

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 device manufacturers and/or 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/cm². 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. The table below describes the testing conditions.

Table 1 Testing conditions for ISO 4892-2 method B

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/m ²	Narrowband (340 nm) in W/(m ² nm)			
1	Continuously dry	50 ± 2	1.10 ± 0.02	65 ± 3	38 ± 3	50 ± 10

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 Tensile Bar

Mechanical testing

When looking at the mechanical properties of the material, the elastic modulus and the ultimate tensile strength increase gradually over time, whereas elongation at break first shows a significant drop, but then also slowly increases over time.

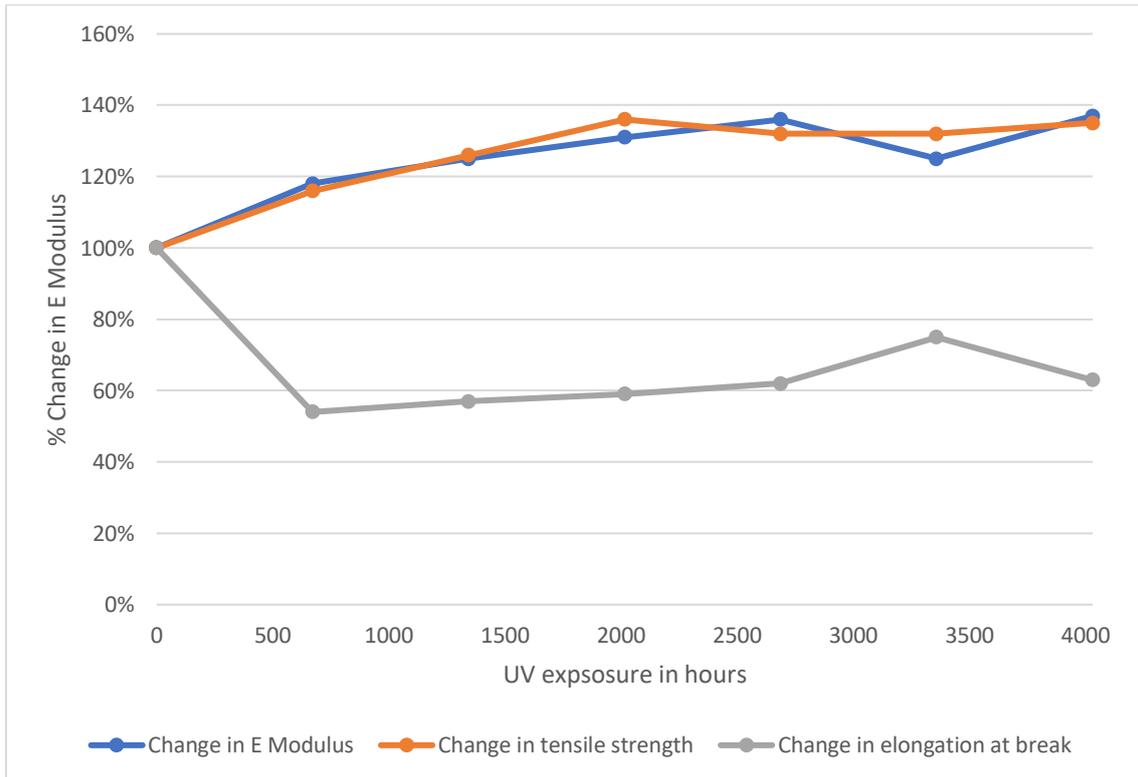


Figure 2 Change in mechanical properties over the course of 4032 hours of UV exposure

After around 4000 hours of long-term UV exposure, the final values can be seen in the table below:

Table 2 Mechanical properties before and after 4032 hours of UV exposure as per ISO 4892:2 method B

Property	Before Long term UV exposure	After 4032 hours of UV exposure
Elastic modulus	1840 MPa	2515 MPa
Ultimate tensile strength	54 MPa	73 MPa
Elongation at break	15 %	5.58 %

Coloration

The material Ultracur3D® ST 45 unfortunately shows visible yellowing after long UV exposure times.



Figure 3 Effect of UV exposure on color of the specimens

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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