Technical Data Sheet

LOCTITE® 3593

September 2012

PRODUCT DESCRIPTION

LOCTITE® 3593 provides the following product characteristics:

Technology	Epoxy
Chemical type	Epoxy
Appearance (uncured)	Black liquid
Components	One component - requires no mixing
Cure	Heat cure
Application	Underfill
Dispense method	Syringe
Key substrates	Electronic components
Specific benefits	Process speed
Reworkable	No

LOCTITE® 3593 is a rapid curing, fast flowing, liquid epoxy designed for use as a capillary flow underfill for chip size packages. It is designed for production where process speed is a key concern. Its rheology is designed to allow it to penetrate gaps as small as 25 µm. LOCTITE® 3593 is easily dispensed, minimizes induced stress, provides improved temperature cycling performance and has excellent chemical resistance.

TYPICAL PROPERTIES OF UNCURED MATERIAL

Specific gravity @ 25°C	1.18
VOC, ASTM D 3960, g/l	<1
Moisture content, ASTM D 4017, %	<0.11
Total volatile content, ASTM D 2369, %	0.12
Filler content, %	0
Viscosity, Cone & Plate, 25°C, mPa·s (cP):	
Shear rate $5s^{-1}$	3,500 - 6,500
Shear rate $20s^{-1}$	4,500 - 6,000
Capillary flow rate, seconds	
Flow time, 100°C, glass to glass, 25 µm:	
6.35 mm flow	≤10
12.7 mm flow	≤30
25.4 mm flow	≤70
Pot life @ 22°C, days	7
Flash point - see SDS	

Recommended cure schedule

3 minutes @ 165°C
5 minutes @ 150°C

Note: With all fast cure systems, the time required for cure depends on the rate of heating. Conditions where a hot plate or heat sink is used are optimum for fastest cure. Cure rates depend on the mass of material to be heated and intimate contact with the heat source. Use suggested cure conditions as general guidelines. Other cure conditions may yield satisfactory results.

TYPICAL PROPERTIES OF CURED MATERIAL

Cured for 1 hour @ 150°C

Physical properties

Coefficient of thermal expansion, ASTM E 831, K^{-1}:		
Pre Tg (Alpha 1)		50×10^{-6}
Post Tg (Alpha 2)		160×10^{-6}
Glass transition temperature, ASTM D 3418, °C		110
Water absorption, ISO 62, %		
2 hours in boiling water		<2
24 hours in water @ 22°C		<1
Coefficient of thermal conductivity ASTM F 433, W/(m-K)		0.21
Extractable ionic content, µg/g		
Sodium (Na+)		<2
Potassium (K+)		<1
Chloride (Cl-)		<45
Shore hardness, Durometer D, ISO 868		88
Volumetric shrinkage, ASTM D 792, %		<5
Elongation, ISO 527, %		2
Tensile strength, ISO 527	N/mm^2 ((psi))	41 (6,000)
Tensile modulus, ISO 527	N/mm^2 ((psi))	2,000 (300,000)

Electrical properties

Dielectric breakdown strength, IEC 60243-1, kV/mm	29
Volume resistivity, IEC 60093, Ω.cm	$>90 \times 10^{15}$
Surface resistivity, IEC 60093, Ω	$>9 \times 10^{15}$
Dielectric constant / Dissipation factor, IEC 60250	
1 kHz	3.5 / 0.01
101 kHz	3.5 / 0.07
100 kHz	3.4 / 0.015

TYPICAL CURING PERFORMANCE

Adhesion properties

Cured for 10 minutes @ 165°C, tested @ 22°C

Lap shear strength, ISO 4587

Epoxyglass	N/mm^2 (psi)	≥8 (≥1,160)

GENERAL INFORMATION

Please consult the Safety Data Sheet (SDS) for safe handling information of this product.

Handling information

Receiving cold shipments:

- All shipping boxes are packed with cold gel packs to maintain temperature below 8°C during transit.

Temperature equilibration:

- A new package of material can be brought to ambient conditions by allowing to stand at room temperature (22 ± 2°C) for 1 to 2 hours (actual time required will vary with package size/volume).
- Do not loosen container lids, caps or covers: syringe packs must be allowed to equilibrate in tip down orientation.
- Heat must never be used as partial polymerization (curing) could occur

DIRECTIONS FOR USE

Load product into dispensing equipment. A variety of application equipment types are suitable and include: hand dispense / time pressure valve; auger style valve; linear piston pump and jet valve. Selection of equipment should be determined by application requirements - for advice on equipment selection and process optimization, users should contact their Technical Service Center.

1. Ensure that air is not introduced to product during equipment set-up.
2. For best results, the substrate should be pre-heated (typically to 90 to 100°C for about 20 seconds) to allow fast capillary flow and facilitate leveling. The dispense nozzle may also be pre-heated (30 to 50°C maximum) to further increase capillary flow.
3. Dispense product at moderate speed (2.5 to 12.7 mm/s). Ensure that needle tip is about 0.025 to 0.076 mm from substrate surface and from chip edge - this will ensure optimal flow conditions for the Underfill.
4. The dispense pattern is typically "I" along one side or "L" pattern along two sides, focused at the corner. Application should start at the location furthest away from the chip center - this helps ensure a void free fill underneath the die. Each leg of the "L" or "I" pattern should not exceed 80% of the length of each die edge being dispensed.
5. In some cases second or third application of product may be necessary.

For cleanup

Wipe the surface using a cotton swab soaked with a suitable solvent (e.g. LOCTITE® 7360™ or acetone). Repeat this step with a clean dry cotton swab.

Do not return product to refrigerated storage; any surplus product should be discarded.

Not for product specifications

The technical data contained herein are intended as reference only. Please contact your local quality department for assistance and recommendations on the specifications of this product.

Storage

Store product in the unopened container in a dry location. Storage information may be indicated on the product container labeling.

Optimal Storage: 2 to 8°C. Storage below 2°C or greater than 8°C can adversely affect product properties.

Material removed from containers may be contaminated during use. Do not return product to the original container. Henkel cannot assume responsibility for product which has been contaminated or stored under conditions other than those previously indicated. If additional information is required, please contact your local Henkel representative.

Conversions

(°C x 1.8) + 32 = °F
kV/mm x 25.4 = V/mil
mm / 25.4 = inches
µm / 25.4 = mil
N x 0.225 = lb
N/mm x 5.71 = lb/in
N/mm^2 x 145 = psi
MPa x 145 = psi
N·m x 8.851 = lb·in
N·m x 0.738 = lb·ft
N·mm x 0.142 = oz·in
mPa·s = cP

Disclaimer

The information provided in this Technical data sheet (TDS) including the recommendations for use and application of the product are based on our knowledge and experience of the product as at the date of this TDS. The product can have a variety of different applications as well as differing application and working conditions in your environment that are beyond our control. Henkel is, therefore, not liable for the suitability of our product for the production processes and conditions in respect of which you use them, as well as the intended applications and results. We strongly recommend that you carry out your own prior trials to confirm such suitability of our product. Any liability in respect of the information in the Technical data sheet or any other written or oral recommendation(s) regarding the concerned product is excluded, except if otherwise explicitly agreed and except in relation to death or personal injury caused by our negligence and any liability under any applicable mandatory product liability law.

In case products are delivered by Henkel Belgium NV, Henkel Electronic Materials NV, Henkel Nederland BV, Henkel Technologies France SAS and Henkel France SA please additionally note the following:

In case Henkel would be nevertheless held liable, on whatever legal ground, Henkel's liability will in no event exceed the amount of the concerned delivery.

In case products are delivered by Henkel Colombiana, S.A.S. the following disclaimer is applicable:
The information provided in this Technical Data Sheet (TDS) including the recommendations for use and application of the product are based on our knowledge and experience of the product as at the date of this TDS. Henkel is, therefore, not liable for the suitability of our product for the production processes and conditions in respect of which you use them, as well as the intended applications and results. We strongly recommend that you carry out your own prior trials to confirm such suitability of our product. Any liability in respect of the information in the Technical Data Sheet or any other written or oral recommendation(s) regarding the concerned product is excluded, except if otherwise explicitly agreed and except in relation to death or personal injury caused by our negligence and any liability under any applicable mandatory product liability law.

In case products are delivered by Henkel Corporation, or Henkel Canada Corporation, the following disclaimer is applicable:
The data contained herein are furnished for information only and are believed to be reliable. We cannot assume responsibility for the results obtained by others over whose methods we have no control. It is the user's responsibility to determine suitability for the user's purpose of any production methods mentioned herein and to adopt such precautions as may be advisable for the protection of property and of persons against any hazards that may be involved in the handling and use thereof. In light of the foregoing, **Henkel Corporation specifically disclaims all warranties expressed or implied, including warranties of merchantability or fitness for a particular purpose, arising from sale or use of Henkel Corporation's products. Henkel Corporation specifically disclaims any liability for consequential or incidental damages of any kind, including lost profits.** The discussion herein of various processes or compositions is not to be interpreted as representation that they are free from domination of patents owned by others or as a license under any Henkel Corporation patents that may cover such processes or compositions. We recommend that each prospective user test his proposed application before repetitive use, using this data as a guide. This product may be covered by one or more United States or foreign patents or patent applications.

Trademark usage
Except as otherwise noted, all trademarks in this document are trademarks of Henkel Corporation in the U.S. and elsewhere. ® denotes a trademark registered in the U.S. Patent and Trademark Office.

Reference 1