FORWARD AM
Innovating Additive Manufacturing

BASF
We create chemistry

Ultracur3D® RG 35

Rigid | HDT 80 | Clear

Extended TDS

Complete Technical Documentation and Testing Summary

Version: 2.0

Contents

Technical Data Sheet

Rigid resin with optimum combination of strength, stiffness and temperature resistance.

General Properties	Norm	Typical Values
Appearance	-	Clear
Viscosity, 25°C	Cone/Plate Rheometer[1)]	900 mPas
Viscosity, 30°C	Cone/Plate Rheometer[1)]	600 mPas
Density (Printed Part)	ASTM D792	1.2 g/cm³
Density (Liquid Resin)	ASTM D4052-18a	1.12 g/cm³

Tensile Properties[2)]	Norm	Typical Values
E Modulus	ASTM D638	2600 MPa
Ultimate Tensile Strength	ASTM D638	80 MPa
Elongation at Break	ASTM D638	6%

Flexural Properties	Norm	Typical Values
Flexural Modulus	ASTM D790	2400 MPa
Flexural Strength	ASTM D790	110 MPa

Impact Properties	Norm	Typical Values
Notched Izod (Machined), -30°C	ASTM D256	11 J/m
Notched Izod (Machined), 23°C	ASTM D256	23 J/m
Unnotched Izod, 23°C	ASTM D256	115 J/m
Notched Charpy (Machined), 23°C	ISO 179-1	0.6 kJ/m²

Thermal Properties	Norm	Typical Values
HDT at 0.45 MPa	ASTM D648	83°C
HDT at 1.82 MPa	ASTM D648	64°C
Flammability	UL 94 (1.5 mm)	HB
Glow-wire Test	IEC 60695-2-12/-13 (2 mm)	GWIT: 650°C GWFI: 625°C

Thermal Properties	Norm	Typical Values
Glass transition temperature (DMA, tan(d))	ASTM D4065	119°C

Dielectric/Electric Properties	Norm	Typical Values
Electrical Strength	DIN EN 60243-1	37 kV / mm

Biocompatibility	Norm	Typical Values
Cytotoxicity – Neutral Red	ISO 10993-5 (2009)	PASS[4)]
Human Skin Irritation[3)]	ISO 10993-10 (2013)	PASS[4)]
In Vivo Sensitization – Local Lymph Node Assay	ISO 10993-10 (2013); OECD Guideline No. 429	PASS[4)]
Systemic Toxicity – In Vitro Endotoxins and Pyrogens Detection	ISO 10993-11 (2018)	PASS[4)]
In Vitro Skin Irritation	OECD Guideline No. 439	PASS[4)]

Other	Norm	Typical Values
Hardness Shore D	ASTM D2240	85
Water Absorption, Short-Term (24 hours)	ASTM D570	0.33%
Water Absorption, Long-Term (>4000 hours)	ASTM D570	2.40%

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 50 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 D648 127 x 3.2 x 13 mm, ISO 179-1 80 x 4 x 10 mm, UL 94 125 x 1.5 x 13 mm, IEC 60695-2-12/-13 60 x 2 x 60 mm.

International Material Data System (IMDS)

This material is listed in the IMDS (International Material Data System), which contains information on materials used in the automotive industry. Access to the database can be granted on request by sharing the IMDS ID with us (sales@basf-3dps.com).

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.

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.

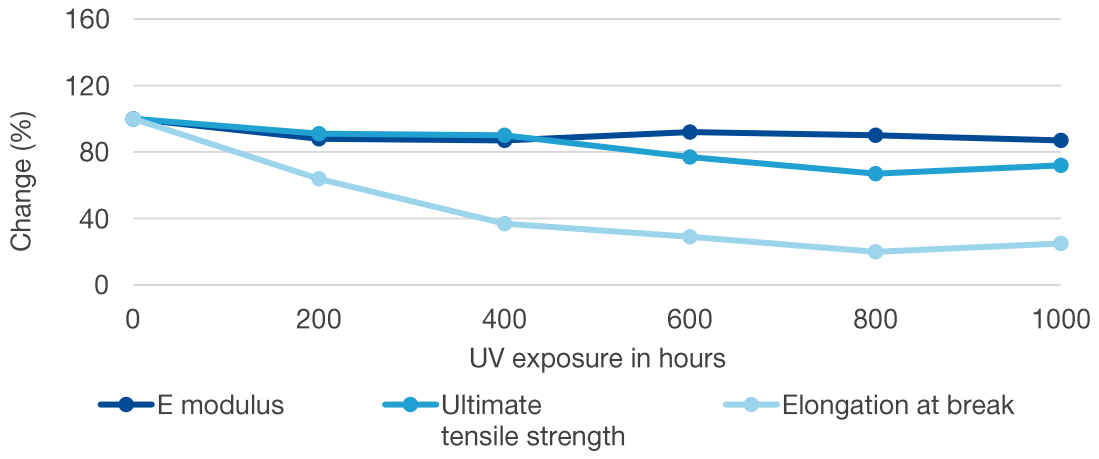
Test Method and Specimens

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 tempera-ture in °C	Chamber tempera-ture 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 1000 hours of long-term UV exposure can be found below.

Property	Before long-term UV exposure	After 1000 hours of UV exposure
E modulus	2870 MPa	2510 MPa
Ultimate tensile strength	70 MPa	50 MPa
Elongation at break	10%	2%

Mechanical properties before and after 1000 hours of UV exposure as per ISO 4892:2 method A

Coloration

After being exposed up to 1000 hours, only slight additional yellowing compared to the reference sample could be detected.

Effect of UV exposure on color of the specimens

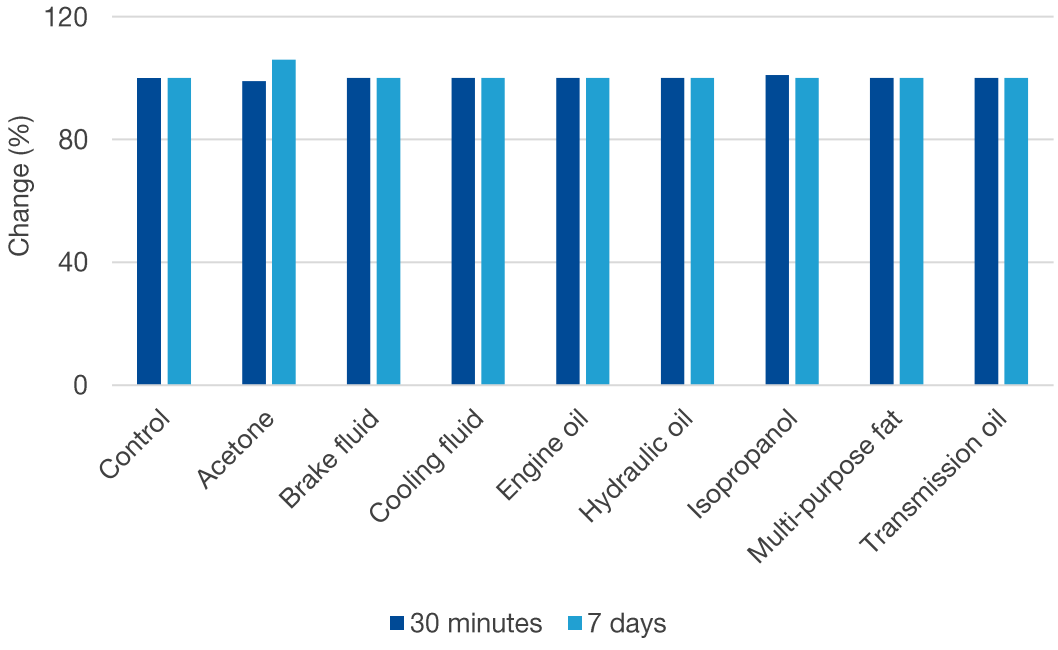
Industrial Chemical Resistance

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.

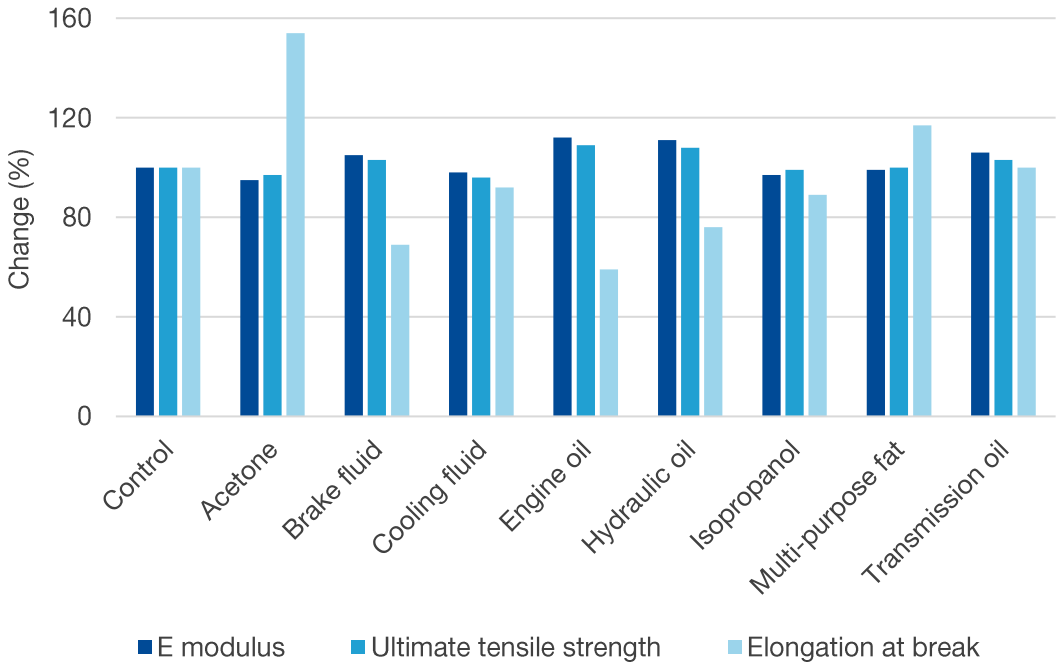
Weight Measurement



Change in weight after immersion time

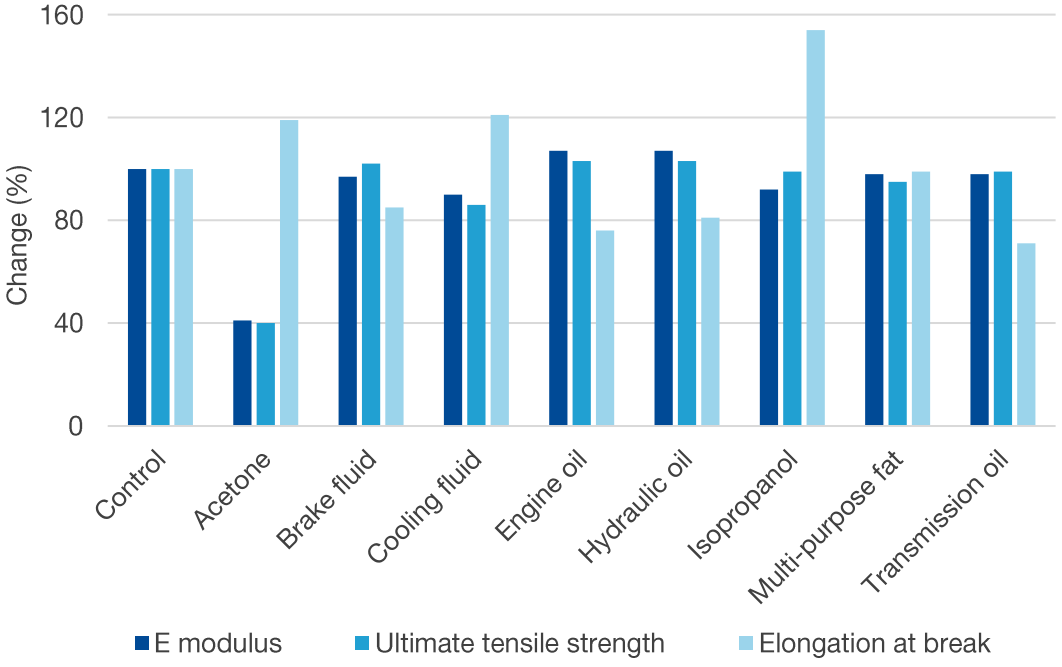
Mechanical Testing

30 minutes



Change in mechanical properties after 30 minutes immersion

7 days



Change in mechanical properties after 7 days immersion

Biocompatibility

Product: Ultracur3D® RG 35

Revision: 29th of March 2021

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

Cytotoxicity Testing- Neutral Red:

(ISO 10993-5 (2009))

In Vitro Skin Irritation Testing:

(OECD Guideline No. 439)

Human Skin Irritation Test:

(ISO 10993-10 (2013))[6)]

In Vivo Sensitization Testing- Local Lymph Node Assay:

(ISO 10993-10 (2013); OECD Guideline No. 429)

Systemic Toxicity - In Vitro Endotoxins and Pyrogens Detection:

(ISO 10993-11 (2018))

6) Patch test on 10 volunteers.

The biocompatibility tests were recorded on test specimen of the above 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 device manufacturers and /or end-users to determine the suitability of all printed parts for their respective application.

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

Four different sterilization techniques were tested according to the conditions listed below, and their effect on mechanical properties and part color was investigated.

E-Beam Sterilization

The samples were exposed to 36.04 – 39.26 kGy (calculated dose).

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

Gamma Sterilization

The samples were exposed to 37.1 – 37.5 kGy gamma radiation (measured via dosimeter).

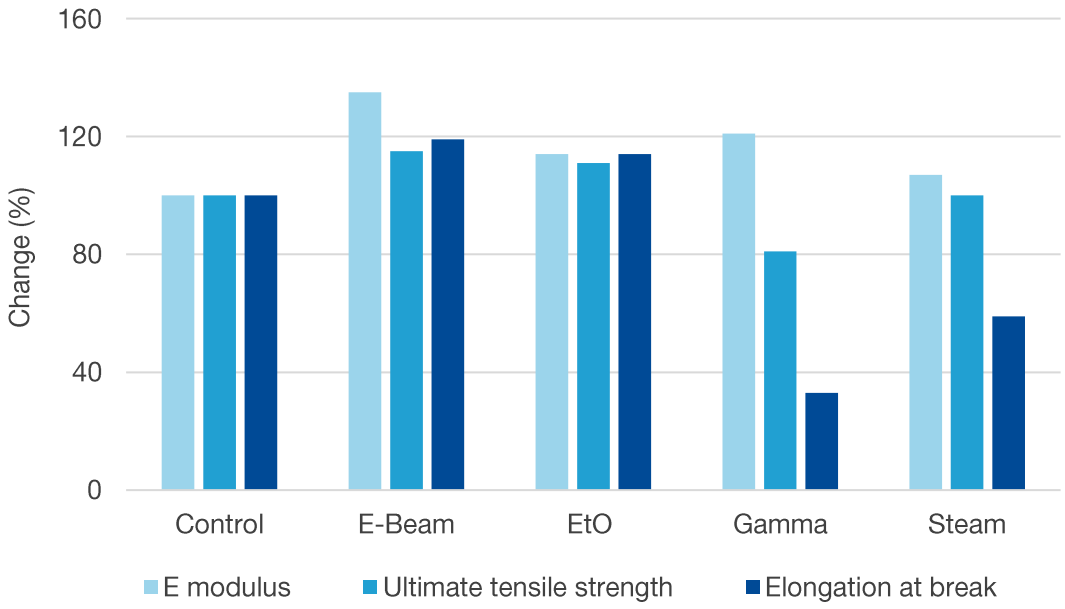
forward-am.com +49 6221 67417 900 sales@basf-3dps.com

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

Mechanical Testing



Change in mechanical properties after sterilization

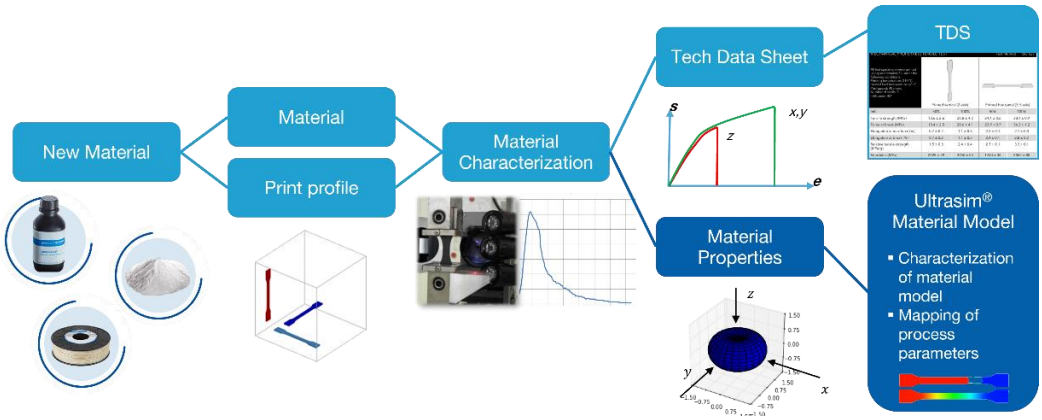
Coloration

Depending on the sterilization process used, different changes in color could be observed as shown below.

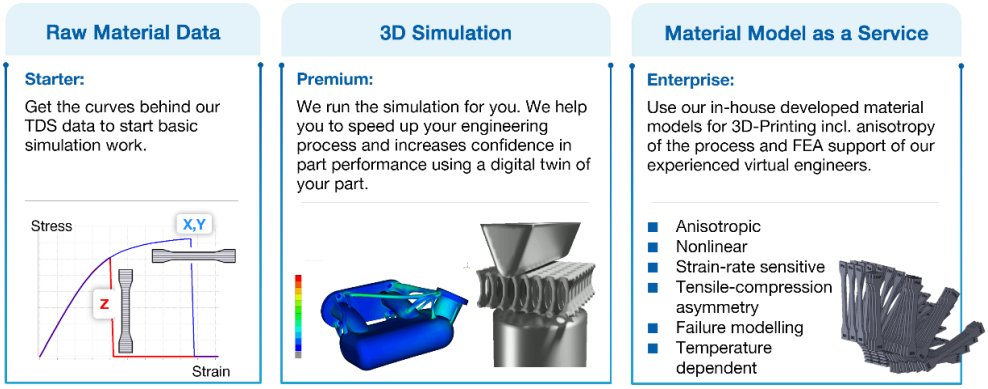
Color discs before and after sterilization

Material Model & FEA Simulation

3D simulation helps to speed up the engineering process using a digital twin. We offer 3 easy methods to get started. Support is available on request (ultrasim3d-support@basf-3dps.com).



Material modeling workflow



Ultrasim® 3D simulation (FEA)

	Available temperatures			Strain rate / loads		Print Orientation / Aniso-tropy
	Low	23°C	High	Quasi static	High speed	
Ultracur3D® RG 35		●		●		

● Validated, available as Material Data Set (Can be converted into a Ultrasim® Material Model)

● Validated, available via Ultrasim® Material Model

○ ○ Preliminary

Simulation material availability