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Technical Data Sheet

x45 Natural, x45 Clear, and x45 Black

Multi-purpose resin with optimum toughness and processing speed

Mechanical Properties *

Tensile Properties	Test	Typical Values
Tensile Modulus	ASTM D638	>1.6 GPa
Ultimate Tensile Strength	ASTM D638	>52 MPa
Tensile Elongation at Break	ASTM D638	>12 %

Impact Properties	Test	Typical Values
Notched Izod (Machined), -30 °C	ASTM D256	20 J/m

Flexural Properties	Test	Typical Values
Flexural Modulus	ASTM D790	>2.1 GPa
Flexural Strength	ASTM D790	>95 MPa

Hardness	Test	Typical Values
Shore D	ASTM D2240	84

Other	Test	
Water Absorption	ASTM D570	6.00%

* Data based on testing by BASF. This information is representative only. Contact your Nexa3D Technical Service Team for further information.

1) Determined with TA-Instrument DHR rheometer, cone/plate, diameter 60 mm, shear rate 100 s^{-1}

Version 4.0

Long term UV tests on
Ultracur3D® ST 45 **

This document is intended to provide guidance for manufacturers regarding ageing of the 3D printed materials under Ultraviolet radiation or UV. BASF3D Printing Solutions GmbH has performed specific ageing tests for the material Ultracur3D® ST 45. Indications on material changes that can occur during the ageing process were studied. It remains the responsibility of the end-users to determine the suitability of all printed parts for their respective application.

Material

Material
Ultracur3D® ST 45

Norm

The Ageing tests were performed at BASF lab as per the ISO Norm ISO 4892-2:2013 Method B. The specimens were kept under UV light in the range of 300 – 400 nm and intensity of 50 W/cm^2. The parts were kept behind a glass window in a chamber at 38°C with 50% relative humidity. The parts were kept inside the chamber for up to 4032 hours, where 1000 hours correspond to roughly one year of UV exposure. The table below describes the testing conditions.

Table 1: Testing conditions for ISO 4892-2

Method B — Exposures using window glass filters						
Cycle No.	Exposure period	Irradiance		Black-standard temperature °C	Chamber temperature °C	Relative humidity %
		Broadband (300 nm to 400 nm) W/m^2	Narrowband (420 nm) W/(m^2·nm)			
2	Continuously dry	50 ± 2	1,10 ± 0,02	65 ± 3	38 ± 3	50 ± 10[c]

Test Specimens

35 tensile bars were printed with the material and were kept under high intensity UV light for longer period of time. After the tensile bars were inside the UV oven for a stipulated time, the change in color as well as the mechanical properties like E modulus, Tensile strength and Elongation at break were measured.

Figure 1: ASTM D638 Type IV – Tensile Bar

Coloration

The material Ultracur3D® ST 45 when printed and post cured shows a little bit of a yellow coloration. After being exposed to UV for up to 4032 hours, the pigmentation or the yellowing of the material was significant. This is however, expected from a clear photopolymer material.

Figure 2: Effect of UV exposure on color of the specimens

Mechanical testing

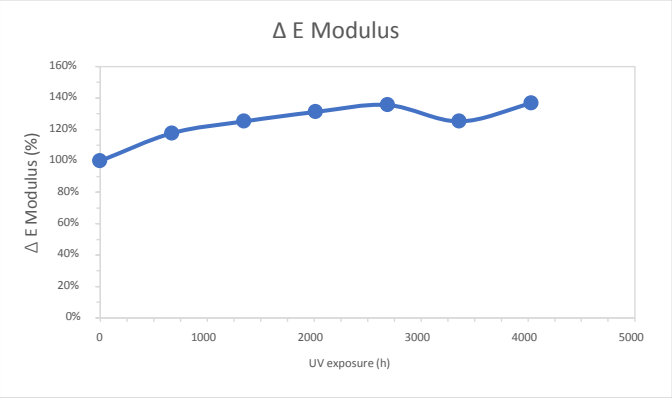

Figure 3: Change in E Modulus vs. UV exposure time

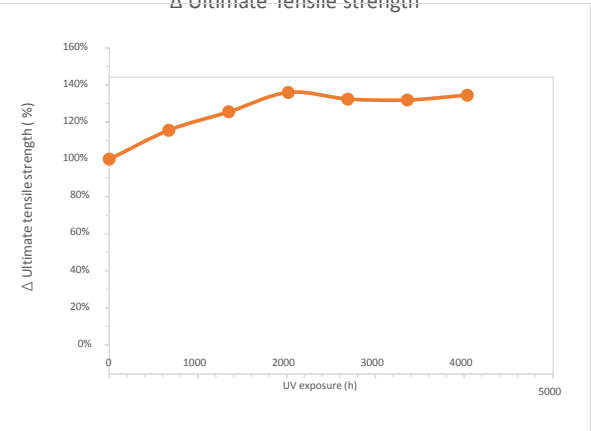

Figure 4: Change in Ultimate tensile strength vs. UV exposure time

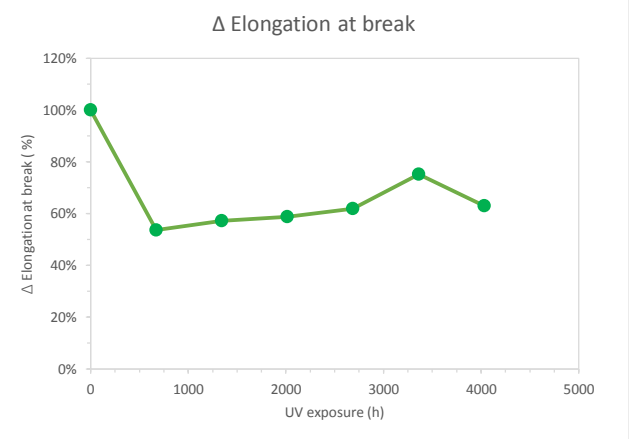

Figure 5: Change in Elongation at break vs. UV exposure time

Conclusion

The results of the performed tests show that **Ultracur3D® ST 45** can be summarized in the table below. **

Long term UV test behind the glass window	Ultracur3D® ST 45
Coloration	☹ The material gets yellowish with time
Mechanical properties	😐 Elongation at break reduces first and then stabilizes after prolonged exposure to UV radiation
	😊 The E modulus and tensile strength slightly increases after prolonged exposure to UV radiation

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Biocompatibility **

Material Name	*ISO 10993-5 Cytotoxicity*	*ISO 10993-10 Skin Irritation*	*ISO 10993-10 Skin sensitization*	*ISO 10993-11 Systemic Toxicity Endotoxins and pyrogens detection*
Ultracur3D® RG 35	😊	😊	😊	😊
Ultracur3D® ST 45	😊	😊	😊	🔒
Ultracur3D® ST 45 M	😊	🔒	🔒	🔒
Ultracur3D® ST 45 B	😊	🔒	🔒	🔒
Ultracur3D® ST 80	😊	😊	😊	🔒
Ultracur3D® EL 60	😊	😊	😊	🔒
Ultracur3D® EL 150	✍	⏳	😊	🔒
Ultracur3D® FL 60	✍	🔒	🔒	🔒
Ultracur3D® FL 300	✍	⏳	😊	🔒
Ultracur3D® EPD 1006	😊	✍	🔒	🔒
Ultracur3D® EPD 4006	😊	🔒	🔒	🔒

Legend

Symbol	*Meaning*
😊	Passed
☹	Not Passed
⏳	Waiting/In Progress
✍	Planned
🔒	Not Planned*

* (possible on customer request)

** Data based on testing by BASF

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.

Rev.4.0

Sterilization Results **

Ultracur3D® ST 45

This document is intended to provide guidance for manufacturers regarding sterilization of the 3D printed materials. BASF3D Printing Solutions GmbH has performed specific sterilization tests for the materials 3D printed employing Ultracur3D® ST 45. Indications on material changes that can occur during the sterilization process were studied. It remains the responsibility of the device manufacturers and/or end-users to determine the suitability of all printed parts for their respective application.

Material

Material
Ultracur3D® ST 45

Print scene and Test Specimens

Three different test parts were chosen, to help determine the impact of the sterilization.

1. *Color disc* (Figure 1) to measure the color of the material before and after sterilization.
2. *Cytotoxicity disc* (Figure 2) to be able to assess the cytotoxic potential
3. *Tensile Bars* (Figure 3) to check possible changes in mechanical properties.

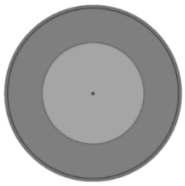

Figure 1: Color disc 2 mm

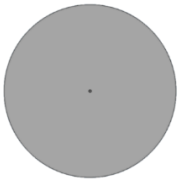

Figure 2: Cytotoxicity disc

Figure 3: ASTM D638 Type IV – Tensile Bar

Overall the following amount of specimens were printed for each test:

- 10 Tensile Bars
- 1 Color disc
- 3 Cytotoxicity disc

The test specimens were provided to the external laboratory (Steris GmbH) for EtO sterilization treatment. Steam Sterilization was performed internally.

Ethylene Oxide (EtO) Sterilization

Information on the process data of the cycle

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

When exposed to EtO sterilization, Ultracur3D® ST 45 demonstrates a 36 % increase in elongation at break and 16 % decreases in modulus. The samples also show a 7 % decrease in ultimate strength. The test specimens show a small color change but become **slightly lighter and more clear** post-sterilization. EtO residuals level after exposure were not recorded.

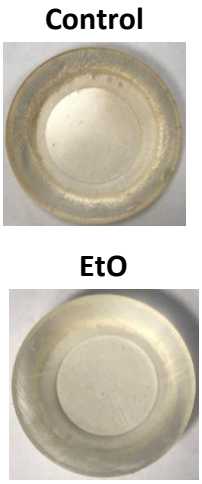

Figure 4: Color discs before and after EtO sterilization

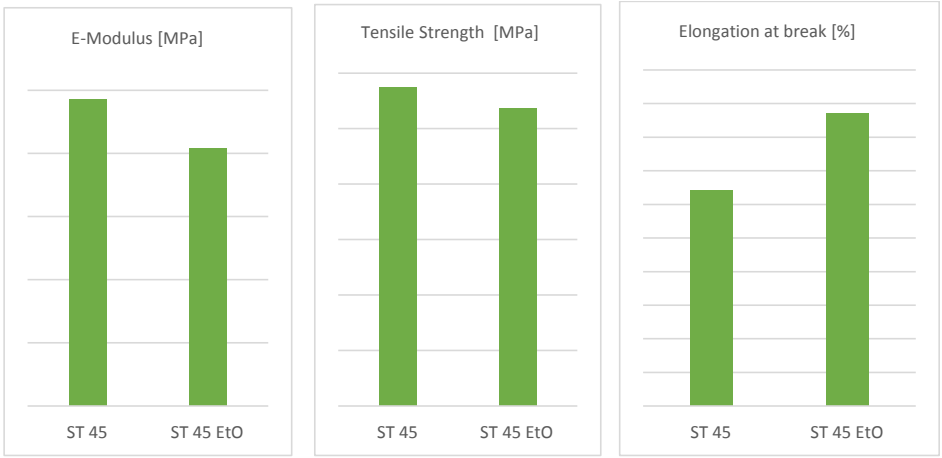

Figure 5: Tensile properties comparison of the EtO-treated samples

EtO sterilization can be suitable for Ultracur3D® ST 45, but the mechanical property changes needs to be taken into consideration by the user.

Steam Sterilization

Information on the process data of the cycle

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

When exposed to steam sterilization, Ultracur3D® ST 45 demonstrates a 23 % decrease in elongation at break and 8 % increases in modulus. The samples also show a 2 % increase in ultimate strength. The test specimens show a color change but become **lighter and clear** post-sterilization.

Control

Steam Sterilization

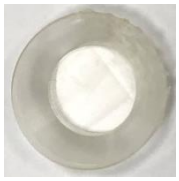

Figure 6: Color discs before and after Steam sterilization

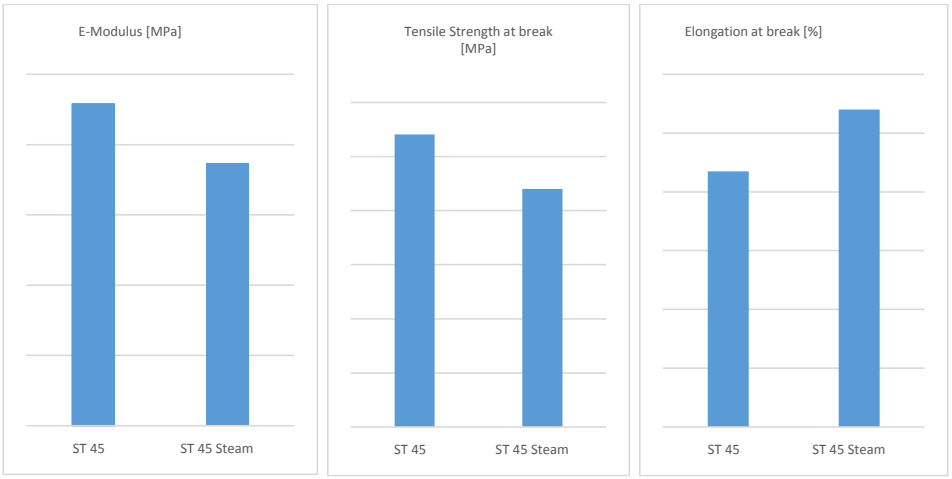

Figure 7: Tensile properties comparison of the Steam-treated samples

Steam sterilization is not recommended for Ultracur3D® ST 45.

Conclusion

The results of the performed tests show that **Ultracur3D® ST 45** can be summarized in the table below.

Sterilization Method	Ultracur3D® ST 45
EtO	😐 recommended, but depend on the final application case
Steam*	☹ not recommended

*Additional information available in a separate document on demand.
** Data based on testing by BASF

The data contained in this publication are based on our current knowledge and experience. They do not constitute an agreed contractual quality of the product and, in view of the many factors that may affect processing and application of our products, do not relieve processors from carrying out their own investigations and tests. The agreed contractual quality of the product at the time of transfer of risk is based solely on the data in the specification data sheet. Any descriptions, drawings, photographs, data, proportions, weights, etc. given in this publication may change without prior information. The customer and/or user is responsible to consider and respect all hazard and safety issues according to the MSDS of Ultracur3D® ST 45 and take, implement and/or install adequate measures and precautions to avoid any personal injuries, property damages and/or environmental pollution. Therefore, BASF3D Printing Solutions GmbH shall not be liable for any personal injury, property damages and/or environmental emissions arising out of or related to the testing, handling or usage, storage and possession of Ultracur3D® ST 45. It is the sole responsibility of the recipient of our product to ensure that any proprietary rights and existing laws and legislation are observed (02/2020)