3M™ Cold Shrink Silicone Rubber Termination Kit QT-III 7620-T and 7690-T Series 5, 8.7, 15, 25/28 and 35 kV

Data Sheet **August 2009**

Product Description

3M™ Cold Shrink Silicone Rubber Termination Kit QT-III 7620-T and 7690-T Series contain one-piece, non-skirted, silicone rubber terminations, qualified as IEEE Standard 48-1990 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 silicone top seal. The insulator is made of a new dark gray silicone rubber with advanced tracking resistant and hydrophobic properties.

***7620-T and 7621-T designed and assembled with stress controlling compound only.**

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 shielded power cable rated 5 through 35 kV, with tape 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 Hi-K, tracking resistant, silicone rubber terminations
- 3 Pre-formed ground braids
- 3 Constant force springs
- 6 strips sealing mastic
- 1 Cable preparation kit
- 1 Instruction sheet

Features

- Conforms to the IEEE Standard 48-1990 Class 1 requirements for 5, 8.7, 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 for 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 surfaces 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 silicone sealing compound are compatible with all common solid dielectric insulations, such as polyethylene (PE), cross-linked polyethylene (XLPE) and ethylene propylene rubber (EPR)

Stress Control

The QT-III termination 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 distributes 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 QT-III reduces the cable stresses at the termination to less that 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 below illustrates an actual computerized stress plot of the QT-III termination.

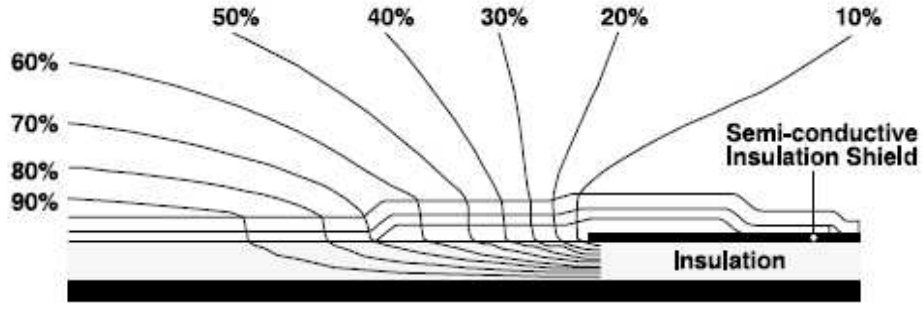


Figure 1

Applications

Designed for:

- 5, 8.7, 15 and 25/28 and 35 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.
- These terminations can be filed-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”).

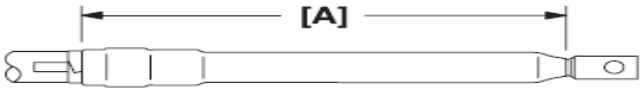
Environmental Classification

Indoor terminations, such as 3M™ Cold Shrink Silicone Rubber Termination Kit QT-III 7620-T and 7690-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.

Physical and Electrical Properties

3M™ Cold Shrink Silicone Rubber Termination Kit QT-III 7620-T and 7690-T Series terminations can be used on cables with a rated maximum operating temperature of 105° C and an overload rating of 140 ° C. 7620-T and 7690-T Series terminations meet all requirements of IEEE Standard 48-1990, “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.

Typical Dimensions



Kit Number	Dimension [A] (Maximum)	Wet Creepage Distance (Maximum)
7620-T-95	8.5” (215 mm)	8.5” (215 mm)
7621-T-95	8.5” (215 mm)	8.5” (215 mm)
7622-T-95	8.5” (215 mm)	8.5” (215 mm)
7624-T-95	8.5” (215 mm)	8.5” (215 mm)
7625-T-95	8.5” (215 mm)	8.5” (215 mm)
7622-T-110	13.0” (330 mm)	13.0” (330 mm)
7624-T-110	13.0” (330 mm)	13.0” (330 mm)
7625-T-110	13.0” (330 mm)	13.0” (330 mm)
7626-T-110	13.0” (330 mm)	13.0” (330 mm)
7693-T-150	16.5” (419 mm)	16.5” (419 mm)
7695-T-150	16.5” (419 mm)	16.5” (419 mm)
7696-T-150	16.5” (419 mm)	16.5” (419 mm)

A. Physical and Electrical Properties

This data is not to be used for specifications. Values are typical and should not be considered minimum or maximum.

Hi-K Stress Control Tube

Physical Properties (Test Method)	Value
Tensile Strength	1500 psi
(ASTM D412 Test Method)	
Modulus @ 100% Elongation	160 psi
Modulus @ 300% Elongation	500 psi
Electrical Properties (ASTM D150 unless noted)	**Value**
Dielectric Constant (K) 60 Hz; @ 1000 V; 73°F (23°C), 50% RH	22
Dissipation Factor 60 Hz; @ 1000V; 73°F (23°C), 50% RH	0.10

Hi-K Stress Controlling Compound

Electrical Properties (Test Method ASTM D150 unless noted)	Value
Dielectric Constant 60 Hz; @ 1000 V; 73°F (23°C), 50% RH 100 mil (2,54 mm) thickness	25
Dissipation Factor 60 Hz; @ 1000 V; 73°F (23°C), 50% RH 100 mil (2,54 mm) thickness	0.90

Silicone Sealing Compound

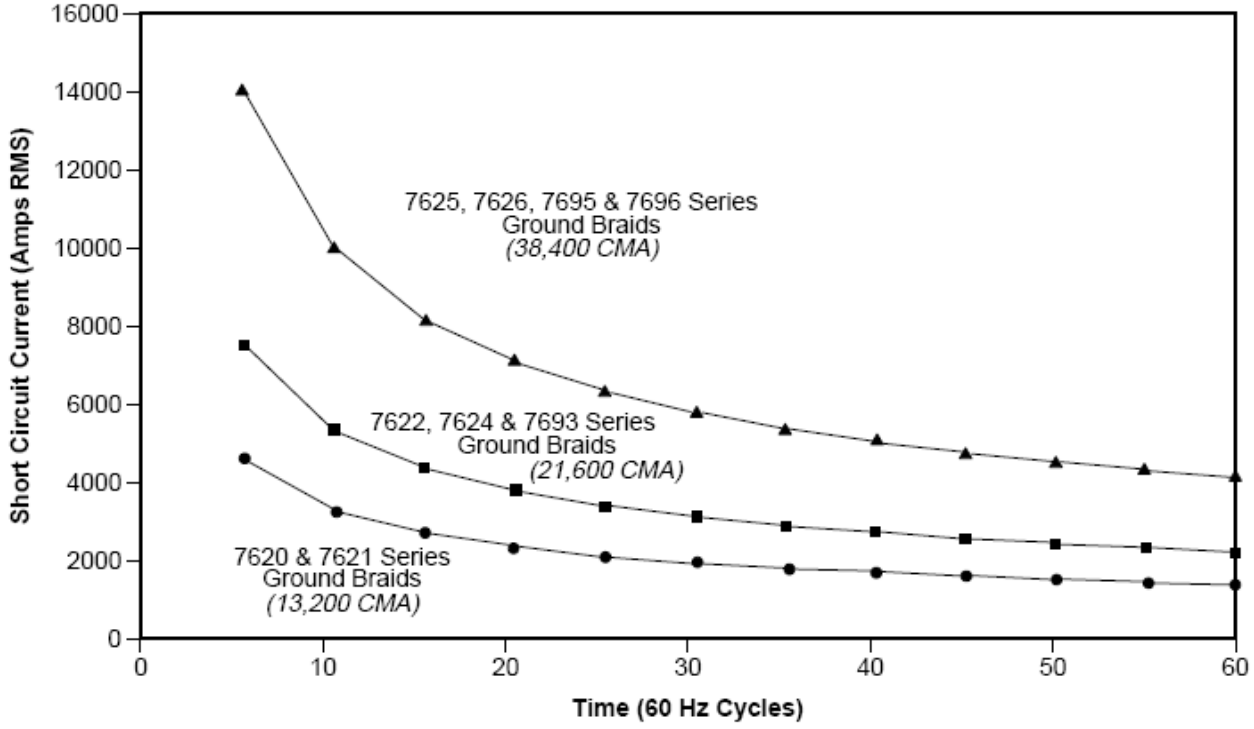
Electrical Properties Test Method ASTM D149	Value
Dielectric Strength 75 mil (1,90 mm) thickness	300 V/mil

Silicone Rubber Insulator

Physical Properties (Test Method)	Value
Color	Dark Gray
Tensile Strength (ASTM D412)	850 psi
Modulus @ 10% Elongation	130 psi
Modulus @ 300% Elongation	400 psi
Hydrophobic Recovery	
(3M Test Method No. 406)	
>90°Contact Angle	5.0 hrs
Electrical Properties (Test Method)	**Value**
Dielectric Constant (S.I.C.) 60 Hz; @ 1000 V; 73°F (23°C), 50% RH	3.6
Dissipation Factor (ASTM D150) 60 Hz; @ 1000V; 73°F (23°C), 50% RH	0.003
Dielectric Strength (ASTM D149) 75 mil (1,90 mm) thickness	500 V/mil
Track Resistance (ASTM 2303) 3.5 kV	5.0 hrs.

B. Ground Braid

Rated Ground Fault Current Limit



C. Common Conductor Size Chart

Cross Sectional Area		
Size	**CMA**	**MM²**
10 AWG	10,380	
	11,844	6
9 AWG	13,090	
	15,792	8
8 AWG	16,510	
	19,740	10
7 AWG	20,820	
6 AWG	26,240	
	27,627	14
	31,580	15
5 AWG	33,090	
4 AWG	41,740	
	43,413	22
	49,430	25
3 AWG	52,620	
	59,200	30
2 AWG	66,360	
	69,070	35
	74,987	38
1 AWG	83,690	

Termination Selection Guide

Kit Number	Cable Insulation O.D. Range	Conductor Size Range (AWG and kcmil)				
		5 kV 100 % 133 %	8.7 kV 100% 133%	15 kV 100% 133%	25/28 kV 100% 133%	35 kV 100% 133%
7620-T-95	0.32 – 0.59" (8,2 – 15,0 mm)	8 – 4 --	8 – 6 --	-- --	-- --	
7621-T-95	0.44 – 0.89" (11,2 – 22,6 mm)	2 – 3/0 --	4 – 2/0 --	-- --	-- --	
7622-T-95	0.69 – 1.08" ((16,3 – 27,4 mm)	4/0 – 400 --	3/0 – 300 --	-- --	-- --	
7624-T-95	0..83 – 1.53" (21,1 – 38,9 m)	500 – 750 --	350 – 750 --	-- --	-- --	
7625-T-95	1.05 – 1.80" (26,7 – 45,7 mm)	700 – 1500 --	600 – 1250 --	-- --	-- --	
7622-T-110	0.64 – 1.08" (16,3 – 27,4 mm)	4/0 – 400 --	3/0 – 300 --	2 – 4/0 (35 – 120 mm^2)	-- --	
7624-T-110	0.83 – 1.53" (21,1 – 38,9 mm)	500 – 750 --	350 – 700 --	4/0 – 500 (120 – 240 mm^2)	-- --	
7625-T-110	1.05 – 1.80" (26,7 – 45,7 mm)	700 – 1500 --	600 – 1250 --	500 – 1000 (240 – 500 mm^2)	-- --	
7626-T-110	1.53 – 2.32" (38,9 – 58,9 mm)	1750 – 2000 --	1500 – 2000 --	1250 – 2000 (500 – 1000 mm^2)	-- --	
7693-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)
7695-T-150	1.05 – 1.80" (26,7 – 45,7 mm)	700 – 1500 --	600 – 1250 --	500 – 1000 (240 – 500 mm^2)	250 – 800 (150 – 400 mm^2)	3/0 – 600 (95 – 325 mm^2)
7696-T-150	1.53 – 2.32" (38,9 – 58,9 mm)	1750 – 2000 --	1500 – 2000 --	1250 – 2000 (500 – 1000 mm^2)	900 – 1750 (500 – 800 m^2)	700 – 1500 (400 – 725 mm^2)

*150kV impulse level meets the impulse requirements for 35 kV class equipment where indoor terminations are used.

Product Specifications

The cable termination must have a voltage class rating equal to or greater than the cable being terminated. The rating shall be 5, 8.7, 15, 25/28 kV or 35 kV as an IEEE Standard 48-1990 Class 1 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 a Hi-K stress control compound and a Hi-K EPDM rubber tube. The installation procedure 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 a one-piece, non-skirted, silicone rubber termination with solderless mechanical ground assembly, and shall accommodate tape (ribbon), wire, or UniShield® shielded cables.

The Class 1 termination kits shall be used with listed copper or aluminum compression lugs.

Engineering/ Architectural Specifications

Terminating of all 5, 8.7, 15, 25/28 and 35kV shielded power cables, indoors and in weather-protected equipment, shall be performed in accordance with instructions included in the 3M™ Cold Shrink Silicone Rubber Termination Kit QT-III 7620-T and 7690-T Series silicone rubber termination kits. This shall include all weather-protected areas for tape shield, wire shield and UniShield® cables. The termination kits shall be used in conjunction with 3M™ Scotchlok™ Lugs 3000 or 4000 Series or 3M™ Stem Connectors SC Series.

Performance Tests

Typical Results, IEEE Standard 48 Short-Term Test Sequence

Insulation Class Test	5 kV		8.7 kV		15 kV		25/28 kV		25/28 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
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 hr. Dry Withstand	15 kV	Passed	25 kV	Passed	36 kV	Passed	55 kV	Passed	75 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	30kV	Passed

***At higher voltages, flashover occurs without breakdown**

Table 4

Typical Results, IEEE Standard 48 Long-Term Test Sequence

Insulation Class Test	5 kV		8.7 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

***At higher voltages, flashover occurs without breakdown**

Table 5

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 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).

Power Frequency (AC) Withstand Tests

All 3M™ Cold Shrink Termination Kit QT-III 7620-T and 7690-T Series meet the IEEE Standard 48-1990 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.

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 3M™ Cold Shrink Termination Kit QT-III 7620-T and 7690-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

Detailed instructions are included in each kit to provide the installer with all information required to properly install the appropriately sized 3M™ Cold Shrink Silicone Rubber Termination Kit QT-III 7620-T and 7690-T Series. A brief summary of the installation steps for tape-shielded cable is outlined as follows:

1. Prepare cable according to standard procedure.

2. Apply bottom mastic seal. (*Figure 2*).

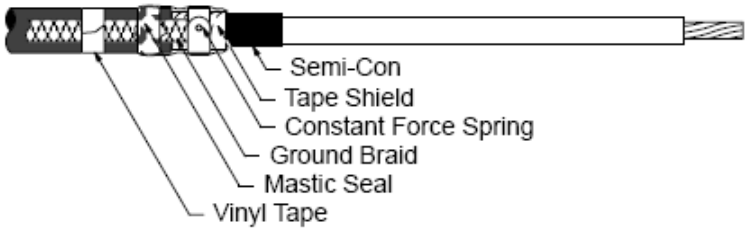


Figure 2

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*).

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

Figure 3

Shelf Life & Storage

Maximum recommended storage temperature is 110°F (43°C). The termination assemblies are not affected by freezing storage temperatures. Normal stock rotation is recommended. As provided in the expanded state, 3M™ Cold Shrink Silicone Rubber Termination Kit QT-II 7620-T and 7690-T Series terminations have an on-shelf storage life of three years from the date of manufacture.

Availability

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

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