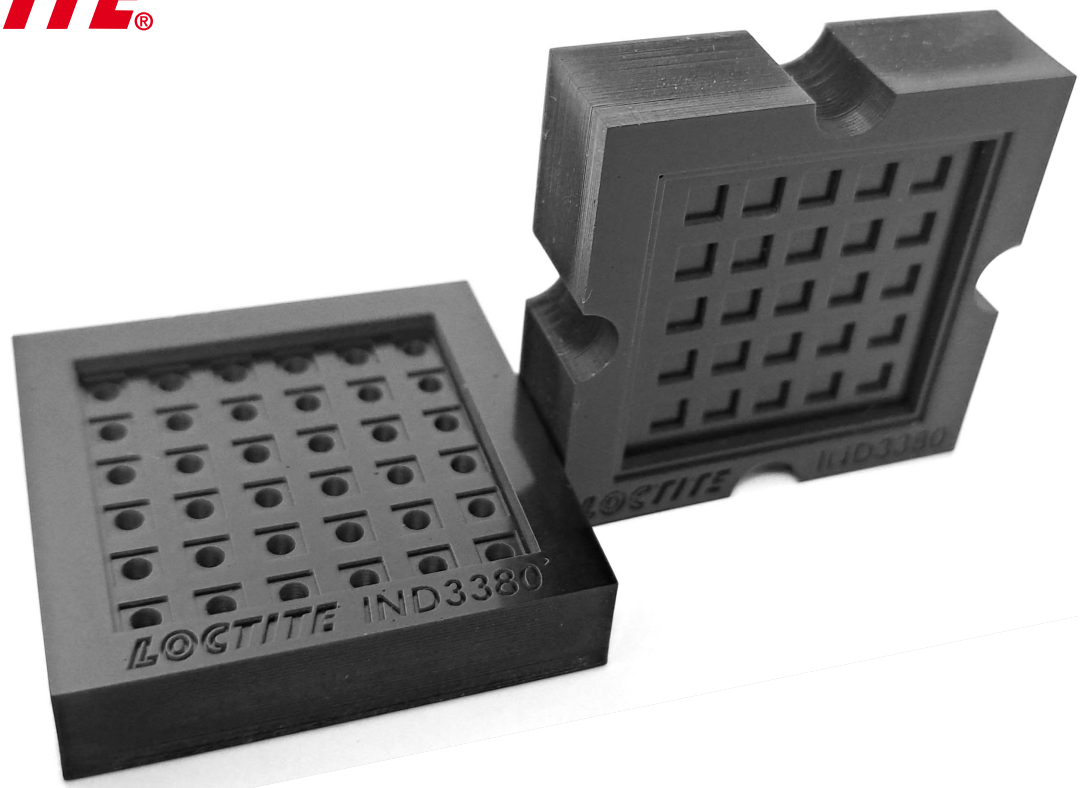
LOCTITE®



LOCTITE 3D IND3380™

ESD
Black

LOCTITE®
Henkel Corporation
loctite3d@henkel.com

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LOCTITE 3D IND3380™

LOCTITE 3D IND3380 is a high temperature resistant resin with HDT of 190°C, electrostatic dissipative properties (ESD), and high stiffness.

LOCTITE 3D IND3380 offers a smooth surface finish and high chemical resistance, making it an ideal choice for jigs and fixtures in general and electronic manufacturing. Additionally, its unique characteristics make it a reliable option for tooling applications, offering versatile solutions for manufacturing needs.

LOCTITE 3D IND3380 is compatible with a broad range of DLP and LCD machines.

Benefits:

- Displays electrostatic dissipative properties (ESD)
- High HDT of 190°C
- High accuracy and fine detail printing

Ideal for:

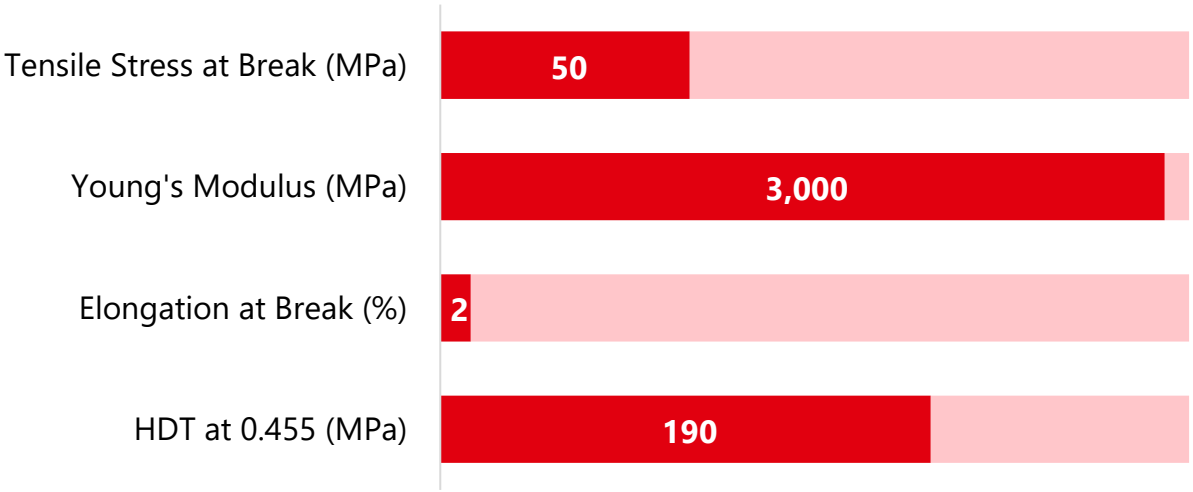
- Tooling at high temperature, low pressure
- Jigs and fixtures for electronic device manufacturing processes

Markets:

Industry

Consumer Goods

Automotive



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PROPERTIES

Mechanical Properties	Measure	Method	Green	Post Processed
Young's Modulus	MPa	ASTM D638	1300 – 1500	2800 – 3000 [1]
Tensile Stress at Break	MPa	ASTM D638	25 – 30	40 – 50 [1]
Elongation at Break	%	ASTM D638	2 – 3	1 – 2 [1]
Flexural Modulus	MPa	ASTM D790	1250 – 1350	3200 – 3400 [2]
Flexural Strength	MPa	ASTM D790	40 – 50	75 – 85 [2]
Flexural Strain at Break	%	ASTM D790	3.0 – 4.3	2.0 – 2.8 [2]
IZOD Impact (Notched)	J/m	ASTM D256		11.5 – 12.5 [3]
Shore Hardness (3s)	D	ASTM D2240		86.5 [4]
Other Properties				
HDT at 0.455 MPa	°C	ASTM D648		180 – 190 [5]
HDT at 1.82 MPa	°C	ASTM D648		100 – 110 [5]
Water Absorption (24 hr)	%	ASTM D570		0.36 [6]
Water Absorption (72 hr)	%	ASTM D570		0.59 [6]
Solid Density	g/cm^3	ASTM D1475		1.20 – 1.25 [7]
Thermal Conductivity	W/(m·K)	ASTM D5930		0.2 [8]
Heat Capacity	J/(g·K)	ASTM D5930		1.4 [8]
CTE (5°C to 60°C)	µm/(m·K)	ASTM E831		97.9 [9]
CTE (60°C to 120°C)	µm/(m·K)	ASTM E831		143.3 [9]
CTE (120°C to 200°C)	µm/(m·K)	ASTM E831		202.6 [9]

Test Parameters:
All specimen are printed unless otherwise noted. All specimen were conditioned in ambient lab conditions at 19-23°C / 40-60% RH for at least 24 hours. D638-14 Type IV, 5 mm/min; D790-17 Method B, 1.5 mm/min; D648-18 Method A; D256-10 (18) - Machine Notched, 6 mm x 12 mm, 2.75 J Striker; D570-98 (18) - 0.125" x 2" Disc , 24hr @ 25°C; D2240-15 (21); D7867-13 (20); D1475-13 (20)

Internal Data Sources
[1] GEN492458, [2] GEN492508, [3] FOR503640, [4] FOR504329, [5] GEN492558, [6] FOR735613, [7] FOR512821, [8] FOR515717, [9] FOR735905

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PROPERTIES

Liquid Properties	Measure	Method	Value
Viscosity at 25°C (77°F)	cP	ASTM D7867	11,500 – 13,300 [1]
Liquid Density	g/cm³	ASTM D1475	1.1 – 1.2 [2]

Electrical Properties	Measure	Method	Green	Post Processed
Surface Resistivity	Ω	DIN EN61340-2-3		10^4 – 10^{11} [3]
Volume Resistivity	Ω·cm	DIN EN61340-2-3		$4 \cdot 10^6$ – $24 \cdot 10^6$ [4]

Test Parameters:
All specimen are printed unless otherwise noted. All specimen were conditioned in ambient lab conditions at 19-23°C / 40-60% RH for at least 24 hours. D638-14 Type IV, 5 mm/min; D790-17 Method B, 1.5 mm/min; D648-18 Method A; D256-10 (18) - Machine Notched, 6 mm x 12 mm, 2.75 J Striker; D570-98 (18) - 0.125" x 2" Disc , 24hr @ 25°C; D2240-15 (21); D7867-13 (20); D1475-13 (20); ASTM D7867 Viscosity Brookfield (Spindle) at 1 RPM;

Internal Data Sources:
[1] GEN793151, [2] FOR415604,[3] FOR504358, [4] FOR501814

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WORKFLOW

Validated workflows need to be followed to achieve properties as provided in the TDS. Examples of validated workflow steps are listed below. Users should defer to the most current workflow information for best results which can be found at https://www.loctiteam.com/printer-validation-settings

PRINTER SETTINGS

LOCTITE 3D IND3380 BK is formulated to print optimally on industrial DLP printer. Read the safety data sheet carefully to get details about health and safety instructions. Recommended print parameters:

- Shake gently to prevent foaming
- Print Temperature: 20°C to 45°C
- Intensity: 5 mW/cm² to 10 mW/cm²

Settings: 385nm at 5mW/cm²	Measure	Method	Value
Layer Thickness	µm	Internal	100
Burn-In region	s	Internal	40-50
Transition region	s	Internal	15-25
Model region	s	Internal	7-8

Settings: 385nm at 5mW/cm²	Measure	Method	Value
E_C	mJ/cm²	Internal	4.9[1]
D_P	mm	Internal	0.09 [1]

Settings: 385nm at 5mW/cm²	Measure	Method	Exposure time
D_C = 50µm	s	Internal	1.7
D_C = 100µm	s	Internal	2.9

Test parameters:
Exposure times are calculated without a safety factor

Internal Data Source:
[1] FOR414287

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WORKFLOW

Validated workflows need to be followed to achieve properties as provided in the TDS. Examples of validated workflow steps are listed below. Users should defer to the most current workflow information for best results which can be found at https://www.loctiteam.com/printer-validation-settings

CLEANING

LOCTITE 3D IND3380 BK requires post processing to achieve specified properties. Prior to post curing, support structures should be removed from the printed part, and the part should then be washed. Use compressed air to remove residual solvent from the surface of the material between intervals.

Post Process Step	Agent	Method	Duration	Intervals	Additional Info
Cleaning Step	IPA	Ultrasonic	2 min	1 or 2	Allow parts to dry
Dry	n.a.	Compressed air	10 to 60 s	1 or 2	Air pressure (50 psi)
Wait before post curing	n.a.	Ambient condition	60 min	1	Room temperature

POST CURING

LOCTITE 3D IND3380 BK requires a two-step post curing to achieve specified properties. In the first step it is recommended that either an LED or wide spectrum lamp be used to UV post cure parts. In the second step the UV post cured parts require an additional Heat post cure to achieve final properties.

STEP 1: UV post cure

UV Curing Unit	UV Source	Intensity	Cure time per side	Additional Settings (Shelf, Output Energy)
Dymax 5000 EC Flood	Mercury Arc Bulb (broad spectrum)	148 mW/cm^2 at 380 nm	10 min	400W, Shelf K
Loctite CL36	405nm LED	80 mW/cm^2 at 405 nm	30 min	100% top & side
Rapidshape RS Cure XL	Multiple LEDs	150%	30 min	Third shelf from bottom

WORKFLOW

Validated workflows need to be followed to achieve properties as provided in the TDS. Examples of validated workflow steps are listed below. Users should defer to the most current workflow information for best results which can be found at https://www.loctiteam.com/printer-validation-settings

POST CURING

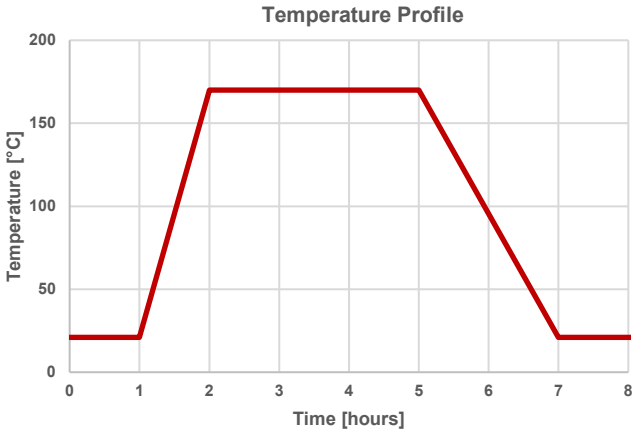
LOCTITE 3D IND3380 BK requires a two-step post curing to achieve specified properties.

STEP 2: Heat post cure

After UV post curing, an additional Heat post cure at 170°C for 3 hours is required to reach final properties. Let parts rest one hour between UV post cure and Heat post cure.

To minimize risk of warpage place parts in the oven at standard lab conditions with T_{start} = 22°C before ramping temperature with are rate of $R_T \leq 5$°C/min to target value of T_{cure} = 170°C.

After 3 hours at T_{cure} = 170°C cool down parts slowly in the switched off oven to standard lab conditions with T_{end} = 22°C . Do not remove the parts from the oven before they reached lab temperature to prevent thermal stress and warpage.



WORKFLOW

Validated workflows need to be followed to achieve properties as provided in the TDS. Examples of validated workflow steps are listed below. Users should defer to the most current workflow information for best results which can be found at https://www.loctiteam.com/printer-validation-settings

STORAGE

Store LOCTITE 3D IND3380 BK in the unopened container in a dry location. Optimal storage: 20°C to 30°C, storage below 20°C or greater than 30°C can adversely affect products properties. More specific information is given in the Safety Data Sheet.

ESD PROPERTIES

LOCTITE 3D IND3380 BK provides ESD properties with a surface resistivity in the range of $10^4\Omega$ to $10^{11}\Omega$ accordingly to DIN EN61340-2-3.

The exact value of the surface resistivity depends on the print orientation and part geometry. Please note that the burn-in region can show higher surface resistivity outside of the ESD range. Due to that we recommend to print with parts on supports or to adjust the print orientation accordingly to ensure that the printed part provides ESD properties at the desired surface.

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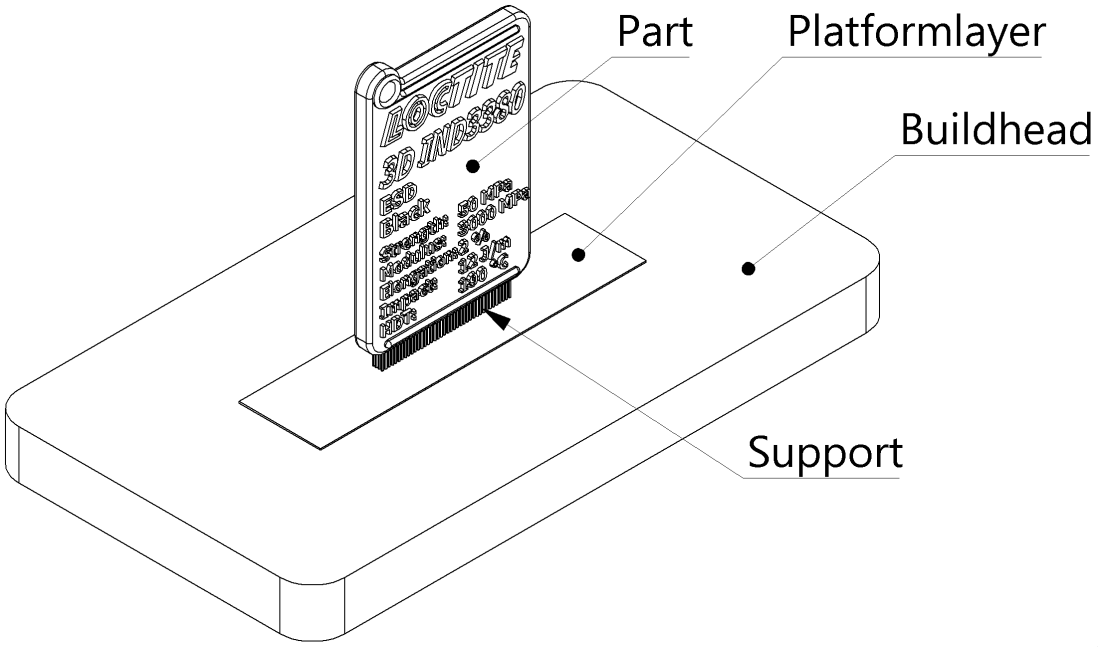
TIPS & TRICKS

This section is a collection of useful advices, guides, and recommendations designed to help users of the LOCTITE 3D IND3380 BK deal with specific process tasks more efficiently.

PRINT ORIENTATION

To enhance the buildhead adhesion of LOCTITE 3D IND3380 BK, it is recommended to use an initial platform layer. The required part should be attached to this layer using supports. The burn-in region, which will be the initial platform layer, can be discarded afterwards. This also ensures that the printed part provides the desired ESD performance since the burn-in region can show higher surface resistivity outside of the ESD range.

The part should be orientated to have the smallest possible cross-sectional area in the z-direction to minimize detachment forces during the print process.



POSTPROCESSING

For complex geometries, such as those containing internal channels, it has proven beneficial to dry the components in an oven for 45min@60°C after the cleaning process, prior to UV curing. This ensures that the IPA is completely evaporated, preventing any adverse effects on the mechanical properties during post-curing processes.

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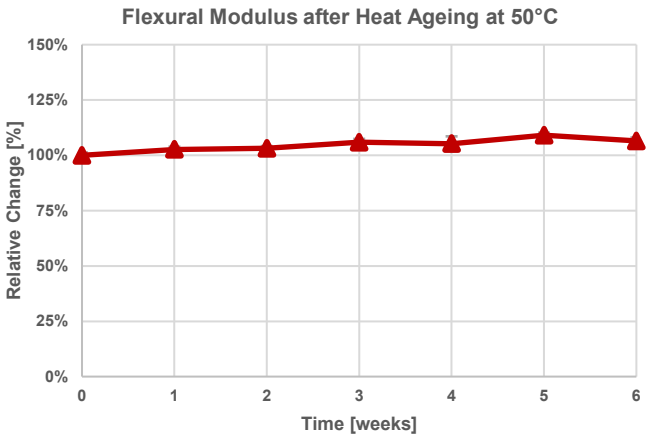
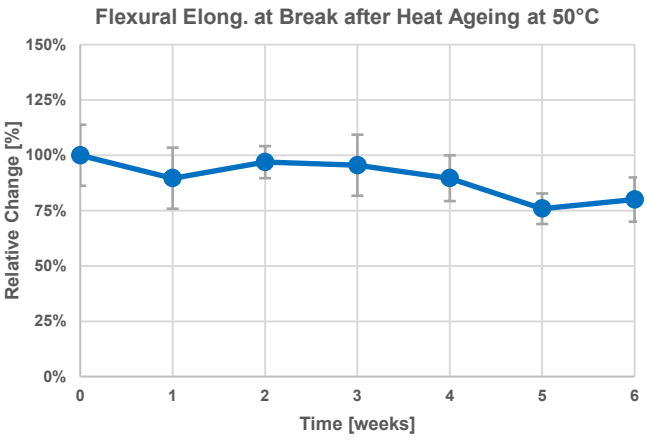
AGEING AND ENVIRONMENTAL EFFECTS – HEAT AGEING

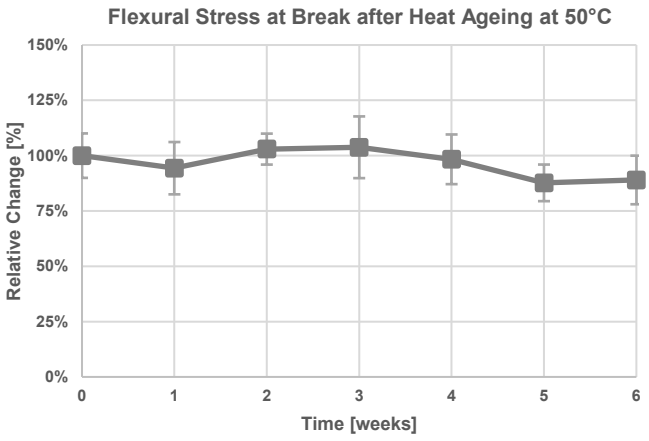
LOCTITE 3D IND3380 BK was heat aged without load according to ASTM D3045. Test samples were exposed for a defined time at 50°C and conditioned for 24 hours at 22°C before mechanical testing. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D790 at standard lab conditions (22°C).

"0 weeks" represents non-aged samples stored at 22°C and tested 24 hours after post-processing.

Based on temperature dependence of reaction rates a test time of 6 weeks at 50°C can be interpreted as approximately 12 months at ambient temperature.







Test parameters:
ASTM D790: Test speed: 1.3 mm/min, Test specimens: 85x12x3 mm, Flexural modulus measured at 0.1-1.0% (regression), 22°C

Internal Data Sources:
FOR508355, FOR508360

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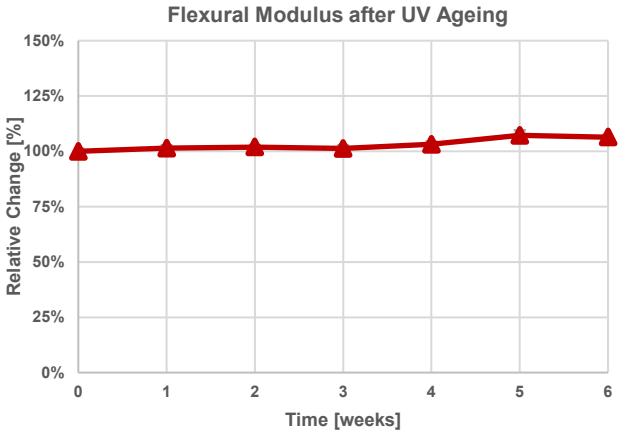
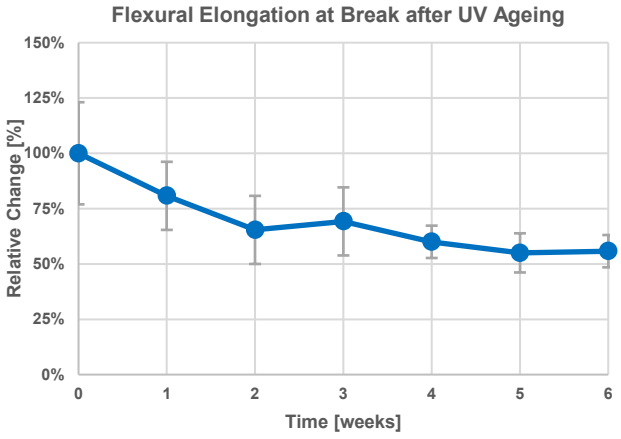
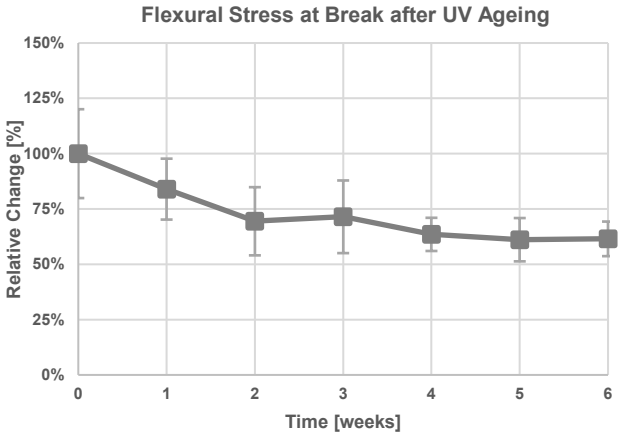
AGEING AND ENVIRONMENTAL EFFECTS – ACCELERATED WEATHERING (UV AGEING)

LOCTITE 3D IND3380 BK has been tested after accelerated outdoor weathering according to ASTM D4329 (Cycle A). Test samples were exposed to defined conditions of heat, water condensation and UV light. Exposed samples were conditioned for 24 hours at 22°C before mechanical testing. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D790 at standard lab conditions (22°C). "0 weeks" represents non-aged samples stored at 22°C and tested 24 hours after post-processing.

Please note, accelerated weathering testing can never fully represent real outdoor conditions and complexity. It is therefore recommended to conduct additional (outdoor) testing relevant for your specific application needs.







Test parameters:
ASTM D790: Test speed: 1.3 mm/min, Test specimens: 85x12x3 mm, Flexural modulus measured at 0.1-1.0% (regression), 22°C
ASTM D4329: Cycle A for general applications, QUV/se, UVA 340 nm, 0.89 W/m2·nm, 8 hours UV light at 60°C followed by 4 hours at 50°C condensation in the dark. To reduce any sample warpage during test time samples were placed in tailor-made holders without any fixation clamps or mechanical load. Exposed samples were always removed from QUV before next condensation cycle to avoid samples that are soaked excessively with water before testing.

Internal Data Sources:
FOR508343, FOR508352

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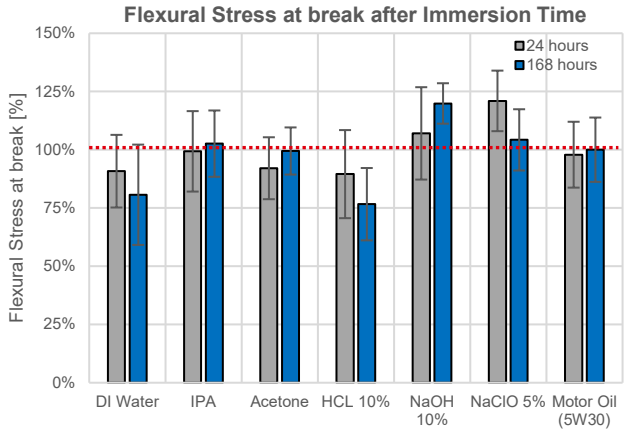
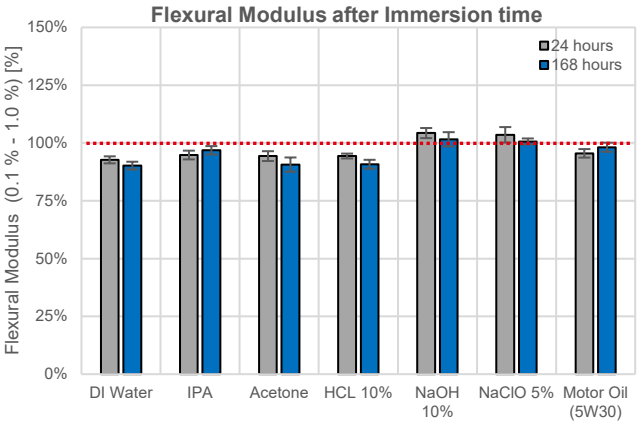
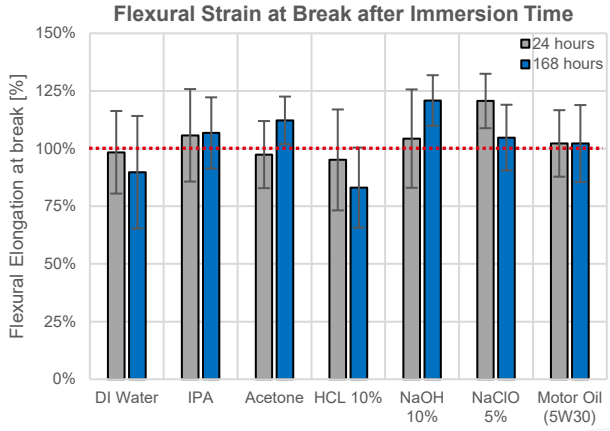
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE INDUSTRIAL

LOCTITE 3D IND3380 BK has been tested after chemical ageing according to ASTM D543. The influence of chemicals was tested by measuring mechanical properties after different test times (Immersion test for 24 and 168 hours). Exposed samples were stored in containers and fully immersed in different chemicals. Samples were stirred every 24 hours using a shaker. After removal, exposed samples were washed and conditioned for 24 hours at 22°C before mechanical testing. All samples were printed using a validated workflow. Mechanical testing was conducted according to ASTM D638 at standard lab conditions (22°C).

The 100% value represents the initial weight 24 hours after post-processing.







Test parameters:
ASTM D790: Pull speed: 1.3 mm/min, Test specimens: 85x12x3 mm, Flexural modulus measured at 0.1-1.0% (regression), 22°C
ASTM D543: Samples immersed in different chemicals were stored at 22°C. Samples immersed in Motor Oil were stored at 50°C.
Properties of media used: pH(HCl, 10%) = 1; pH(NaOH, 10%) = 14; pH(NaClO, 5%) = 13

Internal Data Sources:
DI water: FOR538012, IPA: FOR538013, Acetone: FOR538018, HCl: FOR541205, NaOH: FOR532669, NaClO: FOR532681, 5W30: FOR538023

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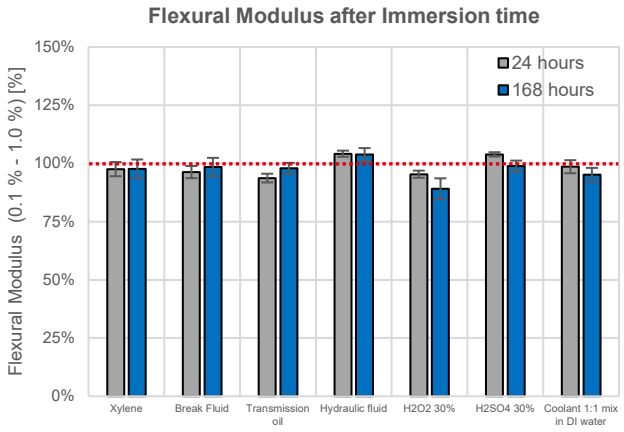
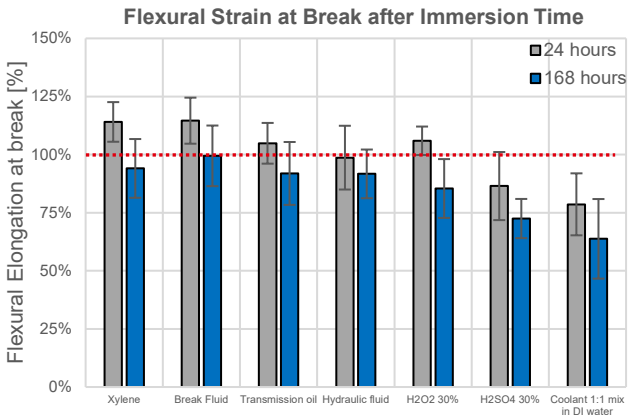
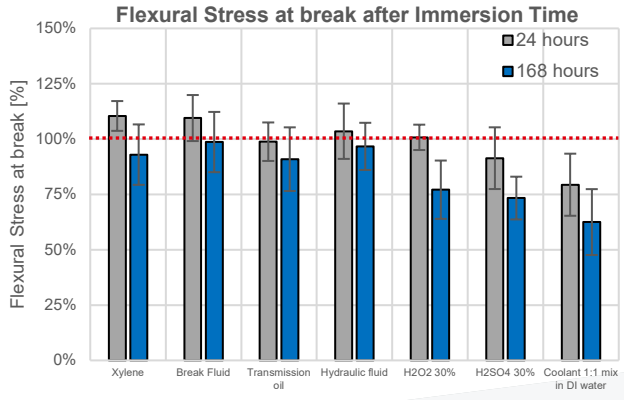
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE AUTOMOTIVE

LOCTITE 3D IND3380 BK has been tested after chemical ageing according to ASTM D543. The influence of chemicals was tested by measuring mechanical properties after different test times (Immersion test for 24 and 168 hours). Exposed samples were stored in containers and fully immersed in different chemicals. Samples were stirred every 24 hours using a shaker. After removal, exposed samples were washed and conditioned for 24 hours at 22°C before mechanical testing. All samples were printed using a validated workflow. Mechanical testing was conducted according to ASTM D638 at standard lab conditions (22°C).

The 100% value represents the initial weight 24 hours after post-processing.







Test parameters:
ASTM D638: Type IV, Pull speed: 5 mm/min, Young's modulus measured at 0.1-1.0% (regression), 22°C
ASTM D543: Samples immersed in different chemicals were stored at 22°C. Samples immersed in Transmission oil and Coolant mix 1:1 were stored at 50°C.
Properties of media used: pH(H_2SO_4 30%) = 0; pH(H_2O_2 30%) = 5; pH (NaCl solution 0.9%) = 5
Viscosity: Hydraulic fluid = 3000 mPas at 40°C; Transmission oil = 8200 mPas at 40°C;
Minimum temperature of coolant mix 1:1 = -40°C

Internal Data Sources:
FOR784026, FOR784028, FOR784030, FOR784042, FOR786027, FOR786028, FOR786029

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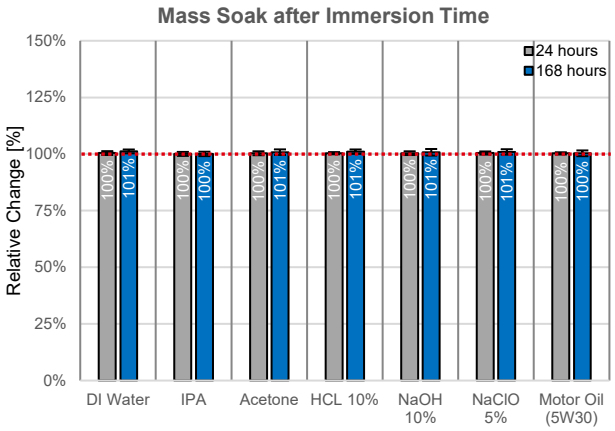
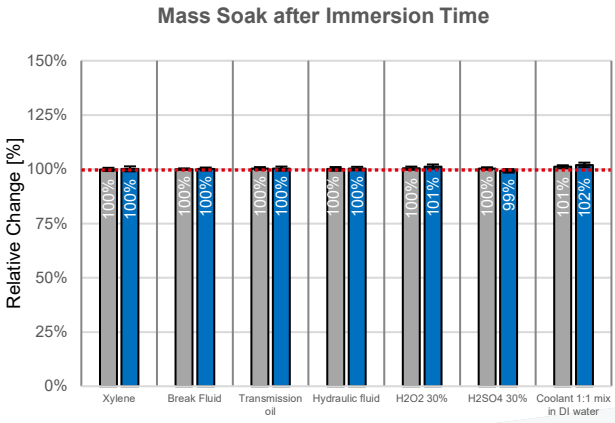
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE MASS SOAK

LOCTITE 3D IND3380 BK has been tested after chemical ageing according to ASTM D543. The influence of chemicals was tested by measuring the mass change after different test times (Immersion test for 24 and 168 hours). Exposed samples were stored in containers and fully immersed in different chemicals. Samples were stirred every 24 hours using a shaker. After removal exposed samples were washed, dried and immediately weighed. All samples were printed using a validated workflow.

The 100% value represents the initial weight 24 hours after post-processing.





Test parameters:
ASTM D543: Samples immersed in different chemicals were stored at 22°C. Samples immersed in Motor Oil, Transmission Oil and Coolant mix 1:1 were stored at 50°C.
Properties of media used: pH(HCl, 10%) = 1; pH(NaOH 10%) = 14; pH(NaClO 5%) = 13; pH(H_2SO_4 30%) = 0; pH(H_2O_2 30%) = 5; pH (NaCl solution 0.9%) = 5
Viscosity: Hydraulic fluid = 3000 mPas at 40°C; Transmission oil = 8200 mPas at 40°C;
Minimum temperature for coolant mix 1:1 = -40°C

Internal Data Sources:
DI water: FOR538030, IPA: FOR538034, Acetone: FOR538036 , HCl: FOR538037 , NaOH: FOR532810, NaClO: FOR532816, 5W30: FOR538041

FOR784026, FOR784028, FOR784030, FOR784042, FOR786027, FOR786028, FOR786029

NOTE

The information provided in this Preliminary Technical Data Sheet (pTDS) 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.
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