LOCTITE®

LOCTITE® 3D PRO417 ™

Tough
Black

LOCTITE®
Henkel Corporation
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LOCTITE 3D PRO417 is a high-strength photoplastic with good impact resistance, moderate heat resistance and excellent surface finish.

LOCTITE 3D PRO417 is ideal for a variety of performance prototype and tooling applications and can be machined, tapped, or polished for final finish.

LOCTITE 3D PRO417 displays high green strength enabling it to print accurately and function at room temperature. It is compatible with a broad range of DLP and LCD machines.

Benefits:

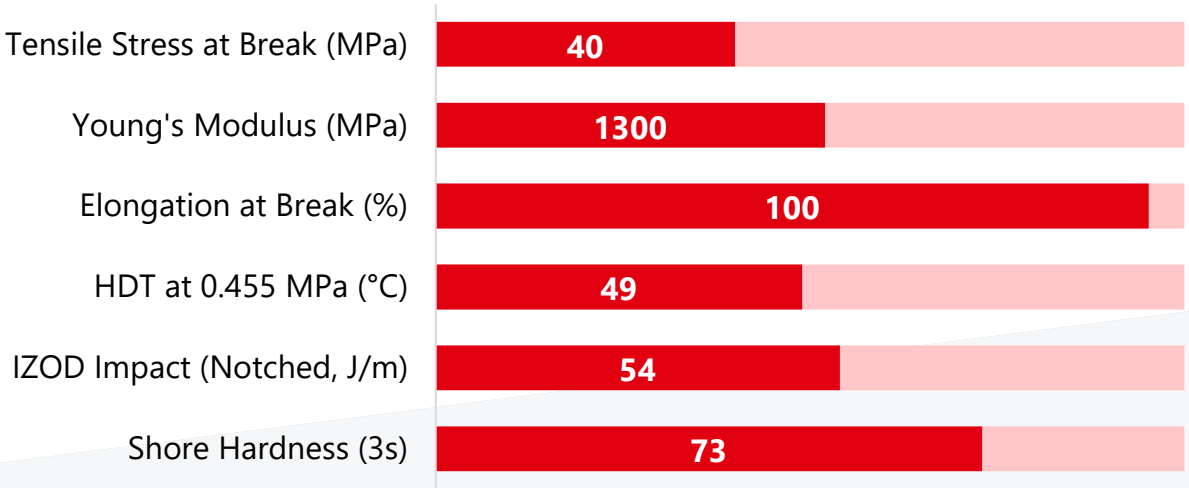
- Moderate heat resistance, HDT 49º C
- Tough with outstanding surface finish
- Superior strength and impact resistant

Ideal for:

- Manufacturing aids
- Jigs and fixtures
- Housings and covers
- Insoles

Markets:

Industry | Automotive | Consumer Goods



**Values shown are linked to LOCTITE PRO417 Black as reference, please refer to the specific mechanical properties for each of the colors shown in this document*

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PROPERTIES

Mechanical Properties	Measure	Method	Green	Post Processed
Young's Modulus	MPa	ASTM D638	1099 – 1255 [1]	1212 – 1384 [1]
Tensile Stress at Yield	MPa	ASTM D638	29 – 34 [1]	33 – 38 [1]
Elongation at Yield	%	ASTM D638	5.4 – 5.8 [1]	5.5 – 6.1 [1]
Tensile Stress at Break	MPa	ASTM D638	32 – 36 [1]	38 – 40 [1]
Elongation at Break	%	ASTM D638	109 – 118 [1]	94 – 105 [1]
Flexural Modulus	MPa	ASTM D790	515 – 547 [2,3]	844 – 952 [2,4]
Flexural Strain at Break	%	ASTM D790	>5 [2,3,4]	>5 [2,3,4]
IZOD Impact (Notched)	J/m	ASTM D256	-	52 [7] – 54 [8]
Shore Hardness (3s)	D	ASTM D2240	60 [11]	71 – 75 [11]
Other Properties				
HDT at 0.455 MPa	°C	ASTM D648	-	48 – 49 [5,6]
HDT at 1.82 MPa	°C	ASTM D648	-	40 – 42 [5,6]
Water Absorption (24hr)	%	ASTM D570	-	1.4 – 1.5 [9]
Water Absorption (48hr)	%	ASTM D570		2.0 – 2.1 [9]
Water Absorption (72hr)	%	ASTM D570	-	2.3 – 2.4 [9]
Solid Density	g/cm^3	ASTM D792	1.64 [13]	1.12 [12]
Biocompatibility				
Irritation		ISO10993-23*	-	Comply [16]
Liquid Properties				
Viscosity at 25°C (77°F)	cP	ASTM D7867	-	1700 – 2200 [13]
Liquid Density	g/cm^3	ASTM D1475	-	1.05 [14]

Test parameters:
"All specimen are printed unless otherwise noted. All specimen were in ambient lab conditions at 19-23°C / 40-60% RH for at least 24 hours." ASTM Methods: D638 Type IV, 5mm/min; D790-B 1.3 mm/min, D256 Notched IZOD (Machine Notched) 6 mm x 12 mm, D2240 Type "D" (3, 5 seconds), D648 127 mm x 13 mm x 6,8 mm ; D570 3.2 mm x 51 mm Disc 24hr@ 25°C, D792 solid 8 mm x 10 mm Disc, D7867@ 25°C (77°F), D1475.
*The biological assessment has been performed based on the in vitro method according to ISO10993-23

Internal Data Sources:
[1] GEN262731 [2] FOR156311 [3] FOR167632, [4] FOR167633 [5] FOR160109, [6] FOR160155, [7] FOR160100, [8] FOR160193, [9] FOR593774, [11] FOR502542, [12] FOR160116, [13] GEN794252, [14] FOR160116, [16] FOR611979

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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 PRO417 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 resin bottle well before usage
- Temperature: 20°C to 35°C
- Intensity: 3 mW/cm² to 7 mW/cm²

Settings: 385 nm at 5 mW/cm²	Measure	Method	Value
Layer Thickness (µm):	µm	Internal	100
Burn-in Region (s)	s	Internal	45
Transition Region (s):	s	Internal	20
Model Region (s):	s	Internal	8

Settings: 385 nm at 5 mW/cm²	Measure	Method	Value
E_C	mJ/cm2	Internal	11.30 [15]
D_P	mm	Internal	0.20 [15]

Settings: 385 nm at 5 mW/cm²	Measure	Method	Exposure time
D_C =50um	s	Internal	2.1*
D_C =100um	s	Internal	2.9*

Test parameters:
" Exposure times are calculated without a safety factor.

Internal Data Sources:
[15] FOR156383

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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 PRO417 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 #1	Cleaner C	Ultrasonic	2 min	1 or 2	Dry after each interval
Cleaning Step #2	IPA	Ultrasonic	1 min	1	
Dry	n.a.	Compressed air	10 s to 60 s	1	Air pressure (50psi)
Wait before post curing	n.a.	Ambient condition	60 min	1	Room temperature

POST CURING

LOCTITE 3D PRO417 BK requires post curing to achieve specified properties. It is recommended that either an LED or wide spectrum lamp be used to post cure parts.

UV Curing Unit	UV Source	Intensity	Cure time per side	Additional Settings (Shelf, Output Energy)
Dymax 5000 EC Flood	Mercury Arc Bulb (broad spectrum)	150 mW/cm² at 380 nm	5 min	400W, Shelf K
Loctite CL36	405nm LED	80 mW/cm² at 405 nm	20 min	100% top & side
Loctite UVALOC 1000	Mercury Arc Bulb (broad spectrum)	30 mW/cm² at 365 nm	5 min	500 W, lowest shelf

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STORAGE

Store LOCTITE 3D PRO417 BK in the unopened container in a dry location. Optimal Storage: 8 °C to 30 °C. Storage below 8 °C or above 30 °C can adversely affect product properties. Material removed from containers may be contaminated during use. For this reason, filter used resin with 190 µm mesh filter before placing back into proper storage container.

LIMITATIONS

DLP / LCD printers: LOCTITE 3D PRO417 BK shows sensitivity to higher shear stress.

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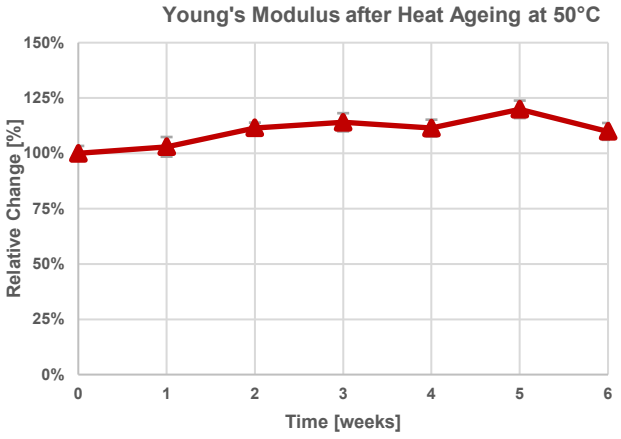
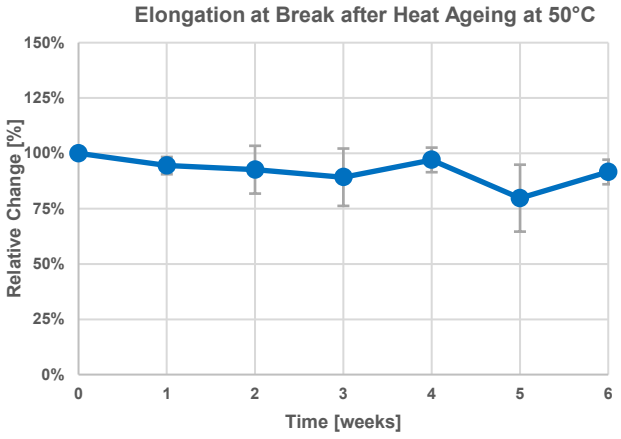
AGEING AND ENVIRONMENTAL EFFECTS – HEAT AGEING

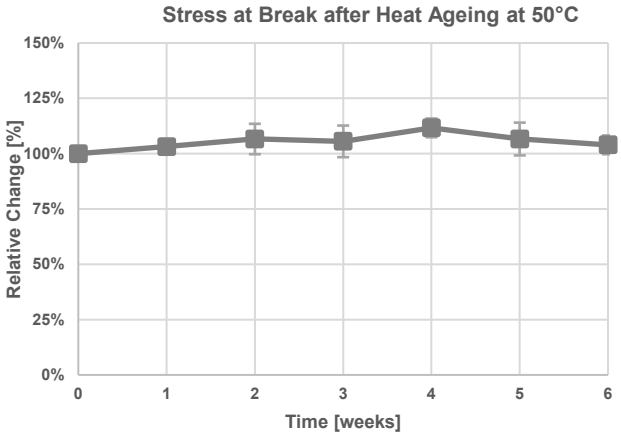
LOCTITE 3D PRO417 BK was heat aged without load according to ASTM D3045. Test samples were exposed for a defined time at 50°C and conditioned for 24 hours at 22°C before mechanical testing. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D638 at standard lab conditions (22°C).

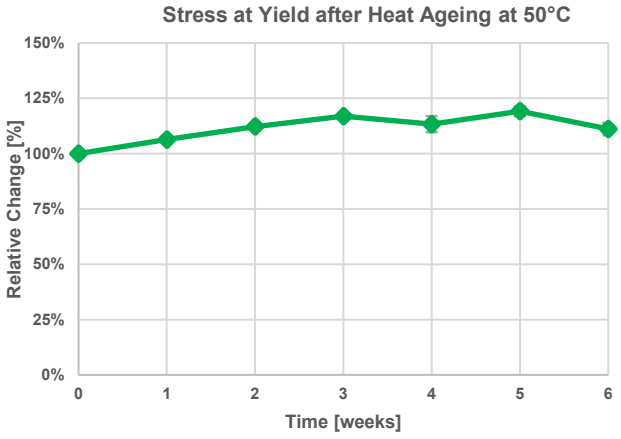
"0 weeks" represents non-aged samples stored at 22°C and tested 24 hours after post-processing.

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 D638: Type IV, Pull speed: 50 mm/min, Young's modulus measured at 0.1-1.0% (regression), 22°C

Internal Data Sources:
FOR88727, FOR88738

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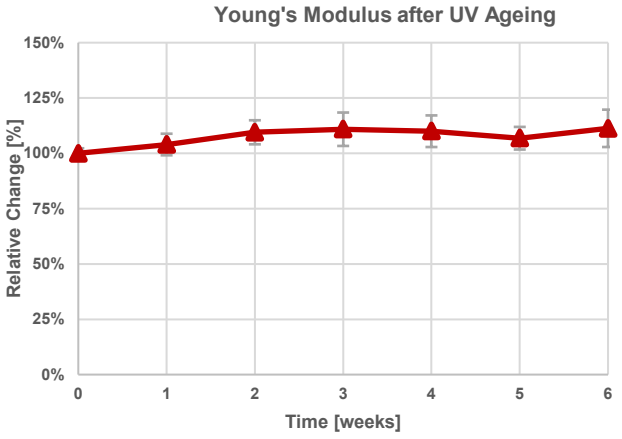
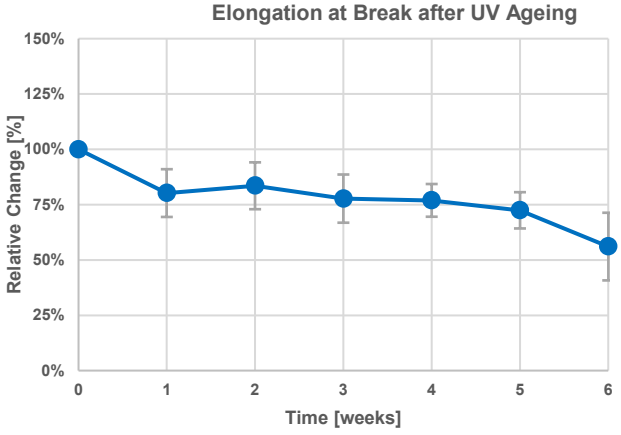
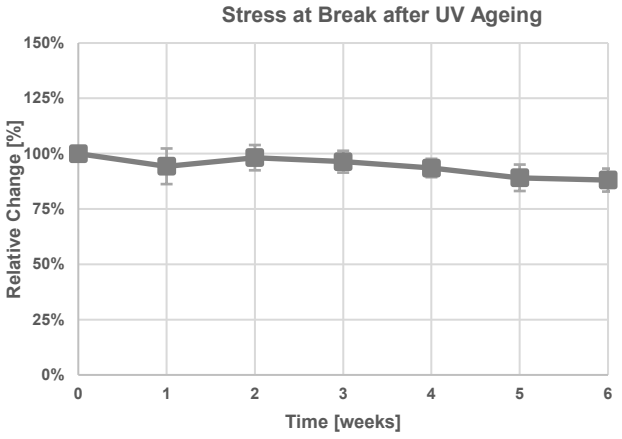
AGEING AND ENVIRONMENTAL EFFECTS – ACCELERATED WEATHERING (UV AGEING)

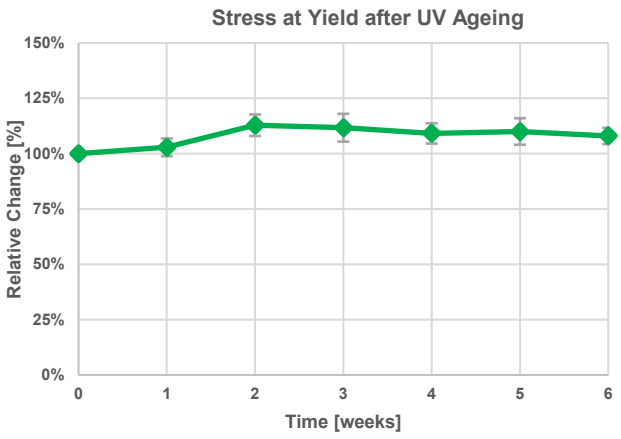
LOCTITE 3D PRO417 BK has been tested after accelerated outdoor weathering according to ASTM D4329 (Cycle A). Test samples were exposed to defined conditions of heat, water condensation and UV light. Exposed samples were conditioned for 24 hours at 22°C before mechanical testing. Control samples were 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 D638 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 D638: Type IV, Pull speed: 50 mm/min, Young's modulus measured at 0.1-1% (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:
FOR123511, FOR123528

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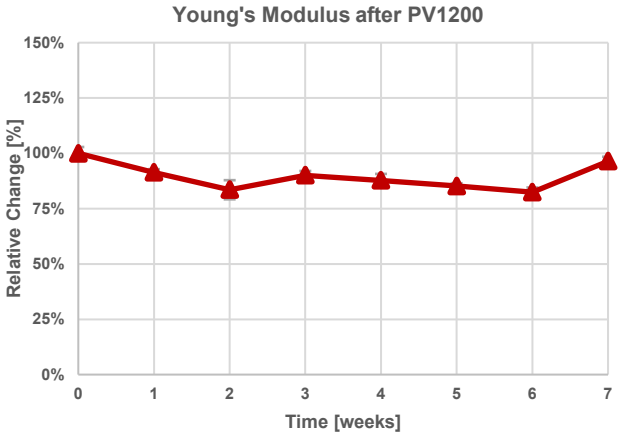
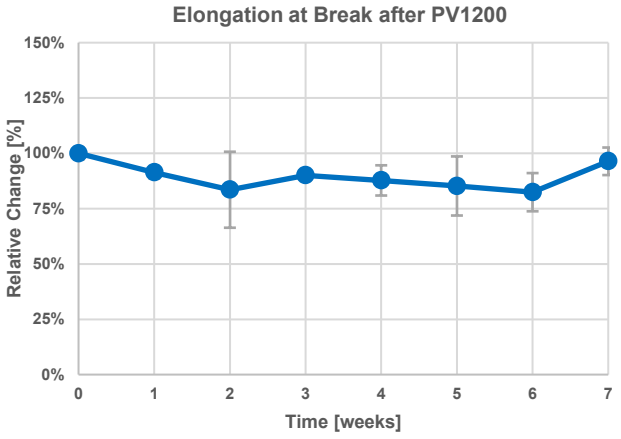
AGEING AND ENVIRONMENTAL EFFECTS – CLIMATE CYCLING TEST (PV1200)

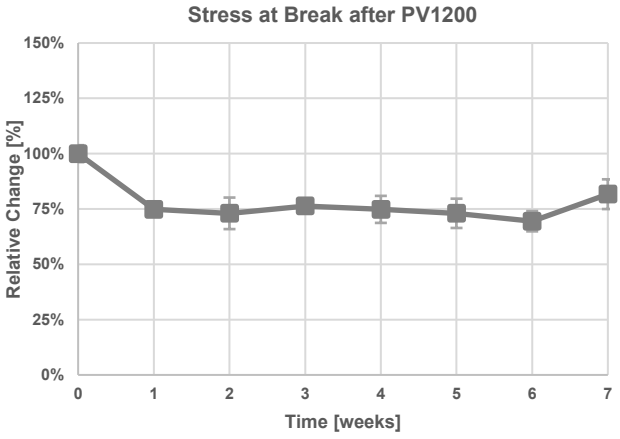
LOCTITE 3D PRO417 BK was tested in an environmental climate cycling test according to PV1200 specification. This specification was developed by Volkswagen AG to evaluate material durability and cycles between -40°C (4 hours) and 80°C (4 hours at 80 % rel. humidity) during a repeating 12-hour cycle. Test samples were exposed to this temperature cycle for a total duration of 7 weeks (100 cycles).

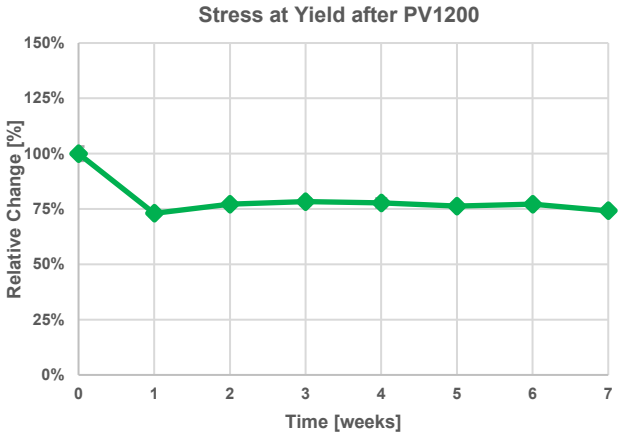
Before mechanical testing samples were conditioned for 24 hours at 22°C. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D638 at standard lab conditions (22°C).

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









Test parameters:
ASTM D638: Type IV, Pull speed: 50 mm/min, Young's modulus measured at 0.1-1.0% (regression), 22°C
PV1200: Samples were removed from climate chamber during heating phase (Cycle time: 240-300 minutes) and then conditioned for 24 hours at 22°C. 1 Test cycle is equal to 12 hours of test time. "7 weeks" of test time represent 100 test cycles or 1200 hours of test time.

Internal Data Sources:
FOR279820, FOR279864

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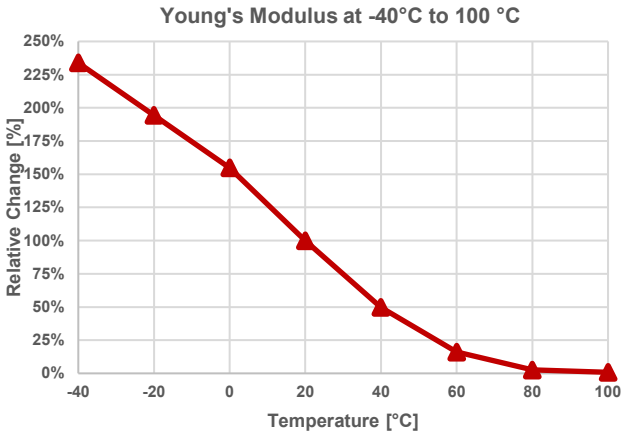
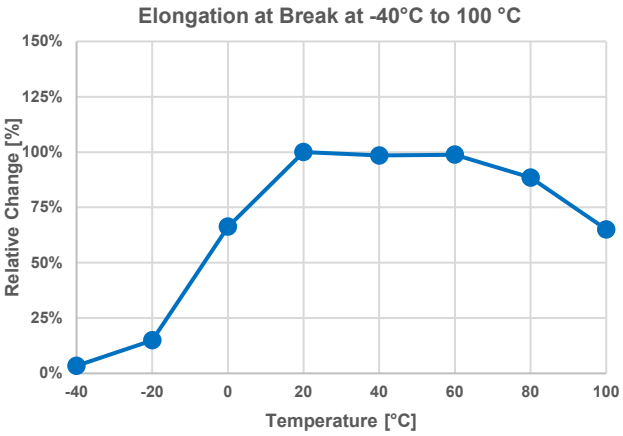
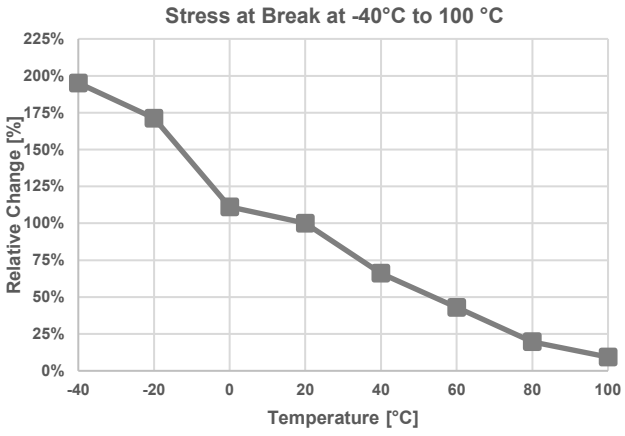
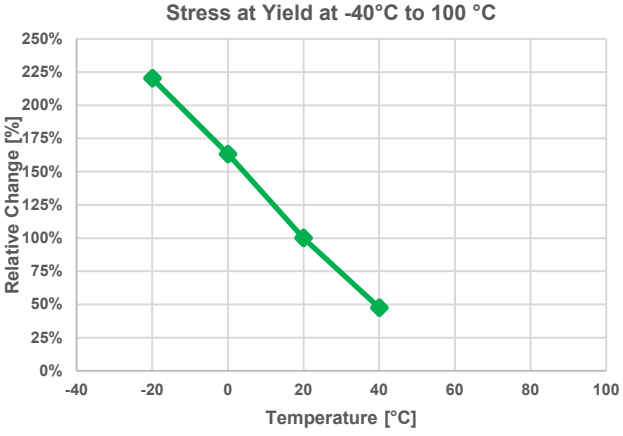
THERMAL INFLUENCE ON MECHANICAL PROPERTIES

LOCTITE 3D PRO417 BK has been tested according to ASTM D638 at varied environmental temperatures, from -40°C to 100°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D638. Before each test series samples were conditioned for 60 minutes at the specific test temperature.









Test parameters:
ASTM D638, Type IV, Pull speed: 50 mm/min, Young's modulus measured at 0.1-1% (regression)

Internal Data Sources:
FOR342155, FOR344586

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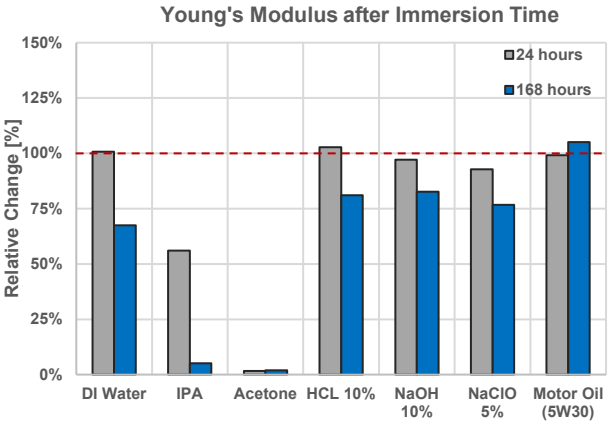
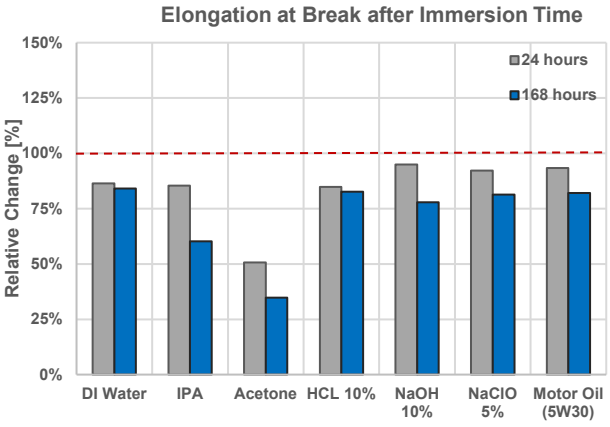
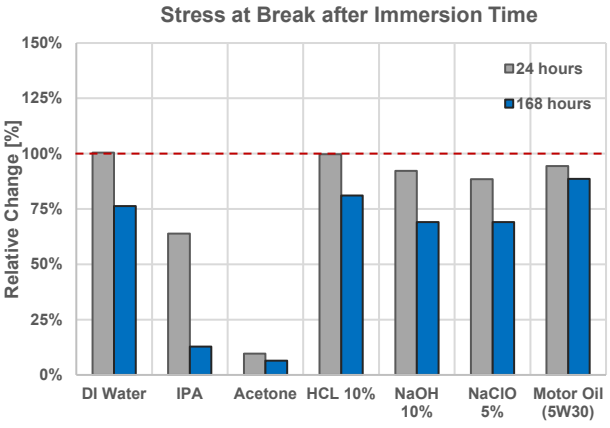
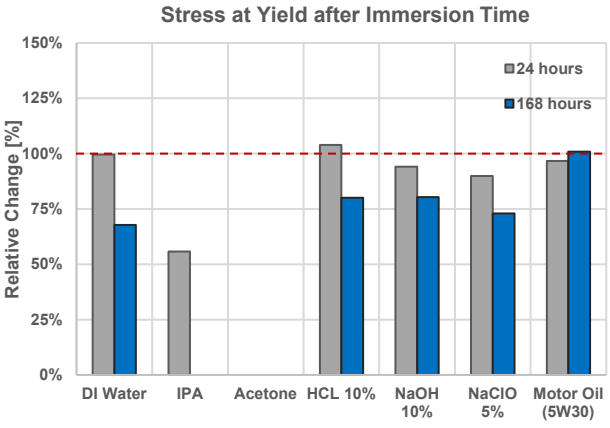
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE (1/2)

LOCTITE 3D PRO417 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). "100%" represents non-aged samples stored at 22°C and tested 24 hours after post-processing.









Test parameters:
ASTM D638: Type IV, Pull speed: 50 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 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] FOR344157, [IPA] FOR344161, [Acetone] FOR344163, [HCl 10 %] FOR344164, [NaOH 10 %] FOR351236, [NaClO 5 %] FOR351237, [5W30] FOR351238

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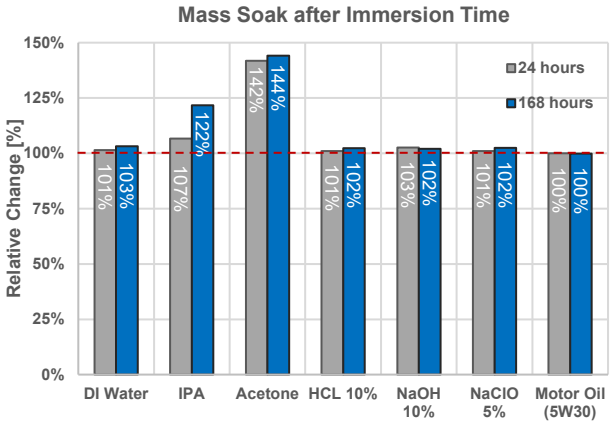
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE (2/2)

LOCTITE 3D PRO417 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. "100%" 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 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] FOR344197, [IPA] FOR344282, [Acetone] FOR344283, [HCl 10 %] FOR344285, [NaOH 10 %] FOR351240, [NaClO 5 %] FOR351242, [5W30] FOR351244

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NOTE

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.

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