LOCTITE®

LOCTITE® 3D IND147™

High Temperature
Black

LOCTITE®
Henkel Corporation
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LOCTITE 3D IND147™

LOCTITE 3D IND147 is a high temperature resistant resin with HDT 230°C, and good dimensional stability for low loads processes in molding applications

LOCTITE 3D IND147 shows good surface finish and sufficient toughness to withstand mechanical stresses from molding processes. Its unique properties make it ideal for applications such as polyurethane and silicone molding

Benefits:

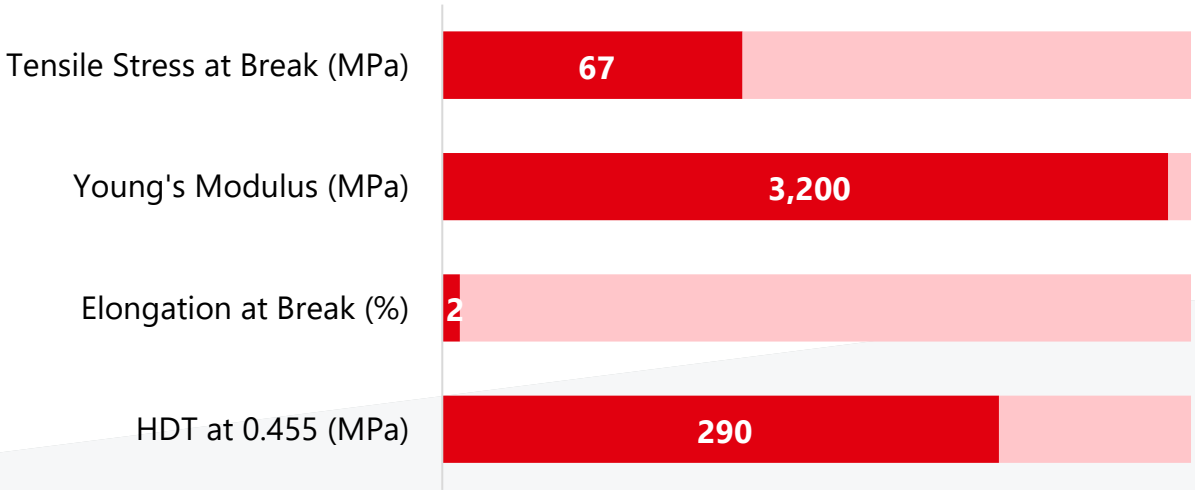
- High HDT >230 ˚C
- Tough with good dimensional stability
- Good surface finish

Ideal for:

- Tooling at high temperature, low pressure
- Prototyping of high temperature parts
- Customized Molds

Markets:

Industry | Consumer Goods | Automotive



**Values shown are linked to LOCTITE IND147 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	1150 ± 160 [2]	3190 ± 80 [1]
Tensile Stress at Break	MPa	ASTM D638	31 ± 2 [2]	67 ± 16 [1]
Elongation at Break	%	ASTM D638	6 ± 2 [2]	2.4 ± 0.7 [1]
Poisson's Ratio	-	ASTM D638	-	0.30 ± 0.03 [16]
Flexural Modulus	MPa	ASTM D790	1170 ± 100 [11]	3690 ± 60 [12]
Flexural Stress at Break	MPa	ASTM D790	-	120 ± 4 [12]
Flexural Strain at Break	%	ASTM D790	>5 [11]	3.5 ± 0.2 [12]
IZOD Impact (Notched)	J/m	ASTM D256	-	14.6 ± 0.1[7]
Shore Hardness (3s)	D	ASTM D2240	-	94 [8]
Other Properties				
HDT @ 0.455 MPa	°C	ASTM D648	-	235 - 291 [15/13]
HDT @ 1.82 MPa	°C	ASTM D648	-	136 - 163 [14]
Water Absorption (24hr)	%	ASTM D570	-	0.24 [9]
Water Absorption (48hr)	%	ASTM D570	-	0.39 [9]
Water Absorption (168hr)	%	ASTM D570	-	0.78 [9]
Solid Density	g/cm^3	ASTM D792	1.25 [10]	1.26 [10]
Thermal Conductivity	W/(m·K)	ASTM D5930	-	0.20 [5]
Heat Capacity	J/(g·K)	ASTM D5930	-	1.3 [5]
CTE (25°C to 200°C)	µm/(m·K)	ASTM E831	-	114 [6]
Tg	°C	ASTM E1640	55 [17]	205-212 [17]

Test parameters:
All specimen are printed unless otherwise noted. All specimen were conditioned in ambient lab conditions at 19-23C / 40-60% RH for at least 24 hours." ASTM Methods: D638 Type IV, 5mm/min, D790-A, D256 Notched IZOD (Machine Notched), 6 mm x 12 mm, D648, D2240, Type "D" (3 seconds), D570 0.125" x 2" Disc 24hr@ 25°C, D7867@ 25°C (77°F), D1475, D638 Type I for Poisson's Ratio, 5 mm/min

Internal Data Sources:
[1] FOR27962, [2] FOR8167, [3] FOR46762, [4] FOR46761, [5] FOR26267, [6] FOR8169, [7] FOR8157, [9] FOR537136, [10] FOR19479, [11] FOR48828, [12] FOR48829, [13] FOR48840, [14] FOR50508, [15] FOR328216, [16] FOR663220, [17] FOR769834

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PROPERTIES

Liquid Properties	Measure	Method	Value
Viscosity at 25°C (77°F)	cP	ASTM D7867	1900 - 2500 [8]
Liquid Density	g/cm³	ASTM D1475	1.07 [10]

Electrical Properties	Measure	Method	Green	Post Processed
Volume Resistivity	Ω·cm	ASTM D257	-	$3.6 \cdot 10^{16}$ [3]
Surface Resistivity	Ω	ASTM D257	-	$3.4 \cdot 10^{16}$ [3]
Dielectric Strength	kV/mm	ASTM D149	-	29 ± 2 [1]
AC Relative Permittivity (Dielectric Constant)[2]				
at 50 Hz (XY)	none	ASTM D150	-	3.0
at 1 kHz (XY)	none	ASTM D150	-	3.0
at 1 MHz (XY)	none	ASTM D150	-	2.8
AC Loss Characteristic (Dissipation Factor)[2]				
at 50 Hz (XY)	none	ASTM D150	-	0.002
at 1 kHz (XY)	none	ASTM D150	-	0.008
at 1 MHz (XY)	none	ASTM D150	-	0.016

Test parameters:

"All specimen are printed unless otherwise noted. All specimen were conditioned in ambient lab conditions at 19-23C / 40-60% RH for at least 24 hours." ASTM Methods: D638 Type IV, 5mm/min, D790-A, D256 Notched IZOD (Machine Notched), 6 mm x 12 mm, D648, D2240, Type "D" (3 seconds), D570 0.125" x 2" Disc 24hr@ 25°C, D7867@ 25°C (77°F), D1475

Internal Data Sources:

[1] FOR25926, [2] FOR25927, [3]FOR25925, [4] FOR20535, [5] FOR8163, [8] GEN792903

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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 IND147 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: 2 mW/cm² to 12 mW/cm²

Exposure time for an intensity of 5 mW/cm²

Layer Thickness (µm):	25	50	100
Burn-in Region (s):	25	25	25
Transition Region (s):	-	-	-
Model Region (s):	3	4	5

Ec (mJ/cm²)	9.47
Dp (mm):	0.12

PRE-USE RECOMMENDATIONS

It is recommended to pre-heat LOCTITE 3D IND147 BK before use, especially when stored at temperature below 20°C. It is recommended to heat it in the provided 1kg or 5kg containers at 60°C for 24 hours in the container. Open the lid during this process to allow the container to remain pressure less.

Let the bottle and resin cool down to ambient temperature and shake container well before pouring resin into the resin tray. The pre-heated material should be used within 2 weeks for best results.

Be advised the container should not be exposed to temperature above 65°C as higher temperature exposure could weaken the container.

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CLEANING

LOCTITE 3D IND147 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	Dry after each interval
Dry	n.a.	Compressed air	10 to 60 s	1	Air pressure (50psi)
Wait before post curing	n.a.	Ambient condition	60 min	1	Room temperature

POST CURING

LOCTITE 3D IND147 BK requires a two-step post curing to achieve specified properties if a low-energy LED or other post cure unit is used. 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)
Uvitron Intelliray 600W	Metal Halide	120 mW/cm^2 (600W, 66%)	10 min	Shelf 3 (2nd from bottom)
Dymax 5000 EC Flood	Mercury Arc Bulb (broad spectrum)	150 mW/cm^2 at 380 nm	10 min	Shelf "K"
Loctite CL36	405 nm LED	80 mW/cm^2 at 405 nm	30 min	Rotary Table, 100% Top and side and heat post cure

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POST CURING

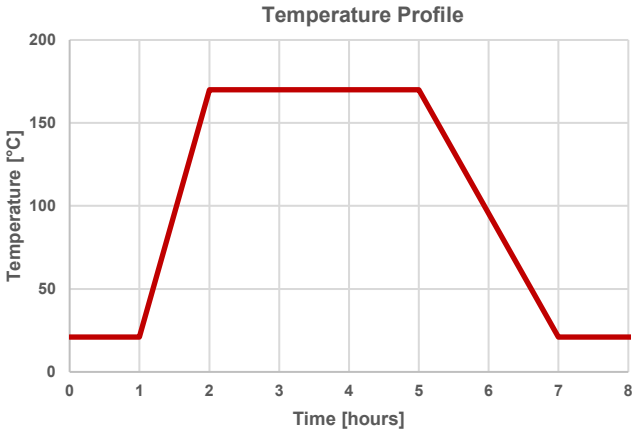
LOCTITE 3D IND147 BK requires a two-step post curing to achieve specified properties if a low-energy LED or other post cure unit is used

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.



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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

STORAGE

Store LOCTITE 3D IND147 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.

Material removed from container may be contaminated during use. For this reason, filter used resin with 190µm mesh filter before placing back into proper storage container.

If LOCTITE 3D IND147 BK is exposed to temperature below 20°C compounds in the resin might crystallize. If crystals are observed during storage, place the closed bottle in a 60°C oven for 24 hours, then remove from the oven and shake the bottle vigorously. Allow the bottle and resin to cool to ambient temperature before usage.

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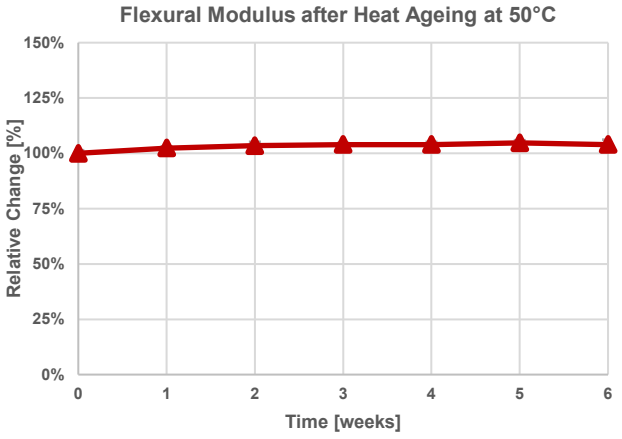
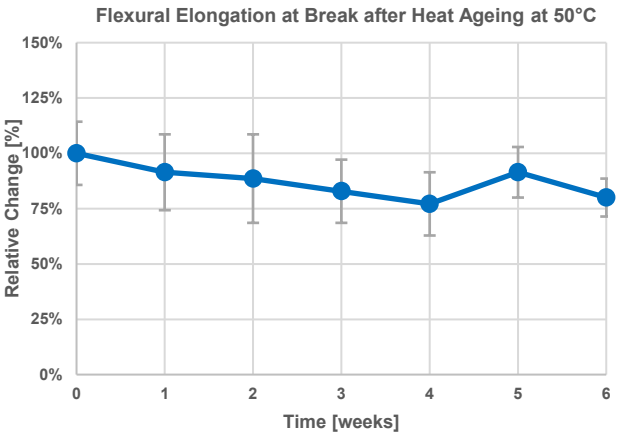
AGEING AND ENVIRONMENTAL EFFECTS – HEAT AGEING

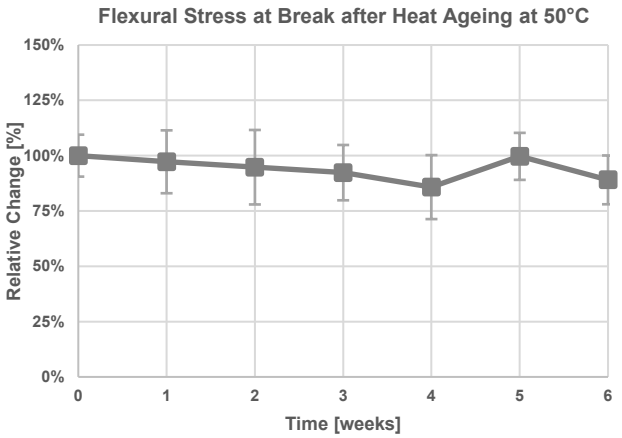
LOCTITE 3D IND147 BK was heat aged without load according to ASTM D3045. Test samples were exposed for a defined time at 50°C and conditioned for 24 hours at 22°C before mechanical testing. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated 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:
FOR230949, FOR230948

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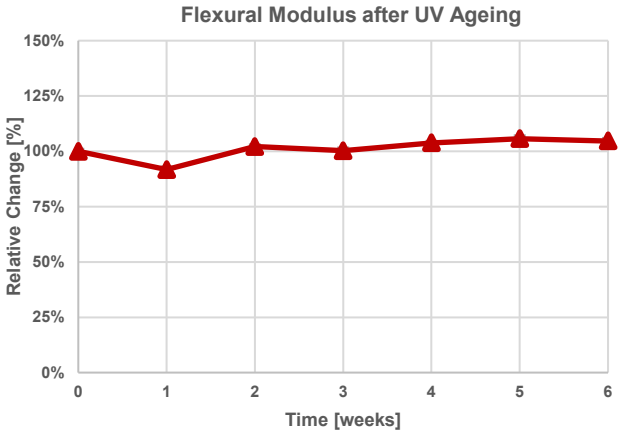
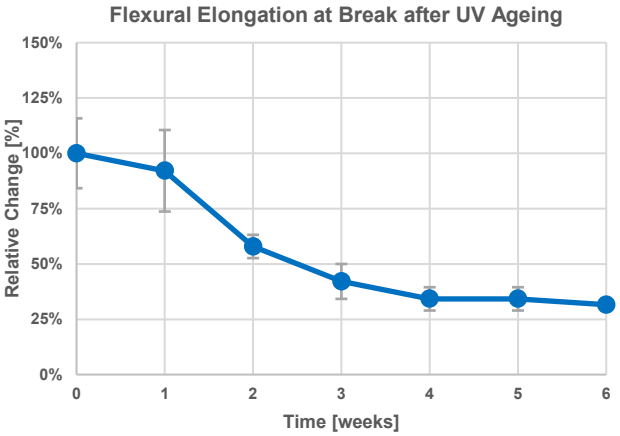
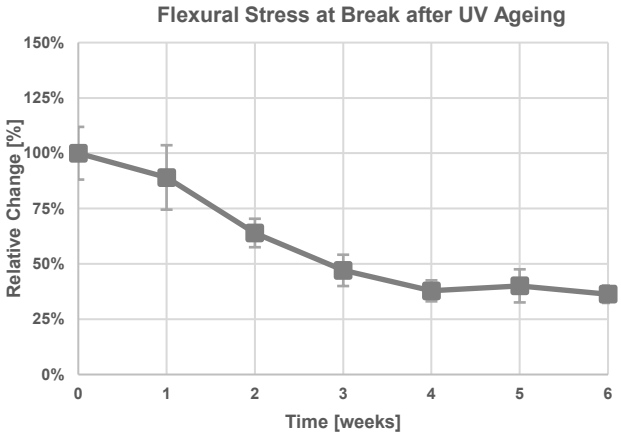
AGEING AND ENVIRONMENTAL EFFECTS – ACCELERATED WEATHERING (UV AGEING)

LOCTITE 3D IND147 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:
FOR219906, FOR219909

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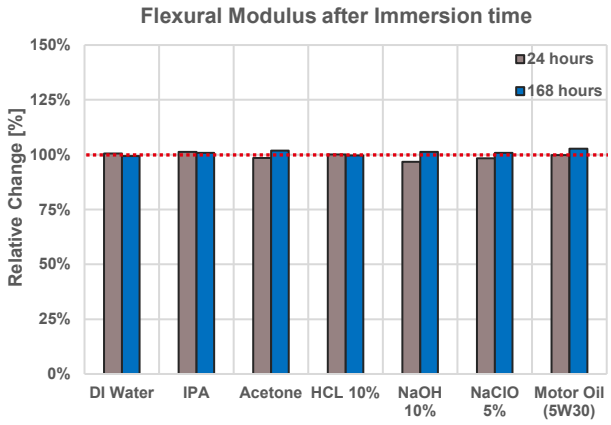
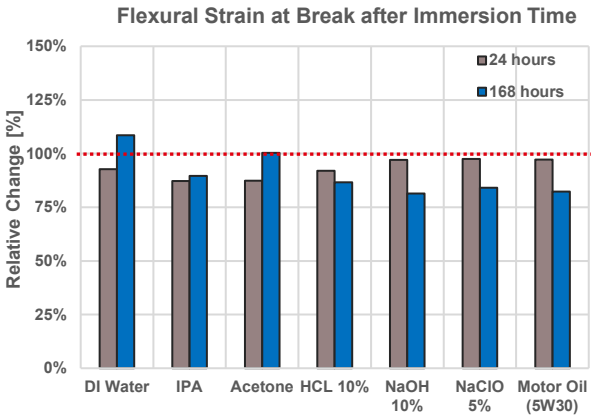
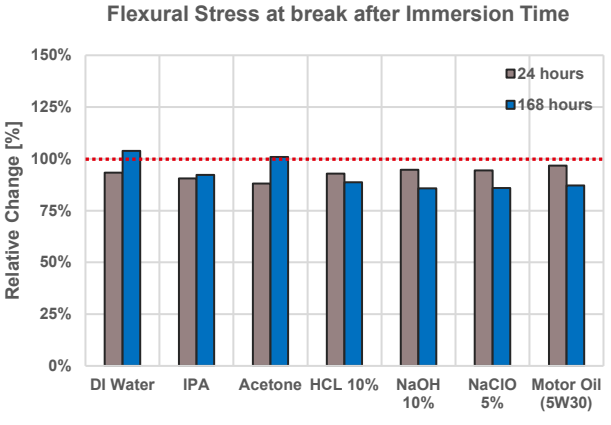
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE INDUSTRIAL

LOCTITE 3D IND147 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: Test 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

Internal Data Sources:
FOR247326, FOR247330, FOR247333, FOR247334, FOR252243, FOR252244, FOR252247

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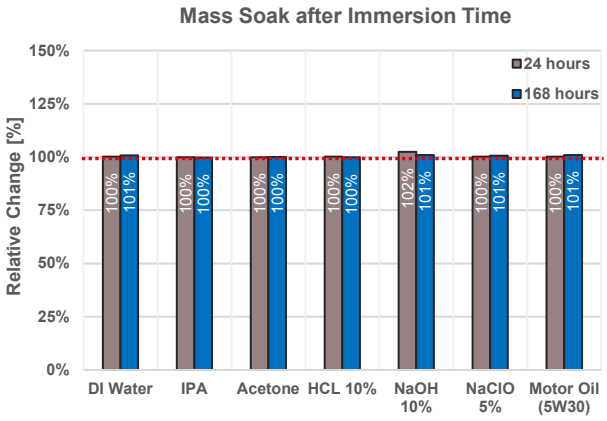
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE MASS SOAK

LOCTITE 3D IND147 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 were stored at 50°C

Internal Data Sources:
FOR247342, FOR247427, FOR247428, FOR247429, FOR252248, FOR252257, FOR252270

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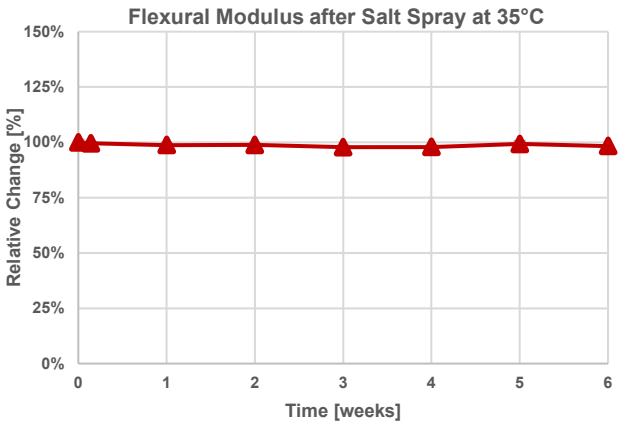
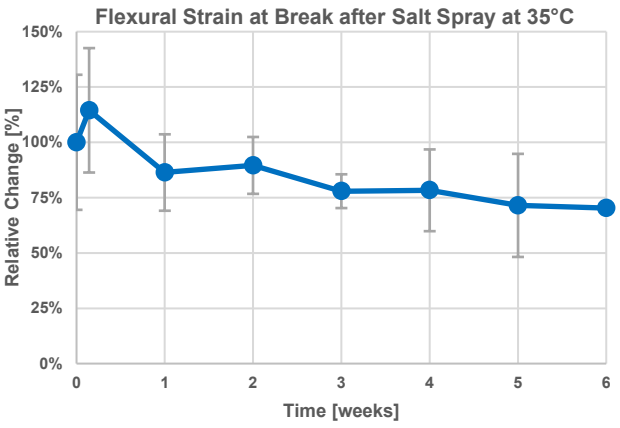
AGEING AND ENVIRONMENTAL EFFECTS – SALT SPRAY EXPOSURE

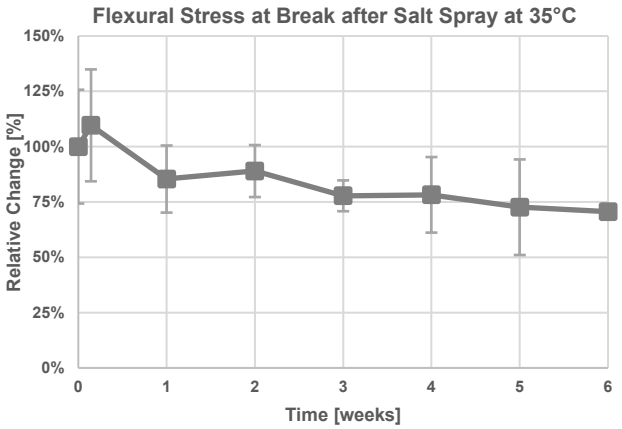
LOCTITE 3D IND147 BK was aged according to ASTM B117-19. During the test samples were exposed to salt spray at 35°C. After removal from the test chamber, exposed samples were dried, inspected, cleaned using water and wiped dry. Before mechanical testing, samples were conditioned for 24 hours at 22°C. 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).

Values at '0 weeks' are non-aged samples stored at 22°C and tested after 24 hours of 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 B117-19: pH = 6.1; Fog collection = 1.3 ml/h
ASTM D638: Type IV, Pull speed: 5 mm/min, Young's modulus measured at 0.1-1.0% (regression), 22°C

Internal Data Sources:
FOR629578, FOR629574

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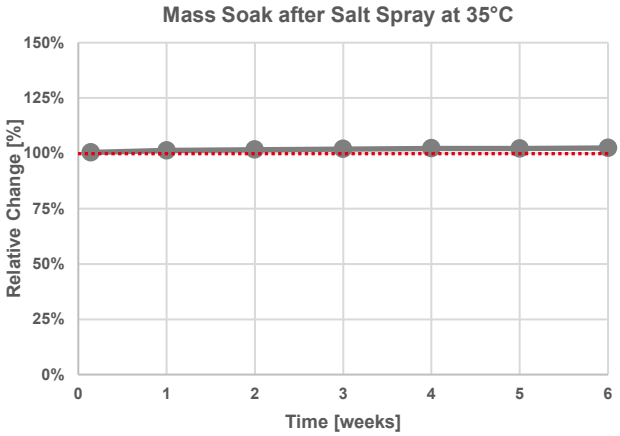
AGEING AND ENVIRONMENTAL EFFECTS – SALT SPRAY EXPOSURE

LOCTITE 3D IND147 BK has been tested after salt spray exposure according to ASTM B117-19. All samples were printed in the same print job using a validated workflow. After removal from the salt spray environment, exposed samples were dried, inspected, cleaned using water, wiped dry and immediately weighed.

The influence of the salt spray was measured by mass change after different exposure times. Samples were weighed after 24 hours and 1 to 6 weeks.

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



Test parameters:
ASTM B117-19: pH = 6.1; Fog collection = 1.3 ml/

Internal Data Sources:
FOR629578, FOR629574

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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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