

# CONFORMAL COATINGS

PRINTED CIRCUIT BOARD PROTECTION  
FOR EXTREME ENVIRONMENTS

Acrylic • Silicone • Polyurethane • Epoxy



[mgchemicals.com](http://mgchemicals.com)

**MG Chemicals**<sup>®</sup>

*Serving you since 1955*

# WHO IS MG CHEMICALS

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MG Chemicals is a manufacturer and wholesaler of chemical products for the electronics industry. Our chemical products include dusters and circuit coolers, electronic cleaners, flux removers, contact cleaners, protective coatings, epoxies, adhesives, RTV silicones, lubricants, EMI/RFI shielding coatings, thermal management products, prototyping supplies, solders, and more. We also distribute related non-chemical products such as wipes, swabs, brushes, desoldering braids, and copper clad boards.

We specialize in the formulation and production of protective coatings for electronics: Conformal Coatings, Epoxy Potting & Encapsulating Compounds, and EMI/RFI Shielding Paints.







## MG SERVICE

MG Chemicals recognizes that setting up production comes with various challenges. Our service team offers a wide variety of experience in material production, equipment, and technical issues you may encounter during planning, pilot studies, and production runs. To overcome these challenges, we offer professional services.

### **As a service, MG Chemicals can**

- Provide advice on equipment and materials
- Assist with setup and troubleshooting
- Review your proposed application processes
- Suggest ways of optimizing and customizing processes to best meet your needs
- Offer training on the proper use of our epoxy products.

### **Quality Assurance**

Since 1955, MG Chemicals has provided the North American electronics industry with a full line of high performance chemicals and accessories. The MG Chemicals manufacturing facility operates under the ISO 9001 Quality System Standard. All products undergo MG Chemicals' design process including the testing and analysis of each product to maximize performance, user safety, environmental safeguards and market desirability.

### **Customer Care**

Customer care is what separates MG Chemicals from the rest. Our commitment to all of these principles focus on getting you the quality product and support you deserve.



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# COMPARISON CHART - CONFORMAL COATINGS

	422B	419C	419D	4223	4223D/4223F (Xylene Free)	4224
<b>Type</b>	Modified Silicone	Acrylic	Acrylic	Urethane	Urethane	Epoxy
<b>Uncured Working Properties</b>						
Formats	Liquid Aerosol	Liquid Aerosol	Liquid	Liquid	Liquid	Liquid
Color	Clear	Clear	Clear	Clear amber	Clear amber	Clear
Solid% Liquid (w/w)	25	16	29.5	32	44.8	88
Solid% Aerosol	15	8.4	–	–	–	–
Density (g/mL)	0.90	0.87	0.92	0.94	0.97	1.03
Viscosity (cP)	13	7.2	100	200	300	73
VOC (Liquid g/L)	430	581	647	571	534	123
Shelf life (y)	≥3	≥3	≥3	≥3	≥3	≥5
<b>Coverage &amp; Application Properties</b>						
Coverage per Liter	<117 ft <sup>2</sup> *	<67.8 ft <sup>2</sup> *	<62 ft <sup>2</sup> *	<136 ft <sup>2</sup> *	<123 ft <sup>2</sup> *	<240 ft <sup>2</sup> **
Coverage per 340g spray can	<28 ft <sup>2</sup> *	<13.7 ft <sup>2</sup> *				
Dry to touch (min)	5-7	3-5	10-15	60	10-15	–
Recoat time (min)	5	2	2	30	3	–
Cure time at room temp. (h)	48	24	24	24	–	–
Cure time at 65 °C (min)	20	30	60	60	–	–
Cure time at 80°C (h)	–	–	–	–	24	2
<b>Physical Properties</b>						
Solderability	Excellent	Excellent	Excellent	Good	Good	No
Fungus Resistance	Excellent	Excellent	Excellent	Excellent	Excellent	Good
Chemical Resistance	Poor	Poor	Poor	Excellent	Excellent	Excellent
<b>Electrical Properties</b>						
Dielectric Strength (V/mil)	1056	–	1100	1800	1020	600
Dielectric Withstand Voltage (V)	>1500	>1500	>1500	>1500	>1500	>1500
Insulation Resistance 24 hr.(ohm)	–	5x10 <sup>12</sup>	~10 <sup>12</sup>	~10 <sup>12</sup>	~10 <sup>12</sup>	–
<b>Thermal Properties</b>						
Constant Service Temp. (°C)	(-40 to 200)	(-40 to 120)	(-40 to 120)	(-40 to 145)	(-40 to 145)	(-40 to 200)
[°F]	[-40 to 392]	[-40 to 248]	[-40 to 248]	[-40 to 293]	[-40 to 293]	[-40 to 392]
Tg (°C)	32	46	43	–	–	113
UL 94 Flammability Classification	V-0	V-0	V-0	V-1	V-0	–

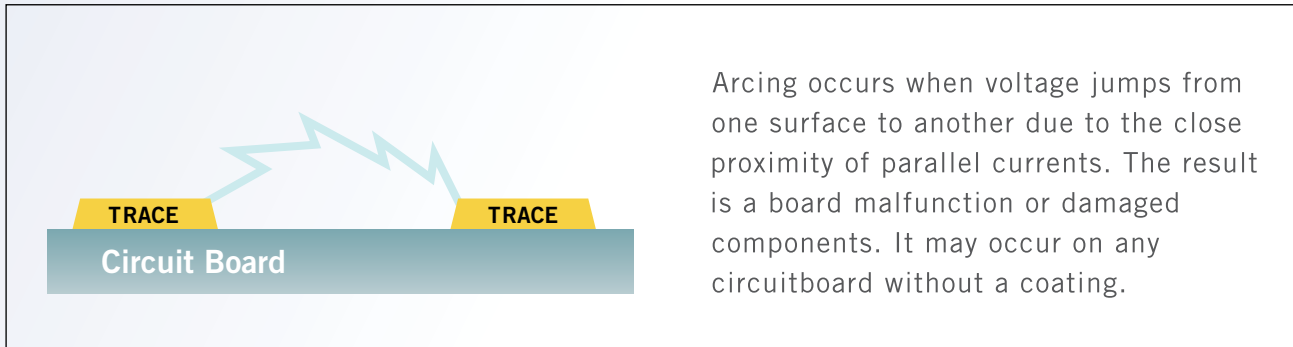
\* based on 1 mil thickness, 65% transfer efficiency

\*\* based on 2 mil thickness, 65% transfer efficiency

# WHY USE COATING?

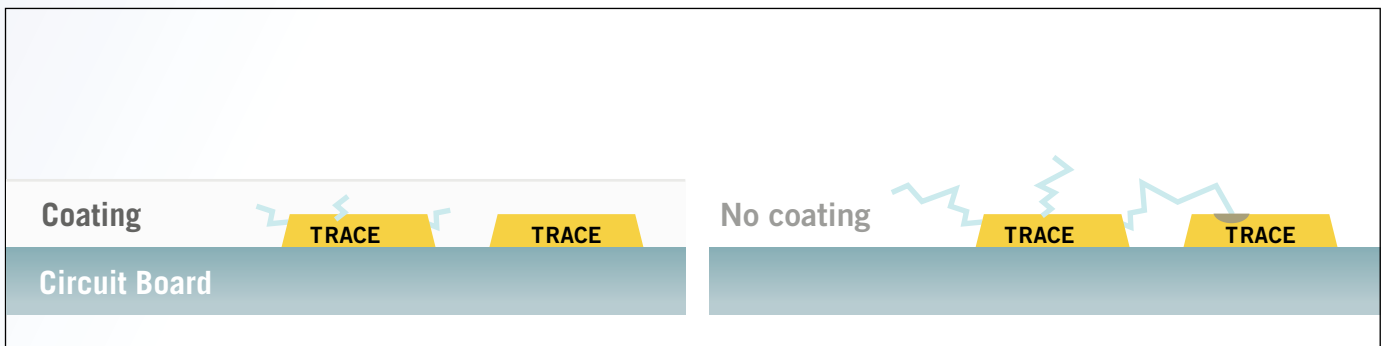
Protective coatings are necessary to ensure a long and effective working life of electrical and electronic components. MG Chemicals offers a wide range of coatings suitable for protecting circuit boards, windings & coils, transformers, field coils, and stator windings from electrical arcing, environmental factors, and physical force.

## WHAT IS ARCING?

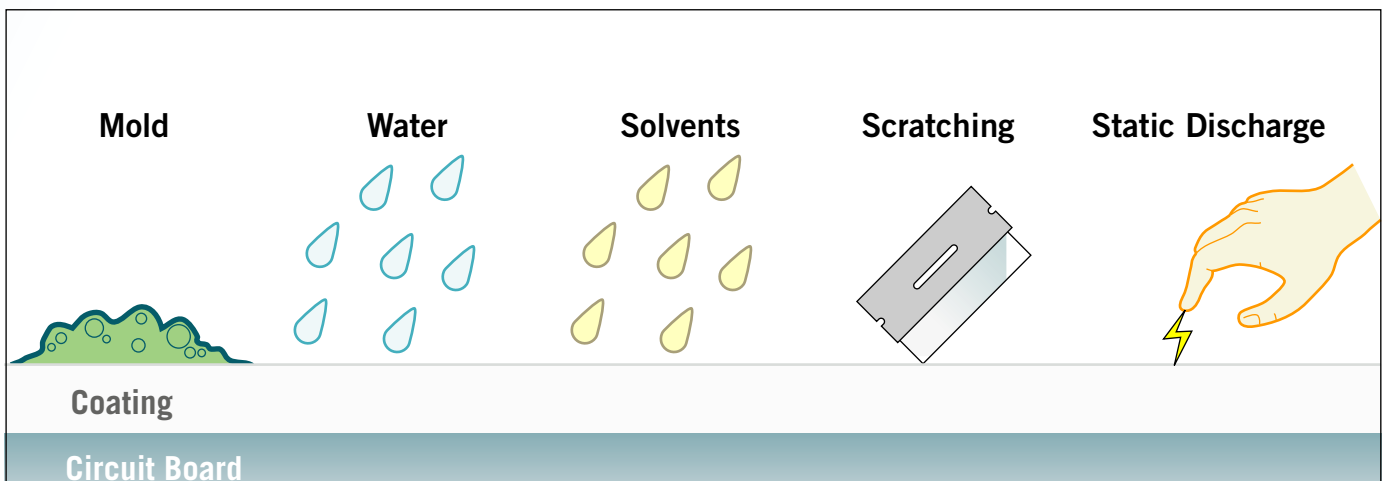


# WHAT CAN COATINGS DO?

## RESIST ARCING



## RESIST ARCING



# CONFORMAL COATING APPLICATION INSTRUCTIONS

## SPRAY GUN APPLICATION INSTRUCTIONS

Follow the procedure below for best results.

### TO APPLY THE REQUIRED THICKNESS BY WEIGHT:

1. Mix thoroughly, and spray a test pattern. This step ensures good flow quality and helps establish appropriate distance to avoid runs.
2. At a distance of 20 to 25 cm (8 to 10 inches), hold the gun at around 45°, and spray a thin and even coat onto the horizontal board. For best results, use spray-and-release strokes with an even motion to avoid excess paint in one spot.
3. Before the next coat, rotate the board 90° to ensure good coverage.
4. Wait at least 2 minutes, and spray another coat. The delay avoids trapping solvent between coats.
5. Apply other coats until desired thickness is achieved. (Go to Step 3)
6. Let dry for 3-5 minutes (flash off time) at room temperature.

### TO CURE AT ROOM TEMPERATURE:

Let air dry 24 hours

### TO ACCELERATE CURE BY HEAT:

After flash off, put in oven or under heat lamp at  $\leq 65^{\circ}\text{C}$  for 60 min

### ATTENTION!

If heat curing, do not exceed  $65^{\circ}\text{C}$  as this may cause surface defects due to solvents evaporating off too quickly.

### NOTE

Coats that are very thick require more time to dry.



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# ACRYLIC CONFORMAL COATING II - FAST CURE

Our 419C Acrylic Conformal Coating is an IPC 830 certified, fast drying, xylene and toluene free product that provides an excellent finish. This one part coating is easy to use and does not require special or costly equipment to apply. It is ideal for high moisture environments and applications requiring easy repair and rework.

The 419C coating protects electric circuits against moisture, dirt, dust, thermal shocks, and scratches that could corrode, short circuit, or otherwise damage the electric component. It insulates against high-voltage arcing, shorts, and static discharges. As well as, this coating provides a high dielectric withstand voltage that allows traces to be put closer together helping with miniaturization.

- **Super fast cure** — reduces production and maintenance bottlenecks
- **No Hazardous Air Pollutants** — free of toluene and xylene
- **Externally Qualified to IPC-CC-830B by Pacific Testing Laboratories, Inc.**
- **UL Recognized for Flame Class 94 V-0 (E203094)**
- **Excellent finish** — smooth, homogeneous, and durable crystal clear coat
- **Protects electronics from moisture, corrosion, fungus, and static discharges**
- **Easy to inspect** — fluoresces under UV (UV-A blacklight)
- **Easy rework and repairs** — can solder through coat; remove with MG Chemicals' Thinner/Cleaner (cat. no. 435-1L) or Conformal Coating Stripper (cat. no. 8310-100ML)

Catalog Number	Sizes Available	Description
419C-55ML	55 ml (2 oz)	Bottle
419C-340G	340 g (12 oz)	Aerosol
419C-1L	1 L (1 quart)	Liquid
419C-4L	4 L (1 gal)	Liquid
419C-20L	20 L (5.3 gal)	Liquid





## CURING & WORK SCHEDULE

	Test Method	Result
<b>Aerosol</b>		
Tack Free		3–5 minutes
Recoat Time		2 minutes
Full Cure	@ 25 °C [77 °F]	24 hours
Full Cure	@ 65°C [149 °F]	30 minutes
Service Temperature		– 65 to +120 °C [–85 to +248 °F]
Max Coverage for 25 µm [1 mil]		< 12,800 cm <sup>2</sup> [< 13.7 ft <sup>2</sup> ]
<b>Liquid</b>		
Tack Free		3–5 minutes
Recoat Time		2 minutes
Full Cure	@ 25 °C [77 °F]	24 hours
Full Cure	@ 65°C [149 °F]	30 minutes
Service Temperature		– 65 to +120 °C [–85 to +248 °F]
Max Coverage per 1L for 25 µm [1 mil]		< 63,000 cm <sup>2</sup> [< 67.8 ft <sup>2</sup> ]

## CURED PROPERTIES: PHYSICAL

	Test Method	Result
Color	Visual	Crystal Clear
Solderability	—	Excellent
Weather Resistance	—	Excellent
Fungus Resistance	IPC-TM-650 2.6.1.1	Excellent
Flexibility	IPC-TM-650 2.4.5.1	Excellent
Flammability	UL registered	94V-0

## CURED PROPERTIES: ELECTRICAL

	Test Method	Result
Dielectric Withstand Voltage per	IPC-TM-650	> 1,500 V
Insulation Resistance (after 24 hours)	IPC-TM-650 Test 2.6.3.4	5 x 10 <sup>12</sup> Ω

## ENVIRONMENTAL & AGING STUDY

	Test Method	Result
Salt Spray Test: 7 day @35 °C +Salt/Fog	ASTM B117-2011	
Cross-hatch adhesion	ASTM D3359-2009	5B = 0% area removed
Cracking, unwashed area	ASTM D661-93	None
Visual Color, unwashed area	ASTM D1729-96	No change
Peeling, unwashed area	ASTM D1729-96	None

## UNCURED PROPERTIES

	Test Method	Result
Odor	—	Ether-like, gasoline and minty
Viscosity @23 °C [73 °F]	Brookfield SP1	7.2 cP [0.0072 Pa·s]
Density	MIL-STD-45662A	0.874 g/ml
Flash Point	Closed Cup	– 19 °C [– 2.2 °F]
Boiling Point		≥ 66 °C [≥ 150 °F]
Solids Content (w/w)		15.8%

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# PREMIUM ACRYLIC CONFORMAL COATING

Our 419D Acrylic Conformal Coating is a fast drying, xylene and toluene free product that provides an excellent finish. This one part coating is easy to use and repair: it does not require special or costly equipment or materials. It is ideal for high moisture environments and applications requiring easy repair and rework.

The 419D coating protects electric circuits against moisture, dirt, dust, thermal shocks, and scratches that could corrode, short circuit, or otherwise damage the electric components. It insulates against high-voltage arcing, shorts, and static discharges. As well, this coating provides a high dielectric withstand voltage that allows traces to be put closer together helping with miniaturization.

- **No Hazardous Air Pollutants** — free of toluene and xylene
- **Certified UL 94V-0 (File# E202094)**
- **Excellent finish** — smooth, homogeneous, and durable crystal clear coat
- **Protects electronics from moisture, corrosion, fungus, and static discharges**
- **Easy to inspect** — fluoresces under black light (UV light)
- **Easy rework and repairs** — can solder through coat; remove with MG Chemicals' Thinner/Cleaner, Thinner 4, or Conformal Coating Stripper

Catalog Number	Sizes Available	Description
419D-1L	945 mL (32 fl. oz)	Liquid
419D-4L	3.8 L (1 gal)	Liquid
419D-20L	18.9 L (5 gal)	Liquid





## CURING & WORK SCHEDULE

	Test Method	Result
Dry to Touch		10–15 minutes
Shelf Life		3 years
Recoat time		2–3 minutes
Full Cure	@ room temp.	24 hours
Full Cure	@ 65 °C [149 °F]	60 minutes
Storage Temperature Limits		–5 to +40 °C [+23 to +104°F]
Service Temperature		–40 to +120 °C [–40 to +248 °F]
Maximum coverage per liter		≤ 75,500 cm <sup>2</sup> [≤ 62 ft <sup>2</sup> ]
Maximum coverage per US gallon		≤ 286,000 cm <sup>2</sup> [≤ 308 ft <sup>2</sup> ]

## CURED PROPERTIES: PHYSICAL

	Test Method	Result
Color	Visual	Crystal Clear
Solderability	—	Excellent
Weather Resistance	—	Excellent
Fungus Resistance	IPC-TM-650 2.6.1.1	Excellent
Flexibility	IPC-TM-650 2.4.5.1	Excellent
Flammability	In-house 94V testing	94V-0

## CURED PROPERTIES: ELECTRICAL

	Test Method	Result
Dielectric Withstand Voltage	per IPC-TM-650	> 1,500 V
Insulation Resistance (after 24 hours)	IPC-TM-650 Test 2.6.3.4	~ 10 <sup>12</sup> Ω

## UNCURED PROPERTIES

	Test Method	Result
Odor	—	
Viscosity at 23 °C [73 °F]	Brookfield SP1	100 cP [0.10 Pa·s]
Density	ASTM D 1475	0.92 g/ml
Flash Point	Closed Cup	–3 °C [26 °F]
Boiling Point		≥ 80 °C [≥ 176 °F]
Solids Content (w/w)		29.5%



# SILICONE CONFORMAL COATING

Ideal for high temperature environments. Silicone Conformal Coating (422B) is a flexible finish product that provides a protective coating for printed circuit boards against moisture, corrosion, and thermal shock. It protects and insulates electrical and electronic components and assemblies, including generators, motors, transformers, relays, and solenoid coils. For spraying, liquid can be thinned using M.G. Thinner Cleaner. Thin up to one half part thinner to one part coating.

- **Certified UL 94V-0** (File # E203094)
- **Maximum Service Temperature of 200 °C**
- **Fast cure** — tack free in 6 min at room temperature, full cure in 20 min at 65 °C
- **Protects electronics from moisture, corrosion, fungus, thermal shock, and static discharges**
- **Easy to inspect:** fluoresces blue at 437 nm  $\pm$  65 nm under UVA light
- **Extended Shelf Life** avoids worries about premature hardening and wastage
- **Easy rework and repairs:** Solders through the coat removable with Cat. No. 435 Thinner or Cat. No. 8310 Stripper

Catalog Number	Sizes Available	Description
422B-55ML	55 mL (2 oz)	Liquid
422B-340G	340 g (12 oz)	Aerosol
422B-1L	950 mL (1 quart)	Liquid
422B-4L	4 L (1 gal)	Liquid
422B-20L	20 L (5.3 gal)	Liquid
422B-P	5 mL (0.16 oz)	Pen



## CURING & WORK SCHEDULE

	Test Method	Result
<b>Aerosol</b>		
Dry to Touch		5–7 minutes
Shelf life		5 years
Full Cure	@20°C [68 °F]	48 hours
Full Cure	@65°C [149 °F]	20 minutes
Service Temperature		-40 to +200 °C [-40 to +392 °F]
Max Coverage for 25 $\mu$ m [1 mil]		< 26,000 cm <sup>2</sup> [< 28 ft <sup>2</sup> ]
<b>Liquid</b>		
Dry to Touch		5–7 minutes
Shelf life		3 years
Full Cure	@20°C [68 °F]	48 hours
Full Cure	@65°C [149 °F]	20 minutesx
Service Temperature		-40 to +200 °C [-40 to +392 °F]
Max Coverage per 1 L for 25 $\mu$ m [1 mil]		< 109,00 cm <sup>2</sup> [< 117 ft <sup>2</sup> ]



## CURED PROPERTIES: PHYSICAL

	Test Method	Result
Color	Visual	Clear
Solderability	—	Fair
Flexibility		Excellent
Flammability	94V (UL File # E203094)	94V-0
UV inspection absorption max	Absorption spectrum	375 nm (near UV)
UV inspection fluorescence max	Emission spectrum	437 nm (blue)

## CURED PROPERTIES: ELECTRICAL

	Test Method	Result
Dielectric Strength at 0.0150 inches	IPC-TM-650 Test 2.5.6.1	1,056 V/mil
Volume Resistivity @23 °C 50% RH	ASTM D 257-07	$1.2 \times 10^{15} \Omega \cdot \text{cm}$
Surface Resistivity	ASTM D 257-07	$4.5 \times 10^{15} \Omega / \text{sq}$
Dielectric Constant @60 Hz & 25 °C	ASTM D 150-98	2.35
Dielectric Constant @1 MHz & 25 °C	ASTM D 150-98	1.99
Dissipation Factor @60 Hz & 25 °C	ASTM D 150-98	0.037
Dissipation Factor @1 MHz & 25 °C	ASTM D 150-98	0.012

## CURED PROPERTIES: THERMAL

	Test Method	Result
Coefficient of Thermal Expansion	IPC-TM-650 Test 2.4.24	253.3 ppm/°C
Softening Point	IPC-TM-650 Test 2.4.24	31.4 °C [88.5 °F]

## ENVIRONMENTAL & AGING STUDY

	Test Method	Result
Salt Spray Test: 7 day @ 35 °C +Salt/Fog	ASTM B117-2011	
Cross-hatch adhesion	ASTM D3359-2009	5B = 0% area removed
Cracking, unwashed area	ASTM D661-93	None
Visual Color, unwashed area	ASTM D1729-96	No change
Peeling, unwashed area	ASTM D1729-96	None

## UNCURED PROPERTIES

	Test Method	Result
Odor	—	Ethereal
Viscosity at 23°C [73 °F]	Brookfield SP1	13 cP [0.013 Pa·s]
Density		0.90 g/mL
Flash Point	Closed Cup	–18°C [–0.40 °F]
Boiling Point		55 °C [131 °F]
Solids Content (w/w)		27% (liquid); 17% (aerosol)



# POLYURETHANE CONFORMAL COATING

Our 4223 Urethane Conformal Coating offers a highly chemical-resistant finish that meets UL standards for indoor conformal coatings. This one part coating is easy to use: it does not require special or costly equipment to apply. It is ideal for extremely corrosive environments.

The 4223 polyurethane protects electric circuits against corrosive chemicals, moisture, dirt, dust, thermal shocks, and scratches. This avoids corrosion and physical damages to electric components. It also insulates against high-voltage arcing, shorts, and static discharges.

- **Excellent Chemical and Abrasion Resistance**
- **Meets indoor UL conformal coating specifications for a 2 mil thick coat on a 0.8mm, FR-4 laminate**
- **Flammability:** meets UL 94V-1
- **Class F Temperature Rating: 160 °C [320 °F]**
- **Transparent Appearance:** the clear amber coat lets you see problems if they occur
- **Protects electronics from chemical corrosion, oil, moisture, fungus, and static discharges**
- **Good Fungus Resistance**
- **Easy to inspect:** fluoresces under UV light

Catalog Number	Sizes Available	Description
4223-55ML	55 mL (2 oz)	Liquid
4223-1L	950 mL (1 quart)	Liquid
4223-4L	4 L (1 gal)	Liquid
4223-20L	20 L (5.3 gal)	Liquid





## CURING & WORK SCHEDULE

	Test Method	Result
Dry to Touch		30 minutes
Shelf life		3 years
Full Cure	@ 20°C [68 °F]	24 hours
	@ 65°C [149 °F]	60 minutes
Service Temperature		-40 to +160 °C [-40 to +320 °F]
Max Coverage for 25 µm [1 mil]		< 127,000 cm <sup>2</sup> [< 136 ft <sup>2</sup> ]

## CURED PROPERTIES: PHYSICAL

	Test Method	Result
Color	Visual	Clear amber
Solderability	—	Good
Flexibility		Good
Flammability	UL 94	Meets 94V-1
Abrasion Resistance	—	Superior
Fungus Resistance	MIL-V-173C-2	Meets

## CURED PROPERTIES: ELECTRICAL

	Test Method	Result
Dielectric Strength (dry)	ASTM D 115	1,800 V/mil
(wet)	ASTM D 115	1,200 V/mil
Dielectric Withstand Voltage (V)		>1500
Insulation Resistance 24 hr.(ohm)		~10 <sup>12</sup>

## CHEMICAL RESISTANCE

	Test Method	Result
Water	—	Good
Acid (10% sulfuric acid)	—	Excellent
Alkali (1% sodium hydroxide)	—	Excellent
Salt water	—	Excellent
Oil	ASTM D-115	Passed
Copper corrosion	—	None

## UNCURED PROPERTIES

	Test Method	Result
Odor	—	Aromatic
Viscosity at 23°C [73 °F]	Brookfield SP1	200 cP
Density		0.90 g/mL
Flash Point	ASTM D 3278	27 °C [81°F]
Boiling Point		Not established
Solids Content (w/w)		32%
Dry Film Thickness per dip		~25 to 38 µm
Dry Film Thickness per dip		~1 to 1.5 mil

# UR+

# PREMIUM POLYURETHANE CONFORMAL COATING

Our 4223D Premium Polyurethane Conformal Coating is a heat curing, one part product that provides an excellent scratch and chemical resistant finish. This one part coating is easy to use and repair: it does not require special or costly equipment or materials. It is ideal for chemically challenging environments.

The 4223D urethane protects electric circuits against aggressive chemicals, moisture, dirt, dust, thermal shocks, and scratches. This avoids corrosion and physical damages to electric components. It insulates against high-voltage arcing, shorts, and static discharges, allowing for traces to be put closer to one another.

## Applications & Usages

The 4223D coating improves reliability, operational range, and lengthens the life of electrical and electronic components and assemblies. It finds application specially for corrosive environments such as those found in the farming, mining, smelting, oil exploration, and marine industries.

Common urethane conformal coatings uses are with electric generators, motors, transformers, relays, and air bag controllers. Commercial applications include fire alarms components, sensors, automotive electronics, electrical connectors, and porcelains.



- **Type UR**
- **UL Recognized conformal coating (UL 746E File # E203094)**
- **Excellent finish**—smooth, flexible, mar resistant
- **High Chemical Resistance**—resists water, solvents, and most household chemicals
- **Durable**—abrasion resistant
- **Protects electronics from moisture, corrosion, fungus, and static discharges**
- **Easy to inspect**—fluoresces under black light (UV light)
- **Easy rework and repairs**—can solder through coat
- **Removable with MG 8312 Urethane Conformal Coating Stripper**
- **Free of isocyanate**

Catalog Number	Sizes Available	Description
4223D-1L	945 mL (32 fl. oz)	Liquid
4223D-4L	3.8 L (1 gal)	Liquid
4223D-20L	20 L (5 gal)	Liquid



## CURING & WORK SCHEDULE

	Test Method	Result
Dry to Touch		10–15 minutes
Recoat time		2–3 minutes
Full Cure	@ 80 °C [176 °F]	24 hours
Shelf Life		2 years
Storage Temperature Limits		-5 to +40 °C [+23 to +104°F]
Service Temperature		-40 to +145 °C [-40 to +293 °F]
Maximum coverage per liter		≤ 114,000 cm <sup>2</sup> [≤ 123 ft <sup>2</sup> ]
Maximum coverage per US gallon		≤ 435,000 cm <sup>2</sup> [≤ 468 ft <sup>2</sup> ]

## CURED PROPERTIES: PHYSICAL

	Test Method	Result
Color	Visual	Clear, amber tint
Solderability	—	Good
Chemical Resistance	—	Excellent
Weather Resistance	—	Excellent
Fungus Resistance	IPC-TM-650 2.6.1.1	Pending
Flexibility	IPC-TM-650 2.4.5.1	Pending
Flammability	In-house 94V testing	94V-0

## CURED PROPERTIES: ELECTRICAL

	Test Method	Result
Dielectric Strength (Volts/mil)		1,020
Dielectric Withstand Voltage	per IPC-TM-650	> 1,500 V
Insulation Resistance (after 24 hours)	IPC-TM-650 Test 2.6.3.4	~101

## UNCURED PROPERTIES

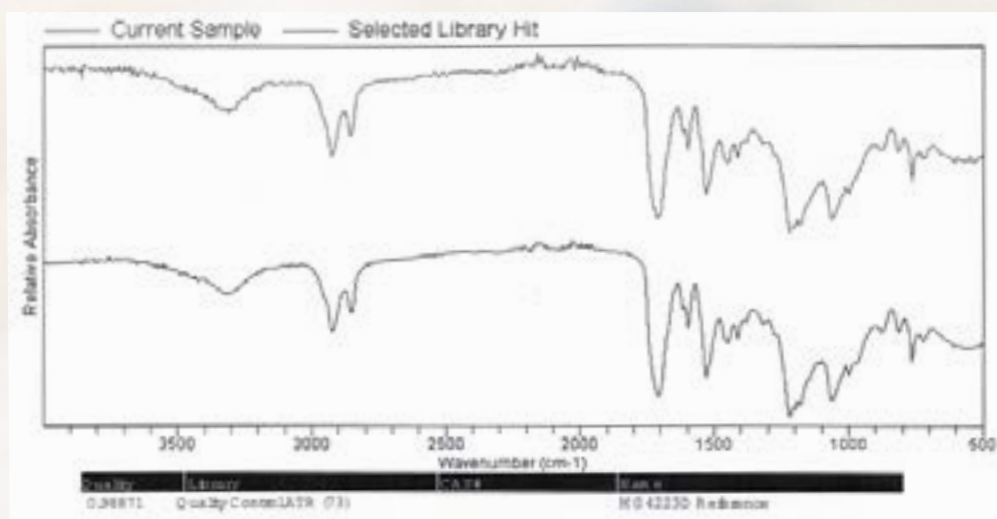
	Test Method	Result
Odor	—	Mild, pungent
Viscosity @25 °C [77 °F]	Brookfield SP1	330 cP [0.330 Pa·s]
Density	ASTM D 1475	0.97 g/ml
Flash Point	Closed Cup	–3 °C [26 °F]
Boiling Point		≥ 80 °C [≥ 176 °F]
Solids Content (w/w)		44.8%

# UR+

## PREMIUM POLYURETHANE CONFORMAL COATING – XYLENE & TOLUENE FREE

Our 4223F Polyurethane Conformal Coating is a xylene-free version of our 4223D Polyurethane Conformal Coating. In its cured state the 4223F is identical to the 4223D coating (see figure 1) and exhibits the same performance. It is a heat curing, one part product that provides an excellent scratch and chemical resistant finish. This one part coating is easy to use and repair: it does not require special or costly equipment or materials. It is ideal for chemically challenging environments.

The 4223F urethane protects electric circuits against aggressive chemicals, moisture, dirt, dust, thermal shocks, and scratches. This avoids corrosion and physical damages to electric components. It insulates against high-voltage arcing, shorts, and static discharges, allowing for traces to be put closer to one another.



- **Certified UL 94V-0 (File # E203094)**
- **Excellent finish**—smooth, flexible, mar resistant
- **High Chemical Resistance**—resists water, solvents, and most household chemicals
- **Durable**—abrasion resistant
- **Protects electronics from moisture, corrosion, fungus, and static discharges**
- **Easy to inspect**—fluoresces under black light (UV light)
- **Easy rework and repairs**—can solder through coat; removable with MG 8312 **Conformal Coating Stripper**
- **Free of isocyanate**

Catalog Number	Sizes Available	Description
4223F-1L	945 mL (32 fl. oz)	Liquid
4223F-4L	3.8 L (1 gal)	Liquid
4223F-20L	20 L (5 gal)	Liquid



## CURING & WORK SCHEDULE

	Test Method	Result
Dry to Touch	@ 80 °C [176 °F]	10–15 minutes
Recoat Time		2–3 minutes
Full Cure		24 hours
Shelf Life		1 year
Storage Temperature Limits		–5 to +40 °C [+23 to +104°F]
Service Temperature		–40 to +145 °C [–40 to +293 °F]
Maximum coverage per liter		≤ 114,000 cm <sup>2</sup> [≤ 123 ft <sup>2</sup> ]
Maximum coverage per US gallon		≤ 435,000 cm <sup>2</sup> [≤ 468 ft <sup>2</sup> ]

## CURED PROPERTIES: PHYSICAL

	Test Method	Result
Color	Visual	Clear, amber tint
Solderability	—	Good
Chemical Resistance	—	Excellent
Weather Resistance	—	Excellent
Fungus Resistance	IPC-TM-650 2.6.1.1	Pass
Flexibility	IPC-TM-650 2.4.5.1	Pass
Flammability	In-house 94V testing	94V-0

## CURED PROPERTIES: ELECTRICAL

	Test Method	Result
Dielectric Strength (Volts/mil)		1,020
Dielectric Withstand Voltage	per IPC-TM-650	> 1,500 V
Insulation Resistance (after 24 hours)	IPC-TM-650 Test 2.6.3.4	~10 <sup>12</sup> Ω

## UNCURED PROPERTIES

	Test Method	Result
Odor	—	Mild, pungent
Viscosity @25 °C [77 °F]	Brookfield SP1	330 cP [0.330 Pa·s]
Density	ASTM D 1475	0.88 g/ml
Flash Point	Closed Cup	–3 °C [26 °F]
Boiling Point		≥ 80 °C [≥ 176 °F]
Solids Content (w/w)		44.8%





# OPTICALLY CLEAR CONFORMAL COATING EPOXY

Our 4224 Optically Clear Conformal Coating Epoxy offers a very strong and UV-resistant finish. This two part coating is easy to use: it does not require special or costly equipment to apply.

The 4224 epoxy coating protects electric circuits against corrosive chemicals, moisture, dirt, dust, thermal shocks, and scratches. This avoids corrosion and physical damages to electric components. It also insulates against high-voltage arcing, shorts, and static discharges.

## Applications & Usages

The 4224 Optically Clear Conformal Coating Epoxy improves reliability, operational range, and lengthens the life of electronic and LED parts. You will find it mainly in corrosive environments such as farming, mining, smelting, oil exploration, and marine industries. As well, it applies to any other areas where corrosion must be avoided.

Common epoxy conformal coatings industrial uses are with electric generators, motors, transformers, relays, and equipment controllers. Commercial applications span fire alarms, sensors, automotive electronics, electrical connectors, and porcelains.

- **Excellent Chemical and Abrasion Resistance**
- **Optically Clear:** Transmission @25 µm [1 mil] <4.5% loss in optical range
- **UV light stable:** non yellowing
- **Protects electronics from chemicals corrosion, oil, moisture, fungus, and static discharges**

Catalog Number	Sizes Available	Description
4224-1	1125 mL (38 fl. oz)	Liquid
4224-2	4.5 L (1.2 gal)	Liquid
4224-3	18.9 L (10.7 gal)	Liquid

## CURING & WORK SCHEDULE

	Test Method	Result
Working Pot Life	@ 25 °C [77 °F]	3 hours
Full Cure	@ 80 °C [172 °F]	2 hours
Storage Temperature		25 °C [77 °F]
Service Temperature		-40 to +100 °C [-40 to +212 °F]
Maximum Withstand Temperature		+115 °C [+239 °F]
Maximum coverage per gallon for 50 µm [2 mil]		< 840,000 cm <sup>2</sup> [< 910 ft <sup>2</sup> ]

## CURED PROPERTIES: PHYSICAL

	Test Method	Result
Color	Visual	Clear
Solderability	—	No
Abrasion Resistance	—	Superior
Fungus Resistance	—	Good
UV Resistant	—	Yes
Optical Transmission Loss @ 25 µm (1 mil)	UV-Vis Spectrophotometer	< 4.5%

## CURED PROPERTIES: ELECTRICAL

	Test Method	Result
Dielectric Strength (dry)	ASTM D149	600 volts/mil

## CURED PROPERTIES: THERMAL

	Test Method	Result
Glass Transition Temperature	ASTM D 115 113 °C	
Thermal Cycling Stability	-40 to 200 °C	Passed
Thermal Stability 24 h @ 80 °C on Cu/Al substrates		No yellowing
Thermal Stability 96 h @ 100 °C on Cu/Al substrates		Slight yellowing

## CURED PROPERTIES: CHEMICAL RESISTANCE

	Test Method	Result
Water	—	Good
Acid (10% sulfuric acid)	—	Excellent
Alkali (1% sodium hydroxide)	—	Excellent
Salt Water	—	Excellent
Copper Corrosion	—	None expected

## UNCURED PROPERTIES

	Part A	Part B	Mixed
Color	Colorless	Colorless	Colorless
Viscosity	120 cP [0.12 Pa·s]	20 cP [0.020 Pa·s]	73 cP [0.073 Pa·s]
Density	1.06 g/mL	0.92 g/mL	1.03 g/mL
Flash Point	150 °C [302 °F]	112 °C [234 °F]	
% solids	~ 85%	100%	
Odor	Aromatic, sweet	Ammonia like	
Typical Dry Film Thickness			50 µm [2 mil]
Mix Ratio by weight (A:B)			4 : 1
Mix Ratio by volume (A:B)			4 : 1



# THINNER SELECTION CHART

Typical Properties	Thinner	Thinner 1	Thinner 2	Thinner 3	Thinner 4
Stock Code Prefix	435	4351	4352	4353	4354
Evaporation Rate	Fast	Moderate	Fast	Moderate	Moderate
Aggressiveness	High	Low (for sensitive plastics)	Moderate	High	High
Key Features	Non-HAP Low VOC Fast Dry Xylene Free	Non-HAP Plastic safe Xylene Free	Non-HAP Xylene and Toluene Free Biodegradable	High solvent power Moderate dry time Great for dip and brush applications	High solvent power Moderate dry time







# THINNER

The 435 Thinner is a super fast drying thinner, low VOC solvent for use with the MG Chemical's conformal and EMI/RFI shielding coating products. It is designed to ensure good adherence to plastic substrates.

## Applications

This fast drying time of the 435 makes is a good choice for spray application of EMI/RFI shielding and conformal coatings that require low VOC and need quick drying times.

Catalog Number	Sizes Available	Description
435-55ML	55 mL (2 oz)	Liquid
435-1L	945 mL (32 fl. oz)	Liquid
435-4L	3.8 L (1 gal)	Liquid

- **Low VOC**
- **Fast Evaporation Rate**
- **Enhances Adhesion to Plastic Substrates**
- **Highly Miscible with Other Common Organic Solvents**
- **Compatible with most substrates used in electronic parts and enclosures**

## PROPERTIES

	Test Method	Result
Color		Clear
Odor	—	Ketone, nail polish remover
Density at 25°C [77 °F]		0.81 g/mL
Viscosity at 25°C [77 °F]	Brookfield SP1	0.5 cP [0.0005 Pa·s]
Flash Point	Closed Cup	-18 °C [-0.4 °F]
Freezing Point		-94 °C [-70 °F]
Boiling Point		56 °C [133 °F]
Vapor Pressure at 25°C [77 °F]		21.7 kPa [163 mm of Hg]
Relative Evap. Rate (BuAc = 1)		~ 6
Volatile Organic Content (VOC)		7.5% [60 g/mL]
MIR value		0.52 g O <sup>3</sup> /g of product

## SOLVATION PARAMETERS

	Test Method	Result
Solubility in water		Highly soluble
Hansen Solubility Parameters (cal/cm <sup>3</sup> ) <sup>½</sup> ; [MPa] <sup>½</sup>	Total	9.7 [19.8]
	Non-Polar	7.3 [14.9]
	Polar	5.1 [10.3]
	Hydrogen Bonding	3.3 [6.8]

# T1

## THINNER 1

The 4351 Thinner 1 is a mild diluents designed for MG Chemical's EMI/RFI shielding products.

### Applications & Usages

This thinner is used to dilute EMI/RFI shielding coatings that require mild, plastic safe solvents. When preparing a surface to be painted, this solvent is also effective at removing various contaminants like oil and greasy flux residues without harming the substrate.

- **Plastic Safe:** compatible with most sensitive substrate used in electronic parts and enclosures
- **Moderately Fast Evaporation Rate**

Catalog Number	Sizes Available	Description
4351-1L	945 mL (32 fl. oz)	Liquid
4351-4L	3.8 L (1 gal)	Liquid

## PROPERTIES

	Test Method	Result
Color		Clear
Odor	—	Rubbing alcohol
Viscosity at 25°C [77 °F]	Brookfield SP1	~1 cP [0.01 Pa·s]
Density at 25°C [77 °F]		0.80 g/mL
Flash Point	Closed Cup	15°C [59 °F]
Boiling Point		65 °C [149 °F]
Vapor Pressure at 25°C [77 °F]		7.5 kPa [56 mm of Hg]
Volatile Organic Content (VOC)		100% [800 g/mL]

# T2 THINNER 2

The 4352 Thinner 2 is a moderately fast drying thinner for use with MG Chemical's conformal products. It is compatible with film forming paint products with acrylic, alkyd, cellulose acetate butyrate, epoxy, nitrocellulose, or polyester resins. Together with these type of resin systems, the 4352 thinner promotes good flow properties and suppresses blushing.

- **Plastic Safe:** compatible with most sensitive substrate used in electronic parts and enclosures
- **Blush Resistant**
- **Moderate Evaporation Rate**
- **Excellent Leveling and Gloss**
- **Not Classified as a "Hazardous Air Pollutant"**
- **Highly Miscible with Other Common Organic Solvents**

Catalog Number	Sizes Available	Description
4352-1L	945 mL (32 fl. oz)	Liquid
4352-4L	3.8 L (1 gal)	Liquid

## PROPERTIES

	Test Method	Result
Color		Clear
Odor	—	fruity
Density at 25°C [77 °F]		0.883 g/mL
Viscosity at 25°C [77 °F]	Brookfield SP1	28 cP [0.028 Pa·s]
Flash Point Tag	Closed Cup	27°C [81 °F]
Freezing Point		-77 °C [126 °F]
Boiling Point		127 °C [257 °F]
Vapor Pressure at 25°C [77 °F]		1.33 kPa [10.0 mm of Hg]
Relative Evap. Rate (BuAc = 1)		1
Volatile Organic Content (VOC)		100% [883 g/mL]
MIR value		0.78

## SOLVATION PARAMETERS

	Test Method	Result
Solubility in water (%wt)		0.7%
Solubility for water (%wt)		1.6%
Hansen Solubility Parameters (cal/cm <sup>3</sup> ) <sup>½</sup> ; [MPa] <sup>½</sup>	Total	17.2 [8.4]
	Non-Polar	15.3 [7.5]
	Polar	3.2 [1.6]
	Hydrogen Bonding	6.8 [3.3]
Dielectric constant @20 °C		5.07



# T3 THINNER 3

The 4353 Thinner 3 is a moderate speed drying thinner for use with the MG Chemical's conformal products. The thinner promotes good flow properties and suppresses blushing.

## Applications

The moderate speed drying time of the 4353 makes it a good choice for dip or brush application of acrylic conformal coatings like the MG 419D.

- **Blush Resistant**
- **Fast Evaporation Rate**
- **Excellent Leveling and Gloss**
- **Highly Miscible with Other**
- **Common Organic Solvents Compatible with most substrates used in electronic parts and enclosures**

Catalog Number	Sizes Available	Description
4353-1L	945 mL (32 fl. oz)	Liquid
4353-4L	3.8 L (1 gal)	Liquid

## PROPERTIES

	Test Method	Result
Color		Clear
Odor	—	sharp, aromatic l
Density at 25°C [77 °F]		0.85 g/mL
Viscosity at 25°C [77 °F]	Brookfield SP1	0.5 cP [0.0005 Pa·s]
Flash Point Tag	Closed Cup	-1 °C [30 °F]
Freezing Point		≤ 86 °C [≤ 66 °F]
Boiling Point		82 °C [180 °F]
Vapor Pressure at 25°C [77 °F]		6.05 kPa [45.4 mm of Hg]
Relative Evap. Rate (BuAc = 1)		3.77
Volatile Organic Content (VOC)		100% [850 g/mL]
MIR value		3.15

## SOLVATION PARAMETERS

	Test Method	Result
Solubility in water		slightly soluble
Hansen Solubility Parameters	Total	9.0 [18.3]
(cal/cm <sup>3</sup> ) <sup>½</sup> ; [MPa] <sup>½</sup>	Non-Polar	8.4 [17.2]
	Polar	1.9 [3.8]
	Hydrogen Bonding	1.5 [3.0]



# THINNER 4

The 4354 Thinner 4 is a slower drying thinner for use with the MG Chemical's urethane and acrylic conformal products. The thinner has excellent solvent strength, making it a good oil and grease remover. It has very low water solubility, so it is unlikely to absorb water and create blush. Its drying speed is slow enough to promote excellent leveling, but it is fast enough to accommodate a reasonable assembly line speed.

## Applications

The 4354 makes is a good choice for spray application.

- **Blush Resistant**
- **Slow Evaporation Rate**
- **Good Leveling and Gloss**
- **Highly Miscible with Other Common Organic Solvents**
- **Compatible with most substrates used in electronic parts and enclosures**

Catalog Number	Sizes Available	Description
4354-1L	945 mL (32 fl. oz)	Liquid
4354-4L	3.8 L (1 gal)	Liquid

## PROPERTIES

	Test Method	Result
Color		Clear
Odor	—	sharp, aromatic
Density at 25°C [77 °F]		0.87 g/mL
Viscosity at 25°C [77 °F]	Brookfield SP1	~0.6 cP [0.0006 Pa·s]
Flash Point Tag	Closed Cup	27 °C [81 °F]
Freezing Point		Not established
Boiling Point		137 °C [279 °F]
Vapor Pressure at 25°C [77 °F]		2.6 kPa [19 mm of Hg]
Relative Evap. Rate (BuAc = 1)		0.60
Volatile Organic Content (VOC)		100 % [868 g/mL]
Product weighted MIR value		4.08

## SOLVATION PARAMETERS

	Test Method	Result
Solubility in water		insoluble
Hansen Solubility Parameters	Total	8.8 [17.9]
(cal/cm <sup>3</sup> ) <sup>½</sup> ; [MPa] <sup>½</sup>	Non-Polar	8.6 [17.7]
	Polar	0.5 [1.0]
	Hydrogen Bonding	1.3 [2.6]

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