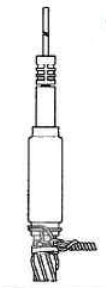
# 3M™ Cold Shrink Hi-K Silicone Rubber Termination Kits QT-II, 5670 Series



**Data Sheet** **July 2010**

| | |
|---|---|
| **Description** | 3M™ Cold Shrink Hi-K Silicone Rubber Termination Kits QT-II, 5670 Series are one-piece, 15kV, non-skirted terminations classified as IEEE Standard 48, Class 3 Terminations. They consist of a Hi-K (high dielectric constant) stress control tube insulated with a silicone rubber insulator, pre-stretched together onto a removable cold shrink core. The kits are designed for terminating 15 kV rated concentric neutral (CN) or jacketed concentric (JCN) #2 AWG solid to 100 kcmil stranded cables with a primary insulation diameter of 0.637" to 1.10" (16,2 to 4,6 mm). |
| **Kit Contents** | Each kit contains sufficient quantities of the following materials to make one termination (lug is not included in kit).<br>• Hi-K silicone rubber termination<br>• Silicone rubber terminator<br>• Packet of silicone grease<br>• Instruction sheet |
| **Features** | • IEEE Standard 48, Class 3<br>• One-piece design; versatile, allowing quick installation and accommodating a wide range of cable sizes<br>• Cold shrink design; easy to install - simply place termination over prepared cable and unwind core to shrink into place (no force fit required)<br>• Specially-formulated, high-impulse, Hi-K material; controls voltage distribution of the electrical field and requires a short cable semi-con cut-back for compliance with BIL requirements<br>• Compatible with polyethylene, cross-linked polyethylene (XLP) and ethylene propylene rubber (EPR) cables<br>• Same installation procedure for both CN and JCN cables |
| **Stress Control** | QT- II terminations control the voltage distribution of the electrical field by use of a special high dielectric constant material, which is built-in as an integral part of the termination. The Hi-K material has a dielectric constant (K) of approximately 30, which capacitively distributes the field that surrounds the termination.<br><br>Electrical flux is regulated to equalize the electrical stresses in a controlled manner along the entire termination area, extending beyond the cable's shield cut-off. By controlling the electrical field, the stress concentrations within the installed termination and on the termination's insulator/air interface, are kept below 10 Volts/mil at rated voltage. Within a 15kV cable, the stress concentrations in a continuous length of shielded cable are typically 50 Volts/mil adjacent to the shield to about 70 Volts/mil at the conductor. The 5671 and 5672 series reduce the cables stresses at the termination to less than those in the continuous shielded portion of the cable. |

**Stress Control, *continued***

The figure below illustrates an actual computerized stress plot of the 3M™ Cold Shrink Hi-K Silicone Rubber Termination Kits QT-II, 5670 Series.

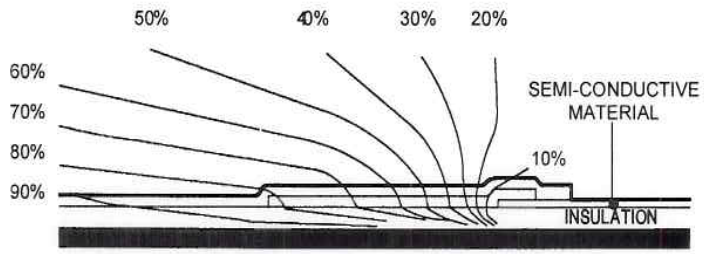



Figure 1

**Applications**

To terminate 15 kV concentric neutral (CN) or jacketed concentric neutral (JCN) cables:

- For class 3 terminations which can be used in environmentally protected areas per service conditions described in IEEE Standard 48
- For solid dielectric cables; polyethylene, cross-linked polyethylene, ethylene propylene rubber
- For free hanging or bracket mounting arrangements
- For upright or inverted installations

**Typical Properties**

Not for specifications. Values are typical, not to be considered minimum or maximum. Properties measured at room temperature 73°F (23°C) unless otherwise stated.

QT-II terminations can be used on cables with a rated operating temperature of 90°C and emergency overload rating of 130°C.

Terminations constructed from these kits meet the requirements of IEEE 48 “Standard Test Procedures and Requirements for High Voltage Alternating Current Cables Terminations” as 15 kV, Class 3 Terminations. (See “Performance Tests” section of this data sheet) The current rating of these kits meets or exceeds the current rating of the cables on which they are installed.

**A. Termination Selection Table**

| Kit Number | Cable Insulation O.D. Range | 15 kV Conductor Range (AWG & kcmil) |
|---|---|---|
| 5671 | 0.637” - 1.120” (16,2 - 28,4 mm) | #2 - 250 |
| 5672 | 0.94 - 1.810” (23,9 - 46,0 mm) | 250 - 1000 |

**B. Typical Dimensions**

| Kit Number | Dimension A | Dimension B |
|---|---|---|
| 5671 | 6.0” (52 mm) | 8.0” (203 mm) |
| 5672 | 6.0” (52 mm) | 8.0” (203 mm) |

NOTE: Dimensions are the same for JCN Cable

**Typical Properties,** ***continued***

Not for specifications. Values are typical, not to be considered minimum or maximum. Properties measured at room temperature 73°F (23°C) unless otherwise stated.

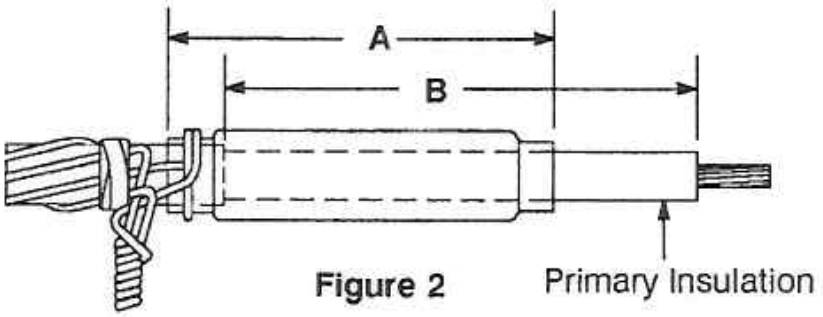



Figure 2

**Silicone Rubber Insulator**

| **Physical Properties (Test Method)** | **Typical Value** US units (metric) |
|---|---|
| **Color** | Munsel Grey |
| **Permanent Set** (3M Test Method)<br>70 hrs @ 90°C<br>100% elongation<br>5 min. recovery | 9% |
| **Ultimate Tensile Strength** (ASTM D-42) | 1200 psi (8.28 MPa) |

| **Electrical Properties (Test Method)** | **Typical Value** US units (metric) | |
|---|---|---|
| **Dielectric Constant (S.I.C.)** (ASTM D-I50)<br>23°C (73°F)<br>90°C (194°F)<br>130°C (266°F) | <br>3.4<br>3.0<br>2.7 | |
| **Dissipation Factor** (ASTM D-I 50)<br>23°C (73°F)<br>90°C (194°F)<br>130°C (266°F) | <br>0.4%<br>1.3%<br>1.2% | |
| **Dielectric Strength** (ASTM D-149)<br>75 mil gap | <br>507 V/mil (20.0 MV/m) | |
| **Track Resistance** (ASTM 2303)<br>2.5 kV<br>3.25kV | <br>10 kOhms<br>50 kOhms | <br>30 hrs.<br>10 hrs. |

**Typical Properties, *continued***

Not for specifications. Values are typical, not to be considered minimum or maximum. Properties measured at room temperature 73°F (23°C) unless otherwise stated.

**EPDM Rubber Hi-K Stress Control Tube**

| **Physical Properties (Test Method)** | **Typical Value** US units (metric) |
|---|---|
| **Permanent Set** (3M Test Method)<br>22 hrs @ 100°C (212°F)<br>100% elongation<br>30 min. recovery | 20% |
| **Ultimate Tensile Strength** (ASTM D-412) | 1394 psi (9.6 MPa) |

| **Electrical Properties (Test Method)** | **Typical Value** US units (metric) | |
|---|---|---|
| **Dielectric Constant (K)** (ASTM D-150) | | |
| 60 Hz @ 60% Strain | @ 400 v | @3000 v |
| 23°C (73°F) | 25.7 | 28.8 |
| 65°C (149°F) | 24.5 | 27.2 |
| 90°C (194°F) | 25.2 | 27.7 |
| Vs. frequency (@ 23°C) | | |
| 150Hz | 35 | |
| 1,000Hz | 29 | |
| 10,000Hz | 24 | |
| 100,000Hz | 20 | |
| **Dissipation Factor** (ASTM D-I 50) | | |
| 60 Hz @ 60% Strain | @ 400 v | @3000 v |
| 23°C (73°F) | 0.096 | 0.166 |
| 65°C (149°F) | 0.093 | 0.165 |
| 90°C (194°F) | 0.132 | 0.161 |
| Vs. frequency (@ 23°C) | | |
| 150Hz | 0.16 | |
| 1,000Hz | 0.15 | |
| 10,000Hz | 0.14 | |
| 100,000Hz | 0.12 | |

**Product Specifications**

The cable termination must be a 15 kV Class device and meet all the requirements set forth in IEEE Standard 48 for a Class 3 Termination. The termination stress control shall be of the stress grading method, constructed of EPDM Rubber. The termination insulator shall be constructed of a silicone rubber, Munsel gray in color. The termination and stress relief must be a one-piece, pre-stretched cold shrink design.

**Engineering/ Architectural Specifications**

Terminating of all 15 kV Class concentric neutral and jacketed concentric neutral cable with Class 3 terminations shall be performed in accordance with instructions contained in the 3M™ Cold Shrink Hi-K Silicone Rubber Termination Kits QT-II, 5670 Series.

**Performance Tests**

**IEEE Standard 48 Tests**

| Insulation Class (kV) | BIL (kV-crest) | 60 Hz 1 min. dry withstand (kV-rms) | 60 Hz 6 hr. Dry withstand (kV-rms) | dc 15 min. dry withstand (kV-avg.) | Corona Extinction Voltage @ 3pc (kV min.) |
|---|---|---|---|---|---|
| 15 | 110 | 50 | 35 | 75 | 13.0 |

Table C

**Operating Temperatures**

| Insulation Class (kV) | Normal Operation (deg .C) | Emergency Operation (deg. C) |
|---|---|---|
| 15 | 90 | 130 |

(reference: AEIC CS5 and AEIC CS6)

Table D

**Typical Performance of QT-II 5670 Series**

| Tests | Results |
|---|---|
| Minimum 1 min. withstand | 15 kV Class (5671 & 5672) |
| Minimum 6 hr. withstand | 50 kV-rms |
| Average Corona: CSV | 35-kV-rms |
| CEV | 27 kV-rms |
| Minimum 15 min. dc withstand | 23 kV-rms |
| Avg. max. impulse withstand | 75 kV-dc |
| | +150 kV-crest |
| | -150 kV-crest |

Table E

**Corona Tests**

The purpose of Corona testing is to ensure that all properly installed terminations operate corona-free at a minimum of 150% of their operating voltage. For this test, the applied test voltage is gradually increased until high frequency discharges appear on the test set's oscilloscope display. The voltage at which these discharges reach a magnitude of 3 pC is recorded as the Corona Starting Voltage (CSV). The applied voltage is then lowered until the discharge level drops below 3 pC, and this is recorded as the Corona Extinction Voltage (CEV).

**Alternating Current Withstand Tests**

Both terminations meet the IEEE Standard 48 requirements for a Class 3 Termination. As the terminations are specified for indoor (weather-protected) applications, the 60 Hz 10 second wet withstand test does not apply.

**Lighting Impulse Tests**

For these tests, a normal 1.2 X 50 micro-second voltage wave is applied to the termination's lug. The testing consists of both positive and negative polarity surges per IEEE Standard 48 BIL requirements. The 3M™ Cold Shrink Hi-K Silicone Rubber Termination Kits QT-II, 5670 Series exceed these BIL requirements.

**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. Apply a liberal coating of silicone grease to the cable semi-con cutoff edge.

C. Install termination onto cable, and unwind core allowing termination to shrink into place. Figure 3.

D. Connect neutral wire to base of termination and install a lug or terminal. Figure 4.

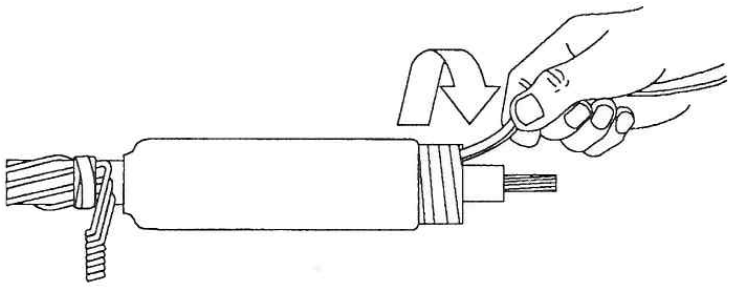


Figure 3

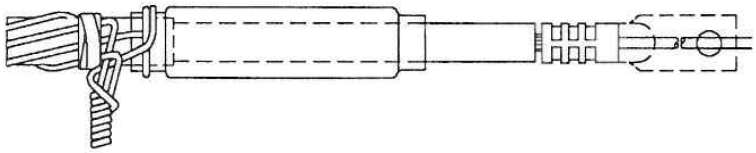


Figure 4

**Maintenance**

The components of the 3M™ Cold Shrink Hi-K Silicone Rubber Termination Kits QT-II, 5670 Series are not impaired by freezing or heating due to ambient temperatures found in storage or shipping. Normal storage and stock rotation are recommended.

These terminations can be field tested by using normal cable testing procedures (Reference: ANSI/IEEE Standard 400 “Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field”).

**Shelf Life & Storage**

As provided in the expanded state, the 5670 Series have an on-shelf life of 3 years from date of manufacture when stored in a humidity controlled storage (10°C/50°F to 27°C/80°F and <75% relative humidity).

**Availability**

Please contact your local distributor; available from 3M.com/electrical [Where to Buy] or call 1-800-245-3573.

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