

# 3M Scotch-Weld™ Epoxy Adhesives DP460 Off-White and DP460NS

Technical Data Sheet

September 2017

**Product Description** 3M™ Scotch-Weld™ Epoxy Adhesives DP460 Off-White and DP460NS are high performance, two-part epoxy adhesives offering outstanding shear and peel adhesion, and very high levels of durability.

**Features**

- High shear strength
- High peel strength
- 60 minute work life
- Non sag (DP460NS)
- Easy mixing

**Typical Uncured  
Physical  
Properties**

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

| Product                              |                                       | 3M™ Scotch-Weld™<br>Epoxy Adhesive<br>DP460 Off-White | 3M™ Scotch-Weld™<br>Epoxy Adhesive<br>DP460NS |
|--------------------------------------|---------------------------------------|---|---|
| Viscosity (approx.)<br>@ 73°F (23°C) | Base<br>Accelerator                   | 20,000-50,000 cps<br>8,000-14,000 cps                 | 150,000-275,000 cps<br>8,000-14,000 cps       |
| Base Resin                           | Base<br>Accelerator                   | epoxy<br>amine  | epoxy<br>amine                                |
| Color                                | Base<br>Accelerator                   | white<br>amber  | white<br>amber                                |
| Net Weight<br>Lbs./Gallon            | Base<br>Accelerator                   | 9.3-9.7<br>8.8-9.2                                    | 9.3-9.7<br>8.8-9.2                            |
| Mix Ratio (B:A)                      | Volume<br>Weight                      | 2:1<br>2:0.96   | 2:1<br>2:0.96                                 |
| Work life, 73°F (23°C)               | 20 g mixed<br>10 g mixed<br>5 g mixed | 60 minutes<br>75 minutes<br>90 minutes                | 60 minutes<br>60 minutes<br>60 minutes        |

# 3M™ Scotch-Weld™ Epoxy Adhesives

## DP460 Off-White • DP460NS

### Typical Cured Thermal Properties

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

| Product   | 3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White                         | 3M™ Scotch-Weld™ Epoxy Adhesive DP460NS            |
|---|---|--|
| Physical Color  | Off-white   | Off-white  |
| Shore D Hardness  | 75-80   | 78-84  |
| Thermal Coefficient of Thermal Expansion (in./in./°C)               | Below Tg<br>59 x 10 <sup>-6</sup><br>Above Tg<br>159 x 10 <sup>-6</sup> | 74.44 x 10 <sup>-6</sup><br>166 x 10 <sup>-6</sup> |
| Thermal Conductivity (btu - ft./ft. <sup>2</sup> - hr. - °F) @ 45°C | 0.104   | 0.104  |
| Electrical Dielectric Strength (ASTM D 149)                         | 1100 volts/mil  | 727 volts/mil                                      |
| Volume Resistivity (ASTM D 257)                                     | 2.4 x 10 <sup>14</sup> ohm-cm   | 3.25 x 10 <sup>15</sup> ohm-cm                     |

### Typical Curing Characteristics

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

#### Rate of Strength Build-Up

Aluminum, Overlap Shear (7 mil Bondline) (ASTM D 1002-72)

Bonds Tested at 73°F (23°C)

#### 3M™Scotch-Weld™ Epoxy Adhesive DP460 Off-White

| Time in Oven | Cure Temperature     |                           |                           |
|--------------|----------------------|---------------------------|---------------------------|
|              | 73°F (23°C)          | 120°F <sup>1</sup> (49°C) | 140°F <sup>1</sup> (60°C) |
| 30 minutes   | —                    | <50                       | 3000/60 <sup>2</sup>      |
| 60           | —                    | 1300                      | 4500/60 <sup>2</sup>      |
| 90           | —                    | 4300/60 <sup>2</sup>      | —                         |
| 2 hours      | —                    | 4400/60 <sup>2</sup>      | 4800                      |
| 3            | —                    | 4800/60 <sup>2</sup>      | —                         |
| 5            | 400                  | —                         | —                         |
| 6            | 1000                 | —                         | —                         |
| 7            | 3500                 | —                         | —                         |
| 24           | 4000/60 <sup>2</sup> | —                         | —                         |

#### 3M™Scotch-Weld™ Epoxy Adhesive DP460NS

| Time in Oven | Cure Temperature |                           |                           |
|--------------|------------------|---------------------------|---------------------------|
|              | 73°F (23°C)      | 120°F <sup>1</sup> (49°C) | 160°F <sup>1</sup> (71°C) |
| 15 minutes   | —                | —                         | 4860                      |
| 30           | —                | 10                        | 5250                      |
| 60           | —                | 2800                      | 5300                      |
| 2 hours      | 1                | 5050                      | 5470                      |
| 4            | 46               | 5400                      | 5320                      |
| 6            | 970              | 5570                      | 5140                      |
| 24           | 4500             | —                         | 5210                      |

<sup>1</sup>This represents the oven temperature to which the bonds were subjected for the prescribed time. The average bondline temperature during the cure time will be somewhat lower than the oven temperature.

<sup>2</sup>The value in the denominator is the expected minimum 73°F (23°C) T-peel strength (piw) measured after the indicated cure cycle.

NOTE: The data in this Technical Data Sheet were generated using the 3M™ EPX™ Applicator System equipped with an EPX static mixer, according to manufacturer's directions. Thorough hand-mixing will afford comparable results.

# 3M™ Scotch-Weld™ Epoxy Adhesives

## DP460 Off-White • DP460NS

### Typical Adhesive Performance Characteristics

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

#### Substrates and Testing

##### A. Overlap Shear (ASTM D 1002-72)

Overlap shear (OLS) strengths were measured on 1 in. wide 1/2 in. overlap specimens. These bonds were made individually using 1 in. x 4 in. pieces of substrate except for aluminum. Two panels 0.063 in. thick, 4 in. x 7 in. of 2024T-3 clad aluminum were bonded and cut into 1 in. wide samples after 24 hours. The thickness of the bondline was 0.005-0.008 in. All strengths were measured at 73°F (23°C) except where noted.

The separation rate of the testing jaws was 0.1 in. per minute for metals, 2 in. per minute for plastics and 20 in. per minute for rubbers. The thickness of the substrates were: steel, 0.060 in.; other metals, 0.05-0.064 in.; rubbers, 0.125 in.; plastics, 0.125 in.

##### B. T-peel (ASTM D 1876-61T)

T-peel strengths were measured on 1 in. wide bonds at 73°F (23°C). The testing jaw separation rate was 20 inches per minute. The substrates were 0.032 in. thick.

##### C. Bell Peel (ASTM D 3167)

Bell peel strengths were measured on 1/2 in. wide bonds at the temperatures noted. The testing jaw separation rate was 6 in. per minute. The bonds are made with 0.064 in. bonded to 0.025 in. thick adherends.

##### D. Cure Cycle

With the exception of Rate of Strength Build-Up Tests, all bonds, were cured 7 days at 73°F (23°C) at 50% RH before testing or subjected to further conditioning or environmental aging.

#### Aluminum, Overlap Shear, at Temperature (PSI)

|                                      | 3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White | 3M™ Scotch-Weld™ Epoxy Adhesive DP460NS |
|--------------------------------------|---|---|
| -67°F (-55°C)                        | 4500  | 4900                                    |
| 73°F (23°C)                          | 4500  | 4650                                    |
| 180°F (82°C) (15 min.) <sup>1</sup>  | 700   | 1360                                    |
| (30 min.) <sup>1</sup>               | 1000  | 1810                                    |
| (60 min.) <sup>1</sup>               | 1400  | 2630                                    |
| (4 hr.) <sup>1</sup>                 | 2500  | 2680                                    |
| 250°F (121°C) (15 min.) <sup>1</sup> | 220   | 420                                     |

<sup>1</sup>Represents time in test chamber oven before test.

#### Metals, Overlap Shear, Tested @ 73°F (23°C) (PSI)

|                   |                  |      |      |
|-------------------|------------------|------|------|
| Aluminum          | Etched           | 4500 | 4500 |
|                   | Oakite degreased | 3200 | 2300 |
|                   | MEK/abrade/MEK   | 3500 | 2670 |
| Cold Rolled Steel | Oakite degreased | 3500 | —    |
|                   | MEK/abrade/MEK   | 2800 | 3600 |
| Copper            | MEK/abrade/MEK   | 4000 | 4400 |
| Brass             | MEK/abrade/MEK   | —    | 3400 |
|                   | CDA 260          | 4000 | —    |
|                   | Cartridge        | 4200 | —    |
| Stainless Steel   | MEK/abrade/MEK   | 4000 | 2400 |
| Galvanized Steel  | Oakite degreased | 2000 | 2480 |
|                   | Hot dipped       | 2100 | 3000 |
|                   | Electrodeposited |      |      |

# 3M™ Scotch-Weld™ Epoxy Adhesives

## DP460 Off-White • DP460NS

Typical Adhesive Performance Characteristics  
(continued)

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

### Substrates and Testing

Aluminum, T-Peel (PIW), at Temperature  
Aluminum, etched (17-20 mil bondline)

|               | 3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White | 3M™ Scotch-Weld™ Epoxy Adhesive DP460NS |
|---------------|---|---|
| -67°F (-55°C) | 5-10  | 3-5                                     |
| 73°F (23°C)   | 60  | 60                                      |
| 180°F (82°C)  | 3-5   | 20                                      |

### Metals, T-Peel, Tested @ 73°F (23°C) (PIW)

|                   |                                    |    |            |
|-------------------|------------------------------------|----|------------|
| Aluminum, etched  | 17-20 mil bondline                 | 60 | not tested |
|                   | 5-8 mil bondline                   | 50 |            |
| Cold Rolled Steel | 17-20 mil bondline                 | 40 | not tested |
|                   | Oakite degreased<br>MEK/abrade/MEK | 25 |            |

### Aluminum Bell Peel (PIW), at Temperature (ASTM D 3167)

| Temperature   | 3M™ Scotch-Weld™ Epoxy Adhesive DP460NS |
|---------------|---|
| -67°F (-55°C) | 19                                      |
| 73°F (23°C)   | 77                                      |
| 180°F (82°C)  | 39                                      |

### Other Substrates, Overlap Shear Tested @ 73°F (23°C)

| Substrate      | Surf. Prep. <sup>1</sup>                        |                   | Surf. Prep. <sup>2</sup>                        |                   |
|----------------|---|-------------------|---|-------------------|
|                | 3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White | DP460NS           | 3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White | DP460NS           |
| ABS            | 300   | 345               | 575   | 572               |
| PVC            | 500   | 815 <sup>3</sup>  | 350   | 313 <sup>3</sup>  |
| Polycarbonate  | 400   | 380               | 500   | 390               |
| Polyacrylic    | 220   | 210               | 330   | 270               |
| Polystyrene    | 450   | 320               | 475 <sup>3</sup>                                | 490               |
| FRP            | 800   | 570               | 1000 <sup>3</sup>                               | 1379 <sup>3</sup> |
| Phenolic       | 1400 <sup>3</sup>                               | 1210 <sup>3</sup> | 1400 <sup>3</sup>                               | 1231 <sup>3</sup> |
| SBR/Steel      | 150 <sup>3</sup>                                | 130               | 140 <sup>3</sup>                                | 239 <sup>3</sup>  |
| Neoprene/Steel | 100   | 90                | 120 <sup>3</sup>                                | 114 <sup>3</sup>  |

<sup>1</sup>Isopropyl Alcohol Wipe. See Surface Preparation Section D for additional information.

<sup>2</sup>Isopropyl Alcohol/Abrade/Isopropyl Alcohol: See Surface Preparation Section E for additional information.

<sup>3</sup>Substrate failure

# 3M™ Scotch-Weld™ Epoxy Adhesives

## DP460 Off-White • DP460NS

Typical  
Adhesive  
Performance  
Characteristics  
(continued)

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

### Substrates and Testing (continued)

#### Environmental Resistance, Aluminum (Etched)

Measured by Overlap Shear Tested @ 73°F (23°C) (PSI)<sup>1</sup> (ASTM D 1002-72)

| Environment                         | Condition  | 3M™ Scotch-Weld™ Epoxy Adhesive |              |
|-------------------------------------|--|---------------------------------|--------------|
|                                     |  | DP460 Off-White                 | DP460NS      |
| 73°F (23°C)/50% RH                  | 30 d <sup>2</sup>  | 5200                            | 5460         |
| Distilled Water                     | 30 d, i <sup>3</sup>                                     | 5100                            | 4550         |
| Water Vapor                         | 120°F (49°C)/100% RH, 30 d<br>200°F (93°C)/100% RH, 14 d | 4500<br>3100                    | 3920<br>3370 |
| Antifreeze/H <sub>2</sub> O (50/50) | 180°F (82°C), 30 d, i                                    | 5000                            | 4400         |
| Isopropyl Alcohol                   | 73°F (23°C), 30 d, i                                     | 5700                            | 5320         |
| Methyl Ethyl Ketone                 | 73°F (23°C), 30 d, i                                     | 4200                            | 4000         |
| Salt Spray (5%)                     | 95°F (35°C), 30 d  | 5100                            | 5200         |
| Skydrol LD-4                        | 150°F (66°C), 30 d, i                                    | 3700                            | 5250         |

<sup>1</sup>Data reported are actual values from the lots tested and may be higher than values published elsewhere in this Technical Data Sheet.

<sup>2</sup>d = days

<sup>3</sup>i = immersion

#### Environmental Resistance, Galvanized Steels<sup>1</sup>

Measured by Overlap Shear Tested @ 73°F (23°C) (PSI)<sup>2</sup> (ASTM D 1002-72)

| Environment                 | Condition  | Hot Dipped  |             | Electrodeposited                                      |             |
|-----------------------------|--|---|-------------|---|-------------|
|                             |  | 3M™ Scotch-Weld™<br>Epoxy Adhesive<br>DP460 Off-White | DP460<br>NS | 3M™ Scotch-Weld™<br>Epoxy Adhesive<br>DP460 Off-White | DP460<br>NS |
| 73°F (23°C)/50% RH          | 30 d <sup>3</sup>  | 2200  | not tested  | 2300  | not tested  |
| Distilled Water             | 30 d, i <sup>4</sup>                                     | 2300  | not tested  | 2300  | not tested  |
| Water Vapor                 | 120°F (49°C)/100% RH, 30 d<br>200°F (93°C)/100% RH, 14 d | 1900<br>1500  | not tested  | 2000<br>1000  | not tested  |
| Antifreeze/H <sub>2</sub> O | 180°F (82°C), 30 d, i                                    | 2000  | not tested  | 1950  | not tested  |
| Isopropyl Alcohol           | 73°F (23°C), 30 d, i                                     | 2000  | not tested  | 2200  | not tested  |
| Methyl Ethyl Ketone         | 73°F (23°C), 30 d, i                                     | 2000  | not tested  | 2200  | not tested  |
| Trichloroethane             | 73°F (23°C), 30 d, i                                     | 2300  | not tested  | 2300  | not tested  |
| Salt Spray (5%)             | 95°F (35°C), 30d   | 1900  | not tested  | 1500  | not tested  |

<sup>1</sup>Hot dipped or electrodeposited. Galvanized steels may afford a wide spectrum of performance due to the diversity of surfaces available. The user should test to determine specific performance.

<sup>2</sup>Data reported are actual values from the lots tested and may be higher than values published elsewhere in this Technical Data Sheet.

<sup>3</sup>d = days

<sup>4</sup>i = immersion

# 3M™ Scotch-Weld™ Epoxy Adhesives

## DP460 Off-White • DP460NS

3M™ EPX™  
Pneumatic  
Applicator  
Delivery Rates

200 ml Applicator – Maximum Pressure 58 psi

| Adhesive*                                       | 6mm Nozzle<br>gms/minute | 10mm Nozzle<br>gms/minute |
|---|--------------------------|---------------------------|
| 3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White | 31.1                     | 132.0                     |

\*Tests were run at a temperature of 70°F ± 2°F (21°C ± 1°C) and at maximum applicator pressure.

Handling/  
Application  
Information

### Directions for Use

3M™ Scotch-Weld™ Epoxy Adhesives DP460 Off-White and DP460 NS are supplied in dual syringe plastic duo-pak cartridges as part of the 3M™ EPX™ Applicator System. The duo-pak cartridges are supplied in 37 ml, 200 ml and 400 ml configurations. To use the 37 ml cartridge simply insert the duo-pak cartridge into the EPX applicator and start the plunger into the cylinders using light pressure on the trigger. Next, remove the duo-pak cartridge cap and expel a small amount of adhesive to be sure both sides of the duo-pak cartridge are flowing evenly and freely. If simultaneous mixing of Part A and Part B is desired, attach the EPX mixing nozzle to the duo-pak cartridge and begin dispensing the adhesive.

With the 200 ml and 400 ml cartridges, the nozzle must be attached before dispensing any material to prevent unmixed adhesive from getting into the applicator cartridge holder. A small quantity of material should be discarded until uniform color, consistency of product and even flow is evident.

When mixing Part A and Part B manually, the components must be mixed in the ratio indicated in the typical uncured properties section. Complete mixing of the two components is required to obtain optimum properties.

Two-part mixing/proportioning/dispensing equipment is available for intermittent or production line use. These systems are ideal for line uses because of their variable shot size and flow rate characteristics and are adaptable to most applications.

# 3M™ Scotch-Weld™ Epoxy Adhesives

## DP460 Off-White • DP460NS

### Surface Preparation

The following surface preparations were used for substrates described in this Technical Data Sheet.

#### A. Aluminum Etch

Optimized FPL Etch - 3M (test method C-2803)

1. Alkaline degrease – Oakite 164 solution (9-11 oz./gallon water) at 190°F ± 10°F (88°C ± 5°C) for 10-20 minutes. Rinse immediately in large quantities of cold running water (3M test method C-2802).

2. Optimized FPL Etch Solution (1 liter):

| Material          | Amount                                   |
|-------------------|--|
| Distilled Water   | 700 ml plus balance of liter (see below) |
| Sodium Dichromate | 28 to 67.3 grams                         |
| Sulfuric Acid     | 287.9 to 310.0 grams                     |
| Aluminum Chips    | 1.5 grams/liter of mixed solution        |

To prepare 1 liter of this solution, dissolve sodium dichromate in 700 ml of distilled water. Add sulfuric acid and mix well. Add additional distilled water to fill to 1 liter. Heat mixed solution to 66 to 71°C (150 to 160°F). Dissolve 1.5 grams of 2024 bare aluminum chips per liter of mixed solution. Gentle agitation will help aluminum dissolve in about 24 hours.

To FPL etch panels, place them in the above solution at 150 to 160°F (66 to 71°C) for 12 to 15 minutes.

Note: Review and follow precautionary information provided by chemical suppliers prior to preparation of this etch solution.

3. Rinse immediately in large quantities of clear running tap water.
4. Dry – air dry approximately 15 minutes followed by force dry at 140°F (60°C) maximum for 10 minutes (minimum).
5. Both surface structure and chemistry play a significant role in determining the strength and permanence of bonded structures. It is therefore advisable to bond or prime freshly primed clean surfaces as soon as possible after surface preparation in order to avoid contamination and/or mechanical damage. Please contact your 3M sales representative for primer recommendations.

#### B. Oakite Degrease

Oakite 164 solutions (9-11 oz./gallon of water) at 190°F ± 10°F (88°C ± 5°C) for 2 minutes. Rinse immediately in large quantities of cold running water.

#### C. MEK/Abrade/MEK

Wipe surface with a methyl ethyl ketone (MEK) soaked swab, abrade and wipe with a MEK soaked swab.\* Allow solvent to evaporate before applying adhesive.

#### D. Isopropyl Alcohol Wipe

Wipe surface with an isopropyl alcohol soaked swab.\* Allow solvent to evaporate before applying adhesive.

#### E. Isopropyl Alcohol/Abrade/Isopropyl Alcohol

Wipe surface with an isopropyl alcohol soaked swab, abrade using clean fine grit abrasives, and wipe with an isopropyl alcohol soaked swab.\* Then allow solvent to evaporate before applying adhesive.

\*Note: When using solvents, extinguish all ignition sources, including pilot lights, and follow the manufacturer's precautions and directions for use.

# 3M™ Scotch-Weld™ Epoxy Adhesives

## DP460 Off-White • DP460NS

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### Storage

Store products at 60-80°F (15-27°C) for maximum shelf life.

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### Shelf Life

These products have a shelf life of 15 months in original containers at room temperature. Bulk containers have a shelf life of 2 years in their unopened containers.

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### Technical Information

The technical information, guidance, and other statements contained in this document or otherwise provided by 3M are based upon records, tests, or experience that 3M believes to be reliable, but the accuracy, completeness, and representative nature of such information is not guaranteed. Such information is intended for people with knowledge and technical skills sufficient to assess and apply their own informed judgment to the information. No license under any 3M or third party intellectual property rights is granted or implied with this information.

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Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. As a result, customer is solely responsible for evaluating the product and determining whether it is appropriate and suitable for customer's application, including conducting a workplace hazard assessment and reviewing all applicable regulations and standards (e.g., OSHA, ANSI, etc.). Failure to properly evaluate, select, and use a 3M product and appropriate safety products, or to meet all applicable safety regulations, may result in injury, sickness, death, and/or harm to property.

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**ISO 9001**

This Industrial Adhesives and Tapes Division product was manufactured under a 3M quality system registered to ISO 9001 standards.



Industrial Adhesives and Tapes Division

3M Center, Building 225-3S-06  
St. Paul, MN 55144-100  
800-362-3550 977-369-2923 ( Fax)  
[www.3M.com/structuraladhesives](http://www.3M.com/structuraladhesives)

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