

# Information About *Dow Corning*<sup>®</sup> brand Conformal Coatings

## Silicones and Electronics

Long-term, reliable protection of sensitive circuits and components is becoming more important in many of today's delicate and demanding electronic applications. Silicones function as durable dielectric insulation, as barriers against environmental contaminants and as stress-relieving shock and vibration absorbers over a wide temperature and humidity range.

In addition to sustaining their physical and electrical properties over a broad range of operating conditions, silicones are resistant to ozone and ultraviolet degradation, have good chemical stability and are available in a variety of useful forms as conformal coatings, encapsulants and adhesives. Dow Corning's broad range of general purpose and specialty products offers you a choice of materials for your application needs.

Dow Corning's line of conformal coatings includes three basic families. The newest of these, the RTV Elastomeric Coatings, are designed to provide fast to very fast room temperature curing in a soft, stress-relieving material. The next group, the RTV Elastoplastic Coatings, are either traditional or ozone-safe solvent-based coatings that provide good abrasion resistance with the expected good board protection. The third group, the Solventless Heat Cure Coatings, are fast heat-curing one-part coatings that again combine excellent protection in a soft, stress-relieving material. All conformal coatings contain a UV indicator enabling blacklight visualization of the coating.

### RTV Elastomeric Coatings

#### Type

Non-corrosive, one-part, solventless, RTV moisture curing silicone elastomer; most are fast cure

#### Physical Form

Translucent liquid available in different viscosities

#### Special Properties

Heat accelerable; transparent to translucent; resists humidity and other harsh environments; good dielectric properties

#### Primary Uses

Low-stress protective coating for rigid and flexible PWBs

### RTV Elastoplastic Coatings

#### Type

One-part RTV silicone resins

#### Physical Form

Translucent liquid, cures to clear elastoplastic resin

#### Special Properties

Heat accelerable; abrasion resistant; resists humidity and other harsh environments; good dielectric properties

#### Primary Uses

Abrasion resistant protective coating for rigid and flexible PWBs, plus a variety of ceramic and hybrid circuits, components, connectors and connections

### Solventless Heat Cure Coatings

#### Type

One-part solventless silicone elastomer

#### Physical Form

Translucent liquid

#### Special Properties

Fast thermal cure; transparent; resists humidity and other harsh environments; good dielectric properties; self-priming adhesion

#### Primary Uses

Protective coating for rigid and flexible printed circuit boards

<b>Dow Corning® brand Product</b>	<b>Description</b>	<b>Features</b>
<b>RTV Elastomeric Conformal Coatings</b>		
3-1753 Conformal Coating	A fast room-temperature vulcanizing (RTV), solventless, silicone elastomer	One-part, medium viscosity; solventless silicone; fast RTV or heat-accelerable cure; transparent
3-1765 Conformal Coating	A lower viscosity version of <i>Dow Corning®</i> 3-1753 Conformal Coating to provide easier spray and for lower thickness dip coating applications	One-part, low viscosity; solventless silicone; fast RTV or heat-accelerable cure; transparent
3-1744 Conformal Coating	A solventless, higher viscosity, tougher, more abrasion-resistant version of <i>Dow Corning®</i> 3-1753 Conformal Coating	One part; high viscosity; non-corrosive; solventless; fast RTV moisture cure; heat accelerable; translucent
3-1953 Conformal Coating	A fast room-temperature vulcanizing (RTV), solventless, silicone elastomer	One-part, medium viscosity; solventless silicone; fast RTV or heat-accelerable cure; light-straw/translucent
3-1965 Conformal Coating	A lower viscosity version of <i>Dow Corning®</i> 3-1953 Conformal Coating to provide easier spray and for lower thickness dip coating applications	One-part, low viscosity; solventless silicone; fast RTV or heat-accelerable cure; light-straw/translucent
3-1944 Conformal Coating	A solventless, higher viscosity, tougher, more abrasion-resistant version of <i>Dow Corning®</i> 3-1953 Conformal Coating	One part; high viscosity; non-corrosive; solventless; fast RTV moisture cure; heat accelerable; light-straw/translucent
3140 RTV Coating	A higher viscosity, self-leveling, ready-to-use, room-temperature vulcanizing silicone elastomer	One part; high viscosity; clear; non-corrosive cure; self-leveling; solventless RTV coating
<b>RTV Elastoplastic Conformal Coatings</b>		
1-2577 RTV Coating	A solvent-borne, one compont, transparent silicone resin	One-part, medium viscosity; solvent-borne, elastoplastic silicone resin; excellent abrasion resistance; RTV or heat-accelerable cure
1-2577 Low VOC RTV Coating	A more environmentally friendly version of <i>Dow Corning®</i> 1-2577 Conformal Coating	One-part, medium viscosity; ozone-safe (VOC exempt) solvent-borne, elastoplastic silicone resin; excellent abrasion resistance; RTV or heat-accelerable cure
1-2620 RTV Coating	A lower viscosity version of <i>Dow Corning®</i> 1-2577 Conformal Coating. Cured films of <i>Dow Corning®</i> 1-2620 RTV Coating are identical to cured films of <i>Dow Corning®</i> 1-2577 Conformal Coating.	One-part, lower viscosity; lower % solids; solvent-borne, elastoplastic silicone resin; excellent abrasion resistance; RTV or heat-accelerable cure
1-2620 Low VOC RTV Coating	A more environmentally friendly version of <i>Dow Corning®</i> 1-2620 RTV Coating	One-part, lower viscosity; lower percent solids; ozone safe (VOC exempt) solvent-borne, elastoplastic silicone resin; excellent abrasion resistance; RTV or heat-accelerable cure
<b>Solventless Heat Cure Conformal Coatings</b>		
Q1-4010 Conformal Coating	A solventless, medium viscosity, heat cure, transparent coating	One part, solventless elastomer; heat curable; good dielectric properties; resists severe humidity and other harsh environments; self-priming
1-4105 Conformal Coating	A lower viscosity, lower temperature and faster curing, heat cure, transparent coating	One part, solventless elastomer; fast thermal cure; transparent; resists humidity and other harsh environments; good dielectric properties

<b>Dow Corning® brand Product</b>	<b>Potential Uses</b>	<b>Application Methods</b>	<b>Cure</b>
<b>RTV Elastomeric Conformal Coatings</b>			
3-1753 Conformal Coating	Protective coating for rigid and flexible circuit boards. These fast curing, one-part, self-priming coatings cure to flexible, transparent elastomers ideally suited for electronic printed wiring board (PWB) applications, particularly those employing sensitive components and fine pitch designs.	Applied by spray, brush, flow, or some automated pattern coating. May be dip coated with special precautions.	Time to cure is dependent on several variables including the method of application, film thickness, temperature and humidity. Tack free time in the data table gives an indication of typical times until surface is dry enough to handle. Cure time for full cure are indications of time needed to develop full physical properties such as durometer, tensile strength or adhesion. These times, including full cure time, can be significantly improved by introducing mild heat of 60°C or less.
3-1765 Conformal Coating		Applied by spray, brush, flow or automated pattern coating requiring lower viscosity material. May be dip coated with special precautions.	
3-1744 Conformal Coating	Designed to provide excellent pin/solder joint coverage and thin section encapsulation. This fast-curing, one-part, self-priming coating cures to a flexible, translucent elastomer.	Applied by brush or flow coating or syringe dispensed for spot protection of pins or other devices.	
3-1953 Conformal Coating	Protective coating for rigid and flexible circuit boards. These fast curing, one-part, self-priming coatings cure to flexible, transparent elastomers ideally suited for electronic printed wiring board (PWB) applications, particularly those employing sensitive components and fine pitch designs.	Applied by spray, brush, flow, or some automated pattern coating. May be dip coated with special precautions.	
3-1965 Conformal Coating		Applied by spray, brush, flow or automated pattern coating requiring lower viscosity material. May be dip coated with special precautions.	
3-1944 Conformal Coating	Designed to provide excellent pin/solder joint coverage and thin section encapsulation. This fast-curing, one-part, self-priming coating cures to a flexible, translucent elastomer.	Applied by brush or flow coating or syringe dispensed for spot protection of pins or other devices.	
3140 RTV Coating	Supplied at a higher viscosity, this material cures to a tough, abrasion-resistant elastomer for improved pin/solder joint coverage and thin-section encapsulation.		
<b>RTV Elastoplastic Conformal Coatings</b>			
1-2577 RTV Coating	Protective coating for rigid and flexible circuit boards. These one-part, self-priming coatings cure to flexible, transparent elastoplastic coatings ideally suited for electronic printed wiring board (PWB) applications, particularly those requiring toughness and abrasion resistance.	Applied by spray, brush, flow, dip or automated pattern coating. For spraying operations, solvent dilution of up to 60% is recommended. For dip coating operations, material may be used as is or solvent diluted if thinner film build is desired. Care should be taken to ensure the solvent is free from moisture and dip tanks should be covered when not in use. For dilution of low VOC coatings, <i>Dow Corning®</i> OS-20 Fluid is recommended.	The time required to reach a tack-free state can be reduced with heat. When using heat for this purpose, allow adequate time for the solvent to evaporate prior to exposing to elevated temperatures in an air circulating oven. A typical cure schedule for 3 mil coatings is 10 minutes at room temperature, followed by 10 minutes at 80°C. If the coating blisters or contains bubbles, allow additional time at room temperature for the solvent to flash off prior to oven cure.
1-2577 Low VOC RTV Coating			
1-2620 RTV Coating			
1-2620 Low VOC RTV Coating			
<b>Solventless Heat Cure Conformal Coatings</b>			
Q1-4010 Conformal Coating	Protective coating for rigid and flexible circuit boards. These heat cure, one-part, self-priming coatings cure to flexible, transparent elastomers ideally suited for electronic printed wiring board (PWB) applications, particularly those employing sensitive components and fine pitch designs.	Applied by dip, spray, brush, flow or automated pattern coating. The stable bath life of these materials makes them ideal for dip coating applications.	Time to cure is dependent on film thickness, type of oven, and board population density. Heat cure time in the data table gives an indication of typical times after the coating is heated to the temperature indicated. Highly populated, large, heavy boards may take longer than the indicated times due to the large thermal mass taking extra time to warm up.
1-4105 Conformal Coating			

## TYPICAL PROPERTIES

Specification Writers: Please contact your local Dow Corning sales office or your Global Dow Corning Connection before writing specifications on this product.

Dow Corning® brand Product	Product Form	Color	Viscosity, centipoise or mPa-s	Durometer	Specific Gravity	RT Tack Free Time, minutes	RT Cure Time, hours <sup>1</sup>	Heat Cure Time, minutes <sup>2</sup>	UL Reference <sup>3</sup>	
									Flammability Classification	UL 746C Approval
RTV Elastomeric Conformal Coatings										
3-1753 Conformal Coating	1-part RTV cure	Clear	385	25 A	0.99	8	24 @ 25°C	NA	94 V-1 <sup>4</sup>	Yes
3-1765 Conformal Coating	1-part RTV cure	Clear	150	25 A	1.03	8	24 @ 25°C	NA	94 V-1 <sup>4</sup>	Yes
3-1744 Conformal Coating	1-part RTV cure	Translucent	60,000	35 A	1.04	15	24 @ 25°C	NA	94 V-0 <sup>5</sup>	Yes
3-1953 Conformal Coating	1-part RTV cure	Lt. straw/translucent	360	26 A	0.99	10	24 @ 25°C	NA	Pending	Pending
3-1965 Conformal Coating	1-part RTV cure	Lt. straw/translucent	110	29 A	0.99	5	24 @ 25°C	NA	Pending	Pending
3-1944 Conformal Coating	1-part RTV cure	Lt. straw/translucent	60,000	29 A	1.03	13	24 @ 25°C	NA	Pending	Pending
3140 RTV Coating	1-part RTV cure	Translucent	30,000	32 A	1.03	70	72 @ 25°C	NA	94 V-1 <sup>4</sup> Pending	Yes
RTV Elastoplastic Conformal Coatings										
1-2577 RTV Coating	1-part RTV cure	Clear	725	23 D	1.04	20	72 @ 25°C	10 @ RT followed by 10 @ 80°C	94 V-0 <sup>4,6</sup> , 94 HB <sup>6,7</sup>	Yes <sup>6</sup>
1-2577 Low VOC RTV Coating	1-part RTV cure	Clear	1250	25 D	0.88	20	72 @ 25°C	NA	94 V-0 <sup>5</sup>	Yes
1-2620 RTV Coating	1-part RTV cure	Clear	135	25 D	1.00	20	72 @ 25°C	10 @ RT followed by 10 @ 80°C	94 V-0 <sup>4</sup> , 94 HB <sup>7</sup>	Yes
1-2620 Low VOC RTV Coating	1-part RTV cure	Clear	250	25 D	0.88	20	72 @ 25°C	NA	94 V-0 <sup>4</sup> , 94 HB <sup>7</sup>	Yes
Heat Cure Conformal Coatings										
Q1-4010 Conformal Coating	1-part heat cure	Clear	830	30 A	1.00	NA	NA	15 @ 110°C	94 V-1 <sup>8</sup>	Yes
1-4105 Conformal Coating	1-part heat cure	Clear	470	65 OO	0.97	NA	NA	10 @ 105°C	94 V-1 <sup>4</sup>	Yes

<sup>1</sup>Typical for a 5-mil thickness sample in 180° peel.

<sup>2</sup>Time to cohesive failure on a 180° peel strip. Coating strength may continue to improve with time.

<sup>3</sup>All materials have electrical and mechanical relative temperature index ratings of 105°C. All materials are listed in "Coatings for Use on Recognized Printed Wiring Boards," Section QMJU2, under Dow Corning file E-81611 (N).

<sup>4</sup>Product tested on FR-4, CEM-1 and CEM-3 printed wiring boards.

<sup>5</sup>Product tested on FR-4, CEM-1, CEM-3, G-10 and G-11 printed wiring boards.

<sup>6</sup>Application of Dow Corning® 1204 Primer required to achieve rating indicated.

<sup>7</sup>Product tested on G-10 and G-11 printed wiring boards.

<sup>8</sup>Product tested on FR-4 printed wiring board.

<b>Dow Corning® brand Product</b>	<b>Mil Spec<sup>9</sup></b>		<b>Dielectric Strength</b>		<b>Dielectric Constant at 100Hz</b>	<b>Dielectric Constant at 100 kHz</b>	<b>Volume Resistivity, ohm-cm</b>	<b>Dissipation Factor at 100 Hz</b>	<b>Dissipation Factor at 100 kHz</b>	<b>Shelf Life from Date of Manufacture at Room Temp, months</b>
	<b>Specification</b>	<b>Type, Class, Group</b>	<b>volts/mil</b>	<b>kV/mm</b>						
<b>RTV Elastomeric Conformal Coatings</b>										
3-1753 Conformal Coating	MIL-I-46058C, Amend. 7	Type SR, QPL	380	15.0	2.51	2.5	1.0 x 10 <sup>15</sup>	0.001	<0.001	12
3-1765 Conformal Coating	MIL-I-46058C, Amend. 7	Type SR, QPL	400	15.8	2.59	2.59	2.1 x 10 <sup>15</sup>	0.001	<0.001	12
3-1744 Conformal Coating	MIL-I-46058C, Amend. 7	Type SR, QPL	590	23.2	2.56	2.55	2.5 x 10 <sup>15</sup>	0.001	<0.001	12
3-1953 Conformal Coating	Pending IPC-CC-830A		410	16.1	2.49	2.52	1.6 x 10 <sup>15</sup>	0.0007	<0.0002	12
3-1965 Conformal Coating	Pending IPC-CC-830A		450	17.8	2.5	2.53	5.7 x 10 <sup>14</sup>	0.001	<0.0002	12
3-1944 Conformal Coating	Pending IPC-CC-830A		425	16.7	2.63	2.73	1.3 x 10 <sup>15</sup>	0.0013	<0.0002	12
3140 RTV Coating	MIL-I-46058C, Amend. 7	Type SR, QPL	445	17.5	2.52	2.52	2.1 x 10 <sup>14</sup>	0.004	<0.001	12
<b>RTV Elastoplastic Conformal Coatings</b>										
1-2577 RTV Coating	MIL-I-46058C, Amend. 7	Type SR, QPL	400	15.8	2.74	2.74	5.0 x 10 <sup>13</sup>	0.0042	<0.001	36
1-2577 Low VOC RTV Coating	MIL-I-46058C, Amend. 7 Pending	Type SR, QPL	340	13.4	2.34	2.33	1.9 x 10 <sup>14</sup>	0.0011	<0.001	36
1-2620 RTV Coating	MIL-I-46058C, Amend. 7	Type SR, QPL	450	17.7	2.55	2.54	7.4 x 10 <sup>13</sup>	0.0025	<0.001	12
1-2620 Low VOC RTV Coating	MIL-I-46058C, Amend. 7 Pending	Type SR, QPL	410	16.2	2.49	2.48	1.05 x 10 <sup>15</sup>	0.002	<0.004	12
<b>Heat Cure Conformal Coatings</b>										
Q1-4010 Conformal Coating	MIL-I-46058C, Amend. 7	Type SR, QPL	530	20.9	2.64	2.66	5.8 x 10 <sup>14</sup>	0.001	<0.001	12
1-4105 Conformal Coating	—	—	500	19.7	2.63	2.63	2.7 x 10 <sup>13</sup>	<0.001	<0.001	2 @ 25°C; 6 @ 10°C

<sup>9</sup>Coatings presently qualified to MIL-I-46058C shall also be recognized as meeting the requirements of IPC-CC-830A.

## POT LIFE AND CURE RATE

The pot life of *Dow Corning* RTV Conformal Coatings is dependent on the application method chosen. To extend pot life, minimize exposure to moisture by using dry air or dry nitrogen blanketing whenever possible.

The pot life of *Dow Corning* Heat Cure Conformal Coatings is also dependent on the conditions with which they are processed, but is typically greater than 2 months. Dip tanks or containers should be closed and sealed when not in use. Tank temperatures should be maintained at less than 29°C (85°F) to maximize pot life.

## REPAIRABILITY

In the manufacture of electronic devices it is often desirable to salvage or reclaim damaged or defective units. *Dow Corning* Conformal Coatings offer excellent repairability in that they can be removed from substrates and circuitry by scraping or cutting. Removal may be assisted by the application of solvents or stripping agents. If only one circuit component is to be replaced, a soldering iron may be applied directly through the coating to remove the component.

After the circuit board has been repaired, the area should be cleaned by brushing or by using solvent, then dried and recoated with the original coating, as the coatings have very good adhesion to themselves. Heat cure coatings can be repaired with RTV coatings but heat cure coatings may not work well when used to repair RTV coatings.

## COMPATIBILITY

Certain materials, chemicals, curing agents and plasticizers can inhibit the cure of *Dow Corning*® Q1-4010 and 1-4105 Conformal Coatings. Most notable of these include:

- Organotin and other organometallic compounds
- Silicone rubber containing organotin catalyst
- Sulfur, polysulfides, polysulfones or other sulfur-containing material

- Amines, urethanes or amine-containing materials
- Unsaturated hydrocarbon plasticizers
- Some solder flux residues

If a substrate or material is questionable with respect to potentially causing inhibition of cure, it is recommended that a small scale compatibility test be run to ascertain suitability in a given application. The presence of liquid or uncured product at the interface between the questionable substrate and the cured gel indicates incompatibility and inhibition of cure.

## ADHESION

*Dow Corning* Conformal Coatings are formulated to provide adhesion to most common electronic substrates and materials. With heat cure coatings, the adhesion is complete with the full cure time and temperature. With RTV cure coatings, adhesion typically lags cure and may take 72 hours to build in some coatings. On certain difficult, low-surface-energy surfaces, adhesion may be improved by priming or by special surface treatment such as chemical or plasma etching.

## USEFUL TEMPERATURE RANGES

For most uses, silicone elastomers (including 3-1753, 3-1765, 3-1744, 3-1953, 3-1965, 3-1944, 3140, Q1-4010 and 1-4105 coatings) should be operational over a temperature range of -45 to 200°C (-49 to 392°F) for long periods of time. However, at both the low and high temperature ends of the spectrum, behavior of the materials and performance in particular applications can become more complex and require additional considerations.

For low-temperature performance, thermal cycling to conditions such as -55°C (-67°F) may be possible, but performance should be verified for your parts or assemblies. Factors that may influence performance are configuration and stress sensitivity of components, cooling rates and hold times, and prior temperature history. RTV elastoplastic coatings maintain performance at -65°C (-85°F) and below.

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At the high-temperature end, the durability of the cured silicone elastomer is time and temperature dependent. As expected, the higher the temperature, the shorter the time the material will remain useable.

#### **STORAGE AND SHELF LIFE**

Shelf life is indicated by the “Use Before” date found on the product label.

For best results, *Dow Corning* RTV Conformal Coatings should be stored at or below 25°C (77°F). Special precautions must be taken to prevent moisture from contacting these materials. Containers should be kept tightly closed and head or air space minimized. Partially filled containers should be purged with dry air or other gases, such as nitrogen.

*Dow Corning* Heat Cure Conformal Coatings should also be stored at or below 25°C (77°C). Containers should be kept tightly closed and kept in cold storage at all times to extend shelf life.

#### **LIMITATIONS**

These products are neither tested nor represented as suitable for medical or pharmaceutical uses.

#### **PACKAGING**

In general, *Dow Corning* Conformal Coatings are supplied in nominal 0.45-, 3.6-, 18- and 200-kg (1-, 8-, 40- and 440-lb) containers, net weight. Not all coatings may be available in all packages and some additional packages, such as bladder packs or tubes, may be available for certain coatings and package sizes.

#### **SAFE HANDLING INFORMATION**

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE FROM YOUR DOW CORNING REPRESENTATIVE, OR DISTRIBUTOR, OR BY WRITING TO DOW CORNING CUSTOMER SERVICE, OR BY CALLING (517) 496-6000.

#### **WARRANTY INFORMATION**

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that Dow Corning's products are safe, effective, and fully satisfactory for the intended end use. Dow Corning's sole warranty is that the product will meet the Dow Corning sales specifications in effect at the time of shipment. Your exclusive remedy for breach of such warranty is limited to refund of purchase price or replacement of any product shown to be other than as warranted. Dow Corning specifically disclaims any other express or implied warranty of fitness for a particular purpose or merchantability, unless Dow Corning provides you with a specific, duly signed endorsement of fitness for use. Dow Corning disclaims liability for any incidental or consequential damages. Suggestions of use shall not be taken as inducements to infringe any patent.

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Printed in USA

AGP5831

Form No. 10-899C-01