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Ultracur3D® ST 80

Tough | Economic | Clear

Extended TDS

Complete Technical Documentation and Testing Summary

Version 2.0

Contents

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Technical Data Sheet

Multi-purpose resin targeting the lowest cost per part.

General Properties	Method	Typical Values
Appearance	-	Clear
Viscosity, 25°C	Cone/Plate Rheometer[1)]	600 mPas
Viscosity, 30°C	Cone/Plate Rheometer[1)]	400 mPas
Density (Printed Part)	ASTM D792	1.2 g/cm³
Density (Liquid Resin)	ASTM D4052-18a	1.08 g/cm³

Tensile Properties[2)]	Method	Typical Values
E Modulus	ASTM D638	1500 MPa
Ultimate Tensile Strength	ASTM D638	35 MPa
Elongation at Break	ASTM D638	20%

Flexural Properties	Method	Typical Values
Flexural Modulus	ASTM D790	1700 MPa
Flexural Strength	ASTM D790	60 MPa

Impact Properties	Method	Typical Values
Notched Izod (Machined), -30°C	ASTM D256	14 J/m
Notched Izod (Machined), 23°C	ASTM D256	24 J/m
Unnotched Izod, 23°C	ASTM D4812	720 J/m
Notched Charpy (Machined), 23°C	ISO 179-1	1.4 kJ/m²

Thermal Properties	Method	Typical Values
HDT at 0.45 MPa	ASTM D648	46°C
HDT at 1.82 MPa	ASTM D648	42°C
Glass transition temperature (DMA, tan(d))	ASTM D4065	58°C

Biocompatibility	Method	Typical Values
Cytotoxicity – Neutral Red	EN ISO 10993-5 (2009)	PASS[4)]
Human Skin Irritation[3)]	EN ISO 10993-10 (2013)	PASS[4)]
In Vitro Skin Irritation	OECD Guideline No. 439	PASS[4)]
In vitro Sensitization Testing-KeratinoSens™	prEN ISO 10993-10 (2020)	PASS[4)]

Other	Method	Typical Values
Hardness Shore D	ASTM D2240	80
Water Absorption, Short-Term (24 hours)	ASTM D570	0.50%
Water Absorption, Long-Term (>1100 hours)	ASTM D570	1.90%

Mechanical properties overview

1) Determined with TA-Instrument DHR rheometer, cone/plate, diameter 60 mm, shear rate 100 s^{-1}
2) Tensile type ASTM D638 type IV, Pulling speed 5 mm/min
3) Patch test on 10 volunteers
4) For the statement on Biocompatibility data see Chapter: Biocompatibility.
5) If not noted otherwise, all specimens are 3D printed. Samples were tested at room temperature, 23°C. ASTM sample size (L x W x H): ASTM D790 80 x 4 x10 mm, ASTM D256 63 x 3.2 x 12 mm, ASTM D4812 63 x 3.2 x 12 mm, ASTM D648 127 x 3.2 x 13 mm, ISO 179-1 80 x 4 x 10 mm

Printing Performance

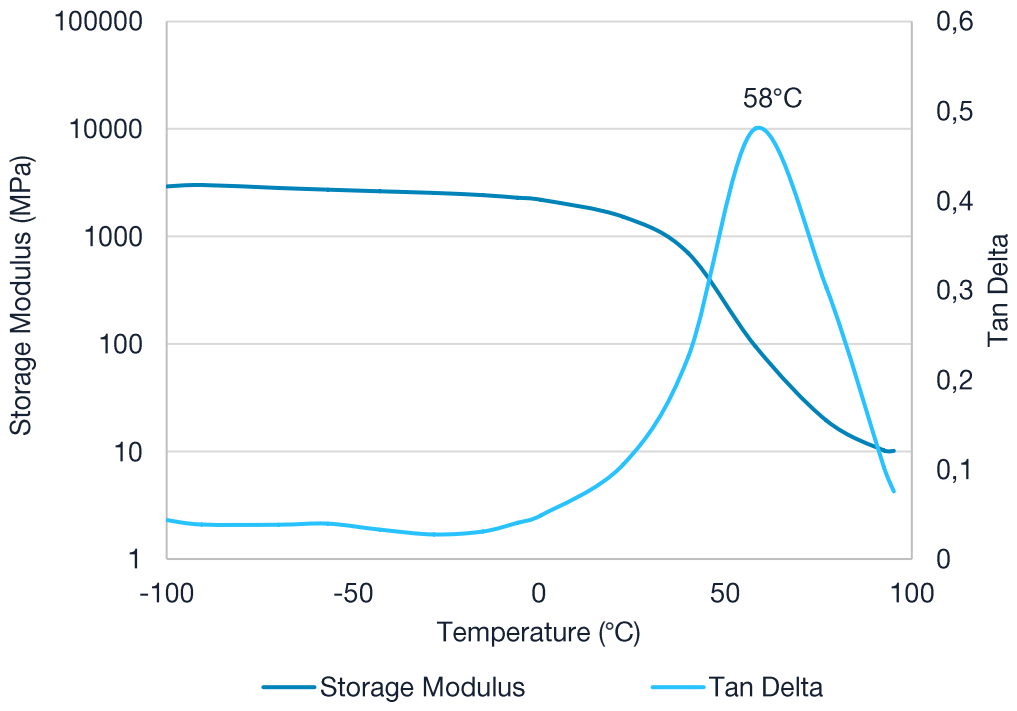
The combination of 3D printer and material has a huge impact on the quality of the parts produced. The measured design characteristics as well as the printing speed can be found in the Printing Evaluation Guideline of Ultracur3D® Resins.

Dynamic Mechanical Analysis (DMA)

In this DMA measurement, a cyclic strain is applied to the sample, and the response of the sample is recorded as a function of temperature. This can give a good impression of the changes in material behavior, both at low and high temperatures. The measured Storage modulus is a good indication of the stiffness of the material. The maximum in Tan Delta gives the glass transition temperature.

	Setting
Measurement	Strain-controlled
Temperature sweep	1°C / min
Strain	0.035% (linear viscoelastic regime)
Type of loading	Dual cantilever
Frequency	1 Hz

Testing conditions DMA



DMA curve

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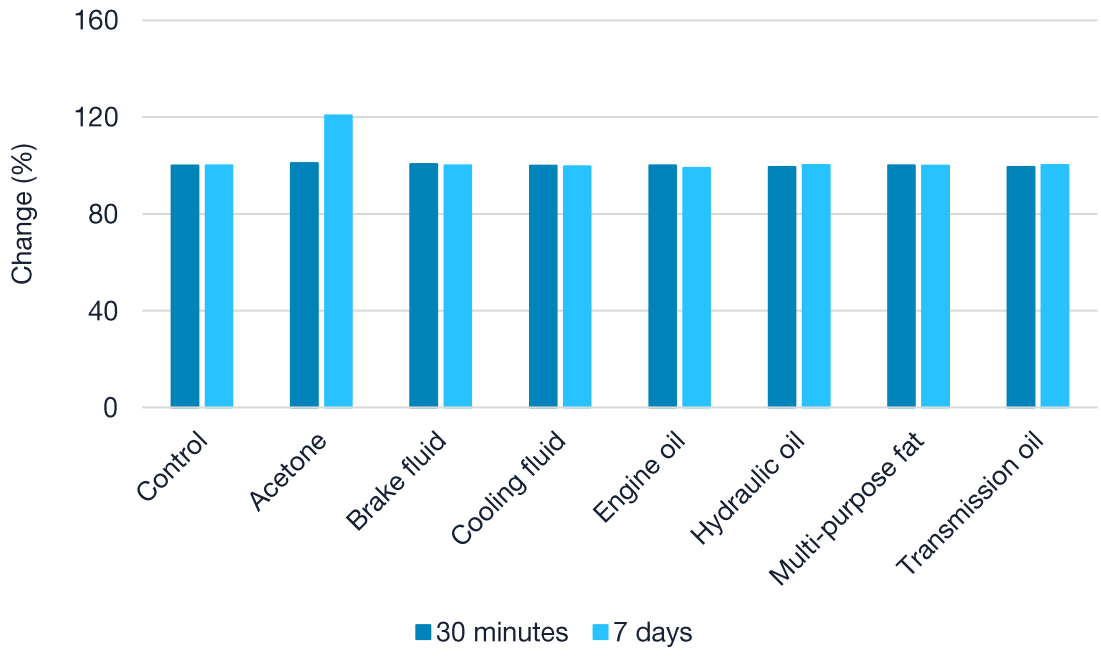
Industrial Chemical Resistance

The resistance of resin materials against chemicals, solvents and other contact substances is an important criterion of selection for many industrial applications. General chemical resistance depends on the period of exposure, the temperature, the quantity, the concentration and the type of the chemical substance. When exposed to industrial chemicals, the chemical bonds of photopolymers can break or degrade, causing a change in the mechanical properties.

Test Method and Specimens

ASTM D638 type IV tensile bars were soaked in each fluid at room temperature, one set for 30 minutes and one set for 7 days. Upon completion of the soaking time, the parts were removed from the test fluid and were dried to measure the weight and the mechanical properties.

Weight Measurement



Change in weight after immersion time

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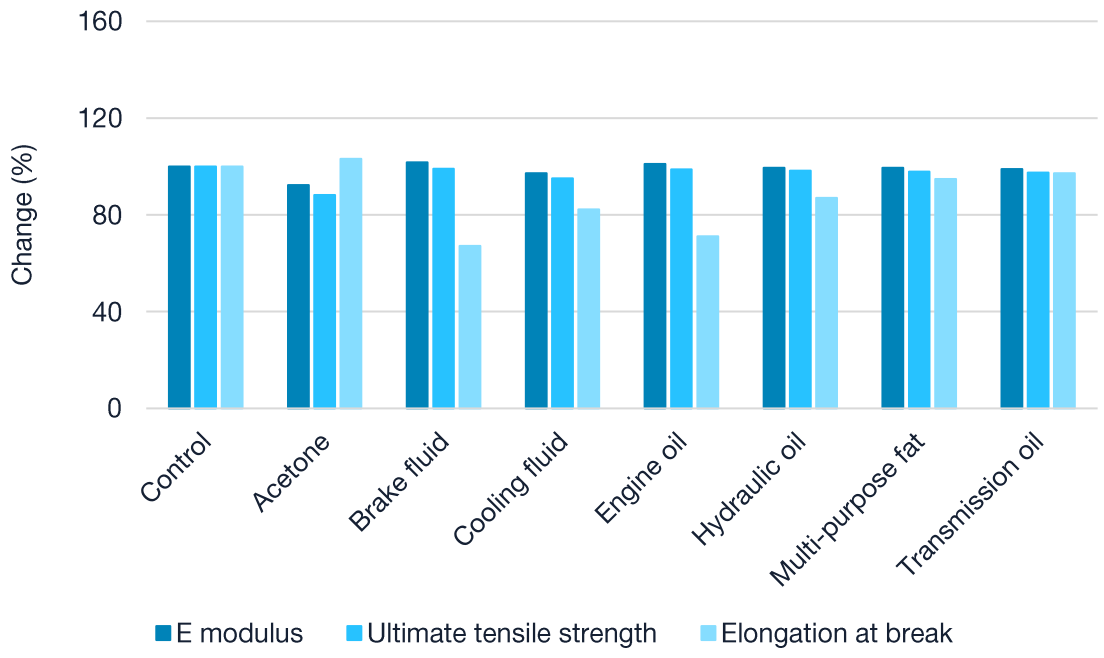
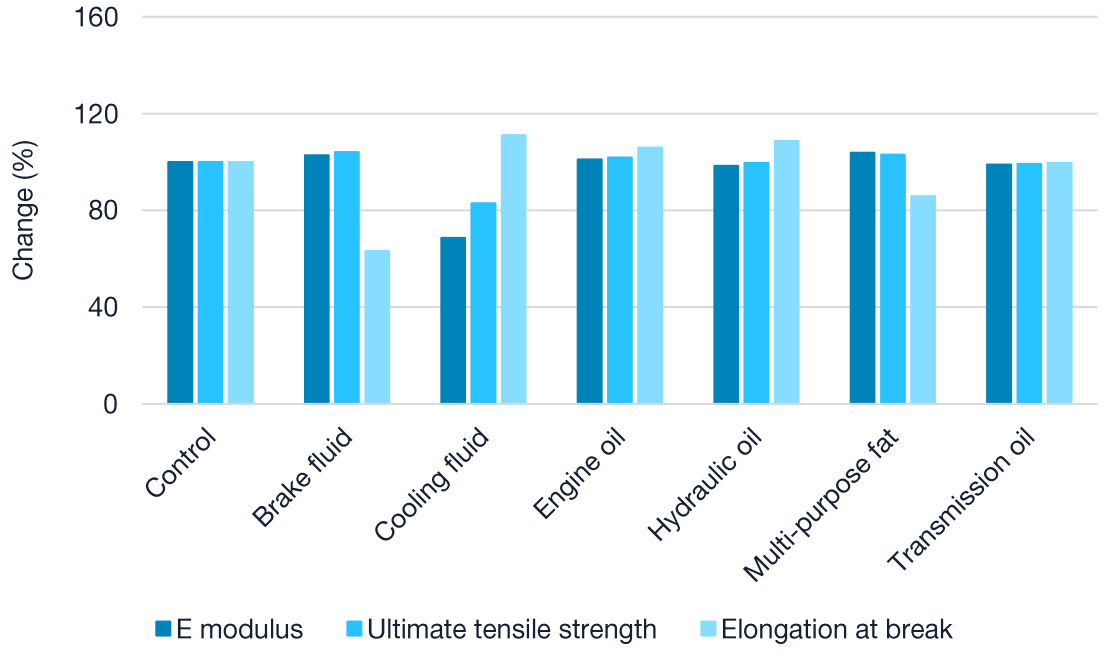
Mechanical Testing

30 minutes



Change in mechanical properties after 30 minutes immersion

7 days



Change in mechanical properties after 7 days immersion

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Long-Term UV

Durability is a key feature for the components utilized within many industries, as they expect the materials used to withstand years of exposure to the elements. Through the effects of UV radiation, photopolymers can degrade over time. The aging can be caused by the influence of UV light, heat and water. The degree of ageing depends on duration and intensity.

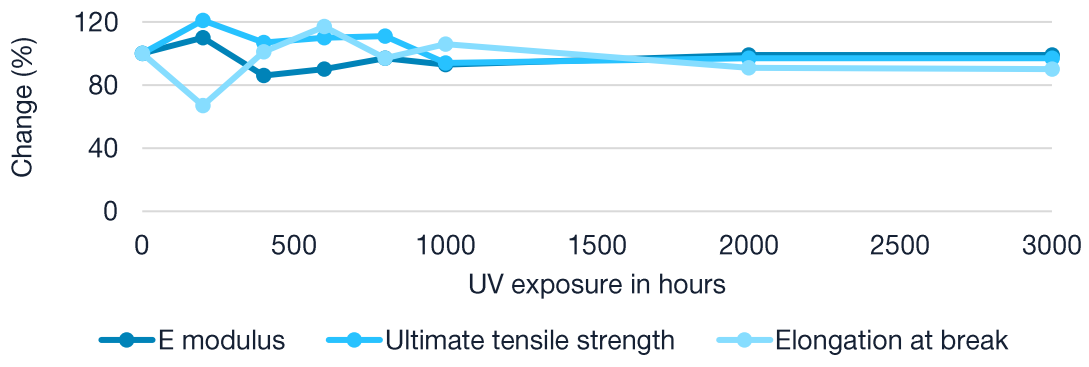
Test Method and Specimens

The ageing tests were performed with ASTM D638 type IV tensile bars and color cones as per ISO 4892-2:2013 method A, cycle 1.

Cycle No.	Exposure period	Irradiance		Black standard temperature in °C	Chamber temperature in °C	Relative humidity in %
		Broadband (300 nm to 400 nm) in W/m²	Narrowband (340 nm) in W/(m² nm)			
1	102 min dry	60 ± 2	0.51 ± 0.02	65 ± 3	38 ± 3	50 ± 10
	18 min water spray	60 ± 2	0.51 ± 0.02	-	-	-

Testing conditions for ISO 4892-2 method A, cycle 1

Mechanical Testing



Change in mechanical properties after accelerated weathering

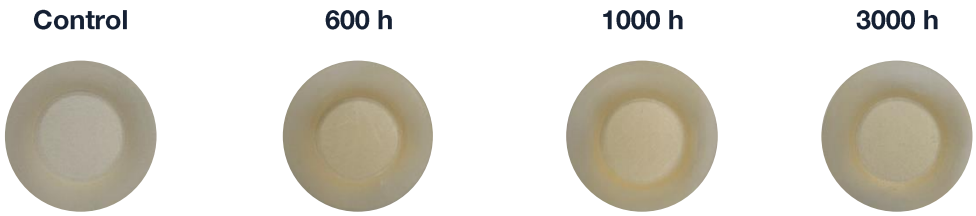
The final values after 3000 hours of long-term UV exposure can be found below.

Property	Before long-term UV exposure	After 3000 hours of UV exposure
E modulus	1797 MPa	1774 MPa
Ultimate tensile strength	45 MPa	44 MPa
Elongation at break	11%	10%

Mechanical properties before and after 3000 hours of UV exposure as per ISO 4892:2 method A

Coloration

After being exposed up to 3000 hours, visible yellowing can be seen.



Effect of UV exposure on color of the specimens

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Sterilization

Sterilization is an essential requirement in many applications especially when used in the medical field. Testing not only ensures the material quality but also determines how effectively the chosen sterilization process is eliminating potential microorganisms.

Test Method and Specimens

Ethylene Oxide (EtO) Sterilization

EtO sterilization parameters	Settings
Preconditioning temperature	48°C
Preconditioning humidity	60%
Preconditioning time	8 hours
Chamber temperature	45°C
Vacuum	75 mbar A
EO dwell time	3 hours
EO concentration (calculated)	610 mg/l
Postconditioning time	48 hours
Postconditioning temperature	45°C

Testing conditions Ethylene Oxide

Steam Sterilization

Steam sterilization parameters	Settings
Vacuum pulses	4
Temperature	134°C
Pressure	210 kPa
Holding time	4 minutes
Drying time	20 minutes

Testing conditions steam sterilization

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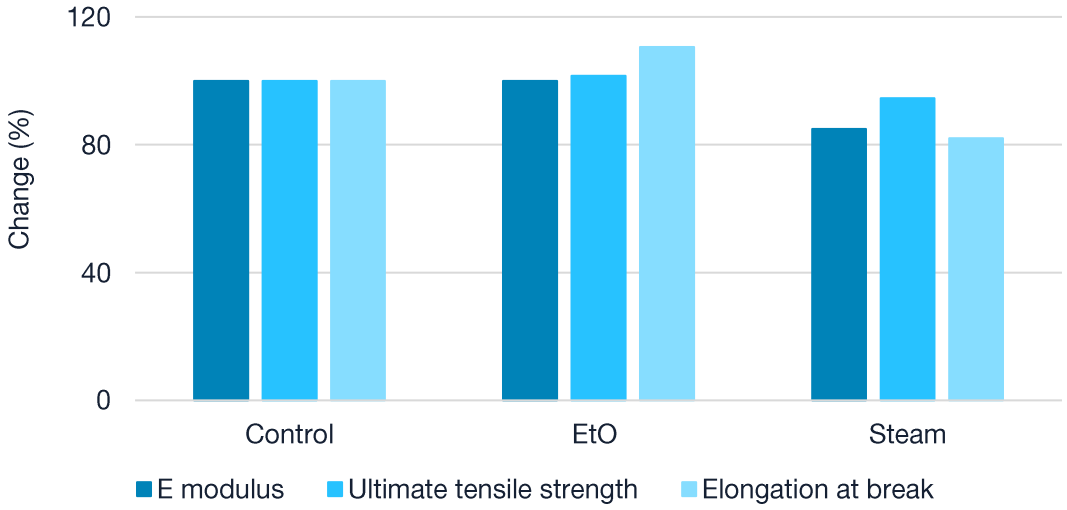
Mechanical Testing



Change in mechanical properties after sterilization

Biocompatibility

Product: Ultracur3D® ST 80

Revision: 16th of August 2021

3D printed test items of the above stated product have fulfilled the requirements of tests as stated below:

Cytotoxicity Testing- Neutral red:
(EN ISO 10993-5 (2009))
Human Skin Irritation Test:
(EN ISO 10993-10 (2013))[6)]
In vitro Skin Irritation Testing:
(OECD Guideline No. 439)
In vitro Sensitization Testing- KeratinoSens™
(prEN ISO 10993-10 (2020))

6) Patch test on 10 volunteers.

Additionally

In vivo Sensitization Testing- Local Lymph Node Assay (ISO 10993-10 (2013); OECD Guideline No. 429) was also performed
The 3D printed test item, Ultracur3D® ST80, was found to be **no skin sensitizer** under the test conditions of this study, **when extracted with the polar extract** in 30 wt% ethanol solution (EtOH).

The biocompatibility tests were recorded on test specimen of the referenced product to show compatibility of the material in general. The biocompatibility tests listed are not part of any continuous production protocol. The test assessments reflect only the test specimen and have to be retested on the final product. It remains the responsibility of the de-vice manufacturers and /or end-users to deter-mine the suitability of all printed parts for their respective application.

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