Advanced Silicone Materials for Electric Vehicle Applications

DOWSIL™

Imagine Improved Thermal Management, Reliability and Cost-Effectiveness for Electric Vehicle Applications

Designs for the Future ... Today

The market for plug-in hybrid and battery-powered electric vehicles (xEV) has the potential to grow exponentially in the coming years. But realizing that potential will depend on a number of factors, including the industry's ability to meet consumer expectations for performance and value.

This will challenge battery makers to design for the large-volume production of lithium battery packs that are smaller, lighter and less expensive. These higher-energy-density packs will be capable of delivering more power, longer, through better thermal control.

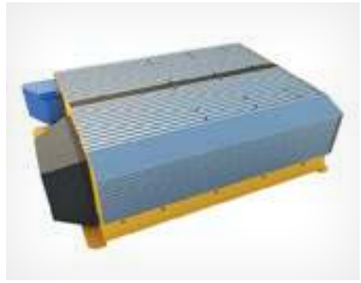
Manufacturers and designers of other xEV components – including battery management systems, power control units, DC/DC converters and electric motors – face many of the same thermal management, assembly and protection challenges.

Dow can help, with an extensive portfolio of proven, innovative and emerging silicone technologies for xEV applications.

Silicone Advantages

The properties that have enabled silicone materials from Dow to excel in a wide range of PCB system assembly and automotive applications could prove invaluable in helping you address challenges associated with designing and producing large volumes of lithium battery systems and other components for the electric vehicles of tomorrow:

- Very low thermal resistance
- Flow, wetting, adhesion and cure properties that can help speed and simplify processing
- Excellent thermal stability – wide operating temperature range
- Reliable performance under harsh conditions – resistance to thermal shock, oxidation, moisture and chemicals
- Excellent electrical insulation (dielectric strength)
- Excellent stress relief

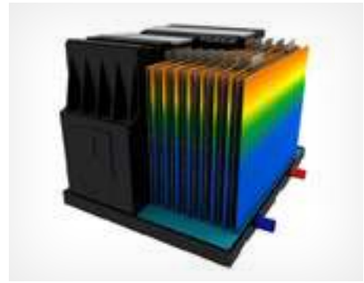


AC/DC Charger

Inverter/Converter

Motor/Generator

Electric Compressor for Air Conditioner



Battery Module

DC/DC Converter

Sheath Heater

PTC Heater

Battery Management System (BMS)

Enabling & Problem-Solving Silicone Materials

Silicone is an amazingly versatile material that can be produced in many forms. Dow is a silicone pioneer and a global leader in engineering silicones to meet specific performance and processing requirements.

For Thermal Management

Thermally conductive silicone materials from Dow have properties that can help you reduce operating temperatures and extend the life and performance of batteries and other electric vehicle PCB system components.

Dow offers a wide range of thermal interface materials with the potential for creating effective, efficient designs and assembly applications. Examples of leading technologies include:

- **Thermally conductive silicone adhesives** for coupling the battery pack to the heat sink; also may be appropriate for use within or between cells
- **Noncuring thermally conductive silicone compounds**, with a possible applied temperature range of -40 to 150°C, for conducting heat from the battery cells to the heat sink
- **Thermally conductive silicone gels and encapsulants** are flowable materials that facilitate high-volume processes in automated production; can be used as an alternative to precured pads to couple cells and modules to heat sinks or as conformable gap-fillers

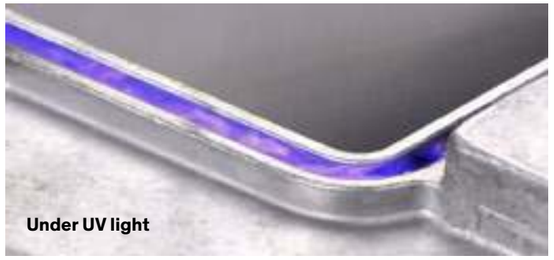
For Other Challenges

Dow offers proven and innovative materials to help you meet a wide range of electric vehicle application challenges.

- **Silicone gels** for potting of PCB circuitry in the battery pack's power management system
- **Adhesives** for a variety of bonding applications, including staking large capacitors for vibration control, extra support for large components on circuit boards, and housing sealing
- **Conformal coatings** for protecting printed circuit boards in the power management system
- **Engineered elastomers** for heat-resistant sealing and gasketing

Breakthrough Technologies

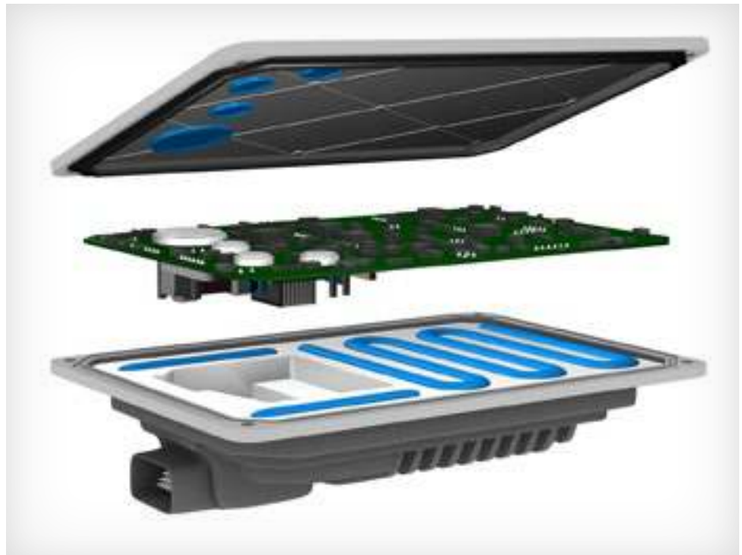
To meet needs for performance, design flexibility and cost control



DOWSIL™ EA-7100 Adhesive

A Thermal Radical Cure™ *adhesive for use in the assembly of circuitry housings and for attaching connectors, control units or sensors to substrates.*

DOWSIL™ EA-7100 Adhesive cures much faster at moderate temperatures than conventional heat-curable silicones, and it may allow you to eliminate some cleaning steps, enabling faster throughput and lower energy costs. Plus, it offers durable adhesion to a broad range of diverse substrates for greater design flexibility. Other quality- and performance-enhancing benefits include adhesion in harsh environments, low void formation, superior anti-corrosion performance and less sensitivity to contamination.



DOWSIL™ TC-4525 Gap Filler

A cost-effective way to manage the rising heat in next-generation PCB system assemblies.

DOWSIL™ TC-4525 Gap Filler is a soft and compressible silicone material designed to dissipate heat from PCB system assemblies. This high-performing new silicone technology deliversthermal conductivity of 2.5 W/m.K, greatly improved dispensability and stable performance for more reliablecircuitry in harsh automotive underhood environments.

xEV Battery Pack

Thermal Management

Product		1 or 2 Part	Color	Thermal Conductivity, W/m.K	Thermal Resistance, °C/W		Lap Shear	Cure, time/temp.	Viscosity, cP	Density, g/cm³	Durometer	CTE, ppm/K	Notes
Thermally Conductive Gap Fillers	DOWSIL™ TC-4515 Gap Filler†	In development: 1.8 W/m.K silicone gap filler material						In development: 1.8 W/m.K silicone gap filler material					
	DOWSIL™ TC-4525 Gap Filler	2 part (1:1 mix ratio)	Part A: White Part B: Blue	2.6	0.42 @ 85 µm 0.73 @ 115 µm 1.23 @ 309 µm		-	120 min/25°C 20 min/50°C 10 min/80°C	Part A: 207,000 Part B: 193,000 Mixed: 217,000	2.9	55 (Shore 00)	-50 to 80°C: 95 -50 to 150°C: 123	-
	DOWSIL™ TC-4525 GB Gap Filler	Glass bead option (180 micron) for DOWSIL™ TC-4525 Gap Filler						Glass bead option (180 micron) for DOWSIL™ TC-4525 Gap Filler					
	DOWSIL™ TC-4525 CV Gap Filler	2 part (1:1 mix ratio)	Part A: White Part B: Blue	2.6	-		-	120 min/25°C 10 min/80°C	Part A: 223,000 Part B: 216,000 Mixed: 217,000	Cured: 2.9	40 (Shore 00) 32 (Asker C)	-	-
	DOWSIL™ TC-4529 Gap Filler	1 part	Gray	3.2	0.44 @ 78 µm 0.58 @ 100 µm 1.84 @ 400 µm		-	Noncuring	300,000	3.1	-	-	-
Thermally Conductive Adhesives	DOWSIL™ TC-2030 Adhesive	2 part (1:1 mix ratio)	Gray	2.7	-		Al: 435 psi, 3 MPa, 300 N/cm²	60 min/130°C	Part A: 250,000 Part B: 200,000 Mixed: 220,000	-	92 (Shore A)	-	-
	DOWSIL™ TC-2035 Adhesive	2 part (1:1 mix ratio)	Part A: White Part B: Reddish brown	3.3	0.25 @ 50 µm 0.44 @ 100 µm		Al: 381 psi, 2.63 MPa, 263 N/cm² Cu: 416 psi, 2.87 MPa, 287 N/cm²	30 min/125°C 10 min/150°C	Part A: 130,000 Part B: 118,000 Mixed: 125,000	Wet: 3	95 (Shore A [JIS Type A]) 45 (Shore D)	-50 to 200°C: 92	-
	DOWSIL™ SE 4485 Thermally Conductive Adhesive	1 part	White	2.8	-		Glass to glass: 168 psi, 1.2 MPa, 120 N/cm²	Tack-free time(1) @ 25°C: 10 min	Fluidity: 54 mm	Cured: 2.9	90 (Shore A [JIS])	-	UL 94 V-0
	DOWSIL™ SE 4485 L Adhesive	1 part	White	2.2	-		Glass to glass: 262 psi, 1.8 MPa, 180 N/cm²	Tack-free time(1) @ 25°C: 8 min	Fluidity: 47.4 mm	Cured: 2.84	90 (Shore A [JIS])	-	-
	DOWSIL™ SE 4486 Adhesive	1 part	White	1.6	-		Glass to glass: 240 psi, 1.65 MPa, 165 N/cm²	Tack-free time(1) @ 25°C: 4 min	19,600 Fluidity: 60 mm	Cured: 2.6	81 (Shore A [JIS])	-	-
Thermally Conductive Encapsulants	DOWSIL™ TC-4605 Encapsulant	2 part (1:1 mix ratio)	Gray	1	-		Al: 110 psi	60 min/120°C	Part A: 3,100 Part B: 2,500 Mixed: 2,900	Cured: 1.67	30 (Shore A)	-	UL flammability @ 1.5 mm: 94 V-0
	DOWSIL™ TC-4605 HLV Encapsulant	2 part (1:1 mix ratio)	Gray	1	-		Anodized Al: 220 psi	60 min/120°C	Part A: 1,600 Part B: 1,400 Mixed: 1,900	Cured: 1.67	60 (Shore A)	-	UL flammability @ 1.5 mm: 94 V-0

(1)Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.

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Assembly

Product		1 or 2 Part	Color	Viscosity, cP	Density, g/cm³		Cure, time/temp.	Lap Shear	Durometer	Tensile Strength, MPa	Elongation, %	Notes
Adhesives	DOWSIL™ EA-5151 Assembly Adhesive(1)†	1 part	-	60,000 @ 120°C	1.08		Room temperature cure when exposed to moisture in the air	Polycarbonate lap shear adhesion: 1 day: 0.5 MPa 7 days: 1.7 MPa	55-57 (Shore A)	4.5-4.7	> 900	Can be used with standard hot-melt dispensing equipment
	DOWSIL™ 7091 Adhesive Sealant(2)	1 part	Black, white, gray	-	1.4		Room temperature cure when exposed to moisture in the air; tack-free time(3): 28 min	-	32 (Shore A)	2.5	680	FIPG(2)
	DOWSIL™ SE 9168 RTV Adhesive	1 part	Gray	-	Cured: 1.32		Room temperature cure when exposed to moisture in the air; tack-free time(3) @ 25°C: 6.5 min	Glass: 275 psi, 1.9 MPa, 189 N/cm²	44 (Shore A [JIS])	3.69	363	UL 94 V-0
	DOWSIL™ SE 9185 Clear or White Adhesive	1 part	Clear or white	-	Cured: 1.05		Room temperature cure when exposed to moisture in the air; tack-free time(3) @ 25°C: 8 min	Glass: 120 N/cm²	31 (Shore A)	3	515	-
	DOWSIL™ EA-1236 Base and Catalyst Special Adhesive	2 part; (base-to-catalyst mix ratio by weight: 100 to 14)	Base: White Catalyst: Black	180,000 @ 0.5 s^{-1} 160,000 @ 5 s^{-1}	Base: 1.31 Catalyst: 1.05 Cured: 1.28		Room temperature cure; tack-free time(3): 10 min	-	36 (Shore A)(4)	2.2	300	Fast room-temperature cure
Silicone Foam	DOWSIL™ 3-8209 Silicone Foam(5)	2 part (1:1 mix ratio)	Part A: Dark gray Part B: Colorless	Part A: 11,000-17,000 Part B: 12,000-17,000	Part A: 1.07 Part B: 1.01 Density: 200-280 (cured @ 23°C and tested after 24 hr)		Room temperature cure when exposed to moisture in the air; tack-free time(3) @ 25°C: max 10 min	-	45 (Shore 00)	-	-	Compression set @ 50% compression, 22 hr @ 70°C: • Non-post-cured: 32% • Post-cured 1 hr @ 100°C: 4% • Stress-strain characteristics in compression, 50% compression: 74 KPa

(1)Developmental product data. DOWSIL™ EA-5151 Assembly Adhesive. Utilizes silicone technology to achieve instant green strength when dispensed and cures to a strong moisture-cured silicone adhesive.
(2)Used as formed-in-place gasket (FIPG) material. Mechanical properties: cured 7 days in air at 23°C (73°F) and 50% relative humidity.
(3)Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.
(4)Measured after 7-day cure at room temperature.
(5)Designed to be dispensed and cured directly on parts to form an integrated compression gasket.

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xEV Battery Pack (continued)

Connector

	Product	1 or 2 Part	Color	Viscosity, cP	Density, g/cm³		Cure, time/temp.	Lap Shear	Durometer	Tensile Strength, MPa	Elongation, %	Notes
Encapsulants	SYLGARD™ 170 Silicone Elastomer	2 part (1:1 mix ratio)	Black	Part A: 3,160 Part B: 1,110 Mixed: 2,135	Part A, Uncured: 1.37 Part B, Uncured: 1.37		24 hr/25°C 25 min/70°C 10 min/100°C	-	47 (Shore A)	-	-	Thermal conductivity: 0.48 W/m.K
	SYLGARD™ 170 Fast Cure Silicone Elastomer	2 part (1:1 mix ratio)	Black	Part A: 3,436 Part B: 1,287 Mixed: 2,361	Part A, Uncured: 1.38 Part B, Uncured: 1.38		0.2 hr/25°C	-	41 (Shore A)	-	-	Thermal conductivity: 0.4 W/m.K
	SYLGARD™ 567 Primerless Silicone Encapsulant	2 part (1:1 mix ratio)	Black	Part A: 2,060 Part B: 570	Uncured: 1.24		180 min/70°C 120 min/100°C	-	40 (Shore A)	-	-	Thermal conductivity: 0.29 W/m.K
Adhesive	DOWSIL™ SE 9186 Clear or White Sealant	1 part	Clear or white	64,000	Cured: 1.03		Room temperature cure when exposed to moisture in the air; tack-free time[1] @ 25°C: max 10 min	Glass: 360 psi, 2.5 MPa, 25 N/cm²	20 (Shore A)	2.5	550	-
Silicone Foam	DOWSIL™ 3-6548 Silicone RTV Foam[2]	2 part	Black	Part A: 40,000-60,000 Part B: 50,000-75,000	Part A: 1.05-1.11 Part B: 1.05-1.11 Cured: 0.22-0.32		-	-	-	228,000 N/m², 33 psi	-	Compression deflection: • @ 20% compression: 35,900 N/m², 5.2 psi • @ 40% compression: 69,600 N/m², 10.1 psi • @ 60% compression: 146,000 N/m², 21.2 psi

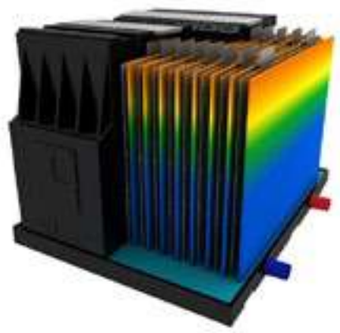
[1]Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.
[2]Silicone RTV foam for fire-resistant penetration seals.

Battery Management System (BMS)

PCB Protection

	Product	1 or 2 Part	Color	Viscosity, cP	Density, g/cm³		Tack-Free Time[1], time/temp.	Nonvolatile Content (NVC), %	Durometer	Notes
Conformal Coatings	DOWSIL™ 3-1953 Conformal Coating	1 part	Translucent	350	Cured: 0.98		8 min/25°C 0.5 min/60°C (15% RH)	99.4	34 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E
	DOWSIL™ 3-1965 Conformal Coating	1 part	Translucent	115	Cured: 0.99		6 min/25°C	-	33 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830 with Amendment 1
	DOWSIL™ 1-2577 Low VOC Conformal Coating	1 part	Transparent	1,050	Cured: 1.12		6 min/25°C 1.5 min/60°C (15% RH)	NVC – forced draft volatility: 33.6	85 (Shore A) 25 (Shore D)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E

[1]Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.



Power Control Unit (PCU), Including Inverter, Converter, Etc.

Thermal Management

	Product	1 or 2 Part	Color	Thermal Conductivity, W/m.K	Thermal Resistance, °C/W		Lap Shear	Cure, time/temp.	Viscosity, cP	Density, g/cm³	Durometer	CTE, ppm/K	Notes
Thermally Conductive Compounds	DOWSIL™ TC-5026 Thermally Conductive Compound	1 part	Gray	2.9	0.03°C-cm²/W @ 7 µm (40 psi)		-	Noncuring	102,118	Uncured: 3.5	-	-	-
	DOWSIL™ TC-5625C Thermally Conductive Compound	1 part	Green gray	2.6	0.1°C-cm²/W (20 psi)		-	Noncuring	81,757	Uncured: 4.2	-	-	-
	DOWSIL™ SC 4471 CV Thermally Conductive Compound	1 part	White	2	-		-	Noncuring	116,000	Cured: 2.76	-	-	-
Thermally Conductive Gap Fillers	DOWSIL™ TC-4515 Gap Filler†	In development: 1.8 W/m.K silicone gap filler material					In development: 1.8 W/m.K silicone gap filler material						
	DOWSIL™ TC-4525 Gap Filler	2 part (1:1 mix ratio)	Part A: White Part B: Blue	2.6	0.42 @ 85 µm 0.73 @ 115 µm 1.23 @ 309 µm		-	120 min/25°C 20 min/50°C 10 min/80°C	Part A: 207,000 Part B: 193,000 Mixed: 217,000	2.9	55 (Shore 00)	-50 to 80°C: 95 -50 to 150°C: 123	-
	DOWSIL™ TC-4525 GB Gap Filler	Glass bead option (180 micron) for DOWSIL™ TC-4525 GB Gap Filler					Glass bead option (180 micron) for DOWSIL™ TC-4525 GB Gap Filler						
	DOWSIL™ TC-4525 CV Gap Filler	2 part (1:1 mix ratio)	Part A: White Part B: Blue	2.6	-		-	120 min/25°C 10 min/80°C	Part A: 223,000 Part B: 216,000 Mixed: 217,000	Cured: 2.9	40 (Shore 00) 32 (Asker C)	-	
	DOWSIL™ TC-4529 Gap Filler	1 part	Gray	3.2	0.44 @ 78 µm 1.84 @ 400 µm		-	Noncuring	300,000	3.1	-	-	-
Thermally Conductive Adhesives	DOWSIL™ Q1-9226 Thermally Conductive Adhesive	2 part (1:1 mix ratio)	Gray	0.8	-		Al: 375 psi, 2.6 MPa, 260 N/cm²	Heat cure (100°C or above)	Part A: 48,000 Part B: 43,000 Mixed: 59,000	Cured: 2.14	67 (Shore A)	-	-
	DOWSIL™ 1-4174 Thermally Conductive Adhesive	1 part	Gray	1.78	-		Al: 646 psi, 4.5 MPa, 445 N/cm²	90 min/100°C 30 min/125°C 20 min/150°C	62,300	Uncured: 2.71	92 (Shore A)	125 ppm/°C	UL 94-V0
	DOWSIL™ TC-2030 Adhesive	2 part (1:1 mix ratio)	Gray	2.7	-		Al: 435 psi, 3 MPa, 300 N/cm²	60 min/130°C	Part A: 250,000 Part B: 200,000 Mixed: 220,000	-	92 (Shore A)	-	-
	DOWSIL™ TC-2035 Adhesive	2 part (1:1 mix ratio)	Part A: White Part B: Reddish brown	3.3	0.25 @ 50 µm 0.44 @ 100 µm		Al: 381 psi, 2.63 MPa, 263 N/cm² Cu: 416 psi, 2.87 MPa, 287 N/cm²	30 min/125°C 10 min/150°C	Part A: 130,000 Part B: 118,000 Mixed: 125,000	Wet: 3	95 (Shore A [JIS Type A]) 45 (Shore D)	-50 to 200°C: 92	-

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Power Control Unit (PCU), Including Inverter, Converter, Etc.
(continued)

Assembly

	Product	1 or 2 Part	Color	Viscosity, cP	Density, g/cm³	Cure, time/temp.		Lap Shear	Durometer	Tensile Strength, MPa	Elongation, %	CTE, ppm/°C	Notes
Adhesives	DOWSIL™ EA-7100 Adhesive[1]	1 part	Gray	360,000	Cured: 1.09	15 min/100°C		Al: 350 psi, 2.4 MPa, 240 kg/cm² PBT: 375 pcs, 2.6 MPa, 260 N/cm²	43 (Shore A)	3.4	260	247	Durable adhesion to a wide variety of substrates
	DOWSIL™ EA-5151 Assembly Adhesive[2]†	1 part	-	60,000 @ 120°C	1.08	Room temperature cure when exposed to moisture in the air		Polycarbonate lap shear adhesion: 1 day: 0.5 MPa 7 days: 1.7 MPa	55-57 (Shore A)	4.5-4.7	>900	-	Can be used with standard hot-melt dispensing equipment
	DOWSIL™ EA-6060 Adhesive†	In development							In development				
	DOWSIL™ 3-6265 Thixotropic Adhesive	1 part	Black	Low shear: 1,020,000 High shear: 235,000	Cured: 1.34	60 min/125°C 30 min/150°C		Al: 611 psi	60 (Shore A)	4.8	165	275	UV indicator for inspection
	DOWSIL™ 3-6265 HP Adhesive	1 part	Black	1,070 Pa-sec	Cured: 1.33	240 min/100°C 25 min/125°C 10 min/150°C		Al: 825 psi, 5.7 MPa, 568 N/cm²	68 (Shore A)	5.8	275	215	High tensile strength
	DOWSIL™ 3-1598 HP Adhesive	1 part	Black	82,000	Cured: 1.31	180 min/100°C 30 min/125°C 15 min/150°C		Al: 712 psi, 4.97 MPa, 497 N/cm²	57 (Shore A)	5.4	260	277	Able to flow, fill or self-level after dispensing
	DOWSIL™ 866 Primerless Silicone Adhesive	1 part	Gray	48,000	Cured: 1.29	60 min/125°C 30 min/150°C		Al: 774.5 psi, 5.34 MPa, 534 N/cm²	57 (Shore A)	6.4	210	350	High tensile strength
	DOWSIL™ 7091 Adhesive Sealant[3]	1 part	Black, white, gray	Extrusion rate: 185 g/min	1.4	Room temperature cure when exposed to moisture in the air; tack-free time[4]: 28 min		-	32 (Shore A)	2.5	680	-	FIPG[3]
	DOWSIL™ 744 RTV Sealant	1 part	-	Extrusion rate: 184 g/min	Cured: 1.42	Room temperature cure; tack-free time[4]: 55 min		Al: 430 psi, 3 MPa, 296 N/cm²	37 (Shore A)	2.7	590	-	Bonding large components to circuit boards
	DOWSIL™ EA-1236 Base and Catalyst Special Adhesive	2 part (base-to-catalyst mix ratio by weight: (100 to 14)	Base: White Catalyst: Black	180,000 @ 0.5 s^{-1} 160,000 @ 5 s^{-1}	Base: 131 Catalyst: 1.05 Cured: 1.28	Room temperature cure; tack-free time[4]: 10 min		-	36 (Shore A)[5]	2.2	300	-	Fast room-temperature cure
Silicone Foam	DOWSIL™ 3-8209 Silicone Foam[6]	2 part (1:1 mix ratio)	Part A: Dark gray Part B: Colorless	Part A: 11,000-17,000 Part B: 12,000-17,000	Part A: 1.07 Part B: 1.01 Density: 200-280 (cured @ 23°C and tested after 24 hr)	Room temperature cure when exposed to moisture in the air; tack-free time[4] @ 25°C: max 10 min		-	45 (Shore 00)	-	-	-	Compression set @ 50% compression, 22 hr @ 70°C: • Non-post-cured: 32% • Post-cured 1 hr @ 100°C: 4% • Stress-strain characteristics in compression, 50% compression: 74 KPa

[1]Durable adhesion to a wide variety of substrates, including plastics, metals, cured silicones and other substrates (contact Dow for details).
[2]Developmental product data. DOWSIL™ EA-5151 Assembly Adhesive. Utilizes silicone technology to achieve instant green strength when dispensed and cures to a strong moisture-cured silicone adhesive.
[3]Used as formed-in-place gasket (FIPG) material. Mechanical properties: cured 7 days in air at 23°C (73°F) and 50% relative humidity. Extrusion rate measured using 3.18 mm diameter nozzle at 0.62 MPa.
[4]Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.
[5]Measured after 7-day cure at room temperature.
[6]Designed to be dispensed and cured directly on parts to form an integrated compression gasket.
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Assembly (continued)

	Product	1 or 2 Part	Color	Extrusion Rate, g/min	Density, g/cm³	Cure, time/temp.		Durometer	Tensile Strength, MPa	Elongation @ Break, %	Modulus 100%, MPa	Tear Strength, kN/m	Compression Set @ -25%, %	Lap Shear Adhesion, MPa
CIPGs (Cured-in-Place Gaskets)	SILASTIC™ RBL-9694-20P A&B Liquid Silicone Rubber	2 part (1:1 mix ratio)	Part A: Black Part B: White	[1]Part A: 119 Part B: 282	1.17	165 sec/115°C, T90%		21 (Shore A)	Die C, 5.9	925	0.39	Die B, 13	Compression for 22 hr @ 132°C: 36	Vinyl ester (10 min/150°C): 1.3
	SILASTIC™ RBL-9694-30P A&B Liquid Silicone Rubber	2 part (1:1 mix ratio)	Part A: Black Part B: White	[1]Part A: 75 Part B: 178	1.2	46 sec/115°C, T90%		32 (Shore A)	Die C, 7.2	820	0.8	Die B, 14	Compression for 22 hr @ 177°C: 31	Al (10 min/150°C): 1.0
	SILASTIC™ RBL-9694-45M A&B Liquid Silicone Rubber	2 part (1:1 mix ratio)	Part A: Black Part B: White	[2]Part A: 77 Part B: 98	1.2	34 sec/115°C, T90%		45 (Shore A)	Die C, 7.25	600	1.45	Die B, 45	Compression for 22 hr @ 177°C: 29	Al (10 min/150°C): 1.64 PA66 GF30 (10 min/150°C): 1.35

[1]Extrusion rate: 3.2 mm nozzle at 0.63 MPa.
[2]Extrusion rate: 90 psi, 1/8-inch orifice.

PCB Protection

	Product	1 or 2 Part	Color	Viscosity, cP	Density, g/cm³		Tack-Free Time[1], time/temp.	Nonvolatile Content (NVC), %	Durometer	Notes
Conformal Coatings	DOWSIL™ 3-1953 Conformal Coating	1 part	Translucent	350	Cured: 0.98		8 min/25°C 0.5 min/60°C (15% RH)	99.4	34 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E
	DOWSIL™ 3-1965 Conformal Coating	1 part	Translucent	115	Cured: 0.99		6 min/25°C	-	33 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830 with Amendment 1
	DOWSIL™ 1-2577 Low VOC Conformal Coating	1 part	Transparent	1,050	Cured: 1.12		6 min/25°C 1.5 min/60°C (15% RH)	NVC – forced draft volatility: 33.6	85 (Shore A) 25 (Shore D)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E

[1]Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.

Electric Motor

Protection

Product		1 or 2 Part	Color	Thermal Conductivity, W/m.K	Thermal Resistance, °C/W		Lap Shear	Cure, time/temp.	Viscosity, cP	Density, g/cm³	Durometer	CTE, ppm/K	Notes
Thermally Conductive Encapsulants	DOWSIL™ CN-8760G Encapsulant	2 part (1:1 mix ratio)	Dark gray	0.67	-		-	24 hr/25°C	Part A: 2,900 Part B: 3,200 Mixed: 3,200	Cured: 1.58	45 (Shore A)	-	UL 94 V-0; UL RTI rating: 150°C
	DOWSIL™ TC-4605 Encapsulant	2 part (1:1 mix ratio)	Gray	1	-		Al: 110 psi	60 min/120°C	Part A: 3,100 Part B: 2,500 Mixed: 2,900	Cured: 1.67	30 (Shore A)	-	UL flammability @ 1.5 mm: 94 V-0
	DOWSIL™ TC-4605 HLV Encapsulant	2 part (1:1 mix ratio)	Gray	1	-		Anodized Al: 220 psi	60 min/120°C	Part A: 1,600 Part B: 1,400 Mixed: 1,900	Cured: 1.67	60 (Shore A)	-	UL flammability @ 1.5 mm: 94 V-0

Protection (continued)

Product		1 or 2 Part	Color	Viscosity, cP	Density, g/cm³		Tack-Free Time[1], time/temp.	Nonvolatile Content (NVC), %	Durometer	Notes
Conformal Coatings	DOWSIL™ 3-1953 Conformal Coating	1 part	Translucent	350	Cured: 0.98		8 min/25°C 0.5 min/60°C (15% RH)	99.4	34 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E
	DOWSIL™ 3-1965 Conformal Coating	1 part	Translucent	115	Cured: 0.99		6 min/25°C	-	33 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830 with Amendment 1
	DOWSIL™ 1-2577 Low VOC Conformal Coating	1 part	Transparent	1,050	Cured: 1.12		6 min/25°C 1.5 min/60°C (15% RH)	NVC – forced draft volatility: 33.6	85 (Shore A) 25 (Shore D)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E
	DOWSIL™ LDC 2577 D Dispersion Coating	1 part	Transparent	104	Cured: 1.0		5 min/25°C 2 min/60°C (15% RH)	-	23 (Shore D)	-

[1]Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.

Control Unit Thermal Management

Product		1 or 2 Part	Color	Thermal Conductivity, W/m.K	Thermal Resistance, °C/W		Lap Shear	Cure, time/temp.	Viscosity, cP	Density, g/cm³	Durometer	CTE, ppm/K	Notes
Thermally Conductive Encapsulant	DOWSIL™ TC-6020 Thermally Conductive Encapsulant[1]†	2 part (1:1 mix ratio)	Gray	2.7	-		Al: 40.5 psi	23 min/60°C, T90% 13 min/80°C, T90% 5 min/100°C, T90%	Part A: 10,800 Part B: 9,960 Mixed: 10,640	2.926	63 (Shore A)	-	-

[1]Developmental product data.

†Dow developmental material. The composition, features, benefits and other properties are subject to change. The future availability of this product is not guaranteed. You are responsible to determine the suitability of the Product for your contemplated use. The Product is provided "AS IS" WITH ALL FAULTS, AND WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

On-Board Charger

Thermal Management

Product		1 or 2 Part	Color	Thermal Conductivity, W/m.K	Thermal Resistance, °C/W		Lap Shear	Cure, time/temp.	Viscosity, cP	Density, g/cm³	Durometer	CTE, ppm/K	Notes
Thermally Conductive Encapsulants	DOWSIL™ TC-4605 Encapsulant	2 part (1:1 mix ratio)	Gray	1	-		Al: 110 psi	60 min/120°C	Part A: 3,100 Part B: 2,500 Mixed: 2,900	Cured: 1.67	30 (Shore A)	-	UL flammability @ 1.5 mm: 94 V-0
	DOWSIL™ TC-4605 HLV Encapsulant	2 part (1:1 mix ratio)	Gray	1	-		Anodized Al: 220 psi	60 min/120°C	Part A: 1,600 Part B: 1,400 Mixed: 1,900	Cured: 1.67	60 (Shore A)	-	UL flammability @ 1.5 mm: 94 V-0
	DOWSIL™ TC-6020 Encapsulant[(1)†]	2 part (1:1 mix ratio)	Gray	2.7	-		Al: 0.5 psi	23 min/60°C, T90% 13 min/80°C, T90% 5 min/100°C, T90%	Part A: 10,800 Part B: 9,960 Mixed: 10,640	2.926	63 (Shore A)	-	-

[(1)]Developmental product data.

†Dow developmental material. The composition, features, benefits and other properties are subject to change. The future availability of this product is not guaranteed. You are responsible to determine the suitability of the Product for your contemplated use. The Product is provided "AS IS" WITH ALL FAULTS, AND WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Assembly

Product		1 or 2 Part	Color	Viscosity, cP	Density, g/cm³	Cure, time/temp.		Lap Shear	Durometer	Tensile Strength, MPa	Elongation, %	CTE, ppm/°C	Notes
Adhesive	DOWSIL™ EA-9189 H RTV Adhesive	1 part	White	-	Cured: 1.68	Room temperature cure when exposed to moisture in the air; tack-free time[(1)] @ 25°C: 2 min		Al: 327 psi, 2.2 MPa, 225 N/cm² Cu: 343 psi, 2.3 MPa, 236 N/cm² PC: 187 psi, 1.2 MPa, 128 N/cm² FR4: 349 psi, 2.4 MPa, 240 N/cm²	80 (Shore A)	3.9	32	-	Thermal conductivity: 0.88 W/m.K UL 94 V-0

[(1)]Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.

Protection

Product		1 or 2 Part	Color	Viscosity, cP	Density, g/cm³		Tack-Free Time[(1)], time/temp.	Nonvolatile Content (NVC), %	Durometer	Notes
Conformal Coatings	DOWSIL™ 3-1953 Conformal Coating	1 part	Translucent	350	Cured: 0.98		8 min/25°C 0.5 min/60°C (15% RH)	99.4	34 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E
	DOWSIL™ 3-1965 Conformal Coating	1 part	Translucent	115	Cured: 0.99		6 min/25°C	-	33 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830 with Amendment 1
	DOWSIL™ 1-2577 Low VOC Conformal Coating	1 part	Transparent	1,050	Cured: 1.12		6 min/25°C 1.5 min/60°C (15% RH)	NVC – forced draft volatility: 33.6	85 (Shore A) 25 (Shore D)	UL 94 V-0; MIL I-46058C Amend 7 IPC-CC-830B; UL 746E

[(1)]Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.

PTC Heater

Thermal Management and Assembly

	Product	1 or 2 Part	Color	Thermal Conductivity, W/m.K	Thermal Resistance, °C/W		Lap Shear	Cure, time/temp.	Viscosity, cP	Density, g/cm³	Durometer	CTE, ppm/K	Notes
Thermally Conductive Adhesives	DOWSIL™ Q1-9226 Thermally Conductive Adhesive	2 part (1:1 mix ratio)	Gray	0.8	-		Al: 375 psi, 2.6 MPa, 260 N/cm²	Heat cure (100°C or above)	Part A: 48,000 Part B: 43,000 Mixed: 59,000	Cured: 2.14	67 (Shore A)	-	-
	DOWSIL™ SE 4402 Adhesive	1 part	Gray	0.9	-		Al: 530 psi, 3.65 MPa, 365 N/cm²	30 min/150°C	32,000	Cured: 2.2	75 (Shore A)	-	-
	DOWSIL™ TC-2035 Adhesive	2 part (1:1 mix ratio)	Part A: White Part B: Reddish brown	3.3	0.25 @ 50 µm 0.44 @ 100 µm		Al: 381 psi, 2.63 MPa, 263 N/cm² Cu: 416 psi, 2.87 MPa, 287 N/cm²	30 min/125°C 10 min/150°C	Part A: 130,000 Part B: 118,000 Mixed: 125,000	Wet: 3	95 (Shore A [JIS Type A]) 45 (Shore D)	-50 to 200°C: 92	-

Electric Compressor

Protection

	Product	1 or 2 Part	Color	Viscosity, cP	Density, g/cm³		Tack-Free Time[1], time/temp.	Nonvolatile Content (NVC), %	Durometer	Notes
Conformal Coatings	DOWSIL™ 3-1953 Conformal Coating	1 part	Translucent	350	Cured: 0.98		8 min/25°C 0.5 min/60°C (15% RH)	99.4	34 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E
	DOWSIL™ 3-1965 Conformal Coating	1 part	Translucent	115	Cured: 0.99		6 min/25°C	-	33 (Shore A)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830 with Amendment 1
	DOWSIL™ 1-2577 Low VOC Conformal Coating	1 part	Transparent	1,050	Cured: 1.12		6 min/25°C 1.5 min/60°C (15% RH)	NVC – forced draft volatility: 33.6	85 (Shore A) 25 (Shore D)	UL 94 V-0; MIL I-46058C Amend 7; IPC-CC-830B; UL 746E

[1]Tack-free time is the time required for the product to develop a nontacky surface based on adhesion to a polyethylene film.

Sheath Heater

Protection

	Product	1 or 2 Part	Color	Viscosity, cP	Density, g/cm³		Cure, time/temp.	Durometer	Notes
Encapsulants	SYLGARD™ 170 Silicone Elastomer	2 part (1:1 mix ratio)	Black	Part A: 3,160 Part B: 1,110 Mixed: 2,135	Part A, Uncured: 1.37 Part B, Uncured: 1.37		24 hr/25°C 25 min/70°C 10 min/100°C	47 (Shore A)	Thermal conductivity: 0.48 W/m.K
	SYLGARD™ 170 Fast Cure Silicone Elastomer	2 part (1:1 mix ratio)	Black	Part A: 3,436 Part B: 1,287 Mixed: 2,361	Part A, Uncured: 1.38 Part B, Uncured: 1.38		0.2 hr/25°C	41 (Shore A)	Thermal conductivity: 0.4 W/m.K

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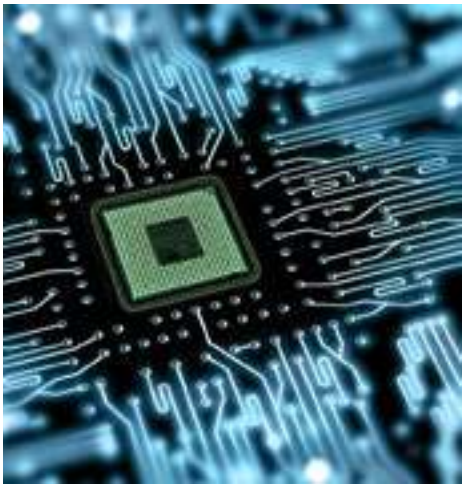

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