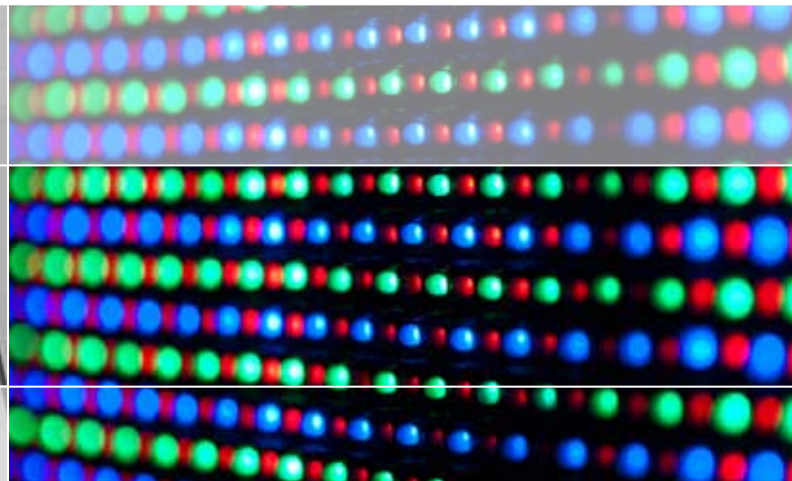




Silicones for  
Power Electronics

# Adhesive, Gel and Thermal Material Solutions



# We're the science behind long-term reliability.

**With the development of alternative energy sources to power our world, the need for power electronics is increasing. High power conversion requires high switching frequency, resulting in increased junction temperatures that require materials that can withstand higher operating temperatures. Momentive offers a range of silicone products that may be used for power electronic devices.**

## Enabling Reliable and Sustainable Technologies

Reducing carbon dioxide emissions from systems and processes, lowering a dependence on fossil fuels, and using energy more efficiently are trends leading to the increased use of power electronics.

In the automotive industry, moving away from the traditional fuel engine has opened the door for hybrid electric vehicles (HEV) and electric vehicles (EV). Cost efficiency, miniaturization

of high performance components, and multiple system integration has led to higher operating temperatures. Momentive silicones have been shown to be key enablers of this technology trend, due to temperature stability, dielectric strength and low modulus. Momentive is developing silicone products to withstand a wider range of operating temperatures as compared to epoxies, while still providing the needed protection for sensitive electronic components.



## Potential Uses

- Hybrid, Electric, and Fuel Cell Vehicles
- Renewable Energy
- Trains

## Typical Applications

- Power Modules
- Battery Modules
- Electric Motors
- Converters
- Inverters
- Battery Packs

Potential Application	Heat Cure (Addition)	Room Temperature Cure (Condensation, Moisture)	UV Cure	Material Type
Potting/Encapsulation	Available	Available	Available	Gel, Rubber
Sealing/Adhesives	Available	Available	-	Rubber
Thermal Management	Available	Available	-	Grease, Gel, Rubber
Conformal Coating	Available	Available	-	Coating



Silicone Feature	Application Benefit
Broad operational temperature range	Useful operating temperature range of -50°C to 200°C
Oxidative stability	Resistance to deterioration caused by ozone and UV
Dielectric stability	Stability of dielectric properties over a range of temperatures
Dielectric strength	Non-conductivity (insulator)
Gel	Vibration dampening



## Thermal Materials

Momentive's thermal materials dissipate heat from critical components. Many can be cured with heat or at room temperature. Thermal greases offer re-workable options and low oil bleed to provide stable thermal performance across wide temperature ranges.

Property	Units	Greases		Potting	
		TIG210BX	TIG830SP	TIA130G	TIA216G
Appearance		Gray	Gray	Gray	Gray
Type/Cure System		1-part	1-part	1-part/Addition cure	2-part/Addition cure
Flowability		Semi-flowable	Semi-flowable	Flowable	Flowable
Mix Ratio	A:B by weight	-	-	-	1:1
Viscosity	Pa-s	250	300	110	7.8
Cure Condition	°C/minutes	-	-	150/60	70/30
Cure Condition 2	°C/hours	-	-	-	25/6
Hardness	Type E	-	-	45	45
Penetration	(23°C)	345	360	-	-
Density (23°C)	g/cm <sup>3</sup>	2.90	2.88	3.04	2.69
Oil Bleed	150°C, 24h	0.0	0.0	-	-
Evaporation	150°C, 24h	0.1	0.3	-	-
Dielectric Strength	kV/mm	12	18	18	18
Thermal Conductivity	W/m·K	2.1	4.1	3	1.6
Thermal Resistance	mm <sup>2</sup> ·K/W	26 (45µm)	8 (20µm)	-	-
Volatile Siloxane D4-D10	ppm	<100	<100	<200	<200
Na <sup>+</sup> , K <sup>+</sup> , Cl <sup>-</sup> Content	ppm	2.0/0.0/0.0	0.5./0.0/0.1	-	-

Typical data are average data and should not be considered specifications. Actual values may vary.

## Gels

To meet manufacturing needs, Momentive offers both one and two component gels with a variety of viscosities and curing mechanisms to allow for varying times and temperatures. Some gels are thermally stable to 200°C and provide protection from external shock and vibration, dielectric protection and a dampening effect for components.

Property	TSE3051	TSE3051SK	TSE3070	TSE3062	UV Gel 100
Appearance	Transparent	Light Yellow Transparent	Transparent	Transparent	Transparent
Cure Type	1-P Addition cure	1-P Addition cure	2-P Addition cure	2-P Addition cure	2-P UV Process
Mix Ratio A:B by weight	-	-	1:1	1:1	10:1
Viscosity Pa·s (20 rpm)	0.7	0.7	0.8	0.8	1
Pot Life (23°C) day	-	-	4h	1h	3
Cure Condition °C/h	100/4, 125/2, 150/1	100/1	70/0.5	70/0.5	23/0.5 (post UV exposure)
Density (23°C) g/cm <sup>3</sup>	0.97	0.97	0.97	0.97	0.98
Penetration 1/10 of mm	85	60	65	55	47
Loss Coefficient G <sup>2</sup> /G <sup>1</sup> , 1Hz	0.128	-	0.652	0.098	-
Dielectric Strength kV/mm	18	18	18	18	-
Volume Resistivity MΩ/m	1.00 x 10 <sup>7</sup>	1.00 x 10 <sup>7</sup>	1.00 x 10 <sup>7</sup>	1.00 x 10 <sup>7</sup>	3.00 x 10 <sup>6</sup>
Dielectric Constant (60Hz)	2.8	2.7	2.7	2.7	2.9 (50Hz)
Dielectric Loss (60Hz)	0.001	0.001	0.001	0.001	0.0006 (50Hz)
Thermal Conductivity W/m·K	0.17	-	0.17	0.17	-
Moisture Absorptivity (%)	0.05	-	0.05	0.05	-
UL Recognition	-	RTI 105C	-	-	-

TSE3051SK silicone rubber compound is recognized by Underwriters Laboratories, Inc. under their Component Recognition Program (UL File Number QMFZ2.E56745).

Typical data are average data and should not be considered specifications. Actual values may vary.

## Condensation (Moisture) Cure Adhesives

Momentive's condensation cure adhesives cure at room temperature to form a strong bond to most plastic and metal substrates. They offer short tack free times that may contribute to productivity in high volume manufacturing.

Property	Units	Snapsil* TN3005	Snapsil TN3085	Snapsil TN3305	Snapsil TN3705
Cure Type		1P Condensation cure	1P Condensation cure	1P Condensation cure	1P Condensation cure
Cure Chemistry		Ti Alcohol	Ti Alcohol	Ti Alcohol	Ti Alcohol
Flowability		Thixotropic paste	Non-flowable paste	Flowable	Flowable
Viscosity	Pa·s (cps)	-	-	47 (47,000)	1.5 (1,500)
Tack Free Time	min	7	7	9	7

### Cured Properties (3 days @ 23°C, 50% RH)

Color		Clear, White, Black	Gray, White	Clear, White, Black	Clear, White, Black
Density	g/cm <sup>3</sup> (23°C)	1.04	1.63	1.04	1.01
Hardness	Type A	22	46	14	13
Adhesion Strength <sup>(1)</sup>	MPa (psi)	1.2 (174)	1.3 (189)	1.0 (145)	0.2 (29)
Elongation	%	330	150	400	130
Tensile Strength	MPa (psi)	1.8 (261)	2.3 (333)	1.5 (217)	0.4 (58)
Thermal Conductivity	W/m·K	0.18	0.7	0.18	0.18
Volume Resistivity	MΩ·m	2.0 x 10 <sup>7</sup>	4.0 x 10 <sup>6</sup>	2.0 x 10 <sup>7</sup>	2.0 x 10 <sup>7</sup>
Dielectric Strength	KV/mm	26	23	26	26
Dielectric Constant (60Hz)		2.7	4.0	2.7	2.7
Dissipation Factor (60Hz)		0.002	0.04	0.002	0.002
Volatile Siloxane <sup>(2)</sup> (D3-D10)	wt%	0.01	0.01	0.01	0.01
UL Recognition		-	UL94 V-0	UL94 HB	-

<sup>1</sup> Glass lap shear, 7 days @ 23°C, 50%RH

<sup>2</sup> In-house test method

Snapsil TN3085 and Snapsil TN3305 silicone rubber compounds are recognized by Underwriters Laboratories, Inc. under their Component Recognition Program (UL File Number QMF22.E56745).

Typical data are average data and should not be considered specifications. Actual values may vary.

## Addition (Heat) Cure Adhesives

Momentive's addition (heat) cure adhesives form a strong bond to most plastic and metal substrates and seal against moisture and environmental contaminants. Flexible cure conditions offer options for cure temperatures and for cure times.

Property	Units	TSE322	TSE322S	TSE3212	TSE3251	TSE326
Cure Type		1 Part Addition	1 Part Addition	1 Part Addition	1 Part Addition	1 Part Addition
Color		Light blue	Light blue	White	White	Reddish brown

### Uncured Properties (23°C)

Flowability		Flowable	Semi-flowable	Semi-flowable	Semi-flowable	Flowable-paste
Viscosity	Pa·s	110	70	280	8.5	28
Cure Condition	°C/h	150/1	150/1	150/1	150/1	150/1

### Cured Properties (1 hour @ 150°C)

Density	g/cm <sup>3</sup> (23°C)	1.27	1.26	1.26	1.02	1.45
Hardness	Type A	45	37	52	16	43
Linear Coefficient of Expansion	ppm/K	280	280	280	320	260
Adhesive Strength	MPa (psi)	2.5 (365)	2.5 (365)	2.6 (375)	0.4	2
Elongation	%	230	230	240	200	170
Tensile Strength	MPa (psi)	3.4 (495)	3.6 (520)	3.7 (535)	0.7 (102)	3.4 (493)
Thermal Conductivity	W/m·K	0.29	0.29	0.29	0.18	0.41
Volume Resistivity	MΩ·m	2.0 x 10 <sup>7</sup>	2.0 x 10 <sup>7</sup>	2.0 x 10 <sup>7</sup>	2.0 x 10 <sup>7</sup>	2.0 x 10 <sup>7</sup>
Dielectric Strength	KV/mm	20	20	20	21	22
Dielectric Constant	60Hz	3.1	3.1	3.2	2.8	3.3
Dissipation Factor	60Hz	0.006	0.006	0.006	0.002	0.02
UL Recognition		-	-	-	-	UL94 HB

TSE326 silicone rubber compound is recognized by Underwriters Laboratories, Inc. under their Component Recognition Program (UL File Number QMFZ2.E56745).

Typical data are average data and should not be considered specifications. Actual values may vary.

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