3M™ Cold Shrink QT-III Silicone Rubber Termination Kits 7640-T and 7650-T Series

5, 8, 15, 25/28 and 35 kV

Data Sheet **July 2012**

Description	3M™ Cold Shrink QT-III Silicone Rubber Termination Kits, 7640-T and 7650-T Series, contain one-piece, non-skirted, silicone rubber terminations, qualified as IEEE Standard 48 Class 1 for indoor and weather-protected applications. The termination assemblies consist of a tubular insulator, high-dielectric constant (Hi-K) stress control tube, conformable Hi-K stress controlling compound and built-in environmental top sealing compound. The insulator is made of a dark gray silicone rubber with excellent tracking resistance and hydrophobic properties. The complete assembly is pre-stretched and loaded onto a removable core. The disposable core can be recycled. The kits are designed for terminating solid dielectric jacketed concentric neutral (JCN) and concentric neutral (CN) power cables rated 5 through 35 kV.
Kit Contents	Each kit contains sufficient quantities of the following materials to make one single-phase termination (compression lug is not included in kit). • 1 Hi-K, Tracking Resistant, Silicone Rubber Termination • 2 Strips Scotch® Mastic Strip 2230 • 1 Instruction Sheet
Features	• Conforms to IEEE Standard 48 Class 1 requirements for 5, 8, 15, 25/28 and 35 kV terminations • One-piece versatile design, allowing quick installation and accommodating a wide range of cable sizes • Cold shrink delivery system allows easy installation: Simply place termination over prepared cable and unwind core to shrink into place (no force fit required) • Hi-K stress control: Specially formulated high-dielectric constant material minimizes surface stress by more uniformly distributing the electrical field over the entire surface of the insulator • Compact design provides for easier installation in restricted spaces • Silicone rubber insulators, EPDM stress control tubes, stress controlling compound and environmental sealing compound are compatible with common solid dielectric insulations, such as polyethylene (PE), cross-linked polyethylene (XLPE) and ethlylene propylene rubber (EPR)

Stress Control

The 3M™ Cold Shrink QT-III Silicone Rubber Termination Kits, 7640-T and 7650-T Series, controls the electric field stress distribution with special Hi-K materials, which are an integral part of the termination. The Hi-K materials, with a dielectric constant (K) of greater than 15, capacitively distribute the field that surrounds the termination.

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 3M™ QT-III termination reduces the cable stresses at the termination to less than those in the continuous shielded portion of the cable.

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 electric field, the stress concentrations on the termination insulator surface are kept below 15 V/mil at rated voltage. This stress distribution permits high power frequency performance and impulse performance with a compact termination design.

Figure 1 illustrates an actual computerized stress plot of the 3M™ QT-III termination.

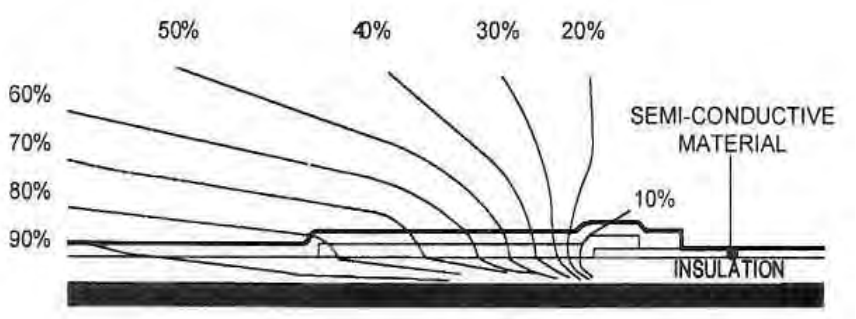


Figure 1

Applications

The 3M™ Cold Shrink QT-III Silicone Rubber Termination Kits, 7640-T and 7650-T Series, are designed for:

- 5, 8, 15, 25/28 and 35 kV voltage classes
- Jacketed concentric neutral (JCN) and concentric neutral (CN) cables
- Solid dielectric insulations, such as polyethylene, XLPE 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
- These terminations can be field tested 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.)

3M™ Cold Shrink QT-III Silicone Rubber Termination Kits, 7640-T and 7650-T Series 5, 8, 15, 25/28 and 35 kV

Environmental Classification

Indoor terminations, such as the 3M QT-III Termination Kits, 7640-T and 7650-T Series, can be specified for most outdoor, pad-mounted switchgear and transformer applications, since these enclosure interiors are protected from direct exposure to the elements.

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.

3M™ Cold Shrink QT-III Silicone Rubber Termination Kits, 7640-T and 7650-T Series terminations, can be used on cables with a rated maximum operating temperature of 221°F (105°C) and emergency overload rating of 284°F (140°C).

Terminations constructed from these kits meet the requirements of IEEE 48, "IEEE Standard Test Procedures and Requirements for High Voltage Alternating-Current Cable Terminations" and are designated Class 1 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.

Termination Selection Table

Kit Number	Cable Insulation O.D. Range in. (mm)	Conductor Range (AWG and kcmil)				
		5 kV 100% and 133%	8 kV 100% and 133%	15 kV 100% and 133%	25/28 kV 100% and 133%	35 kV 100% and 133%
7642-T-110	0.64 - 1.08" (16,3 - 27,4 mm)	4/0 – 400	3/0 – 300	2 - 4/0 (35 - 120 mm^2)	–	–
7644-T-110	0.83 - 1.53" (21,1 – 38,9 mm)	500 – 750	350 – 700	4/0 – 500 (120 – 240 mm^2)	–	–
7645-T-110	1.05 – 1.80" (26,7 – 45,7 mm)	700 – 1500	600 – 1250	500 – 1000 (250 – 500 mm^2)	–	–
7646-T-110	1.53 – 2.32" (38,9 – 58,9 mm)	1750 – 2000	1500 – 2000	1250 – 2000 (625 - 1000 mm^2)	–	–
7653-T-150	0.72 – 1.29" (18,3 – 32,8 mm)	300 -500	250 – 500	2/0 – 300 (70 – 150 mm^2)	2 – 4/0 (35 – 120 mm^2)	2 – 2/0 (35 - 70 mm^2)
7655-T-150	1.05 – 1.80" (26,7 – 45,7 mm)	700 – 1500	600 – 1250	500 – 1000 (250 – 500 mm^2)	250 – 800 (150 – 400 mm^2)	3/0 – 600 (95 – 325 mm^2)
7656-T-150	1.53 – 2.32" (38,9 – 58,9 mm)	1750 – 2000	1500 – 2000	1250 – 2000 (625 – 1000 mm^2)	900 – 1750 (500 – 800 mm^2)	700 – 1500 (400 – 725 mm^2)

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.

Hi-K Stress Control Tube

Physical Properties (Test Method)	**Typical Value** English units (metric)
Tensile Strength (ASTM D412)	1500 psi (10,34 N/mm^2)
Modulus, Elongation @ 100% @ 300%	 160 psi (1,10 N/mm^2) 500 psi (3,45 N/mm^2)
Electrical Properties (Test Method)	**Typical Value**
Dielectric Constant (K) (ASTM D150) 60 Hz @ 1,000 V, 73ºF (23ºC), 50% RH	22
Dissipation Factor (ASTM D150) 60 Hz @ 1,000 V, 73ºF (23ºC), 50% RH	0.10

Hi-K Stress Controlling Compound

Electrical Properties (Test Method)	**Typical Value**
Dielectric Constant (K) (ASTM D150) 60 Hz @ 1,000 V, 73ºF (23ºC), 50% RH 100 mil (2,54 mm) thickness	25
Dissipation Factor (ASTM D150) 60 Hz @ 1,000 V, 73ºF (23ºC), 50% RH 100 mil (2,54 mm) thickness	0.90

Environmental Sealing Compound

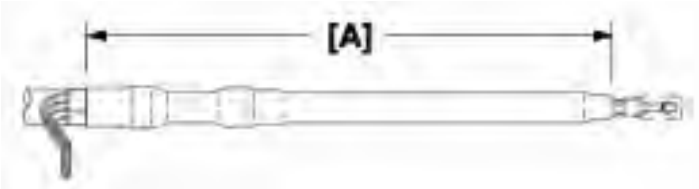
Electrical Properties (Test Method)	**Typical Value** English units (metric)
Dielectric Strength (ASTM D149) 75 mil (1,90 mm) thickness	300 V/mil (11,8 kV/mm)

Typical Properties,
continued

Silicone Rubber Insulator

Physical Properties (Test Method)	**Typical Value** English units (metric)
Color	Dark Gray
Tensile Strength (ASTM D412)	850 psi (5,86 N/mm^2)
Modulus Elongation @ 100% @ 300%	 130 psi (0,90 N/mm^2) 400 psi (2,76 N/mm^2)
Hydrophobic Recovery (3M Test Method 406) > 90º Contact Angle	5.0 hrs.
Electrical Properties (Test Method)	**Typical Value** English units (metric)
Dielectric Constant (S.I.C.) (ASTM D150) 60 Hz @ 1,000 V, 73ºF (23ºC), 50% RH	3.6
Dissipation Factor (ASTM D150) 60 Hz @ 1,000 V, 73ºF (23ºC), 50% RH	0.003
Dielectric Strength (ASTM D149) 75 mil (1,90 mm) thickness	500 V/mil (19,68 kV/mm)
Track Resistance (ASTM 2303) 3.5 kV	5.0 hrs.

Typical Dimensions



Kit Number	Dimension [A] Max.	Wet Creepage Distance Max.	Arcing distance Max.
7642-T-110	13.0” (330 mm)	13.0” (330 mm)	13.0” (330 mm)
7644-T-110	13.0” (330 mm)	13.0” (330 mm)	13.0” (330 mm)
7645-T-110	13.0” (330 mm)	13.0” (330 mm)	13.0” (330 mm)
7646-T-110	13.0” (330 mm)	13.0” (330 mm)	13.0” (330 mm)
7653-T-150	16.5” (419 mm)	16.5” (419 mm)	16.5” (419 mm)
7655-T-150	16.5” (419 mm)	16.5” (419 mm)	16.5” (419 mm)
7656-T-150	16.5” (419 mm)	16.5” (419 mm)	16.5” (419 mm)

Product Specifications

3M™ Cold Shrink QT-III Silicone Rubber Termination Kits, 7640-T and 7650-T Series terminations must have a voltage class rating equal to or greater than the cable being terminated. The rating shall be 5, 8, 15, 25/28 or 35 kV as an IEEE Standard 48 Class 1 termination. It must have a maximum continuous operating temperature rating of 221ºF (105ºC), with an emergency overload rating of 284ºF (140ºC). The termination stress control shall be capacitive and constructed of a Hi-K stress control compound and a Hi-K EPDM rubber tube. The installation shall not require using silicone grease.

The termination insulator shall be of a non-skirted tubular design, constructed of tracking resistant silicone rubber, dark gray in color. The termination must be of a pre-stretched cold shrink design, installed without the application of a heat source. The termination kit shall include all materials required (except lug and vinyl tape) and shall accommodate jacketed concentric neutral (JCN) and concentric neutral (CN) cables. The Class 1 termination kits shall be used with listed copper or aluminum compression lugs.

Engineering/ Architectural Specifications

Terminating of all 5, 8, 15, 25/28 and 35 kV shielded power cables, indoors and in weather-protected equipment, shall be performed in accordance with instructions included in the 3M QT-III Termination Kits,7640-T and 7650-T Series. This shall include all outdoor weather-protected areas for jacketed concentric neutral (JCN) and concentric neutral (CN) cables. The termination kits shall be used in conjunction with 3M™ Scotchlok™ Copper Compression Lugs, 30000 and 31000 Series, 3M™ Scotchlok™ Copper/Aluminum Compression Lugs, 40000 Series or 3M™ Stem Connectors SC Series.

Performance Tests

Typical Results, IEEE Standard 48 Short-Term Test Sequence

Insulation Class Test	5 kV		8 kV		15 kV		25/28 kV		35 kV	
	Require-ments	Results	Require-ments	Results	Require-ments	Results	Require-ments	Results	Require-ments	Results
Partial Discharge Extinction Voltage @ 3pC	4.5 kV	Passed	7.5 kV	Passed	13 kV	Passed	21.5 kV	Passed	30 kV	Passed
Power Frequency Voltage 1 min. Dry Withstand	25 kV	Passed	35 kV	Passed	50 kV	Passed	65 kV	Passed	90 kV	Passed
Power Frequency Voltage 6 hour Dry Withstand	15 kV	Passed	25 kV	Passed	35 kV	Passed	60 kV	Passed	76 kV	Passed
Direct Voltage 15 min. Dry Withstand	50 kV	Passed	65 kV	Passed	75 kV	Passed	105 kV	Passed	140 kV	Passed
Lightning Impulse Voltage Withstand (BIL)	75 kV	Passed	95 kV	Passed	110 kV	Passed	150 kV	Passed	150 kV	Passed
Partial Discharge Extinction Voltage @ 3 pC	4.5 kV	Passed	7.5 kV	Passed	13 kV	Passed	21.5 kV	Passed	30 kV	Passed

*All higher voltages, flashover occurs without breakdown.

Typical Results, IEEE Standard 48 Long-Term Test Sequence

Insulation Class Test	5 kV		8 kV		15 kV		25/28 kV		35 kV	
	Require-ments	Results	Require-ments	Results	Require-ments	Results	Require-ments	Results	Require-ments	Results
Partial Discharge Extinction voltage @ 3 pC	4.5 kV	Passed	7.5 kV	Passed	13 kV	Passed	21.5 kV	Passed	30 kV	Passed
Cyclic Aging (30 days, 130° C cond. temp.) Power frequency Voltage Withstand	8.5 kV	Passed	15 kV	Passed	26 kV	Passed	43 kV	Passed	60 kV	Passed
Partial Discharge Extinction Voltage @ 3 pC	4.5 kV	Passed	7.5 kV	Passed	13 kV	Passed	21.5 kV	Passed	30 kV	Passed
Lightning Impulse Voltage Withstand (BIL)	75 kV	Passed	95 kV	Passed	110 kV	Passed	150 kV	Passed	150 kV	Passed

*All higher voltages, flashover occurs without breakdown.

Partial Discharge (Corona Tests)	The purpose of corona testing is to determine whether 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 discharges appear on the test set's oscilloscope display. The voltage at which these discharges reach a magnitude of 3 pico-coulombs 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).
Performance Tests	**Power Frequency (AC) Withstand Tests** All 3M™ Cold Shrink QT-III Silicone Rubber Termination Kits, 7640-T and 7650-T Series, exceed the IEEE Standard 48 requirements for a Class 1 termination. As the terminations are specified for indoor (weather-protected) applications, the 60-Hz ten-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 QT-III 7640-T and 7650-T 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 submerged in water. Both seals withstand this internal air pressure for 6 hours without leaking.

Installation Techniques

> **⚠ 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.

Detailed instructions are included in each kit to provide the installer with all information required to properly install the appropriately sized 3M™ QT-III 7640-T and 7650-T Series terminations. A brief summary of the installation steps for jacketed concentric neutral (JCN) cable is outlined as follows:

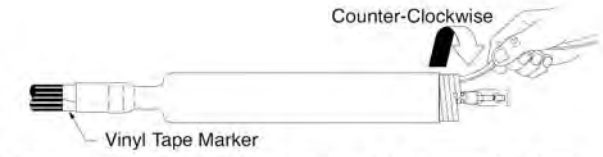
1. Prepare cable according to standard procedure.

2. Apply bottom mastic seal. (Figure 2)

Figure 2

3. Install lug using a listed crimping tool and die.

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



Note: The material being removed at this step is mixed polymers and can be recycled with other waste.

Figure 3

Shelf Life & Storage	As provided in the expanded state, the 3M™ Cold Shrink QT-III Silicone Rubber Termination Kits, 7640-T and 7650-T Series, have a 3-year shelf life from the date of manufacture when stored in a humidity controlled storage (50°F/10°C to 80°F/27°C 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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NOTE: The core material being removed from the Termination is mixed polymers and can be recycled with other  waste.

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