

**LOCTITE®**



# **LOCTITE® 3D IND403™**

HDT80 High Modulus

Photo plastic

Black

**LOCTITE®**

Henkel Corporation

[loctite3dp@henkel.com](mailto:loctite3dp@henkel.com)



**TRI-TECH 3D**  
STANFORD MARSH GROUP



# LOCTITE®

## IND403™

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



### LOCTITE 3D IND403™

LOCTITE 3D IND403 is a high temperature resistance material that allows the production of parts with high surface quality and outstanding dimensional accuracy.

LOCTITE 3D IND403 is ideal for tooling production for processes such as silicone casting, low pressure molding and open mold PU molding. The material can withstand mechanical stresses while maintaining dimensional stability for multiple cycles, for fast product development and rapid process iteration.



#### Benefits:

- High heat deflection temperature, HDT 80°C
- Tough with good dimensional stability
- Good surface finish



#### Ideal for:

- Tooling and molds
- Interior applications in automotive



#### Markets:



Industry



Automotive



Consumer Goods

Tensile Stress at Break (MPa)

70

Young's Modulus (MPa)

2,600

Elongation at Break (%)

10

IZOD Impact (Noched, J/m)

27

HDT at 0.455 (MPa)

80

*\*Values shown are linked to LOCTITE IND403 Black as reference, please refer to the specific mechanical properties for each of the colors shown in this document*





## IND403™

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



## PROPERTIES

Mechanical Properties	Measure	Method	Green	Post Processed
Tensile Stress at Yield	MPa	ASTM D638	40 ± 3 <sup>[1]</sup>	72 ± 2 <sup>[2]</sup>
Tensile Stress at Break	MPa	ASTM D638	32 ± 3 <sup>[1]</sup>	67 ± 3 <sup>[2]</sup>
Young's Modulus	MPa	ASTM D638	1777 ± 97 <sup>[1]</sup>	2572 ± 31 <sup>[2]</sup>
Elongation at Break	%	ASTM D638	21 ± 3 <sup>[1]</sup>	10 ± 3 <sup>[2]</sup>
Flexural Modulus	MPa	ASTM D790	1879 ± 34 <sup>[3]</sup>	2654 ± 66 <sup>[4]</sup>
Flexural Elongation at Break	%	ASTM D790	>5 <sup>[3]</sup>	>5 <sup>[4]</sup>
Flexural Stress at Break	MPa	ASTM D790	-	-
Other Properties				
IZOD Impact (Notched)	J/m	ASTM D256	-	27 ± 5 <sup>[5]</sup>
Shore Hardness (3s)	D	ASTM D648	76 <sup>[6]</sup>	78 <sup>[7]</sup>
Solid Density	g/cm <sup>3</sup>	ASTM D1475	1.17 <sup>[8]</sup>	1.20 <sup>[8]</sup>
Water absorption (24h)	%	ASTM D570	-	1.8 ± 0.2 <sup>[9]</sup>
Water absorption (72h)	%	ASTM D570		4.0 ± 0.3 <sup>[9]</sup>
Water absorption (168h)	%	ASTM D570		5.0 ± 0.1 <sup>[9]</sup>
T <sub>G1</sub> (Primary)	°C	ASTM E831		50 – 62 <sup>[10]</sup>
T <sub>G2</sub> (Secondary)	°C	ASTM E831		92 – 94 <sup>[10]</sup>
CTE (< T <sub>G1</sub> )	µm/(m·K)	ASTM E831		72 – 76 <sup>[10]</sup>
CTE (> T <sub>G2</sub> )	µm/(m·K)	ASTM E831		134 – 146 <sup>[10]</sup>
Liquid Properties				Value
Viscosity at 25°C (77°F)	cP	ASTM D7867		100 – 200 <sup>[11]</sup>
Liquid Density	g/cm <sup>3</sup>	ASTM D1475		1.08 <sup>[12]</sup>

\*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.\* ASTM Methods: D638 Type IV, 5mm/min, D790-B, 2mm/min, D256 Notched IZOD (Machine Notched), 6 mm x 12 mm, D2240, Type "D" (3 seconds), D7867, D1475

### Internal Data Sources:

[1] FOR22924 [2] FOR22926 [3] FOR16923 [4] FOR20444 [5] FOR16913 [6] FOR16912 [7] FOR16911 [8] FOR16928 [9] FOR51810 [10] FOR90709 [11] FOR16921 [12] FOR16910



# LOCTITE®

## IND403™

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



## PROPERTIES

Thermal Properties	Measure	Method	Green	Post Processed
HDT at 0.455 MPa	°C	ASTM D648	-	82 ± 1 <sup>[13]</sup>
HDT at 1.82 MPa	°C	ASTM D648	-	65 ± 1 <sup>[14]</sup>
Thermal Conductivity	mW/(m·K)	ASTM D5930	-	222 ± 2 <sup>[15]</sup>
Heat Capacity	J/(g·K)	ASTM D5930	-	1.46 ± 0.08 <sup>[15]</sup>

Electrical Properties	Measure	Method	Green	Post Processed
Dielectric Strength	kV/mm	ASTM D149	-	25 ± 1 <sup>[16]</sup>
Volume Resistivity	Ω·cm	ASTM D257	-	2.5 E+15 <sup>[17]</sup>
Surface Resistivity	Ω	ASTM D257	-	1.9 E+15 <sup>[17]</sup>
AC Relative Permittivity (Dielectric Constant)				
at 50 Hz	none	ASTM D150	-	4.7 <sup>[18]</sup>
at 1 kHz	none	ASTM D150	-	4.5 <sup>[19]</sup>
at 1 MHz	none	ASTM D150	-	4.0 <sup>[20]</sup>
AC Loss Characteristic (Dissipation Factor)				
at 50 Hz	none	ASTM D150	-	0.014 <sup>[18]</sup>
at 1 kHz	none	ASTM D150	-	0.014 <sup>[19]</sup>
at 1 MHz	none	ASTM D150	-	0.040 <sup>[20]</sup>

Internal Data Sources:

[13] FOR19730 [14] FOR16920 [15] FOR26106 [16] FOR25879 [17] FOR25878 [18] FOR254522 [19] FOR25877 [20] FOR254521





## IND403™

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



## 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 IND403 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 45°C
- Intensity: 3 mW/cm<sup>2</sup> to 7 mW/cm<sup>2</sup>

Settings: 385nm at 6 mW/cm <sup>2</sup>	Measure	Method	Value
Layer Thickness	µm	Internal	100
First Layer	s	Internal	120
Burn-in Region	s	Internal	15
Model Layer Cure Time	s	Internal	6.5

Settings: 385nm at 5 mW/cm <sup>2</sup>	Measure	Method	Value
E <sub>C</sub>	mJ/cm <sup>2</sup>	Internal	7.26 <sup>[21]</sup>
D <sub>P</sub>	mm	Internal	0.12 <sup>[21]</sup>

Settings: 385nm at 5 mW/cm <sup>2</sup>	Measure	Method	Exposure time
D <sub>C</sub> = 50µm	s	Internal	2.3*
D <sub>C</sub> = 100µm	s	Internal	3.40*

Internal Data Sources:

<sup>[21]</sup> GEN198946

Exposure times are calculated without a safety factor





## IND403™

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



## 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 IND403 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	IPA	Ultra sonic bath	2 min	1 or 2	Allow parts to dry between intervals
Dry	n.a.	Compressed air	10 to 60 s	1 or 2	Air pressure (50psi)
Wait before post curing	n.a.	Ambient condition	60 min	1	Room temperature

### POST CURING

LOCTITE 3D IND403 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)
Loctite CL36	405nm LED	80 mW/cm <sup>2</sup> at 405 nm	20 min	100% top & side
Loctite UVALOC 1000	Mercury Arc Bulb (broad spectrum)	30 mW/cm <sup>2</sup> at 365 nm	5 min	500 W, lowest shelf
Dymax 5000 EC Flood	Mercury Arc Bulb (broad spectrum)	150 mW/cm <sup>2</sup> at 380 nm	4 min	400W, Shelf K

### STORAGE

Store LOCTITE 3D IND403 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 190µm mesh filter before placing back into proper storage container.





**IND403™**

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK

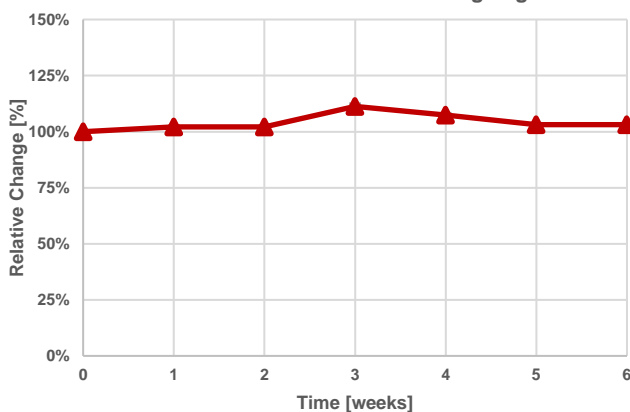


## AGEING AND ENVIRONMENTAL EFFECTS – HEAT AGEING

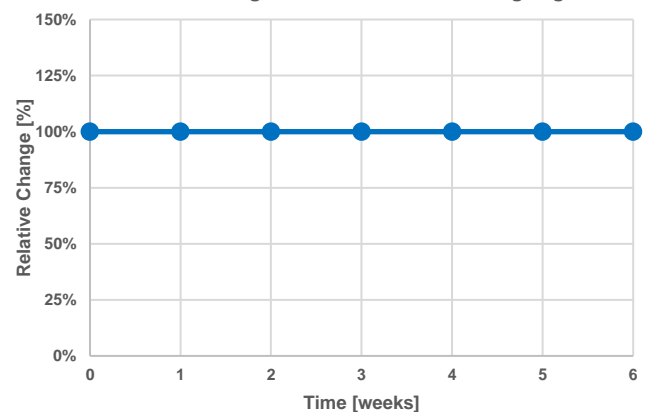
LOCTITE 3D IND403 BK was heat aged without load according to ASTM D3045. Test samples were exposed for a defined time at 50°C and conditioned for 24 hours at 22°C before mechanical testing. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated 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.

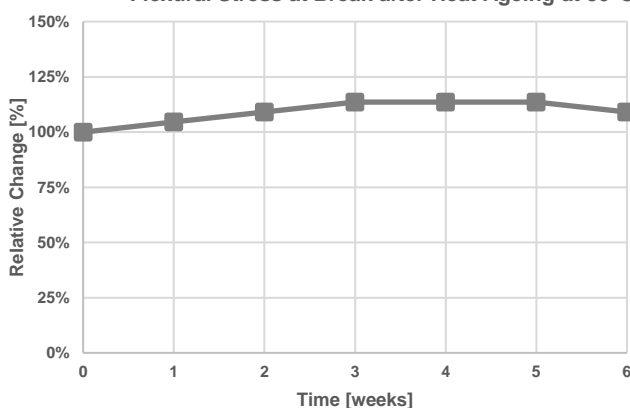
Flexural Modulus after Heat Ageing at 50°C



Flexural Elongation at Break after Heat Ageing at 50°C



Flexural Stress at Break after Heat Ageing at 50°C



### 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:  
FOR103717, FOR103718



# LOCTITE®

## IND403™

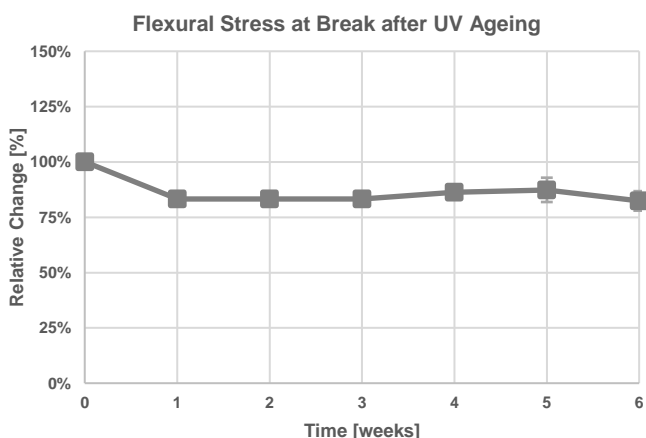
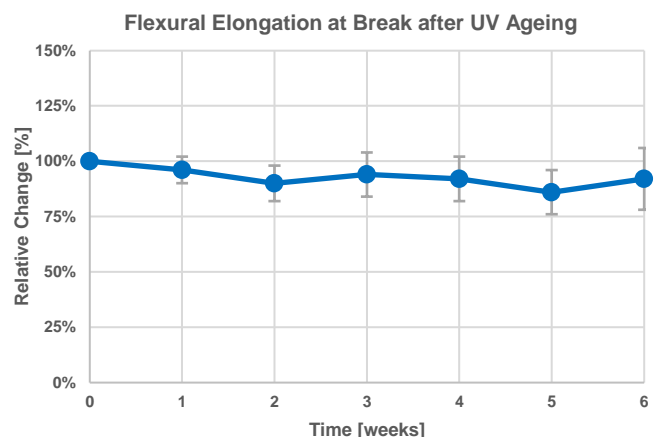
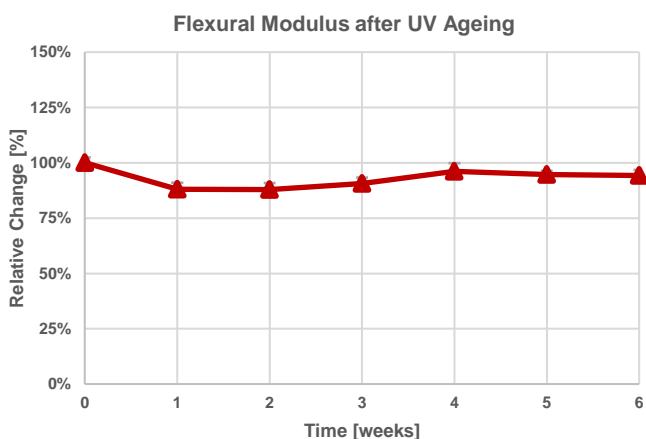
HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



### AGEING AND ENVIRONMENTAL EFFECTS – ACCELERATED WEATHERING (UV AGEING)

LOCTITE 3D IND403 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/m<sup>2</sup>·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:

FOR148177, FOR148236







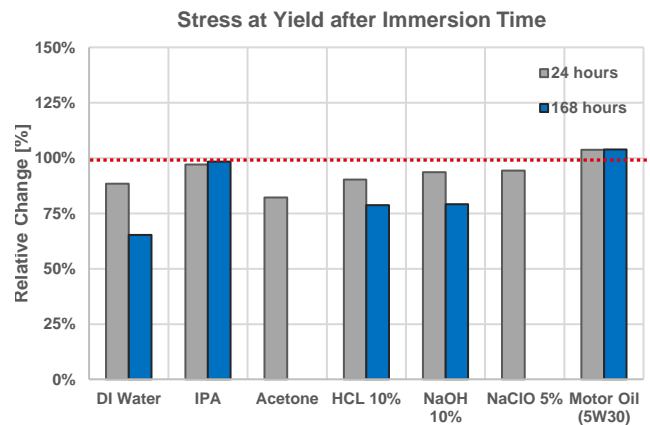
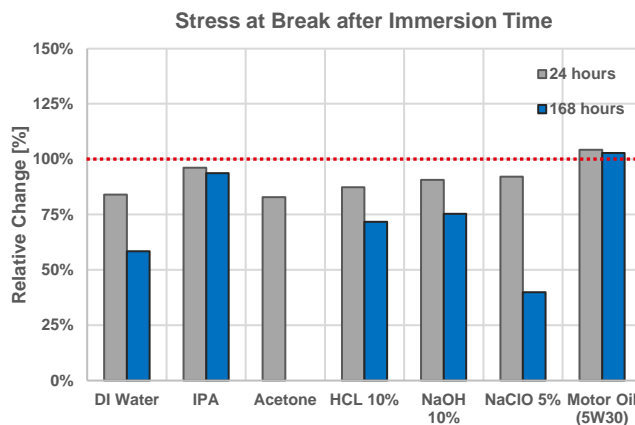
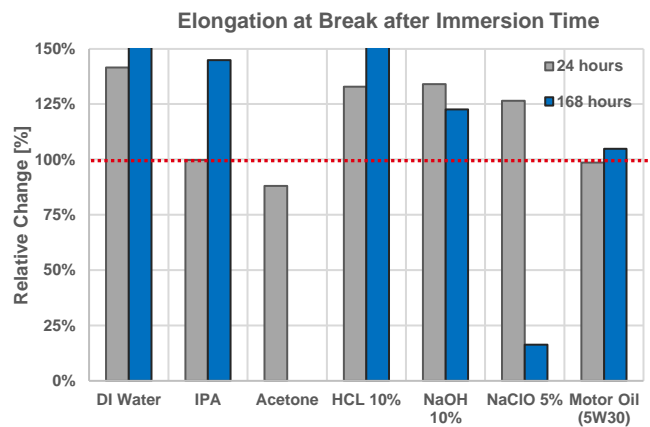
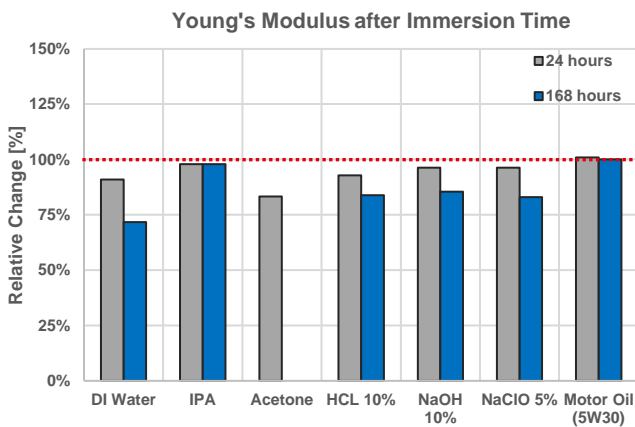
## IND403™

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



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

LOCTITE 3D IND402 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: 5 mm/min, 22°C

ASTM D543: Samples immersed in different chemicals were stored at 22°C. Samples immersed in Motor Oil were stored at 50°C

#### Comment:

The samples after 168 h after the immersion in Acetone were not possible to test, therefore there is no value for this immersion time

#### Internal Data Sources:

FOR282116, FOR282127, FOR282131, FOR282134, FOR288317, FOR288318, FOR288320





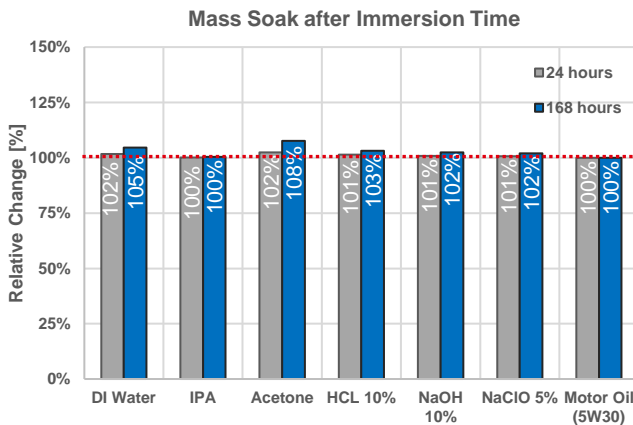
**IND403™**

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



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

LOCTITE 3D IND402 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.

### Internal Data Sources:

FOR282136, FOR282146, FOR282148, FOR282174, FOR288321, FOR288322, FOR288323



# LOCTITE®

## IND403™

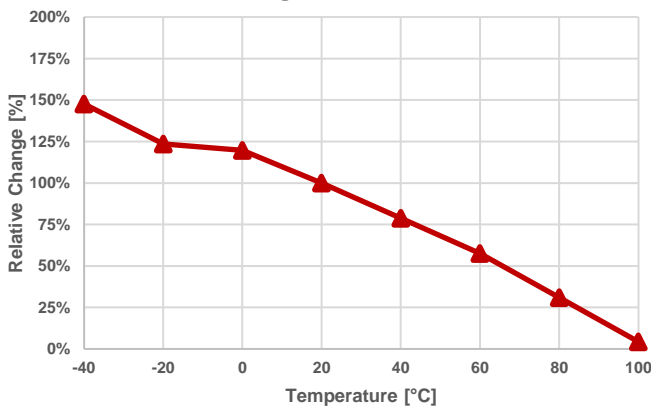
HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



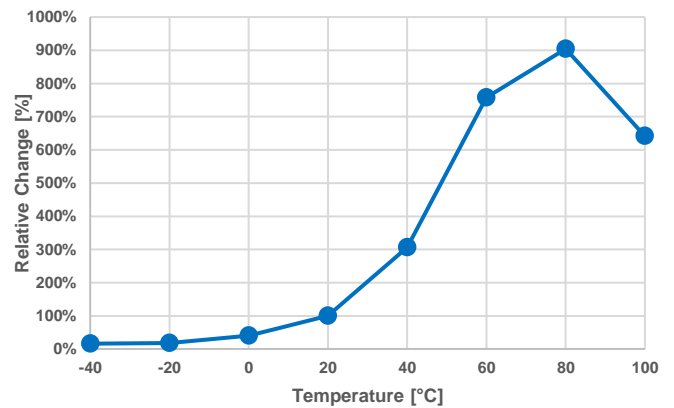
### THERMAL INFLUENCE ON MECHANICAL PROPERTIES

LOCTITE 3D IND403 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.

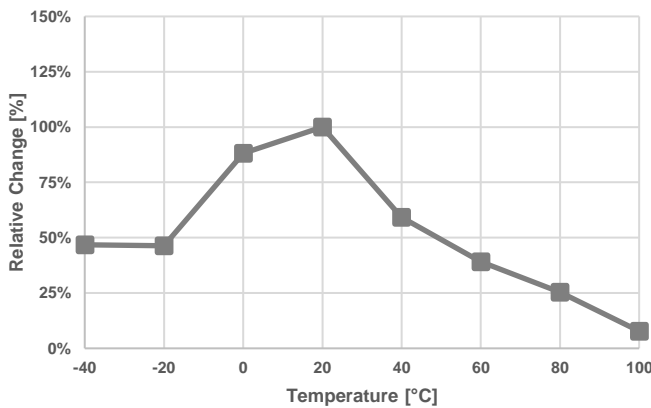
Young's Modulus at -40°C to 100 °C



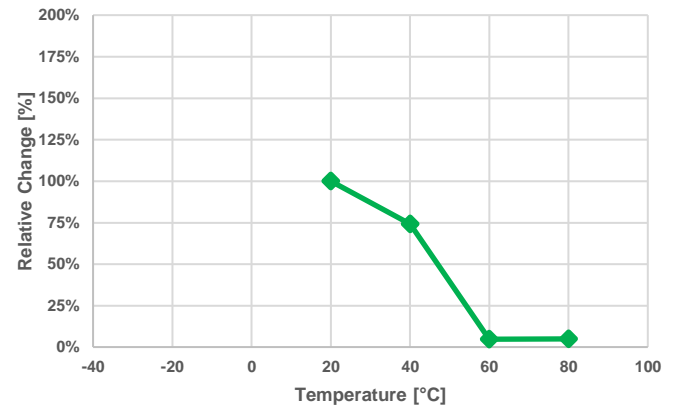
Elongation at Break at -40°C to 100 °C



Stress at Break at -40°C to 100 °C



Stress at Yield at -40°C to 100 °C



**Test parameters:** ASTM D638, Type IV, Pull speed: 5 mm/min, Young's modulus measured at 0.1-1% (regression),

Internal Data Sources:  
FOR101977



# LOCTITE®

## IND403™

HDT80 HIGH MODULUS  
PHOTO PLASTIC  
BLACK



## 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.

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 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, Resin Technology Group, Inc., or Henkel Canada, Inc. 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.



**LOCTITE®**



**FIND OUT MORE AT**  
**LOCTITEAM.COM**



HEADQUARTERS  
3-4 Innovation Way, North Staffs Business Park, Stoke-On-Trent. ST6 4BF  
[www.tritech3d.co.uk](http://www.tritech3d.co.uk)  
01782 814551  
[info@tritech3d.co.uk](mailto:info@tritech3d.co.uk)



Version 2023/03/16