LOCTITE®

# LOCTITE® 3D IND402™

## Elastomer
## Black

**LOCTITE®**
Henkel Corporation
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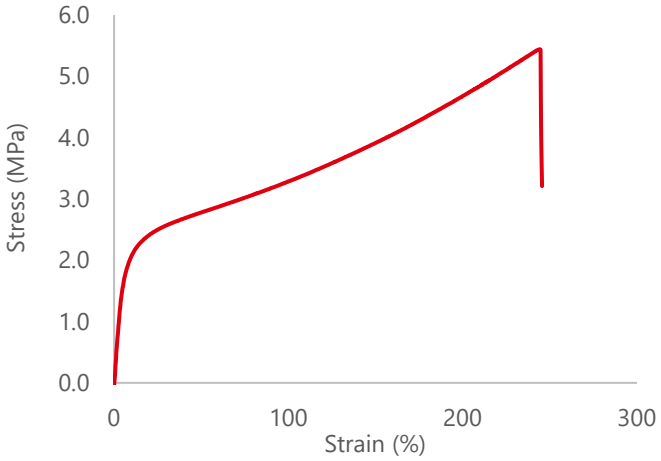
## LOCTITE 3D IND402™

LOCTITE 3D IND402 is a single component elastomer material with high elongation and high resilience, excellent tensile strength and high energy return while also not requiring thermal post processing.

Parts can be printed with various DLP platforms.




### Benefits:

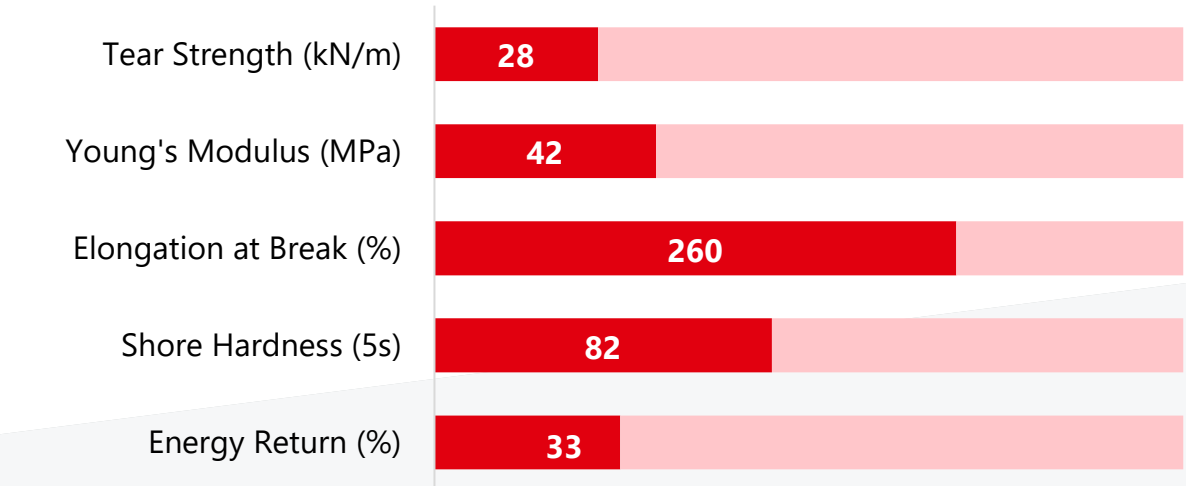
- True elastomeric behavior
- Excellent interlayer adhesion
- Good rebound performance

### Ideal for:

- Consumer products
- Lattice structures for sportswear

### Markets:

Industry | Automotive | Consumer Goods




**Values shown are linked to LOCTITE IND402 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 | 15 ± 2 [7] | 42 ± 5 [1] |
| Tensile Stress at Break | MPa | ASTM D638 | 2.3 ± 0.31 [7] | 5.5 ± 0.2 [1] |
| Elongation at Break | % | ASTM D638 | 176 ± 44 [7] | 230 ± 10 [1] |
| Poisson's Ratio | - | ASTM D638 | - | 0.49 ± 0.04 [14] |
| Stress at 50% Strain | MPa | ASTM D412 | - | 3.0-3.5 [8] |
| Stress at 100% Strain | MPa | ASTM D412 | - | 3.4-4.0 [8] |
| Stress at 150% Strain | MPa | ASTM D412 | - | 4.0-4.6 [8] |
| Strain at Break | % | ASTM D412 | - | 260 - 295 [8] |
| Stress at Break | MPa | ASTM D412 | - | 6.1 - 7.0 [8] |
| Tear Strength | kN/m | ASTM D624 | - | 28 ±1 [4] |
| Energy Return | % | Internal | - | 30 – 35 [2] |
| Compression Set (22hr) | % | ASTM D395 | - | 57.1 [11] |
| Shore Hardness (5s) | A | ASTM D2240 | - | 82 [5] |
| **Other Properties** | | | | |
| Water Absorption (24hr) | % | ASTM D570 | - | 3.62 [3] |
| Water Absorption (48hr) | % | ASTM D570 | - | 4.94 [3] |
| Solid Density | g/cm³ | ASTM D1475 | - | 1.1 [6] |
| Thermal Conductivity | W/(m·K) | ASTM D5930 | - | 0.16 [13] |
| Heat Capacity | J/(g·K) | ASTM D5930 | - | 2.0 ± 0.2 [13] |
| CTE (-40°C to 40°C) | µm/(m·K) | ISO 11359-2 | - | 187.1 [9] |
| Glass Transition ($T_G$) | °C | ASTM E1356 | - | -66 [10] |
| **Biocompatibility** | | | | |
| Irritation | | ISO 10993-23* | | Comply[12] |

All specimen are printed unless otherwise specified. ASTM Methods: D638 Type IV, 50mm/min, 2mm/min, D624, D570-98 24-hour water immersion, specimen 50.8mm diameter, 3.2mm thick, D412 Type C 500mm/min, D638 Type I for Poisson's Ratio, 5 mm/min

The biological assessment has been performed based on the in vitro method according to ISO10993-23

**Internal Data Sources:**
[1]FOR18387, [2]FOR18388, [3]FOR22826, [4]FOR18664, [5]FOR464255, [6]FOR20028, [7]FOR18709, [8]GEN1526, [9]FOR94747, [10]FOR99382, [11]FOR146871, [12]FOR52817
[13]FOR574325, [14] FOR663210

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## PROPERTIES

| Liquid Properties | Measure | Method | Value |
|---|---|---|---|
| Viscosity at 25°C (77°F) | cP | ASTM D7867 | 10800 - 15400 [1] |
| Viscosity at 35°C (95°F) | cP | ASTM D7867 | 8000 - 9000 [2] |
| Viscosity at 40°C (104°F) | cP | ASTM D7867 | 6000 - 7000 [2] |
| Liquid Density | g/cm³ | ASTM D1475 | 1.0439 [3] |
| Flow Characteristic | - | | Self-leveling |
| Appearance Color | - | | Black |

| Electrical Properties | Measure | Method | Green | Post Processed |
|---|---|---|---|---|
| Volume Resistivity | Ω·cm | ASTM D257 | - | $2.0 \cdot 10^{11}$ [4] |
| Surface Resistivity | Ω | ASTM D257 | - | $4.7 \cdot 10^{12}$ [4] |
| Dielectric Strength | kV/mm | ASTM D149 | - | 21.3 [4] |
| AC Relative Permittivity (Dielectric Constant) | | | | |
| at 50 Hz (XY) | none | ASTM D150 | - | 5.1 [5] |
| at 1 kHz (XY) | none | ASTM D150 | - | 4.8 [5] |
| at 1 MHz (XY) | none | ASTM D150 | - | 4.5 [5] |
| AC Loss Characteristic (Dissipation Factor) | | | | |
| at 50 Hz (XY) | none | ASTM D150 | - | 0.24 [5] |
| at 1 kHz (XY) | none | ASTM D150 | - | 0.02 [5] |
| at 1 MHz (XY) | none | ASTM D150 | - | 0.03 [5] |

**Internal Data Sources:**
[1] GEN792914, [2]FOR19857, [3]FOR20028, [4]FOR549180, [5] FOR549162

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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 IND402 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

**Exposure time for an intensity of 6 mW/cm²**

| | | | |
|---|---|---|---|
| Layer Thickness (µm): | 50 | 100 | 50 |
| First layer time (s) | 25 | 25 | 25 |
| Burn in region (s): | 2-4 | 4-6 | 2-4 |
| Model Layer Exposure (s): | | | 6.5 |

| | |
|---|---|
| Ec (mJ/cm²) | 6.06 |
| Dp (mm): | 0.09 |

### CLEANING

LOCTITE 3D IND402 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 | Manual | 2 min | 2 | Ensure parts are dry before next interval |
| Dry | n.a. | Compressed air | 30 s | 1 | Air pressure (30 psi) |
| Wait before post curing | n.a. | Ambient condition | 60 min | 1 | Room temperature |

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### POST CURING

LOCTITE 3D IND402 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 UVALOC 1000 | Mercury Arc Bulb (broad spectrum) | 30 mW/cm² at 365 nm | 5 min | 500 W, lowest shelf |
| Dymax 5000 EC Flood | Mercury Arc Bulb (broad spectrum) | 148 mW/cm² at 380 nm | 2 min | 400W, Shelf K |

### STORAGE

Store LOCTITE 3D IND402 BK in the unopened container in a dry location. Optimal Storage: 8°C to 30°. 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.

### LIQUID HANDLING

When handling liquid, always wear gloves and protective glasses to prevent skin and eye contact. ***User must provide adequate ventilation (like fume hood) or wear suitable respiratory protection (like filter type: A per EN 14387) when printing/processing.***
Please refer to the Safety Data Sheet (SDS) on this product for more information on safe handling.

### LIMITATIONS & OPTIONS

**Post Cure:** LOCTITE 3D IND402 BK requires broadband spectrum for post cure.

**Modification:** LOCTITE 3D IND402 BK has limited potential for any tensile property adjustments.

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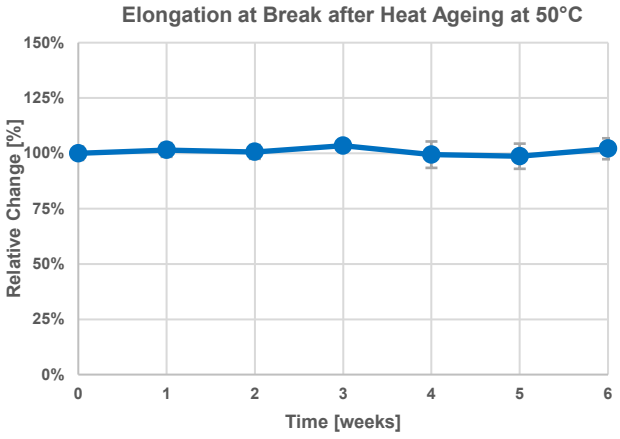
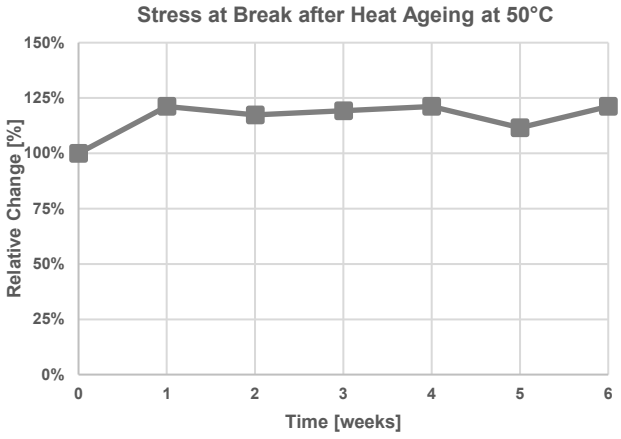
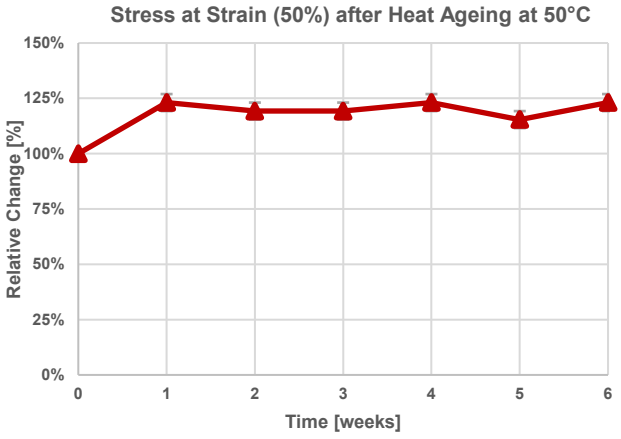
## AGEING AND ENVIRONMENTAL EFFECTS – HEAT AGEING

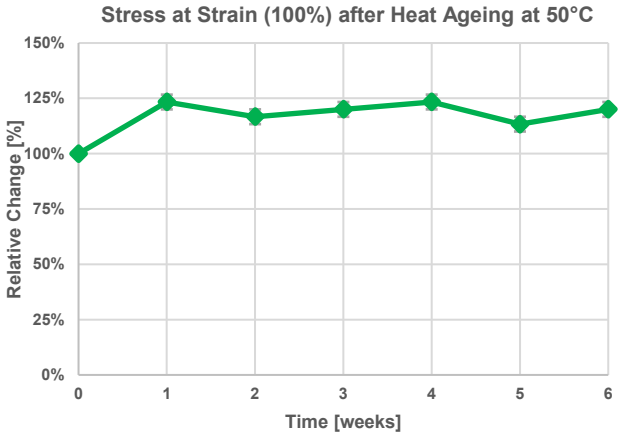
LOCTITE 3D IND402 BK was heat aged without load according to ASTM D3045. Test samples were exposed for a defined time at 50°C and conditioned for 24 hours at 22°C before mechanical testing. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D412 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 D412: Type Die C, Pull speed: 500 mm/min, 22°C

**Internal Data Sources:**
FOR154441, FOR154442

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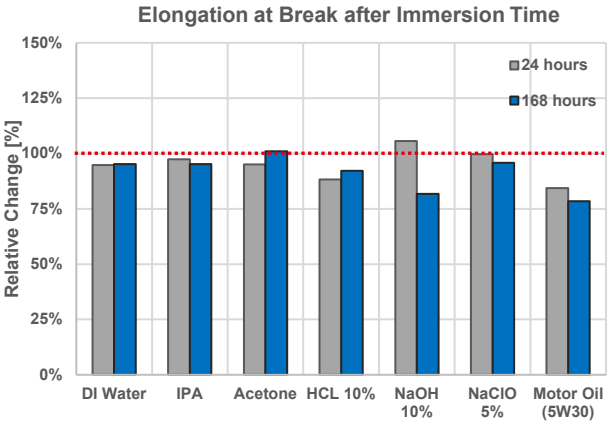
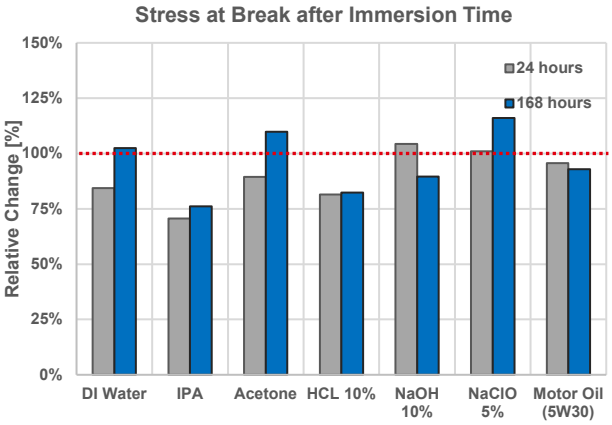
## AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE (1/2)

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 D412 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 D412: Type Die C, Pull speed: 500 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.

**Internal Data Sources:**
FOR228570, FOR228564, FOR228558, FOR228550, FOR235260, FOR235270, FOR235328

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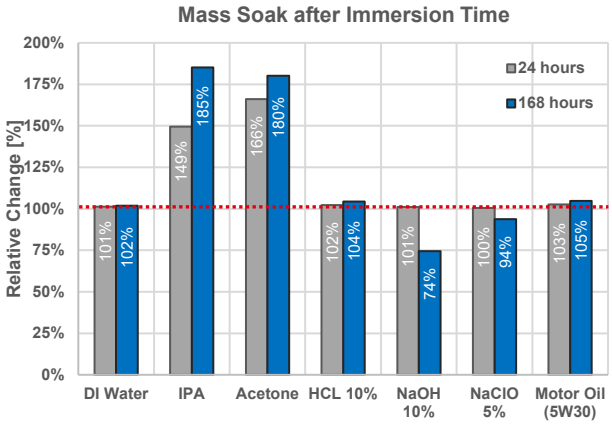
## AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE (2/2)

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:**
FOR225180, FOR225181, FOR225182, FOR225184, FOR235312, FOR235315, FOR235289

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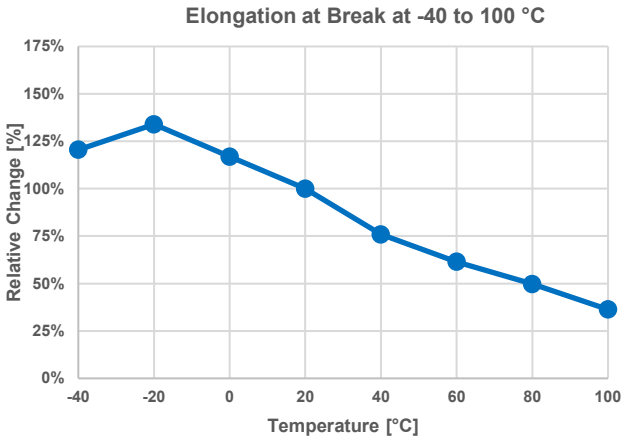
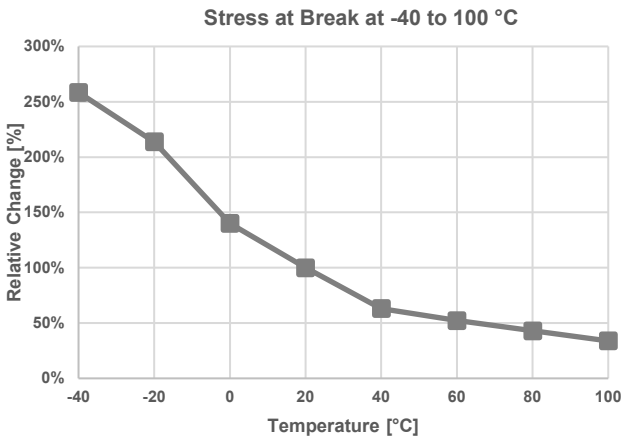
## THERMAL INFLUENCE ON MECHANICAL PROPERTIES

LOCTITE 3D IND402 BK has been tested according to ASTM D412 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 D412. Before each test series samples were conditioned for 60 minutes at the specific test temperature.




**Test parameters:**
ASTM D412: Type Die C, Pull speed: 500 mm/min

**Internal Data Sources:**
FOR178967

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## NOTE

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