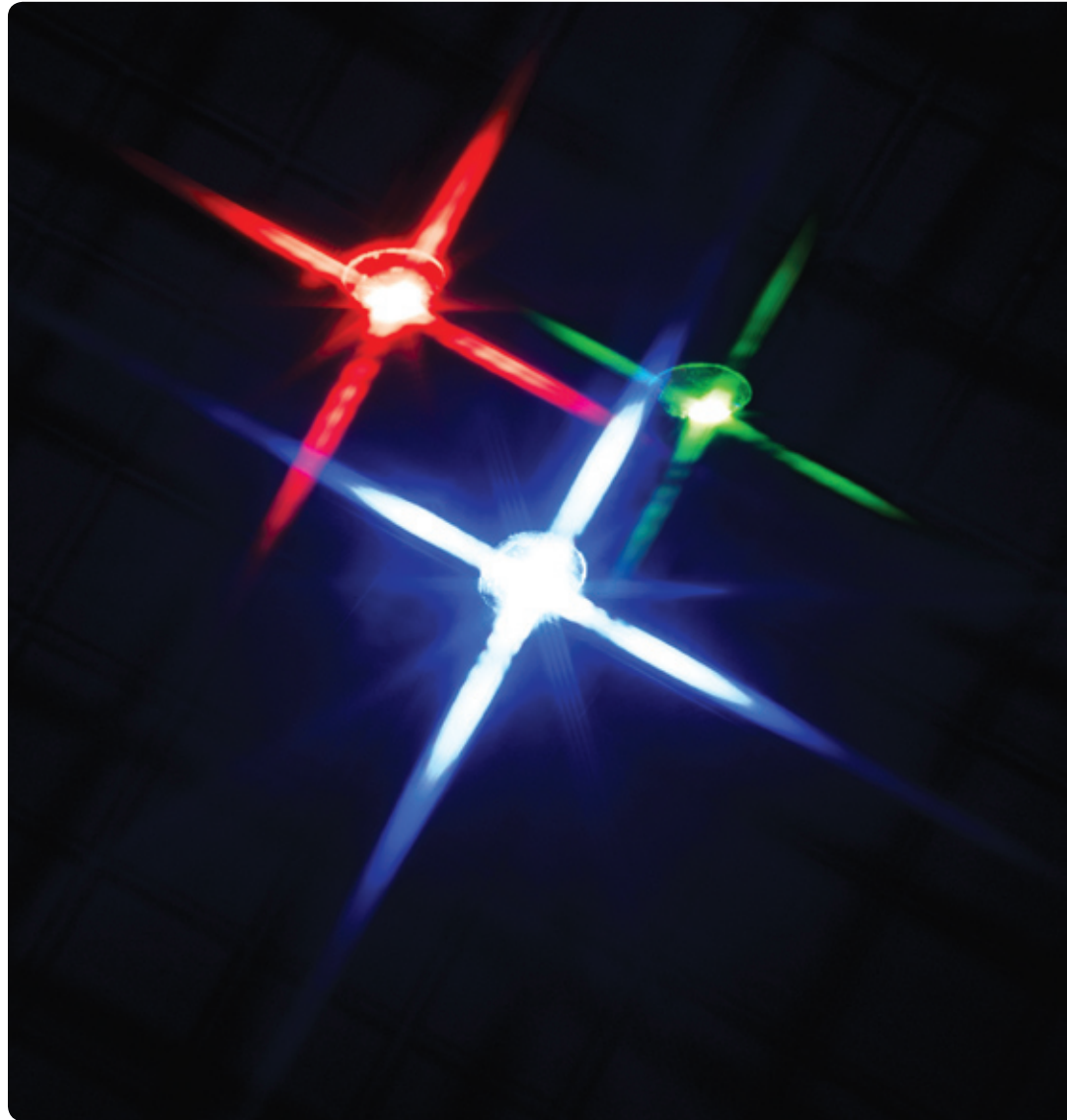




**MOMENTIVE**  
performance materials



## Silicone Material Solutions for LED Packages and Assemblies

# LED Packaging and Assembly Solutions from Momentive Performance Materials

The growth of optoelectronic devices and LEDs in segments such as handheld devices, mobile phones, display backlights, automotive, and electronic signs, has led to an increase in demand for enhanced performance and long-term reliability. Designers of LEDs and optoelectronic devices will find a range of silicone material solutions from Momentive, that are excellent candidates to address a wide array of challenges facing the LED industry.

## InvisiSil\* LED Encapsulants

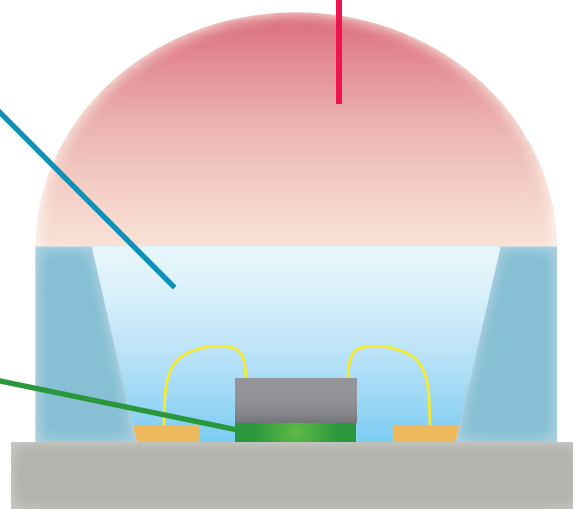
Momentive's InvisiSil series of silicone encapsulants exhibit unique optical efficiencies and a high-refractive index, while providing long-term resistance against the yellowing and delamination typical of conventional epoxy-based materials. (p.3-4)

## Silicone Lens Materials

For optical lens fabrication Momentive offers a series of products engineered to provide high transparency and mechanical strength. These moldable silicone materials are excellent candidates for injection molding systems that maximize the benefits of LIM processing. (p.6)

## Silicones for LED Die Attach

Momentive's die attach silicones offer a high heat and UV resistant alternative to conventional epoxy based die attach materials. These silicone materials are characterized by minimal yellowing, and contribute to long-term stability of light output. (p.7)



## Glob Top Encapsulants

Momentive's Glob Top encapsulants exhibit good light transmittance, and are formulated to provide consistent dispensing performance and material flow to form a dome shape for COB (chip on board) encapsulation. Component designers with chip-mounting and wire-bonding capabilities can benefit from the process simplicity that these materials offer in LED COB packaging applications. (p.5)

## Dot Matrix and LED Assembly Materials

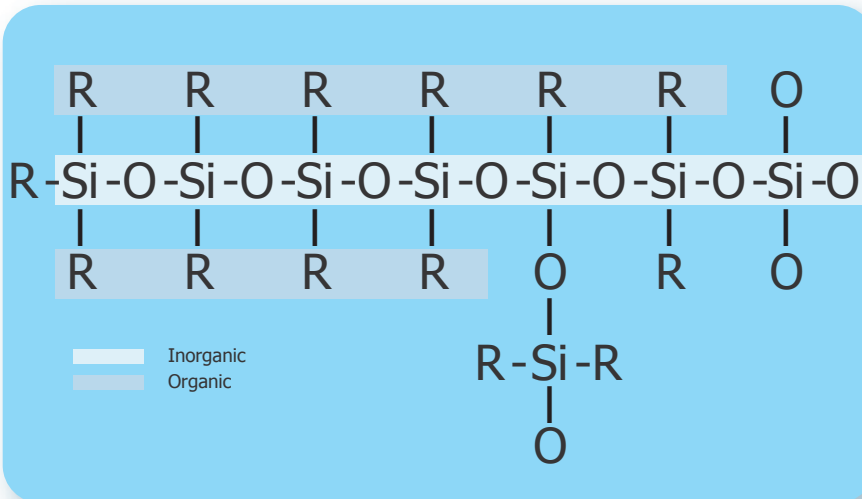
LED dot matrix potting materials are available in room temperature and heat-accelerated alternatives. The low viscosities of these potting materials make them great materials of choice for potting applications in intricate Dot Matrix applications and LED Assemblies. (p.8)

## Thermal Management Silicones

Momentive's thermal management silicone materials help dissipate heat generated from power and high-brightness LEDs. Products includes silicone grease, and heat-cure and condensation cure adhesives. (p.9)

# Silicone Advantages

The chemical structure of silicone provides several advantages over conventional materials used in optoelectronic applications. The backbone structure of polydimethylsiloxane consists of silicon (Si) and oxygen (O). The siloxane bond (Si-O) is inorganic and has a higher bond energy of (444kJ/mol) than either carbon (C) - carbon (C) bond (356kJ/mol), or carbon (C) - oxygen (O) bond (339kJ/mol). One of the better thermal stability of silicone over that of epoxy resin is ascribed to this bond energy difference.



## Performance Comparison

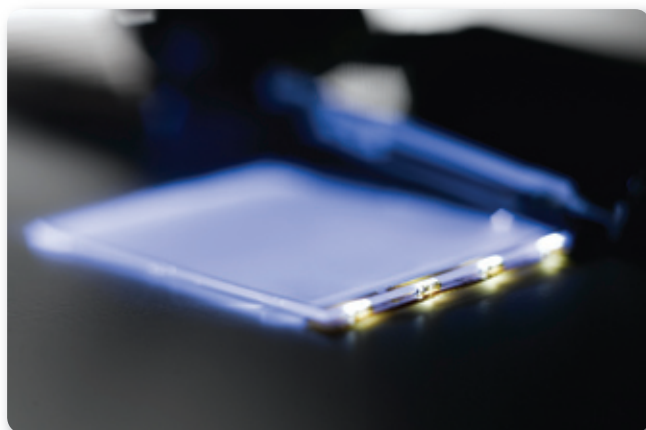
The inorganic siloxane bond of silicone materials and its resultant bond energy, contributes to stable performance under harsh operating conditions. This is manifest in performance advantages to epoxy resins under some usage conditions.

	Silicone	Epoxy
Thermal Resistance	Excellent	Fair
UV Resistance	Excellent	Poor
Hardness	Good	Excellent
Adhesion Strength	Good	Excellent
Thermal Expansion	Fair	Good
Moisture Absorption	Good	Fair
Moisture Permeability	Fair	Good

# InvisiSil\* LED Encapsulants

InvisiSil series, silicone encapsulants deliver high refractive index & light transmittance to effectively transmit light emitted from LEDs. They help contribute to durability and reliability of devices through their long-term resistance to yellowing and delamination of encapsulant from the substrate, and provide low viscosities that make them candidates for a wide variety of LED packages.

- Key features:**
- Selection from a range of refractive index up to 1.53 ( $n_D^{25}$ )
  - High light transmittance (>95%, 400-800nm)
  - Good workability
  - High purity
  - Adhesion to PPA, LCP

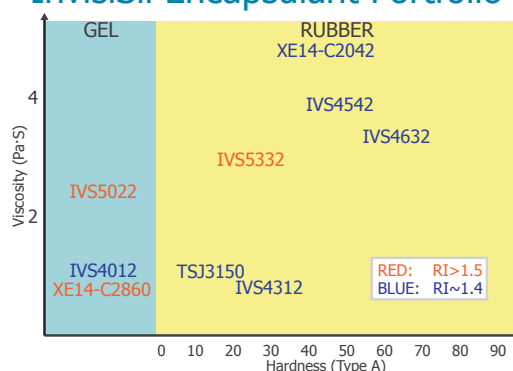


## Product Details

			High Refractive Index		
			IVS5022	IVS5332	XE14-C2860
Components			2 Part	2 Part	2 Part
Cure Type			Heat Cure	Heat Cure	Heat Cure
Property			Gel	Rubber	Gel
Appearance			Transparent	Transparent	Transparent
Viscosity:	(A)	Pa·s	2.4	5.6	0.9
	(B)	Pa·s	2.0	2.0	0.6
Mixing Ratio (A:B)			100:100	100:100	100:100
Viscosity (mixed) @23°C		Pa·s	2.2	3.3	0.8
Refractive Index ( $n_D^{25}$ )			1.51	1.53	1.515
Curing Condition		°C/h	150/1 <sup>1</sup>	150/1 <sup>1</sup>	80/1
Penetration			34	-	35
Hardness (Type A)			-	30	-
Tensile Strength		MPa	-	0.3	-
Elongation		%	-	50	-
Specific Gravity @23°C			1.06	1.12	-
Adhesion Strength (PPA)		MPa	-	0.3	-
CTE		1/K	-	2.5x10 <sup>-4</sup>	-

Packaging: 500g Bottles <sup>1</sup>Step cure 80°C@90min, 150°C@1h  
Typical property values should not be used as specifications

## InvisiSil Encapsulant Portfolio



			Normal Refractive Index					
			IVS4012	IVS4312	IVS4542	IVS4632	TSJ3150	XE14-C2042
Components			2 Part	2 Part	2 Part	2 Part	1 Part	2 Part
Cure Type			Heat Cure	Heat Cure	Heat Cure	Heat Cure	Heat Cure	Heat Cure
Property			Gel	Rubber	Rubber	Rubber	Rubber	Rubber
Appearance			Transparent	Transparent	Transparent	Transparent	Transparent	Transparent
Viscosity:	(A)	Pa·s	0.8	1.2	5.7	7.5	-	6.2
	(B)	Pa·s	0.7	0.8	3.2	1.4	-	4.4
Mixing Ratio (A:B)			100:100	100:100	100:100	100:100	-	100:100
Viscosity (mixed) @23°C		Pa·s	0.8	1.0	3.8	3.2	1.2	4.9
Refractive Index ( $n_D^{25}$ )			1.40	1.41	1.41	1.41	1.41	1.41
Curing Condition		°C/h	70/0.5	150/1 <sup>1</sup>	150/1 <sup>1</sup>	150/1 <sup>1</sup>	150/4	150/1 <sup>1</sup>
Penetration			57	-	-	-	-	-
Hardness (Type A)			-	29	48	64	12	43
Tensile Strength		MPa	-	0.8	6.6	9.0	-	6.0
Elongation		%	-	110	110	80	-	170
Specific Gravity @23°C			0.98	0.99	1.03	1.05	0.97	1.02
Adhesion Strength (PPA)		MPa	-	0.3	3.7	1.5	0.2 (AI)	3.0
CTE		1/K	-	3.3x10 <sup>-4</sup>	2.8x10 <sup>-4</sup>	2.8x10 <sup>-4</sup>	-	2.8x10 <sup>-4</sup>

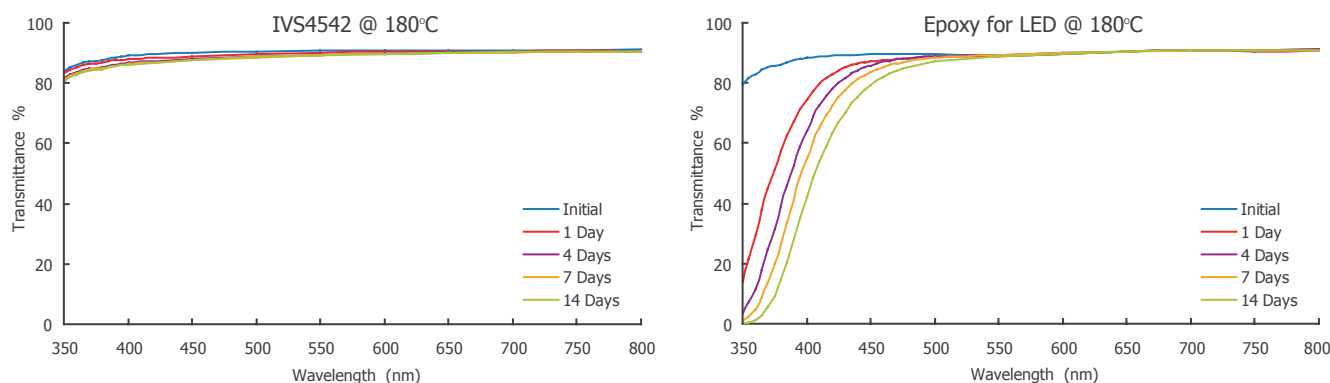
Packaging: 500g Bottles <sup>1</sup>Step cure 80°C@90min, 150°C@1h

Typical property values should not be used as specifications

# InvisiSil Encapsulants Technical Data

## Thermal Stability

InvisiSil LED Encapsulants help contribute to long-term thermal stability of LEDs. This is represented in thermal stability tests conducted using IVS4542 and LED grade epoxy resins. Tests were performed by exposing both materials, sandwiched between glass plates, to 180°C temperatures. While the transmittance of IVS4542 remained stable under prolonged periods of heat exposure, epoxy resins demonstrated deterioration in transmittance over time accompanied by yellowing of the encapsulant material.

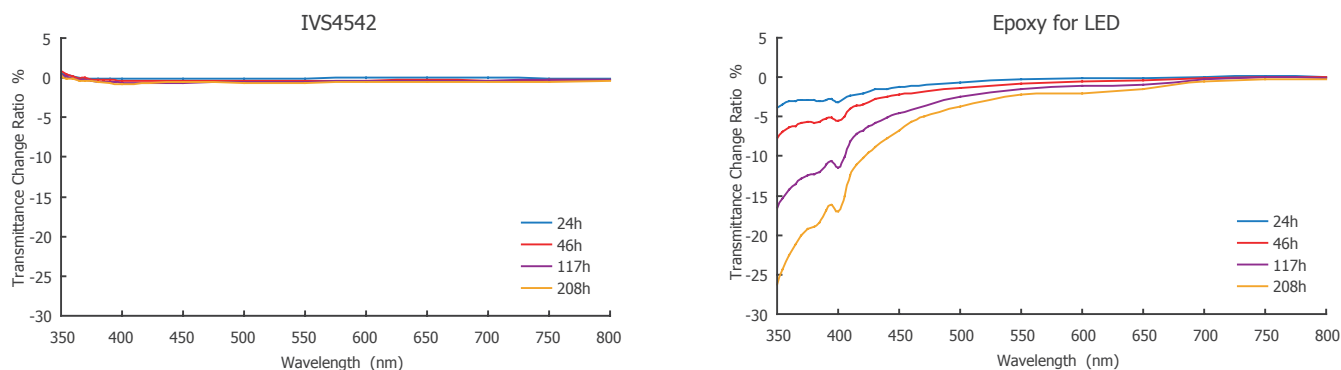


Test Conditions: IVS4542 and epoxy resin cured in glass sandwich specimens and exposed to 180°C temperatures for specified time intervals



## UV Stability

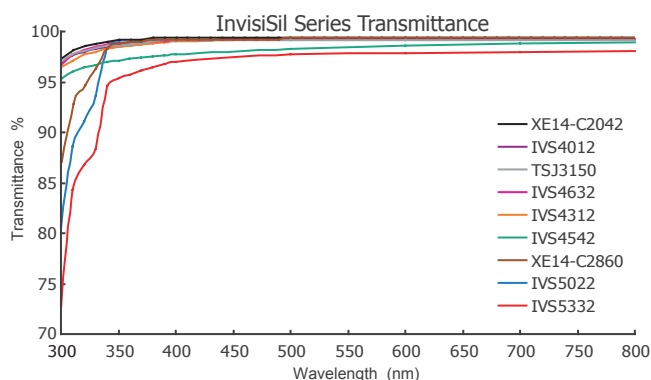
InvisiSil LED Encapsulants also help contribute to long-term UV stability of LEDs. This is represented in UV stability tests conducted using IVS4542 and LED grade epoxy resins. Tests were performed by exposing both materials, sandwiched between glass plates, to black lamp UV light. Change in transmittance against initial spectra values were measured. IVS4542 silicone encapsulant demonstrated stable performance, while LED epoxy resins generated results suggesting lower UV stability.



Test Conditions: IVS4542 and epoxy resin cured in glass sandwich specimens and exposed to UV lamp: Black light, 100mJ/cm<sup>2</sup>/min at 365nm detector



## Transparency Performance<sup>1</sup>



<sup>1</sup>Transmittance measured using 1mm liquid film

# Glob Top Encapsulants

Momentive's Glob Top encapsulants exhibit good light transmittance, and are excellent candidates to provide consistent dispensing performance and material flow to form a dome shape for COB (chip on board) encapsulation. Component designers with chip-mounting and wire-bonding capabilities can benefit from the process simplicity that these materials offer in LED COB packaging applications.



## Product Details

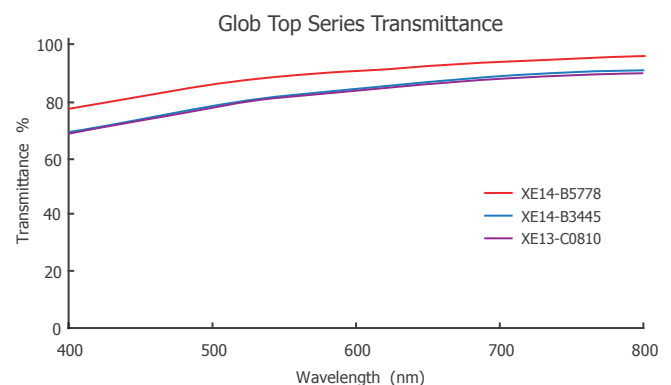
			XE14-B3445	XE14-B5778	XE13-C0810
Components			2 Part	2 Part	1 Part
Cure Type			Heat Cure	Heat Cure	Heat Cure
Property			Rubber	Rubber	Rubber
Appearance			Translucent	Translucent	Translucent
Viscosity:	(A)	Pa·s	70	5.0	-
	(B)	Pa·s	55	4.9	-
Mixing Ratio	(A:B)		100:100	100:100	-
Viscosity (mixed) @23°C		Pa·s	63	14	14
Pot Life @23°C		h	72	8	-
Refractive Index (n <sub>D</sub> 25)			1.41	1.41	1.41
Curing Condition		°C/h	150/1	80/2	150/1
Specific Gravity @23°C			1.10	1.02	1.03
Hardness (Type A)			70	16	23
Tensile Strength		MPa	-	50	-
Elongation		%	-	190	160
Adhesive Strength (AI)		MPa	3.5	0.3	-
Thermal Conductivity		W/m·K	0.2	0.2	0.2
CTE		1/K	2.7x10 <sup>-4</sup>	2.3x10 <sup>-4</sup>	-
Volume Resistivity		MΩ·m	1x10 <sup>15</sup>	2x10 <sup>5</sup>	2x10 <sup>7</sup>
Dielectric Strength		kV/mm	20	24	24
Dielectric Constant (60Hz)			2.8	2.7	2.6
Dielectric Loss (60Hz)			0.0004	0.001	0.0068
Ionic Content (Na/K, Cl)		ppm	<2, <2, <5	<2, <2, <5	<2, <2, <5

Typical property values should not be used as specifications

## Packaging

	10ml syringe	500g bottle	1kg can	4kg can
XE14-B3445 (A)		●		
XE14-B3445 (B)		●		
XE14-B5778 (A)		●		●
XE14-B5778 (B)		●		●
XE13-C0810	●	●	●	

## Transparency Performance<sup>1</sup>



<sup>1</sup>Transmittance measured using 0.5mm liquid film



# Lens Fabrication Materials

For optical lens fabrication Momentive offers a series of products engineered to provide high transparency and mechanical strength. These moldable silicone materials are excellent candidates for injection molding systems that maximize the benefits of LIM processing.



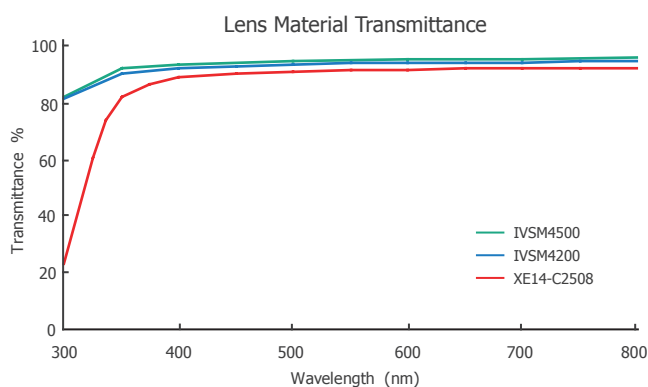
## Product Details

			IVSM4200 <sup>1</sup>	IVSM4500	XE14-C2508 <sup>1</sup>
Components			2 Part	2 Part	2 Part
Cure Type			Heat Cure	Heat Cure	Heat Cure
Property			Rubber	Rubber	Rubber
Appearance			Transparent	Transparent	Translucent
Viscosity:	(A)	Pa·s	400	350	85
	(B)	Pa·s	250	50	480
Mixing Ratio	(A:B)		100:100	100:100	100:10
Viscosity (mixed) @23°C		Pa·s	300	30	93
Pot Life @23°C		h	3	24	24
Curing Condition		°C/h	150/1	150/1	180/1
Refractive Index ( $n_D^{25}$ )			1.42	1.41	1.53
Transmittance (400nm, 800nm)%			91.3, 93.9	99, >99	87.8, 91.3
Hardness (Shore D)			16	50	68
Young's Modulus			MPa	80	-
Tensile Strength			MPa	4.7	-
Elongation			%	<5	-
CTE			1/K	$2.2 \times 10^{-4}$	-
Shrinkage				2.5	-

Packaging: 18kg Pails <sup>1</sup> Experimental grade

Typical property values should not be used as specifications

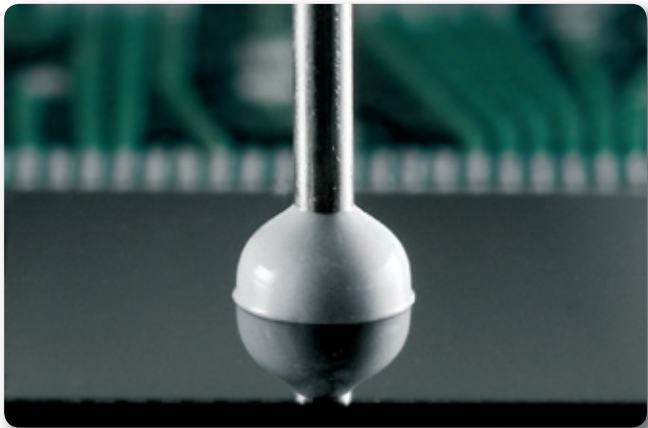
## Transparency Performance<sup>1</sup>



<sup>1</sup>Transmittance measured using 1mm liquid film

# Die Attach Silicones

Momentive's die attach silicones offer a high heat and UV resistant alternative to conventional epoxy based die attach materials. These silicone materials are characterized by minimal yellowing, and contribute to long-term stability of light output.



## Product Details

	SDC5003 <sup>1</sup>	TSE3282-G	XE13-C2476
Characteristic	Electro-Conductive	Thermally Conductive	Electro-Insulative
Components	1 Part	1 Part	1 Part
Cure Type	Heat Cure	Heat Cure	Heat Cure
Property	Rubber	Rubber	Rubber
Appearance	Yellow Metallic	Gray	Translucent
Viscosity @23°C	Pa·s	33	20
Curing Condition	°C/h	150/1	150/1
Thermal Conductivity	W/m·K	3.1	2.0
Specific Gravity @23°C		2.70	1.15
Hardness (Type A)		80	58
Elongation	%	150	50
Adhesive Strength (AI)	MPa	1.0	2.5
Volume Resistivity	MΩ·m	3.0x10 <sup>-4*</sup>	5x10 <sup>6</sup>
Refractive Index (n <sub>D</sub> <sup>25</sup> )		-	1.42
Ionic Content (Na/K, Cl)	ppm	<10, <2, <5	-

<sup>1</sup> Experimental grade

\*Ω·cm

Typical property values should not be used as specifications

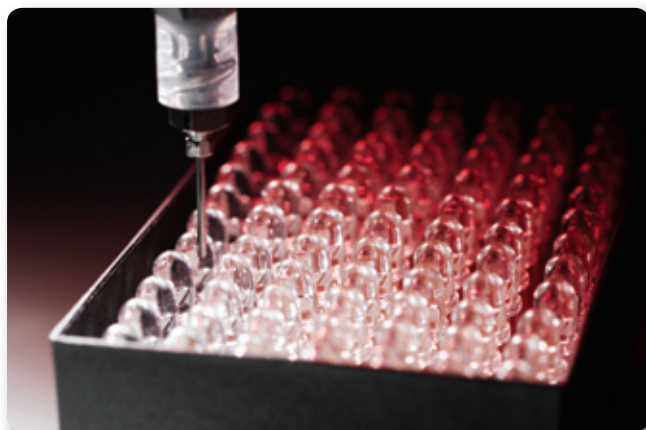
## Packaging

	10ml syringe	200g tube	500g bottle	1kg can
SDC5003	●			
TSE3282-G		●		●
XE13-C2476	●			



# Dot Matrix and Assembly Materials

LED dot matrix potting materials are available in room temperature and heat-accelerated alternatives. The low viscosities of these potting materials make them excellent materials of choice for intricate Dot Matrix applications and LED Assemblies for a variety of industries ranging from signage, automotive, to lighting. These silicone materials provide enhanced weatherability performance, especially in locations with high salt air concentrations, and represent a smart alternative to conventional epoxy or urethane materials.



Product Details			Dot Matrix Materials		LED Assembly Materials		
			XE12-B2543	XE14-C0447	TSE3032	TSE3033	RTV615
Components			2 Part	2 Part	2 Part	2 Part	2 Part
Cure Type			Room Temp.	Heat Cure	Heat Cure	Heat Cure	Heat Cure
Property			Rubber	Rubber	Rubber	Rubber	Rubber
Appearance			Black	Black	Transparent	Transparent	Transparent
Viscosity:	(A)	Pa·s	1.8	2.0	4.2	1.1	4.3
	(B)	Pa·s	-	2.0	0.7	0.9	-
Mixing Ratio	(A:B)		100:2	100:100	100:10	100:100	100:10
Viscosity (mixed) @23°C		Pa·s	-	2.0	4.0	1.0	4.0
Pot Life @23°C		h	2	2	4	6	4
Tack Free Time		min	180	-	-	-	-
Curing Condition		°C/h	-	80/1	100/1	150/0.5	100/1
Specific Gravity @23°C			1.11	0.99	1.02	0.99	1.02
Hardness			26 (Type A)	14 (Type E)	35 (Type A)	30 (Type A)	44 (Type A)
Tensile Strength		MPa	0.6	-	4.5	1.0	6.3
Elongation		%	150	-	210	130	160
Adhesion Strength		MPa	0.43 (Al)	0.15 (PC)	-	0.3 (glass)	-

Typical property values should not be used as specifications

## Packaging

	30g bottle	100g bottle	1 lb (454g)	500g bottle	1kg can	10 lb (4.5kg)	15kg pail	18kg pail	44 lb (20kg)
XE12-B2543 (A)					●			●	
XE12-B2543 (B)	●			●					
XE14-C0447 (A)							●		
XE14-C0447 (B)							●		
TSE3032 (A)					●		●		
TSE3032 (B)		●		●			●		
TSE3033 (A)					●			●	
TSE3033 (B)					●			●	
RTV615 (A:B Kit)			●			●			●

# Thermal Management Silicones

## SilCool\* Silicone Grease

		TIG2000	Low Thermal Resistance TIG830SP
Property / Color		Pale Blue Paste	Gray Paste
Thermal Conductivity <sup>1</sup>	W/m·K	2.0	4.1
Thermal Resistance <sup>2</sup> (BLT)	mm <sup>2</sup> ·K / W	24 (50µm)	8 (30µm)
Specific Gravity	@23°C	2.80	2.88
Penetration <sup>3</sup>	@23°C	400	310
Viscosity	@23°C Pa·s	-	300
Bleed <sup>3</sup>	@150°C/24h wt%	<0.1	<0.1
Evaporation	@150°C/24h wt%	<0.1	0.3
Volume Resistivity <sup>4</sup>	MΩ·m	1x10 <sup>6</sup>	1x10 <sup>4</sup>
Dielectric Strength	kV/0.25mm	5	4.5
Volatile Siloxane (D <sub>3</sub> -D <sub>10</sub> )	ppm	<100	<100
Ionic Content* <sup>5</sup> (Na/K, Cl)	ppm	-	0.5, 0.0, 0.1

<sup>1</sup>Bulk sample measurement (hot wire method), <sup>2</sup>Laser flash analysis on a Si-Si sandwiched material  
<sup>3</sup>JIS K 2220, <sup>4</sup>MIL-S-8660B, <sup>5</sup>Ion chromatography analysis on water extracts  
 Typical property values should not be used as specifications

## Packaging

	200g tube	2kg can	2kg bottle
TIG2000	●	●	
TIG830SP			●

## SilCool Silicone Adhesive - Heat Cure

		XE13-C1822	TSE3282-G
Type		1 Part	1 Part
Property (uncured)		Semi-Flowable	Flowable
Color		Gray	Gray
Viscosity	@23°C Pa·s	150	20
Curing Condition	°C/h	150/1	150/1
Thermal Conductivity <sup>1</sup>	W/m·K	3.2	2.0
Thermal Resistance <sup>2</sup> (BLT)	mm <sup>2</sup> ·K / W	17 (50µm)	33 (50µm)
Specific Gravity	@23°C	3.04	2.70
Hardness (Type A)		94	80
Tensile Strength	MPa	5.6	4.0
Elongation	%	10	50
Adhesion (Lap Shear) <sup>4</sup>	MPa	4.0	2.5
CTE	ppm/K	100	140
Glass Transition Temp	°C	-120	-120
Volume Resistivity <sup>3</sup>	MΩ·m	5.0x10 <sup>6</sup>	4.8x10 <sup>6</sup>
Dielectric Strength	kV/mm	20	23
Ionic Content <sup>5</sup> (Na/K, Cl)	ppm	each <5	each <10
Moisture Absorption	wt%	<0.6	<0.6

<sup>1</sup>Bulk sample measurement (hot wire method), <sup>2</sup>Laser flash analysis on a Si-Si sandwiched material, <sup>3</sup>ASTM E 14561, <sup>4</sup>Aluminum lap shear, <sup>5</sup>Ion chromatography analysis  
 Typical property values should not be used as specifications

## Packaging

	200g tube	1kg can
XE13-C1822		●
TSE3282-G	●	●

## Condensation Cure Silicone Adhesives

		XE11-C3165	XE11-B5320
Type		1 Part	1 Part
Property (uncured)		Flowable	Non-Flowable
Color		Light Gray	White
Viscosity	@23°C Pa·s	180	-
Tack Free Time	Min	10	5
Thermal Conductivity	W/m·K	2.6	1.3
Specific Gravity	@23°C	3.00	2.59
Hardness (Type A)		93	80
Tensile Strength	MPa	6.5	3.6
Elongation	%	40	40
Adhesive Strength	MPa	2.6	1.3
CTE	ppm/K	100	120
Volume Resistivity	MΩ·m	7.0x10 <sup>6</sup>	2.0x10 <sup>7</sup>
Dielectric Strength	kV/mm	20	17
Volatile Siloxane (D <sub>3</sub> -D <sub>10</sub> )	wt%	0.001	0.010

Typical property values should not be used as specifications

## Packaging

	333ml cart.
XE11-C3165 <sup>1</sup>	
XE11-B5320	●

<sup>1</sup>Contact a Momentive Performance Materials sales representative for package availability

# Product Availability by Region<sup>1</sup>

	Japan	Korea	China	US	Europe
IVS5022	●	●	●	●	●
IVS5332	●		●	●	●
XE14-C2860	●		●	●	●
IVS4012	●	●	●	●	●
IVS4312	●	●	●	●	●
IVS4542	●	●	●	●	●
IVS4632	●		●	●	●
TSJ3150	●		●		●
XE14-C2042	●	●	●		●
XE14-B3445	●	●	●	●	●
XE14-B5778	●	●	●	●	●
XE13-C0810	●		●	●	●
IVSM4200	●	●	●	●	●
IVSM4500	●	●	●	●	●
XE14-C2508	●				
SDC5003	●	●	●	●	●
TSE3282-G	●	●	●		●
XE13-C2476	●				
XE12-B2543	●				
XE14-C0447	●	●	●	●	
TSE3032	●	●	●	●	●
TSE3033	●	●	●	●	●
RTV615	●	●	●	●	●
TIG2000	●	●	●	●	●
TIG830SP	●	●	●		●
XE13-C1822	●	●	●		●
XE11-C3165	●	●	●	●	●
XE11-B5320	●	●	●	●	●

<sup>1</sup> Contact a Momentive Performance Materials sales representative for availability in countries and regions not listed

PATENT STATUS: Nothing contained herein shall be construed to imply the non-existence of any relevant patents or to constitute the permission, inducement or recommendation to practice any invention covered by any patent, without authority from the owner of the patent.

## Other Electronic Solutions from Momentive Performance Materials



12-page brochure provides detailed information on silicone materials used for thermal management applications in electronics and micro-electronics. Includes SilCool\* grease & adhesives, and conventional grades for adhesion, encapsulation and potting.



Comprehensive package of adhesion, sealing, coating, and encapsulation / potting solutions for a wide range of silicone applications in electric and electronic devices and component assemblies.

## Principal Locations

Regional Information	Phone	Fax
<b>North America</b> World Headquarters 187 Danbury Road Wilton, CT 06897, USA	800.295.2392	607.754.7517
<b>Latin America</b> Rodovia Eng. Constâncio Cintra, Km 78,5 Itatiba, SP - 13255-700 Brazil	+55.11.4534.9650	+55.11.4534.9660
<b>Europe, Middle East, Africa and India</b> Leverkusen Germany	00.800.4321.1000 +31.164.293.276	+31.164.241.750
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<b>Customer Service Centers</b>		
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