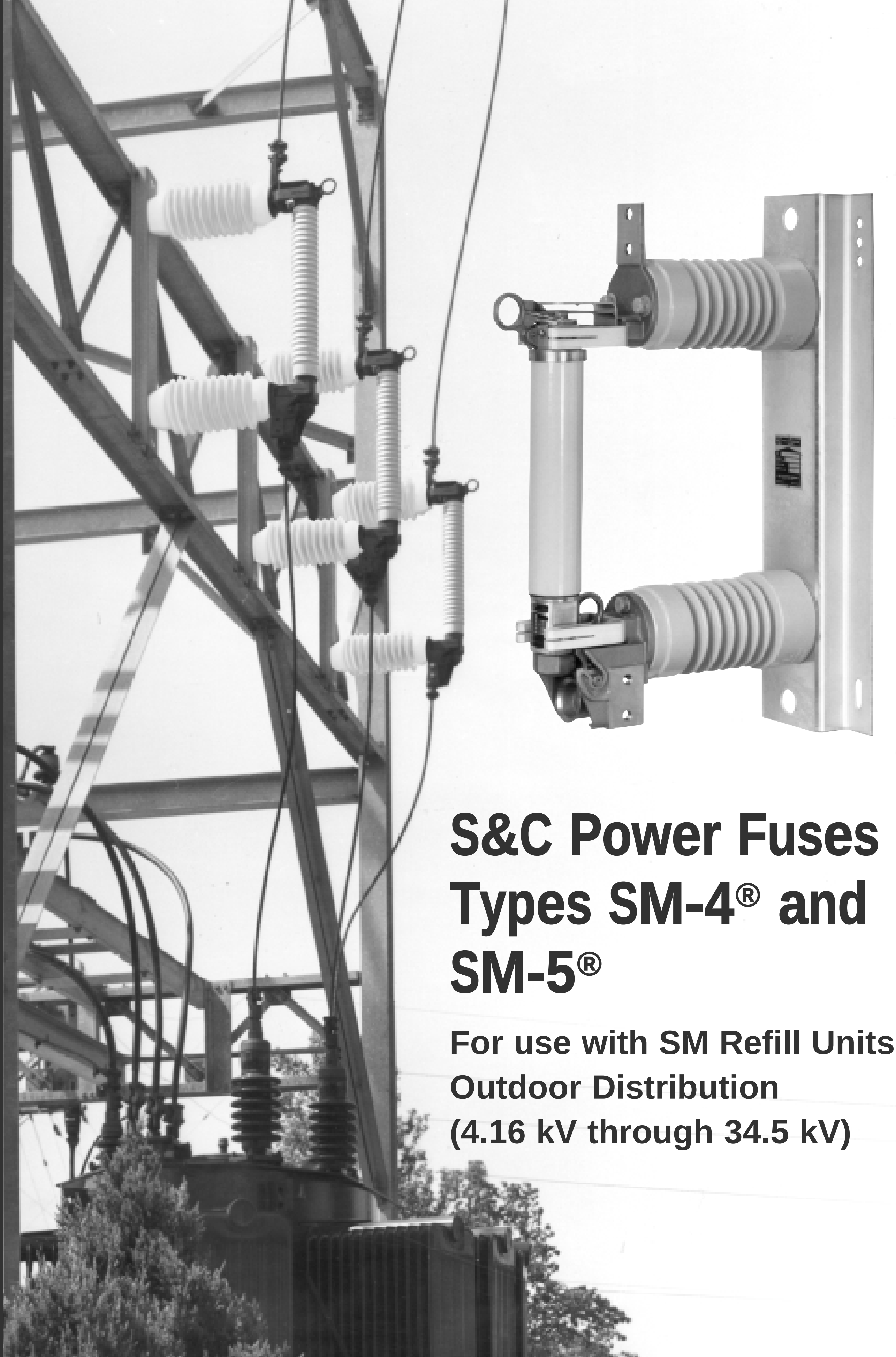


S&C Power Fuses Types SM-4® and SM-5®

For use with SM Refill Units
Outdoor Distribution
(4.16 kV through 34.5 kV)

Supersedes Descriptive Bulletin 242-30 dated 7-12-93

S&C ELECTRIC COMPANY

APPLICATION

Type SM Power Fuses Set the Standard for System and Equipment Protection

S&C Power Fuses—Type SM are especially suited for protecting transformers, capacitor banks, and cables in outdoor distribution substations on systems rated up through 34.5 kV. They offer the superior performance characteristics and reliability required to provide twofold protection—protection for the system upstream, and protection for downstream equipment. Like other S&C power fuses, these fuses incorporate precision-engineered nondamageable silver or nickel-chrome fusible elements. Consequently, the time-current characteristics are precise and permanently accurate—assuring not only reliable and predictable performance, but also the continued integrity of carefully engineered system coordination plans. The precise time-current characteristics and nondamageability of these power fuses permit upstream protective devices to be set for faster operation than may be practical with other fuses or power circuit breakers. . . providing better system protection without compromising coordination.

Type SM Power Fuses are offered with maximum continuous current ratings of 200, 300, 400, and 720 amperes . . . and are available with fault-interrupting ratings from 28,000 amperes RMS asymmetrical at 34.5 kV to 60,000 amperes RMS asymmetrical at 4.16 kV. These power fuses are available in a variety of ampere ratings as well, and in three different speeds: S&C Standard, Slow, and Coordinating. The broad selection of available ampere ratings and speeds permits close fusing to achieve maximum protection and optimum coordination.

Type SM Power Fuses may be operated (i.e., opened or closed when not carrying load) using a hookstick or a universal pole equipped with a variety of fuse-handling fittings. The SM-4 Power Fuse in the Disconnect Vertical Style is available with an optional Loadbuster® attachment hook for full-load switching at full voltage. And, for convenience in fitting station layouts, Type SM Power Fuses are offered in three mounting configurations, as illustrated on pages 12 through 14.

Type SM Power Fuses are offered with a choice of Cypoxy® or porcelain station post insulators. Cypoxy is the S&C trademark for S&C's cycloaliphatic epoxy resin system. Cypoxy station post insulators are nontracking, self-scouring, nonweathering, and meet or exceed the electrical and mechanical-strength requirements established in ANSI standard C29.9 (1983) for porcelain standard-strength station post insulators.

Transformer Protection with Type SM Power Fuses

The unique solid-material technique of fault interruption within the refill unit of the Type SM Power Fuse provides *full-fault-spectrum* protection. In protecting single transformers, *full-fault-spectrum* protection means that the fuses will detect and interrupt all faults—large, medium, and small (even down to minimum melting current); whether the fault is on the primary or secondary side; with line-to-line or line-to-ground voltage across the fuse; whether the transformer is adjacent to the fuse or cable-connected to it from a remote location; and regardless of transformer winding connections. SM Power Fuses are capable of handling the full range of transient recovery voltages associated with these conditions. And they develop a positive internal gap of high dielectric strength after circuit interruption, thus precluding destructive reignitions when exposed to full system voltage—such as are experienced with current-limiting fuses after clearing under low recovery-voltage conditions.

The close fusing necessary to provide superior protection for secondary-side faults is possible with SM Power Fuses because: they utilize silver or pretensioned nickel-chrome fusible elements that are not damaged by transient surges that may heat the element nearly to the severing point; they are available in a variety of speeds that provide time-current characteristics especially suited to protecting transformers for very low-magnitude fault currents; and because they possess substantial overload capabilities and surge capacity more than adequate to withstand transformer magnetizing-inrush currents as well as severe hot- and cold-load pickup currents. Close fusing with SM Power Fuses, coupled with the exceptional low-current fault-interrupting performance, assures maximum protection for the transformer for a broad range of secondary-side fault currents, thus minimizing the life-shortening thermal and mechanical stresses associated with prolonged transformer through-faults.

Superior to Current-Limiting Fuses

Type SM Power Fuses have helically coiled silver fusible elements that are of solderless construction and are surrounded by air. Because of this construction, the fusible element is free from mechanical and thermal stress and confining support, and therefore is not subject to damage—even by inrush currents that approach but do not exceed the fuse's minimum melting time-current characteristic curve. Current-limiting fuses, in contrast, have fusible elements which consist of a number of very fine diameter wires, or one or more perforated or notched ribbons, surrounded by, and in contact with, a filler material such as silica sand. Because of this construction, current-limiting fuses are susceptible to element damage caused by current surges that approach the fuse's minimum melting time-current characteristic curve. This damage may occur in one or more of the following ways:

- The fusible element may melt, but not completely separate because the molten metal is constrained by the filler material—resulting, possibly, in resolidification of the element with a different cross-sectional area.
- One or more, but not all, of the parallel wires or ribbons of the fusible element may melt and separate.
- The fusible element may break as a result of fatigue brought about by current-cycling that can cause localized buckling from thermal expansion and contraction.

Damage to fusible elements of current-limiting fuses, as described above, may shift or alter their time-current characteristics, resulting in a loss of complete coordination between the fuse and other downstream overcurrent protective devices. Moreover, a damage current-limiting fuse element may melt due to an otherwise harmless inrush current, but the fuse may fail to clear the circuit due to insufficient power flow—with the fuse continuing to arc and burn internally due to load-current flow.

Because of the potential for damage to the fusible element from inrush currents, and because of the effects of loading and manufacturing tolerances, current-limiting fuse manufacturers typically require that, when applying such fuses, adjustments be made to the minimum melting time-current characteristic curves. These adjustments are referred to as "safety zones" or "setback allowances," and range from 25% in terms of *time* to 25% in terms of *current*. The latter can result in an adjustment of 250% or more in terms of time, depending on the slope of the time-current characteristic curve at the point where the safety zone or setback allowance is measured.

Furthermore, most current-limiting fuses inherently have steep, relatively straight time-current characteristic curves which, together with the required large safety-zone or setback-allowance adjustments, force the selection of a current-limiting fuse ampere rating substantially greater than the transformer full-load current in order to withstand combined transformer-magnetizing and load inrush currents, and also to coordinate with secondary-side protective devices. The selection of such large fuse ampere ratings results in reduced protection for the transformer and possible impairment of coordination with upstream protective devices. Also, since high-ampere-rated current-limiting fuses typically require the use of two or three lower-ampere-rated fuses connected in parallel, increased cost and space requirements may be encountered.

Because S&C's solid-material power fuses incorporate fusible elements that are nondamageable, there's no need for "safety zones" or "setback allowances" . . . allowing closer fusing than is possible with other fuses. They are thus better able to protect the transformer against damage due to faults between the transformer and the secondary-side protective device, and furthermore, to supply backup protection in the event of incorrect functioning of the secondary-side protective device. In addition, the ability to fuse closer to the transformer full-load current facilitates coordination with upstream protective devices by allowing them to have lower ampere ratings and/or settings for faster response.

Another *plus* for Type SM Power Fuses derives from the fact that they are not "voltage critical," and therefore may be applied at any system voltage equal to or less than the rated voltage of the fuse. Current-limiting fuses, in contrast, can be applied only at system voltages between 70% and 100% of the nameplate rating. Moreover, current-limiting fuses will often produce severe voltage surges during circuit interruption that can cause spurious operation—or even destruction—of surge arresters or failure of transformer insulation.

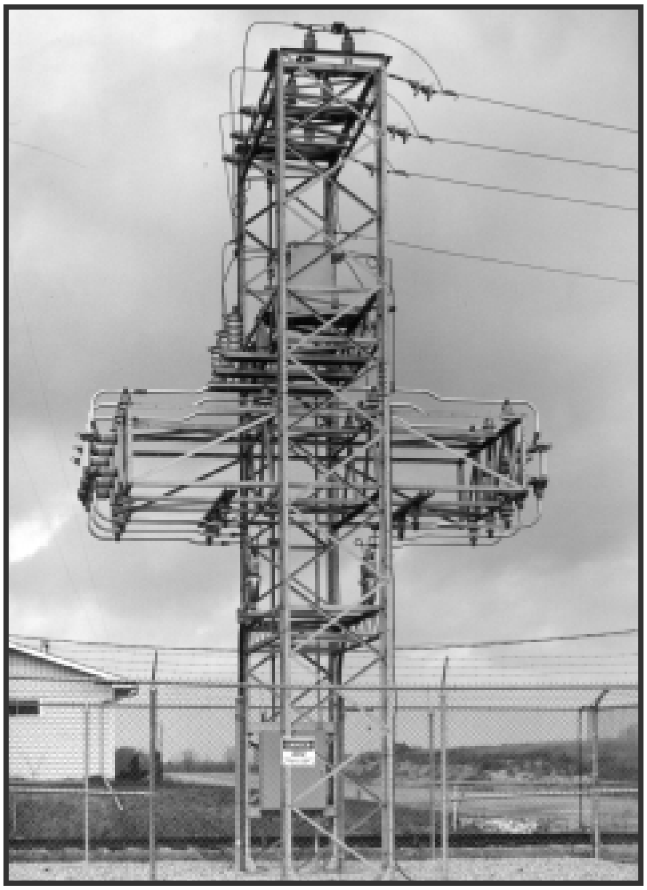
Cable Protection with Type SM Power Fuses

An important consideration in planning underground distribution systems is the protection of insulated cables. The primary concern in establishing such protection is to prevent the conductor temperature rise under short-circuit conditions from exceeding the maximum allowable temperature limits specified for the conductor insulation. This type of protection can be achieved by careful selection of the conductor size and material, as well as by careful selection of the types and characteristics of the upstream protective devices. There is no need for upstream protective devices to provide *overload* protection for medium-voltage cables, since the cable sizes are typically selected to carry the maximum anticipated level of overload current on a continuous basis.

S&C Type SM Power Fuses located on riser poles or at cable-feeder terminations in distribution substations provide excellent protection for insulated cables because they are extremely fast operating, and because they are offered in a wide selection of ampere ratings and permanently accurate and precise time-current characteristics . . . with these attendant benefits:

- The conductor temperature rise following a fault is minimized due to the fast operation of the fuse, permitting the use of conductors one or more sizes smaller than those required by slower operating circuit breakers—resulting in considerable savings; and
- The upstream protective device can be set to operate faster while still coordinating with the Type SM Power Fuse. Also, Type SM Power Fuses provide selective isolation of only faulted phases of three-phase feeders serving single-phase loads, unlike the undiscriminating operation of circuit breakers which remove all three phases from the system—even on single-phase faults.

Circuit breakers (and their associated relays) are commonly used where the reclosing capability of the circuit breaker is an advantage, such as applications involving



overhead lines which have a relatively high incidence of transient or temporary faults. This reclosing feature is neither useful nor desirable, however, on underground cable distribution systems where the conductors are direct buried or enclosed in conduit. The incidence of faults on these systems is low, and the rare faults that do occur are not transient and result in significant damage that would only be compounded by an automatic reclosing operation.

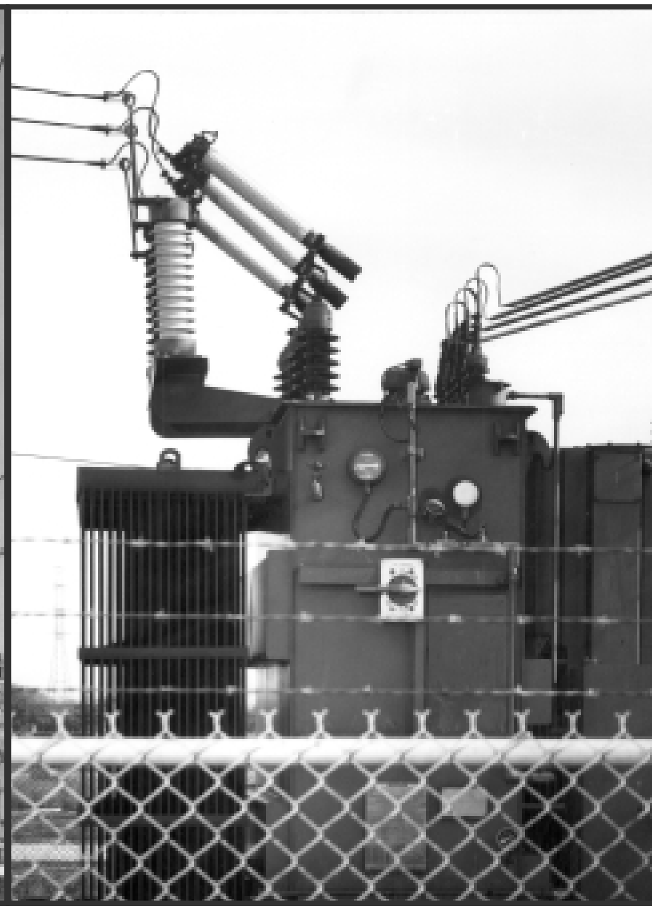
Capacitor Bank Protection with Type SM Power Fuses

In addition to transformer and cable protection, Type SM Power Fuses are suitable for group fusing of station capacitor banks, particularly where available fault currents are high. These power fuses have a substantial continuous peak-load capability which permits the use of smaller ampere ratings than would be possible with distribution fuse links, other makes of power fuses, or current-limiting fuses—and without risking nuisance fuse operations ("sneakouts") due to capacitor bank inrush or outrush currents. This close fusing with SM Power Fuses ensures rapid isolation of faulted capacitor banks, protecting the system from unnecessary outages.

Other Application Considerations

The discharge of Type SM Power Fuses is nonconducting—unlike the highly ionized blast of expulsion-type fuses that use fiber-lined fuse tubes. Consequently, it is possible to make use of standard electrical clearances to ground and between adjacent phases . . . a definite *plus* for many station applications where space may be at a premium. (For recommended mounting clearances, refer to the appropriate S&C Data Bulletin.) Moreover, because of the selection of mounting configurations, diverse station layouts can be accommodated using SM Power Fuses.

For additional detailed application recommendations and technical information, including minimum melting and total clearing time-current characteristics, preloading and ambient temperature adjustment factors, and loading capabilities, consult your nearest S&C fusing specialist.



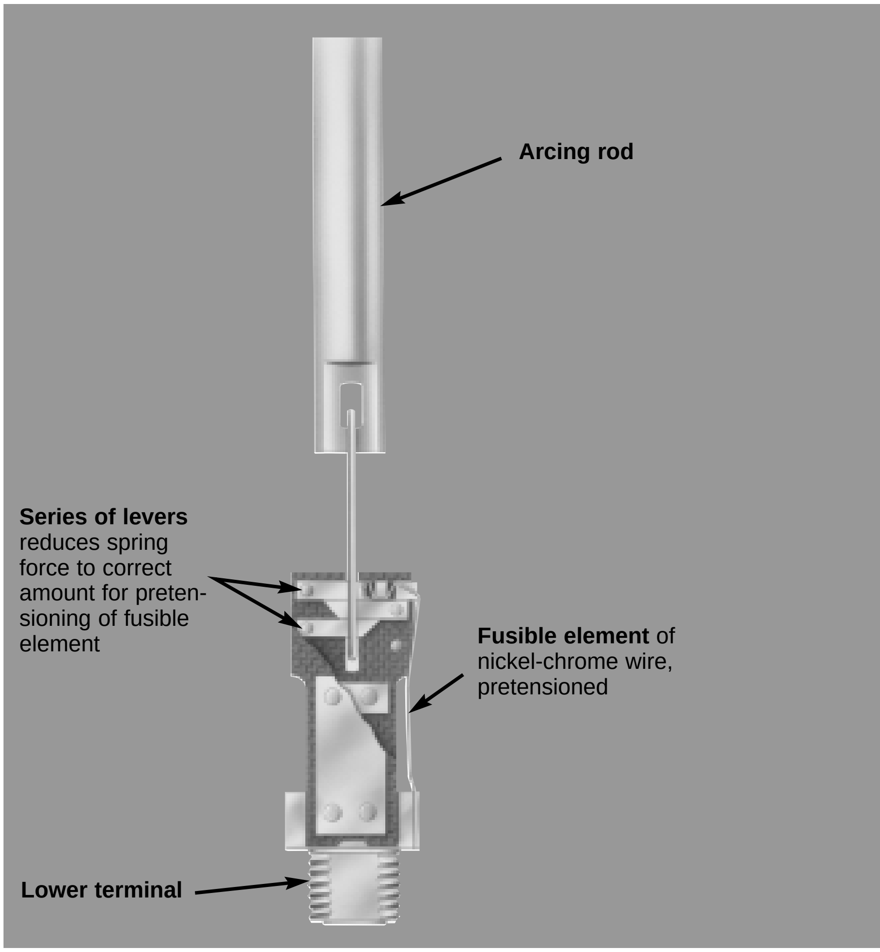
CONSTRUCTION AND OPERATION

The Fusible Element

S&C Type SM Power Fuses possess the performance characteristics and quality that make them especially suitable for fault protection on 4.16-kV through 34.5-kV distribution systems. The fuses are available in a wide variety of ampere ratings and time-current characteristics, permitting close fusing to achieve maximum protection and optimum coordination. The initial and sustained accuracy of their melting time-current characteristics assures that these fuses can be depended upon to operate exactly when they should and—equally important—not to operate when they shouldn't. This permanent accuracy is achieved principally in the design and construction of the fusible element.

Nondamageable Construction

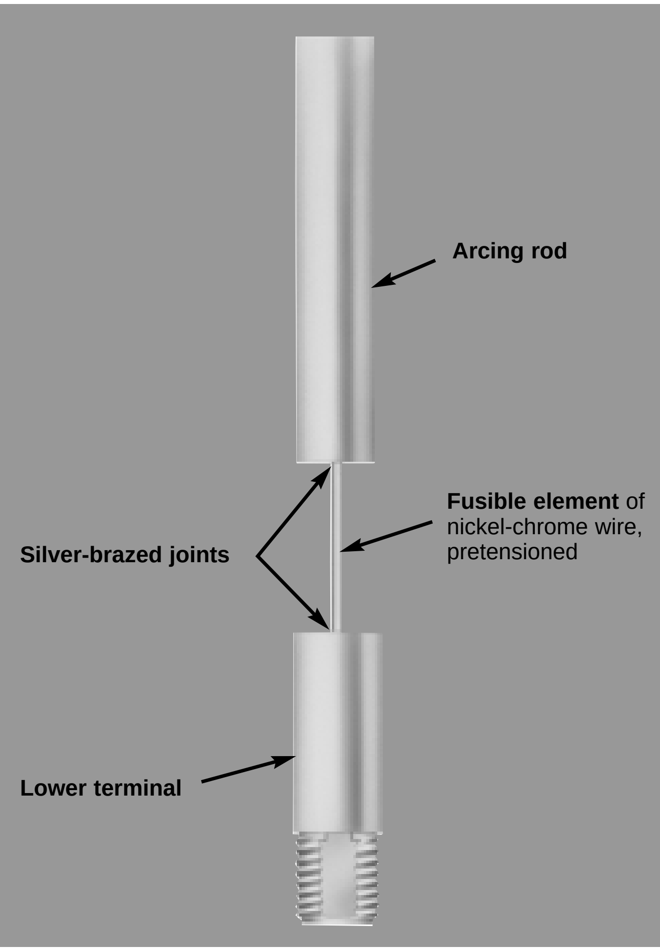
S&C Power Fuses have silver or pretensioned nickel-chrome elements with these characteristics: (1) they are drawn through precision dies to very accurate diameters, and (2) they are of solderless construction, brazed into their terminals. Their melting time-current characteristics are precise, with only 10% total tolerance in melting current, compared to the 20% tolerance of many fuses (20% and 40% respectively, in terms of time). And their design and construction features assure that they will conform to their time-current characteristics not only initially, but on a sustained basis . . . neither age, corrosion, or vibration, nor surges that heat the element nearly to the severing point, will affect the characteristics of S&C Power Fuses.



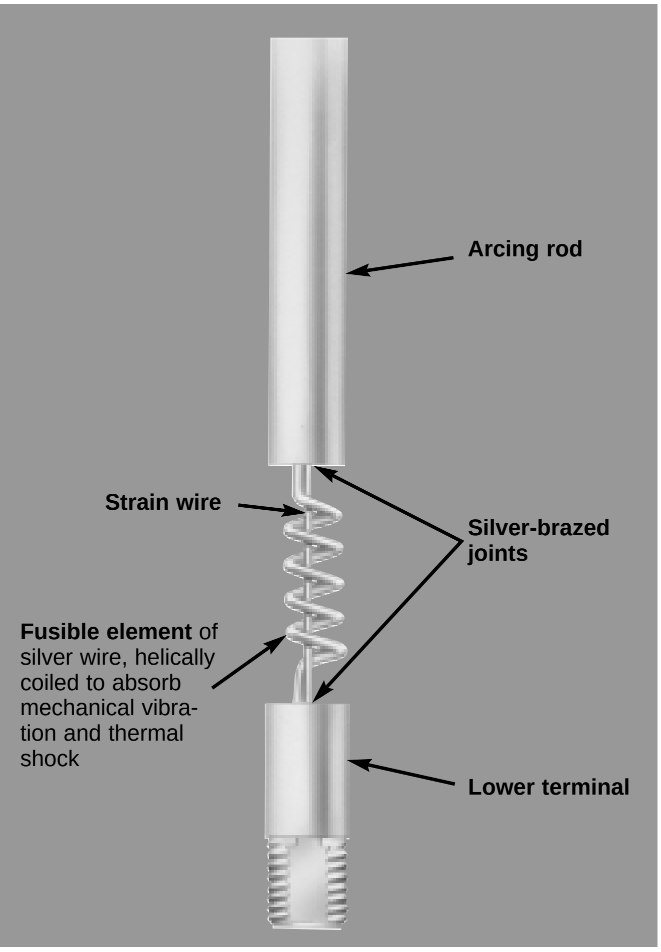
Nondamageable low-current, nickel-chrome fusible element for SM Refill Units rated 1, 2, and 3E amperes. In these ratings, the nickel-chrome wire is too fine to withstand the full force of the spring. An assembly of levers in effect multiplies the tensile strength of the wire to permit the desired pretensioning without jeopardizing the security of the fusible element.

The construction features illustrated below make S&C fusible elements *nondamageable* with these advantages:

1. Superior transformer protection. SM Power Fuses make it possible to fuse close to the transformer full-load current, thus providing protection against a broad range of secondary-side faults.
2. Higher levels of service continuity. “Sneakouts” (unnecessary fuse operations) are eliminated.
3. Close coordination with other overcurrent protective devices . . . attainable because of the initial and sustained precision of the fusible elements, and because no “safety zones” or “setback allowances” need be applied to the published time-current characteristics to protect the element against damage.
4. Operating economies. There is no need to replace unblown companion fuses on suspicion of damage following a fuse operation.



Nondamageable nickel-chrome fusible element for SM Refill Units rated 5E and 7E amperes. When called upon to operate, the pretensioned nickel-chrome wire weakens abruptly and separates before its cross-section changes.



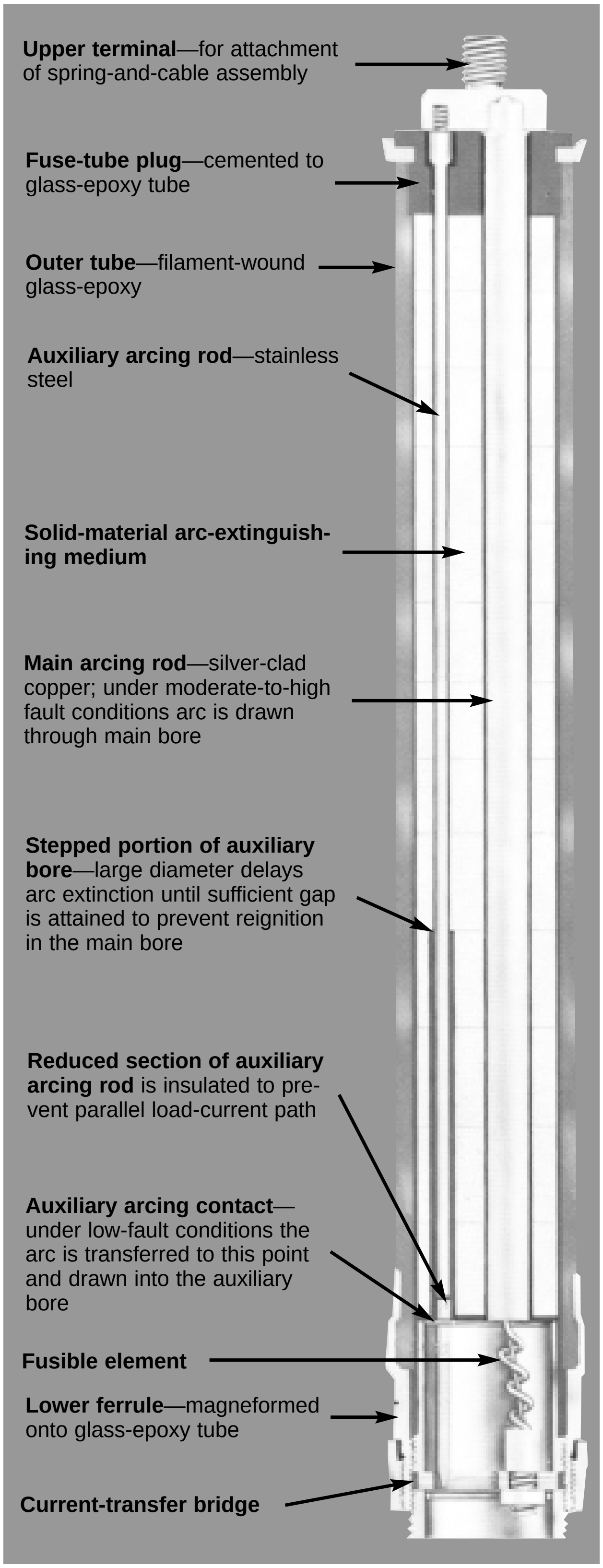
Nondamageable silver fusible element for SM Refill Units rated 10E amperes and larger. These ratings employ the silver-fusible-element, strain-wire construction, which is not damaged by overloads or transient faults approaching the minimum melting current.

The Refill Unit

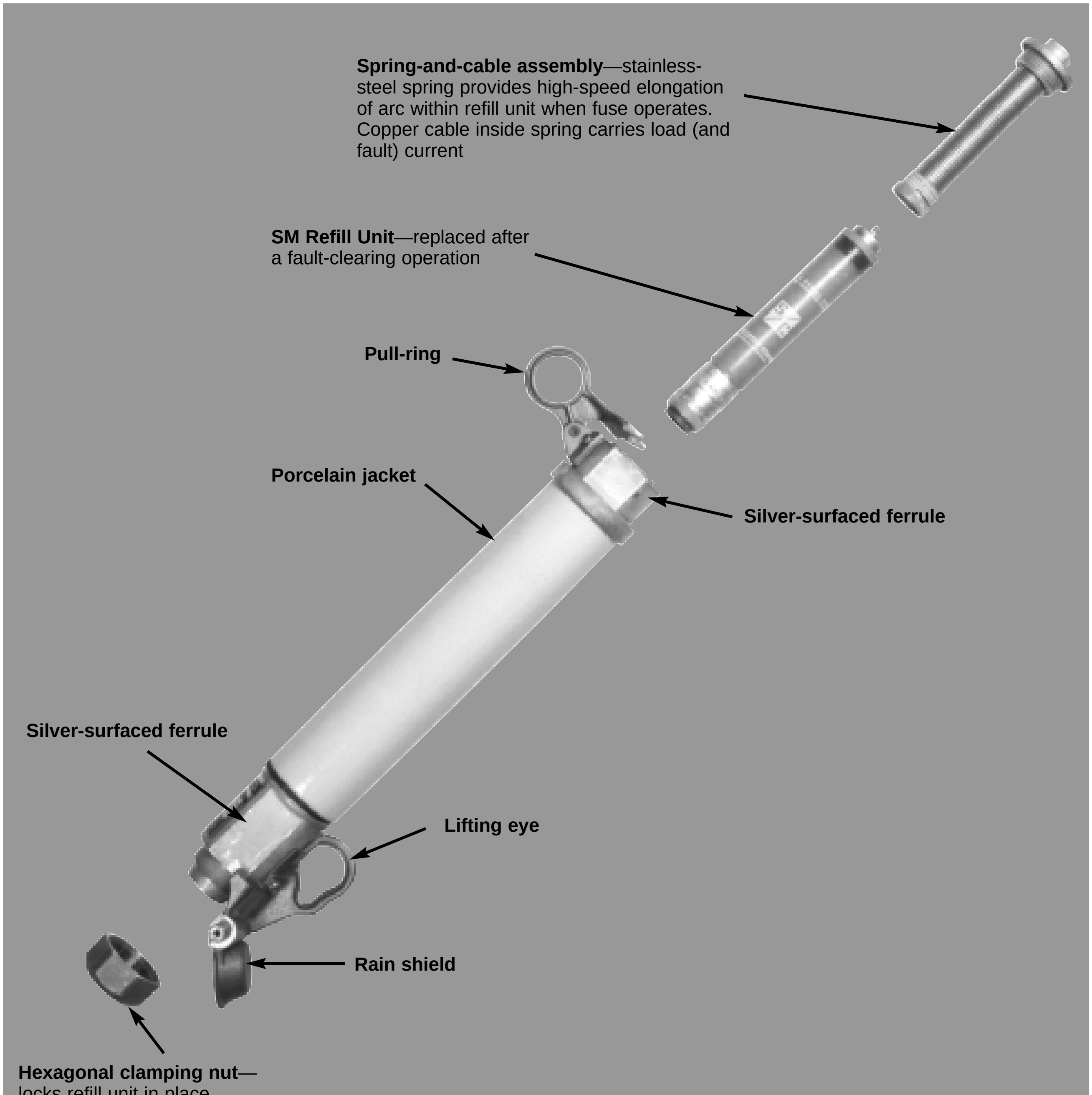
The refill unit consists of a fusible element, arcing rods, and a solid-material arc-extinguishing medium contained within a filament-wound glass-epoxy tube.

The fusible element is connected at one end—through a current-transfer bridge—to the refill unit lower ferrule. At the other end, the fusible element is connected to the main arcing rod, which extends upward through the main bore of the refill unit to the upper terminal.

The auxiliary arcing rod, of stainless steel, is threaded into the upper terminal and extends downward through a small-diameter stepped bore and through an opening in the current-transfer bridge. No load current is carried by this auxiliary rod since, at its small-diameter section, it is insulated from the auxiliary arcing contact.



Refill Unit and Holder Assembly



SM-4 Holder①

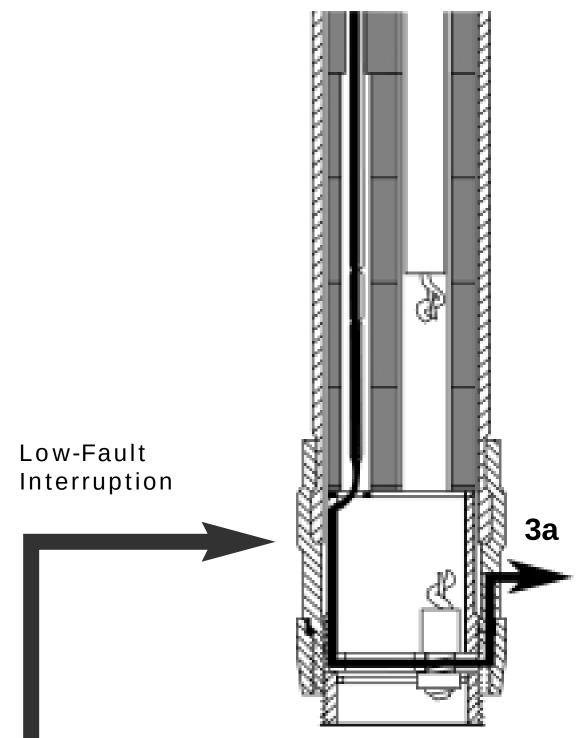
① SM-5 Holders are similar.

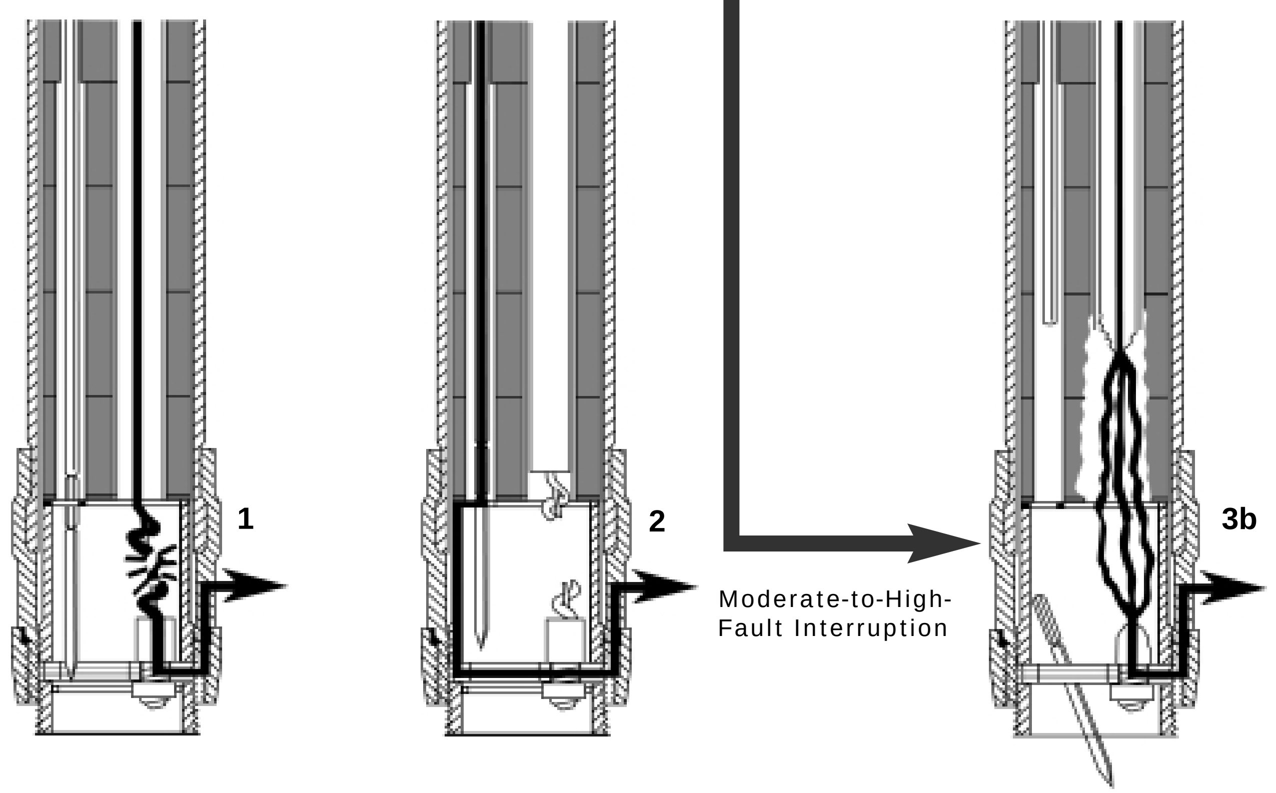
Fault Interruption in SM Refill Units

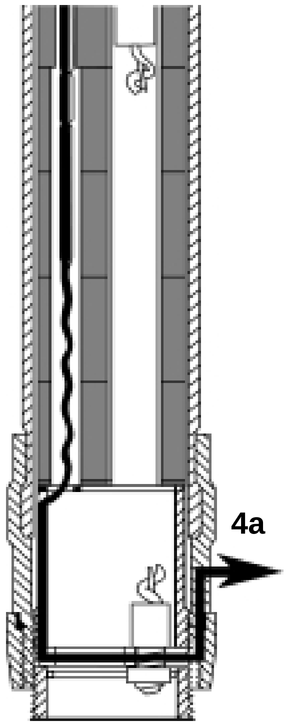
Fast, positive fault interruption is achieved in the SM Power Fuse refill unit—after the fusible element melts—by the high-speed elongation of the arc within one of the two bores, and by the efficient deionizing action of the gases liberated from the solid-material arc-extinguishing medium. Elongation of the arc is accomplished by the action of the spring-and-cable assembly housed within the holder. The illustrations which follow show how the arc is channeled into the bore better suited for interruption of the particular magnitude of fault.

The main bore is sized to accommodate the arc (and gas generation) associated with faults ranging from 1,000 to 60,000 amperes. For faults of 1,000 amperes or less, the small-diameter auxiliary bore provides intimate contact between the arc and the arc-extinguishing medium, to ensure positive arc extinction.

Regardless of fault level, the high rate of dielectric recovery more than matches the transient-recovery-voltage severity of any circuit where the SM is applied.







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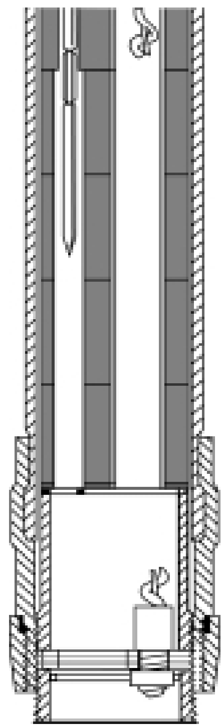

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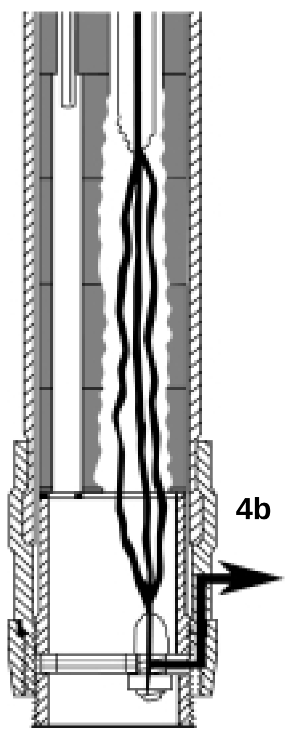
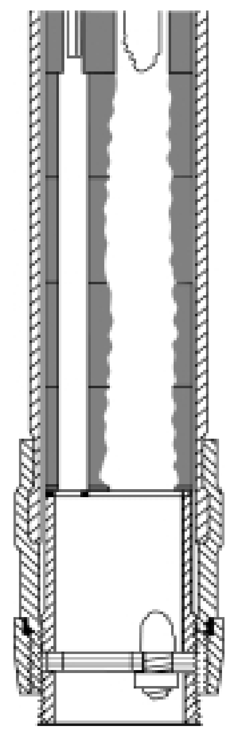


4b



5b

Low-Fault Interruption (Up to 1,000 Amperes)

1 Overcurrent melts the silver fusible element, then transfers to the strain wire, which volatilizes instantly. Arcing is initiated as illustrated.

2 Both the main arcing rod and the auxiliary arcing rod are drawn upward by the spring-and-cable assembly in the fuse holder. After approximately ⅛-inch travel, the lower (uninsulated) section of the auxiliary arcing rod engages the auxiliary contact, momentarily shorting out the arc.

3a Arcing is reinitiated in the small-diameter auxiliary bore when the tip of the auxiliary arcing rod travels about one inch (at which time the tip clears the auxiliary contact).

4a The large-diameter section of the auxiliary bore delays arc extinction until a sufficient gap is attained to preclude reignition in the main bore. Moreover, the tip of the main arcing rod leads the tip of the auxiliary arcing rod by approximately one inch—further ensuring that the arc will not transfer back to the main bore.

5a After the auxiliary arcing rod has traveled about one-half stroke, sufficient deionization has occurred to extinguish the arc.

Moderate-to-High-Fault Interruption

1 Overcurrent melts the silver fusible element, then transfers to the strain wire, which volatilizes instantly. Arcing is initiated as illustrated.

2 Both the main arcing rod and the auxiliary arcing rod are drawn upward by the spring-and-cable assembly in the fuse holder. After approximately ⅛-inch travel, the lower (uninsulated) section of the auxiliary arcing rod engages the auxiliary contact, momentarily shorting out the arc.

3b The auxiliary arcing rod—momentarily providing the only current path for the moderate-to-high magnitude fault current—quickly melts at the reduced section and separates from the one-inch arcing tip. Any arcing initiated in the auxiliary bore cannot persist because of the high-resistance (stainless-steel) path and quickly transfers to the lower-resistance main arcing rod in the main bore.

4b The arc is lengthened as the main rod is drawn upward into the main bore. The large circumference of the main bore provides greater surface exposure of the arc-extinguishing medium to the heating effects of the arc, thereby enhancing the generation of arc-quenching deionizing gases.

5b After the main arcing rod has traveled about one-half stroke, sufficient deionization has occurred to extinguish the arc.

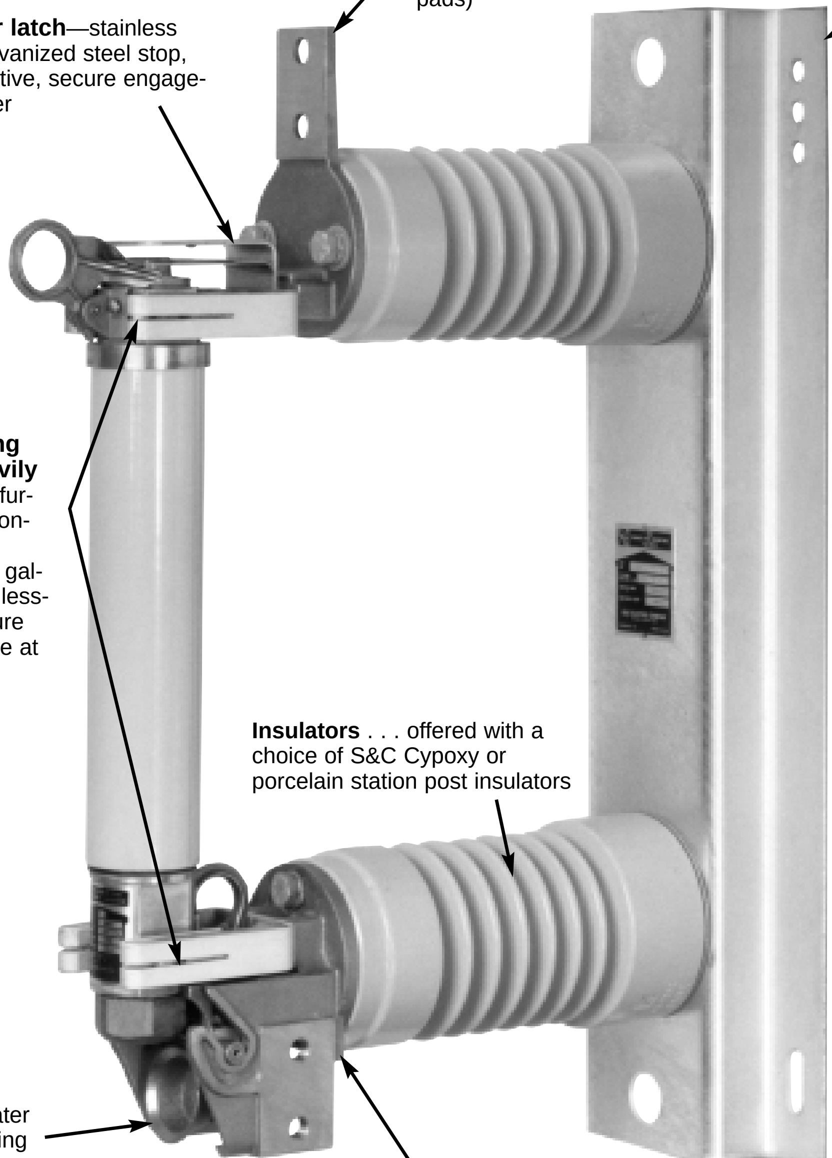
FUSE MOUNTINGS

SM-4 and SM-5 Power Fuses, Vertical Style

Bronze two-hole terminal pad accepts a wide variety of connectors. (Parallel-mounted fuse employs aluminum terminal pads)

Galvanized formed-steel channel base—3/16-inch thick—has multiple mounting holes and slots to facilitate installation

Fuse-holder latch—stainless steel with galvanized steel stop, provides positive, secure engagement of holder



Upper and lower mounting contacts are copper, heavily silver clad. Contacts are bifurcated to provide four-point contact at each ferrule and are backed up by a ¼-inch thick galvanized steel yoke and stainless-steel loading springs to ensure minimum electrical resistance at current-transfer points

Insulators . . . offered with a choice of S&C Cypoxy or porcelain station post insulators

Rain shield—gravity operated—minimizes entry of water when the holder is left hanging open (which is not recommended for more than short periods of time)

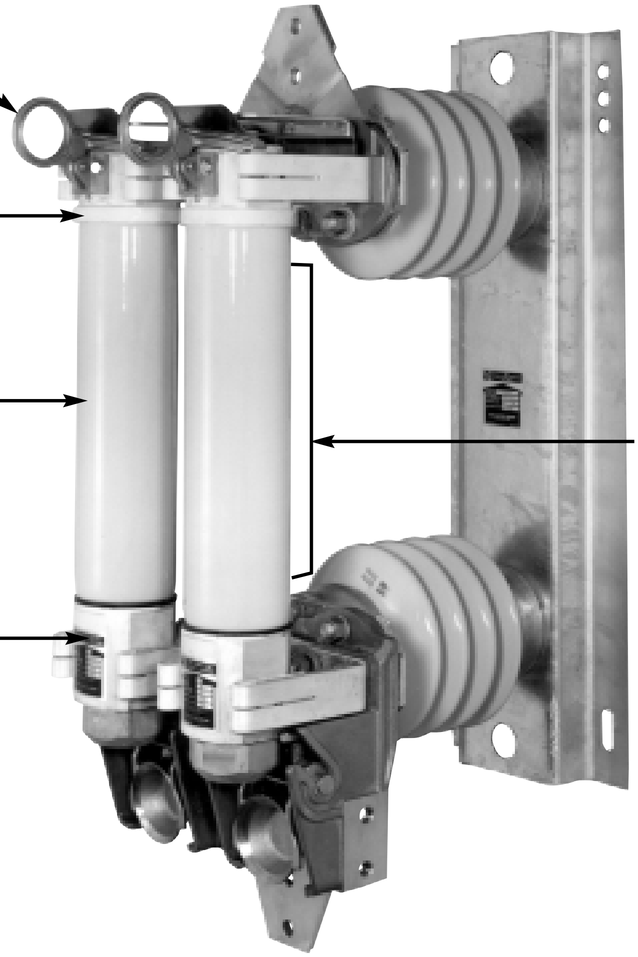
Cast bronze hinge features broad guiding surfaces on inner faces to provide positive self-guiding action for holder during opening and closing; also features two-hole terminal pad which accepts a wide variety of connectors

Disconnect (180° Opening) Vertical Style[1][2]
(14.4-kV model illustrated, with Cypoxy[3] station post insulators)

[1] SM-4 Power Fuse shown; SM-5 Power Fuse is similar.

[2] Complete mounting shown; live parts can be furnished separately.

[3] Cypoxy is the S&C trademark for S&C's cycloaliphatic epoxy resin system. Cypoxy is nontracking, self-scouring, nonweathering . . . there's never a compromise of insulation integrity.



Parallel-Mounted
SM-5 Power Fuse② (14.4-kV model illustrated)

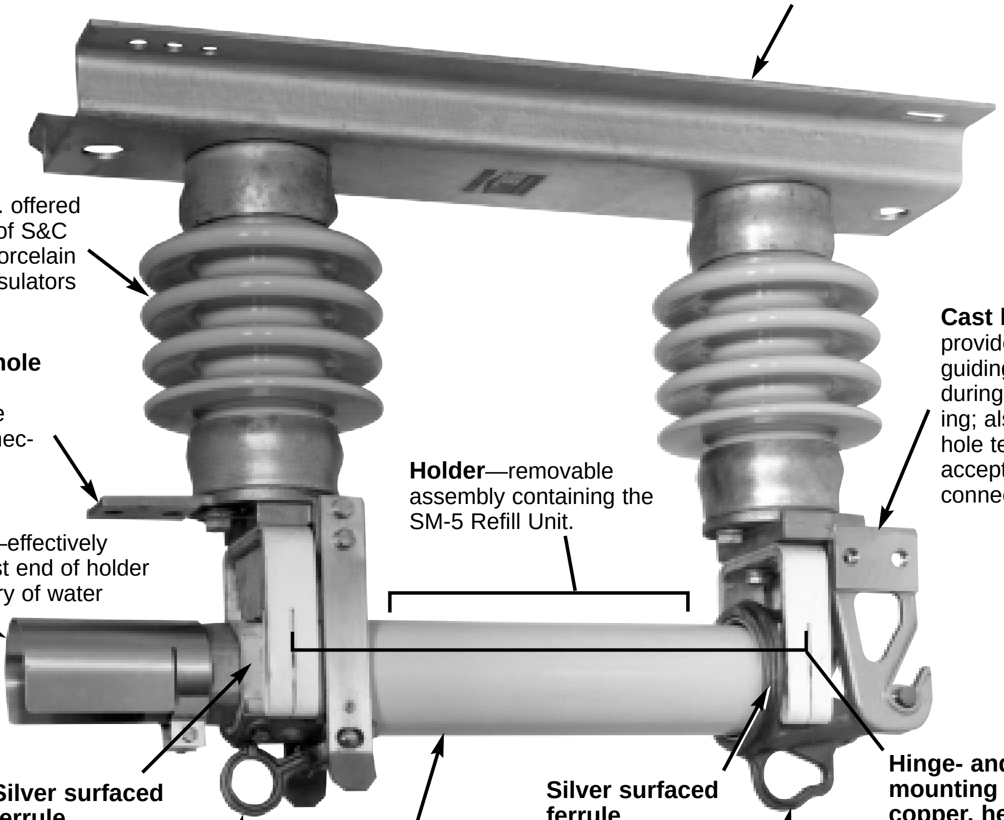
AVAILABLE MOUNTING STYLES AND RATINGS

Style	Fuse Type	Ratings				
		kV			Amperes, RMS	
		Nom.	Max	BIL	Max	Interrupting① (Sym.)
Disconnect 180° Opening Vertical	SM-4	7.2	8.3	95	200E	15 600
		14.4	17.0	110	200E	12 500
		25	27	150	200E	9 400
		34.5	38	200	200E	6 250
	SM-5	7.2	8.3	95	400E	26 000
		7.2	8.3	95	720E◧	26 000
		14.4	17.0	110	400E	34 000
		14.4	17.0	110	720E◧	25 000
		25	27	150	300E	20 000
		34.5	38	200	300E	17 500

① Refer to tables on pages 17 and 18 for additional, detailed information on interrupting ratings.

◧ Parallel fuses.

SM-5 Power Fuses, Inverted Style



Disconnect (90° Opening) Inverted Style①
(14.4-kV model illustrated)

① Complete mounting shown; live parts can be furnished separately.

② Cypoxy is the S&C trademark for S&C's cycloaliphatic epoxy resin system. Cypoxy is nontracking, self-scouring, nonweathering . . . there's never a compromise of insulation integrity.

AVAILABLE MOUNTING STYLES AND RATINGS

Style	Fuse Type	Ratings				
		kV			Amperes, RMS	
		Nom.	Max	BIL	Max	Interrupting① (Sym.)
Disconnect 90° Opening Inverted	SM-5	7.2 14.4 25 34.5	8.3 17.0 27 38	95 110 150 200	400E 400E 300E 300E	26 000 34 000 20 000 17 500

① Refer to table on page 18 for additional, detailed information on interrupting ratings.

FUSE HANDLING

SM Power Fuses in the Disconnect 180° Opening Vertical and Disconnect 90° Opening Inverted Styles have been designed such that opening and closing operations can be performed using any station-class switch stick or a universal pole equipped with an appropriate S&C Handling Tool. Moreover, holders for disconnect style power fuses are equipped with a pull-ring and/or lifting eye to facilitate hot-stick handling for removal and replacement of the holder. These power fuses are *not* designed for live-switching duty (except in the special case detailed on the following page) and must not be opened under load. For a complete description of S&C Handling Tools for use with Type SM Power Fuses, refer to S&C Descriptive Bulletin 851-30.

Note: Installation or removal of holders for Type SM-4 Power Fuses rated 34.5 kV, and also for Type SM-5 Power Fuses rated 25 kV and 34.5 kV, should be performed by hand due to the substantial weight of the holders—but only after the fuse has been de-energized and properly grounded in accordance with local operating procedures.

Handling the Fuse Holder in Disconnect 180° Opening Vertical Style SM-4 Mountings Rated 25 kV and Below

Opening the fuse. The operator uses a station prong to swing the SM fuse holder to the fully open position.

Removing the fuse. The operator inserts the station prong into the lifting eye of the fuse holder, eases the trunnions up and out of the hinge, and lowers the fuse holder to the ground.

Load Switching with Loadbuster®

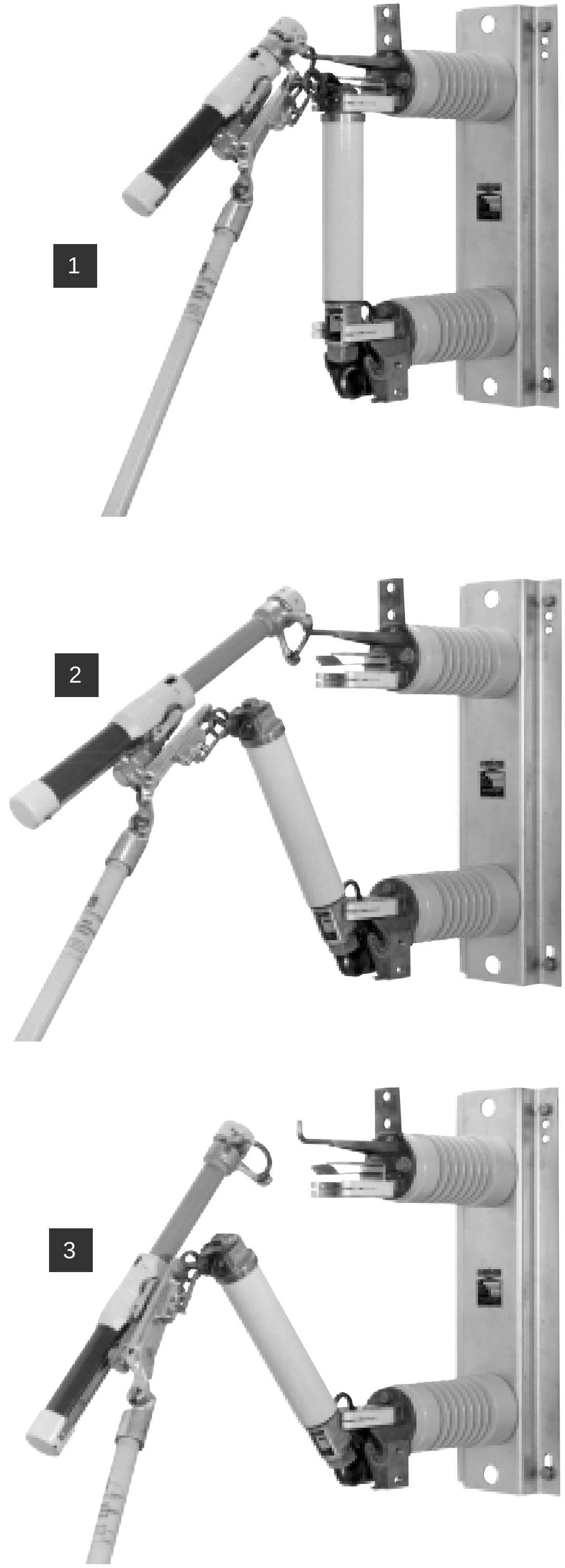
Type SM-4 Power Fuses (Disconnect 180° Opening Vertical Style) may be operated with Loadbuster, S&C's portable loadbreak tool, provided the mounting is equipped with an optional attachment hook. Loadbuster makes possible full-load switching at full voltage, as well as switching of associated magnetizing and line-charging currents. No disconnects (isolators) or interrupter switches need to be installed in series with the fuse. Loadbuster switching of the SM-4 is illustrated at the right.

Elimination of series disconnects and elimination of the need for an interrupting unit or mechanism at each fuse result in greatly improved appearance and immediate cost savings. Because the interrupting unit is in the Loadbuster tool—and only one Loadbuster is needed for each appropriate truck—the advantages of low-cost, universal load switching are available anywhere on the distribution system. S&C Descriptive Bulletin 811-30 fully describes the Loadbuster concept.

1 **ATTACH:** Reach across the front of the SM-4 Power Fuse and attach Loadbuster's anchor to the attachment hook on the fuse upper live parts; then, engage Loadbuster's pull-ring hook with the fuse-holder pull-ring.

2 **PULL:** A firm, steady downward pull on Loadbuster—to its maximum extended length—opens the fuse in the normal manner, as the current is diverted through Loadbuster. At a predetermined point in the opening stroke, Loadbuster trips, breaking the circuit positively.

3 **ROLL OFF:** Loadbuster is disengaged by first removing its anchor from the SM-4 attachment hook, while maintaining the engagement of the pull-ring of the holder and the Loadbuster pull-ring latch. Loadbuster is then used to guide the fuse holder to the fully open position—after which Loadbuster is removed from the pull-ring with a simple "roll-off" motion.



Loadbuster operation of Type SM-4 Power Fuse (Disconnect 180° Opening Vertical Style) equipped with optional Loadbuster attachment hook.

INTERRUPTING RATINGS

Short-Circuit Interrupting Ratings

The ratings shown on pages 17 and 18 are, by definition, the maximum interrupting ratings of the fuses listed based upon full line-to-line voltage across a single fuse. Obviously, this is only one criterion of fuse performance. These fuses have also been rigorously tested through the full spectrum of fault currents, from the lowest to the highest fault—not only primary faults but also secondary-side faults as seen from the primary side of the transformer—and under all realistic conditions of circuitry. In all S&C testing, special attention is given to establishing and controlling circuit parameters to duplicate conditions as severe as those which will be encountered in the field. This involves testing at all degrees of asymmetry and matching of the rate of rise of transient recovery voltage of the test circuit to that found in actual field applications. This rate of rise depends, in turn, on carefully established laboratory test conditions to obtain realistic natural frequencies and typical amplitudes of transient recovery voltage.

The short-circuit interrupting ratings listed in columns 3, 4, and 7 of these tables have been determined in accordance with the procedures described in ANSI Standard C37.41 (1988). Moreover, with respect to the requirement in this standard for testing with circuits having an X/R ratio of at least 15 (corresponding to an asymmetry factor of 1.55), S&C's tests were performed under the more severe condition of X/R = 20, corresponding to an asymmetry factor of 1.6. Based upon the recognition that there are many applications where the X/R ratio is *less* severe than the value of 15 specified by the standard, higher symmetrical interrupting ratings are listed in columns 5 and 6 for X/R = 10 and 5, respectively.

SM-4 POWER FUSES—50/60-Hertz Short-Circuit Interrupting Ratings

kV, Nominal		Amperes, RMS, Interrupting				MVA, Interrupting, Three-Phase Symmetrical, Based on $\frac{X}{R}$ = 15
SM-4	System	Asymmetrical	Symmetrical			
			Based on $\frac{X}{R}$ = 15	Based on $\frac{X}{R}$ = 10	Based on $\frac{X}{R}$ = 5	
7.2◪	2.4	27 500	17 200	18 800	22 000	70
	2.4/4.16Y	27 500	17 200	18 800	22 000	125
	4.8	27 500	17 200	18 800	22 000	145
	7.2	25 000	15 600	17 100	20 000	**195**◐
14.4	7.2	25 000	15 600	17 100	20 000	195
	4.8/8.32Y	25 000	15 600	17 100	20 000	225
	12	20 000	12 500	13 700	16 000	260
	7.2/12.47Y	20 000	12 500	13 700	16 000	270
	7.62/13.2Y	20 000	12 500	13 700	16 000	285
	13.8	20 000	12 500	13 700	16 000	300
	14.4	20 000	12 500	13 700	16 000	**310**◐
	16.5	20 000	12 500	13 700	16 000	355
25	7.2/12.47Y	20 000	12 500	13 700	16 000	270
	7.62/13.2Y	20 000	12 500	13 700	16 000	285
	13.8	20 000	12 500	13 700	16 000	300
	14.4	20 000	12 500	13 700	16 000	310
	16.5	20 000	12 500	13 700	16 000	355
	23	15 000	9 400	10 300	12 000	375
	14.4/24.9Y	15 000	9 400	10 300	12 000	**405**◐
34.5	23	15 000	9 400	10 300	12 000	375
	14.4/24.9Y	13 900	8 700	9 500	11 100	375
	27.6	12 500	7 800	8 500	10 000	375
	20/34.5Y	10 000	6 250	6 800	8 000	**375**◐
	34.5	10 000	6 250	6 800	8 000	**375**◐

◪ For the 50-hertz interrupting ratings of 7.2-kV SM-4 Power Fuses applied at 8.32 kV or less, multiply the values shown by 0.9.

◐ Nominal rating

SM-5 POWER FUSES—50/60-Hertz Short-Circuit Interrupting Ratings

kV, Nominal		Amperes, RMS, Interrupting①				MVA, Interrupting, Three-Phase Symmetrical,① Based on $\frac{X}{R} = 15$
SM-5	System	Asymmetrical	Symmetrical			
			Based on $\frac{X}{R} = 15$	Based on $\frac{X}{R} = 10$	Based on $\frac{X}{R} = 5$	
4.16◧	2.4	60 000	37 500	41 000	48 000	155
	2.4/4.16Y	60 000	37 500	41 000	48 000	**270**◐
7.2	2.4	44 500	28 000	30 500	35 600	115
	2.4/4.16Y	44 500	28 000	30 500	35 600	200
	4.8	43 500	27 000	29 800	34 800	225
	7.2	41 500	26 000	28 500	33 200	**325**◐
14.4 (50/60-Hz ratings)	7.2	40 000	25 000	27 400	32 000	310
	4.8/8.32Y	40 000	25 000	27 400	32 000	360
	12	40 000	25 000	27 400	32 000	520
	7.2/12.47Y	40 000	25 000	27 400	32 000	540
	7.62/13.2Y	40 000	25 000	27 400	32 000	570
	13.8	40 000	25 000	27 400	32 000	600
	14.4	40 000	25 000	27 400	32 000	**620**◐
	16.5	40 000	25 000	27 400	32 000	715
14.4 (60-Hz ratings)	7.2	55 000	34 600	34 600	34 600	430
	4.8/8.32Y	55 000	34 600	34 600	34 600	500
	12	55 000	34 600	34 600	34 600	720
	7.2/12.47Y	55 000	34 600	34 600	34 600	750
	7.62/13.2Y	54 000	34 000	34 000	34 000	780
	13.8	54 000	34 000	34 000	34 000	815
	14.4	54 000	34 000	34 000	34 000	**850**◐
25	7.2/12.47Y	32 000	20 000	21 900	25 600	430
	7.62/13.2Y	32 000	20 000	21 900	25 600	455
	13.8	32 000	20 000	21 900	25 600	480
	14.4	32 000	20 000	21 900	25 600	500
	16.5	32 000	20 000	21 900	25 600	570
	23	32 000	20 000	21 900	25 600	795
	14.4/24.9Y	32 000	20 000	21 900	25 600	**860**◐
34.5	23	28 000	17 500	19 200	22 400	695
	14.4/24.9Y	28 000	17 500	19 200	22 400	755
	27.6	28 000	17 500	19 200	22 400	835
	20/34.5Y	28 000	17 500	19 200	22 400	**1000**◐
	34.5	28 000	17 500	19 200	22 400	**1000**◐

① These ratings apply provided that mounting, holder, and refill unit are matched (identified by large arrow on nameplate or label). For interrupting ratings applying to previous designs, see S&C Data Bulletin 201-190, page 4.

◧ Applies to 4.16-kV refill unit in 7.2-kV holder when applied in 7.2-kV mounting, for systems rated 2.4 or 2.4/4.16Y kV. Note: For 7.2-kV coordinating speed refill unit in a 7.2-kV holder when applied in a 7.2-kV mounting, for systems rated 2.4 or 2.4/4.16Y kV, refer to ratings listed for 7.2-kV SM-5 Power Fuse

◐ Nominal rating.