3M™ Cold Shrink QT-II

Silicone Rubber Termination Kit
5620K Series, for 5–15 kV

Data Sheet

1. Product Description

3M™ Cold Shrink QT-II Silicone Rubber Termination Kits 5620K Series contain one-piece, non-skirted, silicone rubber terminations, qualified as IEEE Class I for weather-protected applications. Termination assemblies consist of a high dielectric constant (High-K) stress control tube insulated with a non-tracking silicone rubber insulator, prestretched and loaded together onto a removable core. The kits are designed for terminating solid dielectric shielded power cable rated 5 through 15 kV, with ribbon shield, wire shield and UniShield® constructions.

Kit Contents:

Each kit contains sufficient quantities of the following materials to make three single-phase terminations (compression lugs are not included in the kit).

3 High-K, Tracking Resistant, Silicone Rubber Terminations

3 Mechanical Ground Strap Assemblies

9 Strips Scotch® Mastic Strip 2230 (black with white release liners, bagged)

3 Strips Scotch® Electrical Shielding Tape 24 (Used for Wire Shielded Cable only)

3 Strips Scotch® Self-Fusing Silicone Rubber Electrical Tape 70 (except 5625-K Kit which has one roll)

3 3M™ EMI Copper Foil Shielding Tape 1181 Strips, 1/2" x 10"

3 Packs of Silicone Grease

1 3M™ Cable Cleaning Preparation Kit CC-2

1 Instruction Manual

Termination Features:

- Conforms to IEEE Standard 48 requirements for Class I, 15 kV terminations.
- One-piece versatile design, allowing quick installation and accommodating a wide range of cable sizes.
- Cold Shrink delivery system for easy installation. Simply place termination over prepared cable and unwind core to shrink into place (no force fit required).
- High-K stress control. Specially formulated high-impulse material minimizes surface stress by uniformly distributing the electrical field over the entire surface of the insulator.
- Compact design provides for easier installation in restricted spaces.
- Silicone rubber insulators and EPDM stress control tubes are compatible with all common solid dielectric insulations, such as polyethylene, cross-linked polyethylene (XLP), and ethylene propylene rubber (EPR).

Stress Control

The QT-II termination is designed to control the electric field stress distribution with a special High-K material which is an integral part of the termination. The High-K material, with a dielectric constant (K) of approximately 30, capacitively distributes the field that surrounds the termination.

Electrical flux is refracted to distribute the voltage stress in a controlled manner along the entire termination length extending beyond the cable shield cutoff. By controlling the electrical field, the stress concentrations within the installed termination and on the termination insulator surface are kept below 15 volts per mil at rated voltage. Within a 15 kV cable, the stress concentrations in a continuous length of shielded cable are typically 50 V/mil adjacent to the shield to about 70 V/mil at the conductor. The QT-II termination is designed to reduce cable stresses at the termination to less than those in the continuous shielded portion of the cable.

The figure below illustrates an actual computerized stress plot of the QT-II termination.

⚠ CAUTION

Working around energized electrical systems may cause serious injury or death. Installation should be performed by personnel familiar with good safety practice in handling electrical equipment. De-energize and ground all electrical systems before installing product.

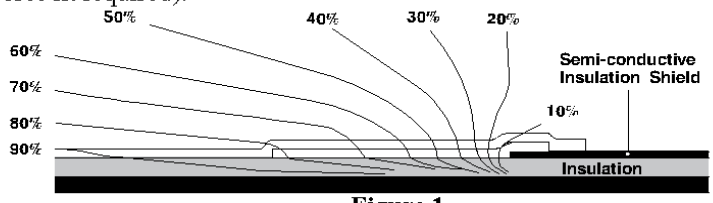

Figure 1

2. Applications

Designed for:

- 5, 8, and 15 kV voltage classes.
- Tape-shielded, wire-shielded, and UniShield® cables.
- Solid dielectric insulations, such as polyethylene, XLP, and EPR.
- Contaminated and non-contaminated indoor (weather-protected) locations.
- Free-hanging or bracket-mounting arrangements.
- Upright or inverted installations.
- Switchgear, transformer, motor lead, bus, and similar connections.

3. Environmental Classification Note

Indoor terminations, such as the 3M™ Cold Shrink QT-II Termination Kit 5620K/6020K series products, can be specified for most outdoor, pad-mounted switchgear and transformer applications, since these enclosure interiors are protected from direct exposure to the elements. The user is reminded, however, that many of these cabinets are vented and that their interiors can be subjected to the effects of condensation and wind-blown contaminants. When conditions of this nature are suspected for a given installation, skirted QT-II terminations should be selected in order to provide greater leakage current and flashover protection.

4. Physical and Electrical Properties

QT-II 5620K series terminations can be used on cables with a rated maximum operating temperature of 105° C and an emergency overload rating of 140° C. QT-II 5620K series terminations meet all requirements of IEEE Standard 48, "IEEE Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations" and are designated Class I for indoor or weather-protected locations. The current rating of these terminations meets or exceeds the current rating of the cables on which they are installed.

Typical Dimensions

Kit No.	Dimension A Maximum	Wet Creepage Distance (Maximum)
5621K	9.5 (241 mm)	9.5 (241 mm)
5622K	9.5 (241 mm)	9.5 (241 mm)
5623K	11.0 (279 mm)	11.0 (279 mm)
5624K	11.0 (279 mm)	11.0 (279 mm)
5625K	11.0 (279 mm)	11.0 (279 mm)

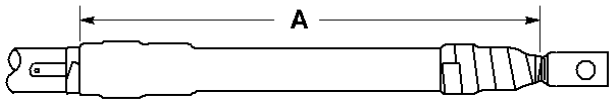

Figure 2

EPDM Rubber High-K Stress Control Tube

Physical Properties		
Test Method	**Typical Value***	
Permanent Set (3M Test Method) 22 hours @ 212° F (100° C) 100% elongation 5 minute recovery	20%	
Ultimate Tensile Strength (ASTM D-42)	1394 psi (9.6 MPa)	
Electrical Properties		
Test Method	**Typical Value***	
Dielectric Constant (K) (ASTM-D-150) 60 Hz; @ 60% strain	@ 400 V	@ 3 kV
73° F (23° C)	25.7	28.8
149° F (65° C)	24.5	27.2
194° F (90° C)	25.2	27.7
vs. frequency @ 73° F (23° C)		
150 Hz	35	
1,000 Hz	29	
10,000 Hz	24	
100,000 Hz	20	
Dissipation Factor (ASTM-D-150) 60 Hz; @ 60% strain	@ 400 V	@ 3 kV
73° F (23° C)	0.096	0.166
149° F (65° C)	0.093	0.165
194° F (90° C)	0.132	0.161
vs. frequency @ 73° F (23° C)		
150 Hz	0.16	
1,000 Hz	0.15	
10,000 Hz	0.14	
100,000 Hz	0.12	

*Average values. Not intended for specification purposes.

Silicone Rubber Insulator

Physical Properties	
Test Method	**Typical Value***
Color	Munsel Gray
Permanent Set (3M Test Method) 22 hours @ 212° F (100° C) 100% elongation 5 minute recovery	8%
Ultimate Tensile Strength (ASTM D42)	1200 psi (8.28 MPa)
Electrical Properties	
Test Method	**Typical Value***
Dielectric Constant (S.I.C.) (ASTM-D-150)	
73° F (23° C)	3.4
194° F (90° C)	3.0
266° F (130° C)	2.7
Dissipation Factor (ASTM-D-150)	
73° F (23° C)	0.4%
194° F (90° C)	1.3%
266° F (130° C)	1.2%
Dielectric Strength (ASTM-D-149) 75 mil (1.90 mm) gap	507 V/mil (20 kV/mm)
Track Resistance (ASTM-2303) 2.5 kV, 10 k Ohms	10 hrs

Termination Selection Guide

Kit No.	Cable Insulation O.D. Range	Conductor Size Range (AWG and kcmil)				
		5 kV – 100%	5 kV – 133% 8 kV – 100%	8 kV – 133%	15 kV – 100%	15 kV – 133%
5621K	0.32–0.46" (8,1–11,7 mm)	8–4	8–6	8	—	—
5622K	0.44–0.65" (11,2–16,5 mm)	2–2/0	4–1/0	6–1	—	—
5623K	0.56–0.87" (14,2–22,1 mm)	2/0–250	1/0–4/0	1–3/0	4–2/0	4–1
5624K	0.78–1.30" (19,8–33,0 mm)	300–750	250–750	4/0–600	2/0–500	1–350
5625K	1.09–1.80" (27,7–45,7 mm)	600–1500	600–1500	500–1250	500–1250	350–1000

5. Specifications

Product

The cable termination must have a voltage class rating equal to or greater than the cable being terminated. The rating shall be 5, 8, or 15 kV as an IEEE Standard 48 Class I termination. It must have a maximum continuous operating temperature rating of 105° C, with an emergency overload rating of 140° C. The termination stress control shall be capacitive and constructed of High-K EPDM rubber. The termination insulator shall be of a non-skirted tubular design, constructed of non-tracking silicone rubber, munsel gray in color. The termination must be of a prestretched cold shrink design, installed without the application of a heat source. The termination kit shall include all materials required (except the lug), including solderless mechanical ground straps, and shall accommodate ribbon (tape), wire, or UniShield® shielded cables.

The Class I termination kits shall be used with UL listed copper or aluminum compression lugs.

Engineering/Architectural

Terminating of all 5, 8, and 15 kV shielded power cables, indoors and in weather-protected equipment, shall be performed in accordance with instructions included in the 3M™ Cold Shrink QT-II Termination Kit 5620K series. This shall include all weather-protected areas for tape or ribbon shield, wire shield, and UniShield cables. The termination kits shall be used in conjunction with 3M™ Scotchlok™ Lugs 30000 or 40000 series, or 3M™ Stem Connectors SC Series.

6. 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 @ 3 pC (kV min)
5	75	25	15	50	4.5
8	95	35	25	65	7.5
15	110	50	35	75	13.0

Operating Temperatures

Insulation Class (kV)	Normal Operation (deg. C)	Emergency Operation (deg. C)
5	105	140
8	105	140
15	105	140

Reference: AEIC CS5 and AEIC CS6.

Typical Performance of 5620K Series QT-II

Test	Results	
	5 kV Class (5621K, 5622K)	15 kV Class (5623K, 5624K, 5625K)
Minimum 1 min. withstand	25 kV–rms	50 kV–rms
Minimum 6 hr. withstand	15 kV–rms	35 kV–rms
Average Corona: CSV	10 kV–rms	27 kV–rms
Average Corona: CEV	8.5 kV–dc	23 kV–dc
Minimum 15 min. DC withstand	50 kV–dc	75 kV–dc
Avg. max. impulse withstand	+105 kV–crest	+130 kV–crest
	–105 kV–crest	–130 kV–crest

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 the test, an applied test voltage is gradually increased until discharges appear on the test set oscilloscope display. The voltage at which these discharges reach a magnitude of 3 picocoulombs is recorded as the corona starting voltage (CSV). The applied voltage is then lowered until the discharge level drops below 3 picocoulombs, and this is recorded as the corona extinction voltage (CEV).

Alternating Current Withstand Tests

All 5620K series terminations meet the IEEE Standard 48 requirements for a Class I termination. As the terminations are specified for indoor (weather-protected) applications, the 60Hz 10-second wet withstand test does not apply.

Lightning Impulse Tests

For these tests a 1.2 x 50 microsecond voltage wave is applied to the termination lug. The testing consists of both positive and negative polarity surges per IEEE Standard 48 BIL requirements. The 5620K series terminations exceed these BIL requirements.

Sealing Tests

Termination top and bottom seals are tested by applying 7 psi (0.05 MPa) to the cable conductor strands with the termination ends submerged in water. Both seals withstand this internal air pressure for six hours without leaking.

7. Installation Techniques

Detailed instructions are included in each kit to provide the installer with all information required to properly install the appropriately sized 3M™ Cold Shrink QT-II Termination Kit 5620K series. A brief summary of the installation steps for tape-shielded cable is outlined as follows:

1. Prepare cable according to standard procedure.
2. Install ground strap assembly (does not apply to UniShield® cable) (Figure 3).
3. Fill in the step at the semiconductor insulation shield cut edge using silicone grease.

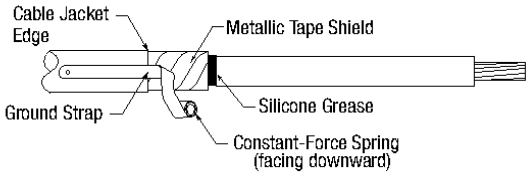

Figure 3

4. Install termination onto cable, and unwind core, allowing termination to shrink into place (Figure 4).

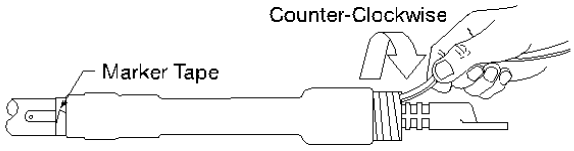

Figure 4

5. Install lug using a listed crimping tool and die.
6. Apply top seal and bottom seal (bottom seals are optional to obtain a Class 1 termination) (Figure 5).

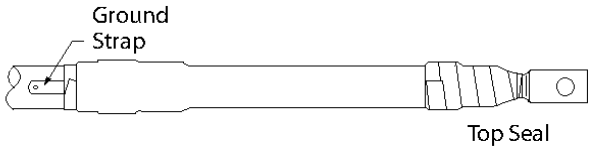

Figure 5

8. Maintenance & Storage

The termination assemblies are not affected by freezing storage temperatures. Normal stock rotation is recommended. As provided, in the expanded state, QT-II terminations 5620K series have an on-shelf storage life of three years from the date of manufacture.

These terminations can be field-tested by using normal cable testing procedures (reference: ANSI/IEEE Standard 400 “Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems"). Refer to most recent version.

9. Availability

3M Cold Shrink QT-II Termination Kits 5620K series are available in five kit sizes for terminating shielded power cables rated 5 through 15 kV. Please contact your local distributor; available from 3M.com/electrical [Where to Buy] or call 1.800.245.3573.

3M

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