



To whom this may concern

December 17, 2021

### UV222™ lamps in compliance with ISO 15858

This letter confirms that the lamps **UV222™** from the Danish company **UV Medico A/S** are in compliance with the **ISO 15858**. The UV222™ are **filtered KrCl excimer lamps** with a central emission at a wavelength of **222 nm**.

The ISO 15858 is an international regulation for “UVC devices, safety information, and permissible human exposure”. UVC is defined as part of the electromagnetic spectrum with wavelengths in the range 200–280 nm. This ISO standard is applicable to any UVC devices which may cause UVC exposure to humans. In particular, it describes the **threshold limit values (TLVs)**, which are guidelines on UVC exposure level under which most people can work consistently for **8 hours a day**, day after day, without adverse effects. Specifically, **Article 5.2** of the ISO 15858 indicates that the maximum permissible UVC exposure shall not exceed the TLVs prescribed by the American Conference of Governmental Industrial Hygienists (**ACGIH**).

The relevant publication from the ACGIH is the **2021 edition** of the “Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®)”. Specifically, the section “Threshold Limit Values → Optical Radiation → Ultraviolet Radiation” on **pages 152–157** defines a **spectral weighting function S** which considers the wavelength dependence of the health effects of UV radiation on eye and skin. Its values are listed in Table 1 on page 154. For a wavelength of 222 nm: **S = 0.1316**.



For what follows three physical quantities are defined:

- the **irradiance** is the radiant power incident per unit area upon a surface, expressed in watts per square meter [ $\mu\text{W} / \text{cm}^2$ ];
- the **radiant exposure**  $H$  is the time integral of the irradiance, expressed in joules per square meter [ $\text{mJ} / \text{cm}^2$ ];
- the **effective radiant exposure**  $H_{\text{eff}}$  is the radiant exposure spectrally weighted by  $S(\lambda)$ , expressed in joules per square meter [ $\text{mJ} / \text{cm}^2$ ].

According to the ACGIH, for a daily exposure of **8 hours**, the **effective radiant exposure should be smaller than:**

$$H_{\text{eff}} = 3 \text{ mJ/cm}^2.$$

This means that the **radiant exposure** for the UV222™ lamps should be smaller than:

$$H = 3 \text{ mJ/cm}^2 / 0.1316 \approx \mathbf{23 \text{ mJ/cm}^2}.$$

If the UV222™ is **turned on continuously for 8 hours**, its **irradiance**  $I$  (optical power per unit area) should then be smaller than:

$$I = 23 \text{ mJ/cm}^2 / (8 \cdot 60 \cdot 60 \text{ s}) \approx \mathbf{0.80 \mu\text{W/cm}^2}.$$

Every UV222™ lamp from UV Medico is characterized by a UV-calibrated goniometer which measures the spatial and the spectral irradiance distribution. For a given distance from the lamp, the light irradiance is maximal at the center position normal to the front glass. In addition, as the distance from the lamp increases, the irradiance decreases. At one meter from the lamp, the maximum irradiance is:

$$I \approx \mathbf{13 \mu\text{W/cm}^2}.$$

This value is larger than the irradiance (of  $0.80 \mu\text{W/cm}^2$ ) corresponding to the TLV. This is in fact the case for distances up to about 4 meters. Therefore, the UV222™ lamps would exceed the TLV if they are turned on continuously. For this reason, every UV222™ lamp is configured with a software to run in **duty cycles** with a specific on/off ratio. This ratio considers the lamp placement in the specific room along with the occupant time of the room. From these parameters the on/off ratio required to conform with the ISO 15858 is computed and the UV222™ lamps are turned on and off in an alternate way and automatically, to **ensure the accumulated dose never exceeds the TLV** at any height between the room floor and 180 cm (standard eye height).



As supplementary safety precautions, each lamp is equipped with a LIDAR (providing 16-point distance measurements) along with a PIR movement sensor. The lamp is configured to shut off should anything come within a pre-defined safety distance. The movement sensor is used in situations where the lamp is configured to be turned on outside of occupant hours, the sensor here assuring that the room is indeed empty.

Should you require any additional information, please use my contact information provided at the bottom of the letter.

Sincerely,



Nicolas Volet  
Assistant Professor

