

# 3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV

Data Sheet

October 2016

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## Description

3M Cold Shrink QT-III Silicone Rubber Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series, contain one-piece, skirted, silicone rubber terminations, or two-piece, Inverted Skirted, silicone rubber terminations, qualified as IEEE Standard 48 Class 1 for outdoor weather-exposed applications. The one-piece termination assemblies consist of a skirted insulator, high-dielectric constant (High-K) stress control tube, conformable High-K stress controlling compound and built-in environmental top sealing compound. The two-piece inverted skirted termination assemblies consist of a non-skirted (tubular) insulator, high-dielectric constant (High-K) stress control tube, conformable High-K stress controlling compound, built-in environmental top sealing compound and a separate skirted assembly. The insulators and separate skirted assemblies are 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.

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## Kit Contents

Each kit contains sufficient quantities of the following materials to make one single-phase termination (lug is not included in kit).

- 1 High-K, Tracking Resistant, Silicone Rubber Termination
- 1 Tracking Resistant Silicone Rubber Skirt Assembly (Inverted Skirted kits only)
- 2 Strips Scotch® Mastic Sealing Strip 2230
- 1 Instruction Sheet

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## Features

- Conforms to IEEE Standard 48 Class 1 requirements for 5, 8, 15, 25/28 and 35 kV terminations
  - One-piece, and two-piece inverted skirted, versatile designs, 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)
  - High-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 ethylene propylene rubber (EPR).
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## 3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV

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### Stress Control

The 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series, control the electric field stress distribution with special High-K materials, which are an integral part of the termination. The High-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 Cold Shrink QT-III Silicone Rubber 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 Cold Shrink QT-III Silicone Rubber Termination.

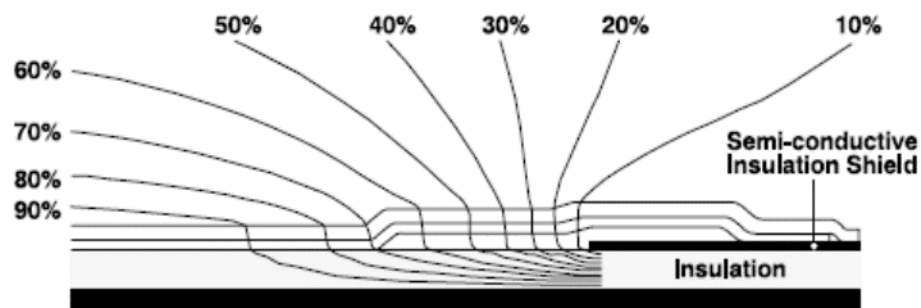


Figure 1

**3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV**

**Applications**

The 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S 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
- Protected and weather-exposed contaminated locations
- Free-hanging or bracket-mounting arrangements
- 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.)

The amount of airborne contamination determines the operating environment. Operating environments are described as areas having varying degrees of airborne contaminant or pollution severity that may or may not affect the long-term performance of terminations. These operating environments are defined as light, medium, heavy and extremely heavy variations of pollution severity. The appropriate termination selection depends on the system voltage and operating environment. (See tables on next page.)

**Recommended Application Guide**

3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kit	System Voltage	Operating Environment			
		Light	Medium	Heavy	Extremely Heavy
(2 Skirt) 7642-S-2, 7642-S-2 (L)**, 7642-S-INV-2, 7642-S-INV-2 (L)**	15 kV	√	√	√	
(4 Skirt) 7652-S-4 – 7656-S-4, 7652-S-4 (L)**, 7655-S-4 (L)**, 7653-S-INV-4, 7655-S-INV-4, 7655-S-INV-4 (L)**, 7656-S-INV-4	15 kV	√	√	√	√
(8 Skirt) 7663-S-8 – 7666-S-8, 7665-S-8 (L)**	15 kV	√	√	√	√
(4 Skirt) 7652-S-4 – 7656-S-4, 7655-S-4 (L)**, 7653-S-INV-4, 7655-S-INV-4, 7655-S-INV-4 (L)**, 7656-S-INV-4	25/28 kV	√	√	√	
(8 Skirt) 7663-S-8 – 7666-S-8, 7665-S-8 (L)**	25/28 kV	√	√	√	√
(4-Skirt) 7653-S-INV-4, 7655-S-INV-4, 7656-S-INV-4	35 kV	√	√	√	
(8 Skirt) 7663-S-8 – 7666-S-8	35 kV	√	√	√	*

Recommended operation environments are marked with a check (√).

\* Consult 3M sales representative.

\*\* The designated (L) version terminations are the same as the non-(L) versions of the above specified termination kits, except that they are on a larger core to accommodate and properly fit specific 3M Mechanical Shearbolt Lugs QL2 Series: Two-Hole and the Insulation O.D. range is slightly different than the non-(L) versions (See Termination Selection Tables on Pages 5 & 6).

**Pollution Severity Level Guide**

<b>Light</b>	<b>Heavy</b>
<ul style="list-style-type: none"> <li>• Areas without industry and with low-density housing</li> <li>• Areas subjected to frequent winds and/or rainfall with low-density industry and housing</li> <li>• Agricultural areas◇</li> <li>• Mountainous areas</li> </ul> <p>All of these regions should be situated at least 7 miles from the coast and should not be exposed to coastal winds.*</p>	<ul style="list-style-type: none"> <li>• High-density industrial areas and some urban areas with high-density housing, especially those with infrequent rainfall</li> <li>• Areas subjected to moderate concentration of conductive dust, particularly industrial smoke-producing deposits</li> <li>• Areas generally close to the coast and exposed to coastal spray or to strong winds carrying sand and salt, and subjected to regular condensation</li> </ul>
<b>Medium</b>	<b>Extremely Heavy</b>
<ul style="list-style-type: none"> <li>• Non-polluting industrial areas subject to infrequent rainfall and with average-density housing</li> <li>• Areas subjected to frequent winds and/or rainfall with high-density industry and housing</li> <li>• Areas exposed to wind from the coast, but generally over two miles from the coast</li> </ul>	<ul style="list-style-type: none"> <li>• Usually very limited areas having extremely heavy pollutants from industrial sites, especially those located near oceans and subjected to prevailing winds from the sea</li> <li>• Very small isolated areas where terminations are located immediately adjacent to a pollutant source, especially downwind (cement plants, paper mills, etc.)</li> </ul>

Use of fertilizers by spraying, or the burning of crop residues, can lead to a higher pollution level due to dispersal by wind.

\* Distances from coast depend on the topography of the coastal area and on the extreme wind conditions.

### 3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV

#### 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 Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S 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 outdoor weather-exposed locations. The current rating of these terminations meets or exceeds the current rating of the cables on which they are installed.

#### 3M Cold Shrink QT-III Silicone Rubber Skirted Termination Selection Table

7640-S, 7650-S and 7660-S Series

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-S-2	0.64 - 1.08 (16,3 - 27,4 mm)	4/0 - 400	3/0 - 300	2 - 4/0 (35 - 120 mm <sup>2</sup> )	-	-
7642-S-2 (L)*	0.69 - 1.22 (17,5 - 31,0 mm)	-	-	1/0 - 4/0 (60 - 120 mm <sup>2</sup> )	-	-
7652-S-4	0.64 - 1.08 (16,3 - 27,4 mm)	4/0 - 400	3/0 - 300	2 - 4/0 (35 - 120 mm <sup>2</sup> )	2 - 1/0 (35 - 50 mm <sup>2</sup> )	-
7652-S-2 (L)*	0.69 - 1.22 (17,5 - 31,0 mm)	-	-	1/0 - 4/0 (60 - 120 mm <sup>2</sup> )	-	-
7653-S-4	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> )	-
7654-S-4	0.83 - 1.53 (21,1 - 38,9 mm)	500 - 750	350 - 700	4/0 - 500 (120 - 240 mm <sup>2</sup> )	2/0 - 250 (70 - 150 mm <sup>2</sup> )	-
7655-S-4	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> )	-
7655-S-4 (L)*	1.15 - 1.98 (29,2 - 50,3 mm)	-	-	750 - 1000 (400 - 500 mm <sup>2</sup> )	500 - 750 (240 - 325 mm <sup>2</sup> )	-
7656-S-4	1.53 - 2.32 (38,9 - 58,9 mm)	1750 - 2000	1500 - 2000	1250 - 2000 (625 - 1000 mm <sup>2</sup> )	900 - 1750 (500 - 800 mm <sup>2</sup> )	-
7663-S-8	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> )	2 - 2/0 (35 - 70 mm <sup>2</sup> )
7664-S-8	0.83 - 1.53 (21,1 - 38,9 mm)	500 - 750	350 - 700	4/0 - 500 (120 - 240 mm <sup>2</sup> )	2/0 - 250 (70 - 150 mm <sup>2</sup> )	2 - 4/0 (35 - 120 mm <sup>2</sup> )
7665-S-8	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> )	3/0 - 600 (95 - 325 mm <sup>2</sup> )
7665-S-8 (L)*	1.15 - 1.98 (29,2 - 50,3 mm)	-	-	750 - 1000 (400 - 500 mm <sup>2</sup> )	500 - 750 (240 - 325 mm <sup>2</sup> )	-
7666-S-8	1.53 - 2.32 (38,9 - 58,9 mm)	1750 - 2000	1500 - 2000	1250 - 2000 (625 - 1000 mm <sup>2</sup> )	900 - 1750 (500 - 800 mm <sup>2</sup> )	700 - 1500 (350 - 725 mm <sup>2</sup> )

\* Conductor Size Range values for this termination only apply when using 3M Mechanical Shearbolt Lugs QL2 Series: Two-Hole, otherwise the Conductor Size Range values for the base termination Kit Number apply.

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**3M Cold Shrink QT-III Silicone Rubber Inverted Skirted Termination Kits Selection Table**

7620-S-INV and 7690-S-INV Series

Kit Number	Cable Insulation O.D. Range	Conductor Size 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-S-INV-2	0.64 - 1.08" (16,3 - 27,4 mm)	4/0 - 400	3/0 - 300	2 - 4/0 (35 - 120 mm <sup>2</sup> )	-	-
7642-S-INV-2 (L)*	0.69 - 1.22" (17,5 - 31,0 mm)	-	-	1/0 - 4/0 (60 - 120 mm <sup>2</sup> )	-	-
7653-S-INV-4	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> )	2 - 2/0 (35 - 70 mm <sup>2</sup> )
7655-S-INV-4	1.05 - 1.80" (26,7 - 45,7 mm)	700 - 1500	600 - 1250	350 - 1000 (185 - 500 mm <sup>2</sup> )	250 - 800 (150 - 400 mm <sup>2</sup> )	3/0 - 600 (95 - 325 mm <sup>2</sup> )
7655-S-INV-4 (L)*	1.15 - 1.90" (29,2 - 48,3 mm)	-	-	750 - 1000 (400 - 500 mm <sup>2</sup> )	500 - 750 (240 - 325 mm <sup>2</sup> )	-
7656-S-INV-4	1.53 - 2.32" (38,9 - 58,9 mm)	1750 - 2000	1500 - 2000	1250 - 2000 (625 - 1000 mm <sup>2</sup> )	950 - 1750 (500 - 800 mm <sup>2</sup> )	700 - 1500 (400 - 725 mm <sup>2</sup> )

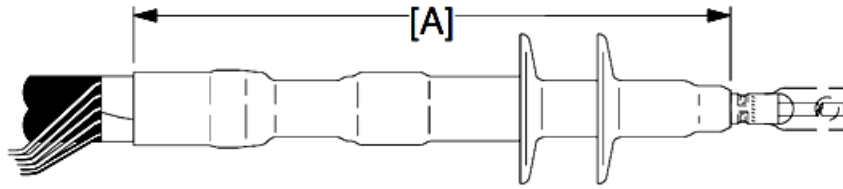
\* Conductor Size Range values for this termination only apply when using 3M Mechanical Shearbolt Lugs QL2 Series: Two-Hole, otherwise the Conductor Size Range values for the base termination Kit Number apply.

**3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV**

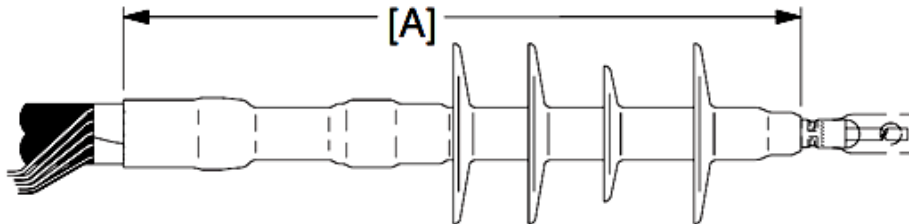
**Typical Properties, *continued***

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.

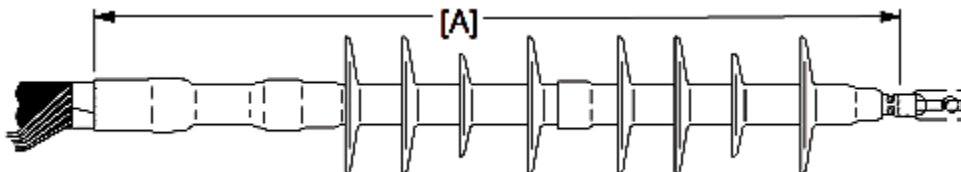
**Typical Dimensions**



Kit Number	Dimension [A] Max.	Wet Creepage Distance Max.	Arcing distance Max.
7642-S-2	9.8" (249 mm)	13.3" (338 mm)	9.8" (249 mm)
7642-S-2 (L)	9.8" (249 mm)	13.3" (338 mm)	9.8" (249 mm)



Kit Number	Dimension [A] Max.	Wet Creepage Distance Max.	Arcing distance Max.
7652-S-4	12.25" (311 mm)	18.5" (470 mm)	12.25" (311 mm)
7652-S-4 (L)	12.25" (311 mm)	18.5" (470 mm)	12.25" (311 mm)
7653-S-4	12.25" (311 mm)	18.5" (470 mm)	12.25" (311 mm)
7654-S-4	12.25" (311 mm)	18.5" (470 mm)	12.25" (311 mm)
7655-S-4	12.25" (311 mm)	18.5" (470 mm)	12.25" (311 mm)
7655-S-4 (L)	12.25" (311 mm)	18.5" (470 mm)	12.25" (311 mm)
7656-S-4	13.25" (337 mm)	19.5" (495 mm)	13.25" (337 mm)



Kit Number	Dimension [A] Max.	Wet Creepage Distance Max.	Arcing distance Max.
7663-S-8	20.50" (521 mm)	33.00" (838 mm)	20.50" (521 mm)
7664-S-8	20.50" (521 mm)	33.00" (838 mm)	20.50" (521 mm)
7665-S-8	20.50" (521 mm)	33.00" (838 mm)	20.50" (521 mm)
7665-S-8 (L)	20.50" (521 mm)	33.00" (838 mm)	20.50" (521 mm)
7666-S-8	21.50" (546 mm)	34.00" (864 mm)	21.50" (546 mm)

**3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV**

<b>Kit Number</b>	<b>Dimension [A] Max.</b>	<b>Wet Creepage Distance Max.</b>	<b>Arcing distance Max.</b>
7642-S-INV-2	12.00" (305 mm)	19.00" (483 mm)	12.00" (305 mm)
7642-S-INV-2 (L)	12.00" (305 mm)	19.00" (483 mm)	12.00" (305 mm)
7653-S-INV-4	16.00" (406 mm)	23.50" (597 mm)	16.00" (406 mm)
7655-S-INV-4	16.00" (406 mm)	23.50" (597 mm)	16.00" (406 mm)
7655-S-INV-4 (L)	16.00" (406 mm)	23.50" (597 mm)	16.00" (406 mm)
7656-S-INV-4	16.00" (406 mm)	24.50" (622 mm)	16.00" (406 mm)



**3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV**

**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.

**High-K Stress Control Tube**

Physical Properties (Test Method)	Typical Value English units (metric)
<b>Tensile Strength</b> (ASTM D412)	1500 psi (10,34 N/mm <sup>2</sup> )
<b>Modulus Elongation</b> @ 100% @ 300%	160 psi (1,10 N/mm <sup>2</sup> ) 500 psi (3,45 N/mm <sup>2</sup> )

Electrical Properties (Test Method)	Typical Value
<b>Dielectric Constant (K)</b> (ASTM D150) 60 Hz @ 1,000 V, 73°F (23°C), 50% RH	22
<b>Dissipation Factor</b> (ASTM D150) 60 Hz @ 1,000 V, 73°F (23°C), 50% RH	0.10

**High-K Stress Controlling Compound**

Electrical Properties (Test Method)	Typical Value
<b>Dielectric Constant (K)</b> (ASTM D150) 60 Hz @ 1,000 V, 73°F (23°C), 50% RH 100 mil (2,54 mm) thickness	25
<b>Dissipation Factor</b> (ASTM D150 ) 60 Hz @ 1,000 V, 73°F (23°C), 50% RH 100 mil (2,54 mm) thickness	0.90

**Environmental Sealing Compound**

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

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**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.

**Silicone Rubber Insulator**

Physical Properties (Test Method)	Typical Value English units (metric)
<b>Color</b>	Dark Gray
<b>Tensile Strength</b> (ASTM D412)	850 psi (5,86 N/mm <sup>2</sup> )
<b>Modulus Elongation</b> @ 100% @ 300%	130 psi (0,90 N/mm <sup>2</sup> ) 400 psi (2,76 N/mm <sup>2</sup> )
<b>Hydrophobic Recovery</b> (3M Test Method 406) > 90° Contact Angle	5.0 hrs.

Electrical Properties (Test Method)	Typical Value English units (metric)
<b>Dielectric Constant (S.I.C.)</b> (ASTM DI50) 60 Hz @ 1,000 V, 73°F (23°C), 50% RH	3.6
<b>Dissipation Factor</b> (ASTM DI50) 60 Hz @ 1,000 V, 73°F (23°C), 50% RH	0.003
<b>Dielectric Strength</b> (ASTM D149) 75 mil (1,90 mm) thickness	500 V/mil (19,68 kV/mm)
<b>Track Resistance</b> (ASTM 2303) 3.5 kV	5.0 hrs.

**Product Specifications**

The 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series, cable 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 221°F (105°C), with an emergency overload rating of 284°F (140°C). The termination stress control shall be capacitive and constructed of a High-K stress control compound and a High-K EPDM rubber tube. The installation shall not require using silicone grease.

The termination insulator shall be of a skirted 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 or Shearbolt 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 Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits 7640-S, 7650-S and 7660-S Series. This shall include all outdoor weather-exposed 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, 3M™ Stem Connectors SC Series, or 3M Mechanical Shearbolt Lugs QL2 Series: Two-Hole.

**3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV**

**Performance Tests**

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

Insulation Class Test	15 kV (2 Skirt)		15 / 25 kV (4 Skirt)		35 kV (8 Skirt)	
	Requirements	Results	Requirements	Results	Requirements	Results
Partial Discharge Extinction Voltage @ 3pC	13 kV	25 kV	13 / 21.5 kV	25 / 33 kV	30 kV	45 kV
Power Frequency Voltage 1 min. Dry Withstand	50 kV	85 kV*	50 /65 kV	95 /100 kV*	90 kV	125 kV*
Power Frequency Voltage 10 sec. Wet withstand	45 kV	65 kV*	45 / 60 kV	70 /75 kV*	80 kV	100 kV*
Power Frequency Voltage 6 hour Dry Withstand	34 kV	75 kV*	35 / 60 kV	85 / 90 kV*	76 kV	115 kV*
Direct Voltage 15 min. Dry Withstand	75 kV	Passed	75 / 105 kV	Passed	140 kV	Passed
Lightning Impulse Voltage Withstand (BIL)	110 kV	135 kV*	110 / 150 kV	165 / 175 kV*	200 kV	240 kV*
Partial Discharge Extinction Voltage @ 3 pC	13 kV	25 kV	13 / 21.5 kV	25 / 33 kV	30 kV	45 kV

\*All higher voltages, flashover occurs without breakdown.

**Typical Results, IEEE Standard 48 Long-Term Test Sequence**

Insulation Class Test	15 kV (2 Skirt)		15 / 25 kV (4 Skirt)		35 kV (8 Skirt)	
	Requirements	Results	Requirements	Results	Requirements	Results
Partial Discharge Extinction Voltage @ 3pC	13 kV	25 kV	13 / 21.5 kV	25 / 33 kV	30 kV	45 kV
Cyclic Aging 30 days, 266°F (130 °C) conductor temperature Power frequency Voltage Withstand	26 kV	Passed	26 / 43 kV	Passed	60 kV	Passed
Partial Discharge Extinction Voltage @ 3 pC	13 kV	25 kV	13 / 21.5 kV	25 / 33 kV	30 kV	45 kV
Lightning Impulse Voltage Withstand (BIL)	110 kV	135 kV*	110 / 150 kV	165 / 175 kV*	200 kV	240 kV*

\*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 high frequency 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, *continued***

**Power Frequency (AC) Withstand Tests**

All 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series, meet, or exceed the IEEE Standard 48 requirements for a Class 1 termination.

**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 QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits 7640-S, 7650-S and 7660-S Series terminations exceed these BIL requirements.

**Sealing Tests**

Termination top and bottom seals are tested per IEEE Standard 48 requirements. The termination is submerged in water, current cycled 8 hours on and 16 hours off for 10 cycles. The termination is then removed and AC Withstand tested.

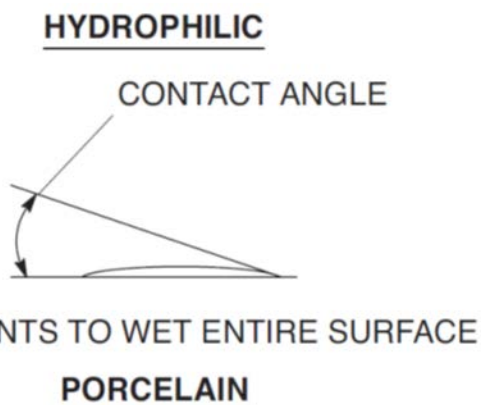
**Environmental Performance – Material Characteristics**

*Hydrophobicity*

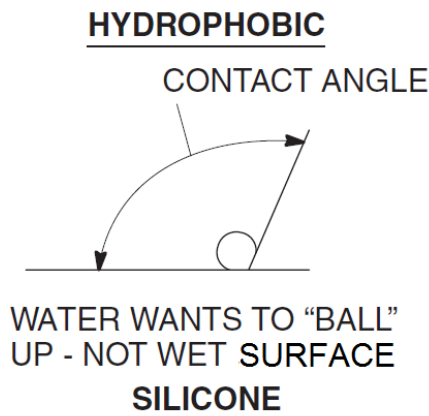
When airborne contaminants are deposited on a termination surface, destructive leakage currents can initiate when the surface becomes wet. Fog and drizzle are normally considered to be worse than rain as these two forms of precipitation can combine with accumulated surface contaminants to reduce surface resistivity making the surface conductive to varying degrees, promoting leakage current formation. Rain tends to wash the pollutants off the termination surface.

The inherent hydrophobic nature of the silicone rubber compound used to make 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits 7640-S, 7650-S and 7660-S Series components tends to reject moisture accumulation, and thereby, reduces the probability for discharge-initiated material erosion and tracking.

On occasion severe environmental conditions that are sustained for long time periods can cause any polymeric surface to lose its hydrophobicity. Because of this, EPD polymers and others tend to lose their hydrophobic nature over time. Porcelain surfaces become increasingly hydrophilic with time, which can result in premature failure or flashover. Silicone surfaces can regenerate their hydrophobic character. The silicone insulator surface will re-establish its hydrophobic surface within 24 hours. This unique ability is a major factor for ensuring a long service life.



**Figure 2**



**Figure 3**

## **3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV**

### *Ozone, Heat and UV Resistance*

One of the most outstanding physical characteristics of silicone rubber is its retention of desirable properties over the very wide temperature range of -150°F (-100°C) to 600°F (315°C). While there are applications that take advantage of these temperature extremes, a more attractive feature might be that of its extremely long life expectancy at moderate operating temperatures.

The silicone polymer molecular backbone, silicone-oxygen linkage, provides the same strong -Si-O-Si- type bond occurring in quartz, sand and glass, which accounts for the outstanding temperature properties of silicones and their resistance to oxidation by ozone, corona and weathering. Polymer chains from organic rubber materials often have double carbon bond molecular backbones, which are quickly cleaved by ozone, ultraviolet light, heat or other influences found in the operating environment.

**3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV**

**Installation Techniques**

<p><b>⚠ Caution</b></p> <p>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.</p>
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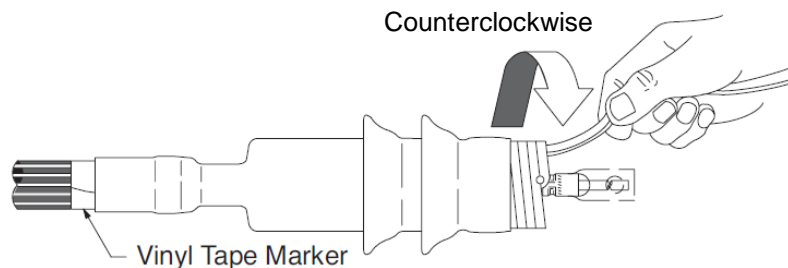
Detailed instructions are included in each kit to provide the installer with all information required to properly install the appropriately sized 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits. A brief summary of the installation steps for Jacketed Concentric Neutral (JCN) cable is outlined as follows:

1. Prepare cable according to standard procedure.
2. Apply bottom mastic seal. (Figure 4)



Figure 4

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 5)




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

Figure 5

## 3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV

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### **Maintenance**

It is good practice to incorporate a general inspection/cleaning of 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Terminations during normal scheduled or maintenance inspections. Once the area has been de-energized, the terminations can be inspected, and if need be, cleaned. Some recommendations for surface cleaning 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Terminations are as follows:

Use a can of compressed 'air' in order to blast off dust and miscellaneous airborne contaminants on the surface of the termination body. If needed, wipe the surface of the termination with a cable cleaning solvent, such as 3M Cable Cleaning System CC Series solvent, and allow it to dry before re-energizing the installation.

Mix a mild soap and water solution (deionized water is recommended, if available) in a hand sprayer, or spray bottle, and spray down the surface of the termination. Wipe dry, or allow to air dry, before re-energizing.

If tan discoloration between skirts is observed on the surface of the termination, wipe with a cable cleaning solvent. The discoloration itself does not pose any detrimental effect to the installation, and may not disappear entirely, but it will lighten up to some degree. This discoloration is a typical result of the outgassing effect of EPR cable and does not interfere with the performance of the termination in any capacity.

Do not abrade the surface of the termination in any way. Do not use high pressure cleaning (this can tear, or split, the termination), high pressure water with corn cobs, sandpaper or other abrasive products. This will damage the termination surface and reduce tracking and arcing resistance.

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### **Shelf Life & Storage**

As provided in the expanded state, the 3M Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits 7640-S, 7650-S and 7660-S 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).

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### **Availability**

Please contact your local distributor; available from [3M.com/electrical](http://3M.com/electrical); Select your Market (Electrical Utility Products, Electrical Construction and Industrial Products or Electrical OEM Materials), then select Where to Buy (Find a Distributor) or call 1.800.245.3573.

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**3M™ Cold Shrink QT-III Silicone Rubber Skirted and Inverted Skirted Termination Kits, 7640-S, 7650-S and 7660-S Series 5, 8, 15, 25/28 and 35 kV**

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Electrical Markets Division  
6801 River Place Blvd.  
Austin, TX 78726-9000  
800.245.3573  
FAX: 800.245.0329  
[www.3M.com/electrical](http://www.3M.com/electrical)

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