



# Silicone Rubber Cold Shrink Connector Insulators 8440 Series

## Data Sheet

### 1.0 Product Description

3M™ Cold Shrink Connector Insulators 8440 Series are open ended, silicone rubber, tubular sleeves. The sleeves are factory expanded and assembled on a removable supporting plastic core. Each rubber assembly is supplied for field installation in this pre-stretched condition. As the core is unwound, the insulating sleeve shrinks to form a tight seal. Three sizes of Cold Shrink Insulators cover terminal lug barrels and three sizes of Cold Shrink Insulators cover inline connectors. Each insulator type, collectively has an application range of 0.35" (8,86 mm) to 0.95" (24,13 mm) for installations on #6 AWG to 3/0 AWG.

- Simple installation, requires only workman's hands.
- No tools required.
- No heat required for installation.
- Seals tight, retains its resiliency and pressure even after years of aging and exposure.
- Resists moisture.
- Wide range, size accommodation.
- Resists acids and alkalies.
- Resists ozone and ultraviolet light.
- Resists fluid splashes.
- Resists fire - will not support flame.
- Operating temperature range - 66° F/ - 55° C to 500°F/260°C.

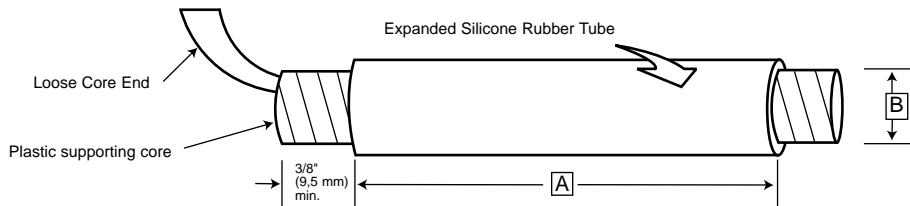
### 2.0 Applications

- Primary electrical insulation for all solid dielectric (rubber and plastic) insulated wire and cable splices rated to 1000 volts.
- Electrical Aircraft cables.
- For indoor, outdoor, in cable tray for overhead use.
- Physical protection and moisture sealing for high voltage, air insulated connectors and lugs.
- Insulation of secondary splices, copper and aluminum conductors.
- Sheath repairs.
- Insulation for inline conductor transition connector.

### 3.0 Data: Physical & Electrical Properties

#### High Stretch Silicone Rubber Typical Physical Properties

| <u>Test Method</u>   | <u>Typical Values</u>        |
|--|------------------------------|
| Color  | Grey                         |
| 100% Modulus<br>ASTM D412-75                               | 180 psi<br>(1.24MPa)         |
| Ultimate Tensile<br>ASTM D412-75                           | 1240 psi<br>(8.55 MPa)       |
| Die B Tear<br>ASTM D624B-73                                | 185 psi<br>(1.28 MPa)        |
| Shore A Hardness<br>ASTM D2240-75                          | 48                           |
| Specific Gravity   | 1.23                         |
| Permanent Set<br>100% Strain - 22 hours<br>@ 212° F/100° C | 7.1%                         |
| Dielectric Strength<br>ASTM D149-75<br>@1.78 mm thickness  | 554 Volts/mil<br>(21.8 MV/m) |
| Dielectric Strength<br>168 hours in H2O<br>@194°F/90°C     | 543 Volts/mil<br>(21.4 MV/m) |



| Part Number | Cable Range<br>AWG | Application Range<br>Inches (mm) |                                 | Dimensions<br>Inches (mm) |                  |
|-------------|--------------------|----------------------------------|---------------------------------|---------------------------|------------------|
|             |                    | Min. Dia.*<br>for Seal           | Max. Dia.**<br>Insulator Covers | A<br>Length               | B<br>I.D. (Core) |
| 8443-2      | 6 - 2              | .350 (8.86)                      | .560 (14.22)                    | 1.4 (36)                  | 0.68 (17.3)      |
| 8443-6.5    | 6 - 2              | .350 (8.86)                      | .560 (14.22)                    | 5.2 (132)                 | 0.68 (17.3)      |
| 8445-2.5    | 2 - 1/0            | .420 (10.7)                      | .720 (18.29)                    | 1.7 (43)                  | 0.84 (21.3)      |
| 8445-7.5    | 2 - 1/0            | .420 (10.7)                      | .720 (18.29)                    | 6.2 (158)                 | 0.84 (21.3)      |
| 8447-3.2    | 1/0 - 3/0          | .550 (14)                        | .950 (24.13)                    | 2.3 (57)                  | 1.07 (27.2)      |
| 8447-8      | 1/0 - 3/0          | .550 (14)                        | .950 (24.13)                    | 6.8 (172)                 | 1.07 (27.2)      |

**Table 1**

## 4.0 Specifications Product

Exposed metallic connectors joining power cable conductors rated 1000 volts or less shall be covered with 3M™ 8440 Series Silicone Cold Shrink tubular rubber insulation.

The inline connections shall be insulated in accordance with the instructions provided with the 3M™ Cold Shrink Connector Insulator 8443-6, 8445-7.5, and 8447-8. The connecting barrel portion of terminal lugs shall be insulated in accordance with the instructions provided with the 3M™ Cold Shrink Connector Insulators 8443-2, 8445-2.5, and 8447-3.2.

### Engineering/Architectural

A silicone Cold Shrink Connector Insulators must be capable of normal operation through a temperature range of -66°F/ -55°C to 500°F/260°C. It must be usable without additional covering or adhesive both indoors and outdoors, in cable tray or overhead applications on cables rated up to 1000V. It must be applied without additional heat or flame and, when applied according to manufacturer's directions, be immediately energizable. It must not support flame or be adversely affected by moisture, mild acids or alkalis, ozone or ultraviolet light. It must provide resistance to aircraft fluids and be compatible with all rubber and plastic insulated power cables.

## 5.0 Performance Tests

### A. Flammability Test

The test for flammability of the 3M Cold Shrink Insulators 8440 Series was conducted with specimens positioned both vertically and horizontally per specification BSS 7230. The silicone rubber insulation passed the Flammability Test of BSS 7230 without supporting a flame. In addition, these insulators were also subjected to a gas flame test as outlined in paragraph 4.4.15 of MIL-C-24643A and met the passing criteria as specified. No fuse was blown during the one hour flame exposure.

### B. Humid Environment

Tests to verify electrical integrity through conditions of high humidity were run per Mil Standard 202-Method B. The test duration was for 10 days at 104°F/40°C and 95% RH. Typical test values are found in Table 2.

### C. Ultraviolet Resistance

After 1000 hours of testing in a Weather-O-Meter according to Specifications ASTM D750 and ASTM G23, the silicone rubber insulation exhibited no crazing, cracking or change in surface appearance.

| Test   | Insulation Resistance  | Withstand  | Result |
|--------|------------------------|------------|--------|
| Before | 3.0 x 10 <sup>12</sup> | 2500 V-rms | Pass   |
| After  | 2.5 x 10 <sup>12</sup> | 2500 V-rms | Pass   |

**Table 2**

#### D. Thermal Shock

Assembled units from the fluid resistance test were used for the thermal shock evaluation. The units were subjected to 15 cycles of the following thermal shock sequence:

1. 30 minutes at -66°F/ -55°C.
2. 5 minutes at 74°F/23°C.
3. 30 minutes at 500°F/260°C.
4. 5 minutes at 74°F/23°C.

The insulation resistance values and results of test are found in Table 3.

| Fluid         | Test   | Insulation Resistance     | Withstand  | Result |
|---------------|--------|---------------------------|------------|--------|
| Monsanto L.D. | Before | $1.5 \times 10^{13}$ ohms | 2500 V-rms | Pass   |
|               | After  | $1.0 \times 10^{12}$ ohms | 2500 V-rms | Pass   |
| Jet A         | Before | $7.0 \times 10^{12}$ ohms | 2500 V-rms | Pass   |
|               | After  | $1.7 \times 10^{12}$ ohms | 2500 V-rms | Pass   |
| MIL-L-7808    | Before | $3.5 \times 10^{12}$ ohms | 2500 V-rms | Pass   |
|               | After  | $6.5 \times 10^{12}$ ohms | 2500 V-rms | Pass   |
| MIL-L-23699   | Before | $8.0 \times 10^{12}$ ohms | 2500 V-rms | Pass   |
|               | After  | $3.5 \times 10^{12}$ ohms | 2500 V-rms | Pass   |
| 5% Saline     | Before | $9.0 \times 10^{12}$ ohms | 2500 V-rms | Pass   |
|               | After  | $6.5 \times 10^{12}$ ohms | 2500 V-rms | Pass   |

**Table 3**

#### E. Altitude

Electrical integrity at high altitudes was determined by testing to Mil Standard 1344A, Test method 1004.1. Typical test values are found in Table 4.

| Altitude | Insulation Resistance     | Withstand  | Result |
|----------|---------------------------|------------|--------|
| 50,000   | $1.0 \times 10^{11}$ ohms | 2500 V-rms | Pass   |
| 70,000   | $1.8 \times 10^{12}$ ohms | 2500 V-rms | Pass   |

**Table 4**

#### F. Heat Aging

Installed silicone rubber insulators were subjected to an eight hour heat aging test at 500°F/260°C. Other units were subjected to 401°F/205°C for 30 days. The silicone rubber remained resilient and showed no sign of deterioration.

## G. Fluid Resistance

To determine the affect of a fluid splash on insulated connected assemblies, the units were subjected to ten cycles of the following test sequence.

1. One minute fluid soak.
2. 24 hour, 74°F/23°C ambient dry.
3. Insulation resistance measurement.
4. 2.4 kV-rms withstand.

Results from the fluid resistance test are found in table 5.

## 6.0 Maintenance

Components of 3M™ Silicone PST Cold Shrink Connector Insulators are stable under normal storage conditions for a period of three years from the date of manufacture. The Cold Shrink Insulators are not impaired by freezing or overheating due to the ambient temperatures found in storage or shipping. Normal storage and stock rotation are recommended.

## 7.0 Availability

3M™ Silicone PST Cold Shrink Connector Insulators 8440 Series are available through your local authorized 3M electrical distributor.

**Fluid Splash Test      Insulation Resistance/2500 V-rms Withstand**

| Fluid   | Monsanto L.D.                | Jet A                        | MIL-L-7808                   | MIL-L-23699                  | 5% Saline                    |
|---------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| Initial | 1.5 x 10 <sup>13</sup> /Pass | 7.2 x 10 <sup>12</sup> /Pass | 3.5 x 10 <sup>12</sup> /Pass | 8.0 x 10 <sup>12</sup> /Pass | 9.0 x 10 <sup>12</sup> /Pass |
| 1       | 3.0 x 10 <sup>9</sup> ohms   | 2.0 x 10 <sup>12</sup> ohms  | 8.0 x 10 <sup>12</sup> ohms  | 2.5 x 10 <sup>12</sup> ohms  | 3.5 x 10 <sup>12</sup> ohms  |
| 2       | 1.2 x 10 <sup>9</sup> ohms   | 1.2 x 10 <sup>12</sup> ohms  | 2.0 x 10 <sup>12</sup> ohms  | 5.0 x 10 <sup>12</sup> ohms  | 5.0 x 10 <sup>12</sup> ohms  |
| 3       | 4.0 x 10 <sup>7</sup> ohms   | 1.2 x 10 <sup>12</sup> ohms  | 2.5 x 10 <sup>12</sup> ohms  | 4.0 x 10 <sup>12</sup> ohms  | 3.5 x 10 <sup>12</sup> ohms  |
| 4       | 1.8 x 10 <sup>7</sup> ohms   | 8.0 x 10 <sup>11</sup> ohms  | 3.0 x 10 <sup>12</sup> ohms  | 3.0 x 10 <sup>12</sup> ohms  | 4.0 x 10 <sup>12</sup> ohms  |
| 5       | 8.0 x 10 <sup>6</sup> ohms   | 3.0 x 10 <sup>11</sup> ohms  | 2.0 x 10 <sup>12</sup> ohms  | 2.5 x 10 <sup>12</sup> ohms  | 6.0 x 10 <sup>12</sup> ohms  |
| 6       | 6.0 x 10 <sup>6</sup> ohms   | 2.0 x 10 <sup>11</sup> ohms  | 1.8 x 10 <sup>12</sup> ohms  | 2.0 x 10 <sup>12</sup> ohms  | 7.0 x 10 <sup>12</sup> ohms  |
| 7       | 5.0 x 10 <sup>6</sup> ohms   | 1.8 x 10 <sup>11</sup> ohms  | 1.0 x 10 <sup>12</sup> ohms  | 2.5 x 10 <sup>12</sup> ohms  | 9.0 x 10 <sup>12</sup> ohms  |
| 8       | 4.0 x 10 <sup>6</sup> ohms   | 1.0 x 10 <sup>11</sup> ohms  | 1.0 x 10 <sup>11</sup> ohms  | 1.4 x 10 <sup>12</sup> ohms  | 3.0 x 10 <sup>12</sup> ohms  |
| 9       | 4.0 x 10 <sup>6</sup> ohms   | 1.0 x 10 <sup>11</sup> ohms  | 6.5 x 10 <sup>11</sup> ohms  | 1.0 x 10 <sup>12</sup> ohms  | 3.0 x 10 <sup>12</sup> ohms  |
| 10      | 3.5 x 10 <sup>6</sup> ohms   | 7.0 x 10 <sup>10</sup> ohms  | 5.0 x 10 <sup>11</sup> ohms  | 1.2 x 10 <sup>12</sup> ohms  | 5.0 x 10 <sup>12</sup> ohms  |

**Table 5**

| Approximate Installed Weight |                 |                             |                 |
|------------------------------|-----------------|-----------------------------|-----------------|
| Terminal Lug Insulators      |                 | Inline Connector Insulators |                 |
| Part No.                     | Weight oz. (gm) | Part No.                    | Weight oz. (gm) |
| 8443-2                       | 0.123 (3.5)     | 8443-6.5                    | 0.388 (11.0)    |
| 8445-2.5                     | 0.190 (.54)     | 8445-7.5                    | 0.564 (16.0)    |
| 8447-3.2                     | 0.335 (9.5)     | 8447-8                      | 0.776 (22.0)    |

**Table 6**

## IMPORTANT NOTICE

Before using this product, you must evaluate it and determine if it is suitable for your intended application. You assume all risks and liability associated with such use.

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Electrical Products Division

6801 River Place Blvd.  
Austin, TX 78726-9000  
800/245-3573  
www.3M.com/elpd



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#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.