



# Scotch-Weld™ Epoxy Adhesives

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

**Technical Data**

**September, 1998**

(Supersedes March 1, 1992)

**Features**

- One part 250°F (121°C) curing 100% solids, paste consistency epoxy adhesives designed for bonding metals and many high temperature plastics such as fiberglass reinforced plastic, polyester, polysyphenylene sulfides and phenolics.
- 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).
- 2214 Hi-Dense is a deaerated version of 2214 Regular for use where a very dense, void free bondline is required.
- 2214 Hi-Flex is an aluminum filled, deaerated product for use where increased shock resistance and peel strength is required.
- 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).
- 2214 Non-Metallic Filled is a non-metal filled version of 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.**

	<b>2214 Regular</b>	<b>2214 Hi-Dense</b>	<b>2214 Hi-Flex</b>	<b>2214 Hi-Temp</b>	<b>2214 Hi-Temp New Formula</b>	<b>2214 Non-Metallic Filled</b>
<b>Viscosity (Approx.) time to deliver 20 grams @ 50 psi thru a .104" orifice (seconds)</b>	130	130	150	25	160	100
<b>Viscosity (Brookfield)</b>	Because of Thixotropic paste nature of these products Brookfield viscosity will be over 1,000,00 cps.					
<b>Color</b>	Gray	Gray	Gray	Gray	Gray	Cream
<b>Base</b>	Modified Epoxy	Modified Epoxy	Modified Epoxy	Modified Epoxy	Modified Epoxy	Modified Epoxy
<b>Net Weight (lbs/gal)</b>	12.0	12.6	12.0	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.

	2214 Regular	2214 Hi-Dense	2214 Hi-Flex	2214 Hi-Temp	2214 Hi-Temp New Formula	2214 Non-Metallic Filled
Color	Gray	Gray	Gray	Gray	Gray Brown	Cream to Tan
Shore D Hardness (Approx.)	85	85	81	88	85	85
Elongation (Approx. %)	<2	<2	3	1	1	<2
Ultimate Tensile (Approx. psi)	10,000	10,000	5,800	8,000	–	9,000
Modulus Elasticity (Approx. psi)	750,000	750,000	460,000	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 <sup>2</sup> /°F/FT)	Coefficient of Thermal Expanse (in./in./°C)
2214 Regular	.231	49 x 10 <sup>-6</sup> (between 0-80°C)
2214 Hi-Dense	.231	49 x 10 <sup>-6</sup> (between 0-80°C)
2214 Hi-Flex	.193	80 x 10 <sup>-6</sup> (between 0-80°C)
2214 Hi-Temp	.189	48 x 10 <sup>-6</sup> (between 0-80°C)
2214 Hi-Temp New Formula	.244	44 x 10 <sup>-6</sup> (between -60 - +80°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)
2214 Regular	(1)	10.5	11.1	16.7	24.0
	(2)	0.126	0.463	0.346	0.515
2214 Hi-Dense	(1)	10.5	11.1	16.7	24.0
	(2)	0.126	0.463	0.346	0.515
2214 Hi-Flex	(1)	11.3	13.9	–	–
	(2)	0.037	0.075	–	–
2214 Hi-Temp	(1)	6.2	7.6	7.8	8.0
	(2)	0.021	0.023	0.025	0.025
2214 Non-Metallic Filled	(1)	4.61	4.96	–	–
	(2)	0.0135	0.0148	–	–
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]

	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)
2214 Regular	76	77	0.0366	$9.8 \times 10^{12}$	$2.8 \times 10^{13}$
2214 Hi-Dense	76	77	0.0366	$9.8 \times 10^{12}$	$2.8 \times 10^{13}$
2214 Hi-Flex	32	83	0.042	$1.2 \times 10^{15}$	$2.8 \times 10^{13}$
2214 Hi-Temp	119	347	0.038	$1.1 \times 10^{17}$	$9.4 \times 10^{14}$
2214 Non-Metallic	26	570	0.039	—	$2.5 \times 10^{13}$

## 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 following section on Surface Preparation.
3. Use gloves to minimize skin contact. 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.

2214 Regular	}	40 min @ 250°F (121°C)
2214 Hi-Dense		
2214 Hi-Flex		
2214 Hi-Temp		
2214 Non-metallic filled	}	5 min @ 350°F (177°C)
2214 Hi-Temp		
New Formula		15 min @ 300°F (149°C)

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

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

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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 or chlorinated solvents.\*
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	Balance of volume

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, EC-3901 primer should be used to prime the glass.

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

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## 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.

### 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

### 2214 Non-Metallic 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

### 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

### 2214 Hi-Flex Production Extrusion Equipment

Pump	Ram	Hose	Flow Gun
Ratio 50:1 with a chopping check valve and priming piston, 6 in. air motor. 1.6 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"	4000*	.2
Length-20', I.D.-3/4"	4000*	.6

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## Equipment Suggestions (continued)

### 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

### 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

\*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 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).

Test Temperature	2214 Regular	2214 Hi-Dense	2214 Hi-Flex	2214 Hi-Temp	2214 Hi-Temp New Formula	2214 Non-Metallic Filled
-67°F (-53°C)	3000	3000	2500	2000	2800	3000
75°F (24°C)	4500	4500	4000	2000	2800	4000
180°F (82°C)	4500	4500	2000	3000	2800	4500
250°F (121°C)	1500	1700	450	2500	2500	1500
300°F (149°C)	600	600	300	2500	2000	600
350°F (177°C)	400	400	250	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.)

Test Temperature	2214 Regular	2214 Hi-Dense	2214 Hi-Flex	2214 Hi-Temp	2214 Hi-Temp New Formula	2214 Non-Metallic Filled
75°F (24°C)	5	5	10	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.)

Test Temperature	2214 Regular	2214 Hi-Dense	2214 Hi-Flex	2214 Hi-Temp	2214 Hi-Temp New Formula	2214 Non-Metallic Filled
-67°F (-53°C)	3000	3000	3500	1650	2000	3000
75°F (24°C)	2500	2500	2500	2400	2500	2200
180°F (82°C)	2000	2000	2000	2000	2000	2000
250°F (121°C)	800	800	250	2000	2000	400
300°F (149°C)	200	200	150	2000	2000	200
350°F (177°C)	100	100	125	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.)

Test Temperature	2214 Regular	2214 Hi-Dense	2214 Hi-Flex	2214 Hi-Temp	2214 Hi-Temp New Formula	2214 Non-Metallic Filled
75°F (24°C)	50	50	65	5	5	12

### 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.)

	2214 Regular	2214 Hi-Dense	2214 Hi-Flex		2214 Hi-Temp	
	Aluminum	Steel	Aluminum	Steel	Aluminum	Steel
Tap Water @ 75°F (24°C)	4630	1620	4610	1900	3060	1580
100% relative humidity @ 120°F (49°C)	1900	1910	1500	1800	3120	2090
Ethyl Gasoline @ 75°F (24°C)	4690	2310	5370	2410	2620	1870

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## Storage and Shelf Life

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. All of these products have a shelf life of 12 months when stored in their unopened containers @ 40°F (4°C) or below.

**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.

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## Precautionary Information

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

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## 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 220-7E-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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