

# Operation

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## Introduction

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### Qualified Persons

#### **WARNING**

Only qualified persons who are knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A qualified person is someone who is 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 your Type SML-4Z and SML-20 Power Fuses. Familiarize yourself with the Safety Information and Safety Precautions on pages 4 through 5. The latest version of this publication is available online in PDF format at [sandc.com/en/support/product-literature/](http://sandc.com/en/support/product-literature/).

### Retain this Instruction Sheet

This instruction sheet is a permanent part of your Type SML-4Z and SML-20 Power Fuses. Designate a location where you can easily retrieve and refer to this publication.

### Proper Application

#### **WARNING**

The equipment in this publication is only intended for a specific fusing applications. The application must be within the ratings furnished for the equipment. Ratings for Type SML-4Z and SML-20 Power Fuses are listed in the ratings table in Specification Bulletin 252-31. The ratings are also on the nameplate affixed to the product.

## Warranty

The warranty and/or obligations described in S&C's Price Sheet 150 "Standard Conditions of Sale-Immediate Purchasers in the United States" (or Price Sheet 153, "Standard Conditions of Sale-Immediate Purchasers Outside the United States"), plus any special warranty provisions, as set forth in the applicable product-line specification bulletin, are exclusive. The remedies provided in the former for breach of these warranties shall constitute the immediate purchaser's or end user's exclusive remedy and a fulfillment of the seller's entire liability. In no event shall the seller's liability to the immediate purchaser or end user exceed the price of the specific product that gives rise to the immediate purchaser's or end user's claim. All other warranties, whether express or implied or arising by operation of law, course of dealing, usage of trade or otherwise, are excluded. The only warranties are those stated in Price Sheet 150 (or Price Sheet 153), and THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY EXPRESS WARRANTY OR OTHER OBLIGATION PROVIDED IN PRICE SHEET 150 (OR PRICE SHEET 153) IS GRANTED ONLY TO THE IMMEDIATE PURCHASER AND END USER, AS DEFINED THEREIN. OTHER THAN AN END USER, NO REMOTE PURCHASER MAY RELY ON ANY AFFIRMATION OF FACT OR PROMISE THAT RELATES TO THE GOODS DESCRIBED HEREIN, ANY DESCRIPTION THAT RELATES TO THE GOODS, OR ANY REMEDIAL PROMISE INCLUDED IN PRICE SHEET 150 (or PRICE SHEET 153.)

## Safety Information

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### Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels and tags attached to your Type SML-4Z and SML-20 Power Fuses. Familiarize yourself with these types of messages and the importance of these various 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 you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C’s website [sandc.com](http://sandc.com), or call the S&C Global Support and Monitoring Center at 1-888-762-1100.

#### **NOTICE**

Read this instruction sheet thoroughly and carefully before installing Type SML-4Z and SML-20 Power Fuses.



### Replacement Instructions and Labels

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

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

**⚠ DANGER**



**Type SML-4Z and SML-20 Power Fuses 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 the S&C Type SM-4Z and SM-5 Power Fuses 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. Always maintain proper clearance from energized components.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, arc-flash clothing, and fall-protection, 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 and tags. Remove tags ONLY if instructed to do so.
5. **ENERGIZED COMPONENTS.** Always consider all parts live until de-energized, tested, and grounded.
6. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components.
7. **Do not leave fuse units installed in the fuse mounting hanging open.** Once closed in, the fuse units will not be damaged by rain or high humidity.
8. **Do not remove the fuse unit from its carton until ready to use.**
9. **Handle fuse units with care.** Do not drop or throw them.
10. **Do not place hand over the upper seal of the fuse unit when handling.** There is the remote possibility the current-responsive section of the fuse unit may have been weakened in shipping or handling. As a result, the spring-loaded actuating pin may be unpredictably released and driven forcibly through the upper seal.
11. **Do not disturb the red cap (rain shield) at the lower end of the fuse unit if the fuse unit is to be installed in an SMD-20 mounting.** If the fuse unit is to be installed in an SM-20, SML-20, or SME-20 mounting, remove the red cap just prior to installing the fuse unit end-fittings.

## Shipping and Handling

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### Inspection

Examine the shipment for external evidence of damage as soon after receipt as possible, preferably before removal from the carrier's conveyance. Check the bill of lading to make sure all listed shipping skids, crates, and containers are present.

If there is visible loss and/or damage:

1. Notify the delivering carrier immediately.
2. Ask for carrier inspection.
3. Note condition of shipment on all copies of the delivery receipt.
4. File a claim with the carrier.

If concealed damage is discovered:

1. Notify the delivering carrier within 15 days of receipt of shipment.
2. Ask for carrier inspection.
3. File a claim with the carrier.

Also, notify S&C Electric Company in all instances of loss and/or damage.

## Application

S&C Power Fuses with Uni-Rupter® Interrupters are designed for the following single-pole live-switching duties in single-phase or three-phase circuits of distribution systems rated 14.4 kV or 25 kV:

### Live Switching—Opening

- **Transformer switching**—Transformer load currents up through 200 amperes, as well as transformer magnetizing currents associated with the applicable loads
- **Line switching**—Load splitting (parallel or loop switching) and load dropping of currents up through 200 amperes; also line dropping (charging currents typical for distribution systems of these voltage ratings)
- **Cable switching**—Load splitting (parallel or loop switching) and load dropping of currents up through 200 amperes; also cable dropping (charging currents typical for distribution systems of these voltage ratings)

### Live Switching—Closing

- **Circuit closing**—Inrush currents associated with the above opening duties
- **Duty-cycle● fault closing**—One-time capability equal to the interrupting rating of the fuse (in amperes RMS asymmetrical):
  - For the SML-20 fuse—22,400 at 14.4 kV; 20,000 at 25 kV
  - For the SML-4Z fuse—20,000 at 14.4 kV; 15,000■ at 25 kV

And two-time capability of 13,000 amperes RMS asymmetrical at 14.4 kV and 25 kV

### A Note on Single-Pole Switching

In single-pole switching of ungrounded-primary three-phase transformers or banks (or single-phase transformers connected line to line), circuit connections or parameters may, in many cases, produce excessive overvoltages. In particular, for the following applications above 22 kV, single-pole switching by any means—including with a Uni-Rupter Interrupter—should be performed only under the conditions stated in italics:

- Switching unloaded or lightly loaded delta-connected or ungrounded primary wye-wye connected three-phase transformers or banks (or line-to-line connected single-phase transformers), rated 150 kVA or less three-phase, or 50 kVA or less single-phase—or of any kVA rating when combined with unloaded cables or lines—where maximum system operating voltage exceeds 22 kV (*Single-pole switching should be performed only if each phase is carrying 5% load or more, or if the transformer or bank is temporarily grounded at the primary neutral during switching.*)
- Switching loaded or unloaded ungrounded-primary wye-delta connected three-phase transformers or banks—alone or combined with unloaded cables or lines—where maximum system operating voltage exceeds 22 kV (*Single-pole switching should be performed only if each phase is carrying 5% load or more and if the lighting-load phase is always switched open first (or switched closed last), or if the transformer or bank is temporarily grounded at the primary neutral during switching.*)

● These values represent the fault-closing capabilities of the fuse with a Uni-Rupter Interrupter when the fuse is closed with a purposeful thrust without hesitation. The values are the available fault currents into which the fuse can be closed the specified number of times (once or twice) with the Uni-Rupter Interrupter remaining operable and able to carry and interrupt rated current.

■ 20,000 amperes RMS asymmetrical when applied on solidly grounded-neutral systems only with fuses connected by single-conductor, concentric-neutral type cable (or directly coupled) to a transformer or transformers.

### Preparatory Procedures

All Type SML Power Fuses feature a Uni-Rupter® Interrupter that provides 200-ampere single-pole switching of single-phase and three-phase circuits (of systems where line-to-line voltage does not exceed 27 kV).

#### **Uni-Rupter Interrupter**

The Uni-Rupter Interrupter offers the ultimate in circuit-interrupting simplicity: a firm, steady opening pull on the fuse with a hookstick provides direct-drive quick-break action of the Uni-Rupter Interrupter's internal moving contact through the arc-extinguishing chamber. Circuit interruption is accomplished by the deionizing gases generated by the thermal reaction of the arc on S&C's uniquely formulated chamber liner and moving-contact trailer—there is no external arc or flame. After circuit interruption, a Uni-Rupter Interrupter automatically self-resets for the next opening operation. Only a swift, nonhesitating stroke with a hookstick is required for circuit closing. The Uni-Rupter Interrupter fault-closing contacts and the fuse hinge provide a positive self-guiding action for the fuse.

#### **S&C Type SML-20 Power Fuse**

In addition to the Uni-Rupter Interrupter, Type SML-20 Power Fuse features fuse unit end-fittings, including S&C's Silencer exhaust control device that virtually eliminates venting, and an SMU-20® Fuse Unit, which is replaced after the fuse operates. See Figure 1 on page 9.

The upper end-fitting features a brilliant-red blown-fuse target that projects from the top of the upper end-fitting when the fuse unit has operated, making it easy to check the fuse condition with the fuse in the **Closed** position. The blown-fuse target retracts within the end-fitting when the blown fuse unit is replaced.

### NOTICE

The current-design upper end-fitting for use in Type SML-20 Power Fuses uses a free-floating blown-fuse target that can move (by force of gravity) into the **Blown Fuse** position should the fuse unit be inverted during handling. The fuse condition can be verified by returning the fuse unit to the **Upright** position. If the fuse unit is blown, the target will remain in the extended (projecting) position.

Type SMU-20 Fuse Units are expendable and inexpensive; they are the only item that needs to be replaced after a fuse operation, thus minimizing fuse-replacement costs. The fuse unit consists essentially of a fusible element, an arcing rod, and a solid-material arc-extinguishing medium contained within a filament-wound glass-epoxy tube. SMU-20 Fuse Units are offered in four time-current characteristics: the S&C "K" Speed, S&C Standard Speed, S&C Slow Speed, and S&C Very Slow Speed. These fuse units are available in ratings through 200K or 200E amperes. (Switch blades, rated 200 amperes continuous, are available for use in lieu of an SMU-20 Fuse Unit with end-fittings.)

#### **SML-4Z Power Fuses**

In addition to the Uni-Rupter Interrupter, Type SML-4Z Power Fuses feature a fuse holder including S&C's Silencer exhaust control device that virtually eliminates venting, and an SM-4® Refill Unit, which is replaced after the fuse operates. See Figure 2 on page 10.

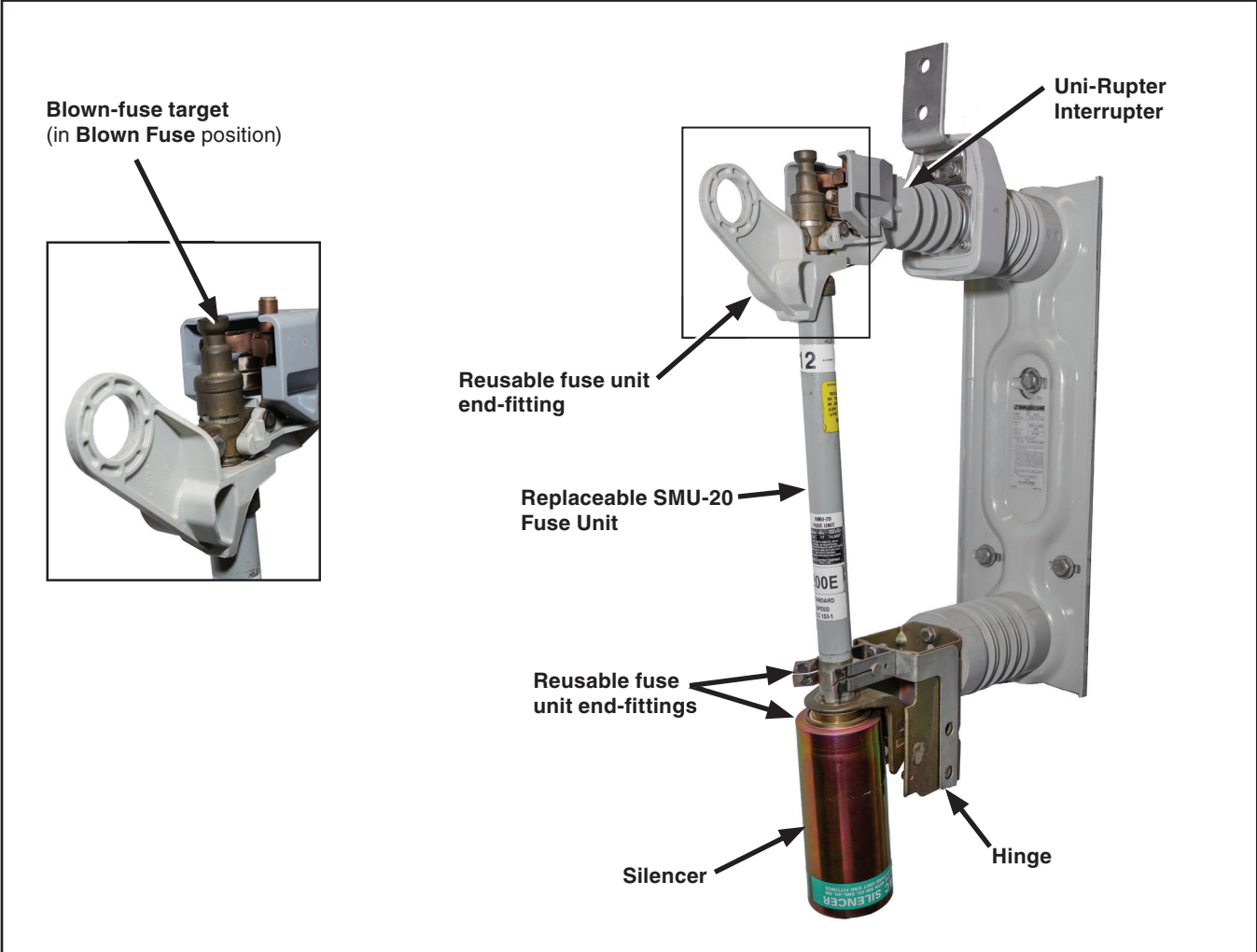


Figure 1. A Type SML-20 Power Fuse.

## Construction and Performance

The SML-4Z Holder incorporates a spring-and-cable assembly that provides high-speed elongation of the arc during a fault interruption. The holder features a fluorescent fire-orange target on the spring-and-cable assembly, visible through the translucent glass-epoxy fuse tube, that moves to the **Blown** indicator window when the fuse operates, permitting a positive visual check of fuse condition without removing the fuse from the mounting. The target fluoresces in the dark when illuminated with a flashlight. (Switch blades, rated 200 amperes continuous, are available for use in lieu of fuse holders.)

SM-4 Refill Units are expendable and inexpensive; they are the only item that needs to be replaced after a fuse operation, thus minimizing fuse replacement costs. The refill unit consists essentially of a fusible element, arcing rods, and a solid-material arc-extinguishing medium contained within a filament-wound glass-epoxy tube. SM-4 Refill Units are offered in two time-current characteristics: S&C Standard Speed and S&C Slow Speed. These refill units are available in ratings of 1 through 200E amperes.

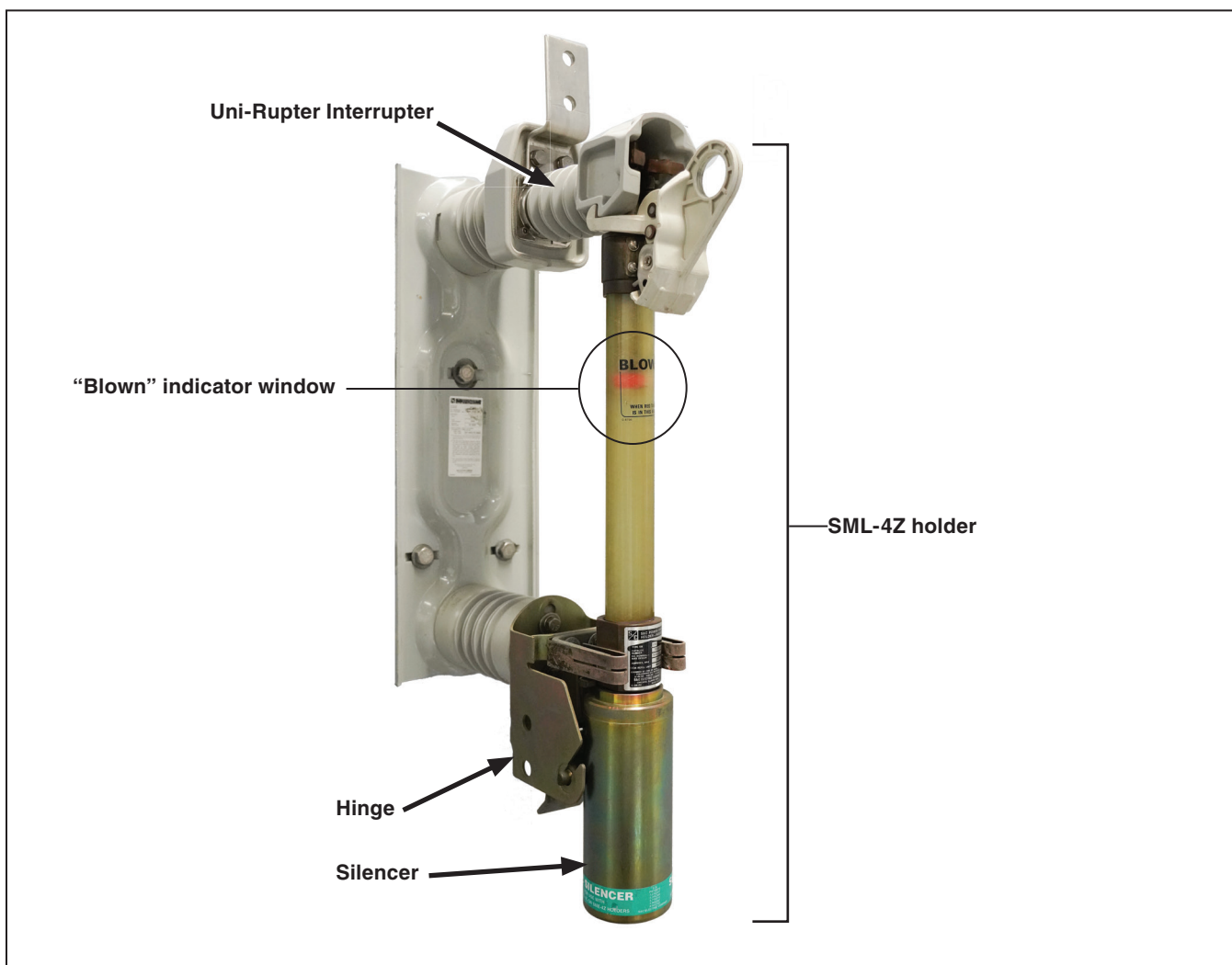


Figure 2. A Type SML-4Z Power Fuse.

The functional performance and live-switching capability of a Uni-Rupter Interrupter are described on page 8. Operate a Uni-Rupter Interrupter as follows, using a universal pole equipped with an S&C Grappler™ Handling Tool (catalog number 4423).■

## Opening

**STEP 1.** With the Grappler tool's prongs pointed downward, insert the longest prong in the pull-ring of the fuse. See Figure 3.▲

**STEP 2.** Pull the fuse vigorously through its full travel without hesitation at any point. A downward force should be maintained on the universal pole through the fuse-opening operation to counteract any tendency the fuse may have to bounce toward the **Closed** position.

**Note:** The Uni-Rupter Interrupter is designed to require a hard pull to unlatch the fuse, thus reducing the possibility of an incomplete opening operation.

**STEP 3.** Remove the Grappler tool from the fuse pull-ring.

### NOTICE

Although a fuse in the fully **Open** position provides visual evidence of an open circuit, it does not necessarily mean either the Uni-Rupter Interrupter, the load-side hinge, or the fuse is de-energized.

Using the universal pole with the S&C Grappler Handling Tool, remove the fuse from its hinge as follows:

**STEP 4.** Using proper hand protection, grasp the universal pole with both hands approximately 2 feet (61 cm) apart, with one hand at the end of the pole opposite from the Grappler tool.

**STEP 5.** Position the Grappler tool's cone in the fuse pull-ring and cradle the fuse in the Grappler tool's prongs. See Figure 4.

● A 1½-inch (31-mm) universal pole, at least 6 feet (183 cm) long, is recommended (S&C catalog number 4202R2-E or equivalent).

■ Use of other handling tools, such as a shotgun stick, is not recommended.

▲ Although the operations as described in this section refer simply to “fuses,” the procedures apply to Type SML-20 and SML-4Z Power Fuses.



Figure 3. A Grappler tool, as positioned for an opening (or closing) stroke, with the longer prong inserted in the fuse pull-ring.



Figure 4. A Grappler tool positioned for fuse removal.

## Switching with a Uni-Rupter® Interrupter

**STEP 6.** Stand in a normal, upright position facing the universal pole. Move the pole forward until resistance between the Grappler tool and the fuse is felt, or approximately 2 inches (51 mm). Then, remove the fuse from its hinge with a *forward and upward* lifting motion. See Figure 5.

### Closing

**STEP 1.** To insert the fuse in its hinge, position the Grappler tool's cone in the fuse pull-ring and cradle the fuse in the Grappler tool's prongs. Using proper hand protection, grasp the universal pole with both hands approximately 2 feet (61 cm) apart, with one hand at the end of the pole opposite from the Grappler tool. Lift the fuse and lower it into its hinge. See Figure 5. Make sure the fuse is seated securely in the hinge. Then, disengage the Grappler tool from the fuse.

#### **⚠ WARNING**

Because there is always the possibility of closing the fuse into a faulted circuit, and because the closing operation is completely operator dependent (with no assist from a quick-make mechanism), the closing operation must be accomplished as described in this section. When so operated, the Uni-Rupter Interrupter associated with the fuse is capable of closing into a fault current at the rated value the specified number of times (once or twice), remaining operable and able to carry *and interrupt* rated current.

**STEP 2.** With the Grappler tool's prongs pointed downward, insert the longest prong in the pull-ring of the fuse. Then, with one's face turned away, close the fuse with a swift, nonhesitating stroke. See Figure 6.

Release the Grappler tool from the pull-ring. Use the Grappler tool to push against the fuse to make sure complete fuse closure is attained.



Figure 5. Installing (or removing) fuse using Grappler.



Figure 6. Closing the fuse.

### **Preparatory Procedures**

Observing the precautions described in the “Safety Precautions” section on page 5, open the switchgear door to gain access to the fuse(s).

### **Installing the Fuse Unit or Refill Unit**

Complete instructions for insertion of new SMU-20 Fuse Units into their end-fittings and for insertion of new SM-4 Refill Units into their holders are described in the instruction sheet furnished with each fuse unit or refill unit.

### **Installing the Fuse in its Mounting**

Follow the instructions found in the “Closing” section on page 12, and observe the precautions described in the “Safety Precautions” section on page 5.

### How to Detect a Blown Fuse

From a safe distance, observe the blown-fuse target for the fuse type furnished:

- **SML-4Z Power Fuse**—A fluorescent fire-orange target in the translucent SML-4Z Holder moves to the **Blown** indicator window when the fuse operates, permitting a positive visual check of the fuse condition without removing the fuse from its mounting. The target fluoresces at night when illuminated with a flashlight.
- **SML-20 Power Fuse**—A brilliant-red blown-fuse target projects from the top of the SML-20 Power Fuse upper end-fitting when the fuse unit has operated, making it easy to check the fuse condition with the fuse in the **Closed** position. The blown-fuse target retracts within the end-fitting when the blown fuse unit is replaced.

**Note On Handling:** The existing-design upper end-fitting for use in SML-20 Power Fuses uses a free-floating blown-fuse target that can move (by force of gravity) into the **Blown Fuse** position should the fuse unit be inverted during handling. Fuse condition can be verified by returning the fuse unit to the **Upright** position. If the fuse unit is blown, the target will remain in the extended (projecting) position.

### Removing the Fuse from the Mounting

Follow the instructions found in the “Opening” section on pages 11 and 12, observing the precautions in the “Safety Precautions” section on page 5.

### Replacing the Fuse Unit or Refill Unit

Complete instructions for insertion of new SMU-20 Fuse Units into their end-fittings and for insertion of new SM-4 Refill Units into their holders are described in the instruction sheet furnished with each fuse unit or refill unit.

### Installing the Fuse in the Mounting

Follow the instructions found in the “Closing” section on page 12, observing the precautions in the “Safety Precautions” section on page 5.