

3M

Scotch-Weld™

Epoxy Adhesive

DP-4XL

Technical Data

June, 1999

Product Description

Scotch-Weld™ Epoxy Adhesive DP-4XL is a high performance, two-part epoxy adhesive offering outstanding shear and peel adhesion, and very high levels of durability. DP-4XL has 5 to 6 hours of worklife to allow for repositioning and fixturing of large parts. DP-4XL will gain handling strength after 24 hours at room temperature 73°F (23°C) and fully cure at RT within several days. Alternatively, DP-4XL can be cured immediately at elevated temperature.

Features

- High shear strength
- High peel strength
- Outstanding environmental performance
- Easy mixing
- 5-6 hour worklife
- Can be heat cured

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		DP-4XL Adhesive
Viscosity (approx.) @ 73°F (23°C)	Base Accelerator	30,000-35,000 cps 15,000 cps
Base Resin	Base Accelerator	epoxy amine
Color	Base Accelerator	white amber
Net Weight Lbs./Gallon	Base Accelerator	9.4 8.7
Mix Ratio (B:A)	Volume Weight	2:1 2:0.1
Worklife, 73°F (23°C)	20 g mixed 10 g mixed 5 g mixed	5-6 hours 5-6 hours 5-6 hours
Handling Strength (50 psi or greater overlap shear, ASTM D 1002-72)		24 hrs @ 73°F (23°C) 180 min @ 120°F (49°C) 60 min @ 160°F (71°C) 5 min @ 250°F (121°C)

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**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	DP-4XL Adhesive	
Physical Color	Off-white	
Shore D Hardness	81-87	
Thermal Coefficient of Thermal Expansion (in./in./°C)	Below Tg	73 x 10 ⁻⁶
	Above Tg	205 x 10 ⁻⁶
Glass Transition Temperature via TMA	139F (59°C)	
Electrical Dielectric Strength (ASTM D 149)	1049 volts/mil	
Volume Resistivity (ASTM D 257)	8.9 x 10 ¹⁵ ohm-cm	

**Handling/Application
 Information**

Directions for Use

Scotch-Weld Epoxy Adhesive DP-4XL is supplied in a dual syringe plastic Duo-Pak cartridge 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 of this Technical Data Sheet (page 1). 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.

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Surface Preparation

For high strength structural bonds, paint, oxide films, oils, dust, mold release agents and all other surface contaminants must be completely removed. However, the amount of surface preparation directly depends on the required bond strength and the environmental aging resistance desired by user.

The following cleaning methods are suggested for common surfaces.

Steel or Aluminum (Mechanical Abrasion)

1. Wipe free of dust with oil-free solvent such as acetone or alcohol solvents.*
2. Sandblast or abrade using clean fine grit abrasives (180 grit or finer).
3. Wipe again with solvents to remove loose particles.
4. If a primer is used, it should be applied within 4 hours after surface preparation. If 3M™ Scotch-Weld™ Structural Adhesive Primer EC-1945 B/A is used, apply a thin coating (0.0005") on the metal surfaces to be bonded, air dry for 10 minutes, then cure for 30 minutes at 180°F (82°C) prior to bonding.

***Note:** When using solvents, extinguish all ignition sources and follow the manufacturer's precautions and directions for use. Use solvents in accordance with local regulations.

Aluminum (Chemical Etch)

Aluminum alloys may be chemically cleaned and etched as per ASTM D 2651. This procedure states to:

1. Alkaline Degrease – Oakite 164 solution (9-11 oz/gal of water) at 190°F ± 10°F (88°C ± 5°C) for 10-20 minutes. Rinse immediately in large quantities of cold running water.
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 150 to 160°F (66 to 71°C). 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 etch aluminum panels, place them in FPL etch solution heated to 150 to 160°F (66 to 71°C). Panels should soak for 12 to 15 minutes.

***Note:** Review and follow suppliers environmental health and safety recommendations prior to preparation of this etch solution.

3. Rinse: Rinse panels in clear running tap water.
4. Dry: Air dry 15 minutes; force dry 10 minutes (minimum) at 140°F (60°C) maximum.
5. If primer is to be used, it should be applied within 4 hours after surface preparation.

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Surface Preparation (continued)

Plastics/Rubber

1. Wipe with isopropyl alcohol.*
2. Abrade using fine grit abrasives (180 grit or finer).
3. Wipe with isopropyl alcohol.*

Glass

1. Solvent wipe surface using acetone or MEK.*
2. Apply a thin coating (0.0001 in. or less) of 3M™ Scotch-Weld™ Structural Adhesive Primer EC-3901 to the glass surfaces to be bonded and allow the primer to dry a minimum of 30 minutes @ 75°F (24°C) before bonding.

***Note:** When using solvents, extinguish all ignition sources and follow the manufacturer's precautions and directions for use. Use solvents in accordance with local regulations.

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 2024 T-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. 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) (3 week room temperature cure 73°F [23°C])

	DP-4XL Adhesive
-67°F (-55°C)	2800
73°F (23°C)	4880
180°F (82°C) (15 min.) ¹	440
180°F (82°C) (30 min.) ¹	630
180°F (82°C) (60 min.) ¹	1240
180°F (82°C) (4 hr.) ¹	2400
250°F (121°C) (15 min.) ¹	280

¹Represents time in test chamber oven before test.

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**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)

Metals, Overlap Shear, Tested @ 73°F (23°C) (PSI) (ASTM D 1002-72)

		DP-4XL Adhesive
Aluminum-	Etched	4740
	Oakite degrease	5020
	MEK/abrade/MEK	4300
Cold Rolled Steel-	MEK/abrade/MEK	3400
Copper-	MEK/abrade/MEK	3200
Brass-	MEK/abrade/MEK	2500
Stainless Steel-	MEK/abrade/MEK	2900
Galvanized Steel-	Oakite degrease	2900
	Hot dipped	

Other Substrates, Overlap Shear Tested @ 73°F (23°C) (ASTM D 1002-72)

(Samples tested after 4 week, room temperature cure)

Substrate	Surface Preparation¹	Surface Preparation²
	DP-4XL Adhesive	DP-4XL Adhesive
ABS	700*	860*
PVC	570*	500*
Polycarbonate	460	570
Polyacrylic	350	330
Polystyrene	540	600*
FRP	860	1300*
Phenolic	1310*	1390*
SBR/Steel	75	190
Neoprene/Steel	37	30

¹Isopropyl Alcohol Wipe. See Surface Preparation Section (Part D) of this Technical Data Sheet for additional information.

²Isopropyl Alcohol/Abrade/Isopropyl Alcohol: See Surface Preparation Section (Part E) of this Technical Data Sheet for additional information.

*Substrate failure.

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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)
(Samples tested after 4 week, room temperature cure)**

Environment	Condition	DP-4XL Adhesive
73°F (23°C)/50% RH	30 d ²	5000
Distilled Water	30 d, i ³	4950
Water Vapor	120°F (49°C)/100% RH, 30 d 200°F (93°C)/100% RH, 14 d	5220 4625
Antifreeze/H ₂ O (50/50)	180°F (82°C), 30 d, i	5200
Isopropyl Alcohol	73°F (23°C), 30 d, i	5100
Methyl Ethyl Ketone	73°F (23°C), 30 d, i	4300
Salt Spray (5%)	95°F (35°C), 30 d	5100
Skydrol LD-4	150°F (66°C), 30 d, i	5240

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

²d = days

³i = immersion

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 (ASTM D 1002-72)

Bonds Tested at 73°F (23°C)

DP-4XL Heat Cured 24 Hours After Application

Time at Temperature (minutes)	Cure Temperature		
	120°F (49°C) (Tested immediately after cure cycle/ tested 1 week after cure cycle)	160°F (71°C) (Tested immediately after cure cycle/ tested 1 week after cure cycle)	250°F (121°C) (Tested immediately after cure cycle/ tested 1 week after cure cycle)
5	1160 / NA psi	1740 / NA psi	4050 / NA psi
10	1190 / 4245	2385 / 4040	5275 / 5495
20	1355 / NA	3480 / NA	5910 / NA
30	1050 / 4150	3410 / 4675	6115 / 5720
60	2125 / 4435	5090 / 5210	6150 / 5715
120	3255 / NA	5880 / NA	5985 / NA
180	3980 / NA	5595 / NA	NA / NA
240	4520 / NA	5345 / NA	NA / NA
300	4875 / NA	5355 / NA	NA / NA

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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 (continued)

DP-4XL Heat Cured Immediately After Application

Time at Temperature (minutes)	Cure Temperature		
	120°F (49°C) (Tested immediately after cure cycle/ tested 1 week after cure cycle)	160°F (71°C) (Tested immediately after cure cycle/ tested 1 week after cure cycle)	250°F (121°C) (Tested immediately after cure cycle/ tested 1 week after cure cycle)
5	0 / NA psi	0 / NA psi	120 / NA psi
10	5 / 4545	5 / 4900	3895 / 5275
20	5 / NA	5 / NA	5905 / NA
30	5 / 4670	30 / 4665	5500 / 6140
60	5 / 4575	2445 / 4775	5775 / 5855
120	15 / NA	5150 / NA	5905 / NA
180	385 / NA	5660 / NA	NA / NA
240	2195 / NA	5775 / NA	NA / NA
300	3650 / NA	5895 / NA	NA / NA

Rate of Strength Build-Up

Aluminum, T-Peel (ASTM D 1876-61T)

Bonds Tested at 73°F (23°C)

Time at Temperature (minutes)	Cure Temperature		
	120°F (49°C) (Cured immediately/ allowed 24 hrs at 73°F [23°C] before heat cure)	160°F (71°C) (Cured immediately/ allowed 24 hrs at 73°F [23°C] before heat cure)	250°F (121°C) (Cured immediately/ allowed 24 hrs at 73°F [23°C] before heat cure)
5	0 / 0 piw	0 / 0 piw	0 / 0 piw
10	0 / 0	0 / 0	49 / 62
20	0 / 0	0 / 0	56 / 67
30	0 / 0	0 / 3.5	65 / 47
60	0 / 0	10 / 66	58 / 53
120	0 / 2	61 / 68	55 / 47

Aluminum Bell Peel (ASTM D 3167)

Bonds Tested at 73°F (23°C)

Time at Temperature (minutes)	Cure Temperature		
	120°F (49°C) (Cured immediately/ allowed 24 hrs at 73°F [23°C] before heat cure)	160°F (71°C) (Cured immediately/ allowed 24 hrs at 73°F [23°C] before heat cure)	250°F (121°C) (Cured immediately/ allowed 24 hrs at 73°F [23°C] before heat cure)
5	0 / 0 piw	0 / 0 piw	0 / 0 piw
10	0 / 0	0 / 0	0 / 0
20	0 / 0	0 / 0	0 / 0
30	0 / 3	0 / 55	69 / 72
60	0 / 6	0 / 75	64 / 67
120	0 / 25	69 / 82	49 / 73

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Storage and Shelf Life

Storage: Store products at 60-80°F (15-27°C) or refrigerate for maximum shelf life.
Shelf Life: These products have a shelf life of 12 months in original containers.

Precautionary Information

Refer to Product Label and Material Safety Data Sheet for Health and Safety Information before using this product.

For Additional Information

To request additional product information or to arrange for sales assistance, call toll free 1-800-362-3550. Address correspondence to: 3M Adhesives Division, 3M Center, Building 220-8E-05, St. Paul, MN 55144-1000. Our fax number is 651-733-9175. In Canada, phone: 1-800-364-3577. In Puerto Rico, phone: 1-787-750-3000. In Mexico, phone: 5-270-2180.

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ISO 9002

This Adhesives Division product was manufactured under a 3M quality system registered to ISO 9002 standards.

For Additional Product Safety and Health Information, See Material Safety Data Sheet, or call:

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Adhesives Division

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