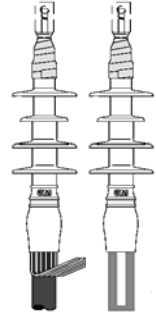


## Quick Term II Silicone Rubber Indoor Termination Kits

5670-I Series (5640 Series)

8.7/15(17.5) - 12/20(24) kV



### 1. Product Description

3M 5670-I series Quick Term II Silicone Rubber Termination Kits are one-piece Cold Shrink terminations for Concentric Neutral (CN), Tape Shield and Wire Shield cable. **They meet the requirements of CENELEC standard HD 628 S1, HD 629.1 S1 for indoor terminations.** The 3M Quick Term II consists of a high dielectric constant (High-K) stress control tube insulated with a molded silicone skirted insulator. There is a four-skirt design rated 12/20(24)kV indoor application. Quick Term II terminations are provided in an expanded state, mounted on a removable inner supporting plastic core. As supplied in this pre-stretched condition the termination is ready for field installation. During installation the core is unwound, allowing termination to shrink and form a tight seal.

### Stress Control

The 3M Quick Term II controls the electric field surrounding the terminated cable insulation shield end, by use of a special high dielectric constant (High-K) material which is an integral part of the termination. The High-K material has a dielectric constant of about 25. By controlling the electrical field, the stress concentration in the applied termination materials and at the air interface is less than 15 volts/mil at rated voltage. In the shielded portion of power cable, the stress concentrations typically vary from 50 volts/mil at the shield to about 70 volts/mil at the conductor. When terminated with the Quick Term II, the stress in the cable underneath this unit is less than it is in the shielded portion of the cable. Figure 1 shows an actual computerized stress plot of the Quick Term II.

### Cold Shrink Insulators

3M Quick Term II Skirted Insulators are constructed of non-tracking silicone rubber that minimizes leakage currents in wetted conditions for three reasons:

1. The smooth surface of the silicone rubber insures that a minimum amount of contamination will adhere to the termination.
2. Silicone rubber has a hydrophobic surface: When condensed water comes in contact with the silicone it **beads** up and runs off the skirts rather than completely wetting these surfaces. Thus a less conductive path is formed on the silicone and leakage currents are lowered.
3. When leakage currents do increase and arcing occurs on the surface, the ash formed by erosion of the silicone insulator is non-organic or nonconductive. Continued degradation is thereby deterred.

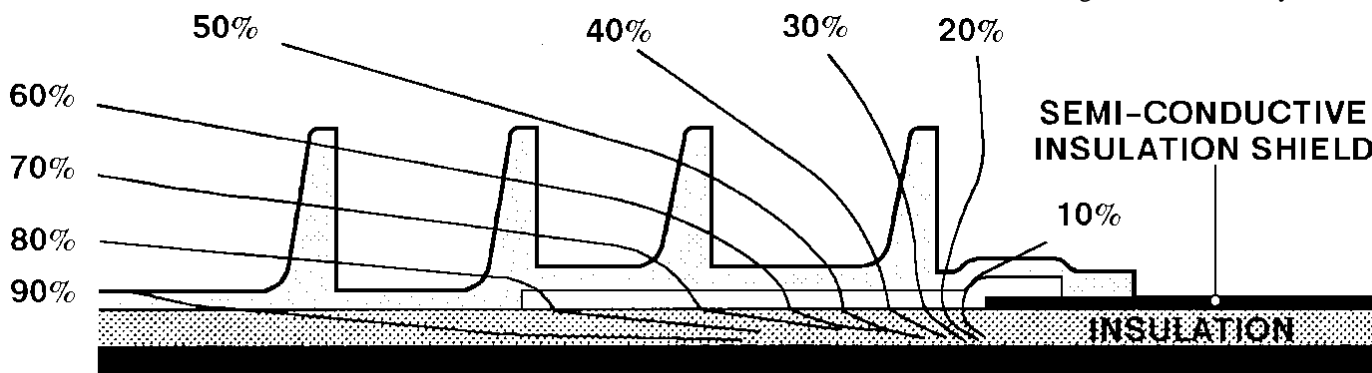


Figure 1

## Kit Contents

Each kit contains sufficient quantities of the following materials to make one termination:

- 1 molded rubber silicone termination
- 1 packets of silicone grease
- 2 strips of Scotch™ 70 Silicone Rubber Tape
- 2 strips of mastic
- 1 instruction sheet

## 2. Applications

The 5670-I Series Quick Term II Silicone Cold Shrink Terminations are used to terminate power cable rated 12/20 (24) kV indoor application having extruded solid dielectric insulation as follows: Polyethylene (high and low density), cross-linked polyethylene (XLP) and ethylene propylene rubber (EPR). The terminations are lightweight for either free-hanging or bracket-mounting arrangements.

## 3. Data: Physical and Electrical Properties

The 5670-I Series Quick Term II terminations can be used on cables with a rated operating temperature of 90°C and an emergency overload rating of 130 °C, (reference: AEIC CS5 and AEIC CS6) These kits meet requirements for **CENELEC standard HD 628 S1, HD 629.1 S1 for indoor terminations.** (See Section5 “Performance Tests”) . The current rating of Quick Term II terminations meets and exceeds the current rating of the cables.

## A. Typical Physical & Electrical Properties

### Silicone Rubber Insulator

#### Physical Properties

Test Method	Typical Value*
- Color	Mussel Gray
- Permanent Set (3M Test Method) 22hours @100 °C (212 °F) 100% ELONGATION 5-minute recovery	8 %

- Ultimate Tensile Strength (ASTM D42-68)	1200 psi (8.28MPa)
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#### Electrical Properties

Test Method	Typical Value
- Dielectric constant (K) (ASTM D150-70) 23°C(73 °F) 90 °C (194 °F) 130 °C (266 °F)	3.4 3.0 2.7
- Dissipation Factor (ASTM D150-70) 23 °C (73 °F) 90 °C (194 °F) 130 °C (266 °F)	0.4% 1.3% 1.2%
- Dielectric Strength (ASTM D149-64 Reproved 1970) 75 mil (1.9mm) gap	507 volts/mil (20 MV/m)
- Track Resistance (ASTM 2303-68) 2.5kV, 10K Ohms 3.25kV, 50K Ohms	30 hrs. 10 hrs.

## EPDM Rubber High-K Stress Control Tube

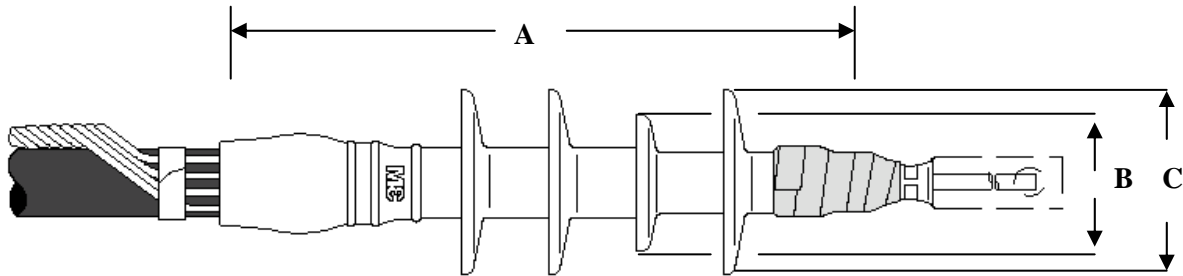
### Physical Properties

Test Method	Typical Value*
- Ultimate Tensile Strength (ASTM D42-680)	1394 psi (9.6Mpa)
- Permanent Set 22 hours @ 100 °C (212 °F) 100% ELOGNATION 15-minute recovery	16%

### Electrical Properties

- Dielectric Constant (K) (ASTM D150-70) 60 Hz: @60% strain @ 400 V @ 3kV	23°C(73°F) 65°C(149°F) 90°C(194°F) vs. frequency @23°C(73°F) 150 Hz 1,000 Hz 10,000 Hz 100,000 Hz	25.7 24.5 25.2 28.8 27.2 27.7 35 29 24 20
- Dissipation Factor (ASTM D150-70) 60Hz: @60% strain @400v @3kV	23°C(73°F) 65°C(149°F) 90°C(194°F) vs. frequency @23°C(73°F) 150 Hz 1,000 Hz 10,000 Hz 100,000 Hz	0.096 0.093 0.161 0.16 0.15 0.14 0.12

\* All values are typical values and are not intended for specification purposes.



### B. Typical Dimensions

Product Number	A (mm)	B (mm)	C (mm)	Creepage Distance	Arcing Distance
5670-I (5641)	254	42.4	68.1	387 mm	267 mm
5670-I-K (5642)	254	46.4	69.8	387 mm	267 mm
5671-I (5643)	279	50.8	82.5	438 mm	292 mm
5671-I-M (5644)	286	50.8	90.2	445 mm	298 mm

### C. Termination Selection Table

Product Number	Primary Insulation O.D Range	Conductor Size Range (mm <sup>2</sup> )	
		12/20(24)kV	8.7/15(17.5)kV
5670-I (5641)	16.2-28.4 mm	35-70	35-95
5670-I-K (5642)	21.3-35.0 mm	95-185	120-240
5671-I (5643)	27.4-45.7 mm	240-400	300-500
5671-I-M (5644)	33.3-53.3 mm	500-630	630-800

## D. Typical Results per CENELEC STD. HD 628 S1, HD 629.1 S1

CENELEC HD 629.1 S1 Test	12/20(24) kV Class	
	Requirement	Result
15 min. w/s dc	72 kV	Pass
5 min. w/s ac	55 kV	Pass
4 hours. w/s ac	48 kV	Pass
Partial discharge at ambient temperature	max 10pC@24kV	<10pC
Impulse w/s +/-	125 kV	Test at 150kV, Pass
Heat cycling in air 126cycles@105C w/s ac	30kV	Pass
Partial discharge at ambient/elevated temperature	max 10pC@24kV	<10pC
Thermal short circuit (screen)/(conductor)	2 surges to max Isc	Pass

Note: Test report is available and refer to the termination body size K(same size as 5670-I series)

(QTH Body size K = QTH No. 5670-I-K = QTH No. 5642)

### 4. Open Specification

The cable termination must be a one-piece Cold Shrink 12/20(24) kV Class device and meet all 12/20 (24) kV requirements for indoor terminations as recorded in CENELEC HD 628 S1, HD629.1 S1. The termination must be a molded rubber unit where the built in stress relief mechanism uses the concept of high dielectric constant capacitance stress grading. The molded rubber insulator must be made from silicone rubber.

### Close Specification

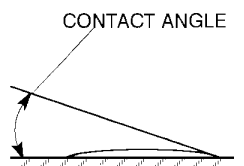
Terminate all 12/20(24) kV class extruded cable in accordance with the instructions in the 3M Brand 5670-I Series Quick Term II Silicone Rubber Termination Kits.

### 5. Performance Test

#### A. Impulse Test (BIL)

In this test a nominal 1.2 x 50 microsecond wave, both positive and negative, is used. Ten consecutive impulses at each polarity are applied. All Quick Term II terminations meet the BIL

#### HYDROPHILLIC

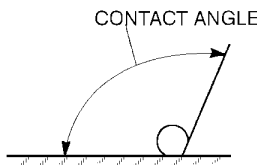


WATER WANTS TO WET ENTIRE SURFACE

#### PORCELAIN

FIGURE 2

#### HYDROPHOBIC



WATER WANTS TO "BALL" UP - NOT WET SURFACE

#### SILICONE

FIGURE 3

requirement as recorded in CENELEC Standard HD 628 S1, HD 629.1 S1 with a considerable amount of safety margin.

### E. Alternating Current Withstand Tests

All terminations meet AC withstand tests as specified in CENELEC Standard HD 628 S1, HD 629.1 S1. See applicable tables "Typical Results per CENELEC STD HD 628 S1, HD 629.1 S1 Tests."

### F. Environmental

RECOVERY OF CONTACT ANGLE FOR QTH SILICONE RUBBER.

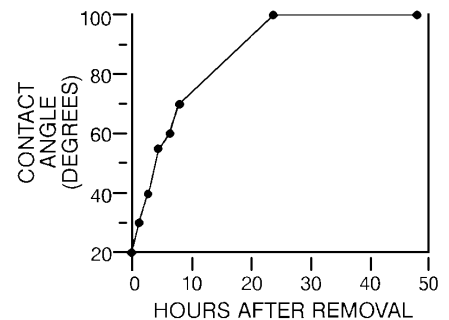


FIGURE 4

#### Performance

When airborne contaminants are deposited on a termination surface destructive leakage currents can be initiated when the surface becomes wet. Fog and drizzle are worse than rain. Rain tends to wash the pollutants off the

termination while fog will wet the pollutants making the surface conduction to varying degrees promoting leakage current formation. This is most typical of hydrophilic surfaces typified by porcelain (Figure 2). The surface of 3M Quick Term II silicone insulator is hydrophobic which make it less likely to erode or track because the surface does not wet readily. (Figure 3). This either prevents or minimizes leakage current formation. On occasion severe environmental conditions can be sustained for long time periods and cause any polymeric surface to lose its hydrophobicity. Because of this, EPDM polymers tend to lose their hydrophobicity over time, and porcelain surfaces become increasingly hydrophilic with time, which will result in premature failure or flashover. However, the silicone surface will re-establish its hydrophobic surface within 24 hours (Figure 4). This unique ability of the Quick Term II silicone is a major factor to insure long service life.

### **E. Sealing**

The bottom seal on shielded power cable is formed with mastic placed under and over the flat ground strap or wire shield, which is then over-wrapped with vinyl tape. The tape wrap compresses the mastic to provide a moisture seal around

the ground strap or wire shield. The elongated base of a 5670-I Series Quick Term II Cold Shrink insulator covers the cable jacket end and tape/ mastic region to complete the seal. The top seal on the lug is provided by the use of Scotch 70 Silicone Rubber Electrical Tape.

### **F. Ultraviolet Resistance**

After 1,000 hours of testing in a Weather-O-Meter according to Specifications ASTM D750 and ASTM G23, the silicone insulator exhibited no crazing, cracking or change in surface appearance. Silicone rubber, unlike carbon based elastomers, is inherently stable under exposure to sunlight. This is because of the silicone molecular backbone (the silicon-oxygen bond) has bond strength greater than the ultraviolet energy of sunlight while the carbon-carbon bond of an EPDM elastomer is less than sunlight.

### **6. Installation Techniques**

A detailed instruction sheet regarding proper installation is included in each kit. A brief summary of these procedures is as follows:

- A. Prepare cable according to standard procedure.
- B. Install lug using appropriate crimp tool.

- C. Apply a liberal coating of silicone grease to the edge of the cable semi-conductive insulation shield.
- D. Place termination over cable and unwind the core allowing the termination to shrink into place.
- E. Install ground strap and apply 70 tape top seal.

### **7. Availability**

3M 5670-I Series Quick Term II Molded Silicone Rubber Termination Kits can be purchased through your local authorized 3M electrical distributors.

### **8. Shelf Life**

3M 5670-I Series Quick Term II Silicone Rubber Termination Kits are packaged one termination per carton. As provided in the expanded state, terminations have an on-shelf storage life of five years from date of manufacture.

Maximum recommended storage temperature is 110°F(43°C). They are not affected by freezing storage temperatures. The year and quarter of manufacture is molded into the base of each Quick Term II termination. Stock rotation practice is recommended.

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## **Important Notice**

Before using this product, you must evaluate it and determine if it is suitable for your intended application. You assume all risks and liability associated with such use.

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