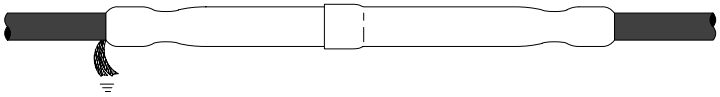
Cold Shrink™ Splice Kits

QS 2000T Series For 15 kV



Data Sheet

1. Product Description

3M™ QS 2000T Series Cold Shrink™ Silicone Rubber Splice Kits are designed to transition splice PILC to Poly/EPR or splice PILC to PILC Cables. **They meet the requirements of IEEE 404–1993. The QS 2000T oil stop passes internal pressure tests at 25 PSI continuous operation and 100 PSI for 36 hours at the rated overload temperature, with no oil leakage.**

QS 2000T Series Splice Bodies, Oil Stop Tube and Re-jacketing Tubes are provided in the expanded state, mounted on removable inner supporting plastic cores. As supplied in this pre-stretched condition the splice is ready for field installation. During installation the cores are unwound, allowing the oil stop tube, splice body and re-jacketing tubes to shrink forming tight seals.

Stress Control

The QS 2000T Splice Kits use a special high dielectric constant (High-K) silicone material, to control the electric field in the splice. By controlling the electric field, the stress concentration at the end of the cable insulation shield, at the High-K material and cable insulation interface is less than 15 volts per mil. As compared to 50 V/mil at the shield and about 70 V/mil at the conductor, in the shielded portion of a 15kV cable. **The stress in the splice body is less than in the cable insulation under the shielded portion of the cable.**

Kit Contents:

Each kit contains sufficient quantities of the following materials to make one splice.

— Cold Shrink™ Splice Body
— Cold Shrink™ Oil Stop Tubes (special EPDM)
— Cold Shrink™ Jacket Tubes
— Shielding Sleeve (3 ft.)
— Constant Force Springs (shield connectors)
— Ground Braids
— White Restricting Tape
— Scotch™ 13 Semi-Conducting Tape
— Scotch™ 23 Rubber Tape
— Scotch™ 2228 Rubber Mastic Tape
— 3M P55/R Compound (red)
— Mastic Sealing Strips
— Cable Preparation Templates
— Instruction Booklets

NOTE: 3M 2000T Series Oil Stop Connectors are available *(see page 5)*. Connector is not provided with kits due to customer specific application requirements.

To ensure a positive oil stop a sealed connector, one with a solid center barrier, should be used with the QS 2000T Series Splice Kits.

Features:

- Complete kit: Everything included to make one transition or PILC to PILC splice (except connector and vinyl tape).
- Cold Shrink™ design: No torches, heat guns or special tools required.
- Eliminates requirement to “sweat” lead.
- Accommodates a wide range of cable sizes.
- Seals tight, retains its resiliency and pressure even after years of aging and exposure.
- Improved tougher rubber formulation to withstand back filling.
- Water Resistant meets the water seal requirements of ANSI C119.1.
- Resists fungus.
- Resists acids and alkalies.
- Resists ozone.

2. Applications

The QS 2000T Series Splice Kits can be used on cables with an operating temperature of 75°C and an emergency overload rating of 110°C (reference: AEIC N0. 1). These kits meet the requirements for 15kV in IEEE Standard Test Procedures and requirements for High Voltage Cable Splices (IEEE Standard 404–1993). (See section 5, Performance Tests). The current rating of QS 2000T Splices meets the current rating of the PILC cables.

Collectively, QS 2000T Series Splice Kits accommodate primary cable insulation diameters for PILC cable from 0.56 inch (14,2 mm) to 1.56 inch (39,6 mm) and Poly/EPR cable from 0.70 inch (17,8 mm) to 1.71 inch (43,2 mm). These kits can be used to splice the following cable types:

— PILC (paper insulated lead covered cable)

TO:

— PILC
— Tape Shielded
— Wire Shielded
— EP–Lead or XLP–Lead

— CN (Concentric Neutral)
— JCN (Jacketed Concentric Neutral)
— LC (Longitudinal Corrugated Shield)
— UniShield® (registered trademark of BICC Cables)

Each kit contains two EPDM Cold Shrink™ tubes to re-jacket and moisture seal the splice. For direct burial and water immersion applications.

A. Typical Physical and Electrical Properties

QS 2000T Splice Body

Silicone Insulating Rubber

Physical Properties

Test Method	Typical Value*
Color	Transparent
Elongation, (%) (ASTM D 412)	750%
Tensile Strength (ASTM D 412)	1160 psi
Shore A Hardness (ASTM D 2240)	33
Compression Set (22 hrs @ 350(F) (ASTM D 395)	20%
Tear Strength (ASTM D 624) (die B)	114 pli
100% Modulus (ASTM D 412)	145 psi
300% Modulus (ASTM D 412)	435 psi

Electrical Properties

Test Method	Typical Value*
Dielectric Constant (SIC) (ASTM D 150)	3.3
Dissipation Factor (ASTM D 150)	0.0025
Dielectric Strength (ASTM D 149)	560 volts/mil

Semi-Conductive Rubber

Physical Properties

Test Method	Typical Value*
Color	Black
Elongation, (%) (ASTM D 412)	580%
Tensile Strength (ASTM D 412)	800 psi
Shore A Hardness (ASTM D 2240)	39
Compression Set (22 hrs @ 350(F) (ASTM D 395)	10%
Tear Strength (ASTM D 624) (die B)	60 pli
100% Modulus (ASTM D 412)	145 psi
300% Modulus (ASTM D 412)	435 psi

Electrical Properties

Test Method	Typical Value*
Volume Resistivity	35 ohm cm

Stress Control

Physical Properties

Test Method	Typical Value*
Color	Black
Elongation, (%) (ASTM D 412)	400%
Tensile Strength (ASTM D 412)	800 psi
Shore A Hardness (ASTM D 2240)	35
Compression Set (72 hrs @ 302(F) (ASTM D 395)	20%
Tear Strength (ASTM D 624) (die B)	80 pli
100% Modulus (ASTM D 412)	145 psi
300% Modulus (ASTM D 412)	435 psi

Electrical Properties

Test Method	Typical Value*
Dielectric Constant (SIC) (ASTM D 150)	20
Dissipation Factor (ASTM D 150)	0.1
Dielectric Strength (ASTM D 149)	200 volts/mil

Cold Shrink™ Jacket Sleeves

Physical Properties

Test Method	Typical Value*
Color	Black
300% Modulus (ASTM D 412)	480 psi
Elongation, (%) (ASTM D 412)	750%
Tensile Strength (ASTM D 412)	1400 psi
Die C Tear (ASTM D 624)	150 pli

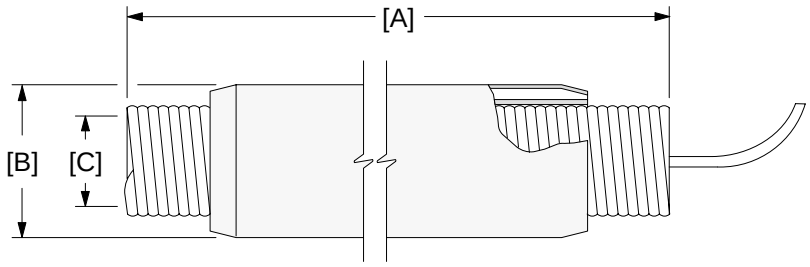
Electrical Properties

Test Method	Typical Value*
Dielectric Strength (ASTM D 149) Original	365 volts/mil
7 days in H_2O 90°C (194°F)	282 V/mil

* All values are averages and are not intended for specification purposes.

B. Typical Dimensions

(for reference only)



Product Number	A inches (mm)	B inches (mm)	C inches (mm)	Approximate Installed Length
QS 2011T	17.3 (440)	2.72 (69)	1.81 (46)	18″ (457 mm)
QS 2012T	17.3 (440)	2.99 (76)	2.09 (53)	18″ (457 mm)
QS 2013T	19.7 (500)	3.39 (86)	2.48 (63)	19″ (483 mm)

Table 1

C. Splice Selection Table

Product Number	PILC Insulation O.D. Range inches (mm)	PILC Conductor Size AWG/kcmil (mm^2)	Poly/EPR Insulation O.D. Range inches (mm)	Poly/EPR Conductor Size AWG/kcmil (mm^2)
QS 2011T	0.56 – 0.88 (14,2 – 22,4)	4 – 2/0 (25 – 70)	0.71 – 1.02 (18,0 – 25,9)	1 – 3/0 AWG (50 – 95)
QS 2012T	0.74 – 1.17 (18,8 – 29,7)	3/0 – 350 (70 – 195)	0.881 – 1.31 (22,4 – 33,3)	4/0 – 350 (100 – 195)
QS 2013T	0.98 – 1.56 (24,9 – 39,6)	400 – 1000 (200 – 500)	1.12 – 1.70 (28,4 – 43,2)	500 – 1000 (200 – 500)

Table 2

D. Typical Results per IEEE Std. 404–1993 Tests

IEEE Std. 404 Test	QS 2000T Series Splice	
	Requirement	Result
6 – Hour AC Withstand (kV–RMS)	35	Pass
15 Minute DC Withstand (kV–DC)	55	Pass
BIL (room temperature) (kV–Crest/Surges) (kV–Crest/Surges)	 +110/10 –110/10	 Pass Pass
BIL (110 Degrees Celsius) (kV–Crest/Surges) (kV–Crest/Surges)	 +110/10 –110/10	 Pass Pass
30 Day Cyclic Aging @ 110 Degrees Celsius AC Withstand (kV)	 in Water 17.4 in Air 17.4	 Pass Pass
High–voltage Time 6 hours in water (kV–RMS)	34.8	Pass
Connector Thermal/Mechanical	ANSI C119.4–1991	Pass

Table 3

3. Specifications

Open Specification

The splice must be a Cold Shrink™ 15 kV class device and meet the requirements of IEEE Std 404–1993. The splice must be capable of splicing PILC to PILC cable or transition splicing PILC to Poly/EPR cable, and must provide an effective oil block. The splice body must be a one-piece, molded silicone rubber device mounted on a removable inner supporting plastic core. The splice body must contain two stress control devices, an inner electrode and an outer semi-conductive shield. The splice must be capable of continuous operation at 75°C with an emergency overload rating of 110°C.

Closed Specification

Splice and re-jacket all 15kV Class single conductor, PILC cables from #4 AWG to 1000 kcmil or transition splice to Poly/EPR cable from #1 AWG to 1000 kcmil, in accordance with the instructions provided with 3M, QS 2000T Series Cold Shrink™ Splice Kits.

4. Performance Tests

Internal Pressure/Vacuum Test

The QS 2000T Series Splices have been pressure tested to levels which exceed those encountered under field service conditions.

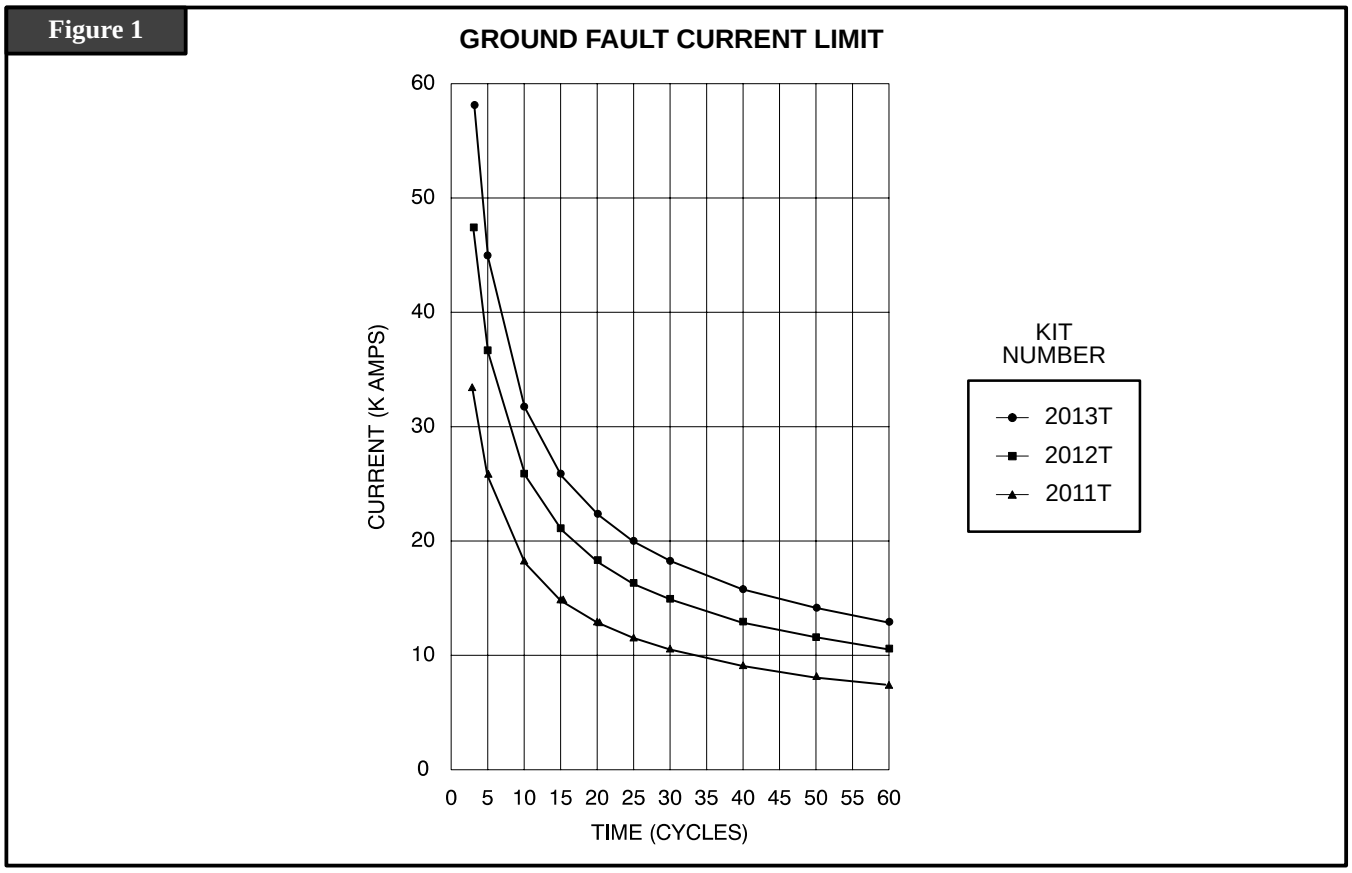
3M, QS 2000T series splices are rated to withstand a continuous internal pressure of 25 PSI or an emergency overload pressure of 100 PSI for 36 hours.

The oil stop used in the 3M, QS 2000T Series Splices exceeds the pressure and vacuum requirements of IEEE 48–1990, which requires 30 PSI for 1 hour and 0.02″ of Hg for 30 minutes. The oil stop was tested for many weeks at both pressures and vacuums. It was tested at pressures exceeding 100 PSI and has held a vacuum of 18″ Hg for more than 30 days. Test report is available, contact 3M Technical Service.

Ground Fault Test

The results of ground fault tests, conducted by an independent test laboratory, on the ground braids included with the kits, *(shown in Figure 1)*.

Figure 1



E. QS 2000T Copper to Copper Connectors

Kit Number PILC to PILC	Kit Number PILC to Poly/EPR	Kit Number With Connector Number*	Conductor Size
QS 2011T	—	xxxxx–4–CU	4 AWG
QS 2011T	—	xxxxx–2–CU	2 AWG
QS 2011T	QS 2011T	xxxxx–1–CU	1 AWG
QS 2011T	QS 2011T	xxxxx–1/0–CU	1/0 AWG
QS 2011T	QS 2011T	xxxxx–2/0–CU	2/0 AWG
QS 2012T	QS 2011T	xxxxx–3/0–CU	3/0 AWG
QS 2012T	QS 2012T	xxxxx–4/0–CU	4/0 AWG
QS 2012T	QS 2012T	xxxxx–250–CU	250 kcmil
QS 2012T	QS 2012T	xxxxx–350–CU	350 kcmil
QS 2013T	QS 2013T	xxxxx–500–CU	500 kcmil
QS 2013T	QS 2013T	xxxxx–600–CU	600 kcmil
QS 2013T	QS 2013T	xxxxx–750–CU	750 kcmil
QS 2013T	QS 2013T	xxxxx–1000–CU	1000 kcmil

*** NOTE: Insert Kit Number in place of xxxxx to order with appropriate connector.**

Table 4

F. QS 2000T Copper to Aluminum Transition Connectors

Kit Number PILC to PILC	Kit Number PILC to Poly/EPR	Kit Number With Connector Number*	Conductor Size	
			Copper	Aluminum
QS 2011T	QS 2011T	xxxxx–4–1/0	4 AWG	1/0 AWG
QS 2011T	QS 2011T	xxxxx–3–1/0	3 AWG	1/0 AWG
QS 2011T	QS 2011T	xxxxx–2–1	2 AWG	1 AWG
QS 2011T	QS 2011T	xxxxx–2–1/0	2 AWG	1/0 AWG
QS 2011T	QS 2011T	xxxxx–1–1/0	1 AWG	1/0 AWG
QS 2011T	QS 2011T	xxxxx–1/0–2/0	1/0 AWG	2/0 AWG
QS 2012T	QS 2011T	xxxxx–3/0–350	3/0 AWG	350 kcmil
QS 2012T	QS 2012T	xxxxx–4/0–350	4/0 AWG	350 kcmil
QS 2012T	QS 2012T	xxxxx–250–350	250 kcmil	350 kcmil
QS 2013T	—	xxxxx–400–500	400 kcmil	500 kcmil
QS 2013T	QS 2013T	xxxxx–500–750	500 kcmil	750 kcmil
QS 2013T	QS 2013T	xxxxx–500–800	500 kcmil	800 kcmil
QS 2013T	QS 2013T	xxxxx–500–1000	500 kcmil	1000 kcmil
QS 2013T	QS 2013T	xxxxx–600–750	600 kcmil	750 kcmil
QS 2013T	QS 2013T	xxxxx–650–750	650 kcmil	750 kcmil
QS 2013T	QS 2013T	xxxxx–700–750	700 kcmil	750 kcmil
QS 2013T	QS 2013T	xxxxx–750–800	750 kcmil	800 kcmil
QS 2013T	QS 2013T	xxxxx–750–1000	750 kcmil	1000 kcmil

*** NOTE: Insert Kit Number in place of xxxxx to order with appropriate connector.**

Table 5

5. Maintenance

Components are stable under normal storage conditions. Normal storage and stock rotation are recommended.

The QS 2000T Series Kits are not impaired by freezing nor by overheated storage up to 140°F (60°C). After installation the QS 2000T Splices can be checked periodically by visual inspection or normal hypotting procedures. 3M Cold Shrink™ removable core material is polypropylene and recyclable with other waste.

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