

Volume: Utility and Industrial
Section: Medium Voltage – U_0/U 18/30 kV (U_m up to 36 kV)
Product: Quick Splice 2000
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1. Product

3M Quick Splice 2000
Cold Shrink Inline Splicing Kits

2. Product Description

The 3M QS 2000 94-AP series kits consist of one-piece cold shrink splices of a multi-layered silicone rubber body provided in an expanded state, solderless earth connection components and a cable jacket replacement.

The basic kits are designed to accommodate power cables 18/30 kV with solid dielectric insulation from 120 mm² up to 240 mm².

Each splice body is tested at the factory to ensure reliability and high quality of the system.

For field installation, the silicone rubber molded body provided in an expanded state is mounted on a removable supporting polyethylene core (Figure 1). During the installation the core is unwound allowing the splice to shrink and form a tight interface with the medium voltage cable.

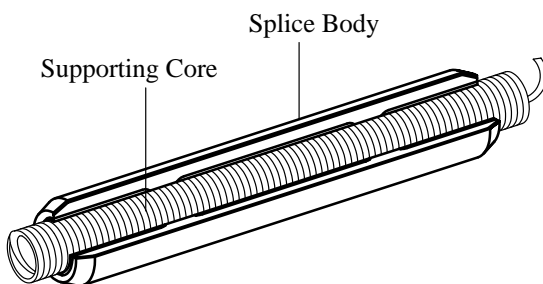


Figure 1.

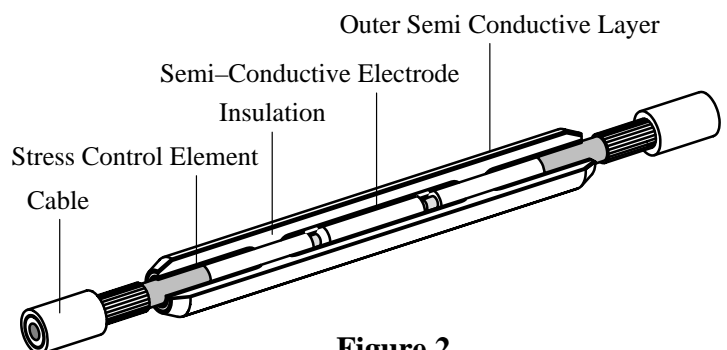


Figure 2.

The splice body provides the essential electric stress relief, reinsulation and semi-conductive screen of power distribution cable systems (Figure 2).

The Splice Body

- Two inner stress control elements provide the proper electric field distribution.
- The inner semi-conductive electrode electrically surrounds the high voltage connector eliminating the use of tape or additional moulded or metallic electrodes.
- The splice insulation effectively replaces and continues the performance characteristics of the cable insulation across the entire splice.
- The outer semi-conductive layer of the splice adapts to the geometry of the insulation and re-establishes the electromagnetic screen.

Additional Kit Components

- Constant force springs and a metallic screen sleeve replace the metallic screen of the cable. This enables a solderless earthing system. The primary purpose of the metallic components is to provide a low resistance path to earth so that essential fault current protection is ensured.
- Pads of rubber mastic are guarantee additional moisture protection, specifically when the splice has to be grounded.
- The cable jacket replacement for single conductor cables can be made by utilizing a PST "Cold Shrink" tube. The addition of heavy walled protection tubes ensures that corrosive liquids and moisture will not compromise the earthing system.

3. Product Features

- Versatile design of prefabricated one-piece splice body allows installation on a wide range of cable sizes and types.
- Designed to fit all standard cable connectors.
- High contact pressure ensures absolute watertightness.
- Wide temperature range
- "Solderless" earth continuity connection.
- Extreme compact size allows installation in narrow areas.
- 100% production tested.
- Cold Shrink technology ensures quick, easy and tool-free installation.

4. Product Applications

The QS 2000 series kits are designed to connect medium voltage cables with solid dielectric insulation: i.e. polyethylene (PE), cross-linked polyethylene (XLPE) and ethylene propylene rubber (EPR); metallic wire or tape screening and plastic jacket. The QS 2000 series kits can be used as areal splice, on cable trays or in direct burial applications.

A. QS 2000 Inline Splices – Selection Table A

Voltage Class U_0/U 18/30 kV

Quick Splice Kit No. with Cold Shrink Jacketing	Quick Splice Kit No. with Cold Shrink Jacketing and Water Barrier	Cable Dimensions			Connector Dimensions	
		Jacket O.D. (mm)	Insulation O.D. (mm)	Conductor Size (mm ²)	O.D. (mm)	Length (mm)
94-AP630-1	94-AP631-1	56	28.4 – 40.3	120 – 240	23.3 – 40.3	170

B. Typical Dimensions

Splice Dimensions – Table B (mm)

Splice Type	A	B	ø C	ø D	E	F	G	H	ø I	ø J	K	L
Splice Body AP33	462	237	22	56	82	112	12	10	63	70	30	450

Splice Body



Figure 3.

Splice Body pre-stretched on core

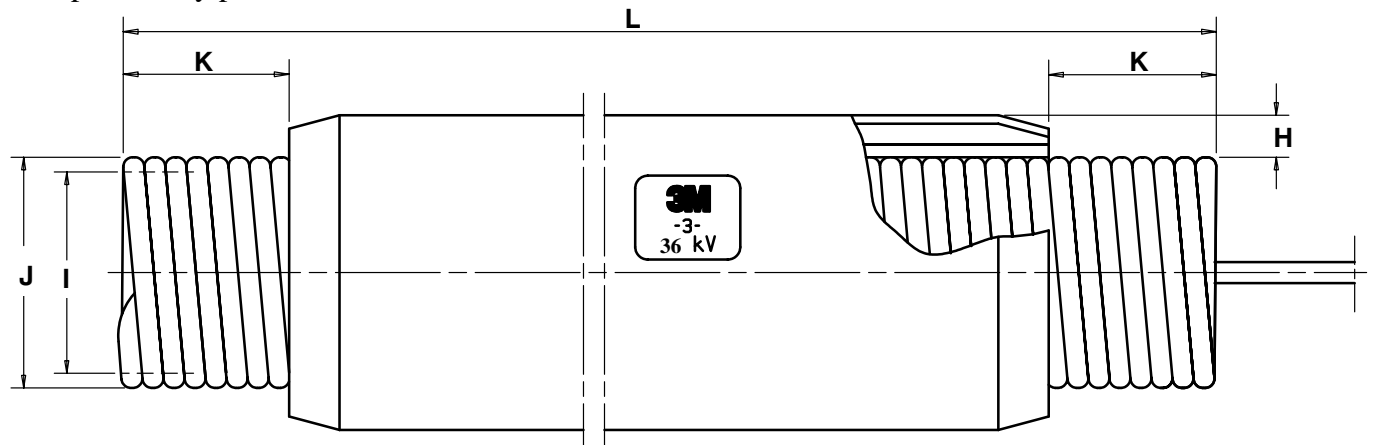


Figure 4.

C. Typical Physical & Electrical Properties

Supporting Core

The supporting core is produced of polyethylene.

Splice Body

The Quick Splice 2000 body is produced of silicone rubber.

Electrical Properties

Test Method	Specification	Typical Value *			
		Stress Control Layer	Inner Semi-Conductive Electrode	Insulation	Outer Semi-Conductive Electrode
Dielectric Strength	VDE 0303	8 kV/mm	---	25 kV/mm	---
Volume Resistivity	TME 400/ DIN/IEC	$10^{11} \Omega \text{ cm}$	$<100 \Omega \text{ cm}$	$10^{14} \Omega \text{ cm}$	$<100 \Omega \text{ cm}$
Relative Dielectric Constant ϵ_r	VDE 0303	20	---	2.8	---
Dissipation Factor $\tan \delta$	VDE 0303	0.100	---	0.003	---

Physical Properties

Test Method	Specification	Typical Value *			
		Stress Control Layer	Inner Semi-Conductive Electrode	Insulation	Outer Semi-Conductive Electrode
Tensile Strength	DIN 53504	5.5 MPa	6.0 MPa	6.0 MPa	6.0 MPa
Tear Resistance	ASTM D 624	14 N/mm	17 N/mm	15 N/mm	17 N/mm
Elongation at Break	DIN 53504	400%	600%	700%	600%
Compression Set 72h/150°C	DIN 53517	20%	20%	20%	20%
Modulus at 100% Elongation	DIN 53504	1.0 MPa	1.0 MPa	1.0 MPa	1.0 MPa
Modulus at 300% Elongation	DIN 53504	3.0 MPa	3.0 MPa	3.0 MPa	3.0 MPa
Shore Hardness A	DIN 53504	40	40	30	40
Colour		black	black	transparent	black

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

D. Electric Field Control

The Quick Splice 2000 is designed to control its electric field distribution. Lines of electric flux are regulated to equalize the electrical stresses along the entire splice area. Figure 5 shows an actual computerised plot of the equipotential lines of the 150 mm² splice. (Voltage stress based on $U_0=18$ kV)

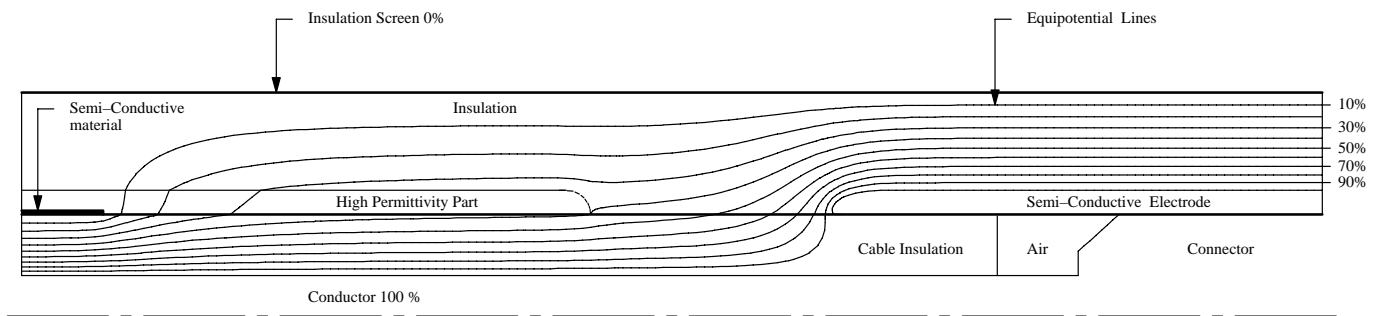


Figure 5.

E. Permanent Set

A plot of permanent set of the silicone splice material versus time in months at 40°C while mounted on cores demonstrates that the splice body will provide adequate performance within 10 minutes field installation time. The splice body is installed on the core at approximately 240% stretch in order to guarantee min. 2 years shelf life at ambient storage temperatures.

Field experience has indicated that the long term life data has been reliable in assuring service performance.

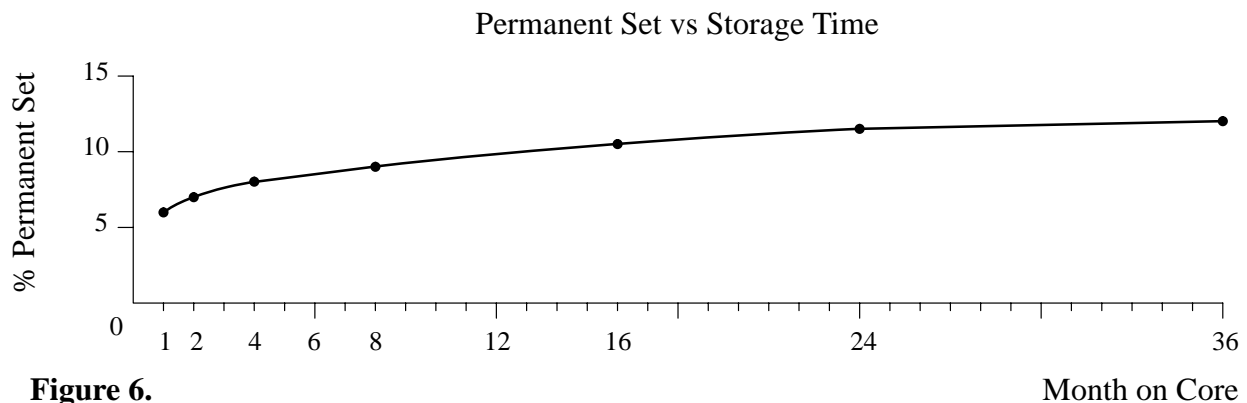


Figure 6.

5. Performance Tests and Data

A. Performance Tests

The 3M QS 2000 inline splices meet the requirements as specified in VDE 0278 part 2 and other appropriate specifications. The current rating of each kit is determined by the maximum conductor size, the elevated operation at 95°C and of the emergency overload operation at 130°C.

B. Performance Data

QS 2000 94–AP series kits installed on single core XLPE insulated cables 150 mm² Al, 18/30 kV.

Test Sequence	Type of Test	Evaluation
1	A.C. Voltage Test 70 kV, 50 Hz, 1 min.	No disruptive discharge shall occur
2	Partial Discharge Test (pC) at 36 kV	With accessories for XLPE cables the corona discharge level shall not exceed 20 pC.
3	Nominal Impulse Voltage Withstand Test, 10 pulses each of positive and negative polarity, 170 kV	No disruptive discharge shall occur
4	Continuous A.C. Voltage Test with cyclic current loads; 45 kV, 488 A, 3 load cycles	No disruptive discharge shall occur
5	Partial Discharge Test, same as 2	With accessories for XLPE cables the corona discharge level shall not exceed 20 pC.
6	Continuous A.C. Voltage Test, same as 4, 60 load cycles	No disruptive discharge shall occur
7	Thermal Short–Circuit Test, 17.8 kA/1 sec., 2 load applications	No visible damage shall occur
8	Continuous A.C. Voltage Test, same as 4, but 63 load cycles and Tightness Test in water bath with jacket partially removed.	No disruptive discharge shall occur
9	Partial Discharge Test, same as 2	With accessories for XLPE cables the corona discharge level shall not exceed 20 pC.
10	Nominal Impulse Voltage Withstand Test, same as 3	No disruptive discharge shall occur
11	D.C. Voltage Test 144 kV/30 min.	No disruptive discharge shall occur

C. Quality Assurance

The factory test include 100% electrical tests of the prefabricated QS 2000 splice body.

1. A.C. Voltage Withstand Test 70 kV, 50 Hz, 5 min.
2. Corona Discharge Test (pC) at 36 kV

6. Installation Techniques

Exact instructions for constructing Quick Splice 2000 are packed in each kit.

7. Availability and Kit Contents

3M Quick Splice 2000 series inline splice kits are available in one size. They are packaged one kit per carton. Connectors are not included.

Each kit contains sufficient of the following components to make one single conductor splice.

<u>Item #</u>	<u>Quantity</u>	<u>Description</u>
1.	One	Splice Body mounted on a removable supporting core
2.	One	Cable jacket replacement of EPDM PST cold shrink tube.
3.	Two	Constant Force Springs
4.	One	Metallic Screen Sleeve
5.	Two	Scotch® 2228 Rubber Mastic Pads (Tape available)
6.	One	Roll of Scotch® 13 Electrical Semi-Conductive Tape
7.	One	Tube of Lubricant P55/1
8.	One	Plastic Glove
9.	One	Instructions (multi-language)

Packaging Labels – English – Multi-language

8. Source of Supply

Plant Hamburg, Hamburg, Germany.

Product Name: QS 2000 Kit 94-AP630-1; QS 2000 Kit 94-AP631-1

9. Attachments

1. EPM Test Report No. 6477 English / German
2. EPM Test Report No. 96 038 English / German
3. 3M Test Report No. D 760-0/3413 English
4. 3M Test Report No. D 778-0/3414 English
5. 3M Test Report No. D 799-0/3447 English
6. 3M Test Report No. D 812-0 English