Outdoor Distribution (15 kV through 25 kV)

S&C Fault Tamer® Fuse Limiter
**Application**

Although the S&C Fault Tamer Fuse Limiter handles like a cutout, its unique design combines the function of a conventional fuse cutout and that of a backup current-limiting fuse in one powerful package. The Fault Tamer Fuse Limiter is a distribution fuse for overhead distribution systems that better addresses the critical issues facing protection engineers today, such as minimizing equipment damage, improving service continuity, enhancing power quality, and improving transformer protection.

Fault Tamer Fuse Limiters are ideally suited for single-phase transformers, for three-phase banks of single-phase transformers, and for three-phase transformers.

**Minimizes Equipment Damage**

The Fault Tamer Fuse Limiter is an energy-limiting fault-interrupting device that can be easily incorporated into new or existing installations of overhead distribution transformers to provide short-circuit protection to the system, limit let-through current to a level that will minimize catastrophic transformer failures from high-magnitude internal faults, and minimize damage from high-magnitude external faults such as bushing flashovers. As a result, the Fault Tamer Fuse Limiter offers an alternative to utilities increasingly concerned about the violent operation of fuse cutouts during fault interruption. Moreover, the Fault Tamer Fuse Limiter complies with Spark Production Class A in Australian Standard AS 1033.1-1990. To be in compliance with Spark Production Class A, no sparks may be produced during a fault-clearing operation (an extremely significant reduction in fire hazard as compared to fuse cutouts).

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**Figure 1.** Limited coordination of a transformer fuse with a lateral fuse.

**Figure 2.** Complete coordination of a Fault Tamer Fuse Limiter with a lateral fuse.
**Improves Service Continuity**

It is usually impossible to achieve complete fuse-link-to-fuse-link coordination close to substations where fault currents can be high. For example, a 20K fuse link will not coordinate with a 65K fuse link above 2,400 amperes, as shown in Figure 1 on page 2. As a consequence, a primary fault at a transformer, such as a bushing flashover caused by a squirrel, can result in both the transformer fuse and the lateral fuse operating so all customers on the lateral will be exposed to an extended outage instead of just those customers served by the transformer involved. By contrast, the fast clearing characteristics of the Fault Tamer Fuse Limiter provide complete coordination with typically sized lateral fuses even at high levels of available fault current. In fact, the Fault Tamer Fuse Limiter coordinates with lateral fuses having ampere ratings as low as 40K, as shown in Figure 2 on page 2.

**Reduces Momentary Outages**

Typical clearing characteristics of fuse links are also too slow to coordinate with the instantaneous settings of substation circuit breakers. As shown in Figure 3, when the available fault current exceeds the instantaneous setting of the breaker, not only will a 20K fuse link protecting a transformer operate for a transformer fault, so, too, will the breaker—resulting in a momentary outage to the entire feeder. The current-limiting action of the Fault Tamer Fuse Limiter, illustrated in Figure 4, prevents these unnecessary instantaneous breaker operations for transformer faults. There’s no longer a need to compromise coordination in high fault areas—a major improvement in service continuity.

![Figure 3. Limited coordination of a fuse link with source-side relays.](image1)

![Figure 4. Complete coordination of a Fault Tamer Fuse Limiter with source-side relays.](image2)
**Enhances Power Quality**

High-magnitude faults near a substation can suppress the voltage at the substation bus as well as on the feeders that emanate from that substation. Voltage dips that last long enough can cause sensitive electronic equipment to shut down. Or, worse yet, they can cause a process to malfunction, potentially resulting in the manufacture of defective parts. The current-limiting action of the Fault Tamer Fuse Limiter clears high-magnitude transformer faults before sensitive equipment can be affected.

Further, laterals downstream from the faulted transformer will be at essentially zero volts until the upstream fault is cleared. Because the Fault Tamer Fuse Limiter will clear faults greater than 2,000 amperes in less than 8.3 milliseconds, power quality is thus maintained to customers on downstream laterals.

**Improves Transformer Overvoltage Protection**

Recent studies have shown that a major cause of overhead transformer failure is voltage surges. Maximum overvoltage protection can be achieved by mounting the surge arrester on the transformer tank, thus minimizing the lead length from the arrester to the transformer winding and to ground. However, with the surge arrester mounted on the load side of the transformer fuse, the fuse is more susceptible to nuisance fuse operations caused by lightning surges.

But with the Fault Tamer Fuse Limiter’s high adiabatic $I^2t$ withstand capability—approximately equal to that of a 20K or a 12T fuse link—the probability of operation caused by lightning surges is less than 1%, even in high isokeraunic areas. Thus, the surge arrester can be located on the load side of a Fault Tamer Fuse Limiter without any added susceptibility to nuisance fuse operations.

**A Note on System Voltage Rating**

A Fault Tamer Fuse Limiter should be selected so that its system maximum three-phase voltage rating is equal to—or greater than—the system line-to-line voltage. To ensure proper coordination of a Fault Tamer Fuse Limiter with system surge arresters, it is also important that the system voltage not be too low relative to the fuse limiter’s system voltage class rating. To satisfy both of these requirements, the following specific system-voltage and minimum surge arrester recommendations should be observed:

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>15 (12)</td>
<td>10 through 15</td>
<td>10 through 15</td>
<td>9</td>
</tr>
<tr>
<td>25 (24)</td>
<td>22 through 29</td>
<td>20 through 26</td>
<td>18</td>
</tr>
</tbody>
</table>

Figure 5. Fault Tamer Fuse Limiter cartridges provide excellent transformer protection and less than 1% probability of operation due to lightning surges.
Handling

The Fault Tamer Fuse Limiter has been designed to retrofit into all vintages of S&C Type XS Fuse Cutout mountings with base catalog numbers 89021, 89031, 89071, and 89221 for the 15-kV class fuse limiter, 89022, 89032, 89042, 89052, 89072, 89092, and 89222 for both the 15-kV class fuse limiter with an extension adapter and the 25-kV class fuse limiter, and 89033 and 89053 for 25-kV class fuse limiter with an extension adapter.

A Fault Tamer Fuse Limiter that has operated can be easily identified from the ground because it drops open. Both the fuse tube and the backup limiter can be quickly removed from the mounting with a telescoping hot stick. By contrast, climbing the pole or using a bucket truck is required to re-fuse bolted-in backup current-limiting fuses.

Re-fusing

Re-fusing is quick and easy. Backup limiters are offered in only one ampere rating size, 20 amperes. Fuse cartridges have ratings of 3, 5, 7, 10, 15, and 20 amperes, all specifically designed to coordinate with the 20-ampere backup limiter. See Figure 5 on page 4. Warehouse and line truck stocking problems are kept to a minimum. Moreover, the backup limiter and fuse cartridge cannot be mismatched, as is possible when fuse cutouts and backup current-limiting fuses are used.

The Fault Tamer Fuse Limiter is also designed to work perfectly with Loadbuster®—The S&C Loadbreak Tool. The Loadbuster tool switching helps keep service interruptions to a minimum. Live switching can be done at the point that minimizes the length of planned outages and at the point where the fewest customers will be involved.

Fault Tamer Components

The Fault Tamer Fuse Limiter consists of four basic components: a mounting (not shown), a backup limiter, a fuse tube, and a fuse cartridge. The fuse cartridge is replaced after each fault-clearing operation. The backup limiter is replaced after a high-magnitude fault-clearing operation. The backup limiter, with integral exhaust control, prevents fuse-cartridge parts from being expelled during a fault-clearing operation. (By contrast, fuse cutouts and even fuse cutouts connected in series with backup current-limiting fuses can expel hot gases and fuse-link particles at high velocity during an operation, resulting in a potential exhaust hazard to operating personnel.)

Figure 6. Components of the Fault Tamer Fuse Limiter.
Figure 7. Catalog number 98021-D rated for 15-kV, 110-kV BIL systems. Also available with composite-polymer silicone insulator.

Figure 8. Catalog number 98072-D rated for 15-kV, 125-kV BIL systems. Includes extension adapter to allow 15-kV Fault Tamer Fuse Limiter components to be installed in 25-kV mounting.

Table 2. Fault Tamer® Fuse Limiter—For new installations.

<table>
<thead>
<tr>
<th>System Class, ANSI (IEC)</th>
<th>Voltage, kV</th>
<th>Amperes, RMS</th>
<th>Leakage Distance to Ground, Minimum, Inches (mm)</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>System Maximum</td>
<td></td>
<td></td>
<td>Porcelain Insulator</td>
</tr>
<tr>
<td></td>
<td>60 Hz</td>
<td>50 Hz</td>
<td>BIL</td>
<td>Max</td>
</tr>
<tr>
<td>15 (12) (see Figure 7)</td>
<td>15</td>
<td>8.7</td>
<td>15</td>
<td>8.7</td>
</tr>
<tr>
<td>15 (12) (see Figure 8)</td>
<td>15</td>
<td>8.7</td>
<td>15</td>
<td>8.7</td>
</tr>
<tr>
<td>25 (24) (see Figure 9)</td>
<td>29</td>
<td>16.8</td>
<td>26</td>
<td>15.1</td>
</tr>
<tr>
<td>25 (24) (see Figure 10)</td>
<td>29</td>
<td>16.8</td>
<td>26</td>
<td>15.1</td>
</tr>
<tr>
<td>25 (24) (see Figure 12)</td>
<td>29</td>
<td>16.8</td>
<td>26</td>
<td>15.1</td>
</tr>
<tr>
<td>22/38 (20.8/36)</td>
<td>—</td>
<td>22</td>
<td>—</td>
<td>20.8</td>
</tr>
</tbody>
</table>

① TCC No. 450-8. Includes mounting, backup limiter, and fuse tube (less mounting bracket, connectors, and Fault Tamer Fuse Limiter fuse cartridge).
② Also applies to phase-to-phase applications. Applications involving single-phase transformers connected phase to phase, as well as three-phase applications require the use of a Fault Tamer in each lead.
▲ Includes an extension adapter for use in mounting with a porcelain insulator having 11-inch (279 mm) leakage distance to ground.
★ Includes an extension adapter for use in mounting with porcelain insulator having 26-inch (660-mm) leakage distance to ground, or a composite-polymer silicone insulator having a 30-inch (762-mm) leakage distance to ground.
■ Meets 170-kV BIL rating requirement of IEC Publication 282-2.
● Applicable only for protection of single-phase transformers in solidly grounded-neutral (multi-grounded-neutral) 34.5-kV systems. Uses a 29-kV, 150-kV BIL mounting.
Figure 9. Catalog number 98022-D rated for 25-kV, 125-kV BIL systems.

Figure 10. Catalog number 98052-D rated for 25-kV, 150-kV BIL systems. Similar in appearance to catalog number 98044-D rated for 25-kV, 150-kV BIL mounting on solidly grounded neutral (multi-grounded neutral) 34.5-kV systems. Both models are available with composite-polymer silicone insulator.

Figure 11. Catalog number 98053-D rated for 25-kV, 150-kV BIL systems. Includes an extension adapter for use in a 25-kV mounting with a porcelain insulator having a 26-inch (660-mm) leakage distance to ground or a composite-polymer silicone insulator having a 30-inch (762-mm) leakage distance to ground.