingers. Do not remove or disassemble operating mechanisms or remove access panels unless directed by S&C Electric Company.
6. **ENERGIZED COMPONENTS.** Always consider all parts live until de-energized, tested, and grounded. Voltage levels can be as high as the peak line-to-ground voltage last applied to the unit. Units that have been energized or installed near energized lines should be considered live until tested and grounded.
7. **GROUNDING.** The Mark V Circuit-Switcher must be connected to a suitable earth ground at the base of the utility pole, or to a suitable building ground for testing, before energizing the switch and at all times when energized.

   The ground wire(s) must be bonded to the system neutral, if present. If the system neutral is not present, proper precautions must be taken to ensure the local earth ground, or building ground, cannot be severed or removed.
8. **SWITCH POSITION**. Always confirm the Open/Closed position of each switch.
   - Switches and terminal pads may be energized from either side.
   - Switches and terminal pads may be energized with the switches in any position.
9. **MAINTAINING PROPER CLEARANCE**. Always maintain proper clearance from energized components.

Overview

The S&C Shunt-Trip Device is available as an accessory for Mark V Circuit-Switchers equipped with a 48-volt or 125-volt dc S&C Type CS-1A Switch Operator.

These instructions are applicable to Mark V Circuit-Switchers rated 34.5 kV through 345 kV and Mark IV Circuit-Switchers rated 34.5 kV through 500 kV.

Circuit-switchers equipped with the shunt-trip device provide high-speed circuit interruption— 8 cycles (0.133 second) maximum interrupting time—for protection of transformers against internal faults, for multiple-contingency backup protection for overloads and secondary faults, and for protection of the transmission circuits from all kinds of transformer faults.

The shunt-trip device takes advantage of the fact the circuit-switcher's interrupters are closed and latched and ready to interrupt the circuit at all times when the disconnect blades are in the closed position.

The shunt-trip device for each circuit-switcher pole-unit, shown in Figure 1, consists of a solenoid mechanism (contained in the weatherproof shunt-trip solenoid housing attached to the pole-unit base), an insulated operating shaft, and a shunt-trip linkage to the brain. Remote high-speed tripping of the interrupters is accomplished before the circuit-switcher disconnect blades begin to open by energizing the solenoid. This action rotates the insulated operating shaft, which in turn actuates the shunt-trip linkage to the brain and trips the stored-energy source.

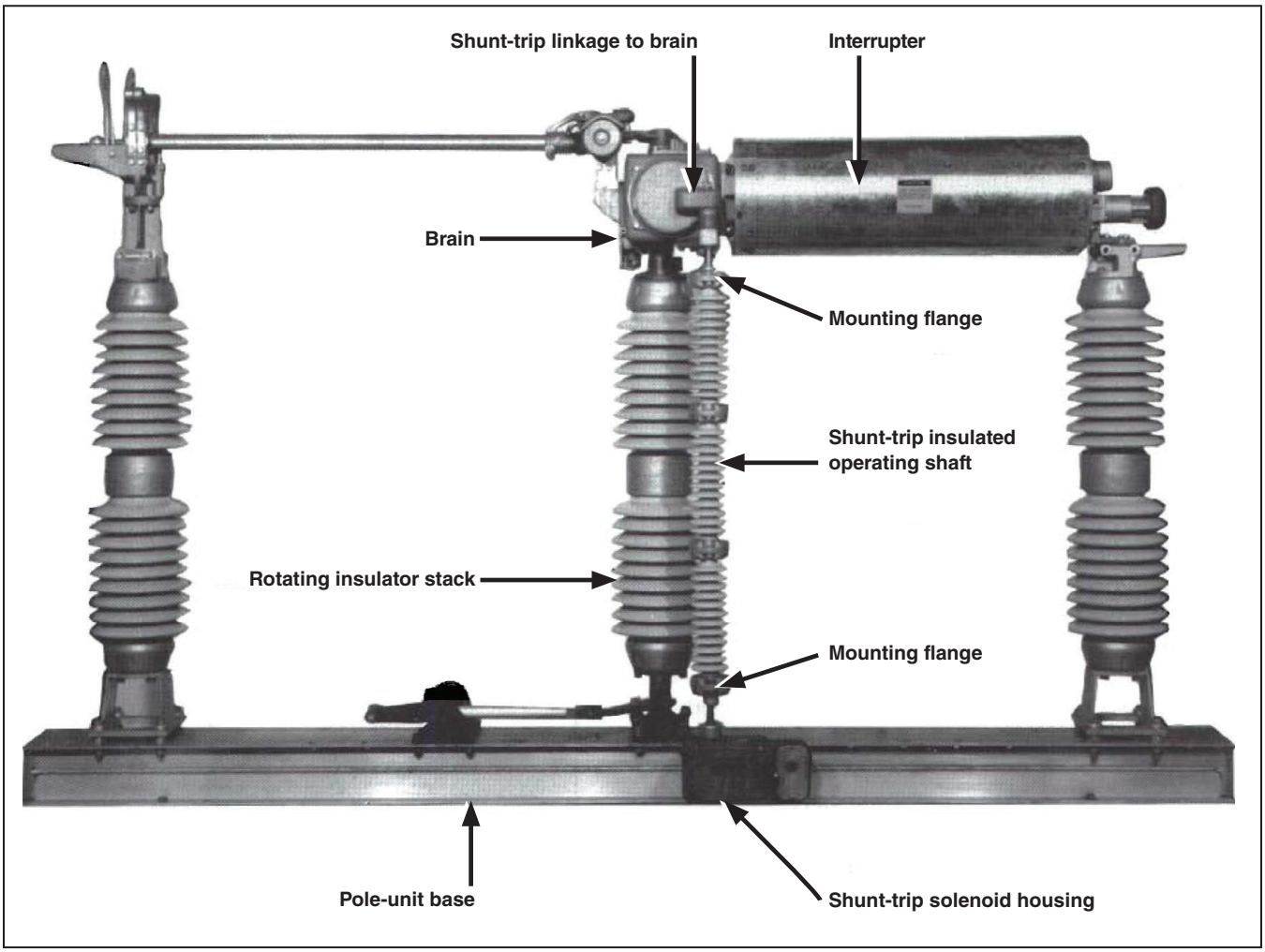


Figure 1. S&C Mark V Circuit-Switcher, Vertical-Break Style (115-kV pole-unit shown).

The interrupter tripping action is the same (except for the time of its occurrence) as that produced by rotation of the rotating insulator stack during a "normal" (non-shunt-trip) opening of the circuit-switcher.

Energizing of the shunt-trip solenoids to trip the interrupters is programmed through the switch operator circuitry so a shunt-trip operation is always followed immediately by opening of the circuit-switcher disconnect blades.

If the shunt-trip device is to be added to an existing circuit-switcher installation, the components including brain covers furnished for that purpose, should be assembled onto the circuit-switcher in accordance with the special drawings provided.

When furnished as original equipment, the shunt-trip device is factory-assembled on the circuit-switcher to the extent possible, consistent with the style and voltage rating of the circuit-switcher.

If the circuit-switcher insulators are shipped separately, each shunt-trip insulated operating shaft is shipped in a carton attached to the circuit-switcher pole-unit base. When shipped separately in this manner, S&C recommends the shunt-trip insulated operating shafts be installed after the pole-units have been permanently mounted in place on the mounting pedestals or supporting structure.

A retractable bracket see Figure 2, is used to hold the upper mounting flange of each insulated operating shaft in its extreme counterclockwise position (when viewed from the top). Each retractable bracket must be disengaged from its respective upper mounting flange, but only after the associated shunt-trip insulated operating shaft has been installed and the mounting bolts at both ends have been tightened.

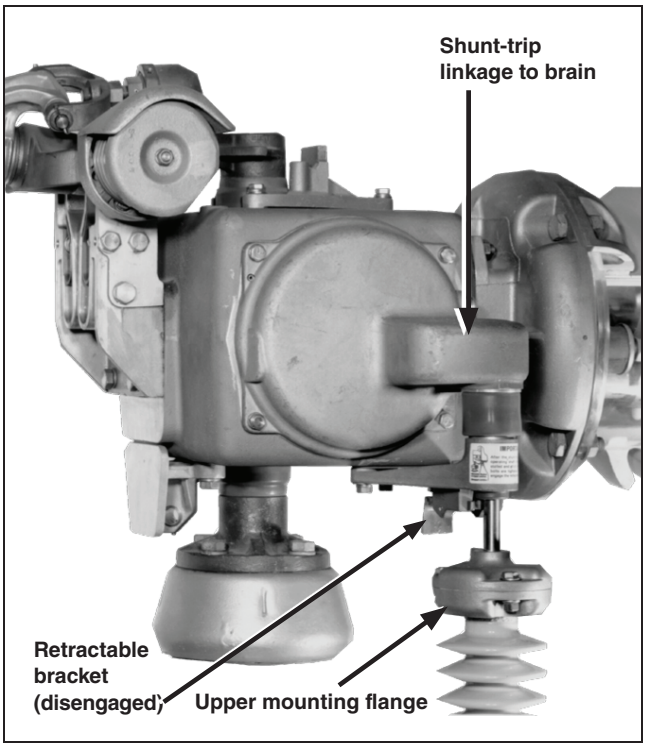


Figure 2. Brain-exterior details.

The integer-style circuit-switcher with shunt-trip device includes factory-installed conduit and wiring from each shunt-trip solenoid housing to a central point on the mounting-frame weldment. S&C Mounting Pedestals for integer-style circuit-switchers with shunt-trip device also include factory-installed conduit and wiring inside the pedestal, with a junction box at the top of the pedestal and a length of flexible conduit near the bottom of the pedestal for connection to the switch operator.

Circuit-switchers shipped as individual pole-units (vertical-break and center-break styles) are not furnished with conduit.

Shunt-trip device components may be installed at separate times during the installation of the circuit-switcher, as recommended in the circuit-switcher instruction sheet. However, the control wiring for the shunt-trip solenoids should be left disconnected at the switch operator end until after the switch operator has been adjusted.

Checking of the operation of the shunt-trip device should be performed only after all wiring has been completed, including the wiring from the protective relays and from the permanent control sources, and only after disengaging each of the three retractable brackets.

Installing the Insulated Operating Shafts

For Integer-style circuit-switchers and 34.5-kV and 46-kV vertical-break style circuit-switchers: These circuit-switchers are shipped with the insulated operating shafts already installed. Disengage the retractable brackets as described below. See Figure 3.

For circuit-switchers rated 230 kV: The insulated operating shafts are two sub-assemblies shipped in a carton attached to the pole-unit base. Bolt the two sub-assemblies together into a single shaft as shown in Figure 4 on page 9, using the ⅜–16-inch hex-head stainless steel cap screws, lockwashers, and hex nuts provided.

STEP 1. At each pole-unit, fasten the insulated operating shaft to the upper mounting flange (extending from the shunt-trip linkage housing on the brain) and to the lower mounting flange (extending from the shunt-trip solenoid housing on the base) and tighten the bolts. Using the ⅜-inch stainless-steel fastening hardware supplied, place the serrated side of the washers toward the slotted holes in the mounting flanges. See Figure 3**.**

Make sure the "dish" of the skirts on the insulated operating shaft is in the same direction as the skirts on the circuit-switcher insulators.

STEP 2. At each pole-unit, disengage the retractable bracket engaging the upper mounting flange extending from the shunt-trip linkage at the brain. (The bracket holds the mounting flange in its fully counterclockwise position during installation of the insulated operating shaft to ensure the proper relationship between the solenoid mechanism and the linkage in the brain.)

NOTICE

If the insulated operating shaft is to be removed for any reason (e.g., to relocate), engage the retractable bracket ***before*** loosening the bolts at either end of the insulated operating shaft. When engaged, the retractable bracket ensures the upper mounting flange is correctly positioned when the insulated operating shaft is re-installed. Disengage the retractable bracket after reinstalling the insulated operating shaft.

The shunt-trip solenoid mechanism has been adjusted at the factory and should not be altered. The shunt-trip linkage at the brain has also been factory-adjusted and requires no field adjustment.

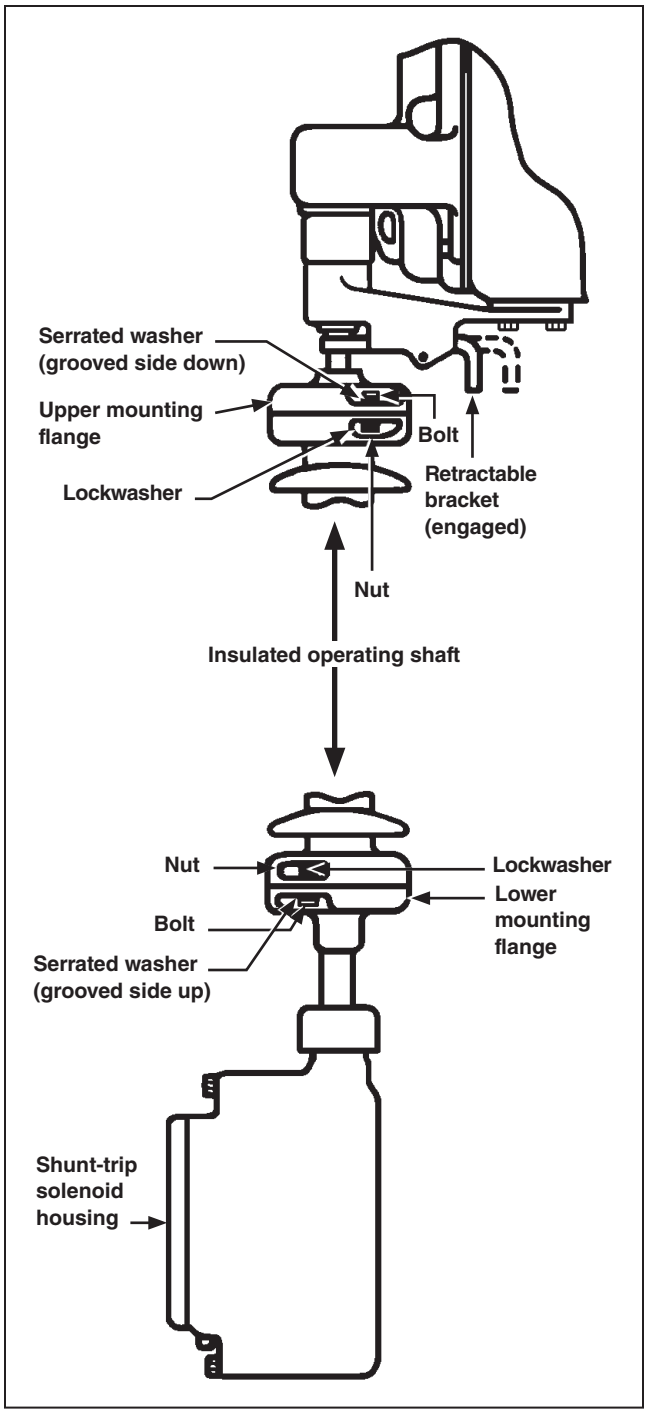


Figure 3. Installation details tor insulated operating shafts.

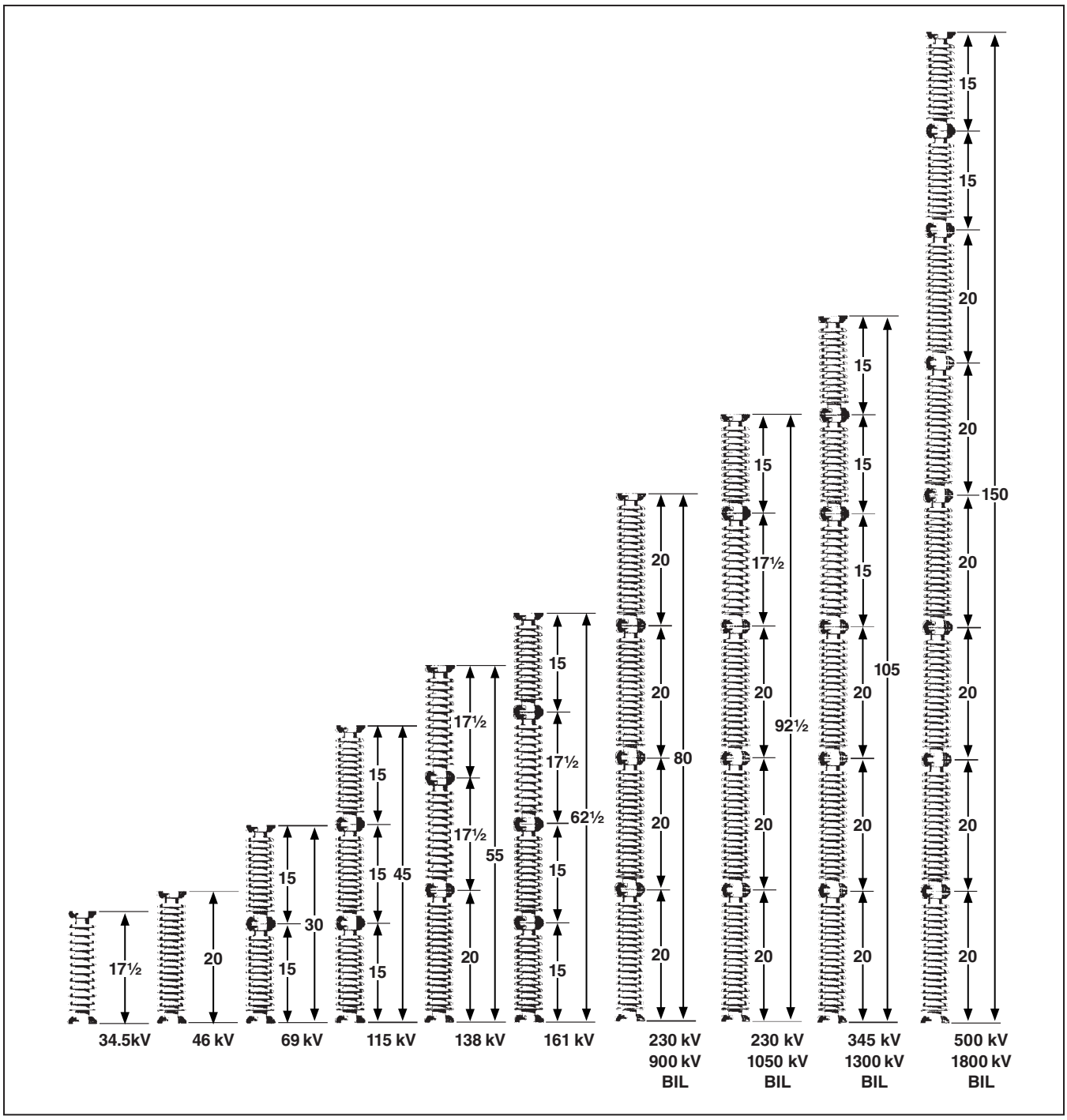


Figure 4. Insulated operating shafts.

Installing Conduit and Control Wiring

For vertical-break and center-break style circuit switchers:

STEP 1. Remove the cover from the terminal-block compartment at each shunt-trip solenoid housing. See Figure 5.

STEP 2. Unscrew the plastic plug from the appropriate conduit entrance. Install one-inch-diameter conduit (using weather-tight fittings) between adjacent terminal-block compartments and between one terminal-block compartment and the switch operator. Use thread sealer on all fittings.

STEP 3. Install the control wiring of a size not less than the minimum specified in Table 1 on page 11.

STEP 4. Remove any loose material from inside the terminal-block compartment and replace the cover.

For integer-style circuit-switchers:

Connect the factory-installed control wiring, at the center of the mounting-frame weldment, to the wiring leading to the switch operator (S&C Mounting Pedestals are furnished with factory-installed wiring, including a junction box at the top of the pedestal and a length of flexible conduit near the bottom of the pedestal for connection to the switch operator). Use thread sealer on all fittings.

Note: An individual pair of control wires is required between each shunt-trip solenoid terminal block and the switch operator, as indicated by the schematic diagram in Table 1 on page 11. This control wiring should be left disconnected at the switch operator end until after the switch operator has been adjusted.

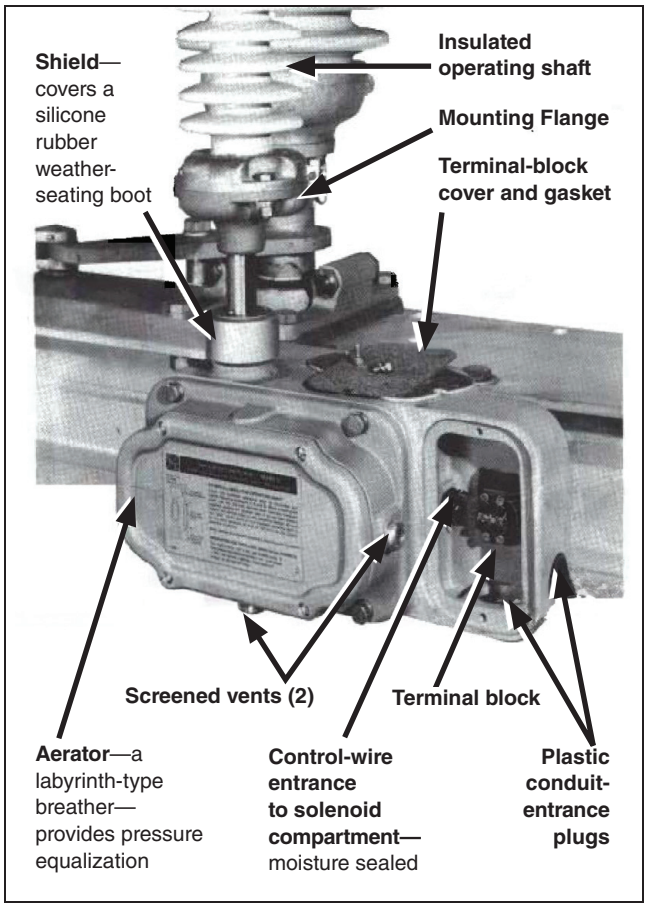
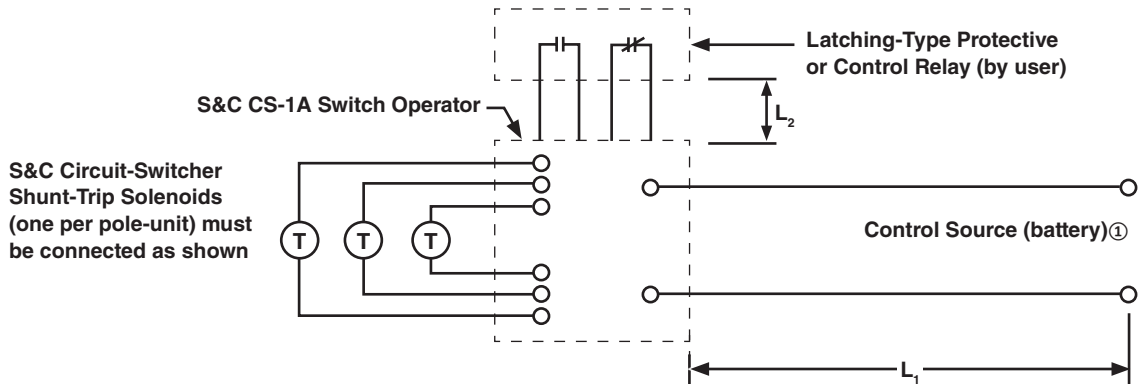


Figure 5. Shunt-trip solenoid housing with cover removed from terminal-block compartment.

Table 1. Switch Operator minimum battery and external control wire size requirements for Circuit-Switchers with Shunt-Trip device.



S&C Switch Operator		Control-Source Voltage	Motor		Circuit-Switcher Shunt-Trip Circuit		Minimum Size of Control Wire③ for Lines L1 and L2 Respectively, A.W.G.								
								Distance, Feet							
Type	Catalog Number		Rating, Volts	Accelerating Current at Rated Voltage, Amperes	Total Solenoid Current, Amperes	Size② of Wire from Switch Operator to Shunt-Trip, A.W.G.	Line	100	200	300	400	500	1000	2000	3000
CS-1A	38846R5-AHP	48V dc	48	80	36	10	L_1	6	4	2	1	1/0	4/0		
							L_2	12	10	8	6	6	2		
	38846R5-B 38858R1-B	125V dc	125	30	23	12	L_1	12	10	8	6	6	3	1/0	3/0
							L_2	12	10	8	6	6	3	1/0	3/0
	38846R5-BHP	125V dc	125	30	23	12	L_1	12	10	8	6	6	3	1/0	3/0
							L_2	12	12	12	12	12	10	6	4

① Recommended minimum one-minute discharge rate of battery for Type CS-1A Switch Operators 75 amperes.

② Assumed total distance between circuit-switcher and switch operator 30 feet.

③ Where long distances and large wire sizes are encountered, comparative cost of relocating battery and protective relays closer to switch operator should be considered.

Checking Operation of the Shunt-Trip Device

Check the operation of the shunt-trip device as follows:

STEP 1. Using the manual operating handle on the switch operator, manually open and close the circuit-switcher to make sure the interrupters are in the **Closed** position and the stored-energy springs within the brain are latched. The interrupter target, located on the side of each brain housing, appears yellow when the interrupter is open; gray when the interrupter is in the **Closed** position**.** See Figure 6.

Actuate the shunt-trip device by energizing through the protective-relay circuit. Listen for all three interrupters to trip simultaneously before the circuit-switcher disconnect blades begin to move; interrupter tripping should also be verified by noting the interrupter targets momentarily appear yellow on each of the three pole-units.

STEP 2. To ensure tripping reliability, adequate voltage must be available at the shunt-trip solenoid coil terminals. Determine this by measuring the voltage across each individual solenoid coil at its terminal block in the shunt-trip solenoid housing. Temporarily hold a jumper across terminals 52 and 54● at the terminal block in the switch operator enclosure to energize the shunt-trip solenoid coils. To prevent damage to the shunt-trip solenoids, voltage should be applied to the solenoid terminals only long enough to obtain an accurate voltmeter reading, and no longer than 30 seconds.

STEP 3. For optimal performance, S&C recommends the voltage measured at the terminal blocks in the shunt-trip solenoid housings not be lower than 38 volts dc for shunt-trip devices rated 48 volts dc or lower than 104 volts dc for shunt-trip devices rated 125 volts dc.

STEP 4. After checking the tripping voltage, it is important not only the temporary jumpers be removed but also the circuit-switcher be operated to the **Open** position to ensure the reclosing of the interrupters before the circuit-switcher is energized.

Make sure none of the three interrupter targets appear yellow after the circuit-switcher is operated to the **Closed** position.

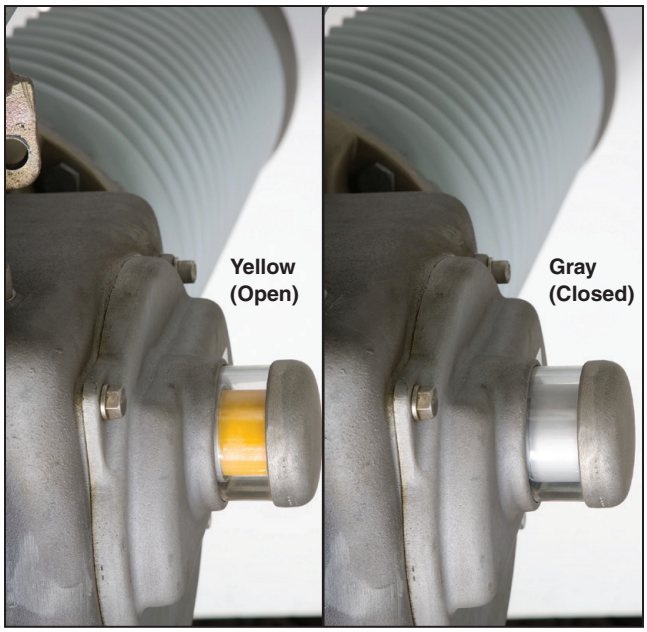


Figure 6. The interrupter target.

● Terminal designations may differ on special wiring diagrams. In such cases, refer to the specific wiring diagram for the correct terminal designations.

To ensure continued proper performance of the shunt trip device, it should be inspected in accordance with S&C's recommended schedule and procedures contained in S&C Instruction Sheet 711-590.