Technical data sheet

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Manufacturer:	3M DEUTSCHLAND GMBH
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3M™ SCOTCH-WELD™ EPOXY ADHESIVE EC-2216

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Scotch-Weld™
Epoxy Adhesive
EC-2216 B/A

Technical Datasheet **June 2009**

Product Description

3M™ Scotch-Weld™ Epoxy Adhesive EC-2216 B/A is a flexible, two-part, room temperature curing epoxy with high peel and shear strength. Scotch-Weld EC-2216 Adhesive has been tested and certified for aircraft and aerospace application.

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**			
	EC-2216 B/A Gray		**EC-2216 B/A Translucent**	
	Base	**Accelerator**	**Base**	**Accelerator**
Color:	White	Gray	Translucent	Amber
Base:	Modified Epoxy	Modified Amine	Modified Epoxy	Modified Amine
Net Wt.: (lb/gal)	11.1-11.6	10.5-11.0	9.4-9.8	8.0-8.5
Viscosity: (cps) (Approx.) Brookfield RVF #7 sp. @ 20 rpm	75,000 - 150,000	40,000 - 80,000	11,000 - 15,000	5,000 - 9,000
Mix Ratio: (by weight)	5 parts	7 parts	1 part	1 part
Mix Ratio: (by volume)	2 parts	3 parts	1 part	1 part
Work Life: 100 g Mass @ 75°F (24°C)	90 minutes	90 minutes	120 minutes	120 minutes

Features

- Excellent for bonding many metals, woods, plastics, rubbers, and masonry products.
- Base and Accelerator are contrasting colors.
- Good retention of strength after environmental aging.
- Resistant to extreme shock, vibration, and flexing.
- Excellent for cryogenic bonding applications.
- The translucent can be injected.
- Meets DOD-A-82720.

3M™ Scotch-Weld™
Epoxy Adhesive EC-2216 B/A
Technical Datasheet

Typical Cured Physical Properties

Product	3M™ Scotch-Weld™ Epoxy Adhesive	
	EC-2216 B/A Gray	EC-2216 B/A Translucent
Shore D Hardness ASTM D 2240	50-65	35-50
Time to Handling Strength	8-12 hrs.	12-16 hrs.

Typical Cured Electrical Properties

Product	3M™ Scotch-Weld™ Epoxy Adhesive	
	EC-2216 B/A Gray	EC-2216 B/A Translucent
Arc Resistance	130 seconds	—
Dielectric Strength	408 volts/mil	630 volts/mil
Dielectric Constant @ 73°F (23°C)	5.51–Measured @ 1.00 KHz	6.3 @ 1 KHz
Dielectric Constant @ 140°F (60°C)	14.17–Measured @ 1.00 KHz	—
Dissipation Factor 73°F (23°C)	0.112 Measured @ 1.00 KHz	0.119 @ 1 KHz
Dissipation Factor 140°F (60°C)	0.422–Measured @ 1.00 KHz	—
Surface Resistivity @ 73°F (23°C)	5.5×10^{16} ohm–@ 500 volts DC	—
Volume Resistivity @ 73°F (23°C)	1.9×10^{12} ohm-cm– @ 500 volts DC	3.0×10^{12} ohm-cm @ 500 volts DC

—No value present.

Typical Cured Thermal Properties

Product	3M™ Scotch-Weld™ Epoxy Adhesive	
	EC-2216 B/A Gray	EC-2216 B/A Translucent
Thermal Conductivity	0.228 Btu-ft/ft^{2}h°F	0.114 Btu-ft/ft^{2}h°F
Coefficient of Thermal Expansion	102×10^{-6} in/in/°C between 0-40°C 134×10^{-6} in/in/°C between 40-80°C	81×10^{-6} in/in/°C between -50-0°C 207×10^{-6} in/in/°C between 60-150°C

Typical Cured Outgassing Properties

Outgassing Data
NASA 1124 Revision 4

	% TML	% CVCM	% Wtr
3M™ Scotch-Weld™ Epoxy Adhesive EC-2216 B/A Gray	.77	.04	.23

Cured in air for 7 days @ 77°F (25°C).

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 completely removed. However, the amount of surface preparation directly depends on the required bond strength and the environmental aging resistance desired by user. For suggested surface preparations of common substrates, see the following section on surface preparation.
2. These products consist of two parts. Mix thoroughly by weight or volume in the proportions specified on the product label and in the uncured properties section. Mix approximately 15 seconds after a uniform color is obtained.

Handling/Curing Information *(continued)*

3. For maximum bond strength, apply product evenly to both surfaces to be joined.
4. Application to the substrates should be made within 90 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 firm. Heat, up to 200°F (93°C), will speed curing.
6. The following times and temperatures will result in a full cure:

Product	**3M™ Scotch-Weld™ Epoxy Adhesive**	
	EC-2216 B/A Gray	**EC-2216 B/A Translucent**
Cure Temperature	**Time**	**Time**
75°F (24°C)	7 days	30 days
150°F (66°C)	120 minutes	240 minutes
200°F (93°C)	30 minutes	60 minutes

7. Keep parts from moving until handling strength is reached. Contact pressure is necessary. Maximum shear strength is obtained with a 3-5 mil bond line. Maximum peel strength is obtained with a 17-25 mil bond line.
8. Excess uncured adhesive can be cleaned up with ketone type solvents.*****

Adhesive Coverage: A 0.005 in. thick bondline will typically yield a coverage of 320 sq. ft/gallon

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 many applications.

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.

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

Surface Preparation ***(continued)***

Aluminum (Chemical Etch)

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

1. Alkaline Degrease – Oakite® Aluminum Cleaner 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 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 etch aluminum panels, place them in FPL etch solution heated to 66 to 71°C (150 to 160°F). Panels should soak for 12 to 15 minutes.

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.

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 Methyl Ethyl Ketone (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.

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

Typical Adhesive Performance Characteristics

A. Typical Shear Properties on Etched Aluminum
ASTM D 1002
Cure: 2 hours @ 150 ± 5°F (66°C ± 2°C), 2 psi pressure

Test Temperature	Overlap Shear (psi)	
	3M™ Scotch-Weld™ Epoxy Adhesive	
	EC-2216 B/A Gray	EC-2216 B/A Translucent
-423°F (-253°C)	2440	—
-320°F (-196°C)	2740	—
-100°F (-73°C)	3000	—
-67°F (-53°C)	3000	3000
75°F (24°C)	3200	1700
180°F (82°C)	400	140

—No value present.

Test Temperature	Shear Modulus (Torsion Pendulum Method)
-148°F (-100°C)	398,000 psi (2745 MPa)
-76°F (-60°C)	318,855 psi (2199 MPa)
-40°F (-40°C)	282,315 psi (1947 MPa)
32°F (0°C)	218,805 psi (1500 MPa)
75°F (24°C)	49,580 psi (342 MPa)

B. Typical T-Peel Strength
ASTM D 1876

Test Temperature	T-Peel Strength (piw) @ 75°F (24°C)	
	3M™ Scotch-Weld™ Epoxy Adhesive	
	EC-2216 B/A Gray	EC-2216 B/A Translucent
75°F (24°C)	25	25

Typical Adhesive Performance Characteristics (*continued)*

C. Overlap Shear Strength After Environmental Aging-Etched Aluminum

Environment	Time	Overlap Shear (psi) 75°F (24°C)	
		3M™ Scotch-Weld™ Epoxy Adhesive	
		EC-2216 B/A Gray	EC-2216 B/A Translucent
100% Relative Humidity @ 120°F (49°C)	14 days 30 days 90 days	2950 psi 1985 psi 1505 psi	— 1390 psi —
*Salt Spray @ 75°F (24°C)	14 days 30 days 60 days	2300 psi 500 psi 300 psi	— 1260 psi —
Tap Water @ 75°F (24°C)	14 days 30 days 90 days	3120 psi 2942 psi 2075 psi	— 1950 psi —
Air @ 160°F (71°C)	35 days	4650 psi	—
Air @ 300°F (149°C)	40 days	4930 psi	3500 psi
Anti-icing Fluid @ 75°F (24°C)	7 days	3300 psi	2500 psi
Hydraulic Oil @ 75°F (24°C)	30 days	2500 psi	2500 psi
JP-4 Fuel	30 days	2500 psi	2500 psi
Hydrocarbon Fluid	7 days	3300 psi	3000 psi

*Substrate corrosion resulted in adhesive failure.
—No value present.

D. Heat Aging of 3M™ Scotch-Weld™ Epoxy Adhesive 2216 B/A Gray
(Cured for 7 days @ 75°F [24°C])

Overlap Shear (psi)	Time aged @ 300°F (149°C)			
Test Temperature	0 days	12 days	40 days	51 days
-67°F (-53°C)	2200	3310	3120	2860
75°F (24°C)	3100	5150	4930	4740
180°F (82°C)	500	1000	760	1120
350°F (177°C)	420	440	560	—

—No value present.

Typical Adhesive Performance Characteristics (*continued)*

E. Overlap Shear Strength on Abraded Metals, Plastics, and Rubbers.

Overlap shear strengths were measured on 1" x 1/2" overlap specimens. These bonds were made individually using 1" by 4" pieces of substrate (Tested per ASTM D 1002).

The thickness of the substrates were: cold rolled, galvanized and stainless steel – 0.056-0.062", copper – 0.032", brass – 0.036", rubbers – 0.125", plastics – 0.125". All surfaces were prepared by solvent wiping/abrading/ solvent wiping.

The free crosshead speed used for testing was 0.1 in/min for metals, 2 in/min for plastics, and 20 in/min for rubbers.

	Overlap Shear (psi) @ 75°F (24°C)
	3M™ Scotch-Weld™ Epoxy Adhesive
Substrate	**EC-2216 B/A Gray**
Aluminum/Aluminum	1850
Cold Rolled Steel/Cold Rolled Steel	1700
Stainless Steel/Stainless Steel	1900
Galvanized Steel/Galvanized Steel	1800
Copper/Copper	1050
Brass/Brass	850
Styrene Butadiene Rubber/Steel	200*
Neoprene Rubber/Steel	220*
ABS/ABS Plastic	990*
PVC/PVC, Rigid	940*
Polycarbonate/Polycarbonate	1170*
Acrylic/Acrylic	1100*
Fiber Reinforced Polyester/ Reinforced Polyester	1660*
Polyphenylene Oxide/PPO	610
PC/ABS Alloy / PC/ABS Alloy	1290

*The substrate failed during the test.

Storage

Store products at 60-80°F (16-27°C) for maximum storage life.

Shelf Life

When stored at the recommended temperatures in the original, unopened containers, the shelf life is two years from date of shipment from 3M or an authorized 3M Aerospace Distributor.

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:

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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.

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