

Notes on Safe Exposure to UV Radiation

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Purpose: Comments on safe exposure to UV light from LED sources.

Disclaimer: Equipment users are responsible for operation of their UV LED equipment in compliance with their local and national regulations. These notes are provided for informational purposes only, and are not for a guarantee for safe operating conditions.

These notes are based on a phone conversation with Carol Mizuno of the Minnesota OSHA, Occupational Safety and Health Act. <http://www.doli.state.mn.us/mnosha.html>. She indicated that MN OSHA and the US Federal OSHA did not have any regulations on UV exposure. Since LEDs are incoherent, lambertian light sources, it is inappropriate to use the restrictions from lasers which are coherent and highly directional light sources. In the absence of Federal and State regulation, Carol Mizuno suggested that an alternate safety maybe found from the American Conference of Governmental Industrial Hygienist (ACGIH). (www.acgih.org). In 2006, the ACGIH published its annual TLV-BEI, Threshold Limit Value and Biological Exposure Indices. The section on UV exposure from traditional mercury gas and discharge lamps can be found on pages 169-172. (<http://www.acgih.org/store/ProductDetail.cfm?id=1824>). There is no section for UV LEDs.

Table 1 is taken from the 2006 TLV-BEI for the closest wavelength ranges relevant to Clearstone's UV LED products. The doses are the recommended maximum dose for exposed skin or eyes during a typical 8 hour working shift.

Table 1, recommended maximum doses for UV radiation.

		365 nm	400 nm
Dose for 8 hour shift	J/m ²	2.70E+05	1.00E+06
Dose for 8 hour shift	J/cm ²	2.70E+01	1.00E+02

The exposure duration can be estimated from the information in table 1 and the emitted power/area from Clearstone's UV LED heads. The calculated values are shown in table 2 for emission at 365 nm and 400 nm. Row three lists the time in seconds to accumulate the maximum recommended dose when the LED head is emitting the specified output power. The output power density is measured at the emission window. To allow for manufacturing tolerances, the typical power/area from the LED head is 10-30% greater than the minimum specified power/area found on the product specification sheets. Therefore, the calculations are repeated in row five at twice the specified power/area emission values. While the emitted values for present products will not be at these levels, it does provide some indicator of safety considerations for future generations of UV LED equipment.

Table 2. Calculated exposure duration to receive recommended exposure duration.

		365 nm	400 nm
1.	Dose for 8 hour shift	J/cm2	27 100
2.	Power/Area (G2 spec. @ z=0)	mW/cm2	124 267
3.	Time to dose	sec	218 375
4.	Power/Area 2x(G2 spec. @ z=0)	mW/cm2	248 534
5.	Time to dose	sec	109 187
6.	Power/Area (spec. @ z=5 cm)	mW/cm2	15 33
7.	Time to dose	sec	1800 3030

To receive the power/area indicated in rows 2 and 4, the exposed tissue must be pressed against the emission window, which would block the beam and therefore be unlikely during typical operation of the LED equipment. Row 6 lists power/area consistent with distances of 5 cm (2 in) from the LED head. This exposure level might occur if the operator holds the exposed material with bare hands during the emission. In these cases, the recommended maximum doses for 365 nm light would be accumulated after 1800 seconds (30 minutes) or 400 nm light after 3030 seconds (50.5 minutes). These exposure values could be exceeded during an 8 hour shift. Therefore, it is recommended that an operator not hold the item being exposed to the UV light. Alternately, the operator should wear opaque gloves during the exposure.

References:

Carol Mizuno, Senior Engineer, Minnesota OSHA, telephone: 651-284-5280, email: carol.mizuno@state.mn.us website: . <http://www.doli.state.mn.us/mnosh.html>.

American Conference of Governmental Industrial Hygienist (ACGIH). (www.acgih.org)
 2006 Annual TLV-BEI, Threshold Limit Value and Biological Exposure Indices, pages 169-172.