

UltraSIL™ Transmission Line Surge Arresters

Electrical Apparatus

235-89

GENERAL

Cooper Power Systems UltraSIL™ Transmission Line Surge Arresters provide lightning protection for transmission and distribution systems. On shielded transmission lines or under-built distribution circuits, the arrester prevents tower-to-phase insulator back-flashovers during a lightning strike. On unshielded subtransmission or distribution circuits, this arrester prevents insulator phase-to-ground flashovers.

OPERATION

The Transmission Line Surge Arrester conducts lightning surges around the protected insulator so that a lightning flashover is not created, which would lead to a system fault on the circuit. The arrester becomes a low ohmic path as the surge voltage across it increases. When the surge voltage is dissipated, the arrester returns to a high ohmic device with only microamperes of leakage current.

FEATURES

Reliability Improvement

The primary purpose of the UltraSIL Transmission Line Surge Arrester is to reduce lightning caused outages on sub-transmission, transmission, and distribution lines by eliminating insulator flashover or back-flashover. The transmission line arrester is designed to be installed in parallel with a line insulator.

In the event of a lightning strike to the shield of a transmission line, a voltage potential between the phase conductor and the tower ground lead will be experienced. An excessive potential difference will cause a back-flashover from the tower ground lead to the phase conductor. This back-flashover creates a system fault to ground requiring a breaker operation to interrupt and clear. Elimination of this momentary outage increases reliability and enhances consumer satisfaction.

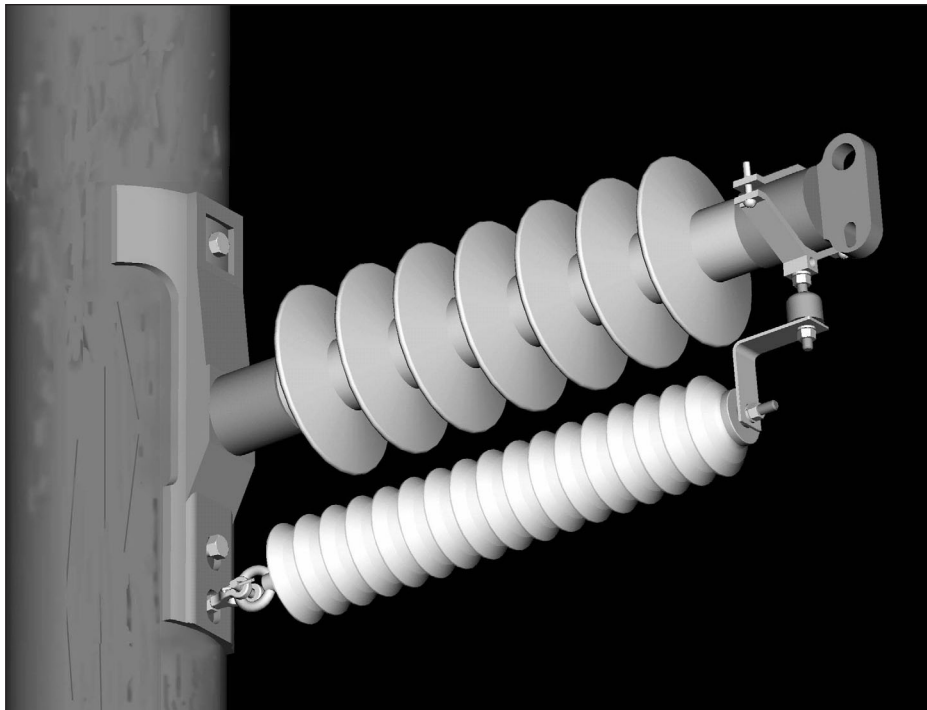


Figure 1.
Typical Transmission Line Arrester installation.

Tower Construction Cost Savings

An additional benefit of this arrester is to lower the first cost of new transmission line construction. This arrester can be used to upgrade the voltage class of a line within the same tower configuration or right-of-way, or to reduce the height of a transmission or sub-transmission system. With a strategic location of arresters, the shield wire can be eliminated and the top phase conductor can be effectively used as the shield for the other phases. This arrangement can have a significant improvement on new construction costs by making construction more compact and transmitting more energy in the same right-of-way with higher reliability or by allowing a system voltage upgrade on the existing structures.

Installation Cost Savings

With the use of this arrester in a suspension configuration or connected across a deadened insulator, reliability can be improved. Often there is no room on the tower or pole to mount a conventional arrester. In this case the line arrester can save installation cost, space, and time.

CONSTRUCTION

Figure 2 shows the unique solid dielectric features of this arrester. It can be seen that there is no place for air, only zinc-oxide or solid dielectric materials. There are no internal springs or washers. This feature insures that moisture ingress is prevented and that there is no internal corona due to air voids. This insures a long life arrester.

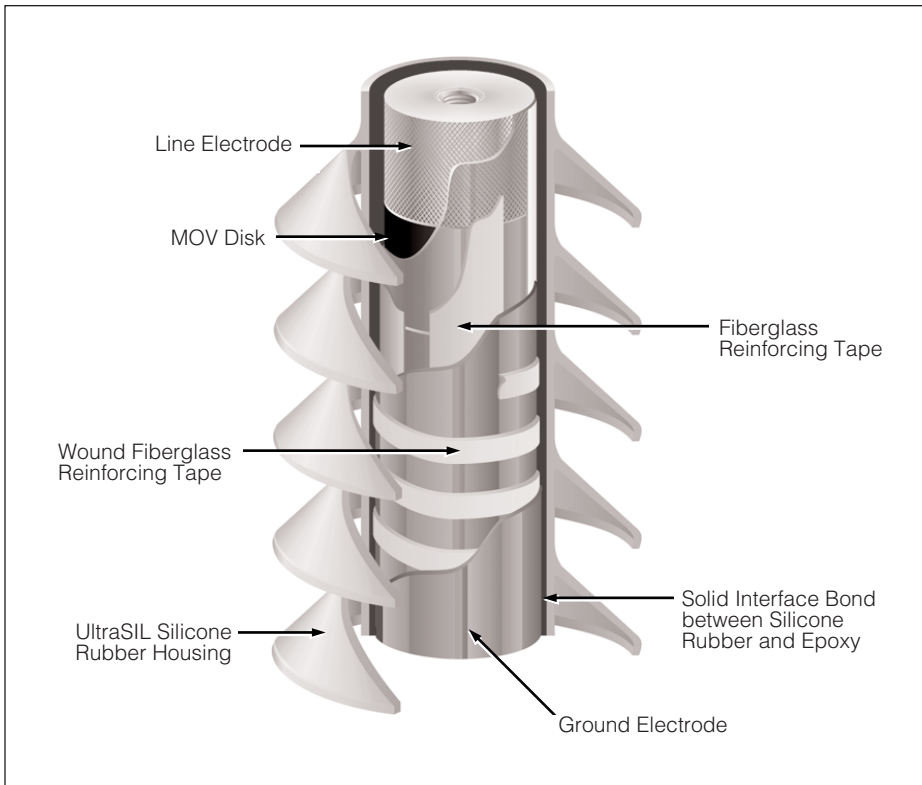


Figure 2.
Typical UltraSIL™ Transmission Line Surge Arrester Construction.

Disconnecter

The optional hermetically sealed disconnecter insures that at the end of the unit's life it will positively disconnect the arrester from the system. The benefit is that a failed arrester will not cause a permanent outage. The disconnecter is not an interrupting device, but a disconnection device. A breaker or fuse must be used to momentarily clear the circuit during a disconnection event.

Epoxy-Fiberglass Structure

The long term mechanical strength of this arrester comes from the unique UltraSIL Housed Module construction. A mix of epoxy with longitudinal and spiral glass reinforcement strips, give the arrester the ability to withstand cantilever and tensile forces.

Silicone Rubber

The silicone rubber housing used on all UltraSIL Arresters has been in service since the early 90s. It has proven to be the best material for all outdoor applications at high voltages. Silicone rubber maintains its hydrophobic nature for the entire life

of the product. This hydrophobic nature results in the lowest surface leakage currents over other arresters in the industry. It should also be noted that because of silicone rubber's superior leakage current resistance, UltraSIL Transmission Line Surge Arresters are shorter, lighter and easier to handle than other polymeric units.

DESIGN CONSIDERATIONS

The arrester is designed for easy installation in parallel with most common insulators. The line and ground option sets allow the user to customize any configuration. The arrester design is fully **IEEE®** certified to C62.11-1999, a certified test report is available under Bulletin Number 95062.

The housing material, internals and hardware work together as a system and will stand up to years of exposure to environmental extremes. To assure a superior level of performance, the components and the assembled arrester units have been subjected to a program of testing that accurately simulates years of exposure to field conditions.

Additional design verification tests of the UltraSIL Transmission Line Surge Arrester include:

- UV Withstand Testing
- Full Dielectric Testing
- Wet Arc Tracking Resistance
- Thermal Shock Test
- Multi-Stress Environmental Test Cycling
- Tracking Wheel Test
- Coefficients of Expansion for Materials Compatibility
- Cantilever Test
- Terminal and Isolator Torque Test

PRODUCTION TESTS

A complete production test program ensures a quality product. Each Metal Oxide Varistor (MOV) receives a series of electrical tests. Quality is maintained with a series of destructive tests performed on every lot of varistors. Listed below are the tests performed on the individual varistors:

- 100% Physical Inspection
- 100% Discharge Voltage Test
- 100% V_{1mA/cm^2}
- 100% Watts Loss Measurement $1.05 \times MCOV$
- High-Current, Short-Duration Test – 100 kA
- Thermal Stability Test
- Aging Test

Each fully assembled UltraSIL Transmission Line Surge Arrester must pass the following production tests:

- 100% Physical Inspection
- 100% Watts Loss Test
- 100% Partial Discharge Test
- 100% Reference Voltage Test

TABLE 1
Recommended Arrester Rating/MCOV

| System Voltage | | Recommended Arrester Rating/MCOV per IEEE™ C62.22 | | | |
|-------------------------------------|-------------------------------------|---|------|---|--------|
| Nominal Line-to-Line Voltage kV rms | Maximum Line-to-Line Voltage kV rms | Effectively Grounded Neutral Circuits (kV rms) | | Temporarily Ungrounded, Impedance Grounded or Ungrounded (kV rms) | |
| | | Rating | MCOV | Rating | MCOV |
| 34.5 | 36.5 | 27 | 22 | 27-45 | 22-36 |
| 46 | 48.3 | 36 | 29 | 36-60 | 29-46 |
| 69 | 72.5 | 54 | 42 | 54-90 | 42-70 |
| 115 | 121 | 90 | 70 | 90-108 | 70-84 |
| 138 | 145 | 108 | 84 | 108-132 | 84-108 |

GENERAL APPLICATION RECOMMENDATIONS

The application considerations for transmission line surge arresters differ from those normally used for arresters applied to protect non-self restoring insulation systems, such as transformers. Conventional surge arresters are applied to have the lowest possible protective characteristics in order to minimize voltage stress on non-self restoring systems – maximizing their economic life.

Transmission Line Surge Arresters are applied such that the insulators are protected from lightning initiated flash-overs at a voltage just below their critical flash-over. This application method:

- reduces arrester operations for duties other than lightning initiated operations.
- reduces the line arrester's necessity to discharge switching surges. Line switching surge energies are a secondary consideration and are substantially reduced per arrester, as the number of transmission line surge arresters in parallel will effectively share this duty.
- permits the line to naturally absorb and dissipate energy to its voltage limits.

A heavy duty arrester design is used, as the unit does not conduct for switching surges on the system, but only when a surge is initiated by lightning. Therefore, its major duty is lightning current conduction. This arrester is fully capable of conducting multiple 100 kA (4/10) impulses without failure or changing characteristics. It is designed for more than 30 years of service life.

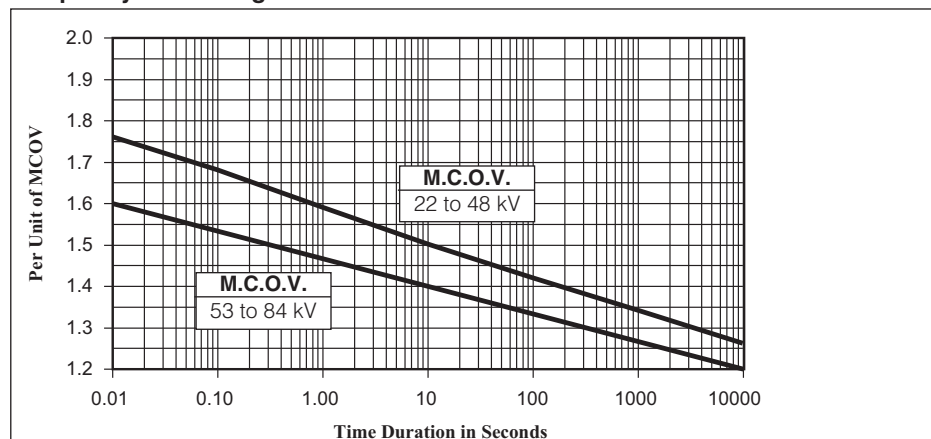
The MCOV of an arrester is the maximum power-frequency, line-to-ground voltage that the arrester will sustain continuously. Table 1 provides a general application guide for the selection of the proper arrester rating

for a given system voltage and grounding configurations as outlined in **IEEE C62.22™** application guide for MOV surge arresters.

Under fault conditions and other system anomalies, higher than normal voltages can be imposed upon an arrester. With an improper arrester selection, these abnormal system voltages can cause an arrester to fail. To help ensure that the proper arrester is selected, Cooper Power Systems application engineers are available to make recommendations. The following information is normally required:

- Maximum system operating voltage.
- System grounding conditions.
 - For four-wire circuits, grounding conditions depend upon whether the system is multi-grounded, whether it has neutral impedance and whether common primary and secondary neutrals are used.
 - For three-wire circuits, grounding conditions depend upon whether the system is solidly grounded at the source, grounded through neutral impedance at the source transformers or ungrounded.
- Available Fault Current.
- Maximum line-to-ground

TABLE 3
Temporary Overvoltage Curve



overvoltage and overvoltage duration during fault conditions.

- Details of the line insulation including the critical wet flashover value of the insulators.
- Shielding of the line.
- Tower grounding and footing resistance.

Consult your Cooper representative to have individual system application needs studied.

Fault Current Withstand Tests

Fault current withstand tests demonstrate the ability to withstand fault currents for specific durations without expelling any internal components. All UltraSIL Transmission Line Surge Arrester designs have been tested in accordance with the requirements listed in **IEEE C62.11™**, and are non-fragmenting to the levels shown below.

TABLE 2
Fault Current Withstand Tests

| Fault Current Amplitude (kA rms) | Fault Current Duration (cycles) |
|----------------------------------|---------------------------------|
| 0.5 | 120 |
| 2.5 | 60 |
| 5.0 | 30 |
| 10.0 | 10 |
| 20.0 | 10 |

TEMPORARY OVERVOLTAGE (TOV) CAPABILITY

The ability to withstand 60 Hz overvoltage conditions [Temporary Overvoltage (TOV)] is shown for transmission line surge arresters. The graph shows, for a given voltage magnitude (on a Per Unit of MCOV), the time an arrester can survive a TOV condition without thermal runaway.

TRANSMISSION SYSTEM APPLICATIONS

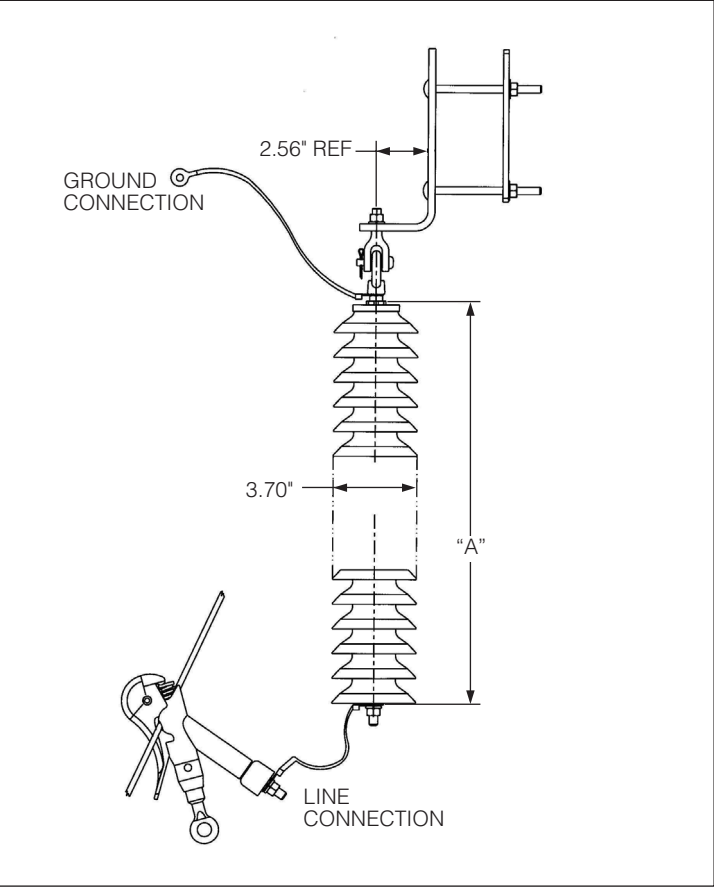


Figure 3.
Arrester suspended from a crossarm.

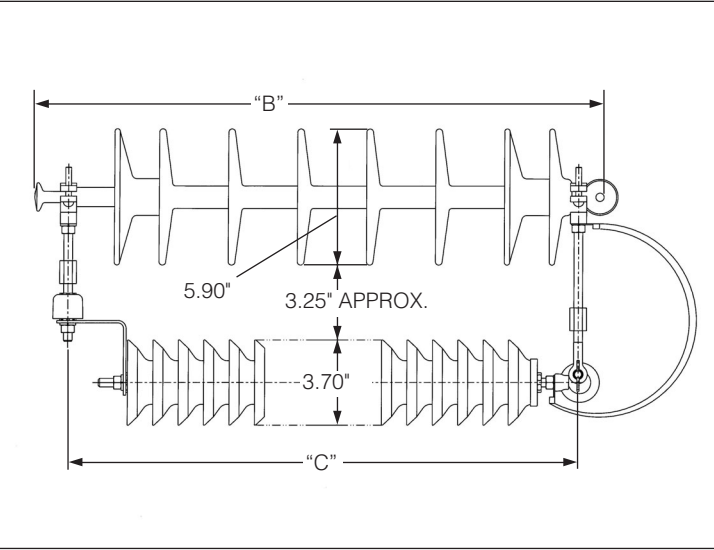


Figure 4.
Arrester on a dead-end insulator.

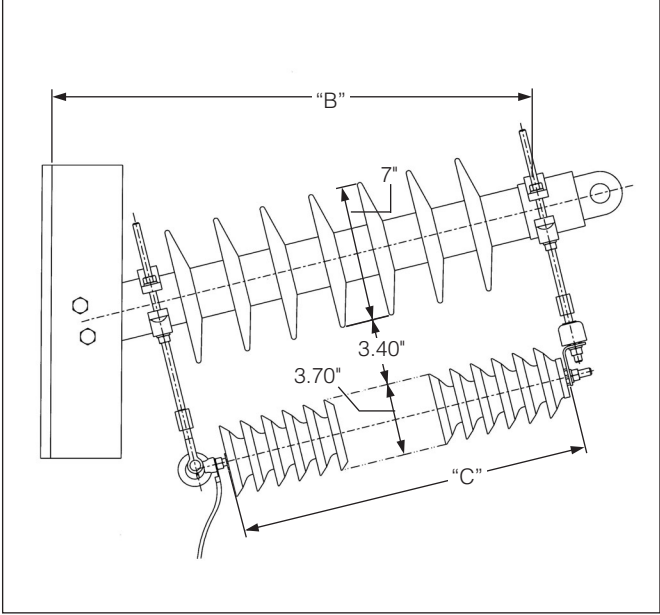


Figure 5.
Arrester on a tangent line post insulator.

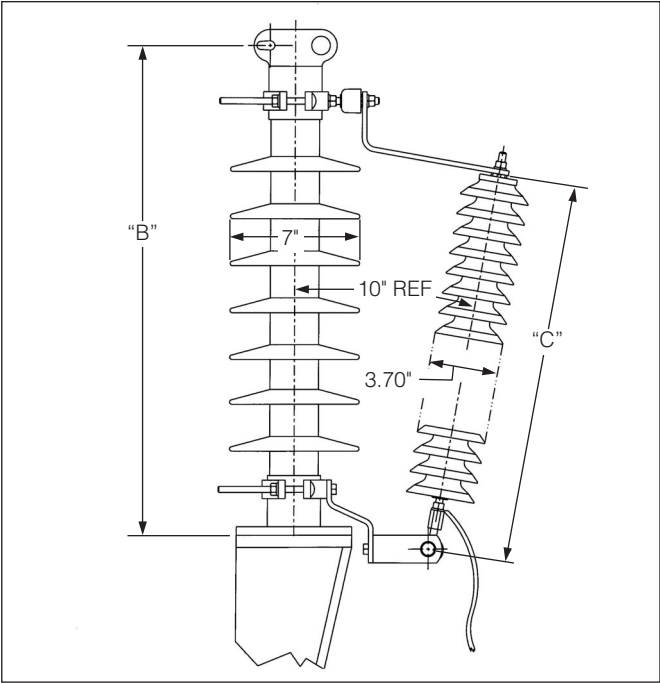


Figure 6.
Arrester mounted on a vertical line post insulator.

NOTE: "B" and "C" dimensions and insulator dimensions vary according to size, rating and hardware attachments.

PROTECTIVE CHARACTERISTICS

UltraSIL Transmission Line Surge Arresters provide excellent insulator flash-over protection for distribution or transmission systems. The protective characteristics of the arrester are shown in Table 4.

TABLE 4
Protective Characteristics

| Catalog Number | Arrester Rating (kV rms) | Arrester MCOV (kV rms) | Front-of-Wave Protective Level (kV Crest) | 8/20 Maximum Discharge Voltage | | | | | |
|--------------------|--------------------------|------------------------|---|--------------------------------|------|------|-------|-------|-------|
| | | | | 1.5 kA | 3 kA | 5 kA | 10 kA | 20 kA | 40 kA |
| UTA 022 12 **** 11 | 27 | 22 | 91 | 68 | 72 | 76 | 82 | 91 | 103 |
| UTA 024 13 **** 11 | 30 | 24 | 101 | 76 | 81 | 84 | 92 | 101 | 114 |
| UTA 026 14 **** 11 | 33 | 27 | 113 | 84 | 90 | 94 | 102 | 113 | 127 |
| UTA 029 15 **** 11 | 36 | 29 | 121 | 91 | 97 | 101 | 110 | 122 | 137 |
| UTA 031 16 **** 11 | 39 | 31.5 | 131 | 99 | 105 | 110 | 119 | 133 | 149 |
| UTA 034 17 **** 11 | 42 | 34 | 142 | 107 | 114 | 118 | 129 | 143 | 161 |
| UTA 036 18 **** 11 | 45 | 36.5 | 151 | 113 | 121 | 126 | 135 | 153 | 171 |
| UTA 039 19 **** 11 | 48 | 39 | 161 | 121 | 129 | 134 | 144 | 163 | 182 |
| UTA 042 20 **** 11 | 54 | 42 | 181 | 136 | 145 | 151 | 162 | 184 | 205 |
| UTA 048 22 **** 11 | 60 | 48 | 202 | 151 | 161 | 168 | 180 | 204 | 228 |
| UTA 053 28 **** 11 | 66 | 53 | 223 | 167 | 178 | 186 | 199 | 225 | 252 |
| UTA 057 30 **** 11 | 72 | 57 | 242 | 181 | 194 | 202 | 216 | 245 | 274 |
| UTA 062 32 **** 11 | 78 | 62 | 263 | 197 | 211 | 220 | 235 | 266 | 298 |
| UTA 068 34 **** 11 | 84 | 68 | 289 | 216 | 231 | 241 | 258 | 292 | 327 |
| UTA 070 34 **** 11 | 90 | 70 | 302 | 227 | 242 | 252 | 270 | 306 | 342 |
| UTA 076 38 **** 11 | 96 | 76 | 323 | 242 | 258 | 269 | 288 | 326 | 365 |
| UTA 084 40 **** 11 | 108 | 84 | 363 | 272 | 291 | 302 | 324 | 367 | 410 |

Notes: **** is determined by the top and bottom terminal hardware selected.

TABLE 5
Housing Characteristics

| Catalog Number | Arrester Rating (kV rms) | Arrester MCOV (kV rms) | Housing Leakage Code | Housing Leakage Distance | Strike Distance | Arrester Length (See Dim. A Fig. 3, Pg. 4) |
|--------------------|--------------------------|------------------------|----------------------|--------------------------|-----------------|--|
| UTA 022 12 **** 11 | 27 | 22 | 12 | 36.1" | 14.2" | 13.2" |
| UTA 024 13 **** 11 | 30 | 24 | 13 | 39.1" | 15.3" | 14.4" |
| UTA 026 14 **** 11 | 33 | 27 | 14 | 42.1" | 16.4" | 15.5" |
| UTA 029 15 **** 11 | 36 | 29 | 15 | 45.1" | 17.5" | 16.6" |
| UTA 031 16 **** 11 | 39 | 31.5 | 16 | 48.1" | 18.6" | 17.7" |
| UTA 034 17 **** 11 | 42 | 34 | 17 | 51.1" | 19.7" | 18.8" |
| UTA 036 18 **** 11 | 45 | 36.5 | 18 | 54.1" | 20.8" | 19.9" |
| UTA 039 19 **** 11 | 48 | 39 | 19 | 57.1" | 21.9" | 20.9" |
| UTA 042 20 **** 11 | 54 | 42 | 20 | 60.2" | 23.0" | 22.1" |
| UTA 048 22 **** 11 | 60 | 48 | 22 | 66.2" | 25.2" | 25.9" |
| UTA 053 28 **** 11 | 66 | 53 | 28 | 86.2" | 32.7" | 31.7" |
| UTA 057 30 **** 11 | 72 | 57 | 30 | 90.7" | 34.2" | 33.2" |
| UTA 062 32 **** 11 | 78 | 62 | 32 | 95.3" | 35.8" | 34.8" |
| UTA 068 34 **** 11 | 84 | 68 | 34 | 104" | 38.9" | 37.9" |
| UTA 070 34 **** 11 | 90 | 70 | 34 | 104" | 38.9" | 37.9" |
| UTA 076 38 **** 11 | 96 | 76 | 38 | 109" | 41.5" | 40.5" |
| UTA 084 40 **** 11 | 108 | 84 | 40 | 122" | 46.1" | 45.1" |

Notes: **** is determined by the top and bottom terminal hardware selected.

TABLE 6
UltraSIL Transmission Line Arrester UltraQUICK Catalog Numbering System

Example of an arrester having a MCOV 42kV rms.

| | | | | | | | | | | | | | |
|--------|---|---|---------------------------|---|---|-----------------|---|------------------|----|--------------------|----|---------|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Prefix | | | Arrester MCOV (kV rms) | | | Housing Code | | Line Terminal | | Ground Terminal | | Packing | |
| | | | | | | | | | | | | | |
| UTA | | | 042 | | | 20 | | 1A | | 1A | | 11 | |

UltraSIL
Transmission Line
Surge Arrester

A – Heavy-Duty Class

See TABLES 7 & 8

Arrester MCOV
(kV rms)

022

024

027

029

032

034

036

039

042

048

053

057

062

068

070

076

084

| Housing Code Selection Table | | | | | | | | | | | | | | | | | | | | | |
|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|--------|
| Housing Code | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 28 | 30 | 32 | 34 | 34 | 38 | 40 |
| Leakage Distance | 33.1" | 36.1" | 39.1" | 42.1" | 45.1" | 48.1" | 51.1" | 54.1" | 57.1" | 60.2" | 63.2" | 66.2" | 69.2" | 72.2" | 86.2" | 90.7" | 95.3" | 104" | 104" | 109" | 120.3" |
| Arrester MCOV kV rms | | | | | | | | | | | | | | | | | | | | | |
| 22 | | * | ○ | ○ | | | | | | | | | | | | | | | | | |
| 24 | | | * | ○ | ○ | | | | | | | | | | | | | | | | |
| 27 | | | | * | ○ | ○ | | | | | | | | | | | | | | | |
| 29 | | | | | * | ○ | ○ | | | | | | | | | | | | | | |
| 32 | | | | | | * | ○ | ○ | | | | | | | | | | | | | |
| 34 | | | | | | | * | ○ | ○ | | | | | | | | | | | | |
| 36 | | | | | | | | * | ○ | ○ | | | | | | | | | | | |
| 39 | | | | | | | | | * | ○ | ○ | | | | | | | | | | |
| 42 | | | | | | | | | | * | ○ | ○ | | | | | | | | | |
| 48 | | | | | | | | | | | | * | ○ | ○ | | | | | | | |
| 53 | | | | | | | | | | | | | * | | * | ○ | | | | | |
| 57 | | | | | | | | | | | | | | | | * | ○ | | | | |
| 62 | | | | | | | | | | | | | | | | | * | ○ | | | |
| 68 | | | | | | | | | | | | | | | | | | * | ○ | | |
| 70 | | | | | | | | | | | | | | | | | | | * | ○ | |
| 76 | | | | | | | | | | | | | | | | | | | | * | ○ |
| 84 | | | | | | | | | | | | | | | | | | | | | * |

* = Standard Leakage Distance Housing
○ = Optional Leakage Distance Housings

ORDERING INFORMATION

Cooper Power System UltraSIL Transmission Line Surge Arresters are supplied in a variety of customer defined options. The catalog system employed allows the purchaser to define the features of the arrester. Table 6 shows the options for the most common arresters. Tables 7 & 8 show what each character in the catalog number represents and list the available line and ground terminal options. A wide variety of option combinations are available, allowing users

to customize the arrester to their specific needs. For further options contact your Cooper Power Systems sales engineer.

TABLE 7
Options

| Option Code | Line and Ground Terminal Option Description (note all hardware comes unattached) | Option Code | Line and Ground Terminal Option Description (note all hardware comes unattached) |
|-------------|--|-------------|---|
| 1A | (Standard line option) 3/8" Stud with hex nut, lock washer and wire clamp | 1H | Isolator, 2 hex nuts, 2 lock washers, and coupling nut |
| 1B | Universal joint (includes eye nut, clevis with pin and cotter pin, hex nut, lock washer and 24" wire rope) | 1J | Line (saddle) Clamp with hex nut and lock washer wire rope |
| 1C | Hotline clamp with hex nut and lock washer | 1K | Dead-End Clevis with eye bolt, (2) hex nuts, coupling nut, wire rope, and lock washer |
| 1D | 6" Threaded extension including 2 hex nuts, 2 lock washers, and coupling nut | 1M | 6" Braided wire rope with hex nut, lock washer, and ring tongue terminals |
| 2D | 12" Threaded extension including 2 hex nuts, 2 lock washers, and coupling nut | 2M | 12" Braided wire rope with hex nut, lock washer, and ring tongue terminals |
| 3D | 18" Threaded extension including 2 hex nuts, 2 lock washers, and coupling nut | 3M | 18" Braided wire rope with hex nut, lock washer, and ring tongue terminals |
| 4D | 24" Threaded extension including 2 hex nuts, 2 lock washers, and coupling nut | 4M | 24" Braided wire rope with hex nut, lock washer, and ring tongue terminals |
| 5D | 30" Threaded extension including 2 hex nuts, 2 lock washers, and coupling nut | 5M | 30" Braided wire rope with hex nut, lock washer, and ring tongue terminals |
| 6D | 36" Threaded extension including 2 hex nuts, 2 lock washers, and coupling nut | 6M | 36" Braided wire rope with hex nut, lock washer, and ring tongue terminals |
| 1E | 6" x 1 3/4" Aluminum bracket with hex nut and lock washer | 2N | 2 x 2" Aluminum angle bracket, hex nut, lockwasher |
| 2E | 12" x 1 3/4" Aluminum bracket with hex nut and lock washer | 3N | 3 x 2" Aluminum angle bracket, hex nut, lockwasher |
| 3E | 18" x 1 3/4" Aluminum bracket with hex nut and lock washer | 4N | 4 x 2" Aluminum angle bracket, hex nut, lockwasher |
| 4E | 24" x 1 3/4" Aluminum bracket with hex nut and lock washer | 5N | 5 x 2" Aluminum angle bracket, hex nut, lockwasher |
| 1F | 6" Lead - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 6N | 6 x 2" Aluminum angle bracket, hex nut, lockwasher |
| 2F | 12" Lead - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 2P | 2 x 2" Aluminum angle bracket with isolator, 3 hex nuts, 3 lock washers, and coupling nut |
| 3F | 18" Lead - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 3P | 3 x 2" Aluminum angle bracket with isolator, 3 hex nuts, 3 lock washers, and coupling nut |
| 4F | 24" Lead - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 4P | 4 x 2" Aluminum angle bracket with isolator, 3 hex nuts, 3 lock washers, and coupling nut |
| 5F | 30" Lead - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 5P | 5 x 2" Aluminum angle bracket with isolator, 3 hex nuts, 3 lock washers, and coupling nut |
| 6F | 36" Lead - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 6P | 6 x 2" Aluminum angle bracket with isolator, 3 hex nuts, 3 lock washers, and coupling nut |
| 1G | 6" Lead with isolator - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 1R | Split ring hanger with hex nut, lockwasher, and bolt |
| 2G | 12" Lead with isolator - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 1S | 6" x 1" Flat aluminum strap with 1 bolt, 1 washer and 1 hex nut |
| 3G | 18" Lead with isolator - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 2S | 12" x 1" Flat aluminum strap with 1 bolt, 1 washer and 1 hex nut |
| 4G | 24" Lead with isolator - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 3S | 18" x 1" Flat aluminum strap with 1 bolt, 1 washer and 1 hex nut |
| 5G | 30" Lead with isolator - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | 4S | 24" x 1" Flat aluminum strap with 1 bolt, 1 washer and 1 hex nut |
| 6G | 36" Lead with isolator - #4 stranded, insulated cable with hex nut, lock washer, and wire clamp | | |

TABLE 8
Combination Options

| Option Code | Line and Ground Terminal Option Description (Note all hardware comes unattached) | Option Code | Line and Ground Terminal Option Description (Note all hardware comes unattached) |
|-------------|--|-------------|---|
| A1 | Universal joint with isolator (includes options 1B and 1H plus 3 hex nuts and 3 lock washers, 1 coupling nut, and wire rope) | E1 | Hotline clamp with isolator and universal joint (includes options 1B, 1C, 1H, plus 3 hex nuts, 3 lock washers, 1 coupling nut, and wire rope) |
| B1 | Line (saddle) clamp with isolator (includes options 1J and 1H plus 3 hex nuts, 3 lock washers and 1 coupling nut) | | |
| C1 | Line (saddle) clamp with Isolator and universal joint (includes options 1J, 1H, and 1B plus 3 hex nuts, 3 lock washers, 1 coupling nut, and wire rope) | | |
| D1 | Hotline clamp with isolator (includes options 1C and 1H plus 2 hex nuts, 2 lock washers and 1 coupling nut) | | |

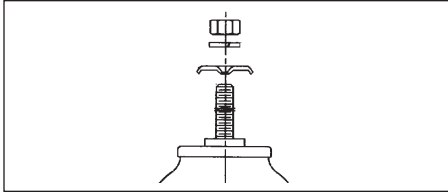


Figure 7.
Option 1A - Wire clamp and nut.

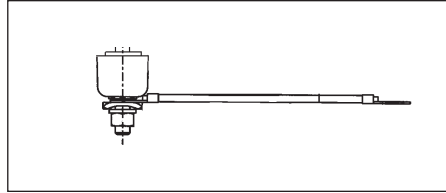


Figure 13.
Option 1G - Isolator with lead.

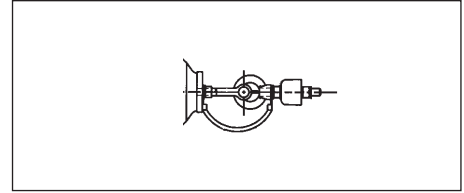


Figure 18.
Option A1 - Universal joint and isolator.

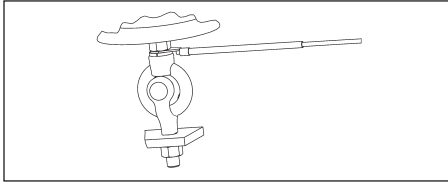


Figure 8.
Option 1B - Universal joint.

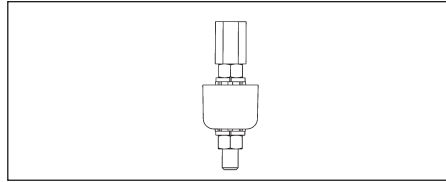


Figure 14.
Option 1H - Isolator with coupling nut.

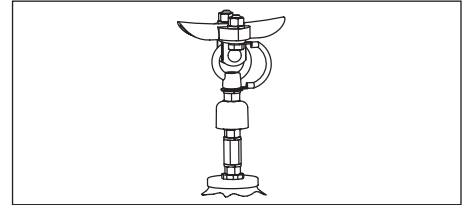


Figure 19.
Option C1 - Line clamp and isolator.

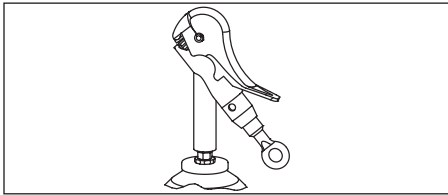


Figure 9.
Option 1C - Hotline clamp.

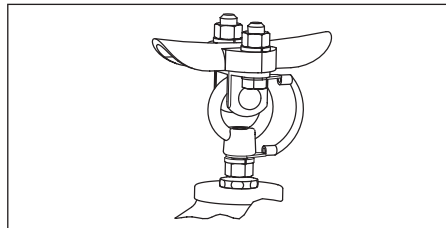


Figure 15.
Option 1J - Line saddle clamp.

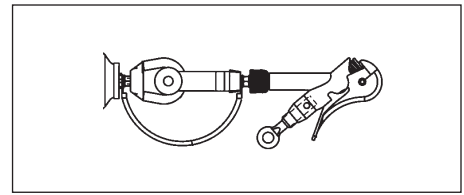


Figure 20.
Option E1 - Universal hotline clamp.

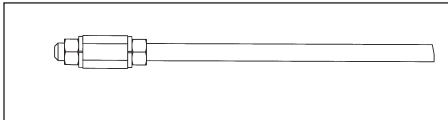


Figure 10.
Option 1D - Threaded extension.

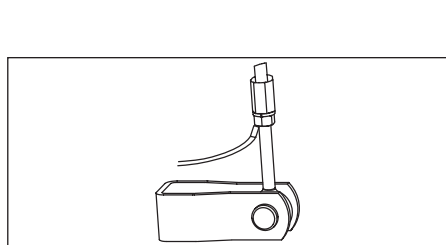


Figure 16.
Option 1K - Dead end clevis.

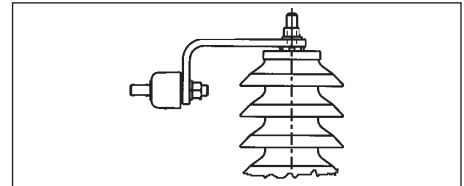


Figure 21.
Option 2P - Aluminum angle bracket and isolator.

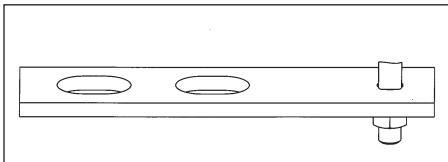


Figure 11.
Option 1E - Aluminum bracket and nut.

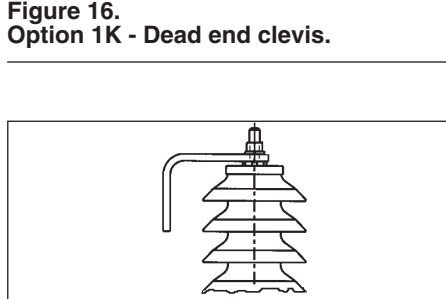


Figure 17.
Option 2N - Aluminum 90° bracket.

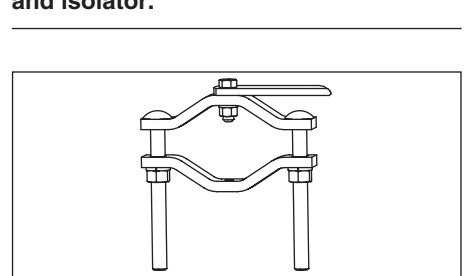


Figure 22.
Option 1R - Split ring hanger.

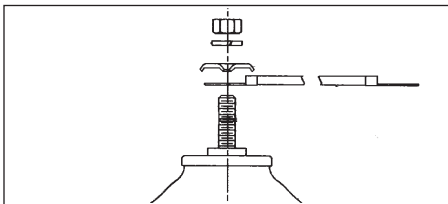


Figure 12.
Option 1F - 6" to 36" #4 lead.

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