S&C TYPE SM AND SML POWER FUSES

FOR USE WITH SM REFILL UNITS OR SMU-20® FUSE UNITS
INDOOR DISTRIBUTION (4.16 KV THROUGH 34.5 KV)

S&C Type SM and SML Power Fuses are the ideal protective devices for transformers and cables on utility, industrial, commercial, and institutional power systems.

Application

Type SM and SML Power Fuses incorporate precision-engineered nondamageable silver or nickel-chrome fusible elements with precise and permanently accurate time-current characteristic (TCC) curves, ensuring not only dependable performance but also continued system coordination reliability.

The fuses are the recognized standard for performance and reliability in solid-material power fuse protection. They are ideally suited for application in pad mounted gear, metal-enclosed switchgear, wall mounted fuse enclosures, and electrical distribution vaults for protection of cables and medium to large power transformers on utility, industrial, commercial, and institutional power systems rated 34.5 kV and below.

Type SM and SML Power Fuses incorporate precision-engineered nondamageable silver or nickel-chrome fusible elements. Consequently, the TCCs of these fuses are permanently accurate and precise, ensuring not only reliable and predictable performance, but also the continued integrity of carefully engineered system coordination plans. The precise TCCs and nondamageability of these power fuses permit upstream protective devices to be set for faster operation than may be practical with other power 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-

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interrupting ratings from 28,000 amperes RMS asymmetrical at 34.5 kV to 60,000 amperes RMS asymmetrical at 4.16 kV. They are available in disconnect as well as non-disconnect styles and may be operated (i.e., opened or closed) using a hookstick or a universal pole equipped with a variety of fuse-handling fittings.

Type SML Power Fuses with Uni-Rupter® Interrupters provide 200-ampere single-pole live switching of single-phase or three-phase circuits on distribution systems rated 25 kV and below. They have a maximum continuous current rating of 200 amperes and fault-interrupting ratings to 22,400 amperes RMS asymmetrical at 14.4 kV and 20,000 amperes RMS asymmetrical at 25 kV, plus, a fault closing capability equal to the fault-interrupting rating of the fuse.

Uni-Rupter Interrupters offer the ultimate in live-switching simplicity: a firm, steady opening pull on the fuse with a hookstick is all that is required for circuit interruption. And, because circuit interruption is internal to Uni-Rupter Interrupter, there's no external arc or flame.

Uni-Rupter Interrupters are self-resetting, and all that is required for circuit-closing is a swift, nonhesitating stroke with a hookstick to move the fuse back to the Closed position. Because of the live-switching capability, these power fuses are available in the disconnect style only.

Type SM and SML Power Fuses are available in a wide range of ampere ratings and, depending on the particular fuse selected, in five different speeds, i.e., S&C "K," Standard, Slow, Very Slow, and Coordinating. The broad selection of available ampere ratings and speeds permits close fusing to achieve maximum protection and optimum coordination.

Transformer Protection with Type SM and SML Power Fuses

A transformer primary-side protective fuse is typically installed to protect the transformer should a fault occur in the secondary buswork between the transformer and the nearest secondary-side overcurrent protective device, as well as to provide backup protection for the transformer should the secondary-side overcurrent protective device either fail to operate because of a malfunction or operates too slowly because of incorrect ratings or settings.

Application of Type SM and SML Power Fuses in S&C Metal-Enclosed Switchgear and Pad-Mounted Gear

Type SM and SML Power Fuses are ideally suited for such applications because they provide the fault-sensing sensitivity and high rate of dielectric recovery required to detect and interrupt the full spectrum of transformer faults i.e., large, medium, and small, even down to minimum melting current. This is regardless of whether the fault is on the primary side or secondary side, there is a line-to-line or line-to-ground voltage across the fuse, the transformer is adjacent to the fuse installation or cable-connected to it from a remote location, or if there are transformer winding connections. See **Figure 1**. Moreover, these power fuses have surge capacity more than adequate to withstand hot-load pickup (the combined inrush of magnetizing and load currents following a momentary interruption of source voltage) even when fusing very close to transformer full-load current, a performance characteristic not generally found in other makes of high-voltage fuses.

FIGURE 1. Application of S&C Type SM and SML Power Fuses in S&C Metal-Enclosed Switchgear and Pad-Mounted Gear.

A Superior Alternative to Circuit Breakers

Type SM and SML Power Fuses are widely applied for transformer protection on utility, industrial, commercial, and institutional power systems because of their inherent simplicity, reliability, economy, fast response characteristics, and freedom from maintenance. These characteristics make Type SM and SML Power Fuses preferable to circuit breakers in most transformer-protection applications. S&C Power Fuses:

- **Do not need a source of control power.** Type SM and SML Power Fuses, unlike circuit breakers, provide fault protection for the transformer without dependence on a source of control power, such as storage batteries, which may become discharged and thus incapable of tripping the circuit breaker should a fault occur.
- **Have inherently faster response.** For high-magnitude faults, Type SM and SML Power Fuses provide an inherently faster response than circuit breakers, permitting more rapid removal of faults from the system, with each of these benefits:
  - The duration of the voltage "dip" associated with the fault is reduced significantly, minimizing the potential for disruption of the remaining loads.
  - The duration of stresses on motors in other segments of the system is shortened.
  - The upstream protective device can be set to operate faster-for better protection-while still coordinating with the transformer-primary fuse.
- **Are simple to install and require no maintenance.** Type SM and SML Power Fuses, unlike circuit breakers, do not require regularly scheduled maintenance because there is no battery, charger, or relay to be tested, nor oil or insulating gas to be maintained. Also, because the TCCs of these fuses are permanently precise, they can be depended on to operate properly, even after years of inattention. Recalibration is neither required nor possible, so elaborate testing procedures are not needed, eliminating the possibility a carefully engineered coordination plan will be disturbed either through initial improper setting of a relay or subsequent inadvertent changes to relay settings during routine inspection and maintenance.

Damage to three-phase loads caused by single-phasing, once thought to be a problem associated with the use of power fuses on the primary side of transformers, is no longer a relevant consideration because the National Electrical Code requires equipping three-phase loads with an overcurrent protective device in each of the three supply phases. Furthermore, devices are now widely available that detect Open Phase conditions caused not only by blown fuses, but also by such other events as broken conductors, single-phase switching, or equipment malfunction, and that initiate a switching operation to isolate the load or transfer to an alternate source.

Systems requiring differential protection, reverse-power relaying, or non-current magnitude tripping of the protective device may require circuit breakers. However, the sizes of transformers normally associated with industrial, commercial, and institutional power systems, as well as many applications on utility systems, generally do not warrant such sophisticated protection. Indeed, many utilities and power users find the complexity of such protective relaying, with its requirement for periodic testing and recalibration, is a distinct disadvantage.

A Superior Alternative to Current-Limiting Fuses, Too

Not only are Type SM and SML Power Fuses a superior alternative to circuit breakers for most transformer-protection applications, but because of their special construction, they are also superior to current-limiting fuses.

Type SM and SML Power Fuses have helically coiled silver fusible elements 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, so it is not subject to damage, even by inrush currents that approach but do not exceed the fuse's minimum melting TCC curve.

Current-limiting fuses, in contrast, have fusible elements that 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 TCC 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, possibly resulting 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 because of fatigue brought about by current-cycling that can cause localized buckling from thermal expansion and contraction.

Certain current-limiting fuses use a eutectic or an "M" spot consisting of a drop of tin or tin alloy deposited on a silver element. The tin or tin alloy melts and amalgamates (combines) with the silver element at a temperature lower than the melting temperature of the silver element, thereby initiating fuse operation for lower levels of fault current more quickly than would be possible for the silver element alone. This faster response is necessary to avoid excessive preheating of the fuse's filler material, a condition that would compromise the low-fault current performance of the fuse.

However, current-limiting fuses that use "M" spots are especially susceptible to element damage because the "M" spot may only partially melt and amalgamate when exposed to current surges, with subsequent resolidification altering the character of the element at that point.

Damage to fusible elements of current-limiting fuses, as described above, may shift or alter their TCCs, resulting in a loss of complete coordination between the fuse and other downstream overcurrent protective devices. Moreover, a damaged current-limiting fuse element may melt because of an otherwise harmless inrush current, but the fuse may fail to clear the circuit because of insufficient power flow, with the fuse continuing to arc and burn internally because of 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 TCC 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 TCC curve at the point where the safety zone or setback allowance is measured.

Furthermore, most current-limiting fuses inherently have steep, relatively straight TCC curves that, 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 to withstand combined transformer-magnetizing and load-inrush currents and to coordinate with secondary-side protective devices, particularly low-voltage circuit breakers.

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, because 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 undamageable fusible elements, there's no need for "safety zones" or "setback allowances," allowing closer fusing than is possible with other fuses and providing the maximum degree of protection against secondary faults. They are thus better able to protect the transformer against damage caused by faults between the transformer and the secondary-side protective device and to supply backup protection should 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.

Cable Protection with Type SM and SML Power Fuses

An important consideration in planning industrial, commercial, and institutional medium-voltage cable distribution systems, as well as utility underground distribution systems, is the provision of protection for 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 and 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 because the cable sizes are typically selected to carry the maximum anticipated level of overload current on a continuous basis.

S&C Type SM and SML Power Fuses are ideal for protection of insulated cables because they are extremely fast-operating and are offered in a wide selection of ampere ratings and permanently accurate and precise TCCs, with each of these attendant benefits:

- The conductor temperature rise following a fault is minimized because of 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 saving.
- The upstream protective device can be set to operate faster while still coordinating with the Type SM or SML Power Fuse. Also, Type SM and SML Power Fuses provide selective isolation of only faulted phases of three-phase feeders serving single-phase loads, unlike the undiscriminating operation of circuit breakers that 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 that have a relatively high incidence of transient or temporary faults. This reclosing feature is neither useful nor desirable, however, on utility underground cable distribution systems or industrial, commercial, and institutional power systems where the conductors are arranged in cable trays or enclosed in conduit or bus duct. 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 exacerbated by an automatic reclosing operation.

Circuit breakers are also used in applications requiring a very high (above 720 amperes-continuous current-carrying capability). While this may be an advantage in some cases, a higher degree of service continuity can be achieved with less expensive Type SM and SML Power Fuses by subdividing the system into a larger number of discrete segments, with the result being a fault on one segment of the system affects fewer loads. This high degree of segmentation also allows the use of smaller transformers located strategically throughout the system, eliminating the need for the unnecessarily long, high-ampacity secondary conductors required where fewer, larger, widely separated transformers are used.

Type SM and SML Power Fuses Are Backed by the Detailed Application Data You'll Need to Optimize Transformer and Cable Protection

S&C Information Bulletin 240-110 provides a compendium of information on transformer protection in medium-voltage industrial, commercial, and institutional power systems (4.16 kV through 34.5 kV), including a detailed exposition of application principles for primary-side protection. Thirty-eight pages of selection tables eliminate the need to perform graphical coordination studies in selecting primary fuses. The tables quantify the degree of protection provided the trans formers, list loading capabilities of fuses, and coordinate the primary fuse with the full spectrum of secondary-side protective devices.

S&C Information Bulletin 240-115 provides similar, detailed fuse selection tables for protection of cables in medium-voltage power systems. These publications, as well as other technical and application data (including fuse minimum melting and total clearing TCC curves), are available on request from the nearest S&C Sales Office or at sandc.com.

Operation

The Fusible Element

S&C Type SM and SML 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 TCCs, permitting close fusing to achieve maximum protection and optimum coordination. See **Figure 2**, **Figure 3**, and **Figure 4**.

The initial and sustained accuracy of their melting TCCs ensures 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:

- They are drawn through diamond or carbide dies to very accurate diameters.
- They are of solderless construction, brazed into their terminals.

Their melting TCCs are precise, with only 10% total tolerance in melting current, compared to the 20% tolerance of many fuses (20% and 40% respectively,

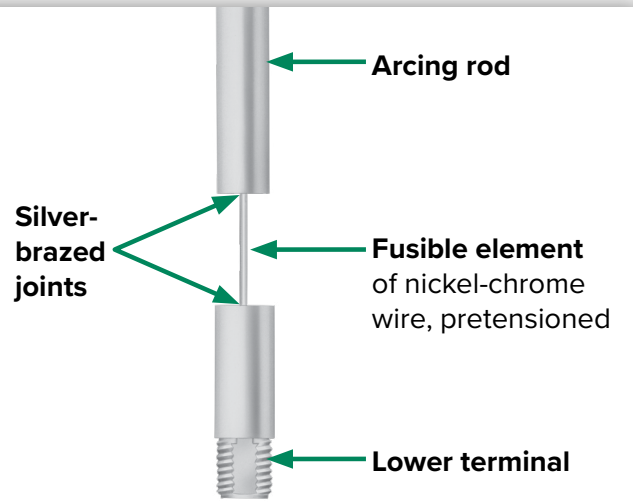


FIGURE 3. Nondamageable nickel-chrome fusible element for SM Refill Units rated SE end 7E amperes and SMU-20 Fuse Units rated 3K, SE, end 7E amperes (SM Refill Unit construction shown.) When called upon to operate, the pretentioned nickel-chrome wire weakens abruptly and separates before its cross-section changes.

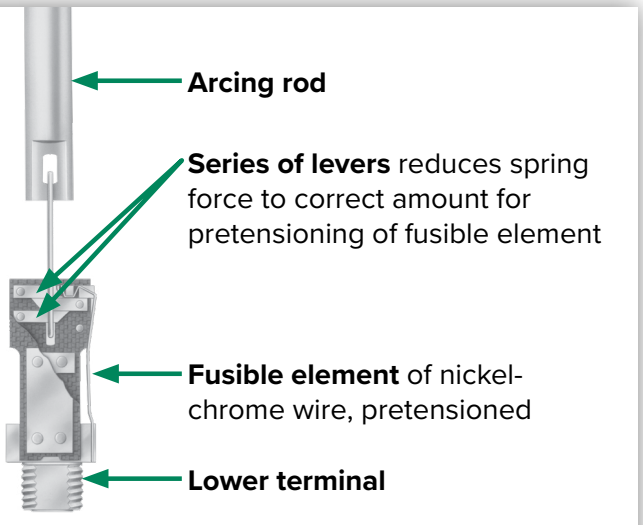


FIGURE 2. Nondamageable low-current, nickel-chrome fusible element for SM Refill Units rated 1, 2, and 3E amperes, and SMU-20 Fuse Units rated 1 ampere. (SM Refill Unit construction shown.) In these ratings, the nickel-chrome wire is too fine to withstand the full force of the spring. An assembly of levers in effect multiplies the tensile strength of the wire to permit the desired pretensioning without jeopardizing the security of the fusible element.

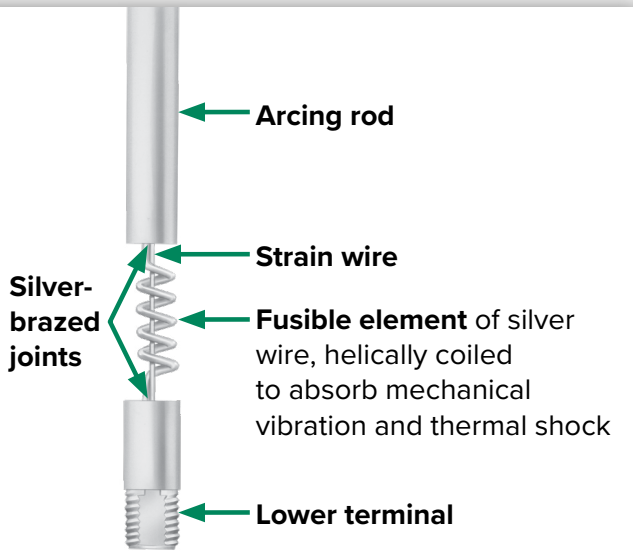


FIGURE 4. Nondamageable silver fusible element for SM Refill Units rated 10E amperes and larger and SMU-20 Fuse Units rated 6K through 200K amperes and 10E through 200E amperes.(SM Refill Unit construction shown.) These ratings use the silver fusible-element, strain-wire construction, which is not damaged by overloads or transient faults approaching the minimum melting current.

in terms of time). And their design and construction features ensure they will conform to their TCCs 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.

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

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

The Refill Unit (for SM-4Z, SML-4Z, SM-5S, and SM-5SS Power Fuses)

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. See **Figure 5**, **Figure 6 on page 8**, and **Figure 7 on page 8**.

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 stainless steel auxiliary arcing rod 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 because at its small-diameter section it is insulated from the auxiliary arcing contact.

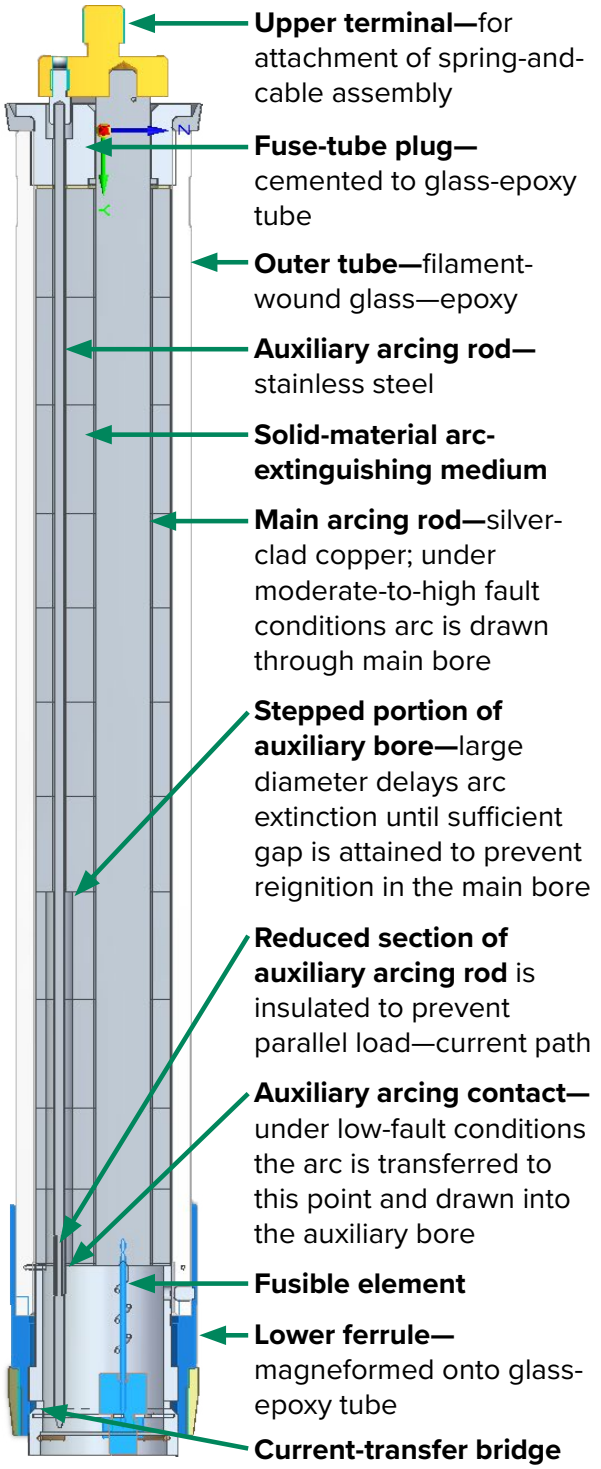


FIGURE 5. Cutaway view of the refill unit for SM-4Z, SML-4Z, SM-5S, and SM-5SS power fuses.

Refill Unit and Holder Assembly for SM-4Z, SML-4Z, SM-5S, and SM-5SS Power Fuses

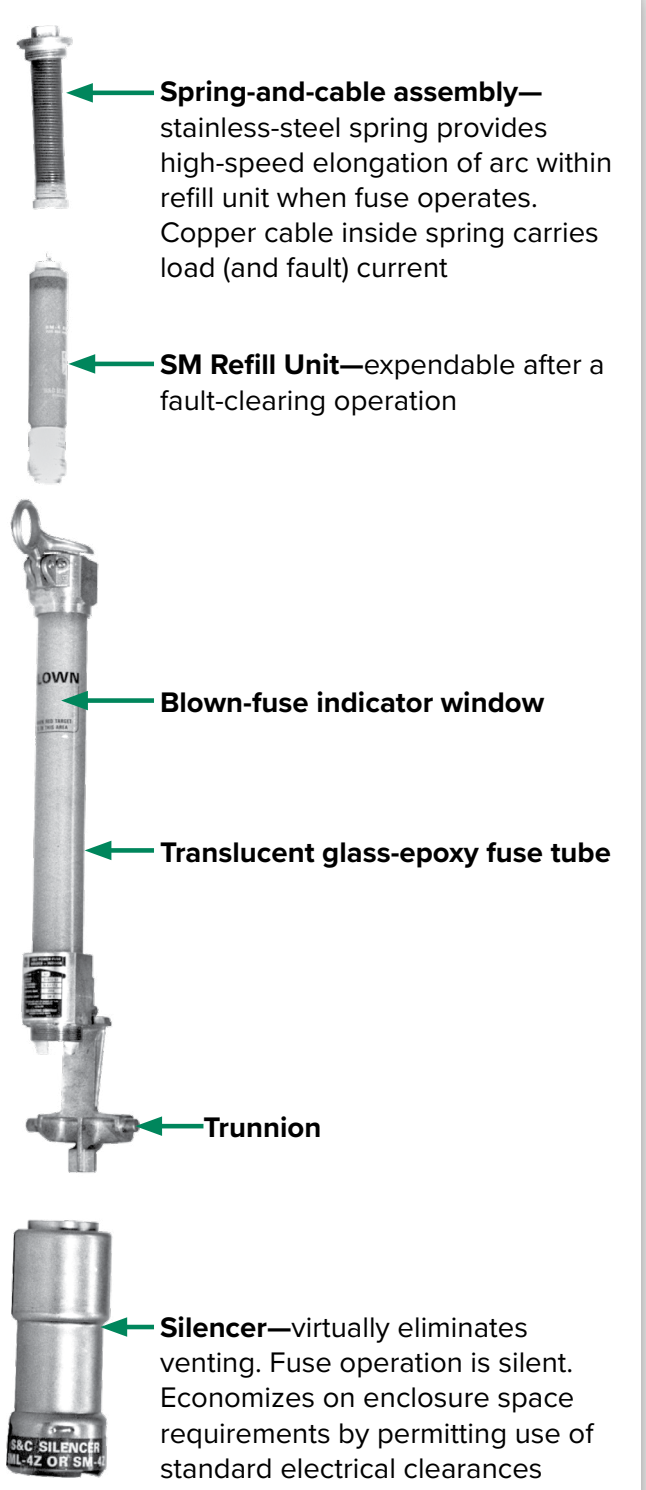


FIGURE 6. Refill unit and holder assembly. SM-4Z holder illustrated.[1]

1 Assembly is similar for holders with SML-4Z, SM-5S, and SM-5SS Power Fuses.

Fuse Unit and End Fitting Assembly SM-20 and SML-20 Power Fuses

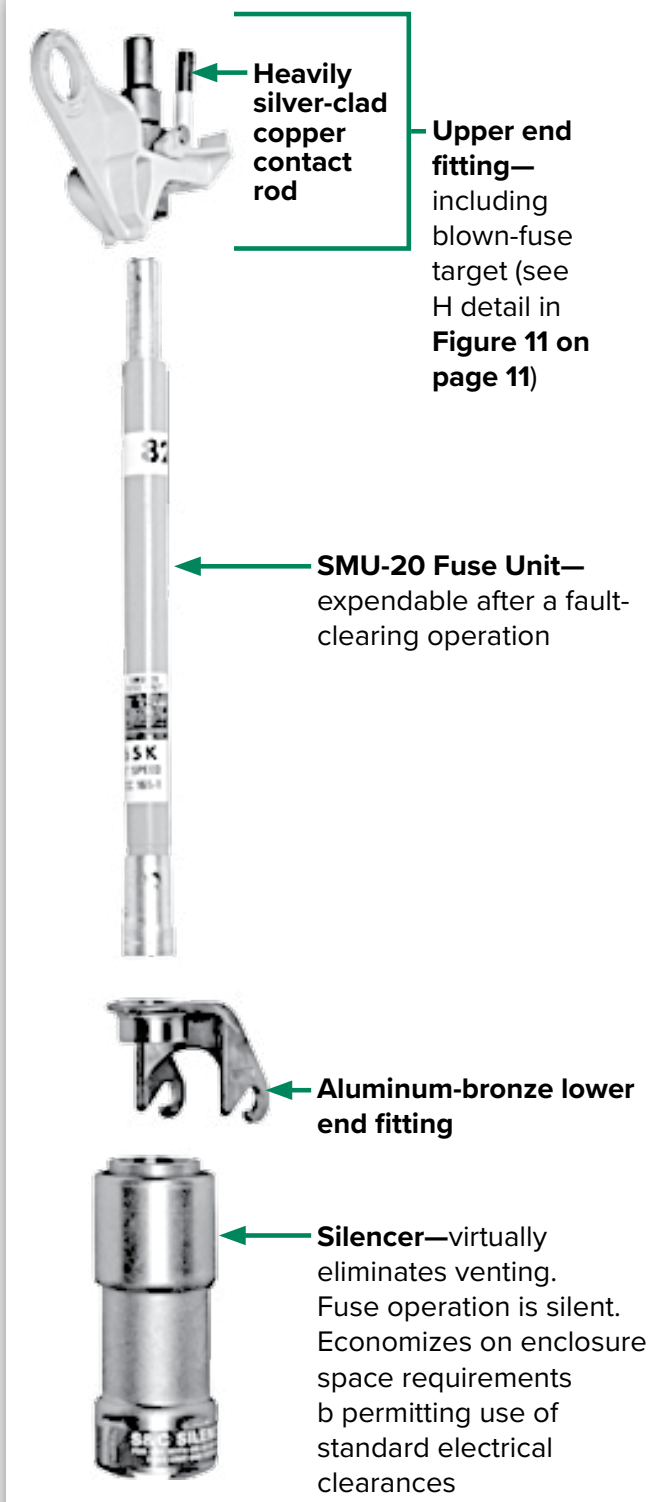
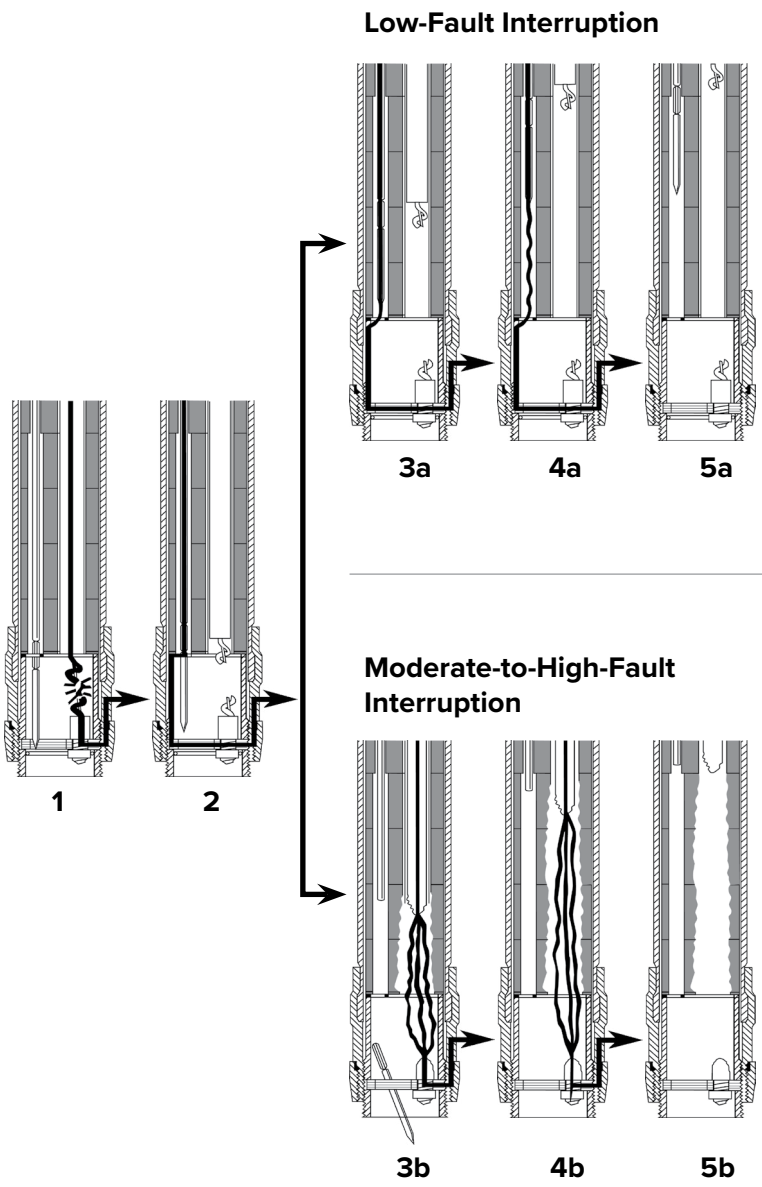


FIGURE 7. SMU-20 fuse unit and end fitting assembly.

Fault Interruption In SM Refill Units

After the fusible element melts, fast, positive fault interruption is achieved in the SM Power Fuse refill unit 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. Arc elongation is accomplished by the action of the spring and-cable assembly housed within the holder. The illustration that follows shows 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 ensures intimate contact between the arc and the arc-extinguishing medium, which is needed for positive, high-speed arc extinction. See **Figure 8**.



1 Overcurrent melts the silver fusible element, and 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 1/8-inch (3 mm) 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 (25 mm), 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 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.

1 Overcurrent melts the silver fusible element, and 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 ¼-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 (6-mm) arcing tip. Arcing commences at the main arcing rod and is drawn into the main bore-the main bore providing the lower-resistance path. Any arcing initiated in the auxiliary bore cannot persist because of the high-resistance (stainless steel) path and the high dielectric strength of the small-diameter 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.

FIGURE 8. Examples of how SM fuse refills address various types of fault interruptions.

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

The SMU-20 Fuse Unit (for SM-20 and SML-20 Power Fuses)

The SMU-20 Fuse Unit consists of a fusible element, an arcing rod, and a solid-material arc-extinguishing medium contained within a filament-wound glass-epoxy tube. See **Figure 9** and **Figure 11 on page 11**.

The fusible element is connected at one end through a current-transfer bridge to the fuse unit exhaust ferrule. At the other end, the fusible element is connected to the arcing rod that extends upward through the stepped bore in the fuse unit. A drive spring located inside the fuse unit provides the stored energy to drive the arcing rod upward through the arc-extinguishing medium during fault-current interruption. At the same time, the drive spring forces the actuating pin upward to trip a blown-fuse target in the fuse unit upper end-fitting.

Fault Interruption in SMU-20 Fuse Units

Fast, positive fault interruption is achieved in the SMU-20 Fuse Unit after the fusible element melts by both the following means:

- High-speed elongation of the arc in the solid-material lined bore (as produced by rapid movement of the spring-driven arcing rod)
- The efficient deionizing action of the gases generated through thermal reaction of the solid material caused by the heat of the confined arc

The resultant high rate of dielectric recovery more than matches the transient recovery-voltage severity of any circuit where the SMU-20 Fuse Unit is applied. See **Figure 10 on page 11**.

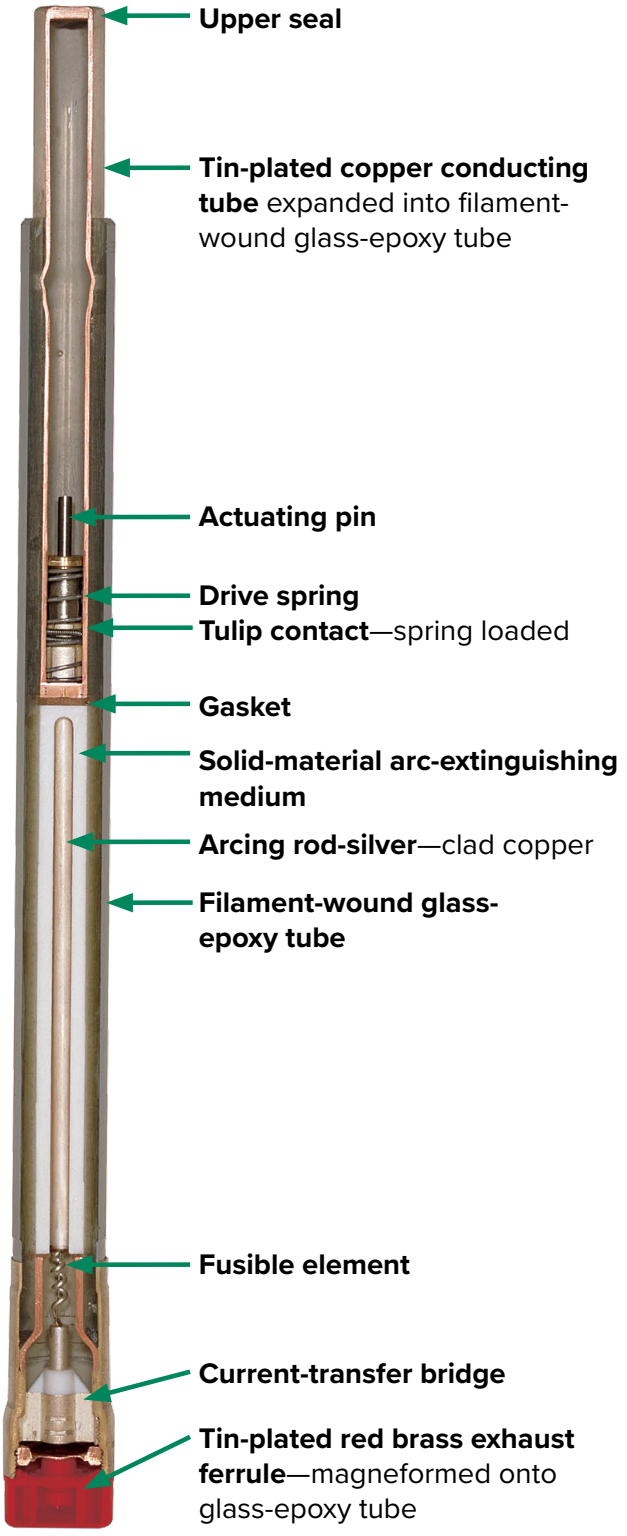
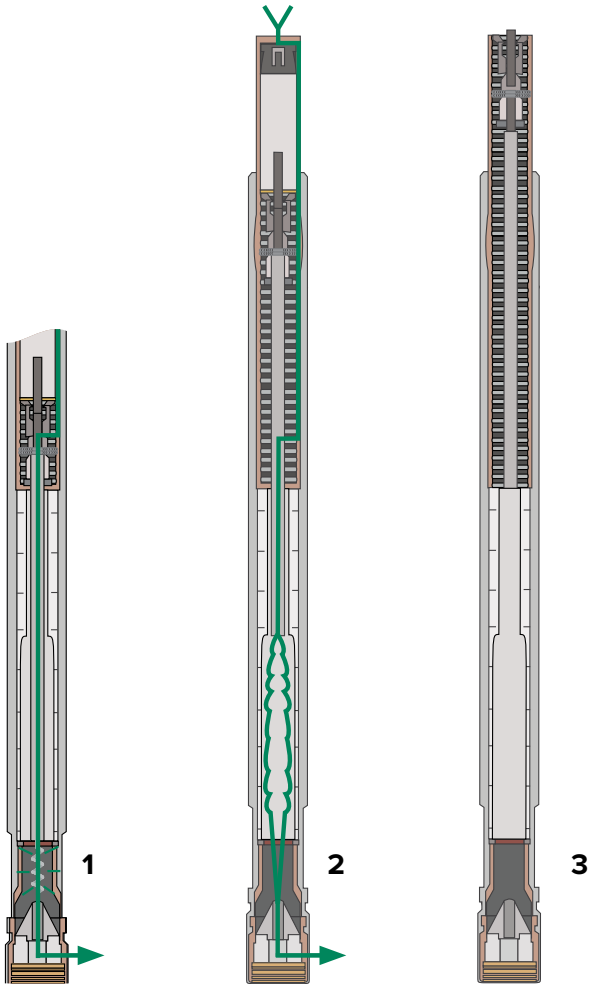


FIGURE 9. The SMU-20 Fuse Unit.



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

2 Released force of the drive spring thrusts the arcing rod upward, causing rapid elongation of the arc in the solid material-lined bore of the fuse unit. Under maximum fault conditions, heat from the confined arc causes the solid material in the large-diameter section of the arc-extinguishing chamber to undergo a thermal reaction, generating turbulent gases and effectively enlarging the bore diameter so the arc energy is released with a mild exhaust. Under low to moderate fault conditions, the arc is extinguished in the upper section of the arc-extinguishing chamber, where the small-diameter bore effectively concentrates the deionizing gases for rapid arc extinction.

3 Continued upward travel of the arcing rod after arc extinction causes the actuating pin to penetrate the upper seal, resulting in the projection of a brilliant red blown-fuse target from the fuse unit upper end-fitting. See H detail in **Figure 11**.

FIGURE 10. Fault Interruption in an SMU-20 Fuse Unit.

Styles and Construction

SM-20 Power Fuses

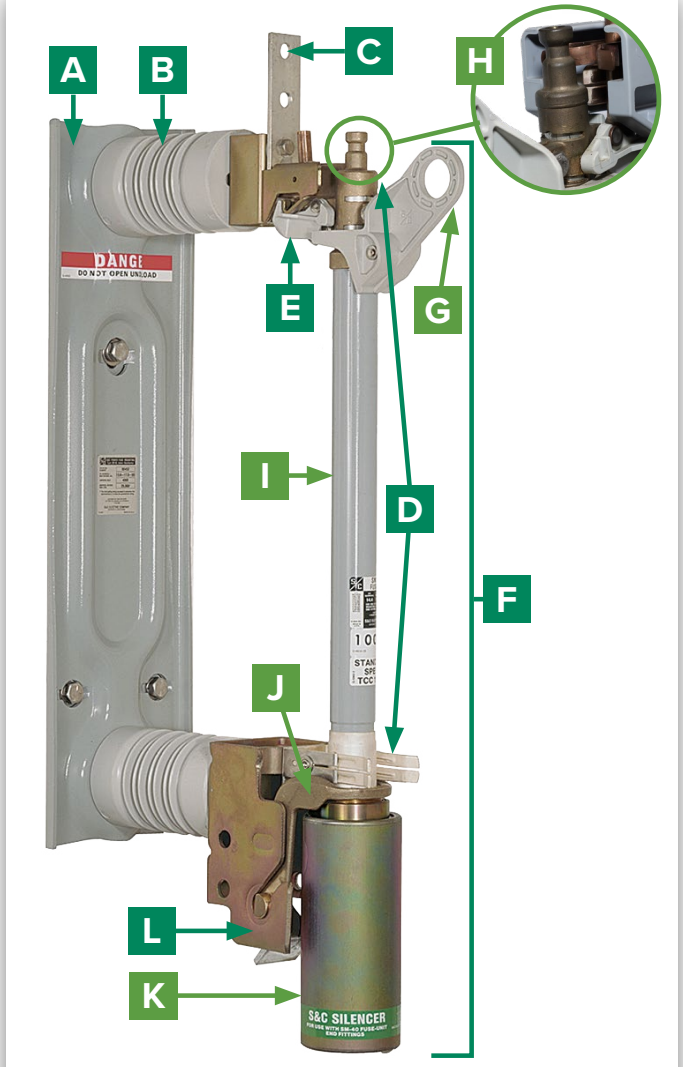


FIGURE 11. Disconnect-style SM-20 Power Fuse (45° Opening)[1].

1 Complete mounting shown; live parts can be furnished separately

A **Rugged 3⁄16-inch (5-mm) thick flanged, formed-steel base** features three-point mounting to simplify installation and to minimize possibility of deforming base when bolting to an irregular surface

B **S&C Cypoxy™ Insulators** use S&C's self-scouring, nontracking, nonweathering cycloaliphatic epoxy resin system. There's never a compromise of insulation integrity

C **Tin-plated copper terminal pad** accepts a wide variety of connectors

D **Spring-backed upper and lower mounting contacts are copper, heavily silver clad**, and are bifurcated to provide four-point contact at each end of the fuse unit assembly

E **Pull-ring operated latch** provides positive, secure engagement of fuse unit assembly

F **SMU-20 Fuse Unit-Assembly** including:

G **Upper end-fitting** with a large accessible and easily operated pull-ring

H **Brilliant-red blown-fuse target** projects from the upper end-fitting when the fuse operates. Fuse condition is easily checked with the fuse in the **Closed** position. Target resets when the blown fuse unit is replaced

I **SMU-20 Fuse Unit** is expendable after fault-clearing operation

J **Aluminum-bronze lower end-fitting** securely engages stainless steel hinge pivot rod for smooth opening and closing operation

K **Silencer**—S&C's exhaust control device that virtually eliminates venting. Fuse operation is silent

L **Zinc-plated hot-rolled steel hinge** provides positive, self-guiding action for the fuse unit during opening and closing. Current is transferred directly from the lower contacts to a separate, tin-plated copper two-hole terminal pad (not visible in photo)

Style	Fuse Type	Ratings				
		kV			Amperes, RMS	
		Nom.	Max.	BIL	Max.	Interrupting[1] (Sym.)
Disconnect 45° opening silencer vertical	SM-20	13.8	17	95	200K or 200E	14 000
		25	27	125	200K or 200E	12 500
		34.5	38	150	200K or 200E	8 450

TABLE 1. Available SM-20 Power Fuse Mounting Styles and Ratings

1 Refer to **Table 6 on page 24** for additional, detailed information on interrupting ratings.

SM-4Z Power Fuses

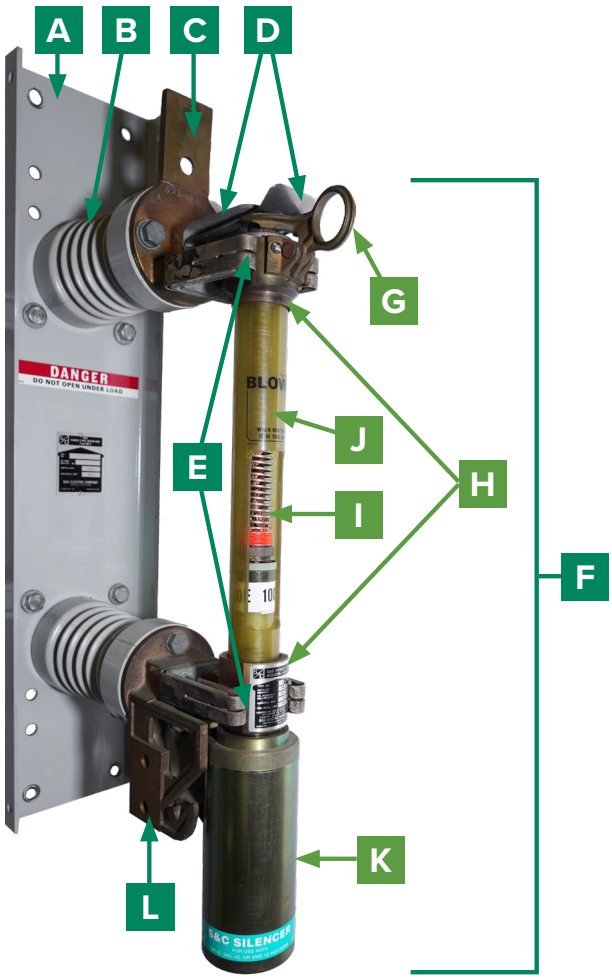


FIGURE 12. Disconnect Style[1] (45° Opening).

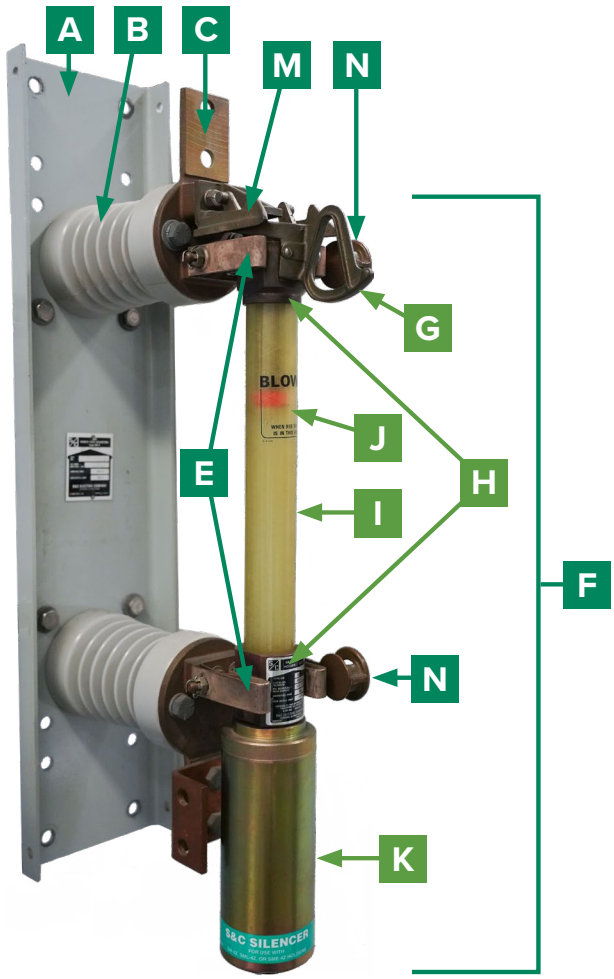


FIGURE 13. Non-Disconnect Style[1].

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

A **Rugged 3⁄16-inch thick flanged, formed-steel base** has numerous mounting holes to facilitate installation (See **Figure 12** and **Figure 13**.)

B **S&C Cypoxy Insulators** use S&C's self-scouring, nontracking, nonweathering cycloaliphatic epoxy resin system. There's never a compromise of insulation integrity

C **Bronze two-hole terminal pad** accepts a wide variety of connectors

D **Fuse-holder latch** (disconnect-style only)-stainless steel with galvanized-steel stop, provides positive, secure engagement of holder

E **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 in disconnect-style power fuses by a ¼-inch (6-mm) thick galvanized-steel yoke and stainless steel loading springs and, in non-disconnect style power fuses, by phosphor-bronze loading springs and cammed clamps to ensure minimum electrical resistance at current-transfer points

F **Holder**—removable assembly containing the SM-4 Refill Unit. The holder includes the following features:

G **Bronze pull-ring** (disconnect-style power fuses). Large, easily accessible. Pivots to pry up latch; **bronze lifting eye** (nondisconnect-style power fuses)-for installing or removing holder

H **Brass upper and lower ferrules**—with broad, machined-flat surfaces for engagement with spring-backed upper and lower contacts

I **Translucent glass-epoxy fuse tube**

J **Blown Fuse indicator window.** Fluorescent fire-orange target within the fuse tube moves to the window position when the fuse operates. Permits positive visual check of fuse condition without removing the holder from the mounting. Target fluoresces in the dark when illuminated with a flashlight

K **Silencer**—S&C's exhaust-control device that virtually eliminates venting. Fuse operation is silent

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

M **Bronze hangers** (non-disconnect style only) for support of the holder in the mounting

N **Bronze stick-operated clamps** (non-disconnect style). When clamps are pulled downward to the position shown, holder ferrules are gripped securely in a low-resistance contact

Style	Fuse Type	Ratings				
		kV			Amperes, RMS	
		Nom.	Max.	BIL	Max.	Interrupting[1] (Sym.)
Disconnect 45° opening silencer vertical	SM-4Z	4.8	5.5	60	200E	17 200
		13.8	17	95	200E	12 500
		25	27	150	200E	9 400[2]
		34.5	38	200	200E	6 250
Non-disconnect silencer vertical	SM-4Z	4.8	5.5	60	200E	17 200
		13.8	17	95	200E	12 500
		25	27	150	200E	9 400[2]
		34.5	38	200	200E	6 250

TABLE 2. Available SM-20 Power Fuse Mounting Styles and Ratings

1 Refer to **Table 6 on page 24** for additional, detailed information on interrupting ratings.

2 Rating is 12,500 amperes RMS symmetrical 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.

SM-5S and SM-5SS[1] Power Fuses

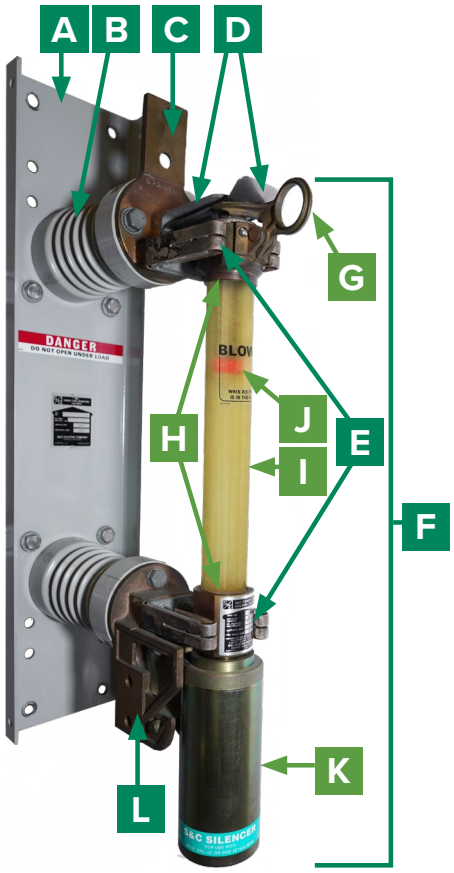


FIGURE 14. Disconnect style (45° Opening)

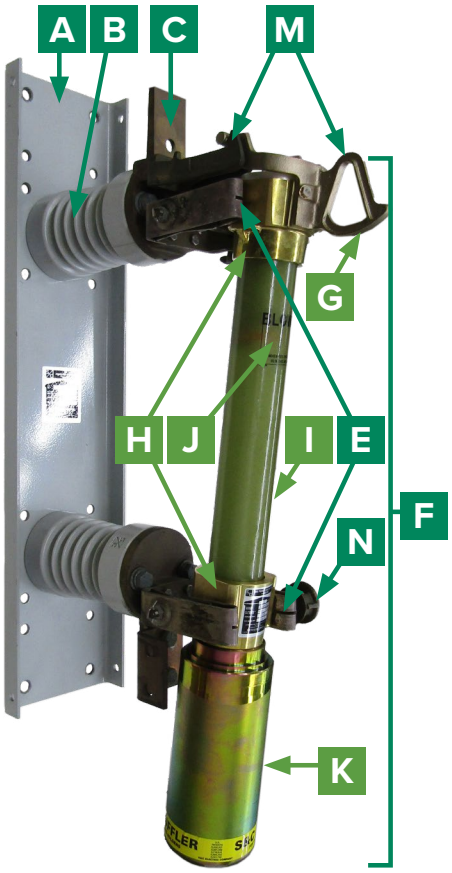


FIGURE 15. Non-disconnect style

FIGURE 16. Parallel-mounted fuse (available in the disconnect style only).

A **Rugged 3⁄16-inch (5-mm) thick flanged, formed-steel base** has numerous mounting holes to facilitate installation

B **S&C Cypoxy Insulators** use S&C's self-scouring, nontracking, nonweathering cycloaliphatic epoxy resin system. There's never a compromise of insulation integrity

C **Bronze two-hole terminal pad** accepts a wide variety of connectors. The parallel-mounted fuse uses aluminum terminal pads (See **Figure 14**, **Figure 15**, and **Figure 16**.)

D **Fuse-holder latch** (disconnect style only)—stainless steel with galvanized-steel stop, provides positive, secure engagement of holder

E **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 in disconnect-style power fuses by a ¼-inch (6-mm) thick galvanized-steel yoke and stainless steel loading springs and, in non-disconnect style power fuses, by phosphor-bronze loading springs and cammed clamps-to ensure minimum electrical resistance at current-transfer points

1 Type SM-5S Power Fuses shown. The Type SM-5SS Power Fuse (not pictured) is similar in construction to the non-disconnect Type SM-5S Power Fuse but carries a super snuffler (in lieu of a snuffler) to provide additional volume and baffling required to achieve higher interrupting rating.

F **Holder**—removable assembly containing the SM-5 Refill Unit. The holder includes the following features:

G **Bronze pull-ring** (disconnect-style power fuses)—large, easily accessible and pivots to pry up latch; **bronze lifting eye** (nondisconnect-style power fuses), for installing or removing the holder

H **Brass upper and lower ferrules**—with broad, machined-flat surfaces for engagement with spring-backed upper and lower contacts

I **Translucent glass-epoxy fuse tube**

J **Blown Fuse indicator window.** Fluorescent fire-orange target within the fuse tube moves to the window position when the fuse operates. Permits positive visual check of fuse condition without removing the holder from the mounting. Target fluoresces in the dark when illuminated with a flashlight

K **Snuffler** (SM-5S Power Fuses)—checks any gases generated by fuse operation. Effectively controls venting. **Super snuffler** (SM-5SS Power Fuse, not pictured)—similar to snuffler but with additional volume and baffling required to achieve the higher interrupting rating of the Type SM-5SS Power Fuse

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

M **Bronze hangers** (non-disconnect style only) for supporting the holder in the mounting

N **Bronze stick-operated clamps** (non-disconnect style only). When clamps are pulled downward to the position shown, holder ferrules are gripped securely in a low-resistance contact

Style	Fuse Type	Ratings				
		kV			Amperes, RMS	
		Nom.	Max.	BIL	Max.	Interrupting[1] (Sym.)
Disconnect 45° opening snuffler vertical	SM-5S	4.8	5.5	60	400E	27 000[2]
		4.8	5.5	60	720E[3]	27 000[2]
		13.8	17	95	400E	25 000
		13.8	17	95	7.20E[3]	25 000
		25	27	150	300E	20 000
		34.5	38	200	300E	17 500
Non-disconnect snuffler vertical	SM-5S	4.8	5.5	60	400E	27 000[2]
		13.8	17	95	400E	25 000
		25	27	150	300E	20 000
		34.5	38	200	300E	17 500
Non-disconnect super snuffler vertical	SM-5SS	13.8	15.5	95	400E	34 000[4]

TABLE 3. Available SM-5S and SM-5SS Power Fuse Mounting Styles and Ratings

1 Refer to **Table 6 on page 24** for additional, detailed information on interrupting ratings.

2 Applies to 7.2-kV refill unit in 7.2-kV holder for 4.8-kV system voltage only. Rating is 37,500 amperes RMS symmetrical for 4.16-kV refill unit in 7.2-kV holder for system voltages through 4.16 kV.

3 Parallel fuses.

4 60-Hertz only.

SML-20 and SML-4Z Power Fuses

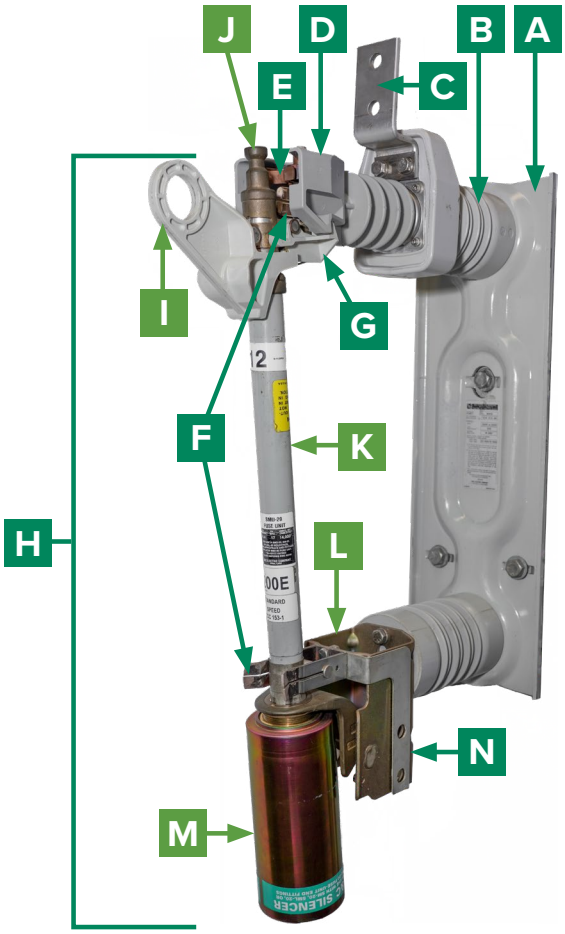


FIGURE 17. SML-20 Power Fuse (45° opening).

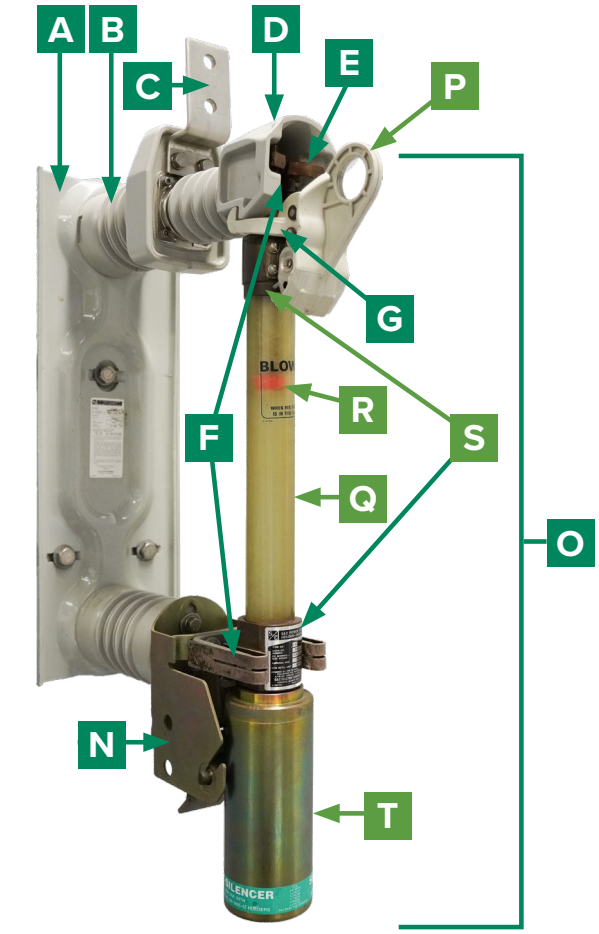


FIGURE 18. SML-4Z Power Fuse (45° opening).

A **Rugged 3⁄16-inch (5-mm) thick flanged, formed-steel base** features three-point mounting to simplify installation and to minimize possibility of deforming base when bolting to an irregular surface

B **S&C Cypoxy Insulators** use S&C's self-scouring, nontracking, nonweathering cycloaliphatic epoxy resin system. There's never a compromise of insulation integrity

C **Two-Inch (51-mm) wide aluminum terminal pad** accepts a wide variety of connectors

D **Uni-Rupter Interrupter** provides 200-ampere single-pole live switching of single-phase and three-phase circuits (refer to **pages 20 through 22** for additional, detailed information on switching with Uni-Rupter Interrupters)

E **Fault-closing contacts**—provide a one-time duty-cycle fault-closing capability equal to the interrupting rating of the fuse (expressed in amperes RMS asymmetrical) and a two-time duty-cycle fault-closing capability of 13,000 amperes RMS asymmetrical; fault-closing contacts also provide self-guiding action for the fuse unit (or holder) during opening or closing

F **Spring-backed upper and lower mounting contacts are copper, heavily silver clad**, and are bifurcated to provide four-point contact at each end of the fuse-unit assembly or holder

G **Pull-ring-operated latch** provides positive, secure engagement of fuse unit assembly or holder

H **SMU-20 Fuse Unit Assembly**—removable assembly including:

- **I** **Upper end-fitting** with large, accessible, and easily operated pull-ring
- **J** **Brilliant-red blown-fuse target** projects from the upper end-fitting when the fuse operates. Fuse condition is easily checked with the fuse in the **Closed** position. Target resets when blown fuse unit is replaced
- **K** **SMU-20 Fuse Unit**—expendable after fault-clearing operation

L **Aluminum-bronze lower end-fitting**—securely engages stainless-steel hinge pivot rod for smooth opening and closing operation

M **Silencer**—S&C's exhaust-control device that virtually eliminates venting. Fuse operation is silent

N **Zinc-plated hot-rolled steel hinge** provides positive, self-guiding action for the fuse unit (or holder) during opening and closing. Current is transferred directly from lower contacts to a separate, tin-plated copper two-hole terminal pad (not visible in photo)

O **SML-4Z Holder**—removable assembly containing the SM-4 Refill Unit. The holder includes the following features:

- **P** **Holder-latch pull-ring**—large, accessible and easily operated
- **Q** **Translucent glass-epoxy fuse tube**
- **R** **Blown Fuse indicator window.** Fluorescent fire-orange target within the fuse tube moves to the window position when the fuse operates. Permits positive visual check of the fuse condition without removing the holder from the mounting. Target fluoresces in the dark when illuminated with a flashlight
- **S** **Brass upper and lower ferrules**
- **T** **Silencer**—S&C's exhaust control device that virtually eliminates venting. Fuse operation is silent

Style	Fuse Type	Ratings					
		kV			Amperes, RMS		
		Nom.	Max.	BIL	Max.	Live Switching	Interrupting[1] (Sym.)
Disconnect 45° opening silencer vertical	SML-20	13.8	17	95	200K or 200E	200	14 000
		25	27	125	200K or 200E	200	12 500
	SML-4Z	13.8	17	95	200E	200	12 500
		25	27	125	200E	200	9 400[2]

TABLE 4. Available SML-20 and SML-4Z Power Fuse Mounting Styles and Ratings

1 Refer **Table 5 on page 23** and **Table 7 on page 25** for additional, detailed information on interrupting ratings.

2 Rating is 12,500 amperes RMS symmetrical 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.

Fuse Handling

Fuse Handling—Disconnect-Style Type SM-20, SM-4Z, and SM-5S Power Fuses

S&C disconnect-style Type SM-20 and Type SM-4Z Power Fuses rated 25 kV and below are best handled using the Grappler™ Handling Tool, which is specially designed for the SMU-20 Fuse Unit and the SM-4Z Holder. The Grappler tool provides the sure grip, perfect balance, and ready control operators appreciate. Its cushion-grip coated prongs provide a non-slip cradle for the fuse, making removal or insertion of fuse units and holders a quick and simple operation. And for Type SM-20 and Type SM-4Z Power Fuses in all voltage ratings, the Grappler tool doubles as a convenient fuse-opening and fuse-closing tool. See **Figure 19** and **Figure 20**.

S&C disconnect-style Type SM-5S Power Fuses rated 13.8 kV and below are best handled using the S&C Large Clamp. This fitting features cushion-grip coated jaws to ensure a non-slip grip of the holder during installation or removal. For convenient handling, the jaws can be preset by a spline lock to any position up to 45 degrees from the axis of the pole. For opening and closing Type SM-5S Power Fuses of all voltage ratings, use of the S&C Station Prong is recommended. See illustration below.

Note: Installation or removal of fuse units or holders for Type SM-20 or Type SM-4Z Power Fuses rated 34.5 kV, and also for Type SM-5S Power Fuses rated 25 kV and 34.5 kV, should be performed by hand because of the substantial weight of the holders and fuse units, but only after the fuse has been de-energized and properly grounded in accordance with local operating procedures. S&C Type SM-20, SM-4Z, and SM-5S Power Fuses are not designed for live-switching duty and must not be opened under load.

Fuse Handling—Non-Disconnect Style Type SM-4Z, SM-5S, and SM-5SS Power Fuses

S&C Type SM-4Z Power Fuses rated 25 kV and below, Type SM-5S Power Fuses rated 13.8 kV and below, and Type SM-5SS Power Fuses rated 13.8 kV- in the non-disconnect style are best handled using the S&C Locking Prong. This prong has an integral "cradle" that engages and steadies the lower edge of the fuse holder's lifting eye during installation or removal of the holder. See **Figure 21 on page 20** and **Figure 22 on page 20**

Note: Installation or removal of holders for Type SM-4Z Power Fuses rated 34.5 kV and Type SM-5S Power Fuses rated 25 kV and 34.5 kV should be performed by hand because of the substantial weight of the holders, but only after the fuse has

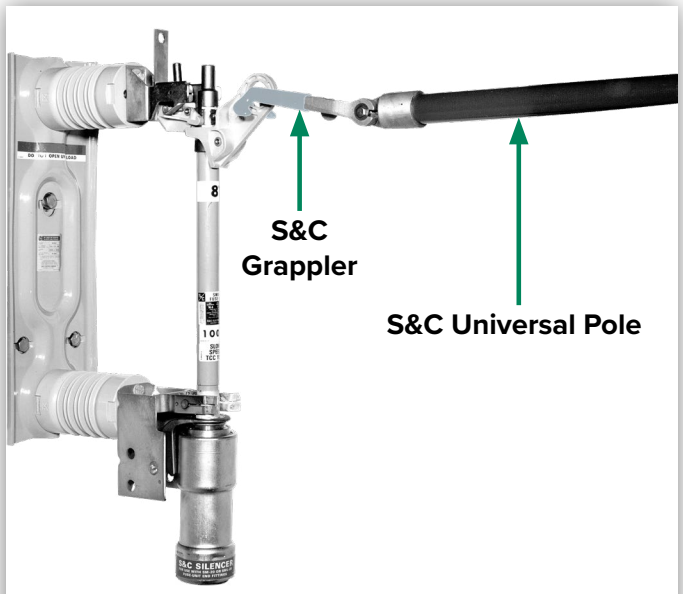


FIGURE 19. Opening or closing a Type SM-20 Power Fuse using a Grappler tool.

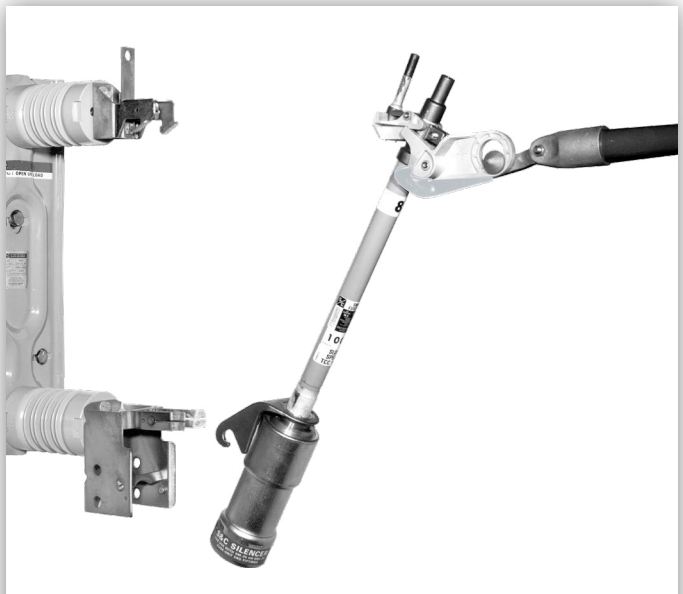


FIGURE 20. Removing or installing an SMU-20 Fuse Unit using a Grappler tool.

been de-energized and properly grounded in accordance with local operating procedures. Fuse holders (for fuses of any voltage rating) must not be installed or removed under load.

FIGURE 21. Opening or closing a disconnect-style Type SM-5S Power Fuse using a station prong.

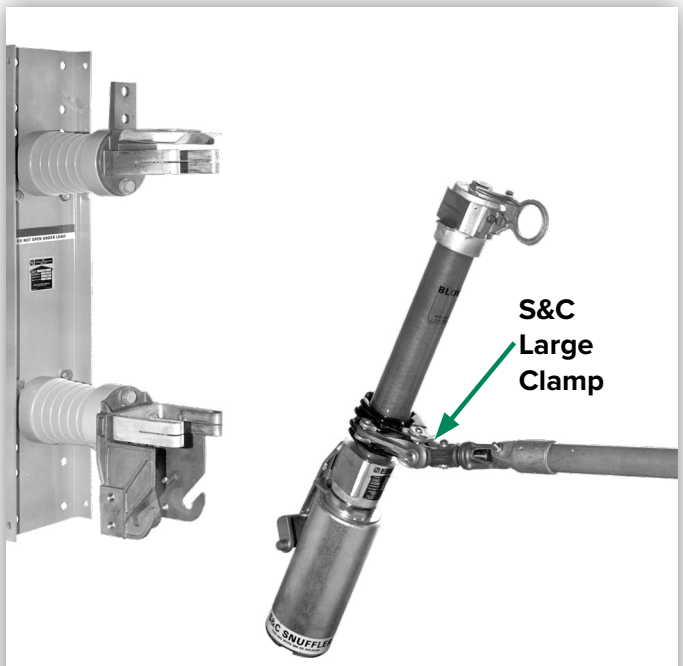


FIGURE 22. Removing or installing an SM-5S Holder (disconnect style) using a large clamp.

Fuse-Handling—Type SML-20 and SML-4Z Power Fuses with Uni-Rupter Interrupters

S&C Type SML-20 and SML-4Z Power Fuses are best handled using S&C's Grappler Handling Tool that features cushion-grip coated prongs for the sure grip and ready control that operators appreciate when removing or installing a fuse unit, holder, or switch blade. And for live-switching operations, a hookstick equipped with Grappler tool (as described below) is all that is required to initiate circuit interruption within Uni-Rupter Interrupters. See **Figure 23** and **Figure 24 on page 21**.

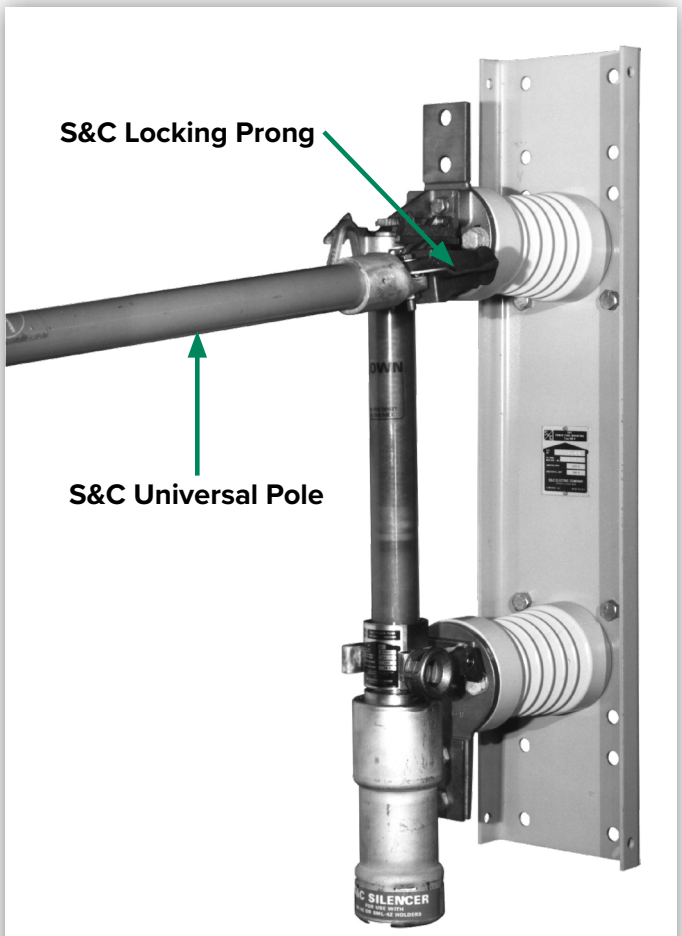


FIGURE 23. Opening or closing stick-operated clamps on a non-disconnect style Type SM-4Z Power Fuse using a locking prong.

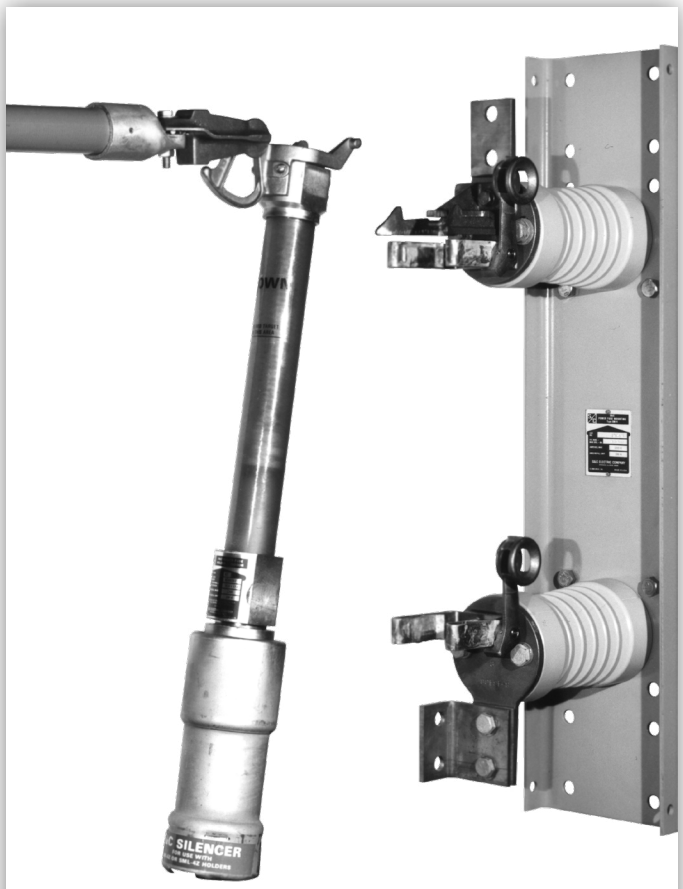


FIGURE 24. Removing or installing a non-disconnect style SM-4Z Holder using a locking prong. Note: Fuse holders must not be installed or removed under load.

FIGURE 25. An up close view of the Uni-Rupter Interrupter, fault-closing contacts, and silver-clad contacts.

Switching With a Uni-Rupter Interrupter

Uni-Rupter Interrupters offer the ultimate in live-switching simplicity: just a firm, steady opening pull on the fuse with a hookstick equipped with a Grappler tool provides quick-break direct-drive 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 thermal reaction of the arc on S&C's uniquely formulated chamber liner and moving-contact trailer. There is no external arc or flame. See **Figure 25**.

At the end of the moving-contact opening stroke, after the arc has been extinguished, the external current-carrying contacts part. Then, the Uni-Rupter Interrupter automatically self-resets for the next opening operation. Switching is easily accomplished without the strained twist-and-pull effort often associated with elbows, without complex gas-assisted or force, multiplying gadgets. The required operating force does not increase with time. And there are no unwieldy cables to wrestle or components to park.

Circuit-closing is easy, too. A swift, nonhesitating stroke with a hookstick is all that's required. The Uni-Rupter Interrupter's fault-closing contacts and the fuse hinge provide an express, self-guiding action for the fuse; there are no hard-to-see components that must be jockeyed into critical alignment before closing.

Circuit-closing inrush currents (including fault currents) are picked up by the fault-closing contacts of the Uni-Rupter Interrupter and the fuse, not by current-carrying, contacts, or interrupting contacts. This allows fault-closing without contact destruction, preserving the operating integrity of Uni-Rupter Interrupter.

Application Notes

S&C Type SML Power Fuses with Uni-Rupter Interrupters are suitable 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—**for S&C Type SML Power Fuses, a one-time fault-closing capability equal to the interrupting rating of the fuse (in amperes RMS asymmetrical: 22,400 for the SML-20 and 20,000 for the SML-4Z at 14.4 kV; 20,000 for either fuse at 25 kV), and a two-time fault-closing capability of 13,000 amperes RMS asymmetrical at 14.4 kV or 25 kV. 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. Following the specified number of such closings (one or two), a Uni-Rupter Interrupter will remain operable and able to carry and interrupt rated current.

Interrupting Ratings

Short-Circuit Interrupting Ratings

The ratings shown in **Table 5 on page 23**, **Table 6 on page 24**, and **Table 7 on page 25** are, by definition, the maximum interrupting ratings of the fuses listed based on 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 encountered in the field.

This involves testing at all degrees of asymmetry and matching 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. 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.

Recognizing 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.

kV, Nominal		Amperes RMS, Interrupting				MVA, Interrupting, Three-Phase Symmetrical, Based on $\frac{X}{R}$=15
			Symmetrical			
SM-4Z and SML-4Z[1]	System	Asymmetrical	Based on $\frac{X}{R}$=15	Based on $\frac{X}{R}$=10	Based on $\frac{X}{R}$=5	
7.2[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
14.4[3]	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**[4]
	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**[4]
	14.4/24.9Y[5]	20 000	12 500	13 700	16 000	540
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**[4]
	34.5	10 000	6 250	6 800	8 000	**375**[4]

TABLE 5. SM-4Z and SML-4Z Power Fuses—60-Hertz Short-Circuit Interrupting Ratings

1 SML-4Z Power Fuses are available in voltage ratings of 13.8 kV and 25 kV, only.

2 Interrupting ratings shown apply to 7.2-kV refill units installed in 7.2-kV SM-4Z Holders and used in 4.8-kV SM-4 Mountings-at system voltages through 4.8 kV.

3 Interrupting ratings shown apply to 14.4-kV refill units installed in 14.4-kV SM-4Z and SML-4Z Holders and used in 13.8-kV SM-4Z and SML-4Z Mountings-at system voltages through 16.5 kV.

4 Nominal rating.

5 Applicable to solidly grounded neutral systems only with fuses connected by a single concentric-neutral cable (or directly coupled) to a transformer or transformers, each with a wye-grounded-neutral primary connection.

kV, Nominal		Amperes RMS, Interrupting				MVA, Interrupting, Three-Phase Symmetrical, Based on $\frac{X}{R}$=15
			Symmetrical			
SM-5S[1]	System	Asymmetrical	Based on $\frac{X}{R}$=15	Based on $\frac{X}{R}$=10	Based on $\frac{X}{R}$=5	
4.16[2]	2.4	60 000	37 500	41 000	48 000	155
	2.4/4.16Y	60 000	37 500	41 000	48 000	**270**[3]
7.2[4]	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
14.4[5] (SM-5S: 50/60-Hertz 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**[3]
	16.5	40 000	25 000	27 400	32 000	715
14.4 (SM-5SS: 60-Hertz 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**[3]
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	750
	14.4/24.9Y	32 000	20 000	21 900	25 600	**860**[3]
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**[3]
	34.5	28 000	17 500	19 200	22 400	**1000**[3]

TABLE 6. SM-5S and SM-5SS Power Fuses—50/60-Hertz Short-Circuit Interrupting Ratings

1 Or SM-5SS where indicated.

2 Interrupting ratings shown apply to 4.16-kV refill units installed in 7.2-kV SM-5S Holders and used in 4.8-kV SM-5 Mountings at system voltages of 2.4 or 2.4/4.16Y kV. For 7.2-kV coordinating-speed refill units installed in 7.2-kV holders and used in 4.8-kV mountings at system voltages of 2.4 or 2.4/4.16Y kV, refer to ratings shown for 7.2-kV SM-5S Power Fuses.

3 Nominal rating.

4 Interrupting ratings shown apply to 7.2-kV refill units installed in 7.2-kV SM-5S Holders and used in 4.8-kV SM-5 Mountings at system voltages through 4.8 kV.

5 Interrupting ratings shown apply to 14.4-kV refill units installed in 14.4-kV SM-5S and SM-5SS Holders and used in 13.8-kV SM-5 Mountings at system voltages through 16.5 kV.

kV, Nominal		Amperes RMS, Interrupting				MVA, Interrupting, Three-Phase Symmetrical, Based on $\frac{X}{R}$=15
SM-20 and SML-20[1] (with SMU-20 Fuse Units)[2]	System	Asymmetrical	Symmetrical			
			Based on $\frac{X}{R}$=15	Based on $\frac{X}{R}$=10	Based on $\frac{X}{R}$ =5	
14.4[3]	7.2	22 400	14 000	15 400	17 900	175
	4.8/8.32Y					200
	12					290
	7.2/12.47Y					300
	7.62/13.2Y					320
	13.8					335
	14.4					**350**[4]
	16.5					400
25	7.2/12.47Y	20 000	12 500	13 800	16 000	270
	7.62/13.2Y					285
	13.8					300
	14.4					310
	16.5					355
	23					500
	14.4/24.9Y					**540**[4]
	23					335
	14.4/24.9Y					365
34.5	27.6	13 500	8 450	9 300	10 800	405
	20/34.5Y					**500**[4]
	34.5					**500**[4]

TABLE 7. SM-4Z and SML-4Z Power Fuses—60-Hertz Short-Circuit Interrupting Ratings

1 SML-20 Power Fuses are available in ratings of 13.8 kV and 25 kV only.
2 These fuse units are also suitable for use in SMD-20 Outdoor Distribution Mountings.
3 Interrupting ratings shown apply to 14.4-kV SMU-20 Fuse Units used in 13.8-kV SM-20 and SML-20 Mountings at system voltages through 16.5 kV.
4 Nominal rating.

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