## 3M Scotch-Weld<sup>™</sup> Epoxy Adhesives DP460 Off-White and DP460NS

Technical Data Sheet         Product Description       3M™ Scotch-Weld™ Epoxy Ad are high performance, two-part shear and peel adhesion, and vertex		January 2019	
		thesives DP460 Off-White and DP460NS t epoxy adhesives offering outstanding ery high levels of durability.	
Features	<ul> <li>High shear strength</li> <li>60 minute work life</li> <li>Easy mixing</li> </ul>	<ul><li>High peel strength</li><li>Non sag (DP460NS)</li></ul>	

<b>Typical Uncured</b>
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.)	Base	20,000-50,000 cps	150,000-275,000 cps
@ 73°F (23°C)	Accelerator	8,000-14,000 cps	8,000-14,000 cps
Base Resin	Base	epoxy	epoxy
	Accelerator	amine	amine
Color	Base	white	white
	Accelerator	amber	amber
Net Weight	Base	9.3-9.7	9.3-9.7
Lbs./Gallon	Accelerator	8.8-9.2	8.8-9.2
Mix Ratio (B:A)	Volume	2:1	2:1
	Weight	2:0.96	2:0.96
Work life, 73°F (23°C)	20 g mixed	60 minutes	60 minutes
	10 g mixed	75 minutes	60 minutes
	5 g mixed	90 minutes	60 minutes

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 Below Tg Thermal Expansion Above Tg (in./in./°C)	59 x 10 <sup>-6</sup> 159 x 10 <sup>-6</sup>	74.44 x 10 <sup>-6</sup> 166 x 10 <sup>-6</sup>
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 <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<sup>™</sup>Scotch-Weld<sup>™</sup> 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 60 90		<50 1300 4300/60 <sup>2</sup>	3000/60 <sup>2</sup> 4500/60 <sup>2</sup>
2 hours 3 5 6 7 24		4400/60 <sup>2</sup> 4800/60 <sup>2</sup> — — —	4800 — — — — —

3M<sup>™</sup>Scotch-Weld<sup>™</sup> 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 30	_	10	4860 5250
60 0 h auna		2800	5300
2 nours 4	46	5050	5320
6 24	970 4500	5570 —	5140 5210

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.

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<sup>™</sup> EPX Applicator System equipped with an EPX static mixer, according to manufacturer's directions. Thorough hand-mixing will afford comparable results.

TypicalNote: The following technical information and data should be consideredAdhesiverepresentative or typical only and should not be used for specification purposes.PerformanceSubstrates 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 Oakite degreased MEK/abrade/MEK	4500 3200 3500	4500 2300 2670
Cold Rolled Steel	Oakite degreased MEK/abrade/MEK	3500 2800	3600
Copper	MEK/abrade/MEK	4000	4400
Brass	MEK/abrade/MEK CDA 260 Cartridge	4000 4200	3400 
Stainless Steel	MEK/abrade/MEK	4000	2400
Galvanized Steel -	Oakite degreased Hot dipped Electrodeposited	2000 2100	2480 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

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 5-8 mil bondline	60 50	not tested
Cold Rolled Steel	17-20 mil bondline Oakite degreased MEK/abrade/MEK	40 25	not tested

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

	3M™ Scotch-Weld™
lemperature	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> 3M™ Scotch-Weld™ Epoxy Adhesive		Surf. Prep. <sup>2</sup> 3M™ Scotch-Weld™ Epoxy Adhesiv 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
Polystryene	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

strate 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)<sup>1</sup> (ASTM D 1002-72)

		3M™ Scotch-Weld™ Epoxy Adhesive	
Environment	Condition	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 200°F (93°C)/100% RH, 14 d	4500 3100	3920 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

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

		Hot D	ipped	Electrod	eposited
Environment	Condition	3M™ Scot Epoxy A DP460 Off-White	ch-Weld™ dhesive DP460 NS	3M™ Scot Epoxy A DP460 Off-White	cch-Weld™ Adhesive DP460 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 200°F (93°C)/100% RH, 14 d	1900 1500	not tested	2000 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<sup>™</sup> EPX Pneumatic Applicator Delivery Rates

#### 200 ml Applicator - Maximum Pressure 58 psi

Adhesive*	6mm Nozzle gms/minute	10mm Nozzle gms/minute
3M <sup>™</sup> Scotch-Weld <sup>™</sup> 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<sup>™</sup> Scotch-Weld<sup>™</sup> Epoxy Adhesives DP460 Off-White and DP460 NS are supplied in dual syringe plastic duo-pak cartridges as part of the 3M<sup>™</sup> 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.

Curfe e e Dren e retiere	<b>T</b> I.		and the state of t
Surface Preparation	Tec	e following surface preparatio	ns were used for substrates described in this
	Δ	Aluminum Etch	
		Optimized EPL Etch - 3M (te	st method C-2803)
		1 Alkalina degrease – Oak	ite 164 solution (9-11 oz (gallon water) at 190°E +
		10°F (88°C ± 5°C) for 10	-20 minutes Rinse immediately in large quantities
		of cold running water (3	M test method C-2802).
		2 Optimized EPL Etch Solut	ion (1 liter):
		Matorial	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 s distilled water. Add sulfu to fill to 1 liter. Heat mixe 1.5 grams of 2024 bare a agitation will help alumir	solution, dissolve sodium dichromate in 700 ml of ric acid and mix well. Add additional distilled water d solution to 66 to 71°C (150 to 160°F). Dissolve Iluminum chips per liter of mixed solution. Gentle hum dissolve in about 24 hours.
		To FPL etch panels, plac 71°C) for 12 to 15 minute	e them in the above solution at 150 to 160°F (66 to s.
		Note: Review and follow chemical supplier	precautionary information provided by prior to preparation of this etch solution.
		3. Rinse immediately in larg	e quantities of clear running tap water.
		4. Dry – air dry approxima (60°C) maximum for 10	ely 15 minutes followed by force dry at 140°F minutes (minimum).
		5. Both surface structure a the strength and perman to bond or prime freshly surface preparation in o damage. Please contact recommendations.	nd chemistry play a significant role in determining nence of bonded structures. It is therefore advisable primed clean surfaces as soon as possible after rder to avoid contamination and/or mechanical your 3M sales representative for primer
	В.	Oakite Degrease	
		Oakite 164 solutions (9-11 oz minutes. Rinse immediately	./gallon of water) at 190°F ± 10°F (88°C ± 5°C) for 2 n large quantities of cold running water.
	C.	MEK/Abrade/MEK	
		Wipe surface with a methyl with a MEK soaked swab.* A	ethyl ketone (MEK) soaked swab, abrade and wipe Illow solvent to evaporate before applying adhesive.
	D.	Isopropyl Alcohol Wipe	
		Wipe surface with an isoproperty before applying adhesive.	byl alcohol soaked swab.* Allow solvent to evaporate
	E.	Isopropyl Alcohol/Abrade/I Wipe surface with an isoprop abrasives, and wipe with an to evaporate before applying	sopropyl Alcohol byl alcohol soaked swab, abrade using clean fine grit isopropyl alcohol soaked swab.* Then allow solvent g adhesive.

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

These products have a shelf life of 24 months from date of manufacture in original containers at room temperature 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		
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		
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.		
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.		
Unless a different warranty is specifically stated on the applicable 3M product packaging or product literature (in which case such warranty governs), 3M warrants that each 3M product meets the applicable 3M product specification at the time 3M ships the product. 3M MAKES NO OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ARISING OUT OF A COURSE OF DEALING, CUSTOM, OR USAGE OF TRADE. If a 3M product does not conform to this warranty, then the sole and exclusive remedy is, at 3M's option, replacement of the 3M product or refund of the purchase price.		
Except for the limited remedy stated above, and except to the extent prohibited by law, 3M will not be liable for any loss or damage arising from or related to the 3M product, whether direct, indirect, special, incidental, or consequential (including, but not limited to, lost profits or business opportunity), regardless of the legal or equitable theory asserted, including, but not limited to, warranty, contract, negligence, or strict liability.		
E I I I I I I I		

on product was manufactured under a 3M quality sys egi

**3**M

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

3M and Scotch-Weld are trademarks of 3M Company. ©3M 2017 (9/17)

### **Mouser Electronics**

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

**3M**:

DP460NS-200ML DP460-200ML 460-OFFWHITE-1Q-PARTAB