

LOCTITE[®]

MATERIAL SOLUTIONS FOR

COMPACT CAMERA MODULES



Henkel

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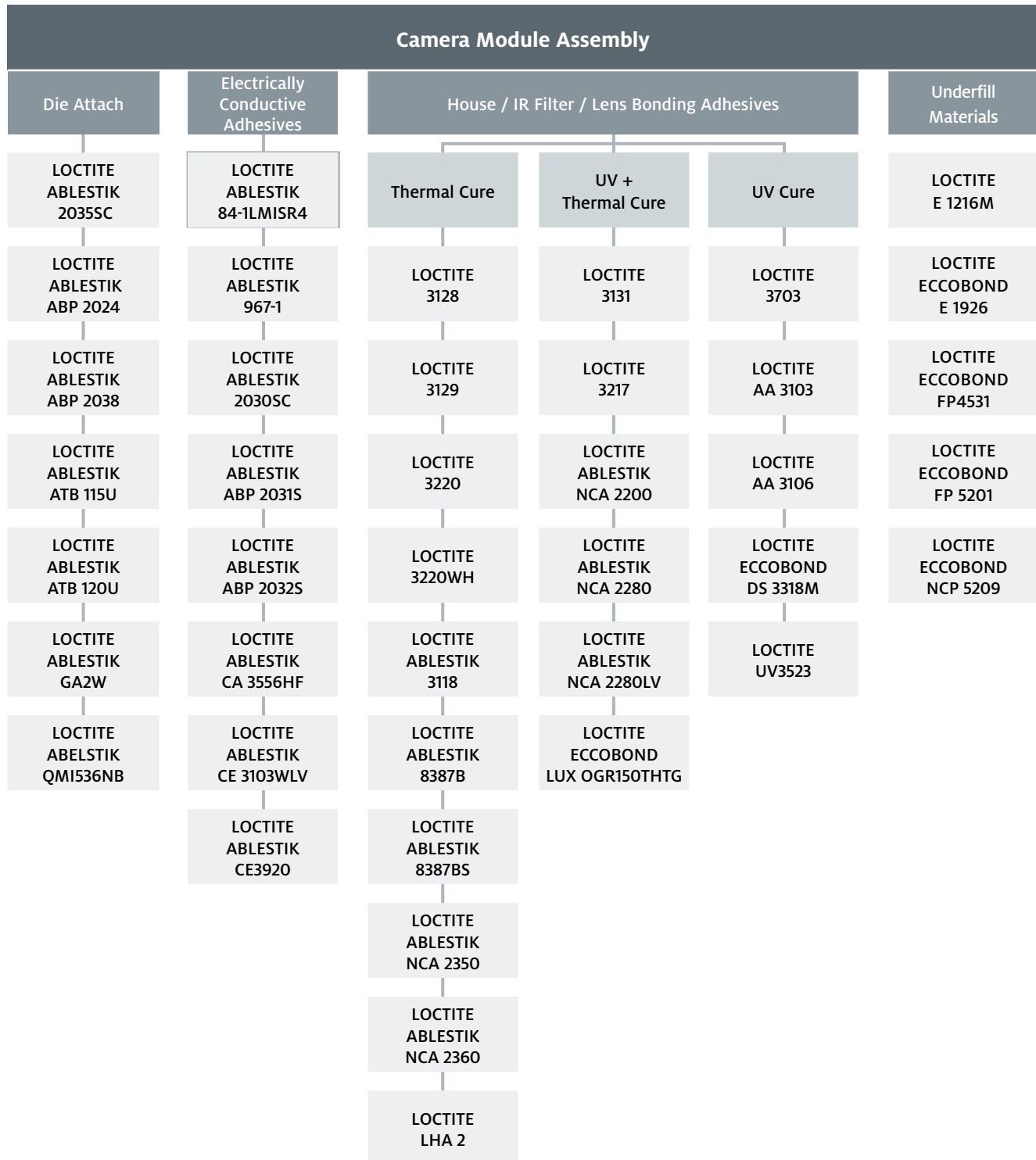
INTRODUCTION

The camera module industry has come into focus as smartphone and tablet manufacturers continue to develop advanced camera module technologies, capitalizing on this sector's fast growth. As smartphones and tablets integrate additional image capture capabilities and continue to push the resolution envelope, camera module functionality and reliability will become even more critical.

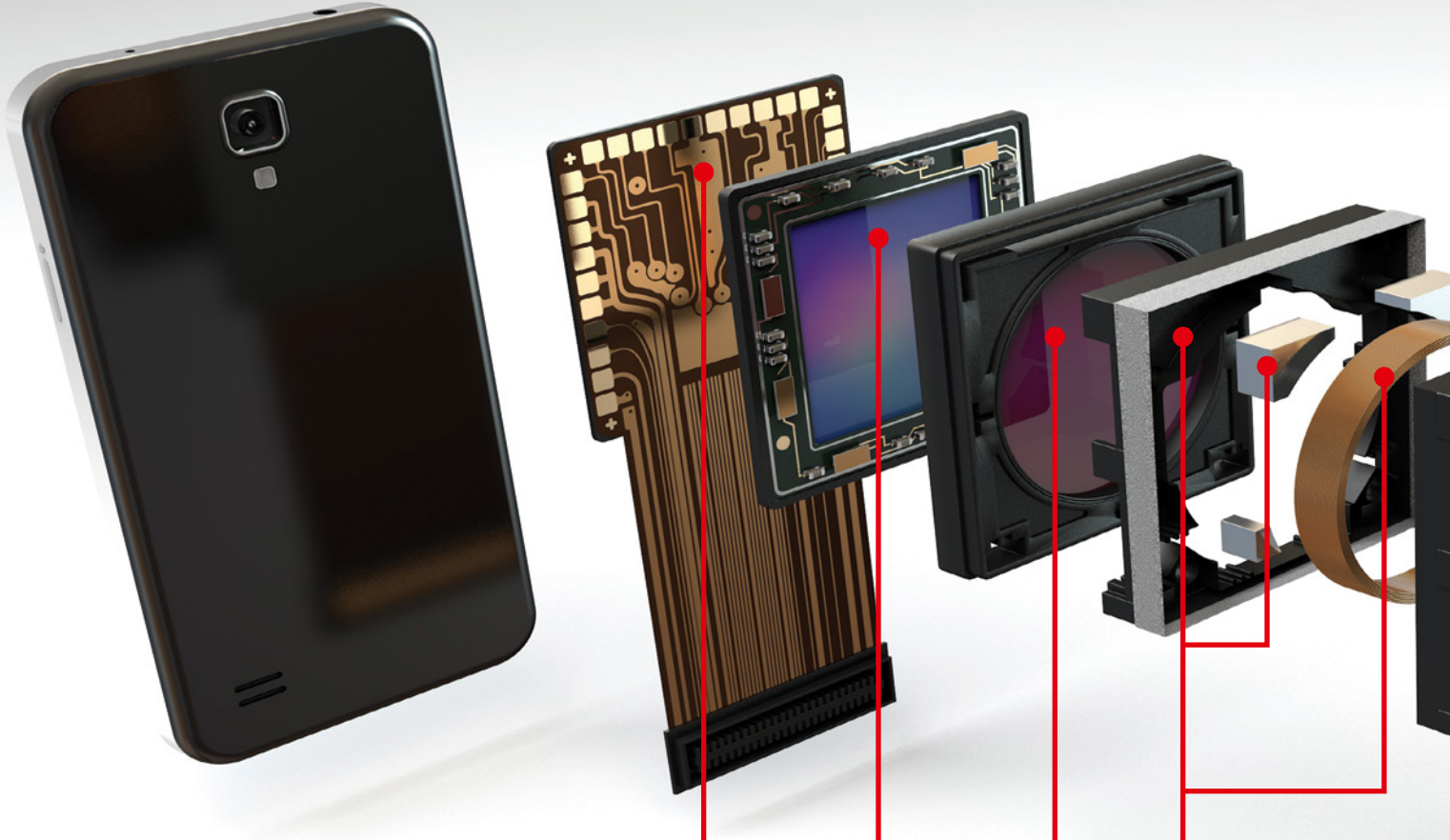
There are generally two types of camera modules found within today's handheld devices: a front-end, fixed-focus module primarily used for video chatting, and a backside auto-focus module for taking pictures and videos. Because of the number of components found in both fixed-focus and auto-focus camera modules and the interdependence of each element on the other for proper function, partnering with a materials supplier that has a broad portfolio and expertise in multiple applications is essential. Understanding die attach characteristics and performance to minimize warpage, bonding adhesive optimization for filter bonding and lens bonding, and reinforcement materials for flexible printed circuit boards (PCB) are all key factors for ensuring a reliable, high-performance module assembly. These requirements are precisely why today's leading camera module manufacturers are partnering with Henkel. With decades of advanced adhesive expertise, a comprehensive portfolio of materials for all elements of camera module assembly, and unmatched global manufacturing footprint and local support, Henkel is unparalleled when it comes to camera module success.

PRODUCT PORTFOLIO

ADHESIVES FOR CAMERA MODULE ASSEMBLY



ADHESIVES IN ACTION

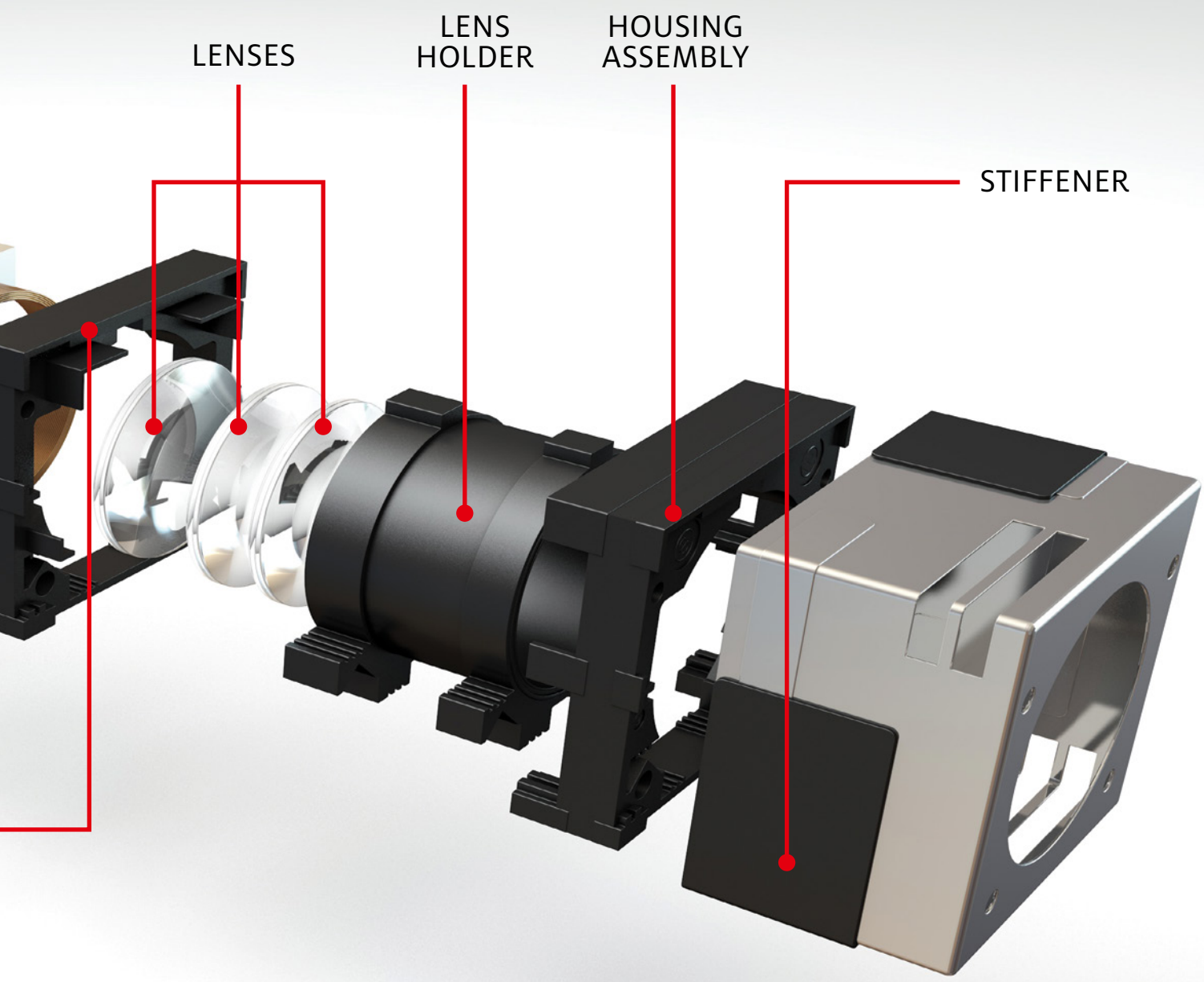


SUBSTRATE

IMAGE
SENSOR

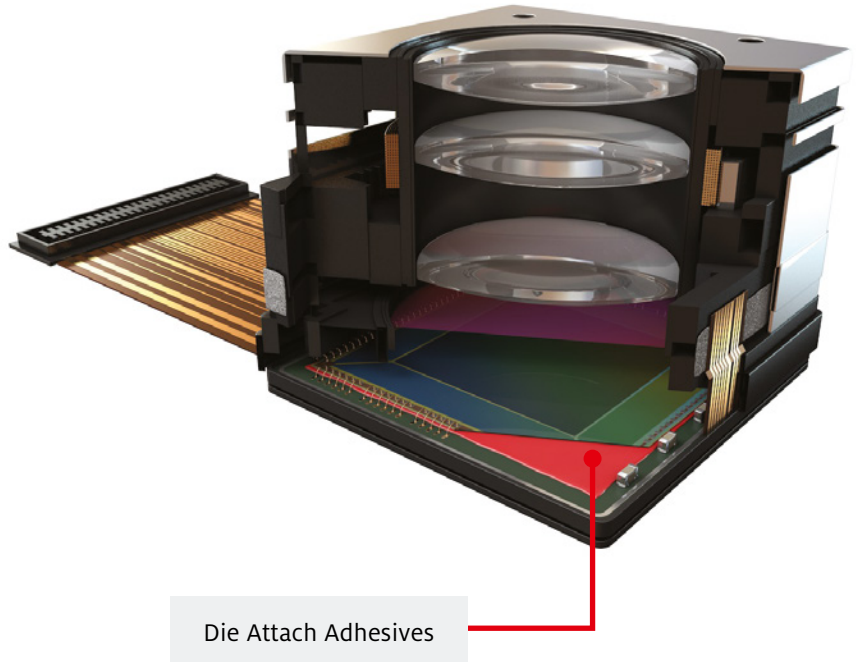
COLOR
FILTER

ACTUATOR



DIE ATTACH ADHESIVES

To facilitate lens function – either in auto- or fixed-focus lenses – an image sensor die is bonded to a substrate, which can be made from any number of materials, including FR4, ceramic or gold-plated PCBs. Because pixel counts are increasing to enable greater image resolution, die sizes are getting larger, which can lead to increased warpage. Controlling die warpage and stress with robust die attach materials is critical to highly reliable camera module operation, and it's why Henkel's formulations ensure success. Henkel's complete portfolio of low-temperature cure, low-stress, low-outgassing die attach pastes for exceptional performance and very high throughput is designed specifically for the requirements of modern camera module die bonding.



Key Material Properties

- Low-temperature cure (80°C)
- Low-stress die attach
- Low outgassing
- Faster cure (Improved throughput)
- Low halogen / RoHS-compliant

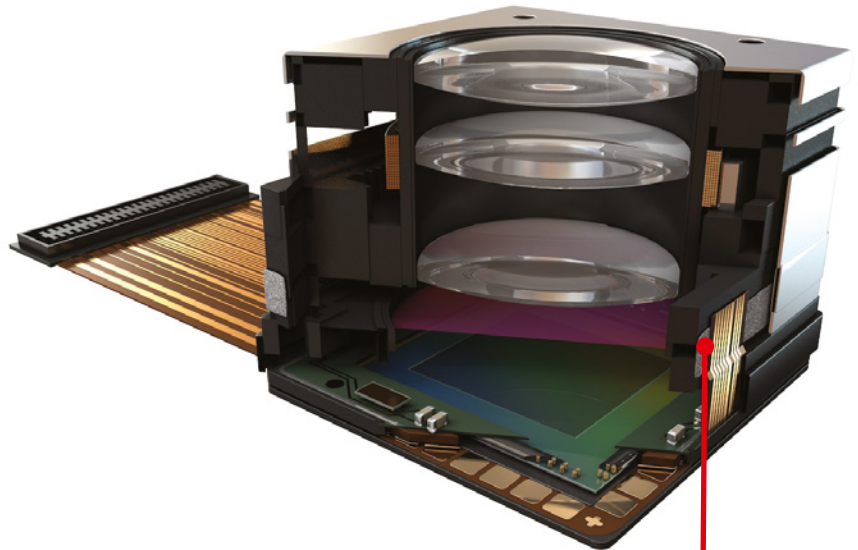
Die Attach Adhesives	
Paste	Film
LOCTITE® ABLESTIK 2035SC	LOCTITE ABLESTIK ATB 115U
LOCTITE ABLESTIK ABP 2024	LOCTITE ABLESTIK ATB 120U
LOCTITE ABLESTIK ABP 2038	
LOCTITE ABLESTIK GA2W	
LOCTITE ABLESTIK QM1536NB	

Paste						
Properties	Units	LOCTITE ABLESTIK 2035SC	LOCTITE ABLESTIK ABP 2024	LOCTITE ABLESTIK ABP 2038	LOCTITE ABLESTIK GA2W	LOCTITE ABLESTIK QMI536NB
Cure Type		Heat	Heat	Heat	Heat	Heat
Appearance		Red	White	Red	Ivory	White
Viscosity (Brookfield) 25°C, 5 rpm	cP	11,000	13,000	14,000	10,000	10,000
Glass Transition Temperature (T_g)	°C	120	47	38	25	-30
Modulus at 25°C	N/mm ²	2,500	510	720	70	300
CTE Below T_g	ppm/°C	54	127	50	58	80
CTE Above T_g		128	156	168	164	150
Recommended Cure		90 sec. at 110°C	30 min. at 150°C	60 min. at 80°C	15 min. at 175°C	30 min. at 150°C

Film			
Properties	Units	LOCTITE ABLESTIK ATB 115U	LOCTITE ABLESTIK ATB 120U
Cure Type		Heat	Heat
Appearance		Transparent	Transparent
Adhesive Thickness	µm	15	20
Glass Transition Temperature (T_g)	°C	75	75
Modulus at 25°C	N/mm ²	875	875
CTE Below T_g	ppm/°C	62	62
CTE Above T_g		238	238
Recommended Cure		30 min. at 120°C	30 min. at 120°C

ELECTRICALLY CONDUCTIVE ADHESIVES (ECAs)

Used as an alternative to solder materials or to remove electrostatic discharge from the substrate, electrically conductive adhesives (ECAs) are found in several locations within auto-focus camera modules. ECAs are used as a solder alternative to enable electrical connection of the voice coil actuator to the spring, facilitate voice coil motor terminal bonding and provide bottom-attach and side-sealing stiffener for ground bonding and fixturing. Henkel's ECAs have been optimized to deliver good electrical connections, stable electrical resistance, fast low-temperature cure, high adhesion to a variety of substrates, and no bleed-out, which all combine to deliver a robust module assembly with excellent performance.



Stiffener attach

Key Material Properties

- Good electrical conductivity
- Fast curing
- High and stable adhesion
- Low-temperature cure
- Long pot life
- Low halogen / RoHS-compliant

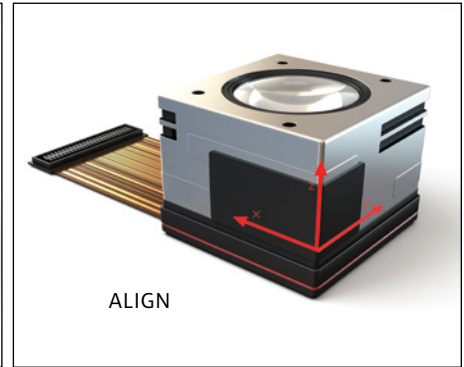
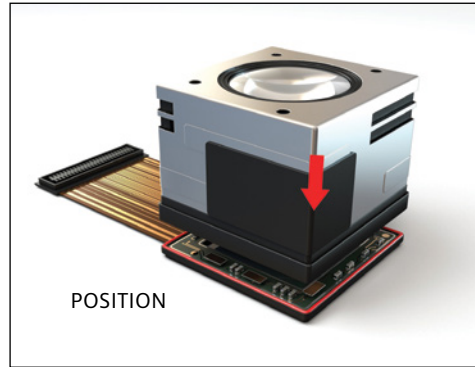
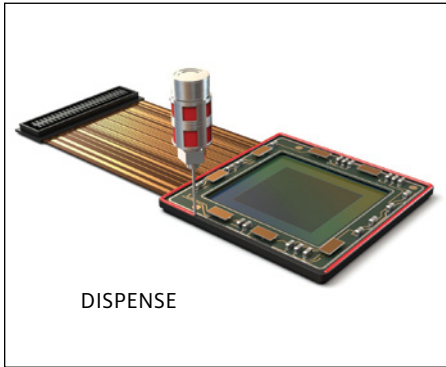
Electrically Conductive Adhesives

Snap Cure	Oven Cure
LOCTITE® ABLESTIK 2030SC	LOCTITE ABLESTIK 84-1LMISR4
LOCTITE ABLESTIK CA 3556HF	LOCTITE ABLESTIK 967-1
LOCTITE ABLESTIK CE 3103WLV	LOCTITE ABLESTIK ABP 2031S
LOCTITE ABLESTIK CE3920	LOCTITE ABLESTIK ABP 2032S

Snap Cure					
Properties	Units	LOCTITE ABLESTIK 2030SC	LOCTITE ABLESTIK CA 3556HF	LOCTITE ABLESTIK CE 3103WLV	LOCTITE ABLESTIK CE3920
Appearance		Silver	Silver	Silver	Silver
Viscosity (Brookfield) 25°C, 5 rpm	cP	11,600	28,000	15,000	26,000 (Cone & Plate)
Glass Transition Temperature (T _g)	°C	28.6	-40	114	119
Modulus at 25°C	N/mm ²	3,300	650	4,500	4,900
Volume Resistivity	ohms-cm	0.0002	0.0025	0.0008	0.0003
CTE Below T _g	ppm/°C	45	95	45	29
CTE Above T _g		130	278	225	130
Recommended Cure		90 sec. at 110°C	15 sec. at 130°C	10 min. at 120°C	5 min. at 150°C

Oven Cure					
Properties	Units	LOCTITE ABLESTIK 84-1LMISR4	LOCTITE ABLESTIK 967-1	LOCTITE ABLESTIK ABP 2031S	LOCTITE ABLESTIK ABP 2032S
Appearance		Silver	Silver	Silver	Silver
Viscosity (Brookfield) 25°C, 5 rpm	cP	8,000	14,000	8,000	11,000
Glass Transition Temperature (T _g)	°C	120	110	100	110
Modulus at 25°C	N/mm ²	3,900	4,849	4,700	4,600
Volume Resistivity	ohms-cm	0.0002	0.002	0.001	0.0002
CTE Below T _g	ppm/°C	40	69	55	54
CTE Above T _g		150	213	145	162
Recommended Cure		1 hr. at 175°C	2 hrs. at 80°C	1 hr. at 80°C	1 hr. at 80°C

HOUSE / IR FILTER / LENS BONDING ADHESIVES



HOUSE BONDING ADHESIVES

Bonding the lens holder to the substrate requires different adhesive characteristics depending on the type of camera module being assembled. For fixed-focus cameras, a traditional thermal-cure, nonconductive house bonding adhesive is the preferred approach. More advanced auto-focus modules, however, require a different technique – particularly as pixels and lens quantity increase. For this application, active alignment is employed and requires dual-cure adhesives with UV and thermal-cure capabilities. Henkel's house bonding materials – whether thermal only or dual-cure formulations – have excellent bonding capabilities for a variety of substrates, which is critical as the industry incorporates both liquid crystal polymer (LCP) and polyphthalamide (PPA) holder materials.

IR FILTER BONDING ADHESIVES

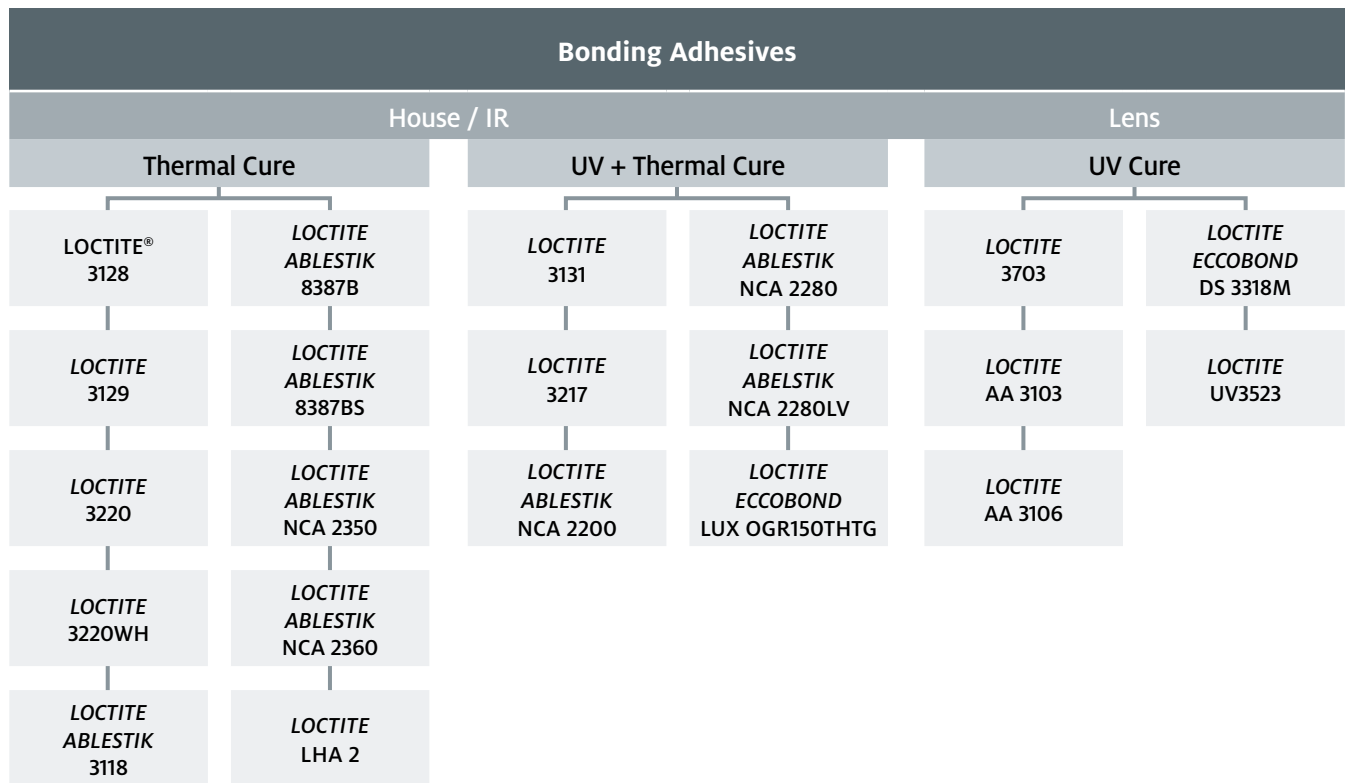
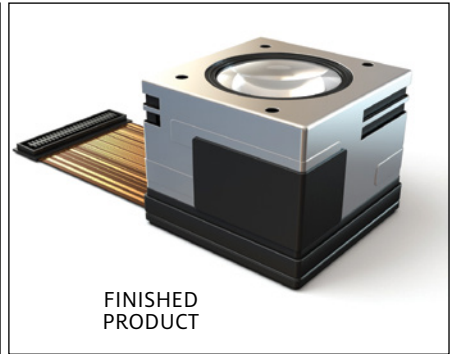
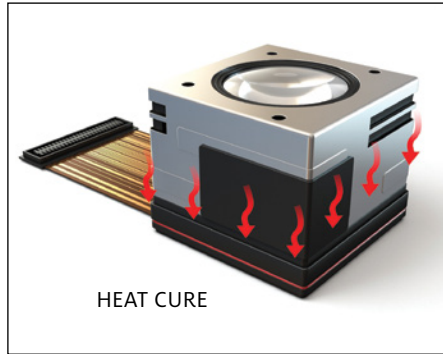
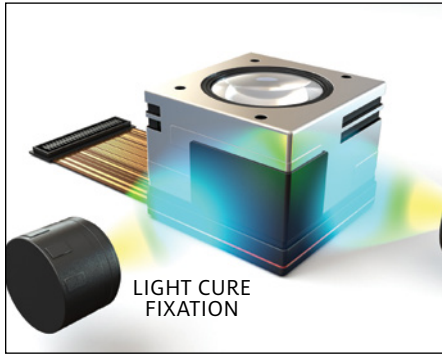
Bonding of the IR filter to the substrate requires a strong, yet flexible, material to accommodate fast, high-adhesion curing with the ability to absorb stress. Though most substrates are ceramic, substrate materials can vary depending on manufacturing preferences and final product function. Because of this, an IR bonding material should be able to adhere to a variety of substrates. Along with excellent UV-cure characteristics, Henkel's IR filter bonding adhesives have been designed to accommodate both fixed- and auto-focus module substrate adhesion requirements for exceptional in-field operation.

LENS BONDING ADHESIVES

Lens locking adhesives also play a critical role in the function of the camera module. Effective bonding of the lens barrel to the lens holder requires specialized adhesives that accommodate low-temperature processing. With very rapid UV cure and handling strength, a high thixotropic index to reduce liquid migration and unwanted contamination, and the ability to enhance load-bearing and shock-absorbing characteristics, Henkel's UV lens bonding adhesives deliver the strength, reliability and performance required – all without high-temperature processing concerns.

Key Material Properties

- High adhesion to LCP, PA, PPA, etc.
- Low-temperature cure (80°C)
- Faster cure (Improved throughput)
- Dual cure (UV & thermal)
- Low halogen / RoHS-compliant



HOUSE / IR FILTER / LENS BONDING ADHESIVES

House Bonding Adhesives / IR Filter Attach (Thermal Cure)											
Properties	Units	LOCTITE® 3128	LOCTITE 3129	LOCTITE 3220	LOCTITE 3220WH	LOCTITE ABLESTIK 3118	LOCTITE ABLESTIK 8387B	LOCTITE ABLESTIK 8387BS	LOCTITE ABLESTIK NCA 2350	LOCTITE ABLESTIK NCA 2360	LOCTITE LHA 2
Appearance		Black	Black	Black	White	White	Black	Black	Black	Black	Black
Viscosity (Brookfield) 25°C, 5 rpm	cP	22,000	11,800	8,200	8,940 (20 rpm)	22,000	9,500	14,250	13,670	6,296	16,000 (Casson)
Glass Transition Temperature (T _g)	°C	45	40	25	29	45	96	122	26	33	88
Modulus at 25°C	N/mm ²	3,900	5,400	550	550	3,900	1,400	1,919	2,500	2,054	6,000
CTE Below T _g	ppm/°C	40	47	47	55	40	94	98	61	53	45
CTE Above T _g		130	145	145	162	130	165	180	177	171	160

House Bonding Adhesives / IR Filter Attach (UV + Thermal Cure)							
Properties	Units	LOCTITE 3131	LOCTITE 3217	LOCTITE ABLESTIK NCA 2200	LOCTITE ABLESTIK NCA 2280	LOCTITE ABLESTIK NCA 2280LV	LOCTITE ECCOBOND LUX OGR150THTG
Chemical Type		Acrylated Epoxy	Acrylated Epoxy	Acrylated Epoxy	Acrylated Epoxy	Acrylated Epoxy	Acrylated Epoxy
Appearance		Amber	Amber	Light Yellow	Black	Black	Clear
Viscosity	cP	14,000	37,600	22,000	55,000	32,800	1,000
Glass Transition Temperature (T _g)	°C	85	82	97	90	75	145
Modulus at 25°C	N/mm ²	954	330	5,000	4,500	3,000	1,300
CTE Below T _g	ppm/°C	49	53	43	45	54	61
CTE Above T _g		175	178	150	160	160	157
Recommended Cure		1 sec. at 100 mW/cm ² + 30 min. at 60°C / 20 min. at 80°C	1 sec. at 100 mW/cm ² + 30 min. at 60°C / 20 min. at 80°C	2 sec. at 100 mW/cm ² + 30 min. at 80°C	2 sec. at 100 mW/cm ² + 30 min. at 80°C	2 sec. at 100 mW/cm ² (LED) + 30 min. at 80°C	40 sec. at 100 mW/cm ² + 1 hr. at 100°C

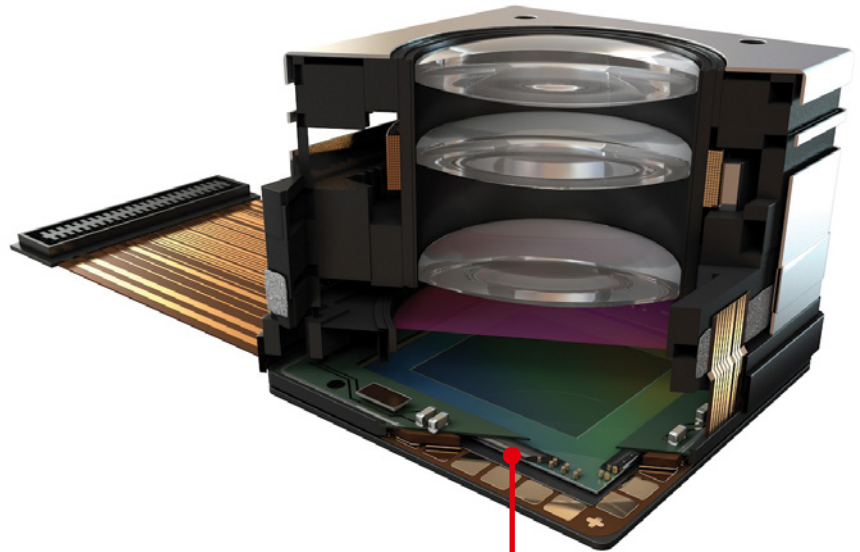
Lens Bonding Adhesives (UV Cure)

Properties	Units	LOCTITE 3703	LOCTITE AA 3103	LOCTITE AA 3106	LOCTITE ECCOBOND DS 3318M	LOCTITE UV3523
Chemical Type		Acrylate Urethane	Acrylate Urethane	Acrylate Urethane	Acrylate Urethane	Modified Acrylate
Appearance		White	Slightly Hazy	Transparent	Light Yellow	Dark Amber
Viscosity (Brookfield) 25°C, 20 rpm	cP	26,000	11,250	5,250	2,360 (HAAKE PK-100)	16,000
Tensile Strength	N/mm ²	13	17	18.6	10	27
Modulus at 25°C	N/mm ²	490	207	255	-	422
Recommended Cure		80 sec. at 30 mW/cm ²	80 sec. at 30 mW/cm ²	80 sec. at 30 mW/cm ²	10 sec. at 100 mW/cm ²	20 sec. at 100 mW/cm ²



UNDERFILL MATERIALS

To safeguard flip-chip image die applications, side fill underfill is the material of choice to ensure bump reinforcement during reliability testing and while in use. The capability of the underfill is critical, with controlled flow essential to material containment and to avoid image sensor contamination. In addition to the flip-chip reinforcement, underfill is also used to protect the connection of the camera module to the PCB. A leader in underfill material development for the semiconductor and electronics assembly markets, Henkel has a portfolio of camera module underfills that delivers outstanding adhesion and protection with the flexibility required to accommodate stress.



Underfill

Key Material Properties

- Controlled flow
- High thixotropic index
- Good bump coverage
- Good fillet capability
- Low-temperature cure
- Long pot life
- Low halogen / RoHS-compliant

Underfill Materials	
Capillary Flow	No Flow
LOCTITE® E 1216M	LOCTITE ECCOBOND FP 5201
LOCTITE ECCOBOND E 1926	LOCTITE ECCOBOND NCP 5209
LOCTITE ECCOBOND FP4531	

Underfill Materials						
Properties	Units	LOCTITE E 1216M	LOCTITE ECCOBOND E 1926	LOCTITE ECCOBOND FP4531	LOCTITE ECCOBOND FP 5201	LOCTITE ECCOBOND NCP 5209
Appearance		Black	Black	Black	Pale Yellow	Pale Yellow
Viscosity (Brookfield) 25°C, 20 rpm	cP	4,000	6,500	10,000	21,000 (5 rpm)	12,500 (5 rpm)
Glass Transition Temperature (T_g)	°C	125	125	161	171	145
CTE Below T_g	ppm/°C	35	40	28	31	28
CTE Above T_g		131	–	104	65	80
Storage Modulus at 25°C	mPa	7,600	2,900	7,600	5,800	7,300
Recommended Cure		3 min. at 165°C	20 min. at 150°C	7 min. at 160°C	30 min. at 165°C	120 min. at 160°C



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