

Ultraviolet-C (UVC) germicidal products reference guide

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Ultraviolet-C (UVC) radiation has sanitizing properties, and has many uses in commercial, healthcare and consumer settings. UVC has germicidal benefits, killing bacteria and deactivating viruses depending on the exposure dose, which is based on source strength, proximity, and time. However, there are serious risks to UVC exposure so proper safety precautions are essential.

What qualifies as UVC?

Electromagnetic wavelengths shorter than the visible spectrum of light are known as ultraviolet (UV) (180 to 400 nm). This reference guide focuses on UVC. Please note that UVA and UVB regions have certain benefits and pose some hazards of their own.

UVC (short wave) 180 to 280 nm	UVB (middle wave) 280 to 315 nm	UVA (long wave) 180 to 280 nm
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What are the primary risks of UVC?

UVC exposure can have serious risks and, if improperly used, be dangerous. In mere seconds, UVC exposure can cause serious damage.

- **EYE** – pain, light sensitivity and gritty sensation on eye can occur, since UVC does not trigger aversion response, e.g., blinking, squinting, looking away
- **SKIN (erythema)** – similar to a sunburns



What are the dangers of breathing emitted ozone from a UVC device?

Some UVC lamps emit ozone, which enhance germicidal effects but, in enclosed spaces, can be hazardous.

- **LUNG DAMAGE** – Ozone may also worsen underlying respiratory conditions



What if the UVC is contained?

Containment is a set of design criteria that ensures people are not exposed to excessive UVC. Consumer products that contain UVC radiation inside its equipment may be safe and eligible for safety certification based on evaluation per the applicable safety standards.



What if you are a trained professional in a controlled setting taking safety precautions?

Commercial and healthcare-related UVC products may have uncontained UVC sources. They are intended for use by trained professionals based on product and site safeguards. Such equipment may be safe and eligible for safety certification based on evaluation per the applicable safety standards.

What will UL Solutions certify?

UL Solutions will certify eligible UVC devices for safety using UL Standards for the product type (see following page for examples). Where the Standard does not already include personal injury requirements for UVC then ANSI/IES RP-27 or IEC 62471 for photobiological assessments will apply. Safety certifications address risks of electric shock, fire and personal injury; safety certifications do not address efficacy claims.

Safety testing

1. Consumer products with contained UVC sources
2. Consumer portable products with uncontained UVC sources
3. Commercial and healthcare related products with UVC sources
4. Components integrated inside UVC equipment, e.g., ballasts, LED drivers, UVC sources, controls and sensors
5. Commercial lighting products, e.g., upper-room ultraviolet germicidal irradiation (UVGI), hybrid lighting systems, UVA and 405 nm systems

Performance assessments

Photobiologic, photometric testing to determine risk category, exposure dose and UVC source characteristics. Performance can be assessed as an independent service with or without a safety certification. Performance evaluation will not result in a UL Solutions safety Mark.

Risk categories for UVC

UVC lamps and lamp systems are classified into risk groups based on UVC exposure limits and the relative photobiological risk of the radiation source. The criteria for each risk group designation is based on the type of UVC source characteristics, the length of exposure under normal conditions and other factors.







UL Solutions can help you understand which risk group your product/design falls into and the corresponding safety implications.

Warning labels are not enough!

Some consumer products without UVC source containment have warning labels or timers – this is not enough! Children and pets cannot be expected to follow written warnings, and home environments have too many variables that could result in misuse. Remember that UVC disrupts DNA – in a home environment, devices without containment pose a hazard to residents, pets and plants.

Key words and information on ultraviolet (UV) lighting






- Products that UL Solutions will certify for safety.
- Products that UL Solutions is unwilling to certify for safety due to high risk.

Type of UVC device	Sample Image	Environment	Assessing the risks	Safety certification(s)
Home-use portable sterilizer Marketed to clean a room in the home, with or without a timer		Consumer	Portable equipment with uncontained UV source. UV overexposure risk is addressed via integral safeguards; <ol style="list-style-type: none"> 1. motion detection as a critical control function, and 2. activation cycle requirements and operating time limits. 	UL 8803 Outline of Investigation IEC 62471 for photobiological assessment
Personal portable sterilizer/wand Marketed to be handheld and moved over surfaces to sterilize		Consumer	UVC is NOT contained — it may produce ozone. Device may be used by untrained persons unfamiliar with the risks involved. There is a risk that people and pets could accidentally be exposed to UVC and be injured, and ozone may be emitted. The exposure dose to people can be far above acceptable levels and can cause injury. Integral timers or proximity and orientation sensors pose concerns with accuracy and reliability of these safeguards as well as opportunities for misuse or bypass. Stationary (non-handheld) products for use in an unoccupied area with specific safeguards may have a path to safety certification.	NOT eligible for certification for consumer use; for medical and professional applications, contact UL Solutions to discuss.
Home-use air cleaners with internal (contained) UVC Marketed to homes and offices		Consumer	UVC is contained The UVC source is inside the product enclosure and a safeguard disables the UVC when an access door is opened.	UL 507 for electrical investigation; standard includes personal injury requirements for UVC based on ANSI RP-27 for photobiological assessment.
Portable UVC sterilization box Marketed to clean cell phones, small personal devices		Consumer and commercial	UVC is contained The UVC source is inside the enclosure; opening the door will disable the UV source. Testing would ensure that any UV “leakage” will be within safe exposure dose limits.	UL 73 for electrical investigation; standard includes personal injury requirements for UVC based on ANSI RP-27 for photobiological assessment.
Upper room (UVGI) Mounted out of easy reach, typically 2.3 m (7 feet) from floor		Commercial	Permanently mounted, i.e., fixed, equipment intended to be installed and operated in non-residential locations. UVC containment is achieved based on product design features, plus site safeguards.	UL 8802 Outline of Investigation IEC 62471 for photobiological assessment
Commercial/industrial heating and ventilation May also be found in home settings		Commercial	UVC is contained inside the air duct and not visible Access is restricted to qualified personnel during installation and service. The design also includes other product safeguards such as ON/ OFF switch and interlock switch.	UL 1598 (or UL 153) and UL 1995 for electrical investigation; UL 1995 includes personal injury requirements for UVC based on ANSI RP-27 for photobiological assessment.

Always follow device labeling and manufacturer recommendations for appropriate settings, use restrictions, recommended personal protective equipment (PPE), if applicable, and required training. Don't see your product type here? We can help. Contact us today.

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Type of UVC device	Sample Image	Environment	Assessing the risks	Safety certification(s)
Water treatment plants UVC disinfects the water as an alternative to chlorination		Commercial	UVC is contained inside a water vessel and not visible Access is restricted to qualified personnel during installation and service.	UL 979 for water treatment equipment ANSI RP-27 for photobiological assessment
Equipment sterilization		Healthcare and commercial	UVC containment is achieved by limiting access to the space so people are not present during disinfection. In addition, the equipment includes reliable safeguards and is operated by staff with training for its proper use.	In healthcare facility and laboratory settings – UL 61010 for electrical investigation; the standard references IEC 62471 for photobiological assessment to address personal injury concerns for UVC.
Sterilizing robots Used in hospital operating rooms as a secondary tool for disinfection				In commercial settings – UL 73 for electrical investigation; standard includes personal injury requirements for UVC based on ANSI/IES RP-27 for photobiological assessment.
Germicidal systems (may have regular lights in addition to UV emitters)		Healthcare and commercial	Permanently mounted, i.e., fixed, equipment intended to be installed and operated in non-residential locations. UVC containment is achieved based on product safeguards, trained staff and site safeguards.	UL 8802 Outline of Investigation IEC 62471 for photobiological assessment
UV Lamps and Components (Ballasts, LED drivers, UV light sources, Controls & Sensors)		Components	Components for use in UVC equipment and germicidal systems; contact UL Solutions to discuss the specific use and design as well as the intended operation, e.g., within luminaires or only within equipment designed specifically for germicidal applications.	Various, as applicable

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UL 8803, Outline of Investigation for Portable UV Germicidal Equipment with Uncontained UV Sources
 UL 8802, Outline of Investigation for UV Germicidal Equipment and Systems
 UL 507, Standard for Electric Fans
 UL 73, Standard for Motor-Operated Appliances
 UL 1598, Standard for Luminaires

UL 153, Standard for Portable Electric Luminaires
 UL 1995, Heating and Cooling Equipment
 UL 979, Standard for Water Treatment Appliances
 UL 61010, Safety Requirements for Electrical Equipment
 IEC 62471, standard for photobiological safety of lamps and lamp systems
 ANSI/RP-27, Recommended Practice for Photobiological Safety for Lamps and Lamp Systems-Measurement Techniques

Learn more at [UL.com/UVLighting](https://www.ul.com/UVLighting).



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