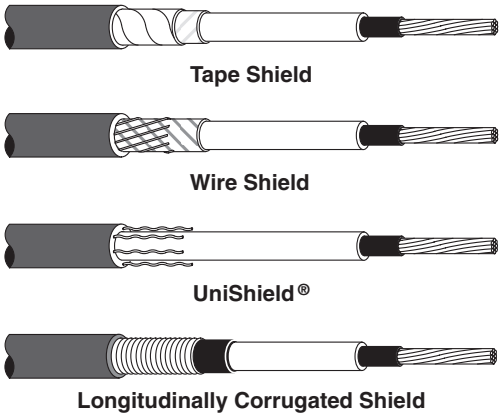
Cold Shrink Inline Splice Kit QS III 5545A 46 kV

Data Sheet



1. Product Description

3M™ Cold Shrink Inline Splice Kit QS-III 5545A is a 46 kV-class inline splice for joining tape, longitudinally corrugated (LC), wire and UniShield® shielded power cables. It is a cold shrink design sized to fit Type MV-90 or Type MV-105 copper or aluminum conductor sizes ranging from 4/0 AWG - 1000 kcmil (120 - 500 mm2). However, 4/0 AWG and 250 kcmil cable may be used with aluminum connectors ONLY - do not use 4/0 AWG or 250 kcmil copper connectors. The cold shrink splice body is a one-piece molded design made of special formulated silicone rubbers, while the cold shrink jacketing is made of EPDM rubber for physical protection. Each splice manufactured is factory tested to provide reliability.

The splices can be used with standard copper (Cu) or aluminum (Al/Cu) inline compression (crimp type) connectors, and can be used for size transitions within the listed kit size range. They are designed to exceed minimum industry test standards, and have a BIL rating of 250 kV. The QS-III 5545A splice meets or exceeds the 46 kV Voltage Class rating requirements of ANSI/IEEE Std. 404.

Kit Contents:

- 1 Cold Shrink Silicone Rubber Splice Body
- 1 Cold Shrink Adapter Tube
- 1 Cold Shrink Jacketing Tube
- 1 Shielding Sleeve
- 1 Ground Strap
- 5 Constant Force Spring Ground Connectors
- 2 Tubes P55/R Red Compound
- 6 Scotch® Mastic Sealing Strips 2230
- 2 Rolls Scotch® Rubber Mastic Tape 2228
- 2 Copper Tape Strips
- 1 3M™ Cable Cleaning Pad CC-3
- 2 Cable Preparation Templates
- 1 Instruction Booklet

Splice Features:

- **Cold Shrink Design** — for quick and easy installation; excellent for cable size transitions
- **Complete Kit** — includes everything required to make one splice
- **Silicone Rubber Construction** — for good high and low temperature performance
- **High Ampacity Shield** — faults current rated for 15,000 Amps for 15 cycles, neutral current rated for 350 Amps.
- **Production Tested** — partial discharge and A.C.withstand tests to provide reliability
- **Computer Aided Design** — for compact size and optimal distribution of electrical field
- **Special Electrode Design** — minimizes electrical stress at critical cable/splice interface

2. Applications

For splicing 46 kV shielded power cables:

- For inline splicing
- For feeder and distribution circuits
- For Tape, Wire, UniShield® & Longitudinally corrugated (LC) shielded cables.
- For transitions from shielded to neutral power cables.
- For copper or aluminum conductors
- For size transition splicing
- For direct burial installations
- For submerged locations

⚠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.

3. Data: Physical and Electrical Properties

The 3M™ Cold Shrink Inline Splice Kit QS-III 5545A can be used on cables with a rated operating temperature up to 105°C, and an emergency overload rating of 140°C. A splice constructed from this kit is rated for 46 kV and meets or exceeds the requirements of IEEE Std. 404. The current rating of the splice meets or exceeds the current rating for the cables on which it is installed. BIL rating is 250 kV.

A. Splice Selection Table

Kit Number	Cable Insulation O.D. Range Inches (mm)	Conductor Size Range AWG or kcmil (mm2)
5545A	1.24 - 2.07 (31,5-52,6)	4/0 - 1000* (120 - 500)

Table 1

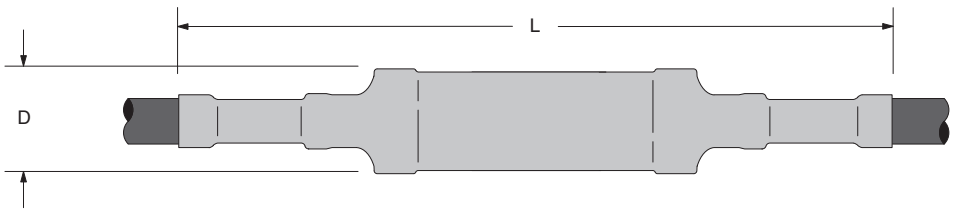
* 4/0 AWG and 250 kcmil cable may be used with aluminum connectors ONLY - do not use 4/0 AWG or 250 kcmil copper connectors.

B. Connector Dimensional Requirements Table

Kit Number	Minimum O.D. Inches (mm)	Maximum O.D. Inches (mm)	Maximum Length Inches (mm)		Connector O.D. Range Requiring Adapters Inches (mm)
			Aluminum (Al/Cu)	Copper (Cu)	
5545A	0.87 (22,1)	2.07 (52,6)	7.50 (191)	8.25 (210)	0.87 - 1.60 (22,1 - 40,6)

Table 2

C. Typical Dimensions (Installed Splice)



Kit Number	Typical Length (L) Inches (mm)	Typical Diameter (D) Inches (mm)
5545A	35 (889)	3.90 (99)

Table 3

D. Typical Physical and Electrical Properties

Silicone Rubber (Splice Body — Insulation)

Physical Properties

Test Method	Typical Value*
Hardness - Shore A (ASTM D 2240)	50
Elongation (%) (ASTM D 412)	610
Tensil Strength (psi) (ASTM D 412)	1090 (7,5 N/mm^2)
Modulus @ 100% (psi) (ASTM D 412)	340 (2,3 N/mm^2)
Permanent Set (%) (100%, 100˚C, 22 hrs) (3M TM 86)	5
Thermal Conductivity (W/m K) (ASTM D 518)	0.24

Electrical Properties

Test Method	Typical Value*
Dielectric Strength (V/mil) (ASTM D 149)	370 (14,6 kV/mm)
Dielectric Strength, Wet (V/mil) (ASTM D 149)	340 (13,4 kV/mm)
Dielectric Constant (ASTM D 150)	3.3
Dielectric Loss (ASTM D 150)	0.005
Volume Resistivity (Ohm-cm) (3M TM 80)	6x10^{14}

Silicone Rubber (Splice Body — Inner Electrode)

Physical Properties

Test Method	Typical Value*
Hardness - Shore A (ASTM D 2240)	43
Elongation (%) (ASTM D 412)	510
Tensile Strength (psi) (ASTM D 412)	880 (6,1 N/mm2)
Modulus @ 100% (psi) (ASTM D 412)	200 (1,4 N/mm^2)
Permanent Set (%) (100%, 100˚C, 22 hrs) (3M TM 86)	4

Electrical Properties

Test Method	Typical Value*
Volume Resistivity (Ohm-cm) (3M TM 80)	50

Silicone Rubber (Splice Body — Semi-Con Shell)

Physical Properties

Test Method	Typical Value*
Hardness - Shore A (ASTM D 2240)	43
Elongation (%) (ASTM D 412)	520
Tensil Strength (psi) (ASTM D 412)	890 (6,1 N/mm^2)
Modulus @ 100% (psi) (ASTM D 412)	230 (1,6 N/mm^2)
Permanent Set (%) (100%, 100˚C, 22 hrs) (3M TM 86)	5

Electrical Properties

Test Method	Typical Value*
Volume Resistivity (Ohm-cm) (3M TM 80)	150

Ethylene Propylene Rubber (Jacketing Tubes)

Physical Properties

Test Method	Typical Value*
Color	Black
Hardness - Shore A (ASTM D 2240)	48
Ultimate Elongation, orig. (%) (ASTM D 412)	635
Ultimate Tensile, orig. (psi) (ASTM D 412)	1680 (11,6 MPa)
Modulus @ 100% (psi) (ASTM D 412)	170 (1,17 MPa)
Fungus Resistance, 28 days (ASTM G 21)	No Growth
Permanent Set (%)	
(250% Strain)	8.8
(5 min. recovery, @ 40˚F, 4.4˚C)	14.6

Electrical Properties

Test Method	Typical Value*
Dielectric Strength, orig. (V/mil) (ASTM D 149)	490 (19,1 kV/mm)
Dielectric Strength, Wet (V/mil) (ASTM D 149)	465 (18,1 kV/mm)
Dielectric Constant, orig. (ASTM D 150)	5.0
Dielectric Constant, Wet (ASTM D 150)	5.6

* All values are averages, based on several determinations and are not intended for specification purposes.

4. Specification

Product
(Open Specification)

The tape, longitudinally corrugated (LC), wire and UniShield® shielded power cable splice shall meet requirements of ANSI/IEEE Std. 404 for a 46 kV rating, and must be rated by the manufacturer for use on 46 kV class cable systems. It must be rated for continuous operation at 105°C, with an emergency overload temperature rating of 140°C. The splice shall be capable of splicing cables with copper or aluminum conductors sized from 4/0 AWG to 1000 kcmil (120 - 500 mm^2 (for 4/0 AWG and 250 kcmil cables, use aluminum connectors ONLY), or accommodate a conductor size transition within those size ranges. The splice shall be of a cold shrink design which does not require any additional heat source for installation. The cold shrink splice body must be of a molded design made of silicone rubber. The splice jacketing shall be of a cold shrink tubing made of EPDM rubber. The color of the splice body and outer jacket shall be black.

Engineering/Architectural
(Closed Specification)

Splicing of all 46 kV rated cables, tape, longitudinally corrugated (LC), wire and UniShield® shielded power cables, sized from 4/0 AWG to 1000 kcmil (120 - 500 mm^2) (for 4/0 AWG and 250 kcmil cables use aluminum connectors ONLY), shall be performed in accordance with the instructions provided with the 3M™ Cold Shrink Inline Splice Kits QS-III 5545A.

5. Performance Tests
A. IEEE Std. 404 35 kV Voltage Rating

Design Test and Sequence	Test Requirement
Minimum partial discharge (corona) level	40 kV-rms @ < 3 pC
Alternating-current 1 minute withstand	80 kV-rms
Direct-current 15 minute withstand	172 kV-dc
Impulse with stand (BIL) at 25˚C (77˚F)	±250 kV-crest
Impulse withstand (BIL) at 140˚C (284˚F)	±250 kV-crest
Minimum partial discharge (corona) level	40 kV-rms @ < 3 pC
Cyclic Aging (in air and water)	67 kV-rms
Minimum partial discharge (corona) level	40 kV-rms @ < 3 pC
High voltage time: 5 hr. alternating-current withstand	80 kV-rms
5 min. alternating-current withstand	100 kV-rms
Short-time current	
(ICEA P-32-382 and ANSI/IEEE C37.09)	250°C conductor temp with no damage
Alternating-current 1 minute withstand	80 kV-rms
Shielding	IEEE Std. 592
Connector thermal and mechanical	ANSI C119.4

B. Operating Temperature

Reference: AEIC CS5 and AEIC CS6:	**Normal Operation**	**Emergency Operation**
	105°C	140°C

C. Shielding Short Circuit Testing

The 3M™ Cold Shrink Inline Splice Kit QS-III 5545A shielding system is rated for 15 kA for 15 cycles. The shielding system was submitted to an independent test laboratory for short circuit testing. High ampacity performance was verified by applying the following series: 10 kA-RMS for 10 cycles, 12 kA-RMS for 12 cycles and 15 kA-RMS for 15 cycles.

The 3M™ Cold Shrink Inline Splice Kit QS-III 5545A Shielding System is rated for 350 Amps of neutral current. The shielding system was tested in a loop similar to that which is used in the ANSI C119.4 Connector Test Method, by measuring temperature and resistance. Ampacity performance was verified by applying current in 3-hour on/3-hour off cycles at levels up to and exceeding the 350 Amp rated current.

The shielding system consists of a tin-plated braided copper sleeve which serves as the splice metallic shield and ground jumper, connected to the cable metallic shields with solderless constant force springs.

6. Installation Techniques

Detailed instructions for installing the 3M™ Cold Shrink Inline Splice Kit QS-III 5545A are included with each kit. A Cable Preparation Template is provided:

1. Prepare cable according to standard procedure.
2. Slide cold shrink jacketing tubes and cold shrink splice body onto prepared cables.
3. Position expanded shield sleeve onto one cable.
4. Install inline compression (crimp) connector. Connector dimensional requirements table provided.
5. Apply a tape marker on one cable.
6. Apply red compound on cable insulation and fill in edge of cable semi-con. **DO NOT use silicone grease.**
7. Install splice over connector area, aligning end with tape marker, and removing core by pulling and unwinding counterclockwise.
8. Install shield sleeve, centered over splice body, and attach to cable metallic shields with constant force springs.
9. Connect ground strap if circuit grounding is required at this location. Apply mastic sealing strips to seal ground wire at end of cable jacket.
10. Apply rubber mastic tape around the end of both cable jackets.
11. Install cold shrink jacketing tube over splice.
12. Connect ground strap to ground if splice is to be grounded.
13. If located in direct sunlight, overwrap splice with vinyl tape.

7. Maintenance

Components of the 3M™ Cold Shrink Inline Splice Kit QS-III 5545A is stable under normal storage conditions. Normal stock rotation procedures are recommended. As provided, in the expanded state, the QS-III splice kits have an on-shelf storage life of three years from the date of manufacture. The installed splices can be field tested using standard field cable testing procedures (reference ANSI/ IEEE Std. 400.1, “Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field”).

8. Availability

3M™ Cold Shrink Inline Splice Kit QS-III 5545A is available to splice 46 kV tape, longitudinally corrugated (LC), wire and UniShield® shielded power cables. Standard dimension copper (Cu) or aluminum (Al/Cu) compression (crimp type) connectors are suitable for use with these splice kits. These kits are available from your local authorized 3M electrical distributor.

9. Connectors for QS-III Splices

The 3M™ Cold Shrink Inline Splice Kits QS-III are designed to be used with 3M™ Scotchlok™ 10000, 11000 and 20000 Series Connectors, 3M™ CI-Series, or other UL listed inline compression connectors that fit within the dimension limits lsited in the Connector Dimensional Requirements Table 2. In addition, the following transition connectors may be used:

Kit Number	Conductor Sizes (AWG or kcmil)	Homac Connectors	Burndy Connectors	Mac Products	3M™ Connectors
5545A	4/0 to 250	SAC250R4/0	YRB29U28		
	4/0 to 350	SAC350R4/0	YRB31U28	MLCR 350-4/0	2000T 4/0-350 Cu/Al
	250 to 350	SAC350R250	YRB31U29		2000T 250-350 Cu/Al
	350 to 500	SAC500R350	YRB34U31		2000T 350-500 Cu/Al
	350 to 750	SAC750R350		MLCR 750-500 plus AAR 500-350	
	500 to 750	SAC750R500	YRB39U34	MLCR 750-500	
	500 to 1000	SAC1000R500		MLCR 1000-750 plus AAR 750-500	
	750 to 1000	SAC1000R750		MLCR 1000-750	

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3M

Electrical Markets Division
6801 River Place Blvd.
Austin, TX 78726-9000
800-245-3573
Fax 800-245-0329
www.3M.com/electrical

78-8127-6670-3