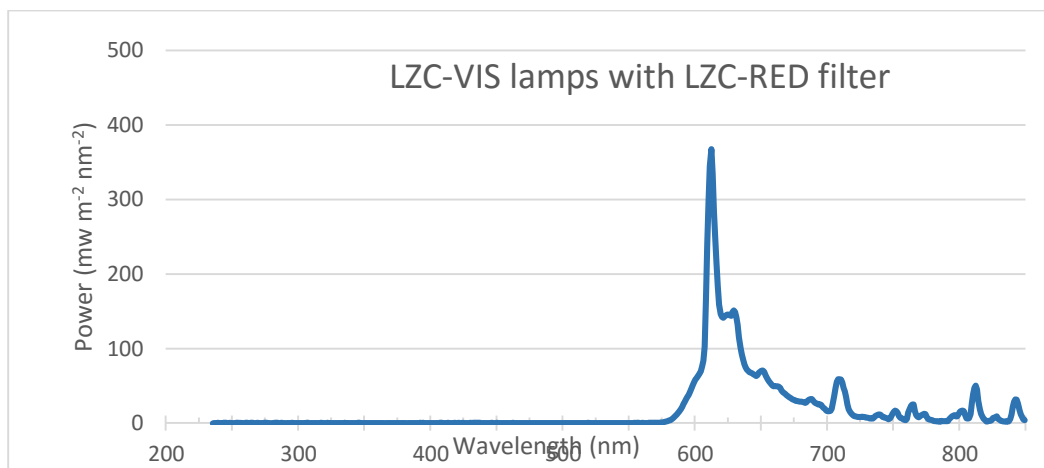


March 8, 2016

TECHNICAL RELEASE
LUZCHEM EXPOSURE STANDARD: LES-RED-16

General information: Luzchem Research, Inc. produces and distributes freely these standards as a service to scientists involved in research in photochemistry, photobiology and photostability. These standards are available in Luzchem's website so that references to any of our standards can be used to define exactly conditions of exposure, and should allow other scientists to readily replicate irradiation conditions. Luzchem has used a calibrated Luzchem SPR-4001 (s/n 047) spectroradiometer calibrated on January 26, 2016. The SPR-4001 is calibrated using NIST traceable lamps: Spectra Physics Deuterium Lamp (UV) Model 63945 Serial # 667172 Calibrated September 2013, and Spectra Physics Tungsten Halogen Lamp (VIS) Model 63355 Serial #7-1769R2 Recalibrated November 2013 and to the best of our knowledge spectral information is accurate within the experimental bandwidth of 2 nm.

Lamp Type	Luzchem LZC-VIS	Internal surface	Unpolished scattering aluminum
Filter	LZC-RED sleeve	Chamber Temp.	25 °C
Filter effect	Direct and reflected exposure	Measurement date	March 7, 2016
Photoreactor model	LZC-ICH2	Monitored range	235 to 850 nm
Number of lamps	8 overhead lamps, side lamps not used.	Harmonic peak interference	None observed
Measurement distance	~ 18 cm lamp to target	Resolved peaks	611, 631(broad), 713, 810 nm



Region	Range, nm	Dose mw*m ⁻²	% energy
UVA	315-400	0	<1%
UVB	280-315	0	<1%
UVC	235-280	0	<1%
Visible	400-700	9110	82%
NIR	700-850	2,010	18%

The table to the left shows the energy distribution at the target, expressed as a percentage of the total energy, and as a percentage of the number of photons. The calculations refer to the monitored range indicated above. The division between UVA and UVB has been taken as 315 nm.

- (1) The same spectral information should also apply to other photoreactors constructed of the same materials, including all of Luzchem models.
- (2) For details of Luzchem's spectra determinations see Technical Release: Recording of Luzchem Exposure Standards.

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