RJS Series

3/C Phase Rejacketing System

Data Sheet

1. Product Description

3M™ RJS Series Rejacketing Sleeves are designed so that 3M Cold Shrink™ QTII and QTIII Silicone Rubber Termination applications can be used on 3/C (three conductor) medium voltage shielded power cables of tape shield, wire shield, armored and non-armored configurations.

RJS Rejacketing Assemblies are a series of silicone rubber insulators incorporating an inner expandable polyester braid designed to reduce sliding friction and deliver the insulator onto the cable.

Rejacketing sleeves are designed to protect the phase legs (core) of 3/C shielded power cable from exposure to moisture, corrosion, ozone, ultra-violet radiation, physical contact and other hazards that are associated with termination operating environments.

Rejacketing sleeves are designed to be used in conjunction with 3M Cold Shrink™ Breakout Boots and Silicone Rubber Terminations.

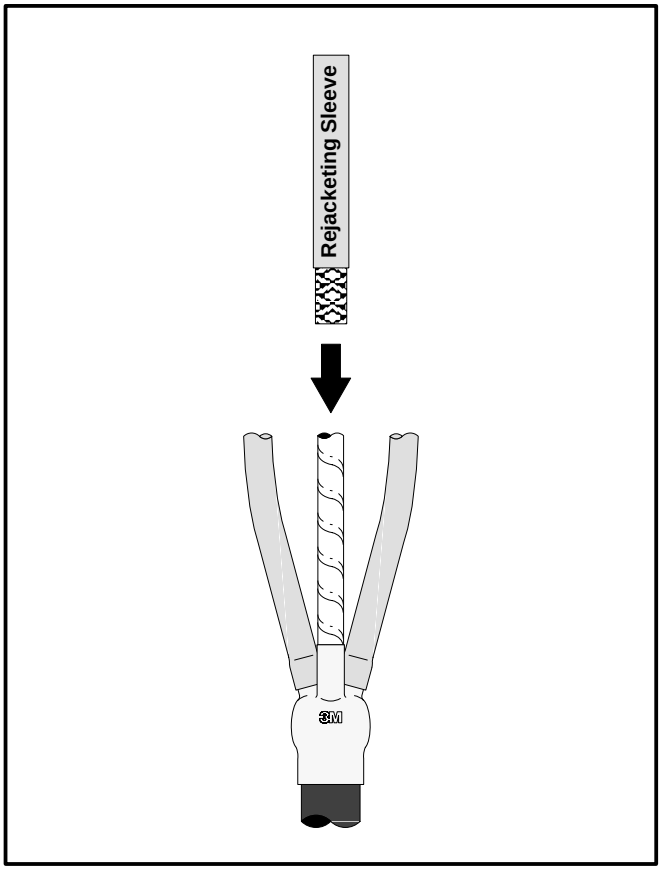
Kit Configurations:

- One poly-bagged four-foot continuous length assembly with inner polyester braid; ten poly bags per carton.
- One poly-bagged ten-foot continuous length assembly with inner polyester braid; one poly bag per carton.

Continuous length assemblies are easily trimmed to length to meet field determined installation requirements.

Features and Benefits:

- Versatile; installs quickly and accommodates a wide range of cable sizes.
- Simple hand application; no need for special installation tools.
- No torches or heat required.
- No specific user skills or craftsmanship required.
- Excellent resistance to ozone and ultra-violet radiation.
- Good solvent resistance; compatible with industry approved cable cleaners
- Excellent thermal stability.
- High dry and wet insulation resistance.
- Excellent shelf life.



- Easy to adjust sleeve length; adapts to variable equipment connection and mounting requirements.
- Compatible with 3M Cold Shrink™ PST Breakout Boots and Termination Products.

2. Applications

3M RJS Series Rejacketing Sleeves are used to protect shielded phase legs (cores) of 3/C medium voltage power cables after the jacket has been removed in preparation for terminating.

Rejacketing sleeves accommodate cable sizes ranging from No. 8 AWG (8 mm^2) @ 3.3 kV to 500 KCMil (240 mm^2) @ 35 kV.

Five sizes are available to cover cable metallic shield diameters ranging from 0.43″ (10,9 mm) to 1.62″ (41,0 mm).

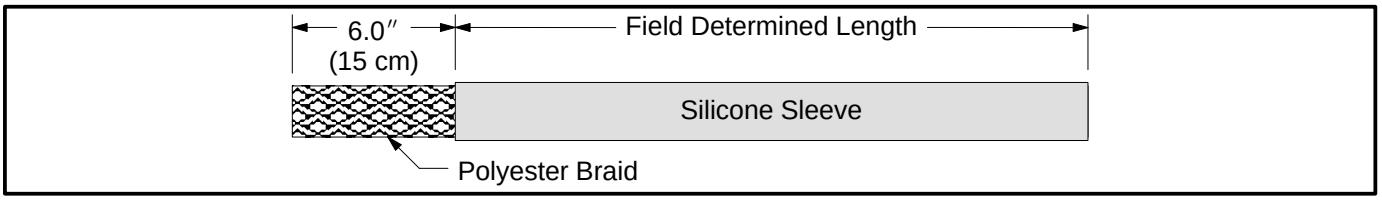
Rejacketing Sleeve Selection Guide — Based on Diameter Range and Cable Conductor Size

Product Number	Metallic Shield Diameter Range	3.3 KV (mm^2)	3.3 KV (mm^2)	5.0 KV (AWG)	6.6 KV (mm^2)	6.6 KV (mm^2)	8.0 KV (AWG)
		IEC	JIS	AEIC	IEC	JIS	AEIC
RJS–1	0.43 – 0.60″ 10,9 – 15,2 mm	16 – 35	8 – 22	8 – 2	16 – 25	8 – 10	6 – 4
RJS–2	0.60 – 0.80″ 15,2 – 20,3 mm	50 – 95	38 – 60	1 – 3/0	35 – 70	14 – 38	2 – 2/0
RJS–3	0.80 – 1.02″ 20,3 – 26,0 mm	120 – 185	100 – 150	4/0 – 400	95 – 150	60 – 100	3/0 – 350
RJS–4	1.02 – 1.28″ 25,9 – 32,4 mm	240 – 300	200 – 250	500 – 750	185 – 300	150 – 250	400 – 600
RJS–5	1.28 – 1.62″ 32,5 – 41,0 mm	—	300 – 325	800 – 1000	—	300 – 325	750 – 1000

Product Number	Metallic Shield Diameter Range	10 KV (mm^2)	15 KV (AWG)	20 KV (mm^2)	25 KV (AWG)	30 KV (mm^2)	35 KV (AWG)
		IEC	AEIC	IEC	AEIC	IEC	AEIC
RJS–1	0.43 – 0.60″ 10,9 – 15,2 mm	—	—	—	—	—	—
RJS–2	0.60 – 0.80″ 15,2 – 20,3 mm	10 – 50	2 – 1	—	—	—	—
RJS–3	0.80 – 1.02″ 20,3 – 26,0 mm	70 – 150	1/0 – 4/0	25 – 70	2 – 1/0	—	—
RJS–4	1.02 – 1.28″ 25,9 – 32,4 mm	185 – 300	250 – 450	95 – 185	2/0 – 250	35 – 70	1/0 – 3/0
RJS–5	1.28 – 1.62″ 32,5 – 41,0 mm	—	500 – 750	240 – 300	300 – 500	95 – 240	4/0 – 500

IEC = International Electrotechnical Commission
JIS = Japanese Industrial Standard
AEIC = Association of Edison Illuminating Companies

3. Typical Physical and Electrical Properties



Silicone Rejacketing Sleeve

Physical Properties

Test Method	Typical Value*
• Color	Dark Gray
• Wall Thickness 3M Test Method	0.065″ (1,65 mm)
• Tear Resistance (ASTM D–624 B)	180 PLI (32 kg/cm)
• Ultimate Tensile Strength (ASTM D–412)	1058 PSI (7,3 MPa)
• Modulus @ 50% Stretch (ASTM D–412)	32 PSI (0,22 MPa)
• Modulus @ 100% Stretch (ASTM D–412)	45 PSI (0,31 MPa)
• Ultimate Elongation (ASTM D–412)	910%
• Temperature Rating 3M Test Method	180°C (Class H)

Electrical Properties

Test Method	Typical Value*
• Voltage Class Rating 3M Test Method	Up to 35 kV (Termination based)
• Dielectric Strength @ 0.065″ 3M Test Method	428 V/mil (17 kV/mm)
• Track Resistance @ 2.5 kV (ASTM D–2303/IEC 587)	6 hours

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

A. Ratings

RJS Series Rejacketing Sleeves can be used on cables with a continuous operating temperature of 90°C and an emergency overload temperature of 130°C.

When used in combination with 3M Cold Shrink™ Terminations, RJS Rejacketing Sleeves meet or exceed, the current rating of the cable on which they have been applied.

According to IEEE Standard 48–1996 definition, a 3/C Class 1 Termination designation is achieved by combining three easy-to-use accessories: (a) 3M Cold Shrink™ Breakout Boot, (b) RJS Rejacketing Sleeves and (c) Cold Shrink™ Silicone Rubber Termination Assemblies.

B. Material Characteristics

Hydrophobicity

When airborne contaminants are deposited on a termination surface destructive leakage currents can initiate when the surface becomes wet. Fog and drizzle are normally considered to be worse than rain as these two forms of precipitation can combine with accumulated surface contaminants to reduce surface resistivity and promote leakage current formation. Rain tends to wash the pollutants off the termination surface.

Silicone RJS Rejacketing Sleeves are hydrophobic, tending to reject moisture accumulation and thereby, reducing the probability for discharge-initiated material erosion and tracking.

Severe environmental conditions that are sustained for long time periods can cause any polymeric surface to lose its hydrophobicity. Because of this, EPDM polymers and others tend to lose their hydrophobic nature over time. Porcelain surfaces become increasingly hydrophilic with time which can result in premature failure or flashover. Silicone surfaces can regenerate their hydrophobic character. This unique ability is a major factor for ensuring a long service life.

Ozone, Heat and UV Resistance

One of the most outstanding physical characteristics of silicone rubber is its retention of desirable properties over the very wide temperature range of –150°F (–100°C) to 600°F (315°C).

While there are applications that take advantage of these temperature extremes, a more attractive feature might be that of its extremely long life expectancy at moderate operating temperatures.

The silicone polymer molecular backbone, silicone-oxygen linkage, provides the same strong –Si–O–Si– type bond occurring in quartz, sand and glass which accounts for the outstanding temperature properties of silicones and their resistance to oxidation by ozone, corona and weathering. Polymer chains from organic rubber materials often have double carbon bond molecular backbones which are quickly cleaved by ozone, ultraviolet light, heat or other influences found in the operating environment.

Solvent Resistance

Solvent resistance testing for RJS Series Rejacketing Sleeve material was done by immersing pieces of the extruded tubing in some of the most common solvents (i.e. heptane acetone, hexane, toluene, MEK, THF, ethanol and 3M CC–4 Cable Cleaning Fluid). Immersion time was at least 96 hours at room temperature.

Visual and tactile inspection of the samples after immersion revealed no dissolution or disintegration in any of the cases. That is, the material does not loose its integrity in the presence of the reference solvents. The table below summarizes these observations.

No chemical degradation (breaking of polymer chains) appears to occur upon exposure. The samples basically recover their initial physical strength upon evaporation of the solvent.

Solvent Type	Degree of Swelling (Approximate)	Physical Resistance (Apparent Strength)
3M CC–4	47%	Good (6)
Heptane	65%	Good (6)
Acetone	00%	No Effect (10)
Ethanol	00%	No Effect (10)
Hexane	63%	Fair (5)
MEK	23%	Excellent (8 – 9)
THF	70%	Fair (4)
Toluene	70%	Fair (5)

The number in parenthesis indicates the perceived strength on a 1 to 10 scale; right after immersion.

3M CC–4 Cable Cleaner contains Petroleum Distillate: d–limonene

4. Specifications

A. Product

Cable phase rejacketing insulators are components of 3/C cable terminations and as such, must conform to all internationally recognized termination performance standards; specifically to VDE 0278 and the class 1 designation of IEEE Standard 48–1996. Each phase (core) insulator shall be made of track resistant silicone rubber, dark gray in color and, shall install by hand as a one-piece, continuous length, assembly. Application shall require no flame, heat source or specialized tools. Rejacketing insulators must be length adjustable to conform with all field determined equipment installation requirements.

B. Engineering/Architectural

Insulate and protect shielded phase (core) legs for all 3/C, 3.3 kV through 35 kV Class, cable in accordance with the instructions provided in 3M RJS Series Rejacketing Sleeve Product Kits.

5. Performance Tests

Critical performance characteristics for 3/C cable termination phase insulators include resistance to damage from impulse flashover and from tracking during long term exposure to severe environmental conditions.

A. Impulse Flashover

3M Test Method — Maximum Impulse

The purpose of this test method is to establish both the maximum impulse withstand level and the 100% impulse flashover level (on both positive and negative polarity) for high voltage terminations.

The test consists of a stepped sequence of surges (3 surges per step) at increasing voltage levels. For terminations this sequence continues until three surges at a given voltage result in three flashovers. There are indications that this stepped method artificially drives the flashover level higher than the termination would normally withstand on a one shot application of the surge.

A 1.2 x 50 micro second voltage wave is applied to the termination as per IEEE Standard 48–1996. Additional test standard references and procedures include those of IEEE Standard 4–1995, *IEEE Standard Test Procedures and Requirements for Alternating Current Cable Terminations 2.5 kV Through 765 kV* and IEEE Standard 82–1994, *IEEE Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors.*

15 kV Class 3/C termination samples were built using RJS Rejacketing Sleeve phase insulators and QTIII Cold Shrink™ Silicone Rubber Terminations. Two configurations were included in this evaluation; those with an exposed grounding ring at the termination base (control) and those without. All specimens exceeded the IEEE Standard 48–1996 BIL requirement by 50% during this test. Increasing the impulse voltage to termination breakdown level resulted in no damage to RJS Rejacketing Sleeve components.

B. Alternating Current (AC) Flashover Test

3M Test Method — AC Step Test

The purpose of this test method is to establish the highest AC voltage that a termination can withstand and is used to determine termination performance relative to the requirements outlined in IEEE Standard 48–1996.

Terminations are exposed to a stepped AC voltage rise to failure or flashover. The voltage magnitude required to arc across the termination surface in air (from terminal lug to ground point) is determined.

3/C 15 kV Class Termination samples tested with and without exposed termination body grounding rings achieved test levels associated with 25 kV Class products during this evaluation. RJS Rejacketing Sleeves were not damaged at the flashover level.

C. Contamination Chamber

3M Test Method — ASTM 2132 Contaminant

Terminations are coated with a slurry consisting of flint, clay, paper pulp, salt and water, and allowed to dry. They are then placed in the test chamber where they are energized at 1 1/2 times rated voltage and exposed to a continuous water mist spray from a rotating nozzle. Individual terminations are recoated every 300 hours.

Because of the salt content and other solid particulates, this procedure is thought to be representative of exposures at industrial/sea coast locations.

To determine the tracking performance capability of RJS Rejacketing Sleeve Products, 15 kV Class 3/C termination specimens were built with grounding rings located over the rejacketing sleeves; eight and sixteen inches below the termination bodies respectively.

Specimens exceeded 2500 hours under these test conditions. This is as long or longer, than 1/C conventionally grounded terminations samples will endure. There were no signs of rejacketing sleeve material degradation or tracking at the conclusion of the test.

6. Installation Technique

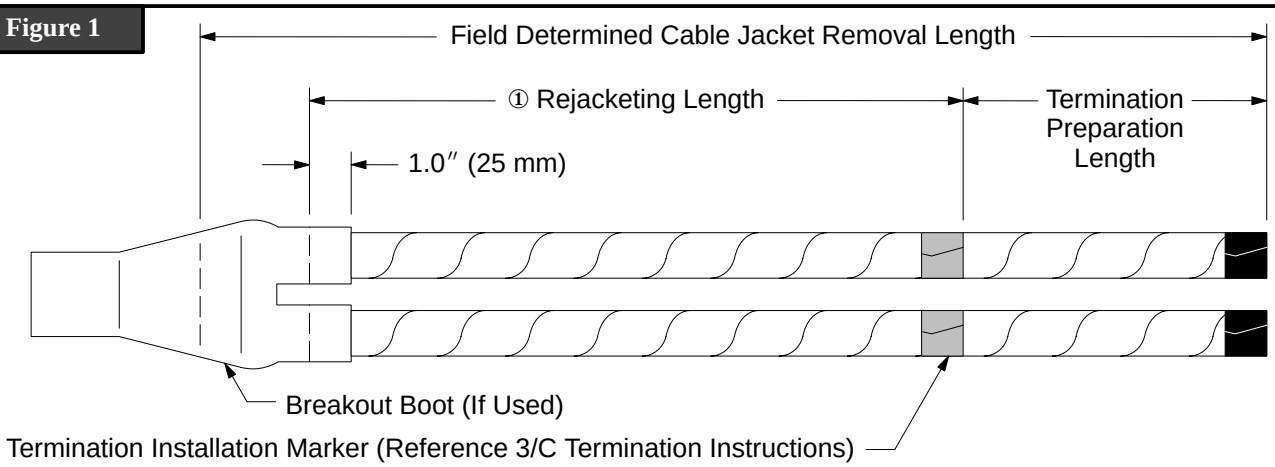
Detailed instructions are included in each kit to provide the installer with all information required to properly install the appropriately sized 3M RJS Series Rejacketing Sleeve Product.

A brief summary of the installation steps for copper tape shielded cable is outlined as follows:

Installation Technique

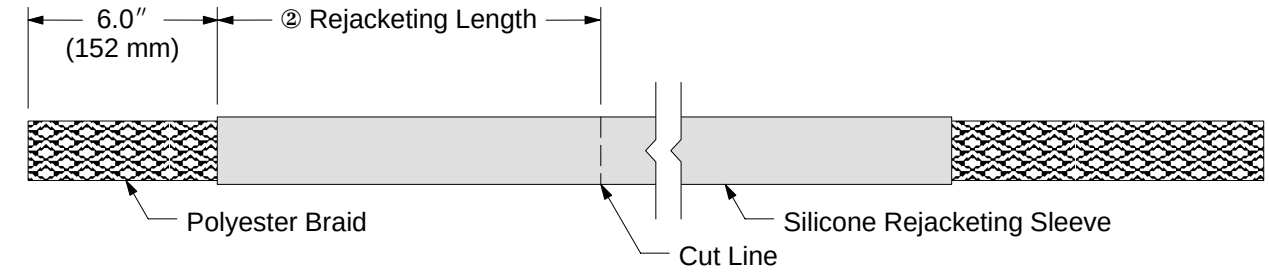
1. Cable jacket removal length and termination dimensional allowances are field determined according to specific equipment needs and user preferences. Phase rejacketing length is determined by voltage class based phase separation and mounting requirements.
2. Determine required length of cable shielding to be rejacketed ① *(Figure 1–Typical)*.

Figure 1



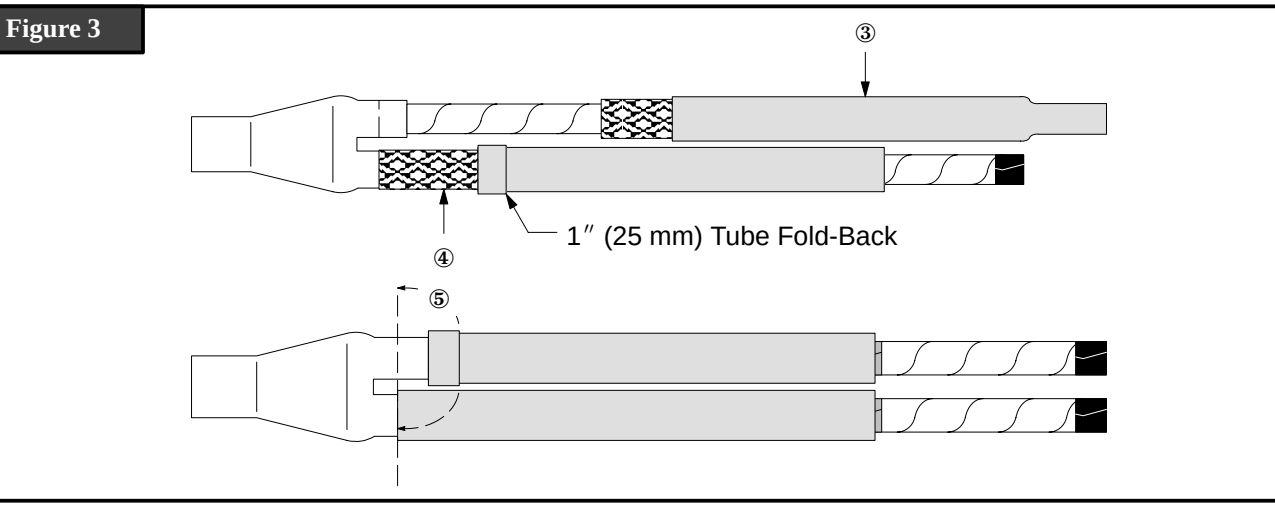
3. Using scissors or sharp knife, cut sleeve/braid assemblies to desired length ② *(Figure 2)*.

Figure 2



4. Install rejacketing sleeve assemblies *(Figure 3)*.
   - **a.** Open polyester braid end and push assembly into place ③ *(Figure 3)*.
   - **b.** Push assembly to desired final position ④ *(Figure 3)*, then fold silicone sleeve back on itself for 1.0″ (25 mm).
   - **c.** Trim off exposed polyester braid material ④ *(Figure 3)*.
   - **d.** Push sleeve assembly into final position and flip silicone sleeve into place ⑤ *(Figure 3)*.

Figure 3



7. Maintenance

Hypotting

Termination designs incorporating RJS Series Rejacketing Sleeves can be field tested by using normal cable testing procedures (reference: ANSI/IEEE Standard 400 “Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field”).

Surface Cleaning

RJS Rejacketing Sleeve Products are not harmed by field surface cleaning. Established techniques for cleaning insulators and terminations, such as high pressure water or pulverized corn cobs, are acceptable. It should be noted however, that only extreme areas of environmental contamination should require this kind of attention.

8. Shelf Life

While RJS Series Rejacketing Sleeve Products are not expected to deteriorate during extended storage periods, a five year shelf life limit is suggested. Maximum recommended storage temperature is 120°F (49°C). RJS Products are not affected by freezing. Standard stock rotation practice is recommended.

9. Availability

Rejacketing Sleeve Products are packaged and supplied in the following kit configurations:

1. One poly-bagged four foot continuous length assembly with inner polyester braid; ten poly bags per carton.
2. One poly-bagged ten foot continuous length assembly with inner polyester braid; one poly bag per carton.

3M RJS Series Rejacketing Sleeve Products can be purchased through your local authorized 3M electrical distributor.

3M

Electrical Products Division

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