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## UVC exposure (265 nm) of UV sensitive material at different irradiation levels

(1 appendix)

RISE Research Institutes of Sweden has evaluated the colour shift for a 100 mJ/cm<sup>2</sup> UVC indicator after exposure to irradiation from a 265 nm UVC LED. The colour of the indicator after exposures of 0, 5, 10, 25, 50 and 100 mJ/cm<sup>2</sup> was measured and evaluated using the 1976 CIE Lab colour space.

### Identification

Object	Yellow 100 mJ/cm <sup>2</sup> UVC indicator.
Object state	Upon arrival the sample had no visual damage and were without any colour changes.
Location	Borås, Sweden
Measurement date	Jan 13, 2020

### Measurement methods and procedures

Small pieces of the sample were exposed by UVC-radiation from an UVC LED with peak wavelength 265 nm (nominal). The irradiation level at the sample plane (about 1000 μW/cm<sup>2</sup>) was determined by a calibrated silicon detector with a precision aperture in front of the detector's photosensitive surface.

Each sample piece was exposed a certain time corresponding to exposure levels of 5, 10, 25, 50 and 100 mJ/cm<sup>2</sup>. The colour of the exposed area was measured using a spectrophotometer Perkin-Elmer Lambda 900 equipped with an Ø150 mm integrating sphere, using the geometry 8°/total. Also, a picture of the exposed sample was taken in a light both using D65 illumination with high colour rendering index (> 95).

Based on the colour coordinates in CIE 1976 L\* a\* b\* colour space (reference illuminant CIE D65, 2° observer), the total colour difference ΔE\* relative to a non-exposed sample was determined as:

$$\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$$

where ΔL\*, Δa\* and Δb\* are the differences between the individual coordinates.

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## Measurement conditions

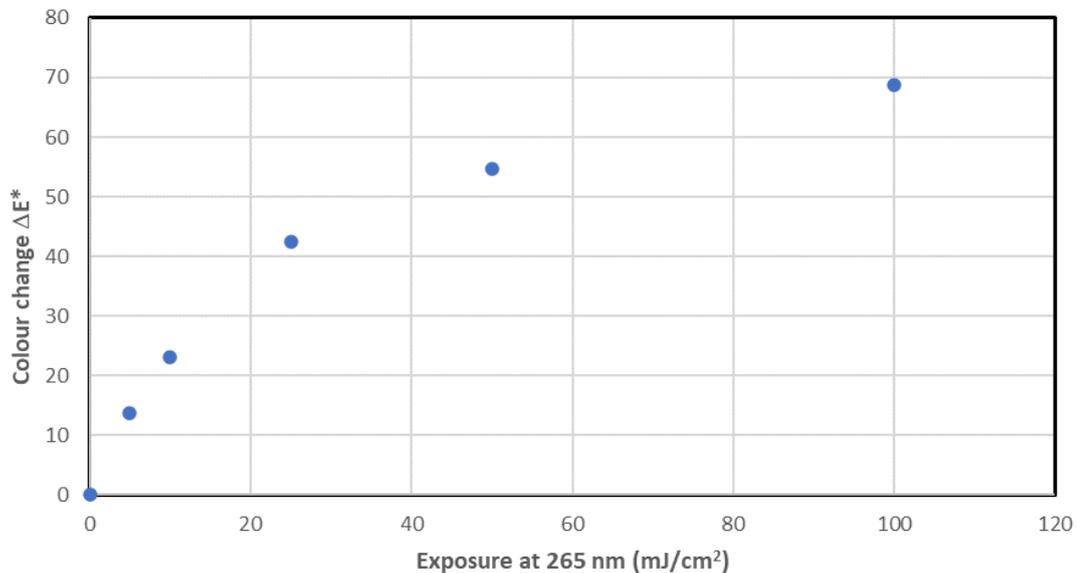
Ambient temperature	23 ±2 °C
Sample temperature (during exposure)	25 ±5 °C
Exposure wavelength	265 ±2 nm (peak wavelength)

## Results

The results only refer to the object specified in this document. Pictures of the sample at the different exposure levels are shown in the appendix.

**Table 1.** Measured colours and colour changes at different exposure levels.

Exposure mJ/cm <sup>2</sup>	CIE 1976 L*a*b* colour coordinates			Colour difference ΔE*
	L*	a*	b*	
0	87,7	0,2	51,9	0,0
5	82,1	7,6	41,8	13,7
10	78,3	12,2	34,6	23,0
25	70,6	22,0	19,7	42,5
50	67,0	28,2	9,7	54,7
100	63,1	34,3	-2,5	68,8



**Figure 1.** Colour change at different exposure levels relative to an unexposed sample-

The uncertainty is estimated to ±8 % of the reported exposure levels. The measurement uncertainty for L\*, a\* and b\* is ±2,0.

## Equipment

Reference silicon detector 10×10 mm, inv.no. 500963  
Stanley UVC LED (265 nm), type ZEUBE265-2CA  
Picoammeter Keithley 6485, inv.no 603159  
Precision aperture Ø7 mm, inv.no. 502607  
Spectrophotometer PE Lambda 900, inv.no. 503052  
Accessory devise for geometry 8°/t, inv.no. 503059  
Light booth True Color TC-60  
iPhone 11Pro camera

## **RISE Research Institutes of Sweden AB** **Measurement Science and Technology - Time and Optics**

Performed by

Stefan Källberg

## **Appendix**

Pictures of the samples at different exposure levels

## Appendix 1

**Pictures of the samples at different exposure levels**