

# 3M™ Cold Shrink QS-III

## Inline Splice Kits 15 kV

5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

Data Sheet

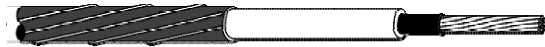
July 2013



Jacketed Concentric Neutral (JCN)



5415A, 5416A, 5417A, 5418A



Concentric Neutral (JCN)



5417A-WG and 5418A-WG

**⚠ 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.

**Product Description**

The 3M™ Cold Shrink QS-III Splice Kits 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG are 15 kV-class inline splices for joining jacketed concentric neutral (JCN) and concentric neutral (CN) power cables. They are a cold shrink design sized to fit Type MV-90 or Type MV-105 cables with copper or aluminum conductor sizes ranging from 2 AWG to 1000 kcmil (35 to 500 mm<sup>2</sup>). 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 splices can be used with standard copper (Cu) or aluminum (Al/Cu) inline compression (crimp type) connectors or specified shearbolt 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 150 kV (equal to a 25 kV voltage class). The Cold Shrink QS-III Splice Kits 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG meet or exceed the 15 kV Voltage Class rating requirements of ANSI/IEEE Std. 404.

# 3M™ Cold Shrink QS-III Inline Splice Kits 15 kV 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

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## Kit Contents for 5415A, 5416A, 5417A and 5418A

- 1 3M™ Cold Shrink Silicone Rubber Splice Body
  - 1 3M™ Cold Shrink Adapter Tube (2 adapters in the 5415A Kit)
  - 1 3M™ Cold Shrink Jacketing Tube
  - 2 3M™ Red Compound Tubes P55/R
  - 6 Scotch® Mastic Sealing Strips 2230
  - 2 Scotch® Rubber Mastic Tape 2228 Rolls
  - 1 Neutral Pad
  - 1 3M™ Cable Cleaning Pad CC-3
  - 1 Cable Preparation Template
  - 1 Instruction Booklet
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## Kit Contents for 5417A-WG and 5418A-WG

- 1 3M™ Cold Shrink Silicone Rubber Splice Body
  - 1 3M™ Cold Shrink Adapter Tube
  - 1 3M™ Cold Shrink Jacketing Tube
  - 2 3M™ Red Compound Tubes P55/R
  - 2 Scotch® Mastic Sealing Strips 2230
  - 1 Cable Preparation Template
  - 1 Instruction Booklet
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## Splice Features

- **Cold Shrink Design** — for quick and easy installation; excellent for cable size transitions
  - **Complete Kit** — includes the required products 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
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## Applications

- For splicing 15 kV shielded power cables:
- For inline splicing
  - For feeder and distribution circuits
  - For jacketed concentric neutral cables (JCN)
  - For concentric neutral cables (CN)
  - For copper or aluminum conductors
  - For use with standard inline crimp connectors
  - For use with specified 3M™ Shearbolt Connectors QCI Series
  - For size transition splicing
  - For direct burial installations
  - For submerged locations
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## Physical and Electrical Properties

The 3M™ Cold Shrink QS-III Splice Kits 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG 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 15 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 150 kV, which exceeds the normal 110 kV BIL rating for a 15 kV voltage class.

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# 3M™ Cold Shrink QS-III Inline Splice Kits 15 kV 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

## Splice Selection Table

Kit Number	Cable Insulation O.D. Range Inches (mm)	Conductor Size Range AWG or kcmil (mm <sup>2</sup> )
5415A	0.64 - 1.01 (16,3 - 25,7)	2 - 4/0 (35 - 95)
5416A	0.84 - 1.38 (21,3 - 35,1)	4/0 - 350 (95 - 185)
5417A, 5417A-WG	1.04 - 1.70 (26,4 - 43,2)	350 - 750 (185 - 325)
5418A, 5418A-WG	1.08 - 1.70 (27,4 - 43,2)	500 - 1000 (240 - 500)

Table 1

## Connector Dimensional Requirements Table

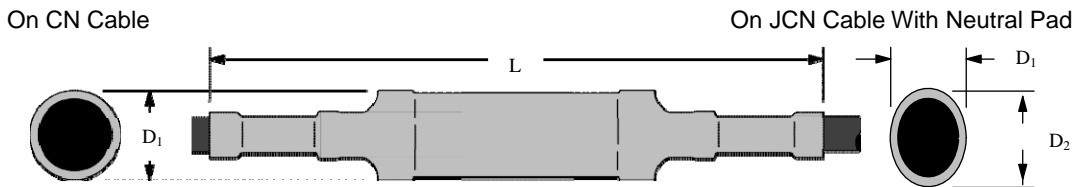
Kit Number	Minimum O.D. Inches (mm)	Maximum O.D. Inches (mm)	Maximum Length Inches (mm)			Connector O.D. Range Requiring adapters Inches (mm)
			Aluminum (Al/Cu) Compression	Copper (Cu) Compression	3M™ Shearbolt Connector QCI Series	
5415A	0.40 (10,2)	1.06 (26,9)	4.50 (114)	5.00 (127)	4.41 (112)	0.40 - 0.64 (10,2 - 16,3)
5416A	0.69 (17,5)	1.38 (35,1)	5.00 (127)	5.75 (146)	5.75 (146)	0.69 - 0.84 (17,5 - 21,3)
5417A, 5417A-WG	0.80 (20,3)	1.84 (46,7)	6.75 (171)	7.50 (191)	6.93 (176)	0.80 - 1.04 (20,3 - 26,4)
5418A, 5418A-WG	0.80 (20,3)	1.84 (46,7)	6.75 (171)	7.50 (191)	7.83 (199)	0.80 - 1.08 (20,3 - 27,4)

Table 2

## Typical Dimensions (Installed Splice)

Kit Number	Typical Length (L) Inches (mm)	Typical Diameter (D <sub>1</sub> ) Inches (mm)	Typical Diameter (D <sub>2</sub> ) Inches (mm)
5416A	29 (736)	2.50 (64)	2.75 (70)
5417A, 5417A-WG	32 (813)	3.00 (76)	3.25 (83)
5418A, 5418A-WG	32 (813)	3.00 (76)	3.25 (83)

Table 3



# 3M™ Cold Shrink QS-III Inline Splice Kits 15 kV 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

## 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 <sup>2</sup> )
Modulus @ 100% (psi) (ASTM D 412)	340 (2,3 N/mm <sup>2</sup> )
Permanent Set % (100%, 100°C, 22 hrs) (3M TM 86)	5
Thermal Conductivity (W/m K) (ASTM D 518)	0.24

### Electrical Properties

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 <sup>14</sup>

## 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/mm <sup>2</sup> )
Modulus @ 100% (psi) (ASTM D 412)	200 (1,4 N/mm <sup>2</sup> )
Permanent Set % (100%, 100°C, 22 hrs) (3M TM 86)	4

### Electrical Properties

Volume Resistivity (Ohm-cm) (3M TM 80)	50
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## 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 <sup>2</sup> )
Modulus @ 100% (psi) (ASTM D 412)	230 (1,6 N/mm <sup>2</sup> )
Permanent Set % (100%, 100°C, 22 hrs) (3M TM 86)	5

### Electrical Properties

Volume Resistivity (Ohm-cm) (3M TM 80)	150
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\*All values are averages, based on several determinations and are not intended for specification purpose.

# 3M™ Cold Shrink QS-III Inline Splice Kits 15 kV 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

## Ethylene Propylene Rubber (Jacketing Tubes)

### Physical Properties

Test Method	Typical Value*
Color	Black
Hardness – Shore A (ASTM D 2240)	48
Elongation (%) (ASTM D 412)	635
Tensile Strength (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) (5 min. recovery, @ 40°F, 4.4°C)	8.8 14.6

### Electrical Properties

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 purpose.

### Product (Open Specification)

The jacketed concentric neutral (JCN) and concentric neutral (CN) power cable splice shall meet the requirements of ANSI/IEEE Std. 404 for a 15 kV rating, and must be rated by the manufacturer for use on 15 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 2 to 4/0 AWG (35 to 95 mm<sup>2</sup>), 4/0 AWG to 350 kcmil (95 to 185 mm<sup>2</sup>), 350 to 750 kcmil (185 to 325 mm<sup>2</sup>) and 500 to 1000 kcmil (240 to 500 mm<sup>2</sup>) 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 15 kV rated cables, jacketed concentric neutral (JCN) and concentric neutral (CN) power cables, sized from 2 AWG to 1000 kcmil (35 to 500 mm<sup>2</sup>) copper or aluminum, shall be performed in accordance with the instructions provided with the 3M™ Cold Shrink QS-III Splice Kits 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG.

# 3M™ Cold Shrink QS-III Inline Splice Kits 15 kV 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

## Performance Test

### IEEE Std. 404 15 kV Voltage Rating

Design Test and Sequence	Test Requirement
Minimum partial discharge (corona) level	13 kV-rms @ < 3pC
Alternating-current 1 minute withstand	35 kV-rms
Direct-current 15 minute withstand	70 kV-dc
Impulse withstand (BIL) at 25°C (77°F)*	±110 kV-crest (150 kV)*
Impulse withstand (BIL) at 140°C (284°F)*	±110 kV-crest (150 kV)*
Minimum partial discharge (corona) level	13 kV-rms @ < 3 pC
Cyclic aging (in air and water)	26 kV-rms
Minimum partial discharge (corona) level	13 kV-rms @ < 3 pC
High voltage time: 5 hr. alternating-current withstand	31 kV-rms
5 min. alternating-current withstand	39 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	35 kV-rms
Shielding	IEEE Std. 592
Connector thermal and mechanical	ANSI C119.4

Production Test	Test Requirement
Production splices tested	100%
Minimum partial discharge (corona) level	13 kV-rms @ < 3 pC
Alternating-current 1 minute withstand	35 kV-rms

\*Notes: (1) BIL rating for 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG QS-III is upgraded to ±150 kV-crest.  
(2) Impulse test wave is 1.2 x 50 µsec. (ANSI/IEEE Std. 4).

### Operating Temperature

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

### Installation Techniques for 5415A, 5416A, 5417A, and 5418A Kits

Detailed instructions for installing the 3M™ Cold Shrink QS-III Splice Kits 5415A, 5416A, 5417A, and 5418A are included with each kit. A Cable Preparation Template is provided:

1. Prepare cable according to standard procedure.
2. Slide cold shrink jacketing tube and cold shrink splice body onto prepared cables.
3. Install connector. Dimensional requirements table provided.
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.
8. Route neutral wires over the neutral pad which is centered on splice body.
9. Connect ground wire 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 wire to ground if splice is to be grounded.
13. If located in direct sunlight, overwrap splice with vinyl tape.

# 3M™ Cold Shrink QS-III Inline Splice Kits 15 kV 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

## Installation Techniques for 5417A-WG, and 5418A-WG Kits

Detailed instructions for installing the 3M™ Cold Shrink QS-III Splice Kits 5417A-WG and 5418A-WG are included with each kit. A Cable Preparation Template is provided:

1. Prepare cable according to standard procedure.
2. Slide cold shrink jacketing tube and cold shrink splice body onto prepared cables.
3. Install connector. Dimensional requirements table provided.
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 along with neutral wires on the splice body .
8. Connect ground wire to neutral wires if circuit grounding is required at this location.
9. Connect ground wire to ground if splice is to be grounded.

## Maintenance

Components of the 3M™ Cold Shrink QS-III Splice Kits 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG 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 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, "Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field").

## Connectors for QS-III Splices

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

Kit Number	Conductor Sizes (AWG or kcmil)	3M™ Compression Connectors	3M™ Shearbolt Connectors QCI Series
5415A	2 to 1	CI-T2	QCI-2-250
	2 to 1/0	CI-T4	
	2 to 2/0		
	1/0 to 3/0		
	2/0 to 3/0		
	2 to 4/0		
	1/0 to 4/0		
	2/0 to 4/0		
	3/0 to 4/0	CI-T7	
5416A	4/0 to 250		QCI-4/0-600
	4/0 to 300		
	4/0 to 350	2000T 4/0-350 CU/AL	
	250 to 350	2000T 250-350 CU/AL	
	300 to 350	2000T 300-350 CU/AL	
5417A 5417A-WG	350 to 500	2000T 350-500 CU/AL	QCI-350-750
	350 to 600		
	500 to 600		
	350 to 750		
	500 to 750		
5418A 5418A-WG	500 to 750		QCI-500-1000
	500 to 1000		
	750 to 1000		

## 3M™ Cold Shrink QS-III Inline Splice Kits 15 kV 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

### Connectors for QS-III Splices

The QS-III Cold Shrink Splice kits are designed to be used with 3M™ Scotchlok™ Connectors 10000, 11000, and 20000 Series, 3M™ Connectors CI-Series, or other UL listed inline compression connectors that fit within the dimension limits listed in the 3M™ 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
5415A	2 to 1		YRB25U2	
	2 to 1/0	SAC1/0R2	YRB25U2	MLCR 1/0-2
	2 to 2/0	SAC2/0R2		
	1/0 to 3/0	SAC3/0R1/0	YRB27U25	MLCR 3/0-1/0
	2/0 to 3/0		YRB27U26	
	2 to 4/0	SAC4/0R2		
	1/0 to 4/0	SAC4/0R1/0		
	2/0 to 4/0	SAC4/0R2/0	YRB28U26	MLCR 4/0-2/0
	3/0 to 4/0			
5416A	4/0 to 250	SAC250R4/0	YRB29U28	MLC 250 + AAR 250-4/0 Adapter
	4/0 to 300	SAC300R4/0		
	4/0 to 350	SAC350R4/0	YRB31U28	MLCR 350-4/0
	250 to 350	SAC350R250	YRB31U29	MLC 350 + AAR 350-250 Adapter
	300 to 350			
5417A 5417A-WG	350 to 500	SAC500R350	YRB34U31	MLC 500 + AAR 500-350 Adapter
	350 to 600		YRB36U31	
	500 to 600		YRB36U34	
	350 to 750	SAC750R350		MLC 750 + AAR 750-350 Adapter
	500 to 750	SAC750R500	YRB39U34	MLCR 750-500
5418A 5418A-WG	500 to 750	SAC750R500	YRB39U34	MLCR 750-500
	500 to 1000			MLCR 1000-750 + AAR 750-500 Adapter
	750 to 1000			MLCR 1000-750



# 3M™ Cold Shrink QS-III Inline Splice Kits 15 kV 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG

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**Shelf-Life** This product has a 3-year shelf life from date of manufacture when stored in a humidity controlled storage (10°C / 50°F to 27°C / 80 °F and <75% relative humidity).

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**Availability** 3M™ Cold Shrink QS-III Splice Kits 5415A, 5416A, 5417A, 5417A-WG, 5418A and 5418A-WG are available to splice 15 kV jacketed concentric neutral (JCN) and concentric neutral (CN) power cables. The connectors can be either ordered with the kit or provided separately. Standard dimension copper (Cu) or aluminum (Al/Cu) compression (crimp type) connectors are suitable for use with these splice kits, as are 3M™ Shearbolt Connectors QCI Series. These kits are available from your local authorized 3M electrical distributor.

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