



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

## Data Sheet



### 1.0 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 dark gray silicone rubber with advanced tracking resistance and hydrophobic properties.

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

The complete assembly is prestretched 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 25/28 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 Spring
- 6 Strips Sealing Mastic
- 1 Cable preparation kit
- 1 Instruction Sheet

### Termination Features

- Conforms to IEEE Standard 48-1990 Class 1 requirements for 5, 8.7, 15 and 25 kV terminations.
- Suitable for use on 28 kV applications.
- 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 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 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 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 QT-III termination.

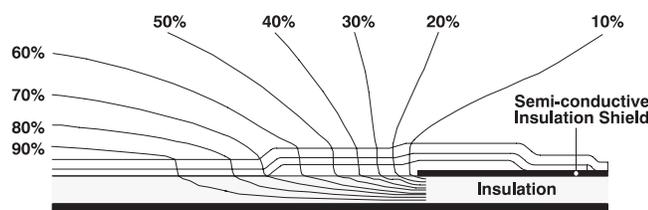


Figure 1

## 2.0 Application

Designed for:

- 5, 8.7, 15 and 25/28 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.

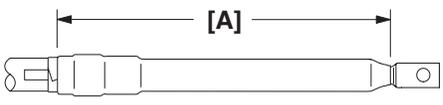
## Environmental Classification

Indoor terminations, such as 3M™ Cold Shrink 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.

## 3.0 Physical and Electrical Properties

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-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)

Table 1

## A. Typical Physical and Electrical Properties

### Hi-K Stress Control Tube

#### Physical Properties

Test Method	Typical Value*
Tensile Strength (ASTM D412)	1500 psi
Modulus @ 100% Elongation	160 psi
Modulus @ 300% Elongation	500 psi

#### Electrical Properties

Test Method	Typical Value*
Dielectric Constant (K) (ASTM D150)	
60 Hz; @ 1000 V; 73°F/23°C, 50% RH	22
Dissipation Factor (ASTM D150)	
60 Hz; @ 1000 V; 73°F/23°C, 50% RH	0.10

### Hi-K Stress Controlling Compound

#### Electrical Properties

Test Method	Typical Value*
Dielectric Constant (ASTM D150)	
60 Hz; @ 1000 V; 73°F/23°C, 50% RH	25
100 mil (2,54 mm) thickness	
Dissipation Factor (ASTM D150)	
60 Hz; @ 1000 V; 73°F/23°C, 50% RH	0.9
100 mil (2,54 mm) thickness	

### Silicone Sealing Compound

#### Electrical Properties

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

## Typical Physical and Electrical Properties (continued)

### Silicone Rubber Insulator

#### Physical Properties

Test Method	Typical Value*
Color	Dark Gray
Tensile Strength (ASTM D412)	850 psi
Modulus @ 100% 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	Typical Value*
Dielectric Constant (S.I.C.) (ASTM D150)	
60 Hz; @ 1000 V; 73°F/23°C, 50% RH	3.6
Dissipation Factor (ASTM D150)	
60 Hz; @ 1000 V; 73°F/23°C, 50% RH	0.003

**Typical Physical and Electrical Properties (continued)**

Dielectric Strength  
(ASTM D149)  
75 mil (1,90 mm) thickness

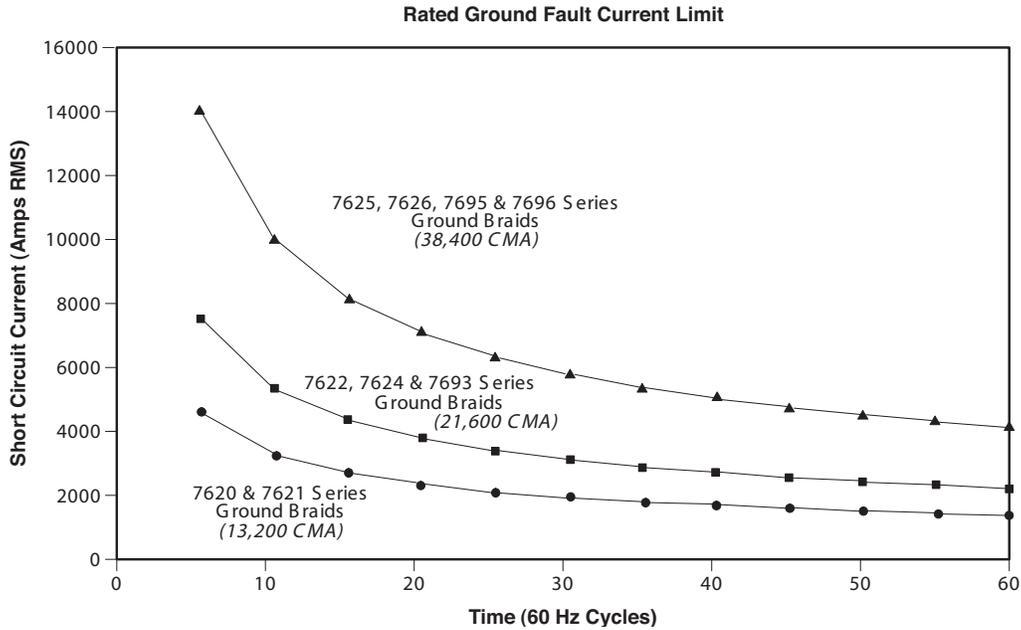
500 V/mil

Track Resistance  
ASTM 2303  
3.5 kV

5.0 hrs.

\*Typical values, not intended for specification purposes.

**B. Ground Braid**



**C. Common Conductor Size Chart**

Size	Cross Sectional Area	
	CMA	MM <sup>2</sup>
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	

**Table 2**

## 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%
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-110	0.64 - 1.08 (16,3 - 27,4 mm)	4/0 - 400 —	3/0 - 300 —	2 - 4/0 (35 - 120 mm <sup>2</sup> )	— —
7624-T-110	0.83 - 1.53 (21,1 - 38,9 mm)	500 - 750 —	350 - 700 —	4/0 - 500 (120 - 240 mm <sup>2</sup> )	— —
7625-T-110	1.05 - 1.80 (26,7 - 45,7 mm)	700 - 1500 —	600 - 1250 —	500 - 1000 (240 - 500 mm <sup>2</sup> )	— —
7626-T-110	1.53 - 2.32 (38,9 - 58,9 mm)	1750 - 2000 —	1500 - 2000 —	1250 - 2000 (500 - 1000 mm <sup>2</sup> )	— —
7693-T-150	0.72 - 1.29 (18,3 - 32,8 mm)	300 - 500 —	250 - 500 —	2/0 - 300 (70 - 150 mm <sup>2</sup> )	2 - 4/0 (35 - 120 mm <sup>2</sup> )
7695-T-150	1.05 - 1.80 (26,7 - 45,7 mm)	700 - 1500 —	600 - 1250 —	500 - 1000 (240 - 500 mm <sup>2</sup> )	250 - 800 (150 - 400 mm <sup>2</sup> )
7696-T-150	1.53 - 2.32 (38,9 - 58,9 mm)	1750 - 2000 —	1500 - 2000 —	1250 - 2000 (500 - 1000 mm <sup>2</sup> )	900 - 1750 (500 - 800 mm <sup>2</sup> )

Table 3

### 4.0 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, 8.7, 15 or 25/28 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 prestretched 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

Terminating of all 5, 8.7, 15 and 25/28 kV shielded power cables, indoors and in weather-protected equipment, shall be performed in accordance with instructions included with the 3M™ Cold Shrink Silicone Rubber Termination Kit QT-III 7620-T and 7690-T Series. 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.

## 5.0 Performance Tests

### Typical Results, IEEE Standard 48 Short-Term Test Sequence

Insulation Class Test	5 kV		8.7 kV		15 kV		25/28 kV	
	Requirements	Results	Requirements	Results	Requirements	Results	Requirements	Results
Partial Discharge Extinction Voltage @ 3 pC	4.5 kV	10.5 kV	7.5 kV	13 kV	13 kV	35 kV	21.5 kV	40 kV
Power Frequency Voltage 1 min. Dry Withstand	25 kV	75 kV*	35 kV	75 kV*	50 kV	95 kV*	65 kV	105 kV*
Power Frequency Voltage 6 hour Dry Withstand	15 kV	70 kV*	25 kV	70 kV*	36 kV	90 kV*	55 kV	100 kV*
Direct Voltage 15 min. Dry Withstand	50 kV	Passed	65 kV	Passed	75 kV	Passed	105 kV	Passed
Lightning Impulse Voltage Withstand (BIL)	75 kV	110 kV*	95 kV	110 kV*	110 kV	130 kV*	150 kV	175 kV*
Partial Discharge Extinction Voltage @ 3 pC	4.5 kV	10.5 kV	7.5 kV	13 kV	13 kV	35 kV	21.5 kV	40 kV

\*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	
	Requirements	Results	Requirements	Results	Requirements	Results	Requirements	Results
Partial Discharge Extinction Voltage @ 3 pC	4.5 kV	10.5 kV	7.5 kV	13 kV	13 kV	35 kV	21.5 kV	40 kV
Cyclic Aging 30 days, 130° C cond. temp.) Power Frequency Voltage Withstand	25 kV	Passed	35 kV	Passed	50 kV	Passed	65 kV	Passed
Partial Discharge Extinction Voltage @ 3 pC	4.5 kV	10.5 kV	7.5 kV	13 kV	13 kV	35 kV	21.5 kV	40 kV
Lightning Impulse Voltage Withstand (BIL)	75 kV	110 kV*	95 kV	110 kV*	110 kV	130 kV*	150 kV	175 kV*

\*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 48-1990 BIL requirements. The 3M 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.

## 6.0 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.

3M and Scotchlok are trademarks of 3M Company. Scotch is a registered trademark of 3M Company.

UniShield is a trademark of General Cable Technologies Corporation.

Note: The core material being removed from the Splice Body and Jacket Tubes are mixed polymers and can be recycled with other waste.



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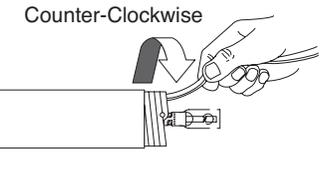
# 3M

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

Figure 3

## 7.0 Shelf Life

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 QT-III 7620-T and 7690-T Series terminations 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 Making High-Direct-Voltage Tests on Power Cable Systems in the Field").

## 8.0 Availability

The 7620-T and 7690-T Series are available in seven kit sizes for terminating shielded power cables rated 5 through 25/28 kV. They are available from your local authorized 3M electrical distributor.

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