LOCTITE®
TECHNOMELT®

BERGQUIST®

MATERIALS FOR AUTOMOTIVE CAMERAS

BONDING, CONNECTING, PROTECTING AND THERMAL SOLUTIONS

Henkel

CONTENTS

Introduction....3

Product Portfolio....4

ADAS Stereo Camera Solutions....5

ADAS Surround Camera Solutions....6

Bonding Solutions for Multiple Assembly Applications....7

MATERIALS FOR ADAS CAMERAS

Bonding Materials....8

Connecting Materials....13

Protecting Materials....18

Thermal Materials....24

INTRODUCTION

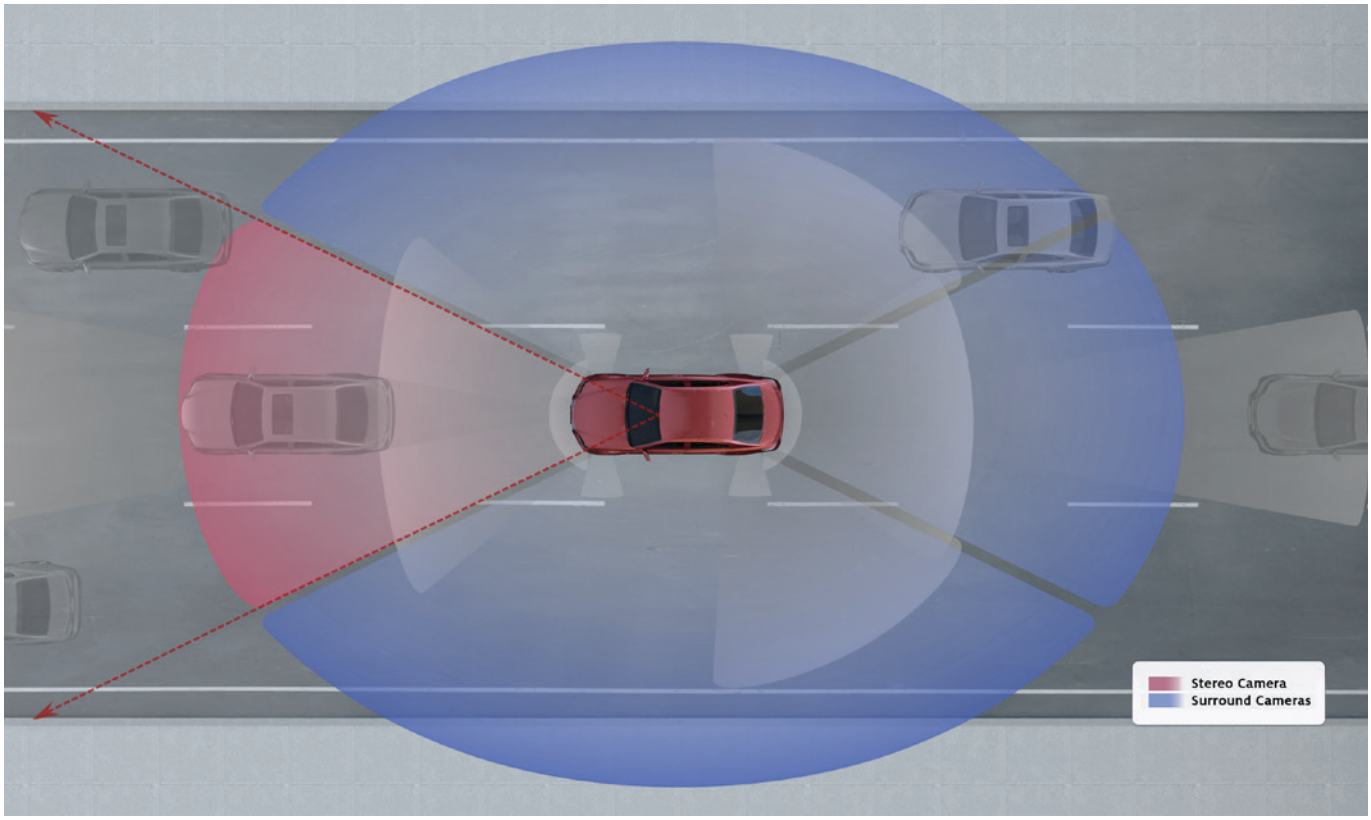
ADAS: THE ROAD TO A SAFER DRIVING EXPERIENCE

Advanced Driver Assistance Systems, commonly referred to as ADAS, are becoming far more common in modern-day vehicles. The current adoption rate of 20% is expected to grow dramatically over the next few years, as ADAS proliferation continues and new technologies deliver greater levels of safety behind the wheel. Key to enabling ADAS functionality is the cooperation of cameras, radar and LiDAR, as well as multiple ultrasonic sensor systems, all of which work in concert to identify objects, pedestrians and potential hazards for the driver. In some cases, these technologies even take independent action to ensure driver, passenger and pedestrian safety.

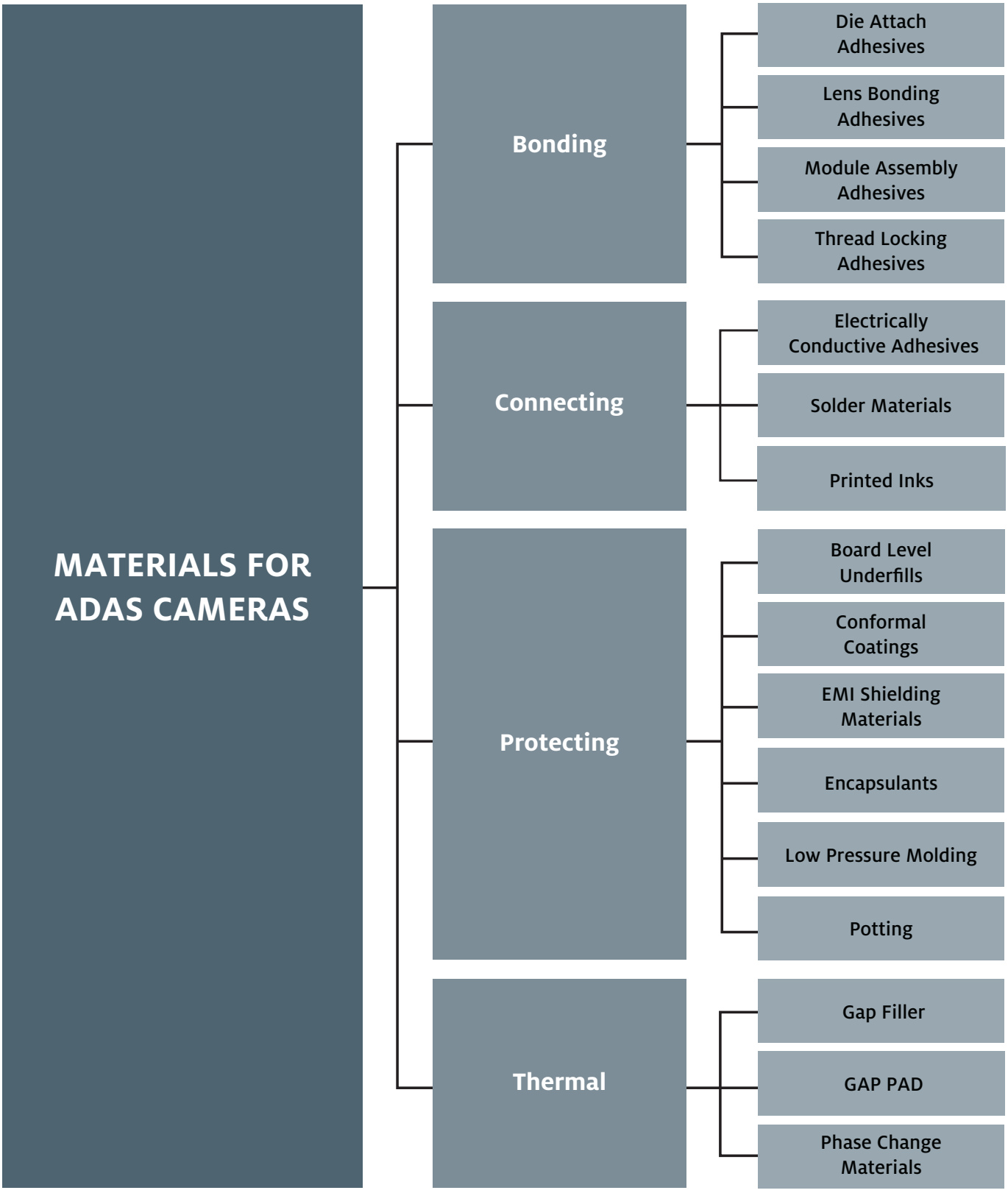
The camera component is essential, with today's automobiles incorporating as few as one or as many as nine cameras –and the number of cameras and the various technology types are expanding quickly. With driver safety often dependent on camera visibility, the performance reliability of these optical systems is crucial.

FOCUSED EXPERTISE

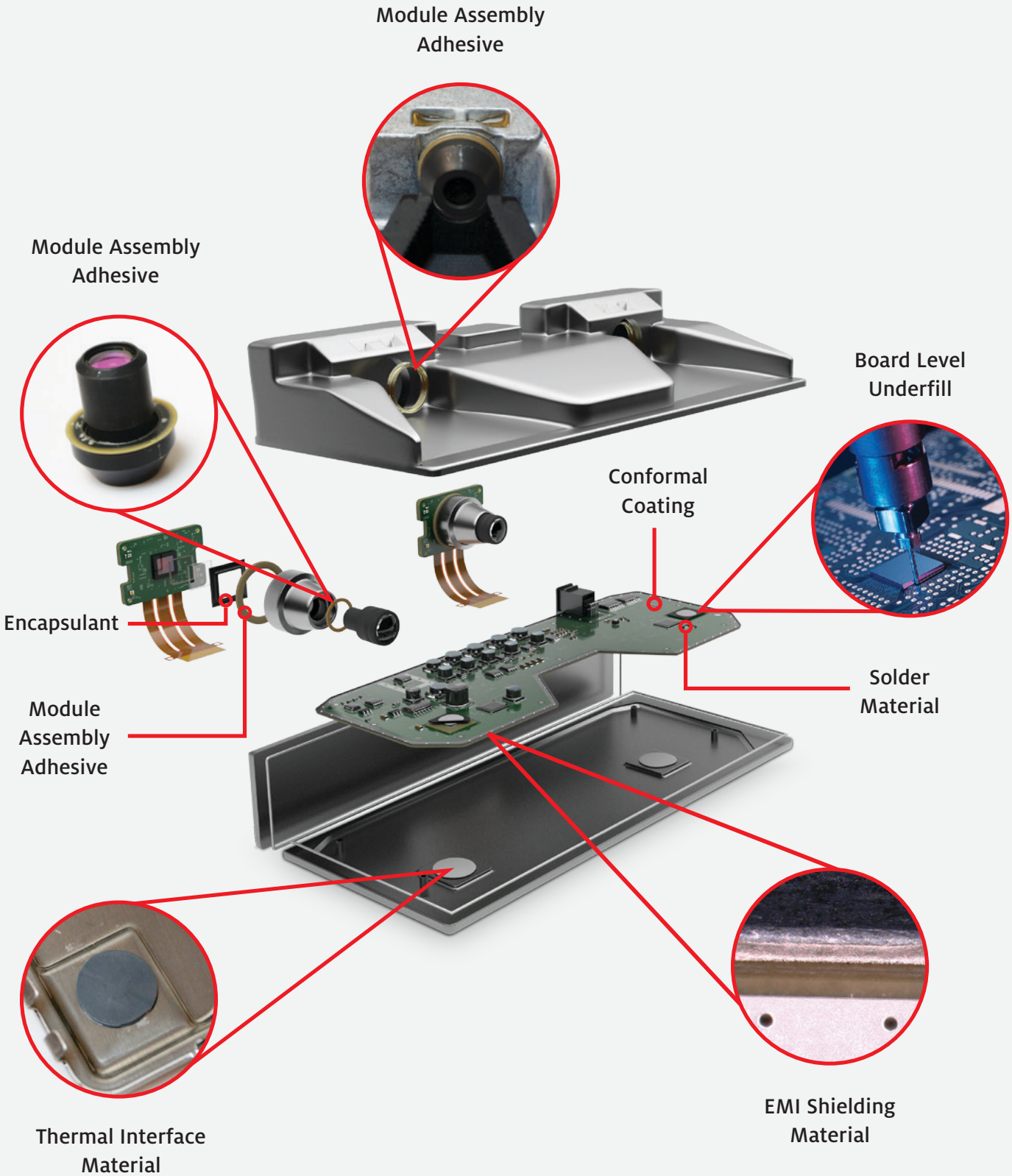
As the world's leading adhesives and electronic materials supplier, Henkel's experience with innovative formulations for functional, reliability-enhancing products is broad and deep. Leveraging our successful work with the top global handheld manufacturers' camera technologies, Henkel has developed high-reliability camera materials solutions tailored to the unique requirements of automotive camera systems. At every level of camera construction – from the die within the image processor to component connection, thermal management, PCB protection and structural bonding of the final lens assembly – Henkel's automotive camera materials are the comprehensive, enabling factor for safety-enhancing functionality. The ability to facilitate reliable performance and a clear view in temperature extremes, during rough rides and after exposure to harsh conditions – all while making the move toward greener, more environmentally friendly formulations – is what sets Henkel automotive camera materials apart.



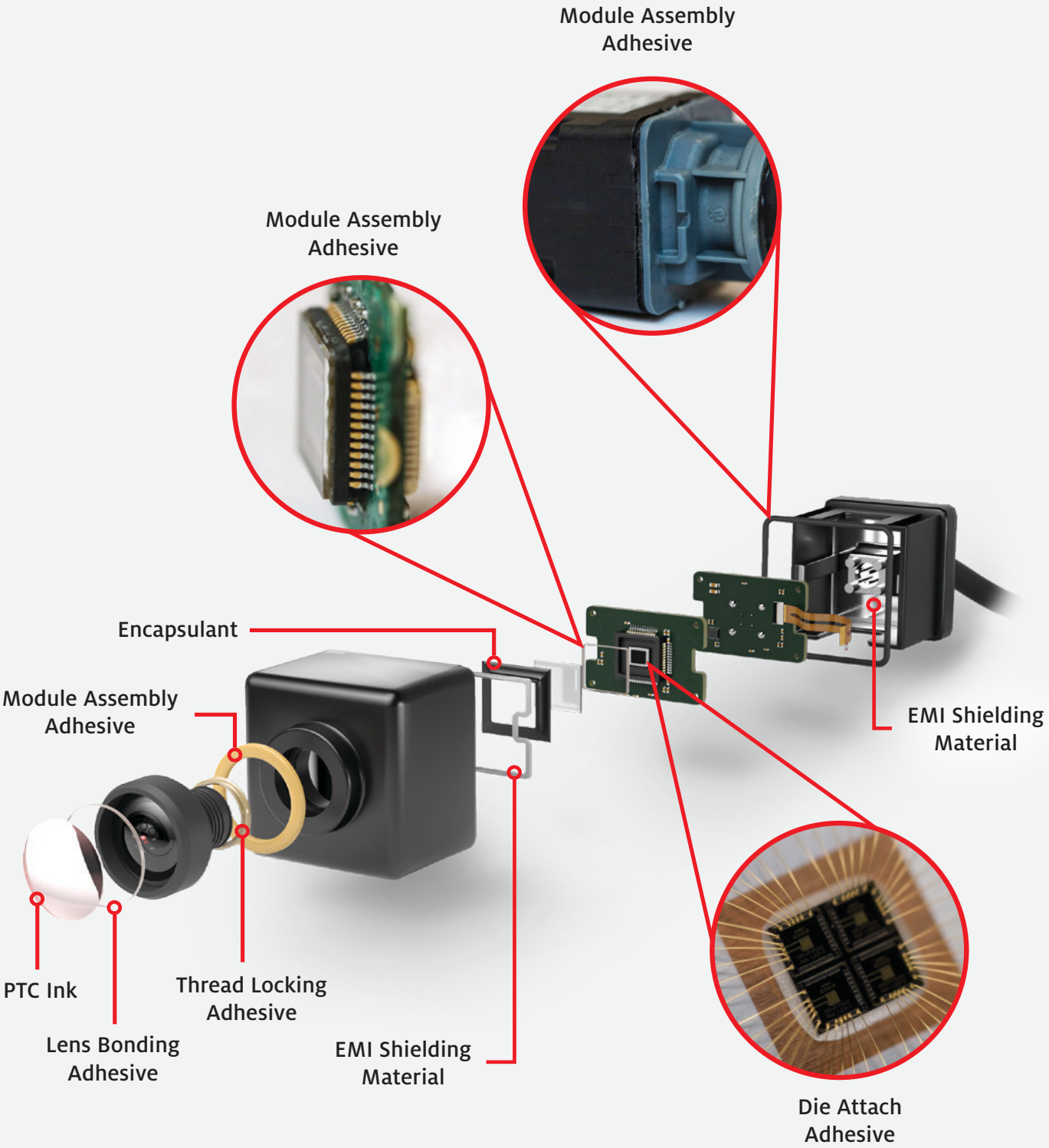
PRODUCT PORTFOLIO



ADAS STEREO CAMERA SOLUTIONS

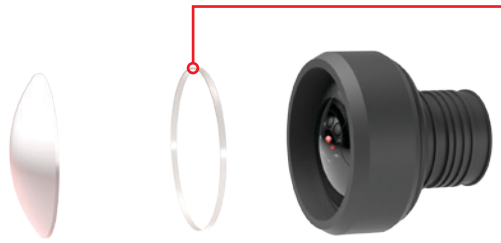


ADAS SURROUND CAMERA SOLUTIONS



BONDING SOLUTIONS FOR MULTIPLE ASSEMBLY APPLICATIONS

Lens To Inside of Lens Barrel



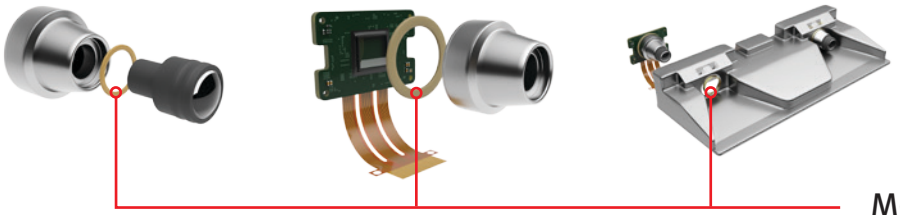
Lens Bonding Adhesive

- Designed to attach lens to inside of lens barrel
- Specialized adhesives that accommodate low temperature processing with rapid UV cure

Lens Barrel To Lens Barrel Housing

Lens Barrel Housing To PCB

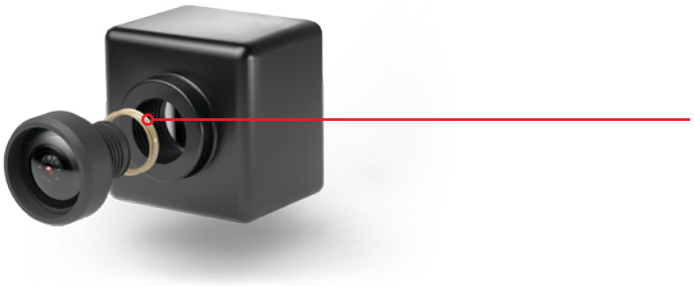
Lens Barrel Housing To Camera Module Housing



Module Assembly Adhesive

- Designed for bonding module housing assemblies with various surface materials

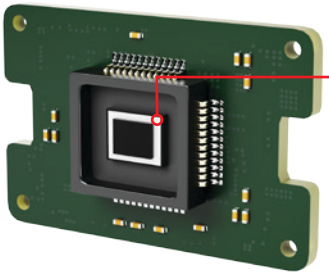
Lens Barrel to Lens Barrel Housing



Thread Locking Adhesive

- Designed for locking and sealing of threaded fasteners
- Used for active optical alignment of lens assemblies

Image Sensor Die to Substrate



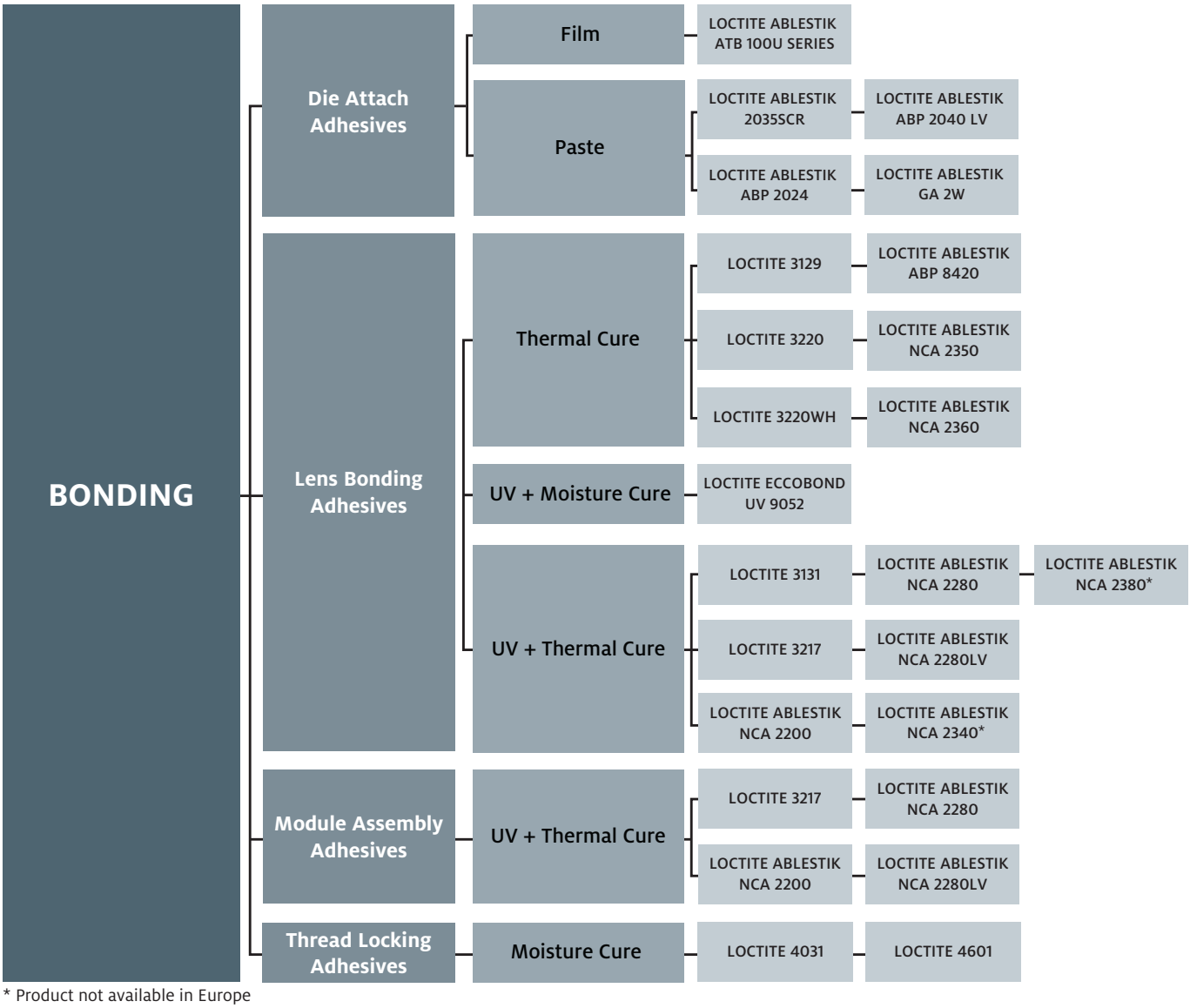
Die Attach Adhesive

- Used to bond image sensor die to substrate
- Low-temperature cure, low-stress, low-outgassing adhesives

BONDING MATERIALS FOR ADAS CAMERAS

STRONG AND RELIABLE BONDS

When it comes to automotive safety, failure is not an option, making lens precision and module durability vital to camera effectiveness. Henkel's broad portfolio of lens bonding, module assembly, thread locking and die attach adhesives– both in customized and original formulations – offer cure flexibility and processing adaptability. UV-, thermal- and dual-cure adhesives for lens bonding provide high stability, with less than a 1% change in size after cure to ensure precision active alignment and in-use focus reliability. Module assembly materials are also as versatile, with UV only, as well as dual-cure (UV and thermal) options for reliable bonding of the lens barrel, housing, PCB, camera module, IR filter and image sensor. At the chip level, non-conductive die attach adhesives in multiple formulations and mediums offer strong die bonding for reliable image sensor performance. Strong adhesion, robust temperature stability, application-specific customization and a move toward green formulations are why automotive camera specialists are increasingly turning to Henkel for bonding solutions.



* Product not available in Europe

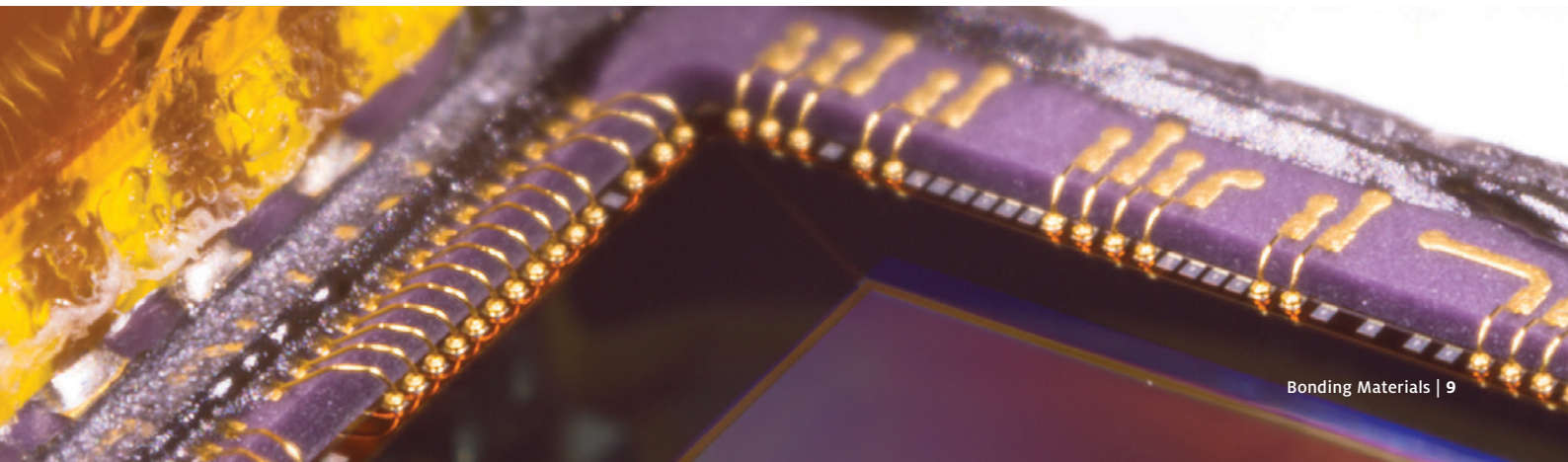
DIE ATTACH ADHESIVES

Die Attach Film

Product Name	Description	Key Attributes	Glass Transition Temperature, T_g (°C)	Film Thickness (µm)	Coefficient of Thermal Expansion, CTE (ppm/°C)		Modulus at 25°C (MPa)	Recommended Cure
					Below T_g	Above T_g		
Non-Conductive								
LOCTITE ABLESTIK ATB 100U Series	Silica-filled, rubberized epoxy die attach adhesive film	• Fast cure • Thin bondline • Excellent gap filling ability • MSL2 260°C capable • Compatible with Cu wire or Au wire packages • Compatible with Stealth Dicing Before Grind (SDBG) process	75	• 15 • 20	62	238	875	30 min. ramp + 30 min. hold at 120°C

Die Attach Paste

Product Name	Description	Key Attributes	Glass Transition Temperature, T_g (°C)	Viscosity at 25°C	Coefficient of Thermal Expansion, CTE (ppm/°C)		Modulus at 25°C (MPa)	Recommended Cure
					Below T_g	Above T_g		
Non-Conductive								
LOCTITE ABLESTIK ABP 2035SCR	Silica-filled die attach adhesive	• One component • Low stress • Snap cure or low temperature oven cure • Excellent dispensing performance for high throughput applications • Compatible with dam and fill encapsulants	118	9,830 at 5 rpm	50	135	1,500	2 min. at 120°C
LOCTITE ABLESTIK ABP 2024	BMI hybrid die attach adhesive	• Low outgassing • One component • High reliability	47	13,000 at 5 rpm	127	156	510	30 min. ramp + 30 min. hold at 175°C
LOCTITE ABLESTIK ABP 2040 LV	Epoxy non-conductive die attach adhesive	• One component • Fast cure • Low temperature cure • Low stress • Low warpage	28	11,000 at 5 rpm	39	129	2,603	2 min. at 120°C
LOCTITE ABLESTIK GA 2W	Acrylic die attach adhesive	• Very low stress • Low chip warpage • Improved viscosity • Thixotropic • Good dispensability • One component	25	10,000 at 5 rpm	58	164	70	30 min. ramp + 15 min. hold at 175°C



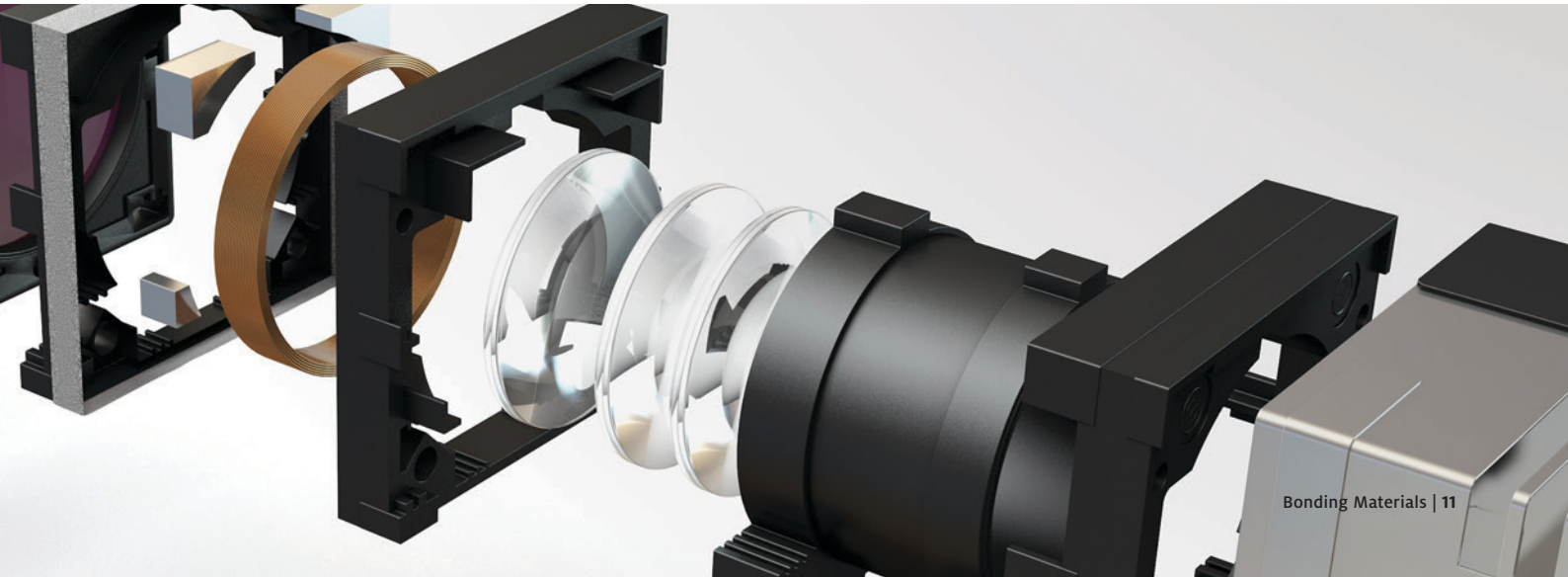
LENS BONDING ADHESIVES

Product Name	Description	Key Attributes	Glass Transition Temperature, T_g (°C)	Coefficient of Thermal Expansion, CTE (ppm/°C)		Viscosity at 25°C (cP)	Modulus at 25°C (MPa)	Recommended Cure
				Belown T_g	Above T_g			
Thermal Cure								
LOCTITE 3129	Epoxy adhesive and sealant	• Excellent adhesion • One component • Low temperature cure	35	47	145	11,800	200	30 min. at 80°C
LOCTITE 3220	Epoxy adhesive and sealant	• One component • Fast cure at low temperatures • Excellent adhesion	26	47	145	8,200	3,240	5 – 10 min. at 80°C
LOCTITE 3220WH	Epoxy adhesive and sealant	• One component • Fast cure at low temperatures • Excellent adhesion • White pigmentation for excellent light reflection	29	55	162	8,940	550	5 – 10 min. at 80°C
LOCTITE ABLESTIK ABP 8420	Epoxy adhesive	• Excellent resin bleed out (RBO) performance • Fast cure at low temperatures • One component • Good adhesion • Medium viscosity	33	53	171	13,500	2,054	15 min. at 150°C
LOCTITE ABLESTIK NCA 2350	Epoxy adhesive and sealant	• Fast cure at low temperatures • One component • Good adhesion • Hot plate or oven cure • Medium viscosity	28	66	180	13,670	2,533	2 min. at 80°C in hot plate
LOCTITE ABLESTIK NCA 2360	Epoxy adhesive and sealant	• Fast cure at low temperatures • One component • Good adhesion • Hot plate or oven cure • Low viscosity	33	53	171	6,296	2,054	2 min. at 80°C in hot plate
UV + Moisture Cure								
LOCTITE ECCOBOND UV 9052	Acrylate adhesive	• One component • Withstands exposure to ink • Cures in shadowed areas • No stringing • T_g can be increased with alternative cure	2	49	248	6,400	1,987	UV cure 0.5 - 1 J for 5 – 10 sec. + moisture cure at ambient humidity
UV + Thermal Cure								
LOCTITE 3131	Acrylated epoxy adhesive	• Designed for image sensor module assemblies and temperature sensitive electronics components • Fast cure at low temperatures • Low viscosity • Low stress	85	49	175	14,000	954	1 sec. at 100 mW/cm² + 30 min. at 60°C
LOCTITE 3217	Acrylated epoxy adhesive	• Designed for image sensor module assemblies and temperature sensitive electronics components • Fast cure at low temperatures	82	53	178	37,600	2,865	1 sec. at 100 mW/cm² + 30 min. at 60°C
LOCTITE ABLESTIK NCA 2200	Acrylated epoxy adhesive	• One component • Low viscosity • Fast cure at low temperatures • Good adhesion to a variety of substrates • Designed for image sensor module assemblies and temperature sensitive electronics components	97	43	150	22,000	5,000	2 sec. at 100 mW/cm² + 30 min. at 80°C

LENS BONDING ADHESIVES – CONTINUED

Product Name	Description	Key Attributes	Glass Transition Temperature, T_g (°C)	Coefficient of Thermal Expansion, CTE (ppm/°C)		Viscosity at 25°C (cP)	Modulus at 25°C (MPa)	Recommended Cure
				Belown T_g	Above T_g			
UV + Thermal Cure – Continued								
LOCTITE ABLESTIK NCA 2280	Acrylated epoxy adhesive	• One component • High thixotropic index • High viscosity • Black in color to prevent light penetration • Fast cure at low temperatures • Good adhesion to liquid crystal polymer (LCP) substrates • Designed for image sensor module assemblies and temperature sensitive electronics components	90	45	156	54,000	4,500	2 sec. at 100 mW/cm² + 30 min. at 80°C
LOCTITE ABLESTIK NCA 2280LV	Acrylated epoxy adhesive	• One component • High thixotropic index • Fast cure at low temperatures • Low transmittance • Good adhesion to liquid crystal polymer (LCP) substrates • Black in color to prevent light penetration • Designed for image sensor module assemblies and temperature sensitive electronics components	75	54	160	32,800	3,000	2 sec. at 100 mW/cm² + 30 min. at 80°C
LOCTITE ABLESTIK NCA 2340*	Acrylated epoxy adhesive	• Excellent adhesion • High viscosity • High thixotropic index • Designed for active alignment in camera module assemblies and temperature sensitive electronics components	83	61	195	35,000	3,000	2 sec. at 100 mW/cm² + 30 min. at 80°C
LOCTITE ABLESTIK NCA 2380*	Acrylated epoxy adhesive	• Excellent adhesion • Good flow performance • High T_g • Low CTE • Designed for active alignment in camera module assemblies and temperature sensitive electronics components	95	56	183	35,000	3,000	3 sec. at 1000 mW/cm² + 60 min. at 80°C

* Product not available in Europe



BONDING MATERIALS FOR ADAS CAMERAS

MODULE ASSEMBLY ADHESIVES

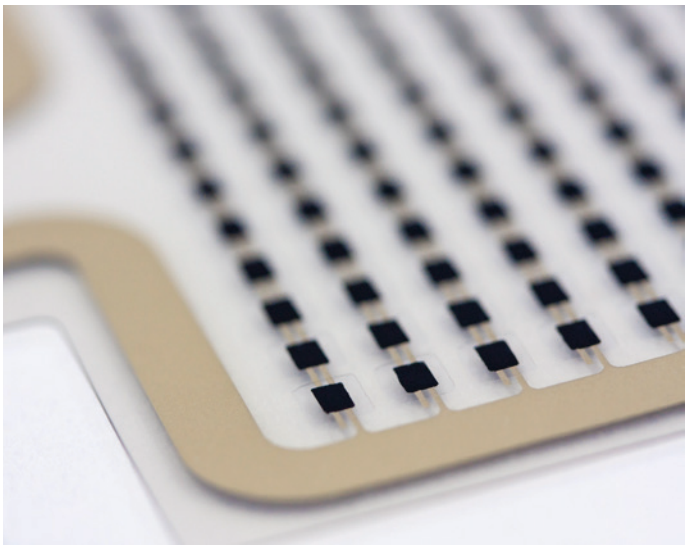
Product Name	Description	Key Attributes	Glass Transition Temperature, T_g (°C)	Coefficient of Thermal Expansion, CTE (ppm/°C)		Viscosity at 25°C (cP)	Modulus at 25°C (MPa)	Recommended Cure
				Below T_g	Above T_g			
UV + Thermal Cure								
LOCTITE 3217	Acrylated epoxy adhesive	• Designed for image sensor module assemblies and temperature sensitive electronics components • Fast cure at low temperatures	82	53	178	37,600	2,865	1 sec. at 100 mW/cm² + 30 min. at 60°C
LOCTITE ABLESTIK NCA 2200	Acrylated epoxy adhesive	• One component • Low viscosity • Fast cure at low temperatures • Good adhesion to a variety of substrates • Designed for image sensor module assemblies and temperature sensitive electronics components	97	43	150	9,000	5,000	2 sec. at 100 mW/cm² + 30 min. at 80°C
LOCTITE ABLESTIK NCA 2280	Acrylated epoxy adhesive	• One component • High thixotropic index • High viscosity • Black in color to prevent light penetration • Fast cure at low temperatures • Good adhesion to liquid crystal polymer (LCP) substrates • Designed for image sensor module assemblies and temperature sensitive electronics components	90	45	156	54,000	4,500	2 sec. at 100 mW/cm² + 30 min. at 80°C
LOCTITE ABLESTIK NCA 2280LV	Acrylated epoxy adhesive	• One component • High thixotropic index • Fast cure at low temperatures • Low transmittance • Good adhesion to liquid crystal polymer (LCP) substrates • Black in color to prevent light penetration • Designed for image sensor module assemblies and temperature sensitive electronics components	75	54	160	32,800	3,000	2 sec. at 100 mW/cm² + 30 min. at 80°C

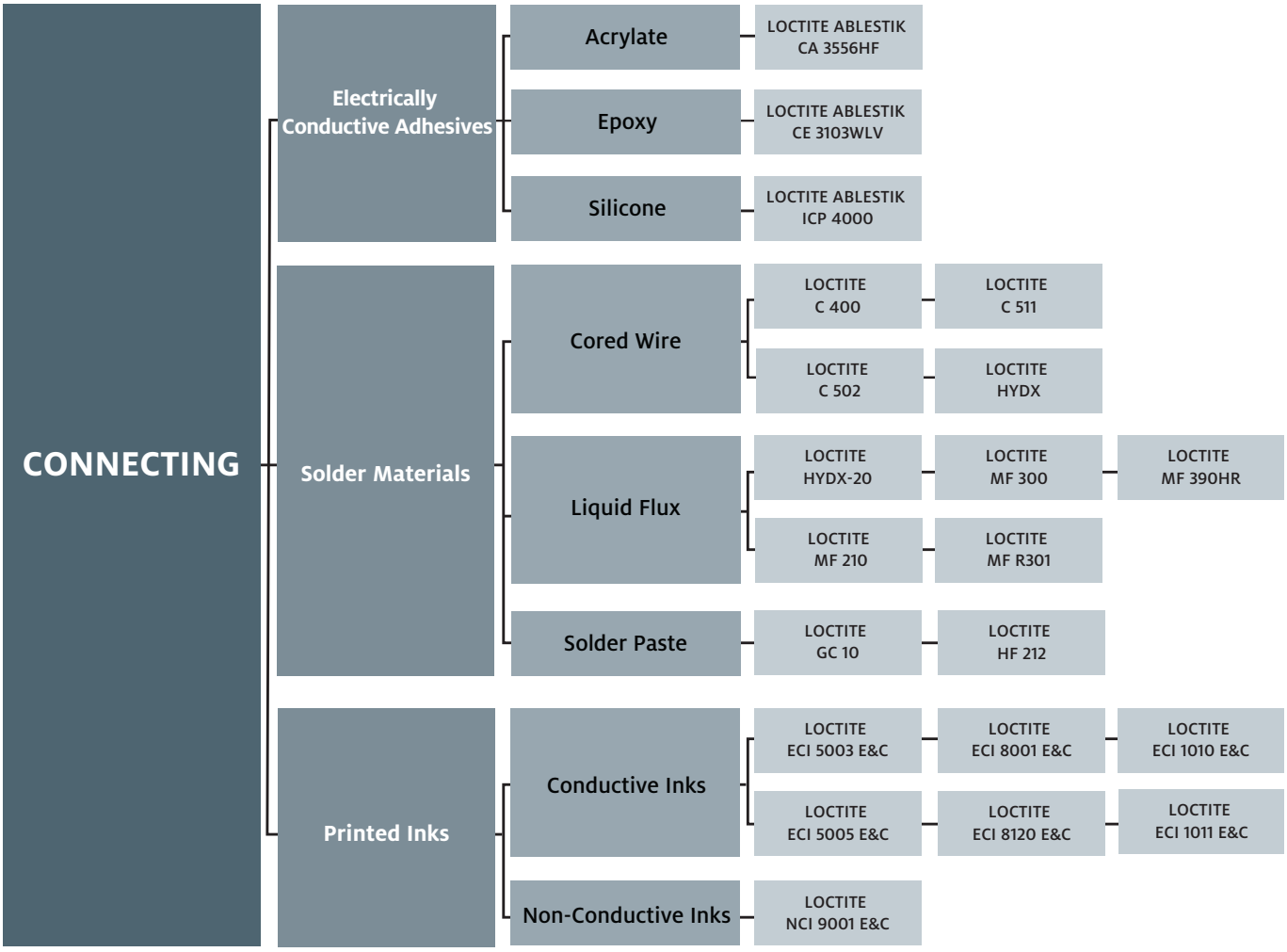
THREAD LOCKING ADHESIVES

Product Name	Description	Key Attributes	Color	Viscosity at 25°C (cP)	Operating Temperature (°C)	Fixture Time at 25°C	Recommended Cure
Moisture Cure							
LOCTITE 4031	Cyanoacrylate thread locking adhesive	• One component • Low odor for applications where vapor control is vital • Low bloom for cosmetic applications • Suitable for metals, plastics and elastomers	Transparent, colorless to pale yellow	1,650	-50 – 70	5 – 180 sec. depending on substrate	24 hr. at 22°C
LOCTITE 4601	Cyanoacrylate thread locking adhesive	• One component • Low odor for applications where vapor control is vital • Low bloom for cosmetic applications • Suitable for metals, plastics and elastomers • Low viscosity	Transparent, colorless to pale yellow	30 – 60	-50 – 70	5 – 180 sec. depending on substrate	24 hr. at 22°C

OUTSTANDING INTERCONNECTION

At the board level, reliable electrical interconnection is the foundation of camera function. A history of innovative solder formulations and market firsts – from high-reliability alloys to game-changing, temperature-stable solder pastes – continue to deliver the performance that electronics specialists require for today's demanding assemblies. As the leading global supplier of electronics assembly materials, Henkel is uniquely capable of delivering a holistic materials approach for reliable electronic performance. Market-leading solder pastes, cored wire and liquid fluxes; electrically conductive adhesives; and, innovative printed inks offer strong component and PCB interconnect for on-demand, long-term, reliable performance.

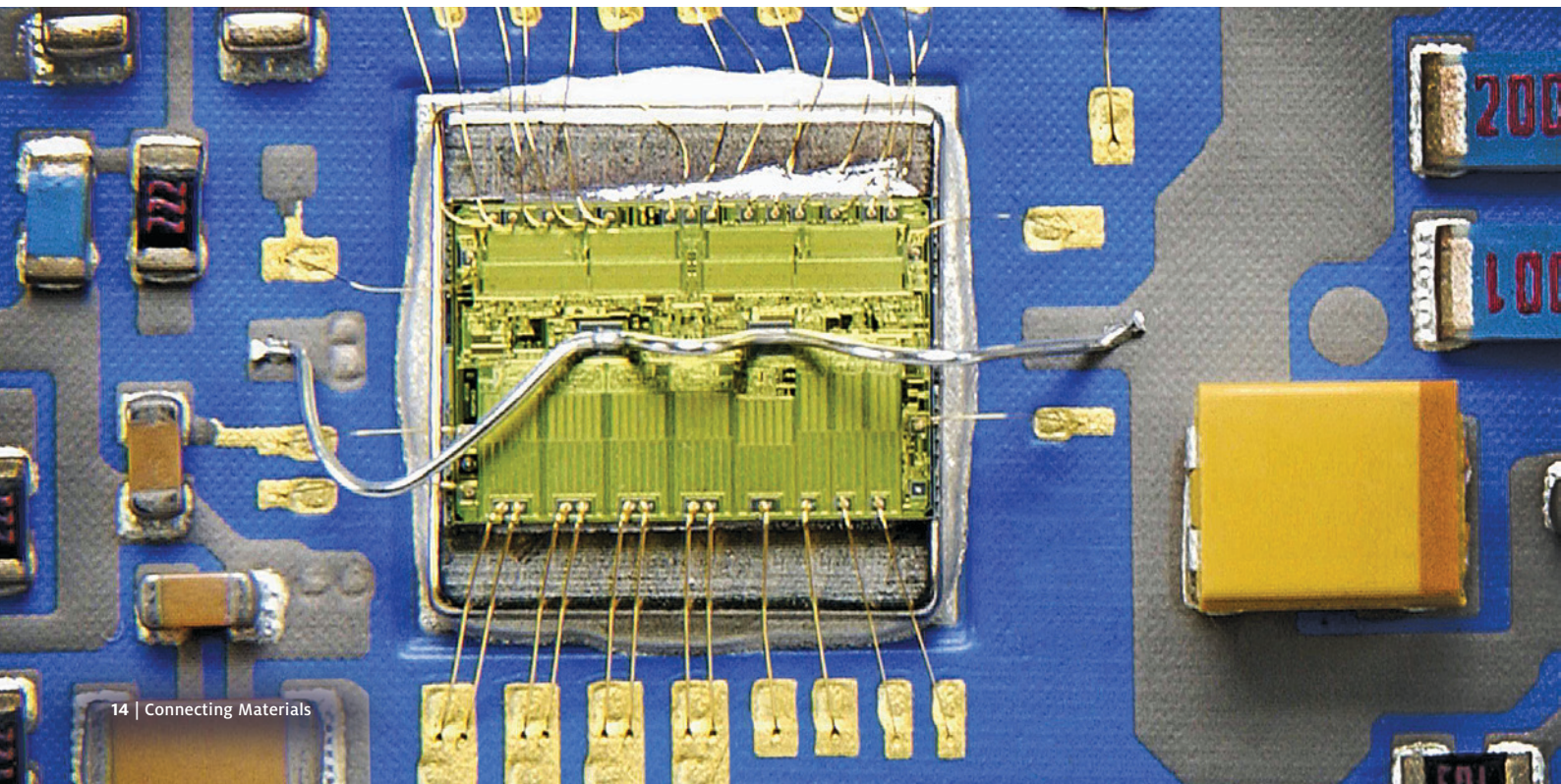




CONNECTING MATERIALS FOR ADAS CAMERAS

ELECTRICALLY CONDUCTIVE ADHESIVES

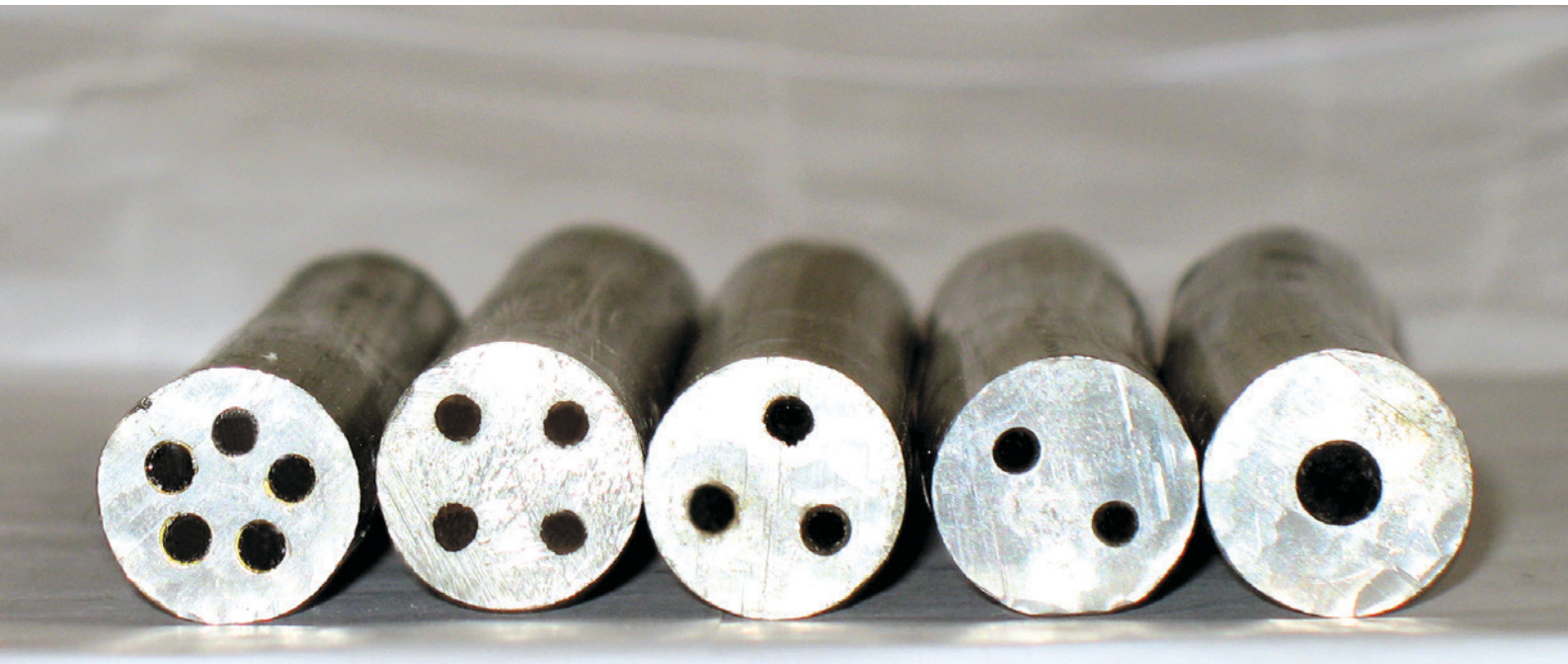
Product Name	Description	Key Attributes	Volume Resistivity (Ω•cm)	Glass Transition Temperature, T_g (°C)	Coefficient of Thermal Expansion, CTE (ppm/°C)		Modulus at 25°C (MPa)	Recommended Cure
					Below T_g	Above T_g		
Acrylate								
LOCTITE ABLESTIK CA 3556HF	Acrylate electrically conductive adhesive	• One component • Fast, low-temperature cure • Excellent flexibility • Good adhesion • Low contact resistance	2.5×10^{-3}	-30	95	278	650	2 min. at 110°C
Epoxy								
LOCTITE ABLESTIK CE 3103WLV	Epoxy electrically conductive adhesive	• Pb-free alternative to solder • Low-temperature cure • Stable contact resistance	8×10^{-4}	114	45	225	4,500	10 min. at 120°C
Silicone								
LOCTITE ABLESTIK ICP 4000	Silicone electrically conductive adhesive	• One component • High flexibility • Excellent electrical conductivity • High-temperature performance • Pb-free alternative to solder • High electrical current carrying capability • Low-temperature cure • Outstanding elongation performance • Low outgassing	6×10^{-5}	-45	N/A	330	101	1 hr. at 130°C



SOLDER MATERIALS

Cored Wire

Product Name	Description	Key Attributes	Approximate Flux Content (% by Weight)	Diameter Range (mm)	Pb-Free Alloy	SnPb Alloy	IPC J-STE-004B Classification
Halogen-Free, No-Clean							
LOCTITE C 400	Cored solder wire	• Clear residue • Increased flux content for improved wetting on challenging surfaces • Award-winning multiple flux core technology that ensures consistent distribution of flux throughout the solder wire • Suitable for manual and robotic soldering	2.2	0.38 – 1.63	• 90iSC • 99C • SAC305 • SAC387	• Sn60 • Sn62 • Sn63	ROL0
Halide-Free, No-Clean							
LOCTITE C 502	Cored solder wire	• Clear residue • Good wetting on difficult substrates • Medium activity flux	2.7	0.25 – 1.63	• 99C • SAC305 • SAC387	• Sn60 • Sn62 • Sn63	ROM1
LOCTITE C 511	Cored solder wire	• Amber residue • Good wetting on difficult substrates • Heat stable • Medium activity flux	2.7	0.38 – 1.63	• 99C • SAC305 • SAC387	• Sn60 • Sn62 • Sn63	ROM1
Halide-Containing, Water Wash							
LOCTITE HYDX	Cored solder wire	• High activity flux • Excellent wetting on difficult substrates	2.0	0.38 – 1.63	• 99C • SAC305 • SAC387	• Sn60 • Sn62 • Sn63	ORH1



SOLDER MATERIALS – CONTINUED

Liquid Flux

Product Name	Description	Key Attributes	Solid Content (% by Weight)	Acid Value (mg KOH/g)	Application	IPC J-STE-004B Classification
Halide-Containing, Water Wash						
LOCTITE HYDX-20	Liquid Flux	• Highly water soluble • Residues designed to be cleaned with deionized water • Solders onto copper, brass, nickel and mild steel efficiently • Compatible with Pb-free and SnPb wave solder processes	20	24	Spray/Foam	ORH1
Halide-Free, No-Clean						
LOCTITE MF 210	Liquid flux	• Resin-free flux designed to solder onto surfaces known to have poor solderability • Recommended for applications where high throughput is required • Compatible with Pb-free and SnPb wave solder processes	2.9	22.5	Spray/Foam	ORM0
LOCTITE MF R301	Liquid flux	• Higher solids flux for better wetting on surfaces known to have reduced solderability • Minimizes bridging on complex geometries • Fully Pb-free and dual wave compatible • Solvent-based flux may be thinned with isopropyl alcohol (IPA) • Compatible with Pb-free and SnPb wave solder processes	6.0	40	Spray/Foam	ROM0
Halogen-Free, VOC-Free, No-Clean						
LOCTITE MF 300	Liquid flux	• General-purpose, resin-free, water-based flux with special formulation designed to minimize solder balling • Compatible with Pb-free and SnPb wave solder processes	4.6	37	Spray/Foam	ORM0
Halogen-Free, No-Clean						
LOCTITE MF 390HR	Liquid flux	• Exceptional through-hole fill • Recommended for automotive applications and general electrical soldering applications • Compatible with Pb-free and SnPb wave solder processes	6.0	20 – 25	Spray/Foam	ROL0

Solder Paste

Product Name	Description	Key Attributes	Alloy	Particle Size Distribution	IPC J-STE-004B Classification	Optimal Shelf Life	Reflow Atmosphere
Temperature Stable, Halogen-Free, No-Clean							
LOCTITE GC 10	Pb-free, solder paste	• RoHS-compliant • Excellent resistance to high humidity • Industry leader in paste transfer efficiency • Improved stability at different storage and operating temperatures • Extended stencil life up to 72 hr. • Extended abandon time up to 24 hr. • Suitable for high-density, small to large boards	• SAC305	• Type 3 • Type 4 • Type 4.5 (4A) • Type 5	ROL0	1 year at 26.5˚C	Designed for air; suitable with nitrogen
Halogen-Free, No-Clean							
LOCTITE HF 212	Pb-free, solder paste	• High tack • Low voiding • RoHS-compliant • Excellent fine pitch coalescence • Designed for medium to large boards	• 90iSC • SAC0307 • SAC305 • SAC387	• Type 3 • Type 4 • Type 4.5 (4A) • Type 5	ROL0	6 months at 0°C – 10°C	Air and nitrogen

PRINTED INKS

Conductive Inks

Product Name	Description	Key Attributes	Coverage at 10 µm (m²/kg)	Sheet Resistance (Ω/sq/25 µm)	Processing	Substrates	Recommended Cure
Transparent Inks							
LOCTITE ECI 5003 E&C	Conductive printable ink	• Low temperature cure • No need for laser etching	2.6	< 100	• Screenprint	• PET*	3 min. at 85°C + 5 min. at 140°C
LOCTITE ECI 5005 E&C	Conductive printable ink	• Low temperature cure • ITO replacement	2.6	< 100	• Screenprint	• PET*	3 min. at 85°C + 5 min. at 140°C
PTC Carbon Inks							
LOCTITE ECI 8001 E&C	Positive temperature coefficient (PTC) printable ink	• Flexible • Printable on most common substrates • Self-regulating heater with PTC temperature of 65°C	48	1,700	• Screenprint	• Polyester • PEN** • Polyimide film • PET*	10 min. at 120°C
LOCTITE ECI 8120 E&C	Positive temperature coefficient (PTC) printable ink	• Flexible • Printable on most common substrates • Self-regulating heater with PTC temperature of 120°C	43	1,700	• Screenprint	• Polyester • PEN** • Polyimide film • PET*	10 min. at 140°C
Silver Inks							
LOCTITE ECI 1010 E&C	Conductive printable ink	• Flexible • Good adhesion • High conductivity with optimum mechanical performance • Compatible with LOCTITE EDAG 440A E&C, LOCTITE EDAG 440B E&C and LOCTITE EDAG PF 455B E&C	10.6	0.007	• Screenprint	• Polyimide film • PET*	15 min. at 120°C
LOCTITE ECI 1011 E&C	Flexography and conductive printable ink	• High conductivity • Small particle size • Excellent adhesion • Excellent printability with flexography • Flexible	8.3	< 0.005	• Screenprint • Flexographic • Rotogravure	• Paper • PET* • Polyimide film • ITO film***	10 min. at 150°C

Non-Conductive Inks

Product Name	Description	Key Attributes	Coverage at 10 µm (m²/kg)	Processing	Substrates	Recommended Cure
Dielectric Inks						
LOCTITE NCI 9001 E&C	Printable dielectric ink	• Insulating • Excellent transparency • Good flexibility • Minimal dielectric strength • Excellent flexibility • Resistant to abrasion • Primer coat to adhere to difficult substrates	18.8	• Screenprint • Flexographic	• Flexible copper circuits • ITO*** sputtered polyester film • Metals • Glass	5 min. at 130°C

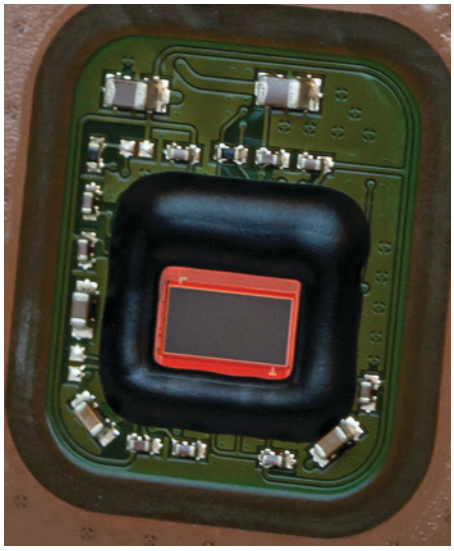
*Polyethylene terephthalate (PET)
**Polyethylene naphthalate (PEN)
***Indium-tin-oxide (ITO)

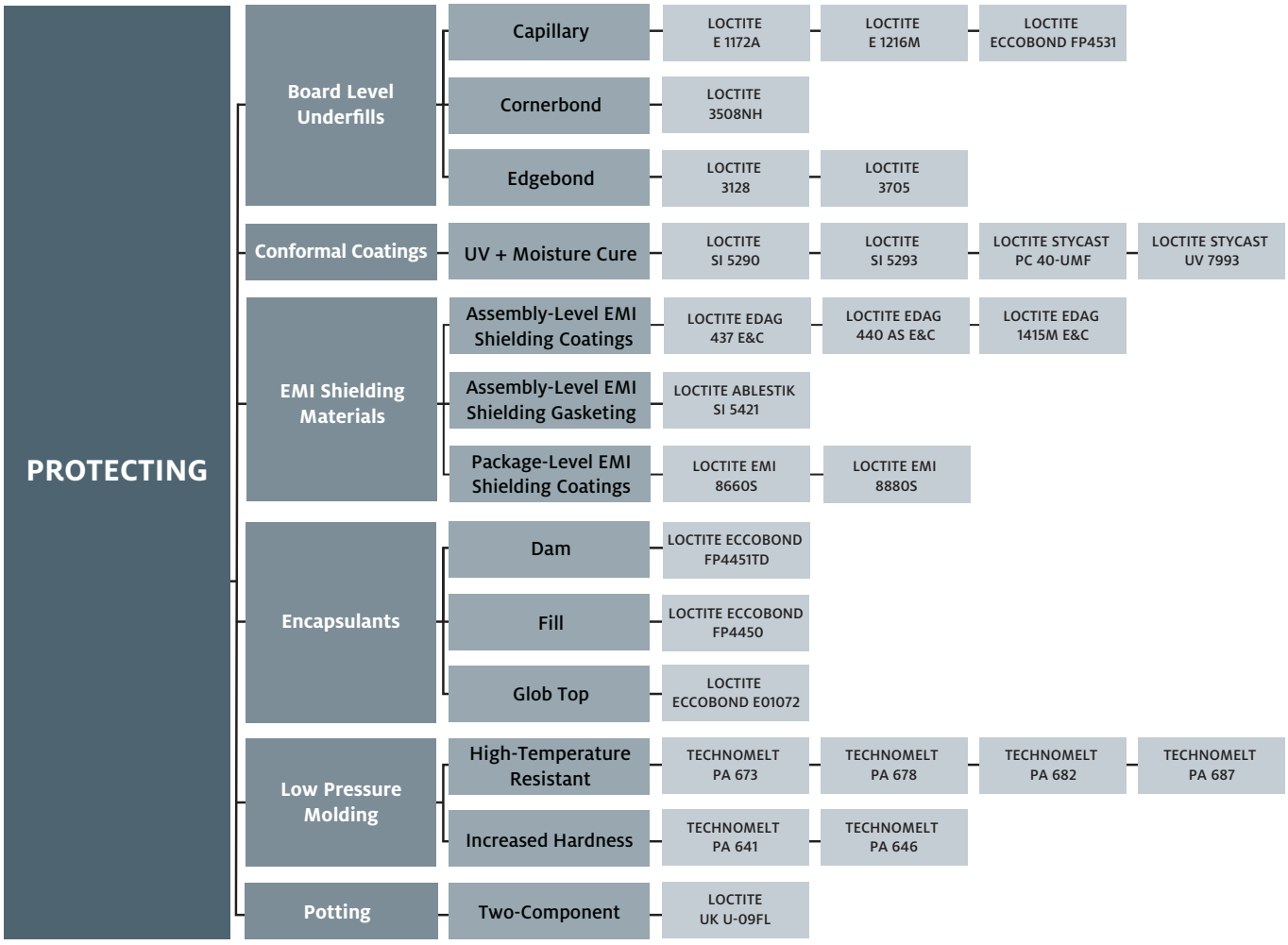
PROTECTING MATERIALS FOR ADAS CAMERAS

RELIABLE CIRCUIT BOARD PROTECTION

Safeguarding all elements of automotive cameras from the effects of moisture, corrosion, adverse environmental conditions, electromagnetic interference, vibration and shock is vital. With many camera technologies now integrated into the vehicle's exterior bumpers, proper protection against external conditions guarantees dependable function. Henkel's range of protecting materials is broad, covering everything from conformal coatings for PCB performance longevity to underfills and encapsulants for image sensor reliability, and EMI shielding coatings and sealants for minimized signal noise.

This focus on exceptional protection extends from the inside out – all the way to the camera housing, where Henkel's TECHNOMELT low-pressure molding materials offer a fast, cost-effective alternative to traditional plastic injected molding techniques, and our potting materials provide rugged defense for cameras mounted on vehicle exteriors. With Henkel materials protecting them, automotive cameras are fail-safe.

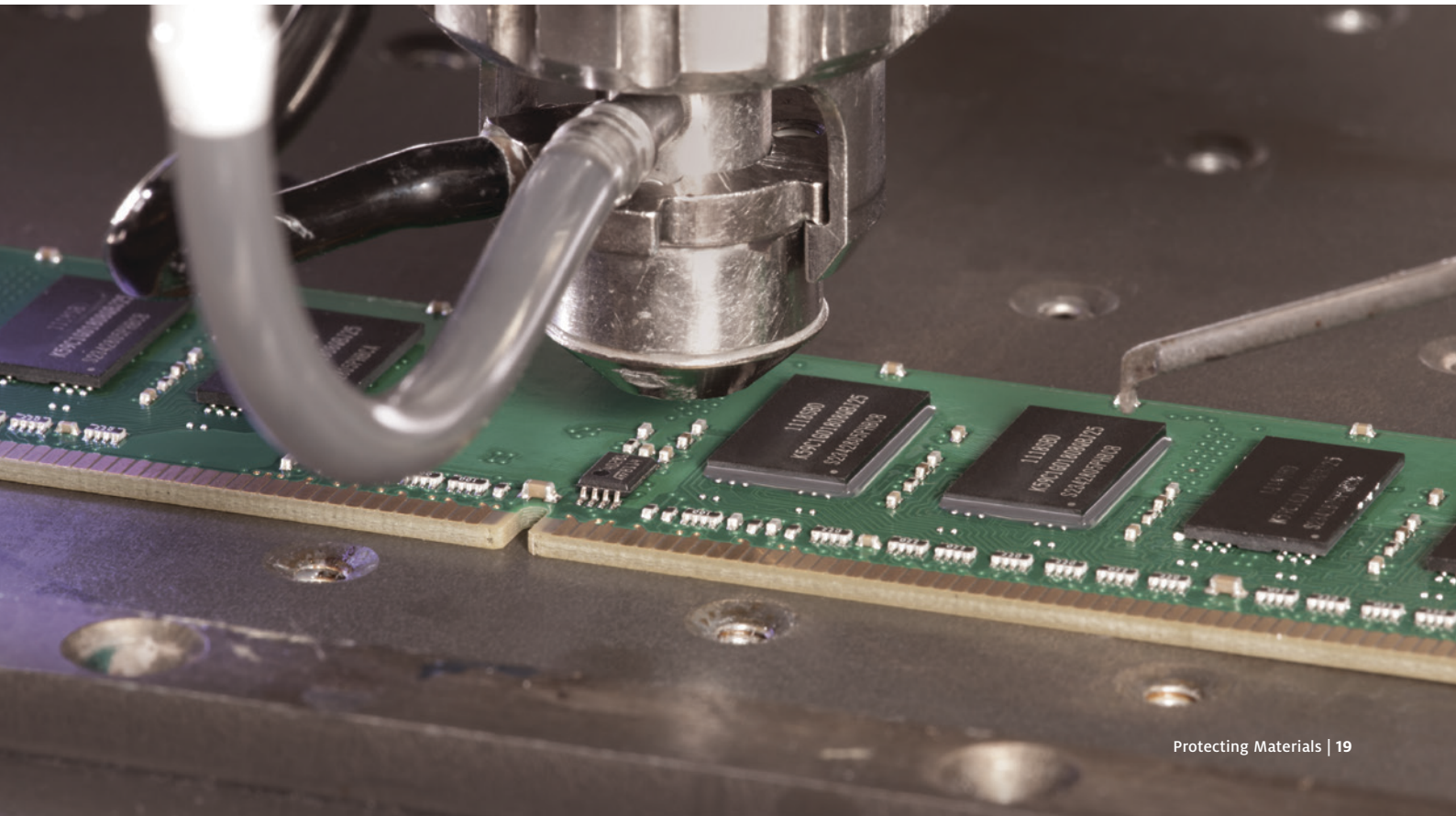




BOARD LEVEL UNDERFILLS

Capillary Underfills

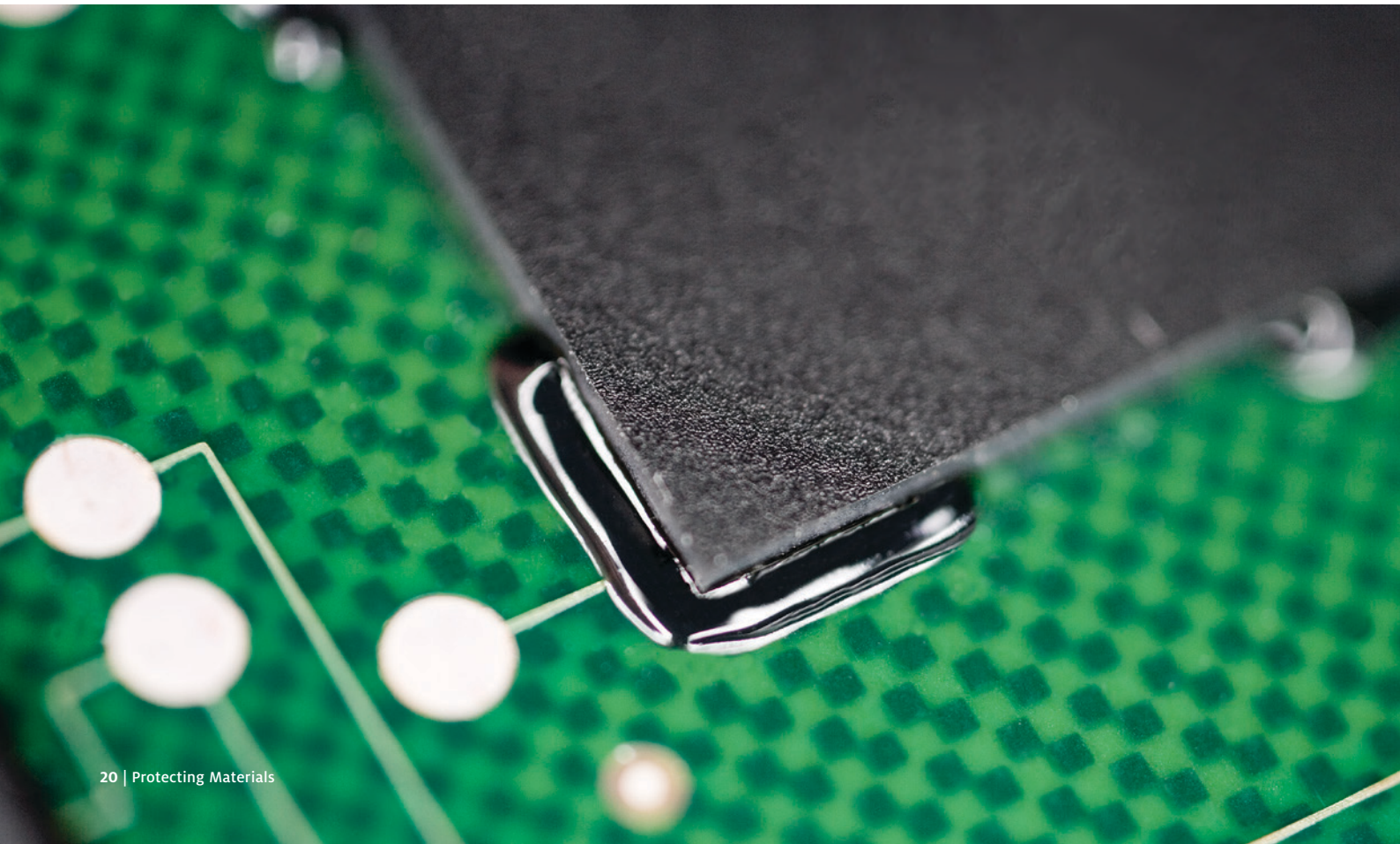
Product Name	Description	Key Attributes	Modulus at 25°C (MPa)	Glass Transition Temperature, T_g (°C)	Coefficient of Thermal Expansion, CTE (ppm/°C)		Pot Life	Recommended Cure
					Below T_g	Above T_g		
LOCTITE ECCOBOND E 1172 A	Non-reworkable, capillary flow, epoxy underfill	• Snap curable • Fast cure at low temperatures • One component • Non-anhydride curing chemistry • Void-free	10,000	135	27	85	48 hr. at 25°C	6 min. at 135°C
LOCTITE E 1216M	Non-reworkable capillary flow underfill	• Snap or inline cure • Fast, void-free underfill of area array devices • Excellent stability during shipping, storage and use • Excellent adhesion and strength • Non-anhydride curing chemistry	2,970	125	35	131	5 days at 25°C	3 min. at 165°C
LOCTITE ECCOBOND FP4531	Capillary flow underfill	• Snap curable • Fast flow • High adhesion strength • Proven workability at high temperatures • Qualified in automotive reliability conditions	7,600	161	28	104	24 hr. at 25°C	7 min. at 160°C



BOARD LEVEL UNDERFILLS – CONTINUED

Cornerbond & Edgebond Underfills

Product Name	Description	Key Attributes	Viscosity at 25°C (cP)	Glass Transition Temperature, T_g (°C)	Coefficient of Thermal Expansion, CTE (ppm/°C)		Pot Life	Recommended Cure
					Below T_g	Above T_g		
Cornerbond								
LOCTITE 3508NH	Reworkable epoxy underfill	• One component • Reflow curable • Eliminates post-reflow dispense and cure steps • Reworkable • Halogen-free	70,000	118	65	175	30 days at 25°C	Cure during Pb-free solder reflow profile at 245°C
Edgebond								
LOCTITE 3128	Epoxy underfill	• One component • Low temperature cure • Excellent adhesion to a wide range of materials	22,000	45	40	130	3 weeks at 25°C	20 min. at 80°C bondline temperature
LOCTITE 3705	Acrylate underfill	• One component • Thixotropic • Medium viscosity • Fast UV cure • No post cure required • Good adhesion to a variety of substrates	44,000	-39 (T_g 1) 77 (T_g 2)	66	151	30 days at 25°C	80 sec. at 30 mW/cm²



CONFORMAL COATINGS

Product Name	Description	Key Attributes	Viscosity at 25°C (cP)	Operating Temperature (°C)	Volume Resistivity (Ω•cm)	Color	Recommended Cure
UV + Moisture Cure							
LOCTITE SI 5290	Silicone conformal coating	• One component • Designed for severe temperature environments and high-reliability automotive applications • Solvent-free	100 – 350	-53 – 200	2×10^{14}	Transparent amber to yellow	20 – 40 sec. at 70 mW/cm² + 72 hr. at 50% relative humidity
LOCTITE SI 5293	Silicone conformal coating	• One component • Exhibits positive fluorescence under UV light • Repairable • Solvent-free • Designed for severe temperature environments and high-reliability automotive applications	400 – 800	-40 – 200	1×10^{14}	Transparent amber to yellow	20 – 40 sec. per side at 70 mW/cm² + 72 hr. at 50% relative humidity
LOCTITE STYCAST PC 40-UMF	Urethane acrylate conformal coating	• One component • VOC-free • Conforms to IPC-CC-830 requirements	250	-40 – 135	3.5×10^{16}	Clear	10 sec. at 300 – 600 mW/cm² + 2 – 3 days at atmospheric moisture
LOCTITE STYCAST UV 7993	Urethane conformal coating	• One component • Solvent-free • Good moisture resistance • Excellent chemical resistance	120	-40 – 130	2.2×10^{16}	Translucent yellow	5 sec. at 400 – 700 mW/cm² + 100 hr. at 50% relative humidity

EMI SHIELDING MATERIALS

Assembly-Level EMI Shielding Coatings

Product Name	Description	Key Attributes	Attenuation	Sheet Resistance (Ω/sq/25 µm)	Surfaces	Coverage at 10 µm (m²/kg)	Recommended Cure
LOCTITE EDAG 437 E&C	Cu-filled, thermoplastic EMI shielding coating	• Burnish resistant • Excellent environmental resistance • Stable electrical properties after heat cycling • Excellent shielding against radiated electromagnetic interference (EMI) and protection against electrostatic discharge (ESD) • Room temperature cure	50 – 70 dB at 50 µm	< 0.5	Plastic	23	30 min. at 25°C
LOCTITE EDAG 440 AS E&C	Ni-filled, thermoplastic EMI shielding coating	• Excellent shielding against radiated electromagnetic interference (EMI) • Protection against electrostatic discharge (ESD) • Stable in difficult environmental conditions such as high humidity or heat • Room temperature or heat cure	50 – 70 dB at 50 µm	< 0.5	Plastic	17	20 min. at 70°C
LOCTITE EDAG 1415M E&C	Ag-filled, thermoplastic EMI shielding coating	• Excellent shielding against radiated electromagnetic interference (EMI) • Maintains low resistance after exposure to heat, cold, humidity and salt spray • Air drying system that requires no primer or top coat • Room temperature or heat cure	60 dB at 25 µm	< 0.015	Plastic	9	30 min. at 70°C

EMI SHIELDING MATERIALS – CONTINUED

Assembly-Level EMI Shielding Gasketing

Product Name	Description	Key Attributes	Attenuation	Shore A Hardness	Volume Resistivity (Ω·cm)	Tensile Lap Show Strength, N/m² (TLSS)	Recommended Cure
LOCTITE SI 5421	Ag-filled, silicone gasketing material	• Room temperature cure • Low stress • High flexibility	• 80 dB at 10 MHz • 110 dB at 100 MHz • 100 dB at 10 GHz	50 – 65	$< 1 \times 10^{-2}$	0.7	24 hr. at 25°C

Package-Level EMI Shielding Coatings

Product Name	Description	Key Attributes	Attenuation	Volume Resistivity (Ω·cm)	Surfaces	Coating Thickness (µm)	Recommended Cure
LOCTITE ABLESTIK EMI 8660S	Package-level, conformal EMI shielding coating	• Thinly spray-coated material provides uniform coverage on top and sidewalls of package • Excellent adhesion to mold compound • Excellent EMI shielding performance at > 100 MHz	90 dB at 3 µm	1.5×10^{-5}	• Epoxy mold compound • Copper	3 – 5	1 hr. at 175°C in air
LOCTITE ABLESTIK EMI 8880S	Package-level, conformal EMI shielding coating	• Thinly spray-coated material provides uniform coverage on top and sidewalls of package • Excellent adhesion to mold compound • Excellent EMI shielding performance at > 10 MHz	90 dB at 3 µm	7.9×10^{-6}	• Epoxy mold compound • Copper	3 – 5	1 hr. at 175°C in air

ENCAPSULANTS

Product Name	Description	Key Attributes	Viscosity at 25°C (cP)	Glass Transition Temperature, T_g (°C)	Coefficient of Thermal Expansion, CTE (ppm/°C)		Modulus at 25°C (MPa)	Recommended Cure
					Below T_g	Above T_g		
Dam								
LOCTITE ECCOBOND FP4451TD	Epoxy dam encapsulant	• Excellent chemical resistance and thermal stability • High thixotropy with high height-to-width aspect ratio (0.7) • Designed for use with fill encapsulant LOCTITE ECCOBOND FP4450	300,000	150	21	65	14,300	30 min. at 125°C + 90 min. at 165°C
Fill								
LOCTITE ECCOBOND FP4450	Epoxy fill encapsulant	• Low stress • Good moisture resistance and excellent chemical resistance • Exhibits relatively high flow • Excellent pressure pot performance on live devices up to 500 hr.	43,900	155	22	80	13,500	30 min. at 125°C + 90 min. at 165°C
Glob Top								
LOCTITE ECCOBOND E01072	Epoxy glob top encapsulant	• High T_g • Low extractable ionics • High performance • Long shelf life • Fast curing • One component	80,000	135	43	123	6,700	5 min. at 140°C – 150°C

LOW PRESSURE MOLDING

Product Name	Description	Key Attributes	Color	Operating Temperature (°C)	Shore Hardness	Flammability Rating	Glass Transition Temperature, T_g (°C)
Increased Hardness							
TECHNOMELT PA 641	Moldable polyamide	• Ideal for applications where strength and hardness are needed • Good adhesion for high-temperature applications	Amber	-40 – 125	92A	UL 94 V-0	-30
TECHNOMELT PA 646			Black				
High-Temperature Resistant							
TECHNOMELT PA 673	Moldable polyamide	• Good adhesion to a variety of substrates • Excellent moisture resistance • Excellent environmental resistance • Good adhesion for high-temperature applications	Amber	-40 – 140	88A	UL 94 V-0	-45
TECHNOMELT PA 678			Black				
TECHNOMELT PA 682	Moldable polyamide	• Suitable for high-humidity applications • Formulated for very low water vapor transmission	Amber	-40 – 150	88A	UL 94 V-0	-40
TECHNOMELT PA 687			Black				

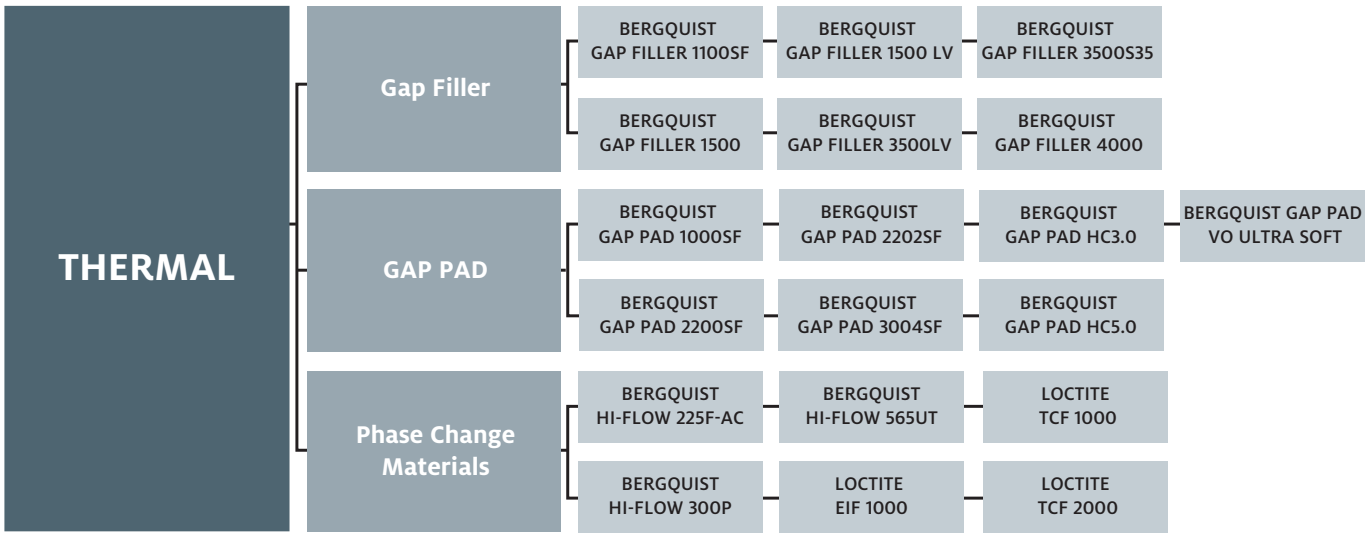
POTTING

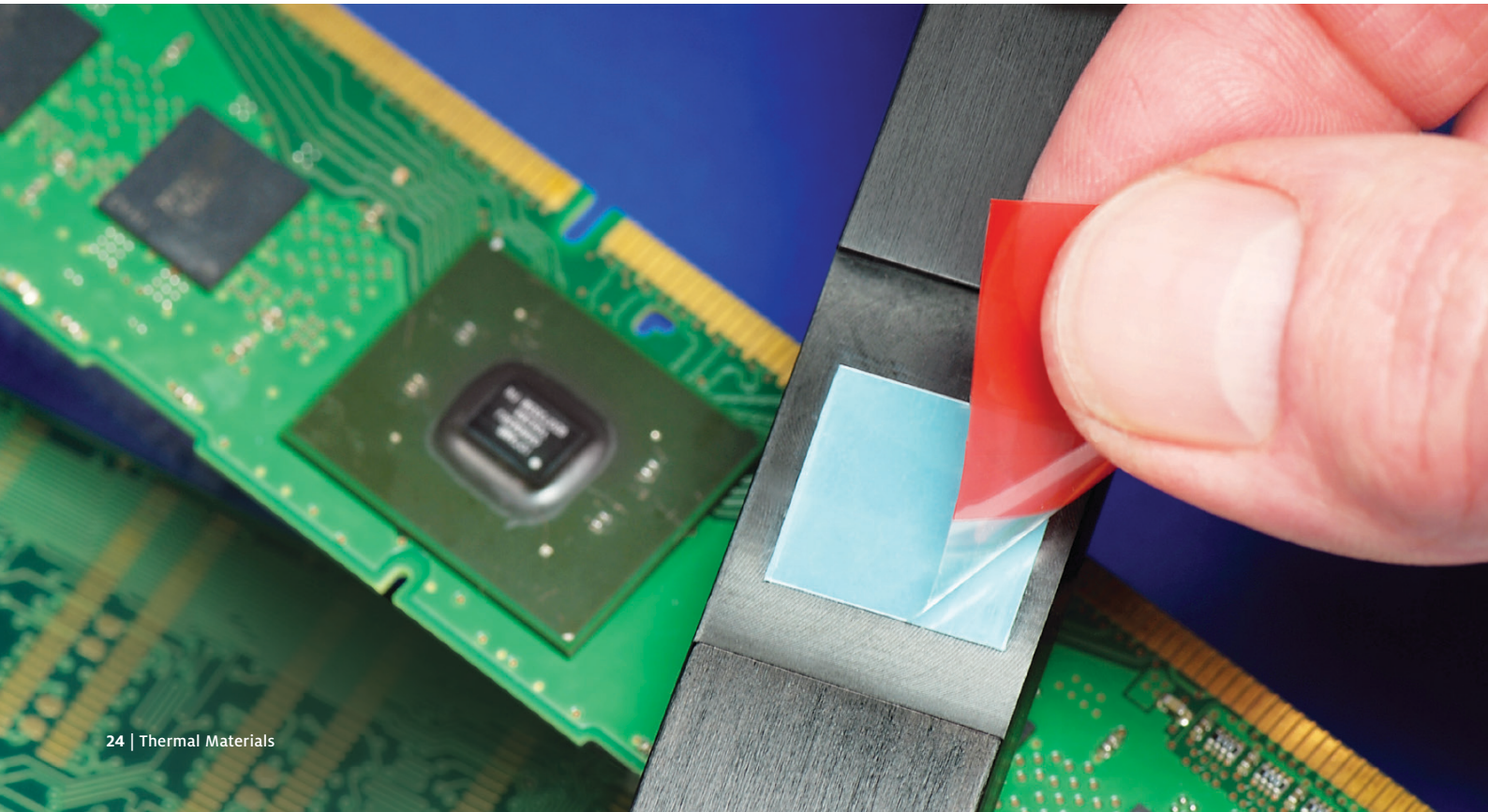
Product Name	Description	Key Attributes	Color	Viscosity at 25°C (cP)		Glass Transition Temperature, T_g (°C)	Shore Hardness	Recommended Cure
				Part 1	Part 2			
Two Component								
LOCTITE UK U-09FL	Industrial-grade urethane adhesive	• Excellent peel strength • Ideal for bonding glass, metal, polycarbonate and other plastics • Provides an ultra-clear, highly flexible bond line that does not yellow	Transparent	7,800	1,100	25.8	45D	5 days at 25°C

THERMAL MATERIALS FOR ADAS CAMERAS

HIGH-PERFORMANCE THERMAL MANAGEMENT

Thermal management is one of the most pressing issues in electronics today. As board densities increase and higher-functioning, smaller form factor components become the norm, managing the heat has become challenging. The CMOS sensor and the logic chip within an automotive camera assembly are prime examples; massive image processing equates to power increases and the need to effectively dissipate the resulting thermal load. As the market leader in thermal management materials, Henkel delivers high-performance BERGQUIST brand thermal interface materials (TIMs) spanning a wide range of mediums and thermal conductivities to accommodate various heat dissipation requirements and manufacturing preferences. Printable phase change TIMs, custom die-cut GAP PADs and liquid dispensable gap fillers offer the conformity, low stress and thermal conductivity required to move heat away from critical components so that automotive cameras maintain their cool to offer safety-enhancing performance.





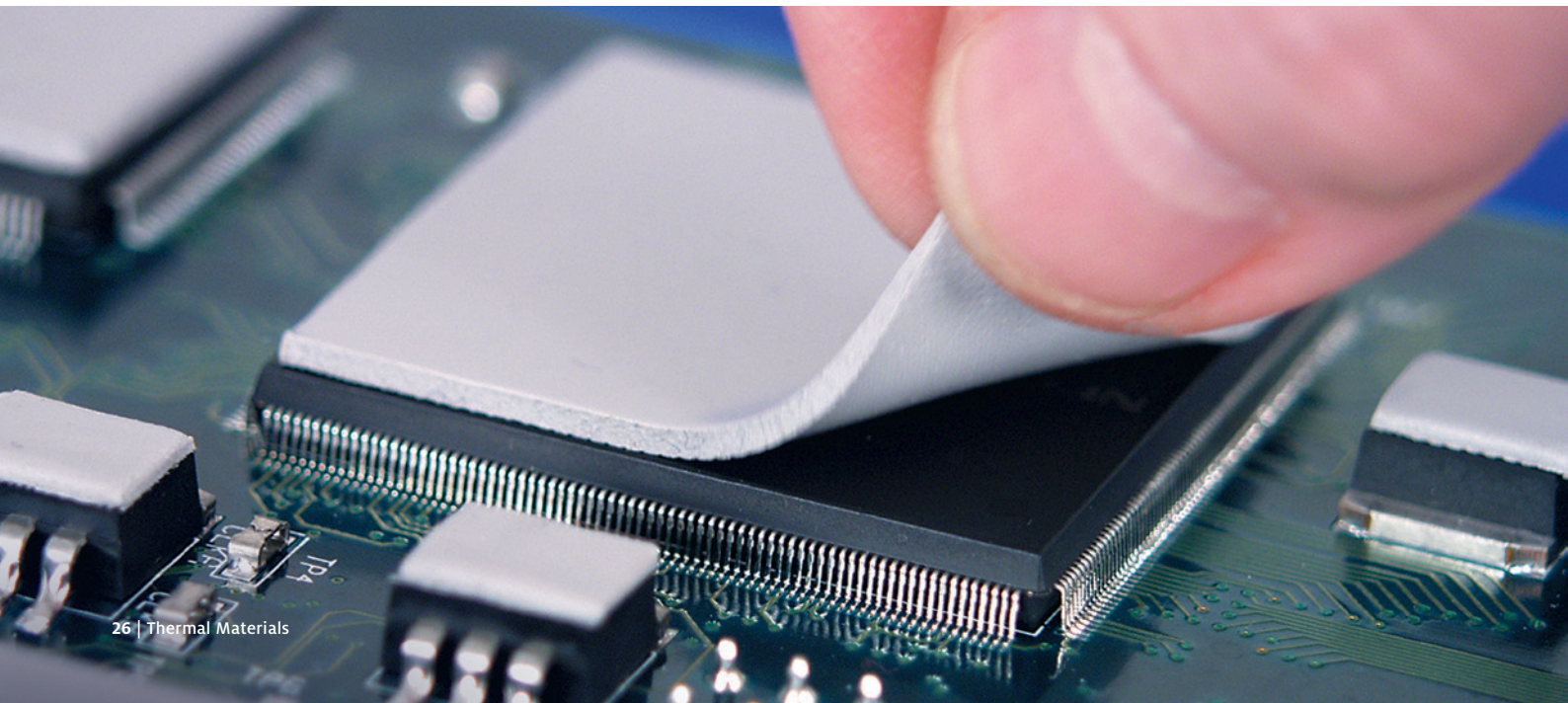
GAP FILLER

Product Name	Description	Key Attributes	Thermal Conductivity (W/m•K)	Viscosity at 25°C (cP)	Dielectric Strength (V/25 µm)	Flammability Rating	Recommended Cure
BERGQUIST GAP FILLER 1100SF	Silicone-free, thermally conductive liquid gap filling material	• No silicone outgassing or extraction • Ultra-conforming material designed for fragile and low-stress applications • Ambient and accelerated cure schedules • 100% solids – no cure by-products	1.1	450,000	400	UL 94 V-0	24 hr. at 25°C
BERGQUIST GAP FILLER 1500	Thermally conductive liquid gap filling material	• Optimized shear thinning characteristics for ease of dispensing • Excellent slump resistance • Ultra-conforming with excellent wet-out for low-stress interface applications • 100% solids – no cure by-products • Excellent low- and high-temperature mechanical and chemical stability • Ambient and accelerated cure schedules	1.8	25,000	400	UL 94 V-0	5 hr. at 25°C
BERGQUIST GAP FILLER 1500 LV	Thermally conductive liquid gap filling material	• Low volatility for silicone sensitive applications • Ultra-conforming with excellent wet-out • 100% solids – no cure by-products • Excellent low- and high-temperature, chemical and mechanical stability • Ambient or accelerated cure schedules	1.8	20,000	400	UL 94 V-0	8 hr. at 25°C
BERGQUIST GAP FILLER 3500LV	Thermally conductive liquid gap filling material	• Low volatility for outgassing sensitive applications • Ultra-conforming with excellent wet-out for low-stress interfaces on applications • 100% solids – no cure by-products • Ambient or accelerated cure schedules	3.5	45,000	275	UL 94 V-0	24 hr. at 25°C
BERGQUIST GAP FILLER 3500S35	Thermally conductive liquid gap filling material	• High thermal performance • Thixotropic nature makes it easy to dispense • Ultra-conforming material designed for fragile and low-stress applications • Ambient or accelerated cure schedules	3.6	150,000	275	UL 94 V-0	15 hr. at 25°C
BERGQUIST GAP FILLER 4000	Thermally conductive liquid gap filling material	• High thermal performance • Extended working time for manufacturing flexibility • Ultra-conforming with excellent wet-out • 100% solids – no cure by-products • Excellent low- and high-temperature, chemical and mechanical stability • Ambient or accelerated cure schedules	4.0	50,000	450	UL 94 V-0	24 hr. at 25°C

THERMAL MATERIALS FOR ADAS CAMERAS

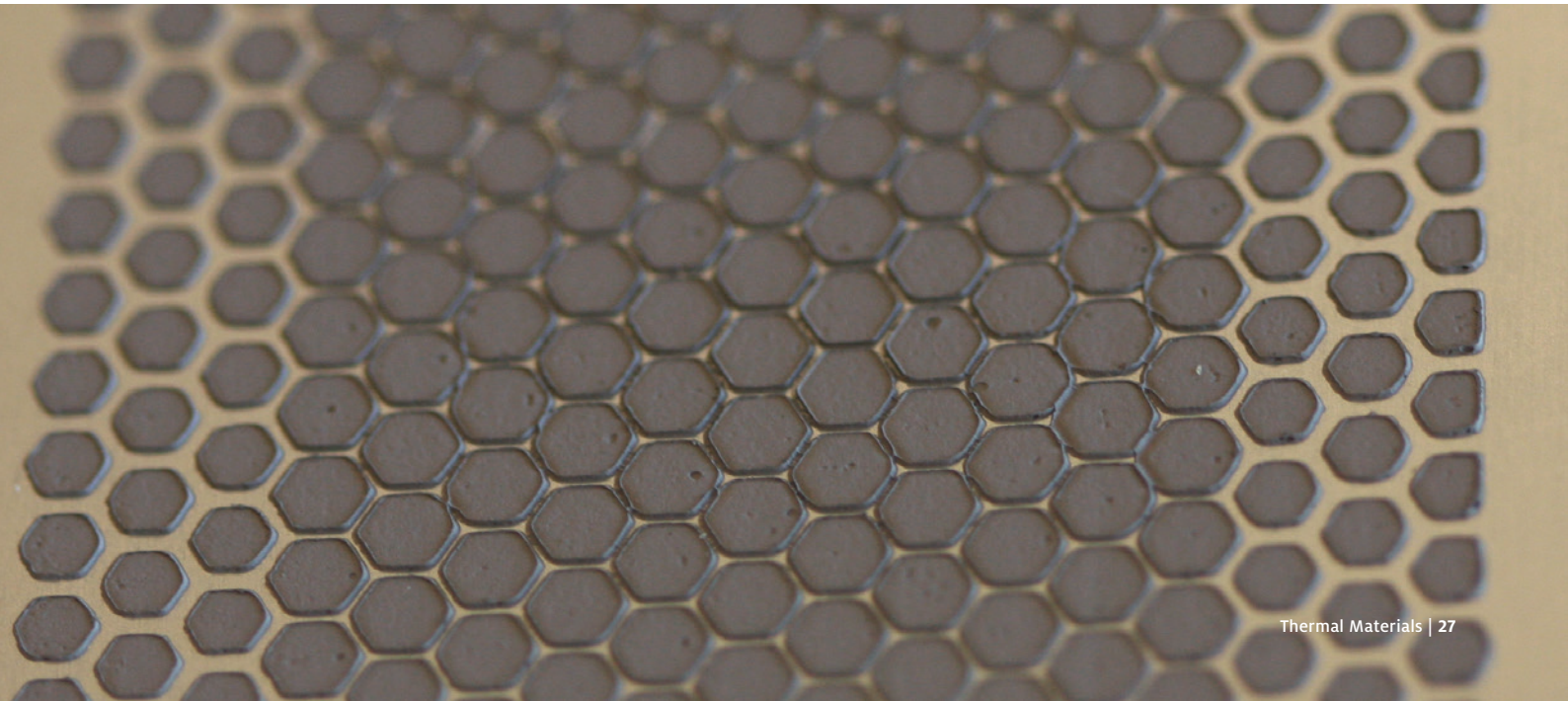
GAP PAD

Product Name	Description	Key Attributes	Thermal Conductivity (W/m•K)	Modulus at 25°C (kPa)	Dielectric Breakdown Voltage	Thickness (mm)	Flammability Rating
BERGQUIST GAP PAD 1000SF	Silicone-free, thermally conductive gap filling material	• No silicone outgassing • No silicone extraction • Reduced tack on one side to aid in application assembly • Electrically isolating	0.9	234	6,000 V at 250 µm	• 0.254 – 3.175	UL 94 V-1
BERGQUIST GAP PAD 2200SF	Silicone-free, thermally conductive gap filling material	• Medium compliance with easy handling • Electrically isolating	2	228	5,000 V at 250 µm	• 0.254 – 3.175	UL 94 V-0
BERGQUIST GAP PAD 2202SF	Silicone-free, high performance, thermally conductive gap filling material	• Minimal compression set • 12.7 µm film provides tack-free surface • Tacky side allows for ease of handling and placement	2	1,500	5,000 V at 250 µm	• 0.254 – 3.175	UL 94 V-0
BERGQUIST GAP PAD 3004SF	Silicone-free, high performance, thermally conductive gap filling material	• Excellent thermal performance • 6.4 µm polyethylene terephthalate (PET) provides easy disassembly, leaving no residue • Tacky side allows for ease of handling and placement	3	2,450	6,000 V at 250 µm	• 0.254 – 3.175	UL 94 V-0
BERGQUIST GAP PAD HC3.0	Thermally conductive gap filling material	• High-compliance, low compression stress • Fiberglass reinforced for shear and tear resistance • Low modulus	3	110	5,000 V at 500 µm	• 0.508 – 3.175	UL 94 V-0
BERGQUIST GAP PAD HC5.0	Thermally conductive gap filling material	• Highly conformable • Exceptional thermal performance • High-compliance, low compression stress • Fiberglass reinforced for shear and tear resistance • Low modulus	5	121	5,000 V at 500 µm	• 0.508 – 3.175	UL 94 V-0
BERGQUIST GAP PAD VO ULTRA SOFT	Thermally conductive gap filling material	• Highly conformable, low hardness • “Gel-like” modulus • Decreased strain • Puncture, shear and tear resistant • Electrically isolating	1	55	6,000 V at 500 µm	• 0.508 – 6.350	UL 94 V-0



PHASE CHANGE MATERIALS

Product Name	Description	Key Attributes	Thermal Conductivity (W/m•K)	Phase Change Temperature (°C)	Dielectric Strength (V/25 µm)	Thickness (mm)	Flammability Rating
Aluminum Carrier							
BERGQUIST HI-FLOW 225F-AC	Phase change thermal interface material	• Low thermal impedance • Can be manually or automatically applied to the surfaces of room-temperature heat sinks • Foil reinforced, adhesive coated • Soft phase change compound	1	55	N/A	• 0.102	UL 94 V-0
LOCTITE TCF 1000	Non-insulating, phase change thermal interface material	• Low thermal impedance • Coated on aluminum foil • Used between any non-isolated heat dissipating component and a heat sink or chassis	1	60	N/A	• 0.06 – 0.2	None
LOCTITE TCF 2000	Non-insulating, phase change thermal interface material	• Used between any non-isolated heat dissipating component and a heat sink or chassis • High thermal conductivity	3	51	N/A	• 0.076	UL 94 V-0
Polyimide Carrier							
LOCTITE EIF 1000	High-performance, phase change thermal Interface material	• High dielectric strength • Excellent cut-through resistance	0.45	60	> 5,000	• 0.05 – 0.2	UL 94 V-0
BERGQUIST HI-FLOW 300P	High-performance, phase change thermal interface material	• Field-proven polyimide film • Excellent dielectric performance • Excellent cut-through resistance • Outstanding thermal performance in an insulated pad	1.6	55	5,000	• 0.102 – 0.127	UL 94 V-0
No Carrier							
BERGQUIST HI-FLOW 565UT	High-performance, phase change thermal interface material	• Very low thermal impedance • High thermal conductivity • Naturally tacky • Tabulated for ease of assembly	3	52	N/A	• 0.127 • 0.254	UL 94 V-0



LOCTITE®
TECHNOMELT®

BERGQUIST®

AMERICAS

HEADQUARTERS:
UNITED STATES
Henkel Electronic Materials, LLC
14000 Jamboree Road
Irvine, CA 92606
USA
Tel: +1.888.943.6535
Fax: +1.714.368.2265

Henkel Electronic Materials, LLC
20021 Susana Road
Rancho Dominguez, CA 90221
USA
Tel: +1.310.764.4600
Fax: +1.310.605.2274

Henkel Electronic Materials, LLC
18930 W. 78th Street
Chanhassen, MN 55317
USA
Tel: +1.952.835.2322
Tel: +1.800.347.4572
Fax: +1.952.835.0430

BRAZIL
Henkel Brazil
Av. Prof. Vernon Krieble, 91
06690-070 Itapevi,
Sao Paulo, Brazil
Tel: +55.11.3205.7001
Fax: +55.11.3205.7100

ASIA-PACIFIC

CHINA
No. 332 Meigui South Road
WaiGaoQiao Free Trade Zone, Pu Dong
Shanghai 200131, P.R. China
Tel: +86.21.3898.4800
Fax: +86.21.5048.4169

JAPAN
Henkel Japan Ltd.
27-7, Shin Isogo-cho
Isogo-ku Yokohama, 235-0017
Japan
Tel: +81.45.286.0161
Email: jp.ae-csdesk@henkel.com

KOREA
Henkel Korea Co.,Ltd
18th floor of tower B, BYC High City Bldg
Gasan Digital 1-ro, Geumcheon-gu, Seoul,
08506, South Korea
Tel : +82.2.6150.3000
Fax: +82.2.6947.5203

Henkel Korea Co.,Ltd
806, Daeryung Techno Town II, 33-33,
Gasan Digital 1-ro, Geumcheon-gu, Seoul,
08594, Korea
Tel : +82.2.6675.8000
Fax: +82.2.6675.8191

SINGAPORE
Henkel Singapore Pte Ltd.
401, Commonwealth Drive
#03-01/02 Haw Par Technocentre,
Singapore 149598
Tel: +65.6266.0100
Fax: +65.6472.8738 / +65.6266.1161

EUROPE

BELGIUM
Henkel Electronics Materials (Belgium)
N.V. Nijverheidsstraat 7
B-2260 Westerlo
Belgium
Tel: +32.1457.5611
Fax: +32.1458.5530

UNITED KINGDOM
Henkel Ltd.
Adhesives Limited Technologies House
Wood Lane End
Hemel Hempstead
Hertfordshire HP2 4RQ
Tel: +44.1442.278000
Fax: +44.1442.278071

Across the Board,
Around the Globe.

henkel-adhesives.com/electronics
henkel-adhesives.com/thermal