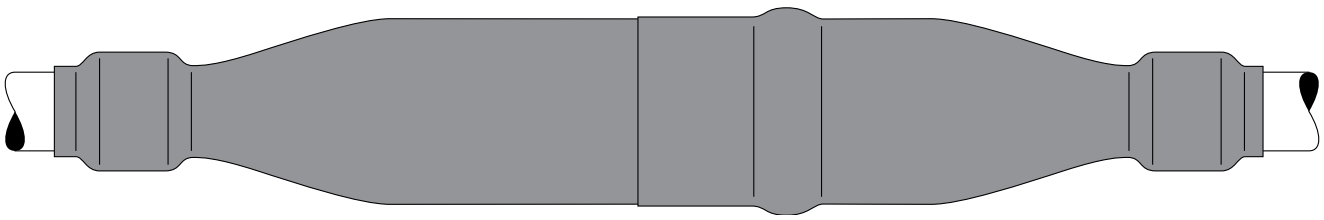
3M™ Cold Shrink QS-III Silicone Rubber Splice Kit 69 kV 5488A, 5488A-JCN-XB, and 5488A-Shielded-XB

For Jacketed Concentric Neutral (JCN), Tape-Shield, Longitudinally-Corrugated (LC) Shielded, Tape-Over-Wire (TOW) or Wire-Over-Tape (WOT) Shielded Power Cables

Data Sheet

⚠ CAUTION

Working around energized 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.



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3M

1. Product Description

The 3M™ Cold Shrink QS-III Splice Kit 5488A is a 69 kV–class splice for joining jacketed concentric neutral (JCN), tape-shield, longitudinally-corrugated (LC) shielded, tape-over-wire (TOW) or wire-over-tape (WOT) shielded power cables. It is a cold shrink design sized to fit Type MV–90 or type MV-105 cables with copper or aluminum conductor sizes ranging from 250 kcmil–2000 kcmil (120–1000 mm2). The cold shrink splice body is a one–piece molded design made of specially 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 splice kit contains a set-screw aluminum (Al/Cu) inline connector, and can be used for size transitions within the listed kit size range. It is designed to exceed minimum industry test standards, and have a BIL rating of 350 kV. The splice meets or exceeds the 69 kV Voltage Class rating requirements of IEEE Std. 404.

Kit Contents for 5488A Splice:

- Silicone Rubber Splice Body
- Jacketing Tubes
- Shielding Sleeve
- Pre-formed Braid Assembly (except JCN)
- Constant Force Springs
- 3M™ Red Compound P55/R Tubes
- (non-silicone grease)
- Roll 3M™ Scotch-Seal™ Mastic Tape 2229
- Rolls Scotch® Rubber Mastic Tape 2228
- Pad Scotch® Electrical Semi-conducting Tape 13
- Roll Scotch® Vinyl Electrical Tape Super 88
- 3M™ Cable Cleaning Pads CC-3
- 3M™ EMI Copper Foil Shielding Tape Strips 1181, 15" long
  (except JCN)
- Rolls 3M™ Armorcast Structural Material 4560, 3" x 15'
- Shear Bolt Connector
- Instruction Booklets

Additional Kit Contents for 5488A-JCN-XB Splice, and 5488A-Shielded-XB:

- Silicone Rubber Tube Assembly
- Roll, Scotch® Linerless Rubber Splicing Tape 130C
- Roll, Scotch® Electrical Shielding Tape 24

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
- **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 69 kV shielded power cables:

- For inline and crossbond/shield break splicing
- For transmission circuits
- For jacketed concentric neutral (JCN), tape-shield, longitudinally-corrugated (LC) shielded, tape-over-wire (TOW) or wire-over-tape (WOT) shielded power cables
- For copper or aluminum conductors
- For direct burial installations
- For submerged locations

3. Data: Physical and Electrical Properties

The 3M™ Cold Shrink QS-III Splcie Kit 5488A 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 69 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 350 kV.

A. Splice Selection Table

Kit Number	Cable Insulation O.D. Range Inches (mm)	Conductor Size Range AWG or kcmil (mm^2)
5488A, 5488A-XB	1.94–3.08" (49,3–75,4 mm)	250–2000 (120–1000 mm^2)

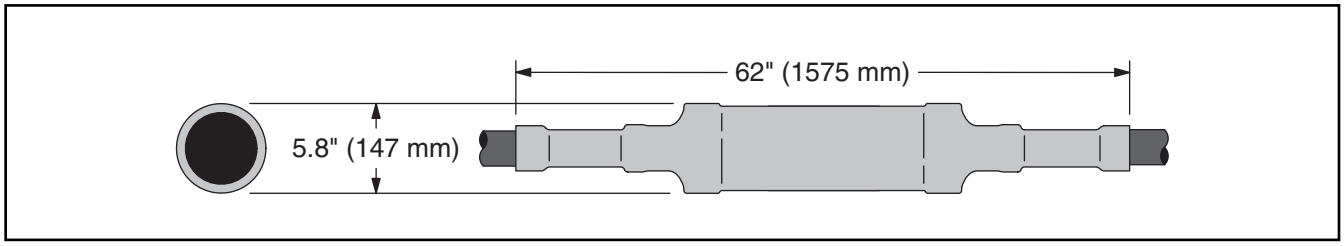
Table 1

B. Connector Dimensional Requirements Table

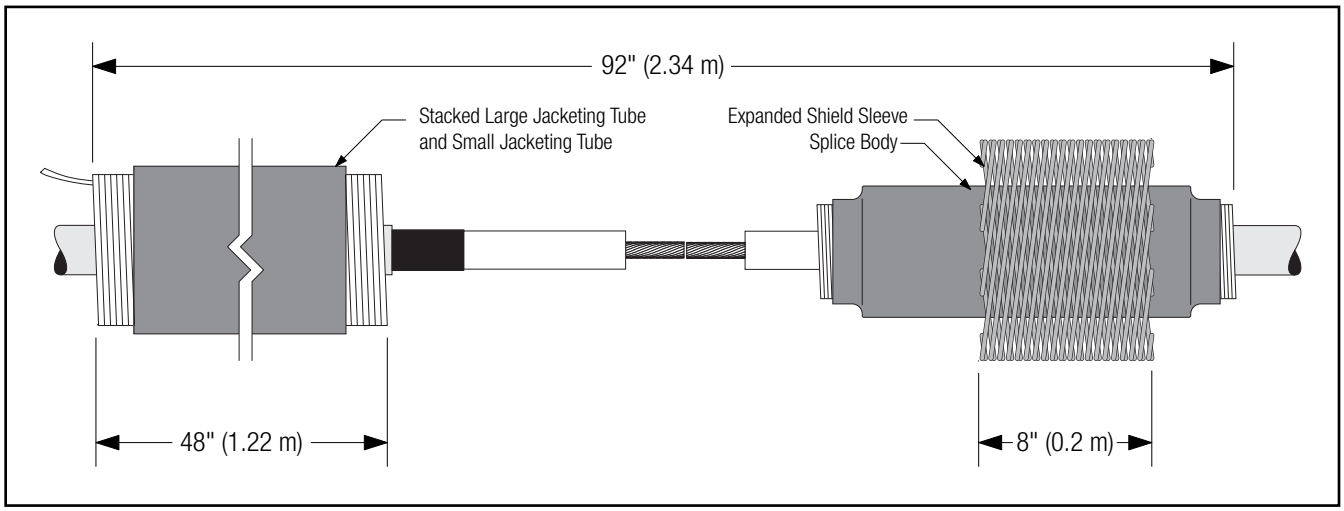
Conductor Size	Connector O.D.	Connector Length
250–600 kcmil (125–325 mm^2)	1.94–2.50" (49,3–63,5 mm)	8"±0.10" (203 mm ± 2.54 mm)
750–1000 kcmil (400-500 mm^2)		
1250–1500 kcmil (655-800 mm^2)	2.51–3.08" (63,6–75,4 mm)	9.25"±0.10" (235 mm ± 2.54 mm)
1750–2000 kcmil (875-1000 mm^2)		

Table 2

C. Typical Dimensions (Installed Splice)



D. Parking Distance (Stacked)



E. 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
Tensile 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/mm2)
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
Tensile 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

A. Product (Open Specification)

The jacketed concentric neutral (JCN), tape-shield, longitudinally-corrugated (LC) shielded, tape-over-wire (TOW) or wire-over-tape (WOT) shielded power cable splice shall meet the requirements of IEEE Std. 404 for a 69 kV rating, and must be rated by the manufacturer for use on 69 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 250–2000 kcmil (120–1000 mm2). 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.

B. Engineering/Architectural (Closed Specification)

Splicing of all 69 kV rated cables, jacketed concentric neutral (JCN), tape-shield, longitudinally-corrugated (LC) shielded, tape-over-wire (TOW) or wire-over-tape (WOT) shielded power cables, sized from 250–2000 kcmil (120–1000 mm2) copper or aluminum, shall be performed in accordance with the instructions provided with the 3M™ Cold Shrink QS-III Splice Kit 5488A, 5488A-JCN-XB, or 5488A-Shielded-XB.

5. Performance Tests

A. IEEE Std. 404 69/72 kV Voltage Rating

Design Test and Sequence	Test Requirement	Result
Minimum partial discharge (corona) level	60 kV–rms @ < 3 pC	Pass
Alternating-current 15 minute withstand	120 kV–rms	Pass
Direct-current 15 minute withstand	240 kV–dc	Pass
Impulse withstand (BIL) at 25˚C (77˚F)*	±350 kV–crest	Pass
Impulse withstand (BIL) at 130˚C (266˚F)*	±350 kV–crest	Pass
Minimum partial discharge (corona) level	60 kV–rms @ < 3 pC	Pass
Cyclic aging (in air and water)	80 kV–rms	Pass
Minimum partial discharge (corona) level	60 kV–rms @ < 3 pC	Pass
Alternating-current 6 hour withstand	100 kV–rms	Pass
Impulse withstand (BIL) at 25˚C (77˚F)	±350 kV–crest	Pass
Minimum partial discharge (corona) level	60 kV–rms @ < 3 p	Pass
Connector thermal and mechanical	ANSI C119.4	Pass

Production Test	Test Requirement
Production splices tested	100%
Minimum partial discharge (corona) level	60 kV–rms @ < 3 pC
Alternating-current 15 minute withstand	120 kV–rms

*Note: .
Impulse test wave is 1.2 x 50 µsec. (ANSI/IEEE Std. 4).

B. Operating Temperature

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

C. IEC 60840 69 kV Voltage Rating

Typical Results, IEC 60840 Test Sequence

3M™ Cold Shrink QS-III Splice Kit 5488A(RW) & 5488A-XB (RW)		72 kV
Insulation Class Test	**Requirements**	**Result**
PD at ambient CSV 63 kV for 10 sec CEV	54 kV	Pass
Load cycle for 20 cycles (8 hour loading to 95°C–100°C, at least 2 hours at temperature, and 16 hours off-24 cycle)	72 kV	Pass
PD at ambient	54 kV	Pass
PD at elevated temperature (95°C–100°C)	54 kV	Pass
Impulse (10 impulses each polarity) at elevated temperature (95°C–100°C)	325 kV	Pass
15 Min AC withstand	90 kV	Pass
Water immersion and heat cycling	70°	Pass
DC Voltage test	20 kV	Pass
DC Volt XB-20 kV	1 min.	Pass
Lightning Impulse XB	60/30 kV	Pass
Cable and accessory examination		Pass (No evidence of electrical activity)

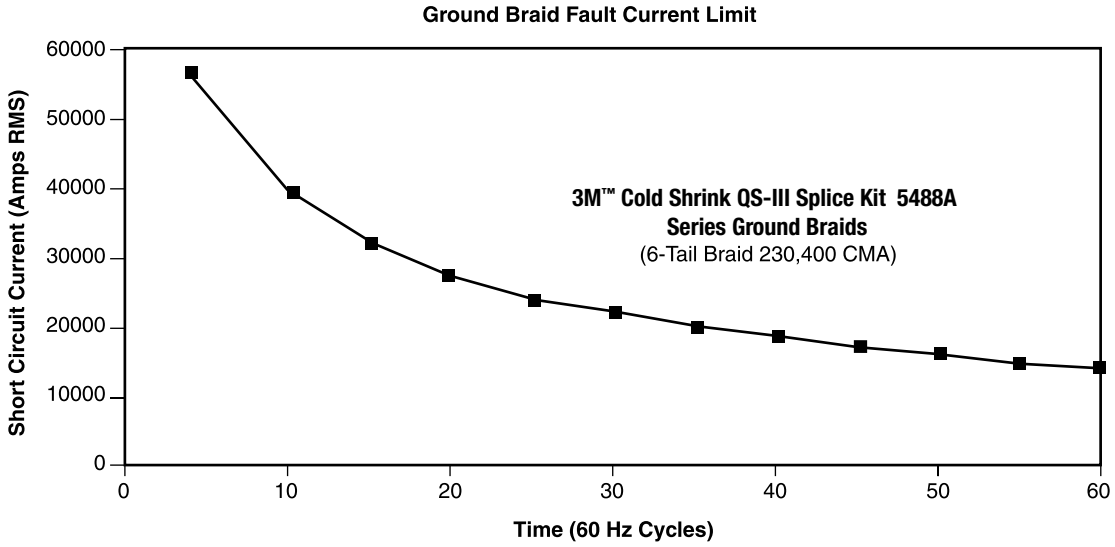
D. Partial Discharge (Corona) Tests

The purpose of partial discharge testing is to determine that all properly installed splices operate corona-free at a minimum of 150% of their operating voltage. For the test, the applied test voltage is gradually increased until discharges appear on the test set oscilloscope display. The voltage at which these discharges reach a magnitude greater than 3 picocoulombs is recorded as the corona starting voltage (CSV). The applied voltage is then lowered until the the discharge level drops below 3 picocoulombs, and this is recorded as the corona extinction voltage (CEV).

E. Lightning Impulse Tests

The QS-III splice 5488A was evaluated to IEEE Standard 404 Basic Impulse Levels. For this test, a 1.2 x 50-microsecond voltage wave is applied to the termination lug. The test consists of both positive and negative polarity surges per the specified standard. The QS-III splice 5488A meets or exceeds the requirements of IEEE Standard 404.

F. Ground Braid



6. Installation Techniques for 5488A Kit

Detailed instructions for installing the 3M™ Cold Shrink QS-III Rubber Splice Kit 5488A are included with each kit.

1. Prepare cable according to standard procedure.

2. Slide cold shrink jacketing tube and cold shrink splice body onto prepared cables.

3. Install connector.

4. Apply a tape marker on one cable.

5. Apply 3M™ Red Compound P55/R on cable insulation and fill in edge of cable semi–con. DO NOT use silicone grease.

6. Install splice over connector area, aligning end with tape marker, and removing core by pulling and unwinding counterclockwise.

7. Connect neutral wires (JCN cable), route neutral wires over the neutral pad which is centered on splice body.

8. Connect ground wire if circuit grounding is required at this location. Apply mastic sealing strips to seal ground wire at end of cable jacket.

9. Apply rubber mastic tape around the end of both cable jackets.

10. Install cold shrink jacketing tube over splice.

11. Cover splice with 3M Armorcast Structural Material.

12. Connect ground wire to ground if splice is to be grounded.

7. Installation Techniques for 3M™ Cold QS-III Shrink Rubber Splice Kit 5488A 5488A-JCN-XB or 3M™ Cold Shrink QS-III Rubber Splice Kit 5488A 5488A-Shielded-XB

Detailed instructions for installing the 5488A-JCN-XB or 5488A-Shielded-XB QS–III kits are included with each kit.

1. Prepare cable according to standard procedure.

2. Install silicone rubber tube assembly.

3. Slide cold shrink splice body onto prepared cables.

4. Install connector.

5. Apply a tape marker on silicone rubber tube.

6. Apply red compound P/55R on cable insulation and silicone tube; 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. Complete shield break installation.

9. Connect wire to neutral wires.

10. Mark and connect wires as required.

11. Maintenance

Components of the 3M™ Cold Shrink QS-III Splice Kits QS-III 5488A, 5488A-JCN-XB and 5488A-Shielded-XB are 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 one year from the date of manufacture. The installed splices can be field tested using standard field cable testing procedures (reference ANSI/IEEE Std. 400, “Guide for Making High–Direct–Voltage Tests on Power Cable Systems in the Field”).

12. Availability

3M™ Cold Shrink QS-III Splice Kits QS-III 5488A, 5488A-JCN-XB and 5488A-Shielded-XB are available to splice 69 kV jacketed concentric neutral (JCN), tape-shield, longitudinally-corrugated (LC) shielded, tape-over-wire (TOW) or wire-over-tape (WOT) shielded power cables. The connectors can be either ordered with the kit or provided separately. These kits are available from your local authorized 3M electrical distributor.

13. Connectors for 69 kV QS-III Splices

The QS-III splice kits 5488A series are designed to be used with 3M shear bolt connectors. Connector sizes and dimensional information are shown in Table 2.

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