Frequently Asked Questions About the Photobiological Safety of Products that Emit UV Radiation

Product designers are increasingly looking to add ultraviolet (UV) emitting LEDs or lamps to devices to take advantage of their potential inactivation properties against COVID-19. The addition of these UV generating components also introduces concerns about the potential harm UV radiation can cause to the skin and eyes.

Take a look at how UL experts answer common questions they have received from customers about how to evaluate potential UV hazards and which safety standards can be used.

If the UV radiation is intended to be contained, where would measurements be taken on the product?

If the UV source is in an enclosure, persons with access to the UV source would have to be determined first as it affects how the measurements would be taken for potential hazard. Where measurements are taken depends on the product, product functions, where the source of UV is and recommended procedures.

What is needed for UL to test and evaluate products for UV safety?

For testing and evaluation to determine risk group and measured results, we would need the working sample of the product, recommended procedures (from operator and service manuals if available) and specifications on the UV source.

If the UV source also emits into the visible spectrum, how is that evaluated?

The photobiological safety standard confirms what are the emitted wavelengths. If the UV source emits into the visible spectrum, it will appear on the spectrometer and will be taken into account during measurement. In the standard, weighing factors are applied so that visible wavelengths are automatically taken into account when measurements are taken and risk groups determined.

Do the photobiological standards mentioned evaluate how well the UV radiation works to kill bacteria or viruses?

Photobiological safety standards look at potential hazards to the skin and eyes. The standards do not go into efficacy or how well the UV kills the bacteria of deactivates the viruses. But UL can help in other ways to determine if the UV is effective outside of these photobiological standards. Please reach out to UL at ConsumerTechInfo@ul.com if you would like to learn more.

What are the limitations on where UVC products can be installed?

This would depend on the product type, who the intended users are and where the product is going to be used. Please reach out to UL at ConsumerTechInfo@ul.com if you have a question for a specific product type.

Do the photobiological safety standards evaluate how well an enclosure material can withstand UV exposure over time?

Concerns exists about UV, including how it can degrade materials over time. If the UV source is in an enclosure, it will degrade the enclosure and may result in UV exposure or shock considerations when the internal parts are exposed. The photobiological standards focus on potential hazards to the skin and eyes, but there are other standards that looks at the effects of UV exposure on materials. UL can also help to assess that. For overall UL certification for UV products, UV effects on materials are likely to be evaluated depending on the UV source and type of material.

Is there any substance that could react with UVC light and produce fume, gas or vapor that could cause any toxicity?

We are not aware of any research or UL supported conclusion on this.

Would a longer exposure duration lead to a higher risk group?

It is possible, based on a variety of factors. We would be able to provide a more specific response if more details are provided.

If the irradiance of air disinfecting equipment running with UVC lamps is measured at 254 nm from 200 mm and the irradiance amount is below the limits, can we say it is safe to use?

If it is below the IEC 62471 exempt risk group limit, it is not considered to pose any photobiological hazard. This is the least hazardous risk group in the IEC 62471.

With regard to the measurement distance of 200 mm, does this relate to the distance to the source or to the nearest accessible port of any enclosure?

This primarily depends on whether the source can be accessible during procedures such as operation, maintenance or service. If it cannot be accessible, then measurements are typically made from the nearest accessible port. If it can be accessed, measurements from the source need to be considered.

With the emergence of Far UV as a safer band, are the standard organizations looking to differentiate this from standard UVC?

Although Far UVC (222 nm) has made claims, it is still considered in the UVC band of 180- 280 nm, and we would recommend testing and evaluation.

Regarding risk group assignment, if the shielding is an inherent and nonremovable part of the design (containment) and the lamps cannot be powered without shielding deployed, is the testing performed behind the shielding?

For photobiological safety of the skin and eye, it is possible that this scenario would not require internal measurements behind the shielding for risk group assessment. It would depend on a construction review of the product and review of the intended procedures for operation, maintenance and service. It could also depend on the overall product safety standard that would apply and what it states about UV radiation hazards.

Do the standards only measure watt/area or are there joule/area

standards also, such as over an 8 hour shift?

For risk group determinations, the limits are expressed using watt units, based on times as defined in the risk group criteria (see IEC 62471 Cl. 6.1). If exposure times are shorter, options may exist to use time-averaged values for exposure considerations to determine the risk group. If you can provide more specific information around this question, we can review and possibly provide a more detailed response.

Can a consumer UVC product use virtual containment (interlocked sensors, etc.)? Or is the requirement physical containment?

The use of virtual containment would most likely need to go through a review of the construction details before confirmation on whether it is a possible acceptable construction for certification to a standard. The acceptance may also be based on the overall end-product safety standard used for total safety of the product. If interested, please contact us at ConsumerTechInfo@ul.com and provide some specific information about the product type, how the virtual containment operates, etc., and we can determine next steps.

Assuming there are suppliers that comply with the applicable standard, can the supplier's approval to this standard be leveraged for use in a finished product?

This is possible depending on if/how the end product impacts the emissions, e.g., accessibility, drive current to the UV component, whether more than one component is used in the end product for additive effects, etc. If you can provide more detailed information on the scenario, we can possibly provide a more detailed response.

Are LEDs considered "not contained" UV?

Yes, LEDs would be considered the same as lamps in this regard.

The U.S. Environmental Protection Agency and U.S. Federal Communication Commission evaluate and regulate UVC devices. How does UL's evaluation differ from the work of these two agencies?

UL's approach in this area is based on three things: first, U.S. federal regulations protecting the public from electronic product radiation including UV which are in Code of Federal Regulations (CFR) Title 21, Chap 1, Subchapter J; second, the American Council of Governmental Industrial Hygienists (ACGIH) that published threshold limit values and biological indices for minimizing human exposure to UV radiation in the workplace; and lastly Recommended Practices for Photobiological Safety for Lamps and Lamp Systems, ANSI/IES RP27 series of standards which contain product-specific requirements to mitigate overexposure to UV radiation.

What are the equivalent UL Standards to IEC 62471, RP-27 or ACGIH?

There are no UL-equivalent Standards to IEC 62471, RP-27 or ACGIH. These existing standards are used in some combination for UL certification, depending on the requirements contained in the overall product safety standard applicable to the product.

What about UV products intended for entertainment lighting? Is this considered projection?

UV products intended for entertainment lighting would typically be evaluated to the photobiological safety requirements discussed in a manner based on their intended function. Typically, these would not be considered General Lighting Service (GLS), since they are not intended to light spaces, so there would be a measurement distance of 200 mm in most applications. A more formal determination can be made upon receipt of specific product information.

Does the product engineer assess risk group or is it part of UL certification?

We can perform the testing and analysis needed for the risk group, and, in most cases, the risk group assessment is part of the UL certification. The requirement for who generates this information is based on the needed deliverable (UL Mark, IEC Informative Report, IEC CB Report, etc.).

There are claims that UV products that are intended to be used on your skin to disable viruses. They also claim it doesn't penetrate beyond the

top layer of dead skin cells and therefore is safe. What is UL's approach in this area?

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Does long-term exposure to UVC in an enclosure produce fire? And does UL take into consideration probability of product flammability?

I am not aware of any research on UVC causing fire. In general, UL does take consideration of flammability of materials during our assessments, but we are not aware of a UVC consideration here.

Please reach out to a UL expert if you didn't find the answer to your question here or if you would like a project quote.