3M Scotch-Weld™ Epoxy Adhesives

DP460 Off-White • DP460 NS

Technical Data **May, 2015**

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
- Outstanding environmental performance
- Easy mixing
- Controlled flow
- 60 minute worklife
- Non sag (Scotch-Weld DP460 NS)

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

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

Typical Cured Thermal Properties

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Product	3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White	3M™ Scotch-Weld™ Epoxy Adhesive DP460NS
Physical Color	Opaque, off-white	Off-white
Shore D Hardness	75-80	78-84
Thermal Coefficient of Thermal Expansion Below Tg Above Tg (in./in./°C)	59 x 10^{-6} 159 x 10^{-6}	74.44 x 10^{-6} 166 x 10^{-6}
Thermal Conductivity (btu - ft./ft.^{2} - 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^{14} ohm-cm	3.25 x 10^{15} 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)
Scotch-Weld Epoxy Adhesive DP460 Off-White

Time in Oven	Cure Temperature		
	73°F (23°C)	120°F[1] (49°C)	140°F[1] (60°C)
30 min.	—	<50	3000/60[2]
60	—	1300	4500/60[2]
90	—	4300/60[2]	—
2 hr.	—	4400/60[2]	4800
3	—	4800/60[2]	—
5	400	—	—
6	1000	—	—
7	3500	—	—
24	4000/60[2]		

Scotch-Weld Epoxy Adhesive DP460 NS

Time in Oven	Cure Temperature		
	73°F (23°C)	120°F[1] (49°C)	160°F[1] (71°C)
15 min.	—	–	4860
30	—	10	5250
60	—	2800	5300
2 hr.	1	5050	5470
4	46	5400	5320
6	970	5570	5140
24	4500	–	5210

[1]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.

[2]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.

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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 DP460 NS
-67°F (-55°C)	4500	4900
73°F (23°C)	4500	4650
180°F (82°C) (15 min.)[1]	700	1360
(30 min.)[1]	1000	1810
(60 min.)[1]	1400	2630
(4 hr.)[1]	2500	2680
250°F (121°C) (15 min.)[1]	220	420

[1]Represents time in test chamber oven before test.

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

		Scotch-Weld Epoxy Adhesive DP460 Off-White	Scotch-Weld Epoxy Adhesive DP460 NS
Aluminum	Etched	4500	4500
	Oakite degrease	3200	2300
	MEK/abrade/MEK	3500	2670
Cold Rolled Steel	Oakite degrease	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 degrease		
	Hot dipped	2000	2480
	Electrodeposited	2100	3000

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)*

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)

		3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White	3M™ Scotch-Weld™ Epoxy Adhesive DP460NS
Aluminum, etched	17-20 mil bondline	60	not tested
	5-8 mil bondline	50	
Cold Rolled Steel	17-20 mil bondline Oakite degreased	40	not tested
	MEK/abrade/MEK	25	

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

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

[1]Isopropyl Alcohol Wipe. See Surface Preparation Section D for additional information.

[2]Isopropyl Alcohol/Abrade/Isopropyl Alcohol: See Surface Preparation Section E for additional information.

[3]Substrate failure

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)[1] (ASTM D 1002-72)

Environment	Condition	3M™ Scotch-Weld™ Epoxy Adhesive DP460 Off-White	3M™ Scotch-Weld™ Epoxy Adhesive DP460NS
73°F (23°C)/50% RH	30 d[2]	5200	5460
Distilled Water	30 d, i[3]	5100	4550
Water Vapor	120°F (49°C)/100% RH, 30 d 200°F (93°C)/100% RH, 14 d	4500 3100	3920 3370
Antifreeze/H_2O (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

[1]Data reported are actual values from the lots tested and may be higher than values published elsewhere in this Technical Data Sheet.
[2]d = days
[3]i = immersion

Environmental Resistance
Galvanized Steels[1]
Measured by Overlap Shear Tested @ 73°F (23°C) (PSI)[2] (ASTM D 1002-72)

Environment	Condition	Hot Dipped		Electrodeposited	
		Scotch-Weld Epoxy Adhesive DP460 Off-White	Scotch-Weld Epoxy Adhesive DP460 NS	Scotch-Weld Epoxy Adhesive DP460 Off-White	Scotch-Weld Epoxy Adhesive DP460 NS
73°F (23°C)/50% RH	30 d[3]	2200	not tested	2300	not tested
Distilled Water	30 d, i[4]	2300	not tested	2300	not tested
Water Vapor	120°F (49°C)/100% RH, 30 d 200°F (93°C)/100% RH, 14 d	1900 1500	not tested	2000 1000	not tested
Antifreeze/H_2O (50/50)	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

[1]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.
[2]Data reported are actual values from the lots tested and may be higher than values published elsewhere in this Technical Data Sheet.
[3]d = days
[4]i = immersion

3M™ Scotch-Weld™
Epoxy Adhesives
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3M™ EPX™

Pneumatic Applicator Delivery Rates

200 ml Applicator – Maximum Pressure 58 psi

Adhesive*	6mm Nozzle gms/minute	10mm Nozzle 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.

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.

Storage

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

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.

Precautionary Information

Refer to Product Label and Material Safety Data Sheet for health and safety information before using this product. For additional health and safety information, call 1-800-364-3577 or (651) 737-6501.

For Additional Information

To request additional product information or to arrange for sales assistance, call toll free 1-800-362-3550 or visit www.3M.com/adhesives. Address correspondence to: 3M Industrial Adhesives and Tapes Division, Building 21-1W-10, 900 Bush Avenue, St. Paul, MN 55144-1000. Our fax number is 651-778-4244. In Canada, phone: 1-800-364-3577. In Puerto Rico, phone: 1-787-750-3000. In Mexico, phone: 52-70-04-00.

Product Use

All statements, technical information and recommendations contained in this document are based upon tests or experience that 3M believes are reliable. However, many factors beyond 3M's control can affect the use and performance of a 3M product in a particular application, including the conditions under which the product is used and the time and environmental conditions in which the product is expected to perform. Since these factors are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for the user's method of application.

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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.

3M
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

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Тел: +7 (812) 336 43 04 (многоканальный)
Email: org@lifeelectronics.ru

www.lifeelectronics.ru