



Scotch-Weld™ Epoxy Adhesives

2214 Regular • 2214 Hi-Dense • 2214 Hi-Temp
2214 Hi-Temp New Formula • 2214 Non-Metallic Filled

Technical Data

March, 2005

Product Description

- One part 250°F (121°C) curing 100% solids, 3M™ Scotch-Weld™ Epoxy Adhesive 2214 is a paste consistency epoxy adhesive designed for bonding metals and many high temperature plastics such as fiberglass reinforced plastic, polyester, and phenolics.
- 3M™ Scotch-Weld™ Adhesive 2214 Regular is an aluminum filled general purpose product for use in applications where high strength bonds are needed in a temperature range of -67°F to 250°F (-53°C to 121°C).
- 3M™ Scotch-Weld™ Adhesive 2214 Hi-Dense is a deaerated version of Scotch-Weld adhesive 2214 regular for use where a very dense, void free bondline is required.
- 3M™ Scotch-Weld™ Adhesive 2214 Hi-Temp and Hi-Temp New Formula are aluminum filled, deaerated products for use where higher strengths are required between 180°F to 350°F (82°C to 177°C).
- 3M™ Scotch-Weld™ Adhesive 2214 Non-Metallic Filled is a non-metal filled version of Scotch-Weld adhesive 2214 regular.

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.

	3M™ Scotch-Weld™ Epoxy Adhesive 2214				
	Regular	Hi-Dense	Hi-Temp	Hi-Temp New Formula	Non-Metallic Filled
Viscosity (Approx.) time to deliver 20 grams @ 50 psi thru a .104" orifice (seconds)	60-200	60-200	15-30	100-250	50-200
Viscosity (Brookfield)	Because of Thixotropic paste nature of these products Brookfield viscosity will be over 1,000,000 cps.				
Color	Gray	Gray	Gray	Gray	Cream
Base	Modified Epoxy	Modified Epoxy	Modified Epoxy	Modified Epoxy	Modified Epoxy
Net Weight (lbs/gal)	12.0	12.6	12.0	13.8	9.6

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Typical Cured Physical Properties

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

	3M™ Scotch-Weld™ Epoxy Adhesive 2214				
	Regular	Hi-Dense	Hi-Temp	Hi-Temp New Formula	Non-Metallic Filled
Color	Gray	Gray	Gray	Gray Brown	Cream to Tan
Shore D Hardness (Approx.)	85	85	88	85	85
Elongation (Approx. %)	<2	<2	1	1	<2
Ultimate Tensile (Approx. psi)	10,000	10,000	8,000	–	9,000
Modulus Elasticity (Approx. psi)	750,000	750,000	800,000	–	700,000

Typical Thermal Properties (Cured)

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

	Thermal Conductivity (BTU/HR/FT ² /°F/FT)	Coefficient of Thermal Expanse (in./in./°C)
3M™ Scotch-Weld™ Adhesive 2214 Regular	.231	49 x 10 ⁻⁶ (between 0-80°C)
3M™ Scotch-Weld™ Adhesive 2214 Hi-Dense	.231	49 x 10 ⁻⁶ (between 0-80°C)
3M™ Scotch-Weld™ Adhesive 2214 Hi-Temp	.189	48 x 10 ⁻⁶ (between 0-80°C)
3M™ Scotch-Weld™ Adhesive 2214 Hi-Temp New Formula	.244	44 x 10 ⁻⁶ (between -60 - +80°C)
3M™ Scotch-Weld™ Adhesive 2214 Non-Metallic Filled	.121	130 x 10 ⁻⁶ (between -30 - 100°C)

Typical Electrical Properties (Cured)

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

Dielectric Constant (1) **ASTM-D-150**

Dissipation Factor (2) **ASTM-D-150**

Power Range 1.00 KC Test Temperature		73°F (23°C)	140°F (60°C)	194°F (90°C)	219°F (104°C)
Scotch-Weld adhesive 2214 Regular	(1)	10.5	11.1	16.7	24.0
	(2)	0.126	0.463	0.346	0.515
Scotch-Weld adhesive 2214 Hi-Dense	(1)	10.5	11.1	16.7	24.0
	(2)	0.126	0.463	0.346	0.515
Scotch-Weld adhesive 2214 Hi-Temp	(1)	6.2	7.6	7.8	8.0
	(2)	0.021	0.023	0.025	0.025
Scotch-Weld adhesive 2214 Non-Metallic Filled	(1)	4.61	4.96	–	–
	(2)	0.0135	0.0148	–	–
Scotch-Weld adhesive 2214 Hi-Temp New Formula	(1)	–	–	–	–
	(2)	–	–	–	–
Arc Resistance	ASTM-D-495-61	Surface Resistivity		ASTM-D-257	
Dielectric Strength	ASTM-D-149	Volume Resistivity		ASTM-D-257	

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Typical Electrical Properties (Cured) [continued] **Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.**

3M™ Scotch-Weld™ Epoxy Adhesive 2214	ARC Resistance (Seconds)	Dielectric Strength (Volts Per Mil Thickness)		Surface Resistivity (500 Volts-DC)	Volume Resistivity (500 Volts-DC)
		Volts/Mil	Sample Thickness Inches	Ohms/Square 73°F (23°C)	Ohms-CM 73°F (23°C)
Regular	76	77	0.0366	9.8 x 10 ¹²	2.8 x 10 ¹³
Hi-Dense	76	77	0.0366	9.8 x 10 ¹²	2.8 x 10 ¹³
Hi-Temp	119	347	0.038	1.1 x 10 ¹⁷	9.4 x 10 ¹⁴
Non-Metallic	26	570	0.039	–	2.5 x 10 ¹³

Handling/Curing Information Directions for Use

1. Warm products to room temperature before opening containers to restore proper application consistency and to prevent moisture condensation on adhesive surface.
2. 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 substrates, the required bond strength, environmental aging resistance, and requirements determined by the user in light of the user's particular purpose and method of application. For specific surface preparations on common substrates, see the section on surface preparation.
3. Use gloves to minimize skin contact and do not use solvents for cleaning hands.
4. For maximum bond strength, apply product evenly to both surfaces to be joined.
5. Join the adhesive coated surfaces and heat cure using the following bondline temperature and time for the specific product being used.

Any of the following cure cycles will result in a full cure.

3M™ Scotch-Weld™ Adhesive 2214 Regular	}	40 min @ 250°F (121°C)
3M™ Scotch-Weld™ Adhesive 2214 Hi-Dense		10 min @ 300°F (149°C)
3M™ Scotch-Weld™ Adhesive 2214 Hi-Flex		5 min @ 350°F (177°C)
3M™ Scotch-Weld™ Adhesive 2214 Hi-Temp		
3M™ Scotch-Weld™ Adhesive 2214 Non-Metallic Filled		
3M™ Scotch-Weld™ Adhesive 2214 Hi-Temp New Formula		60 min @ 250°F (121°C) 15 min @ 300°F (149°C)

6. Keep parts from moving during cure as contact pressure is necessary.
7. Cleanup can be accomplished with solvent such as 3M™ Scotch-Grip™ Solvent No. 3 or Methyl Ethyl Ketone.*

***Note:** Prior to use of these solvents, extinguish or eliminate any ignition sources and read and follow supplier's environmental, health, and safety recommendations listed on the MSDS and product label.

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Surface Preparation

The following cleaning methods are suggested for common surfaces:

Steel:

1. Wipe free of dust with oil-free solvent such as Methyl Ethyl Ketone.*
2. Sandblast or abrade using clean fine grit abrasives.
3. Wipe again with solvent to remove loose particles.

Aluminum:

1. Vapor Degrease – Perchloroethylene* condensing vapors for 5-10 minutes.
2. Alkaline Degrease – Oakite 164 solution (9-11 oz./gallon water) at 190°F ± 10°F (87°C ± 5°C) for 10-20 minutes. Rinse immediately in large quantities of cold running water.
3. Acid Etch – Place panels in their following solution for 10 minutes at 150°F ± 5°F (66°C ± 2°C).

Sodium Dichromate	4.1-4.9 oz./gallon
Sulfuric Acid, 66°Be	38.5-41.5 oz./gallon
2024-T3 aluminum (dissolved)	0.2 oz./gallon minimum
Tap water as needed to balance	

4. Rinse – Rinse panels in clear running tap water.
5. Dry – Air dry 15 minutes; force dry 10 minutes at 150°F ± 10°F (66°C ± 5°C).
6. If primer is to be used, it should be applied within 4 hours after surface preparation.

Plastics:

1. Solvent wipe with Isopropyl Alcohol.*
2. Abrade using clean fine grit abrasives.
3. Solvent wipe with Isopropyl Alcohol.*

Rubbers:

1. Solvent wipe with Methyl Ethyl Ketone.*
2. Abrade using clean fine grit abrasives.
3. Solvent wipe with Methyl Ethyl Ketone.*

Glass:

1. Solvent wipe with acetone or Methyl Ethyl Ketone.*

Note: For glass applications which will be subjected to high moisture/humidity conditions, 3M™ Scotch-Weld™ Primer EC-3901 should be used to prime the glass.

***Note:** Prior to use of these solvents, extinguish or eliminate any ignition sources and read and follow supplier's environmental, health, and safety recommendations listed on the MSDS and product label.

Application/Equipment Information

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

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.

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Equipment Suggestions

Note: Minimum pumping temperature is 65°F (18°C) for all products.

3M™ Scotch-Weld™ Epoxy Adhesive 2214 Regular Production Extrusion Equipment

Pump	Ram	Hose	Flow Gun
Ratio 55:1 with a chopping check valve and priming piston, 8 in. air motor. 3.7 cu. in./cycle	Pneumatic type capacity-12 psi on material surface	Super high pressure with standard lining	High pressure type

**Output based on 1/4" tip flow gun (material temperature 65°F [18°C])
(minimum pumping temperature is 65°F [18°C])**

Hose Assembly	Material Pressure (psi)	(Output lbs./min.)
Length-20', I.D.-1/2"	4800*	.36
Length-20', I.D.-3/4"	4800*	1.0

3M™ Scotch-Weld™ Epoxy Adhesive 2214 Non-Metallic Filled Production Extrusion Equipment

Pump	Ram	Hose	Flow Gun
Ratio 38:1 with a chopping check valve and priming piston	Pneumatic type capacity-10 psi on material surface	Super high pressure with standard lining	High pressure type

**Output based on 3/8" tip flow gun-8" diameter air motor
(minimum pumping temperature is 65°F [18°C])**

Hose Assembly	Material Pressure (psi)	(Output lbs./min.)
Length-10', I.D.-3/4"	3000	2.3
Length-20', I.D.-3/4"	3000	1.6
Length-20', I.D.-3/4" +10, I.D.-1/2"	3000	1.2
Length-20', I.D.-1/2"	3000	.84

3M™ Scotch-Weld™ Epoxy Adhesive 2214 Hi-Temp Production Extrusion Equipment

Pump	Ram	Hose	Flow Gun
Ratio 40:1 with a chopping check valve and priming piston, 6 in. air motor. 2 cu. in./cycle	Pneumatic type capacity-12 psi on material surface	Super high pressure with standard lining	High pressure type

Output based on 1/4" tip flow gun (material temperature 65°F [18°C])

Hose Assembly	Material Pressure (psi)	(Output lbs./min.)
Length-20', I.D.-1/2"	2400	.4
Length-20', I.D.-3/4"	2400	1.1

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Equipment Suggestions (continued)

Note: Minimum pumping temperature is 65°F (18°C) for all products.

3M™ Scotch-Weld™ Epoxy Adhesive 2214 Hi-Dense Production Extrusion Equipment

Pump	Ram	Hose	Flow Gun
Ratio 55:1 with a chopping check valve and priming piston, 8 in. air motor. 3.7 cu. in./cycle	Pneumatic type capacity-12 psi on material surface	Super high pressure with standard lining	High pressure type

**Output based on 1/4" tip flow gun (material temperature 65°F [18°C])
(minimum pumping temperature is 65°F [18°C])**

Hose Assembly	Material Pressure (psi)	(Output lbs./min.)
Length-20', I.D.-1/2"	4500*	.45
Length-20', I.D.-3/4"	4500*	.9

3M™ Scotch-Weld™ Epoxy Adhesive 2214 Hi-Temp New Formula Production Extrusion Equipment

Pump	Ram	Hose	Flow Gun
Ratio 55:1 with a chopping check valve and priming piston, 8 in. air motor. 3.7 cu. in./cycle	Pneumatic type capacity-12 psi on material surface	Super high pressure with standard lining	High pressure type

**Output based on 1/4" tip flow gun (material temperature 65°F [18°C])
(minimum pumping temperature is 65°F [18°C])**

Hose Assembly	Material Pressure (psi)	(Output lbs./min.)
Length-20', I.D.-1/2"	4800*	.36
Length-20', I.D.-3/4"	4800*	1.0

*These pressures will require a special consideration during hose selection. They are actual working pressures.

Typical Adhesive Performance Characteristics

Note: All of the following data was developed using a cure cycle of 40 minutes @ 250°F (121°C) under 25 psi pressure except Scotch-Weld adhesive 2214 Hi-Temp New Formula which was 60 minutes at 250°F (121°C).

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 T3 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. (All data in psi).

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

Test Temperature	3M™ Scotch-Weld™ Epoxy Adhesive 2214				
	Regular	Hi-Dense	Hi-Temp	Hi-Temp New Formula	Non-Metallic Filled
-67°F (-53°C)	3000	3000	2000	2800	3000
75°F (24°C)	4500	4500	2000	2800	4000
180°F (82°C)	4500	4500	3000	2800	4500
250°F (121°C)	1500	1700	2500	2500	1500
300°F (149°C)	600	600	2500	2000	600
350°F (177°C)	400	400	900	1200	400

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Typical Adhesive Performance Characteristics (*continued*)

B. Aluminum T-Peel

T-Peel bonds were measured on 1" wide specimens cut from two FPL etched 8" x 8" x .032" 2024 T3 clad aluminum panels bonded together. The separation rate of the testing jaws was 20"/minute. Tests similar to ASTM D-1876. (All data in lbs./in. of width.)

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

Test Temperature	3M™ Scotch-Weld™ Epoxy Adhesive 2214				
	Regular	Hi-Dense	Hi-Temp	Hi-Temp New Formula	Non-Metallic Filled
75°F (24°C)	5	5	2	2	7

C. Steel Overlap Shear

Overlap shear strength was measured on 1" wide by 1/2" overlap specimens. These bonds were made on 1" x 4" x .035" thick cold rolled steel which was MEK solvent wiped prior to bonding. The separation rate of the testing jaws was .1"/min. Tests similar to ASTM D-1002. (All data in psi.)

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

Test Temperature	3M™ Scotch-Weld™ Epoxy Adhesive 2214				
	Regular	Hi-Dense	Hi-Temp	Hi-Temp New Formula	Non-Metallic Metallic Filled
-67°F (-53°C)	3000	3000	1650	2000	3000
75°F (24°C)	2500	2500	2400	2500	2200
180°F (82°C)	2000	2000	2000	2000	2000
250°F (121°C)	800	800	2000	2000	400
300°F (149°C)	200	200	2000	2000	200
350°F (177°C)	100	100	500	700	100

D. Steel T-Peel

T-Peel bonds were measured on two 1" wide x 8" long specimens bonded together. These bonds were made on MEK wiped .035" steel. After bonding they were then pulled apart in 180° Peel at a jaw separation rate of 20"/in. rate. Tests similar to ASTM D-1876. (All data in lbs./in. of width.)

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

Test Temperature	3M™ Scotch-Weld™ Epoxy Adhesive 2214				
	Regular	Hi-Dense	Hi-Temp	Hi-Temp New Formula	Non-Metallic Filled
75°F (24°C)	50	50	5	5	12

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Environmental Resistance **Note:** The following data is overlap shear after aging for 365 days in the specified environment. Tests were run on FPL etched aluminum and solvent degreased, sandblasted .035" thick cold rolled steel. Bonds and tests similar to ASTM D-1002. (All data in psi.)

	3M™ Scotch-Weld™ Epoxy Adhesive 2214			
	Regular	Hi-Dense	Hi-Temp	
	Aluminum	Steel	Aluminum	Steel
Tap Water @ 75°F (24°C)	4630	1620	3060	1580
100% relative humidity @ 120°F (49°C)	1900	1910	3120	2090
Ethyl Gasoline @ 75°F (24°C)	4690	2310	2620	1870

Storage Store products at 40°F (4°C) or below for maximum storage life. Higher temperatures reduce normal storage life. Rotate stock on a “first-in-first-out” basis.

CAUTION: Products are heat sensitive. Storage above 130°F (54°C) may cause an exothermic reaction resulting in evolution of excessive heat, noxious fumes, and possibly fire.

Shelf Life All of these products have a shelf life of 8 months when stored in their unopened containers @ 40°F (4°C) and 12 months @ 0°F (-18°C).

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.

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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