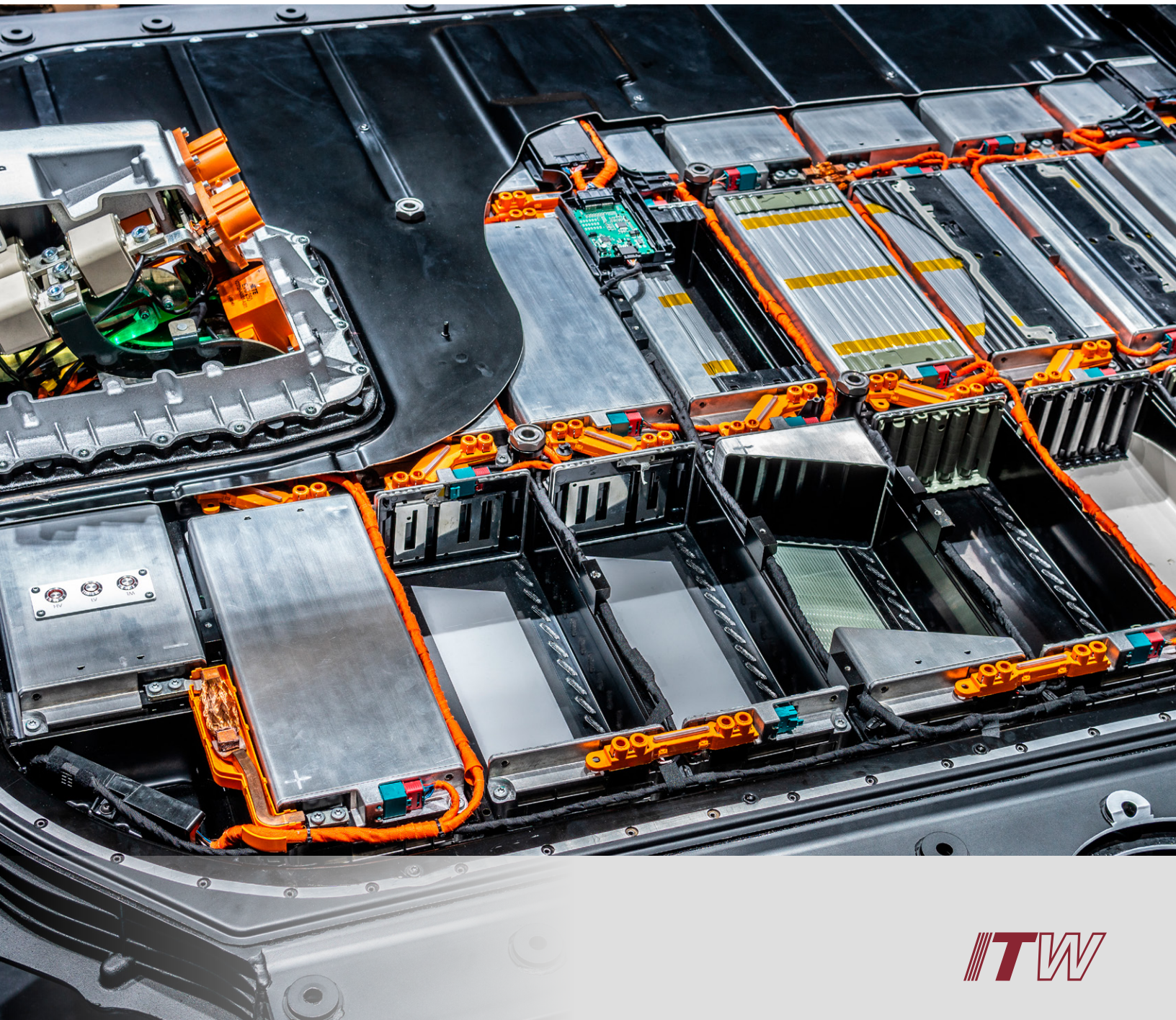


PLEXUS

Devcon

INSULCAST

Adhesive Solutions for Electric Vehicle Batteries



TW



Introduction

Fueled by cost-effective, increasingly powerful, and efficient battery technology, the automotive industry finds itself in a state of profound and ongoing transformation.

Consumers and governments are demanding environmentally conscious policies and technologies, driving innovation in the design and development of electric vehicles and power supply, including non-traditional materials, methods, and chemistry.

Vehicle lightweighting and thermal management are key to achieving required performance targets. That's where adhesive and potting/encapsulating products can play an important role in overcoming engineering challenges.

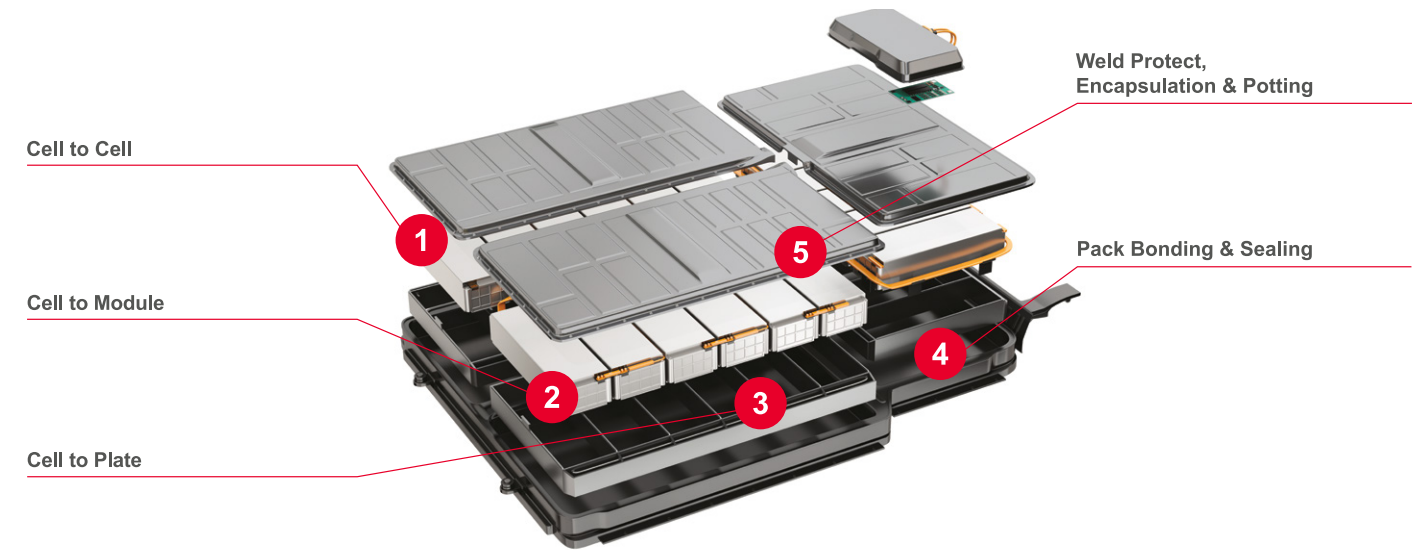
The Plexus and Devcon ranges of structural, thermally conductive, and semi-structural adhesive and sealants bond to metals (including difficult to bond EV cell materials), composites, thermoplastics with little to no surface treatment and can withstand fatigue and climate demands throughout and beyond the life of the battery pack.

Insulcast potting and encapsulating products are specifically developed to protect and insulate electrical assemblies, heat sink bonding, and surface mount and die attach points, improving battery performance and life-cycle.

ITW PERFORMANCE POLYMERS

- Global Manufacturing Presence
- Custom Formulated Solutions
- Dedicated Sales & Technical Teams
- In-House Material Testing
- Wide-Range of Chemistries, Formulations, and Application Options

Applications & Benefits



Durability: ITW Performance Polymers structural adhesives have excellent strength, elongation and fatigue resistance. Long-term durability of assemblies is enhanced by an even distribution of stress, and elimination of point-loads.

Lightweighting: ITW Performance Polymers structural adhesives bond key automotive and battery substrates and accommodate dissimilar substrates (Δ CLTE). This means designers can specify lighter materials and eliminate metal fasteners and assembly points.

Time Saving: Plexus, Devcon, and Insulcast products are formulated for manual and high-speed robotic application. Cure kinetics are optimized for room temperature curing, eliminating ovens and wait time. Little to no surface preparation saves steps and cost.

Fire Management: ITW Performance Polymers offers products that are UL94-V0 certified or contribute to UL94-V0 certified assemblies.

Thermal Management: Plexus brand thermally conductive 2K polyurethanes are available in formulations adjustable for working time and thermal performance. Insulcast potting and encapsulation materials reduce the chances of thermal runaway.

Environmental Resistance: ITW Performance Polymers products are designed to withstand long-term environmental exposure, extending vehicle and battery life-cycle.

Application	Chemistry	Properties
Cell to Cell	Structural PU	Fast-Curing Shear Strength: 7 - 14 MPa T-Peel Strength: ≥ 10 N/mm Aging Performance: Strength Retention >90% Low Odor UL94-V0
Cell to Module		
Cell to Plate	Thermally Conductive PU	Good Rheology/Workability Thermal Conductivity: 1 - 2 W/m.K Shear Strength: 7 - 12.5 MPa T-Peel Strength: 5 - 10 N/mm Low Odor UL94-V0
Pack Bonding & Sealing	MMA	Operation Time: 5 - 90 min Shear Strength: ≥ 18 Mpa T-Peel Strength: > 8 N/mm Fatigue Strength: > 5 M cycles Aging: Strength Retention >90% UL94-V0 (sandwich panel)
	Hybrid	Leak (sealing): ≥ 6000 MPa Lap Shear Strength: ≥ 7 Mpa Elongation at Break: 300% Hardness: Shore 80A Aging: Strength Retention >90% UL94-V0
Potting & Encapsulation	Epoxy/Silicone	Good workability Insulation Strength: ≥ 16 KV/mm Lap Shear Strength: ≥ 5 Mpa IP67, UL94-V0

2K Structural Acrylic Adhesives

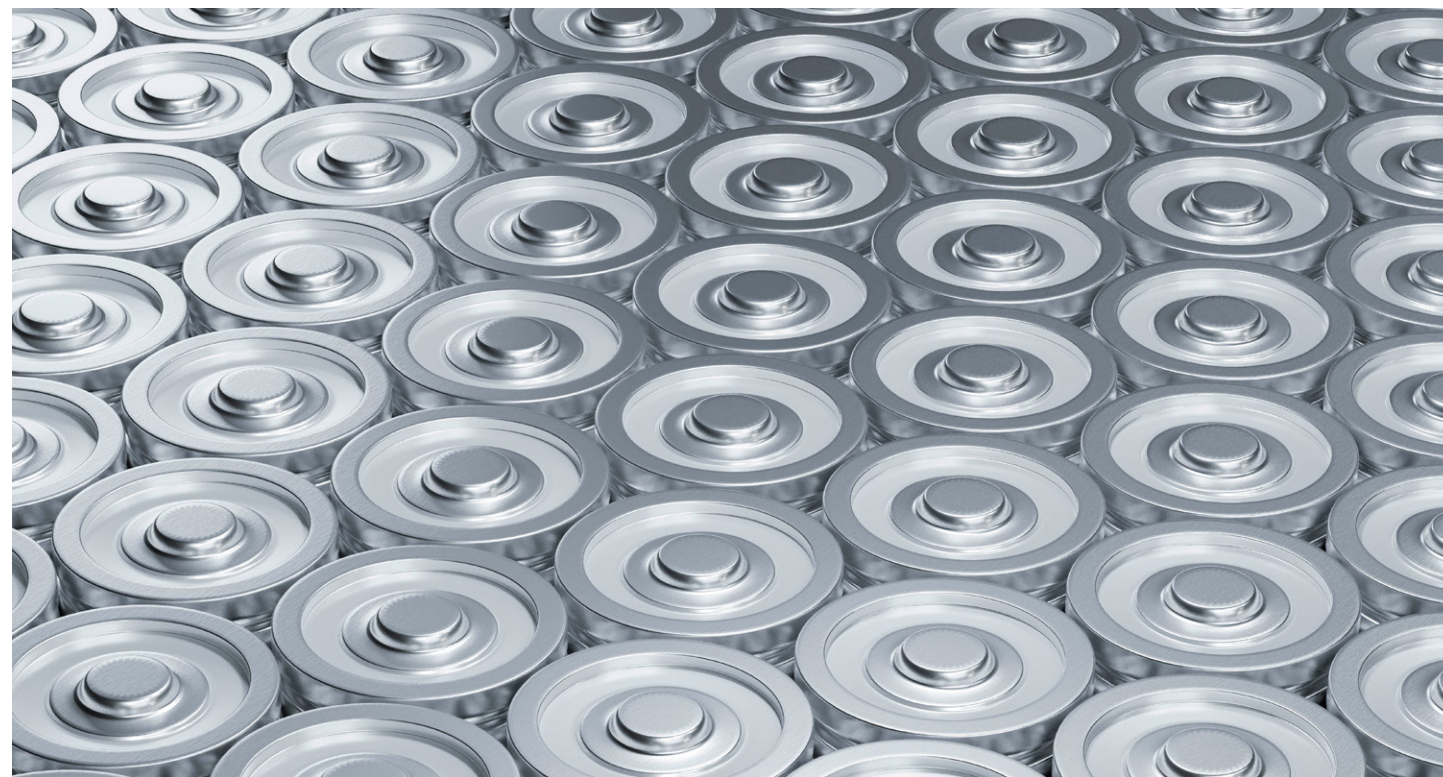
Product	Description	Mix Ratio (v/v)	Working Time min.	Fixture Time ¹ min.	Tensile Strength, psi (MPa)	Tensile Elong. %	Max. Gap Fill, in. (mm)	Part A Viscosity, cP x 10 ³	Part B Viscosity, cP x 10 ³
MA8105 GB	Low Odor, High Toughness, Primerless to Metal	1:1	3 - 6	12 - 14	3,285 - 4,015 22.7 - 27.2	5 - 10	0.5 12.7	70 - 140	50 - 120
MA8110 GB	Low Odor, High Toughness, Primerless to Metal	1:1	8 - 12	33 - 36	3,285 - 4,015 22.7 - 27.2	25 - 45	0.5 12.7	40 - 80	40 - 80
MA8120 GB	Low Odor, High Toughness, Primerless to Metal	1:1	18 - 22	50 - 60	2,907 - 3,630 20.5 - 25.0	30 - 60	0.5 12.7	40 - 80	80 - 120
MA808	High Strength, High Elongation, Low Modulus	10:1	7 - 8	9 - 10	2,070 - 2,530 15.2 - 16.6	>140	NA	35 - 70	15 - 50
MA830	Primerless to Aluminum, High Strength	10:1	4 - 6	15 - 17	2,610 - 3,190 18.0 - 22.0	10 - 20	0.5 13	80 - 120	35 - 80
MA832	Primerless to Aluminum, High Strength	10:1	12 - 14	55 - 60	2,790 - 3,410 19.2 - 23.5	20 - 40	0.5 12	80 - 130	35 - 80
MA7020	Non-flammable, High Toughness, High Strength	4:0	15 - 20	130 - 140	1475 - 1800 10.2 - 12.5	70 - 100	0.125 3.2	360 - 430	170 - 240

1. Varies with bond gap, joint size, assembly weight, and ambient temperature. Present values were measured at 74°F (23°C).

2K Structural Polyurethane Adhesives

Product	Description	Mix Ratio (v/v)	Working Time min.	Fixture Time ¹ hours	Tensile Strength, psi (MPa)	Tensile Elong. %	Max. Gap Fill, in. (mm)	Part A Viscosity, cP x 10 ³	Part B Viscosity, cP x 10 ³
PU/DT2325	High Elongation, Low Modulus, Low Odor, Impact Resistant	1:1	20 - 30	4 - 6	1,910 - 2,330 (13.2 - 16.1)	67 - 124	0.01 - 1.0 (0.25 - 25.4)	55 - 120	55 - 120

1. Varies with bond gap, joint size, assembly weight, and ambient temperature. Present values were measured at 74°F (23°C).



2K Thermally Conductive Polyurethane Adhesives

Product	Description	Mix Ratio (v/v)	Working Time min.	Fixture Time ¹ hours	Mixed Visc. (cP x 10 ³)	Tensile Strength, psi (MPa)	Tensile Elong. %	Thermal Cond. (W/m-K)	Vol. Res. (Ω-cm)	Dielectric Strength (kV/mm)
PU/DT2430	Thermally Conductive, Flame Resistant (UL94 V-0 performance), Low Modulus, Low Odor	1:1	25 - 35	15 - 17	60 - 140	1,660 - 2,030 (11.5 - 14.0)	13 - 24	1.1	4.57x10 ¹⁴	18.54
PU/DT2630LD	High Thermal Conductivity, Flame Resistant (UL94 V-0 performance), Low Odor	1:1	30 - 45	17 - 22	110 - 210	1,190 - 1,450 (8.2 - 10.0)	5 - 8	1.7	8.66x10 ¹⁴	11.81

1. Varies with bond gap, joint size, assembly weight, and ambient temperature. Present values were measured at 74°F (23°C).

2K Hybrid Semi-Structural Adhesive/Sealants

Product	Description	Mix Ratio	Working Time min.	Fixture Time ¹ min.	Tensile Strength, psi (MPa)	Tensile Elong. %	Max. Gap Fill (mm)	Part A Viscosity, cP x 10 ³	Part B Viscosity, cP x 10 ³
H4110	Primerless to Metal, Elastic, Low Shrink, Non-Flammable	1:1	8 - 12	65 - 75	800 - 1,000 6.5	150	NA	40 - 80	40 - 80
HA1820	Primerless to Metal, Fast-Curing Elastic, Low Shrink, Non-Flammable	2:1	20 - 25	NA	1,102 7.6	300	NA	110	30

1. Varies with bond gap, joint size, assembly weight, and ambient temperature. Present values were measured at 74°F (23°C).

Product Recommendations

Plexus two-component adhesive systems are designed to be applied between 18 - 27°C. Lower temperatures will slow cure-speed, higher temperatures will increase cure-speed. The viscosity of both components is affected by temperature. For consistent dispensing, it is best practice to maintain relatively constant application temperatures throughout the year.

For maximum bond strength, ensure the joint is completely filled and mate the parts within the specified working time. After joining, the parts must remain undisturbed until the fixture time has elapsed. Clean-up should be done before the adhesive is cured. In case of cured material, carefully remove adhesives by mechanical means and clean as needed.

Spills should be cleaned-up with absorbent material. (See Plexus SDS and follow local regulations for disposal).

Plexus adhesives can be applied with hand-held applicators or pumping equipment through a static mixer. ITW Performance Polymers Technical Services should be consulted regarding wetted components of dispensing equipment. Refer to equipment manuals for preventative maintenance, cleaning, and shut-down procedures.

Plexus product shelf-life ranges from 6 - 18 months. Consult product TDS for specific information. Shelf-life is based on continuous storage at 12 - 25°C. Prolonged exposure to higher temperatures (>35°C) quickly reduces product reactivity and should be avoided.

Working Time: The time period that begins when the two adhesive components are mixed and ends when the adhesive is no longer usable for bonding. Values shown are tested at 23°C.

Fixture Time: The time required after joining for the adhesive to develop cohesive strength of 0.35 MPa at 23°C.

Tensile Strength: The ultimate cohesive strength of the material tested according to ASTM D638.

Contact ITW Performance Polymers for further information. Consult product SDS for detailed safety and handling information. Product SDS are available at: itwpp.com



How to use Plexus products!

Devcon Epoxy Adhesives

Product	Description	Color	Mix Ratio	Working Time ¹ min.	Fixture Time ² min.	Func. Cure Time ² min.	Mixed Visc. (cPx10 ³)	Lap Shear Strength, psi (MPa)	Tensile Elong.%	Peel Strength (N/cm)	Dielectric Strength (kV/mm)
Minute Epoxy Gel	Primerless to Metal, Elastic, Low Shrink, Non-Flammable	Translucent	1:1	0.75	1	30 - 45	70	1,600 11	1	4 - 5	19.3
5 Minute Epoxy	General purpose, Rigid Bonding or Coating	Amber	1:1	3 - 6	10 - 15	45 - 60	10	1,900 13	1	4 - 5	19.3
2 Ton Epoxy	Primerless to Metal, Elastic, Low Shrink, Non-Flammable	Clear	1:1	8 - 12	30 - 35	120	8	2,250 15.5	1	4 - 5	23.6
Epoxy Plus 25	Rubber Toughened, Non-Corrosive, Broad Adhesion	Grey	1:1	25	120	210	70	2,750 19	20	35 - 45	21.6
HP250	High Shear & Impact Strength, Fatigue and Chemical Resistant	Straw	2:1	65	360	1 day	105	3,200 22	25	50 - 70	21.6

1. Based on 28 g mass @ 23°C. 2. Tested at 23°C

Product Recommendations

Surface Preparation: Devcon epoxies work best on clean surfaces. Surfaces should be free of heavy deposits of grease, oil, dirt or other contaminants, or cleaned with industrial cleaning equipment such as vapour phase degreasers or hot aqueous baths. Abrading or roughing the surfaces of metals will increase the microscopic bond area significantly and optimize the bond strength.

Mixing: Cartridges should be used with an applicator gun and a static mixer. The static mixer nozzle allows the material to be thoroughly mixed when dispensed, so it can be applied directly to the surfaces to be bonded. Please note: Once the product goes beyond its working time the nozzle must be thrown away and a new nozzle used for further dispensing.

Application: Apply mixed epoxy directly to one surface in an even film or as a bead. Assemble the parts within the recommended working time. Maintain firm contact between the parts to ensure good contact of the epoxy between the mating parts, clamping may optimize this part of the process. A small volume of epoxy should flow out the edges to show there is adequate gap filling.

For very large gaps, apply epoxy to both surfaces and spread to cover the entire area, or make a bead pattern, that will allow material to flow throughout the joint. Let bonded assemblies stand for the recommended functional cure time before handling. They are capable of withstanding processing forces at this point, but should not be dropped, shocked, or heavily stressed.

Storage / Shelf Life: Devcon epoxy adhesives should be stored in a cool, dry place when not used for a long period of time. A shelf life of 1 year from date of manufacture can be expected when stored at room temperature (23°C) in their original containers.

ITW Performance Polymers recommends all users to refer to our Technical Data and Safety Data Sheets for typical physical properties and safety precautions prior to use.



Insulcast Potting, and Encapsulation 2K Epoxies

Product	Description	Pot Life. min. (25°C)	Mixed Visc. (cPx10 ³)	Cure Cycle, h ¹	Shore Hardness	Thermal Cond. (W/m·K)	Dielectric Prop.		Vol. Res. (Ω-cm)	Tg (°C)	CTE (m/m·K)	UL94 Rating
							Cons.	Strength (V/m)				
116FR	Convenient mixing and worker friendly formulation, Fast room temp. cure	90	8.1	24	75D	0.65	4.4	420	1 x 10 ¹⁴	70	30 x 10 ⁻⁶	V0
140FR/11B	High thermal conductivity	150	50	See TDS	90 - 95D	2.3	6.3	420	1 x 10 ¹⁵	155	26 x 10 ⁻⁶	V1
Insulgel 70CC NR FS	Unique, exhibits superior thermal shock resistance, reduced shrinkage, excellent alternative for PU potting where additional adhesion is required.	30 - 45	3	16 - 24	50D	0.52	4.1	400	7x10 ¹²	9	78x10 ⁻⁶	V0

1. Tested at 25°C

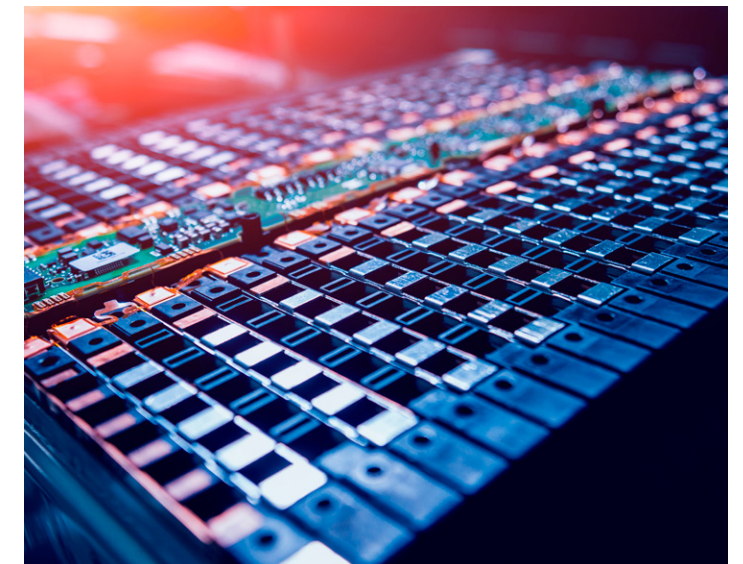
Insulcast Potting, and Encapsulation 2K Silicones

Product	Description	Pot Life. min. (25°C)	Mixed Visc. (cPx10 ³)	Cure Cycle, h ¹	Shore Hardness	Thermal Cond. (W/m·K)	Dielectric Prop.		Vol. Res. (Ω-cm)	Tg (°C)	CTE (m/m·K)	UL94 Rating
							Cons.	(V/m)				
RTVS 27 FC	Low viscosity, Fast-curing, Excellent electric properties	<5	2.9	1	60A	0.3	3	500	1 x 10 ¹⁵	NA	22 x 10 ⁻⁵	V0
RTVS 27HTC	Low viscosity, High TC, Ideal for high-density components needing heat dissipation	60	6	24	60A	1.0	4	500	1 x 10 ¹⁵	NA	17 x 10 ⁻⁵	V0
RTVS 8127	Flame retardant, Low visc	160 - 220	4	24	55A	0.75	4	500	1 x 10 ¹⁵	NA	18 x 10 ⁻⁵	V0
RTVS 3-95-2	High TC, Ideal for high-density components needing heat dissipation	90	35	24	85A	1.44	5	425	1 x 10 ¹⁴	NA	15 x 10 ⁻⁵	V0
RTVS 42 Curtis II	Silicone-Epoxy copolymer, withstands severe thermal shock, excellent dielectric insulation	20	16	See TDS	75A (12D)	0.58	4.0	500	1 x 10 ¹⁵	NA	45 x 10 ⁻⁶	C0

1. Tested at 25°C

Product Recommendations

- Mix Insulcast compound in original container to be sure of uniformity.
- Weigh out sufficient Insulcast for application.
NOTE: Be sure container and stirrer are clean.
- Add catalyst in calculated amount for the desired cure rate. If unsure, use a small amount of compound to check cure rate.
- Mix thoroughly, being sure to incorporate material from sides and bottom of container. Keep air entrainment to a minimum.
- De-aeration under vacuum may be necessary if absolutely void-free castings are needed.
- Pour into mold, cavity, etc.
- Cure at room temperature. Length of cure will depend on amount and type of catalyst used. Faster cure speed can be achieved at 51°C (125°F) for 2 - 3 hours.



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