3M

Scotch-Weld™

Epoxy Adhesive

EC-3501 B/A, Gray

Technical Datasheet **July 2009**

Product Description

3M™ Scotch-Weld™ Epoxy Adhesive EC-3501 B/A Gray is a rapid, room temperature curing, two-part epoxy adhesive for use in bonding many metals, wood, and a variety of plastics. Equal parts by volume are easily mixed to produce strong, impact-resistant bonds.

Features

- Two-part room temperature curing structural adhesive with high shear strength.
- Fast cure.
- Controlled flow/thixotropic.
- Good environmental resistance.
- Excellent for bonding metal, wood, most plastics and masonry products.

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.

Scotch-Weld EC-3501 B/A Adhesive	Base	Accelerator
Color	White	Black
Base Resin	Epoxy	Amine
Viscosity Press Flow @ 75°F (24°C) Seconds to deliver 20 gms. at 60 psi through .104" orifice	20 - 35	40 - 55
Viscosity (Centipoise) Brookfield RVF, #7 spindle, 2 RPM at 75°F (24°C)	> 1,000,000	> 1,000,000
Net Weight (lbs./gal.)	12.6 ± .2	11.9 ± .2
Mix Ratio (B:A) Volume (By Weight) Weight	1 : 1 1.05 : 1	
Work Life at 75°F (24°C)	6-10 minutes for 20.5 grams mass	

3M™ Scotch-Weld™
Epoxy Adhesive EC-3501 B/A, Gray
Technical Datasheet

Typical Cured Properties

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

Physical

Color	Gray
Shore D Hardness	75-80

Thermal

Thermal Coefficient of Expansion (in/in/°C)	60 x 10^{-6} (-50 to -10°C range) 234 x 10^{-6} (-50 to -110°C range)
Thermal Conductivity **btu - ft./ft.^{2} - hr. - °F**	0.193

Electrical

Dielectric Strength	700 volts/mil
Volume Resistivity	1.2 x 10^{13} ohm - cm

Handling/Curing Information

Directions For Use

1. For high strength structural bonds, paint, oxide films, oils, dust, mold release agents and all other surface contaminants must be removed.* The amount of surface preparation depends on the user's required bond strength, and environmental aging resistance. For specific surface preparations on common substrates, see the following section on Surface Preparation.
2. This product consists of two parts. Measure by weight or volume in proportions specified under Typical Uncured Physical Properties section and mix thoroughly. Resulting color should be uniform. Properly reseal containers. Do not inter-change lids or caps of parts A & B or curing may occur.
3. For maximum bond strength, apply product evenly to both surfaces to be joined.
4. Application to the substrates should be made within 6 minutes. Larger quantities and/or higher temperatures will reduce this working time.
5. Join the adhesive coated surfaces and allow to cure at 60°F (16°C) or above until completely firm. Handling strength will be obtained in 20-30 minutes at 75°F (24°C) and a full cure in 24 hours.
6. Keep parts from moving during cure. Contact pressure is necessary. Maximum shear strength is obtained with a 3-5 mil bond line.

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

Application and Equipment Suggestions

These products may be applied by spatula, trowel or flow equipment.

Two part mixing/proportioning/dispensing equipment is available for intermittent or production line use. These systems are ideal because of their variable shot size and flow rate characteristics and are adaptable to most applications. For more information, contact your local 3M sales representative.

Surface Preparation

A thoroughly cleaned, dry, grease-free surface is essential for maximum performance. Cleaning methods that produce a break free water film on metal surfaces are generally satisfactory.

A. Aluminum:

1. Alkaline degrease - Oakite® Aluminum Cleaner 164 solution 9-11 oz./gallon of water at 190° ± 10°F for 10 to 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

Note: Review and follow safety and precautionary information provided by chemical supplier prior to preparation of this etch 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 FPL etch panels, place them in the above solution at 150 to 160°F (66 to 71°C) for 12 to 15 minutes.

3. Rinse immediately in large quantities of clear running tap water.
4. Dry – Air dry approximately 15 minutes followed by a force dry at 140°F (60°C) [maximum].
5. Current theory suggests that both surface structure and chemistry play a significant role in determining the strength and permanence of bonded structure.

   It is therefore advisable to bond or prime freshly cleaned surfaces as early as possible after preparing to avoid contamination and/or mechanical damage.

B. Aluminum Honeycomb Core

1. Soak in clean aliphatic naphtha (conforming to TT-N-95A) for five minutes at room temperature. Dry 10 minutes at 140°F (60°C) [maximum].
2. Optional - Immerse in etching solution above for 2 minutes 155 ± 5°F. Rinse, air dry and force dry in a similar manner to skins.

Typical Performance Characteristics

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

A. Aluminum Overlap Shear

Overlap shear strength was measured on FPL etched 1" wide by 1/2" overlap specimens. The bonds were made from 2 panels of 4" x 7" x .063", 2024 T-3 clad aluminum bonded together and cut into 1" wide specimens. The separation rate of the testing jaws was .1"/minute. Tests similar to ASTM D-1002.

Test Temp	Overlap Shear (PSI)
-67°F (-55°C)	1500
75°F (24°C)	2400
180°F (82°C)	300

B. Steel Overlap Shear

Overlap shear strength was measured on 1" wide by 1/2" overlap bonds of .035" cold rolled steel. The steel was prepared by MEK solvent wiping, abrading and MEK wiping. The separation rate of the testing jaws was .1"/minute. Tests similar to ASTM D-1002.

Test Temp	Overlap Shear (PSI)
-67°F (-55°C)	1000
75°F (24°C)	2000
180°F (82°C)	150

C. Aluminum T-Peel

T-Peel bonds were measured on 1" wide specimens cut from two FPL etched 8" x 8" x .032", 2024 T-3 clad aluminum panels bonded together. The separation rate of the testing jaws was 20"/minute. Tests similar to ASTM D-1876.

Test Temp	T-Peel (PIW)
75°F (24°C)	4

D Steel T-Peel

T-Peel bonds were measured on two 1" wide specimens of .035" cold rolled steel bonded together. The steel was prepared by MEK wiping, abrading and MEK wiping. The separation rate of the testing jaws was 20"/minutes. Tests similar to ASTM D-1876.

Test Temp	T-Peel (PIW)
75°F (24°C)	10

Environmental Resistance

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

The following data was developed in overlap shear on 2024 T-3 clad FPL etched aluminum after aging in the following environments for the specified times. Tests similar to ASTM D-1002.

Environment	Time	Test Results 75°F (24°C)
100% Relative Humidity @ 120°F (49°C)	14 days	2030 psi
Salt Spray @ 95°F (35°C)	14 days	1895 psi
Tap Water @ 75°F (24°C)	14 days	1810 psi

Rate of Strength Build-Up

The following data was developed in overlap shear on 2024 T-3 clad FPL etched aluminum. Adhesive was cured at 75°F (24°C) for the times specified. Test similar to ASTM D-1002.

Time	Overlap Shear Strength
20 minutes	400 psi
30 minutes	500 psi
60 minutes	750 psi
90 minutes	900 psi

Storage and Shelf Life

This product has a shelf life of one year from date of shipment when stored at 60-80°F (15-27°C) in its original unopened container. Higher storage temperatures reduce shelf life, whereas lower temperatures cause increased viscosity of a temporary nature.

3M™ Scotch-Weld™
Epoxy Adhesive EC-3501 B/A, Gray
Technical Datasheet

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, please visit www.3M.com/msds or call 1-800-364-3577 or (651) 737-6501.

For Additional Information

In the U.S., call toll free 1-800-235-2376, or fax 1-800-435-3082 or 651-737-2171. For U.S. Military, call 1-866-556-5714. If you are outside of the U.S., please contact your nearest 3M office or one of the following branches:

Australia	**Austria**	**Brazil**	**Canada**
61-2-498-9711 tel	01-86686-298 tel	55 19 3838-7876 tel	800-410-6880 ext. 6018 tel
61-2-498-9710 fax	01-86686-229 fax	55 19 3838-6892 fax	800-263-3489 fax
China	**Denmark**	**France**	**Germany**
86-21-62753535 tel	45-43-480100 tel	0810-331-300 tel	02131-14-2344 tel
86-21-62190698 fax	45-43-968596 fax	30-31-6195 fax	02131-14-3647 fax
Italy	**Japan**	**Korea**	**Netherlands**
02-7035-2177 tel	03-3709-8245 tel	02-3771-4114 tel	31-71-5-450-272 tel
02-7035-2125 fax	03-3709-8743 fax	02-786-7429 fax	31-71-5-450-280 fax
South Africa	**Spain**	**Switzerland**	**United Kingdom**
11-922-9111 tel	34-91-321-6000 tel	01-724-9114 tel	(0) 161-237-6174 tel
11-922-2116 fax	34-91-321-6002 fax	01-724-9068 fax	(0) 161-237-3371 fax

Technical Information

The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

Product Use

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. Given the variety of factors that can affect the use and performance of a 3M product, user is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application.

Warranty, Limited Remedy, and Disclaimer

Unless an additional warranty is specifically stated on the applicable 3M product packaging or product literature, 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 OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY OR CONDITION ARISING OUT OF A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. If the 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.

Limitation of Liability

Except where prohibited by law, 3M will not be liable for any loss or damage arising from the 3M product, whether direct, indirect, special, incidental or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability.

This product was manufactured under a 3M quality system registered to AS9100 standards.

3M

Aerospace and Aircraft Maintenance Department
3M Center, Building 223-1N-14
St. Paul, MN 55144-1000
1-800-235-2376
www.3M.com/aerospace

60-9700-0230-2