LOCTITE®

Thermal Management Materials

Henkel Excellence is our Passion

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INTRODUCTION

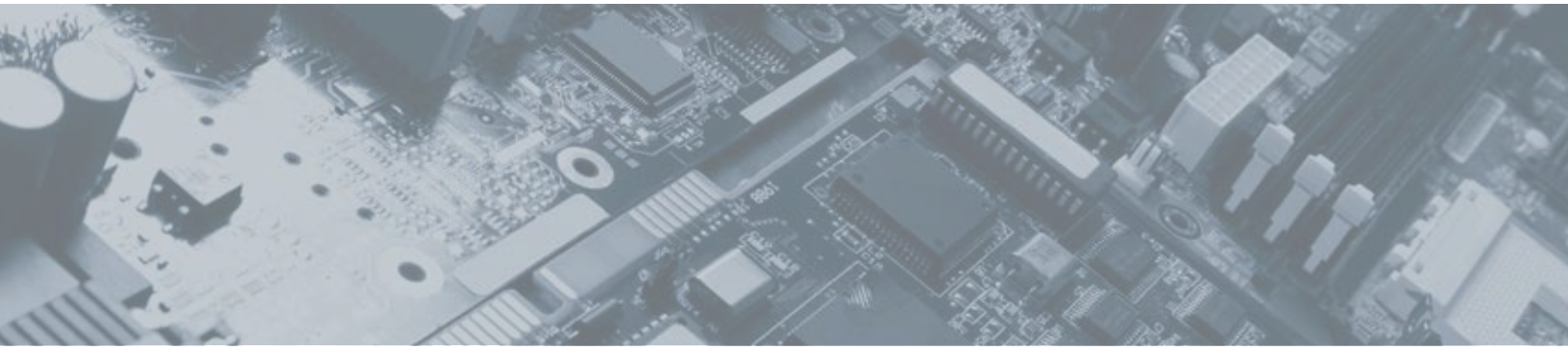
To address the thermal demands of today's electronic devices, Henkel has developed a complete portfolio of high-performance, user-friendly products. Effective control of heat is an increasing concern among today's electronic device manufacturers and, as products become smaller, the need to dissipate damaging heat effectively will be greater than ever.

Of course, each application is unique and its requirements specific, which is why Henkel has formulated a comprehensive range of thermal management materials to suit a variety of current and future heat control needs. Under the banner of the well-respected LOCTITE® brand, Henkel's thermal management materials include:

- Adhesive Films
- Adhesive Pastes
- Phase-Change Materials
- Thermal Absorbent Films
- Thermal Greases
- Thermal Pads

As consumer demand and product capability continue to drive greater function within ever-decreasing footprints, effectively controlling the thermal load will be critical to ensuring long product life cycles and expected reliability. That's why today's electronics manufacturers are increasingly turning to Henkel for trusted, proven thermal management solutions.

PRODUCT PORTFOLIO



Adhesive Films

Thermally Conductive

- LOCTITE® ABLESTIK 506
- LOCTITE® ABLESTIK 561K
- LOCTITE® ABLESTIK 563K

Electrically Conductive

- LOCTITE® ABLESTIK 5025E
- LOCTITE® ABLESTIK CF 3350
- LOCTITE® ABLESTIK ECF 561E

Adhesive Pastes

Shimming Pastes

Room-Temperature Cure

- LOCTITE® 315
- LOCTITE® 3873

Heat Cure

- LOCTITE® 5404
- LOCTITE® ABLESTIK QMI529HT
- LOCTITE® ABLESTIK QMI536HT

Non-Shimming Pastes

Room-Temperature Cure

- LOCTITE® 383
- LOCTITE® 384
- LOCTITE® 3874
- LOCTITE® ABLESTIK 2151

Heat Cure

- LOCTITE® ABLESTIK 8700K
- LOCTITE® ABLESTIK E 3503-1
- LOCTITE® ABLESTIK TE 3530

Phase-Change Materials

- LOCTITE® ECF 1000
- LOCTITE® EIF 1000
- LOCTITE® PSX 8
- LOCTITE® PSX 4000 Series
- LOCTITE® TCF 1000
- LOCTITE® TCP 7000

Thermal Absorbent Films

- LOCTITE® TAF Series

Thermal Greases

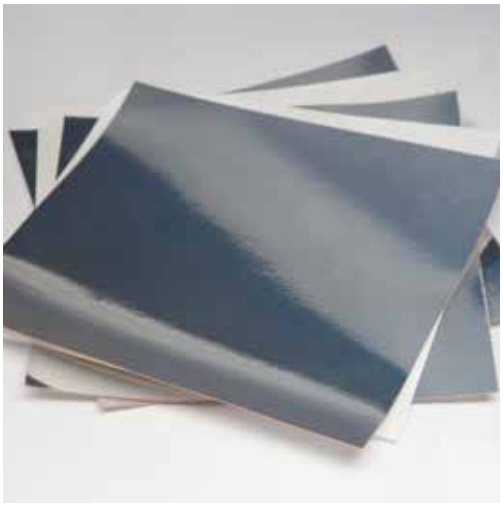
- LOCTITE® NSWC 100
- LOCTITE® TC 4
- LOCTITE® TC 8M
- LOCTITE® TCP 8175M1
- LOCTITE® TG 100

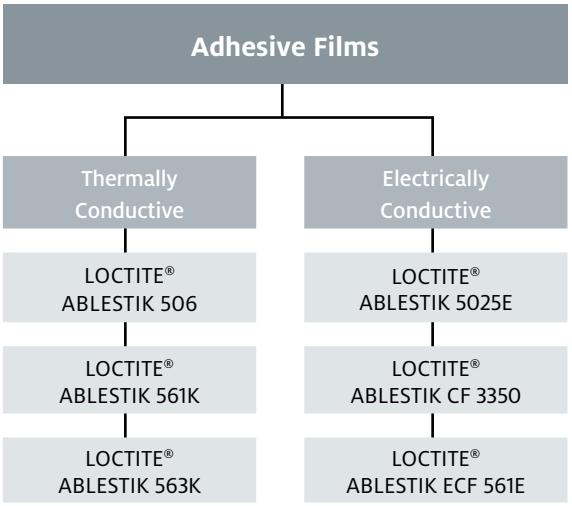
Thermal Pads

- LOCTITE® TFX 1000
- LOCTITE® TFX 1100
- LOCTITE® TFX 3000
- LOCTITE® TFX 3300

ADHESIVE FILMS

When there is a requirement for bonding large areas or complex parts together, thermal adhesive films are the preferred materials. Larger bonding areas are problematic for pastes and other liquid-based mediums, as voids may result; films, however, deliver uniform, void-free bondlines and controlled thicknesses. Supplied in custom, pre-cut formats, Henkel's line of thermal adhesive films offers a clean, waste-free, easily processed solution with a low total cost of ownership in thermally and electrically conductive formulas.





PRODUCT	DESCRIPTION	TENSILE STRENGTH LAP SHEAR (psi)	THERMAL CONDUCTIVITY (W/mK)	VOLUME RESISTIVITY (ohms-cm)	PRIMARY CURE CYCLE	SHELF LIFE	FILM THICKNESS AVAILABLE (mil)
Thermally Conductive							
LOCTITE® ABLESTIK 506	Flexible film adhesive designed for bonding mismatched CTE materials. Slight tack can simplify assembly.	1,200	0.9	7×10^{12}	1 hr. @ 150°C	6 months @ -40°C	4, 5, 6
LOCTITE® ABLESTIK 561K	High adhesion strength with excellent flexibility for bonding mismatched CTE materials.	3,300	0.9	9×10^{12}	30 min. @ 150°C	1 year @ -40°C	4, 5, 6
LOCTITE® ABLESTIK 563K	Electrically insulating film with high thermal conductivity and adhesion strength. Available either unsupported or with a fiberglass carrier.	3,000	1	1×10^{13}	30 min. @ 150°C	1 year @ -40°C	2, 3, 4, 5, 6
Electrically Conductive							
LOCTITE® ABLESTIK 5025E	Sister formulation to CF3350™ that has been certified to MIL-STD-883, Method 5011.	2,500	6.5	2×10^{-4}	30 min. @ 150°C	6 months @ 5°C	2, 3, 4, 5, 6
LOCTITE® ABLESTIK CF 3350	Silver-filled film with an excellent balance of adhesion strength, electrical and thermal conductivity, and processability. It is especially suited for RF applications.	3,400	7	2×10^{-4}	30 min. @ 150°C	9 months @ 5°C	2, 4
LOCTITE® ABLESTIK ECF 561E	Most flexible of the fiberglass-supported, electrically conductive products.	2,000	1.6	6.0×10^{-3}	1 hr. @ 150°C	1 year @ -40°C	4, 5, 6

ADHESIVE PASTES

Henkel's adhesive pastes provide robust mechanical attachment, allowing for the elimination of fasteners such as screws and clips, which also helps reduce device size and weight to align with the trend toward electronics miniaturization. With the ability to maintain thin bondlines and excellent thermal paths, LOCTITE® brand adhesive pastes provide superb thermal management.

PRODUCT	DESCRIPTION	MIL STANDARD 883, METHOD 5011 APPROVED	NASA OUTGASSING ASTM E 595-77/84/90 APPROVED	CURE TYPE	CURE SCHEDULES	VISCOSITY (cP)	THERMAL CONDUCTIVITY (W/mK)	VOLUME RESISTIVITY (ohms-cm)	SHELF LIFE
Shimming – Room-Temperature Cure									
LOCTITE® 315*	A self-shimming, thermally conductive, one-part adhesive for bonding electrical components to heat sinks with an insulating gap.	—	—	Activator (7387) or heat	24 to 72 hrs. @ 20°C	600,000	0.81	1.3 X 10^{12}	9 months @ 5°C
LOCTITE® 3873*	Self-shimming: use with activator 7387. High bonding strength for heat sink application.	—	—	Activator (7387) or heat	24 to 72 hrs. @ 20°C	200,000	1.25	4.3 X 10^{14}	21 months @ 5°C
Shimming – Heat Cure									
LOCTITE® 5404	Self-shimming, flexible silicone adhesive for high-temperature-resistant applications such as ceramic boards.	—	—	Heat	10 min. @ 150°C	Paste	1.0	2.9 X 10^{14}	5 months @ 5°C
LOCTITE® ABLESTIK QMI529HT	High thermal, electrically conductive, silver-filled adhesive.	—	—	Heat	Snap Cure (single zone): 60 sec. @ 185°C. Oven cure: 30 min. @ 185°C	18,500	6	4 X 10^{-5}	12 months @ -40°C
LOCTITE® ABLESTIK QMI536HT	Boron nitride-filled, non-electrically conductive paste.	—	—	Heat	≥8 sec. @ 150°C (SkipCure) 15 min. @ 150°C (oven)	13,000	0.9	1.0 X 10^{13}	12 months @ -40°C
Non-Shimming – Room-Temperature Cure									
LOCTITE® 383*	High-strength, room-temperature curing adhesive for permanent assemblies.	—	—	Activator (7387) or heat	24 to 72 hrs. @ 20°C	500,000	0.6	5.2 x 10^{11}	9 months @ 5ºC
LOCTITE® 384*	Repairable, room-temperature curing adhesive utilized for parts subject to disassembly.	—	—	Activator (7387) or heat	24 to 72 hrs. @ 20°C	100,000	0.76	1.3 X 10^{12}	9 months @ 5ºC
LOCTITE® 3874*	Fast curing, high conductivity for bonding heat-generating devices to thermal spreader "without glass beads."	—	—	Activator (7387) or heat	24 to 72 hrs. @ 20°C	800,000	1.25	4.3 X 10^{14}	9 months @ 5ºC
LOCTITE® ABLESTIK 2151	Thermally conductive, electrically insulating adhesive.	—	Yes	Room Temp. or heat	24 hrs. @ 25°C	40,000	0.95	2.1 X 10^{15}	6 months @ 25ºC
Non-Shimming – Heat Cure									
LOCTITE® ABLESTIK 8700K	Mil standard certified, one-component, thermally conductive epoxy adhesive.	Yes	Yes	Heat	60 min. @ 175°C 2 hrs. @ 160ºC	45,000	0.5	3.0 X 10^{14}	9 months @ -40°C
LOCTITE® ABLESTIK E 3503-1	Smooth paste assuring minimum bondline thickness for lower overall thermal resistance.	—	—	Heat	30 min. @ 100°C 10 min. @ 120°C 5 min. @ 150°C	60,000	1	1.0 X 10^{14}	6 months @ -18°C to -25°C
LOCTITE® ABLESTIK TE 3530	One-component, low-temperature curing, thermally conductive epoxy adhesive.	—	—	Heat	30 min. @ 100°C	60,000	2.3	1.0 X 10^{15}	6 months @ -18°C to -25°C

*Product requires LOCTITE® 7387 Activator for room-temperature cure. Higher-temperature cure does not require activator.

The broad portfolio of pastes is available with shimming for controlled bondlines and optimized adhesive performance, or in non-shimming formulas for optimized thermal performance. To accommodate various manufacturing requirements, thermal or room-temperature cure mechanisms are offered. Like all Henkel thermal materials, the complete line of adhesive pastes is RoHS compliant.

Adhesive Pastes

Shimming Pastes

Room-Temperature Cure

- LOCTITE® 315*
- LOCTITE® 3873*

Heat Cure

- LOCTITE® 5404
- LOCTITE® ABLESTIK QMI529HT
- LOCTITE® ABLESTIK QMI536HT

Non-Shimming Pastes

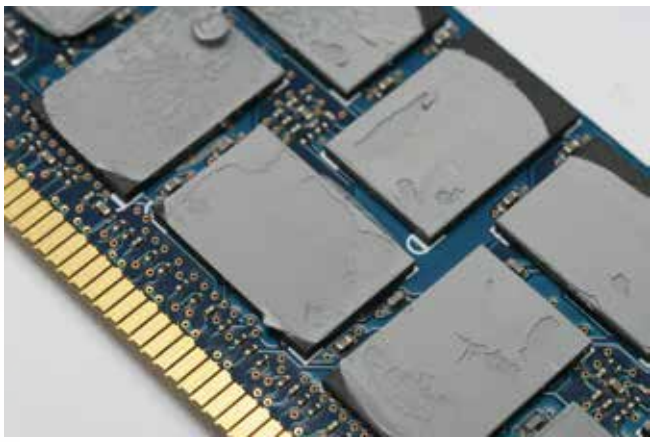
Room-Temperature Cure

- LOCTITE® 383*
- LOCTITE® 384*
- LOCTITE® 3874*
- LOCTITE® ABLESTIK 2151

Heat Cure

- LOCTITE® ABLESTIK 8700K
- LOCTITE® ABLESTIK E 3503-1
- LOCTITE® ABLESTIK TE 3530

PRODUCT	DESCRIPTION
Thermally Conductive Activator	
LOCTITE® 7387	Activator used in combination with LOCTITE® brands 315*, 383*, 384*, 3873*, and 3874*.



PHASE-CHANGE MATERIALS

Ideal for high-performance solid-state devices such as CPUs, GPUs, IGBTs and discrete components, LOCTITE® phase-change films deliver on-demand performance with none of the drawbacks of traditional greases. These materials are solid at room temperature, but melt and flow during device operation to provide a thin bondline and high reliability without the "pump-out" often experienced with some thermal greases. The need for effective heat dissipation is critical for power modules. Henkel's LOCTITE® TCP thermal interface material is incorporated at the design phase to ensure reliable performance over the long term and significantly reduces contact resistance between the metal area on the power semiconductor and heat sink. The material can be screen printed to control for specific patterns and thicknesses to accommodate specific applications.

Phase-Change Materials

- LOCTITE® ECF 1000
- LOCTITE® EIF 1000
- LOCTITE® PSX 8
- LOCTITE® PSX 4000 SERIES
- LOCTITE® TCF 1000
- LOCTITE® TCP 7000

PRODUCT	DESCRIPTION	THERMAL IMPEDANCE (°C-in.²/W @ 80 psi)	THERMAL IMPEDANCE (°C-in.²/W @ 550 kPa)	THERMAL CONDUCTIVITY (W/mK)	PHASE-CHANGE TEMP. (°C)	VOLUME RESISTIVITY (ohms-cm)	DIELECTRIC STRENGTH (V/mil)	THICKNESS (In.)
Phase-Change Materials								
LOCTITE® ECF 1000	Excellent thermal performance, particularly at higher pressures. Typically used on RF devices and SCRs where electrical conductivity is required (silver filled).	0.003	0.022	3.14	51	2	N/A	0.004
LOCTITE® EIF 1000	Industry-standard electrically insulating phase-change material.	0.12	0.78	0.45	60	N/A	4,500 minimum	0.002 to 0.006
LOCTITE® PSX 8	Unsupported film with superior thermal performance even at low pressure. Direct attach to heat sink at room temperature without adhesive.	0.003	0.022	3.4	45	N/A	N/A	0.008
LOCTITE® PSX 4000 SERIES (D, PM, PE, LV)	Repeatable phase-change thermal interface material. Supplied as a paste that can be stenciled, needle dispensed, screen printed, or applied manually onto a heat sink, base plate or other surfaces.	0.003	0.022	3.4	45	N/A	N/A	0.0005 to 0.010+
LOCTITE® TCF 1000	Industry-standard, phase-change thermal interface material. Suitable for power IGBTs, semiconductors, DC-DC converters and other electrically isolated packages.	0.022	0.143	1	60	1.0×10^{12}	N/A	0.0025 to 0.008
LOCTITE® TCP 7000	Silicone-free, reworkable phase-change material designed for high-temperature reliability in power electronics and high-power amplifiers. Applied by screen printing or stenciling.	0.024	N/A	3	45	N/A	N/A	printable / varies

THERMAL ABSORBENT FILMS

Henkel's LOCTITE® TAF series product line consists of market-first thermal absorbent film materials that effectively absorb, spread, insulate and conduct IC-generated heat that is often the cause of high skin temperature in consumer handheld devices. Not only do the materials absorb thermal energy, they also have insulation and controlled directional thermal conductivity to reduce skin temperature. With unique properties that enable the material to be dynamic, LOCTITE® TAF series films regulate heat and the inherent temperature rise and fall of CPU processing. Contourability and application-specific thicknesses make the LOCTITE® TAF series of thermal absorbent films ideal for high-density, space-limited applications.

PRODUCT	DESCRIPTION	DENSITY (g/cc)	HEAT OR FUSION (J/g)	THERMAL CONDUCTIVITY (W/mK)	THICKNESS RANGE (mm)	SUBSTRATE TYPE	SUBSTRATE THICKNESS RANGE (mm)	FINAL PRODUCT THICKNESS RANGE (in.)
Thermal Absorbent Films								
LOCTITE® TAF SERIES	Heat-absorbing material designed to reduce the skin temperature of mobile electronic devices. It can effectively absorb, spread, insulate and slowly dissipate thermal energy generated by ICs, allowing the device to maintain a lower skin temperature.	0.36 to 0.64	115 to 205	0.1	0.012 to 0.15	Cu or Al	0.012 to 0.10	0.047 to 3.0

THERMAL GREASES

For manufacturers with a preference for traditional thermal greases, Henkel has several RoHS-compliant formulations. Used in high-performance applications where minimal bondline thickness is essential for high thermal performance, greases offer immediate functionality upon application. In addition, greases have a tendency to compensate for voids easily, so they are a particularly viable solution for devices that have flatness or coplanarity issues. Available in cartridges or bulk containers, Henkel's thermal greases include high-performance, high-temperature reliability, silicone-free and water-cleanable formulas.

Thermal Greases

- LOCTITE® NSWC 100
- LOCTITE® TC 4
- LOCTITE® TC 8M
- LOCTITE® TCP 8175M1
- LOCTITE® TG 100

PRODUCT	DESCRIPTION	THERMAL CONDUCTIVITY (W/mK)	VOLUME RESISTIVITY (ohms-cm)	DIELECTRIC STRENGTH (V/mil)	THICKNESS (in.)
Thermal Greases					
LOCTITE® NSWC 100	Non-silicone, water-cleanable thermal compound.	1.4	1.9×10^{15}	250 minimum	0.0005 to 0.010+
LOCTITE® TC 4	Thermally conductive, high-temperature silicone thermal grease.	1.5	1×10^{13}	500	0.0005 to 0.010+
LOCTITE® TC 8M	High thermal conductivity, high-temperature thermal grease.	2.3	1×10^{13}	500	0.0005 to 0.010+
LOCTITE® TCP 8175M1	High thermal conductivity, high-temperature stability, high thixo (or non-sag), electrically insulating, self-shimming silicone thermal grease.	2.3	1.00×10^{15}	480	7 mil spacers
LOCTITE® TG 100	Ultra-high-performance thermal grease.	3.4	N/A	N/A	0.0005 to 0.010+

THERMAL GAP PADS

Henkel's latest innovation, thermal gap pads, is a solution for mechanical offset applications found in almost every electronic device. Designed in a range of thicknesses and thermal conductivity capabilities, LOCTITE® thermal gap pads have been developed to address specific heat processing needs. The LOCTITE® TFX product line, for example, is designed to provide a high level of compliance or softness and is available in thermal conductivity performance that ranges from 1 to 3.3 W/mK. All Henkel thermal gap pads comply with RoHS and are available in 200 mm x 300 mm sheets with a range of thicknesses from 0.3 mm to 5.5 mm. Customers may also select specific die-cut pads directly from Henkel or from Henkel distribution partners.

PRODUCT	DESCRIPTION	COLOR	THERMAL CONDUCTIVITY (W/mK)	HARDNESS (SHORE 00)	THICKNESS RANGE
Thermal Gap Pads					
LOCTITE® TFX 1000	Soft silicone-based elastomer sheets with ceramic fillers to increase thermal conductivity.	Grey	1.0	52	0.3 mm to 5.5 mm (custom thicknesses available)
LOCTITE® TFX 1100		Green	1.1	43	
LOCTITE® TFX 3000		Purple	3.0	42	
LOCTITE® TFX 3300		Yellow	3.3	33	

Thermal Gap Pads

- LOCTITE® TFX 1000
- LOCTITE® TFX 1100
- LOCTITE® TFX 3000
- LOCTITE® TFX 3300

LOCTITE®

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