UV Lights and Lamps: Ultraviolet-C Radiation, Disinfection, and Coronavirus

Given the current outbreak of Coronavirus Disease 2019 (COVID-19) disease caused by the novel coronavirus SARS-CoV-2, consumers may be interested in purchasing ultraviolet-C (UVC) lamps to disinfect surfaces in the home or similar spaces. The FDA is providing answers to consumers' questions about the use of these lamps for disinfection during the COVID-19 pandemic.

On this page:

Related page:

- Ultraviolet (UV) Radiation (/web/20210228071017/https://www.fda.gov/radiation-emitting-products/tanning/ultraviolet-uv-radiation)

Ultraviolet Radiation and SARS-CoV-2 Coronavirus

Q: Can UVC lamps inactivate the SARS-CoV-2 coronavirus?

A: UVC radiation is a known disinfectant for air, water, and nonporous surfaces. UVC radiation has effectively been used for decades to reduce the spread of bacteria, such as tuberculosis. For this reason, UVC lamps are often called "germicidal" lamps.

UVC radiation has been shown to destroy the outer protein coating of the SARS-Coronavirus, which is a different virus from the current SARS-CoV-2 virus. The destruction ultimately leads to inactivation of the virus. (see Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses (https://web.archive.org/web/20210228071017/https://www.nature.com/articles/s41598-020-67211-2.pdf) (https://web.archive.org/web/20210228071017mp_/http://www.fda.gov/about-fda/website-policies/website-disclaimer)). UVC radiation may also be effective in inactivating the SARS-CoV-2 virus, which is the virus that causes the Coronavirus Disease 2019 (COVID-19). For more information see "Q: Where can I read more about UV radiation and disinfection?". However, currently there is limited published data about the wavelength, dose, and duration of UVC radiation required to inactivate the SARS-CoV-2 virus.

In addition to understanding whether UVC radiation is effective at inactivating a particular virus, there are also limitations to how effective UVC radiation can be at inactivating viruses, generally.

- **Direct exposure:** UVC radiation can only inactivate a virus if the virus is directly exposed to the

radiation. Therefore, the inactivation of viruses on surfaces may not be effective due to blocking of the UV radiation by soil, such as dust, or other contaminants such as bodily fluids.

- **Dose and duration:** Many of the UVC lamps sold for home use are of low dose, so it may take longer exposure to a given surface area to potentially provide effective inactivation of a bacteria or virus.

UVC radiation is commonly used inside air ducts to disinfect the air. This is the safest way to employ UVC radiation because direct UVC exposure to human skin or eyes may cause injuries, and installation of UVC within an air duct is less likely to cause exposure to skin and eyes.

There have been reports of skin and eye burns resulting from improper installation of UVC lamps in rooms that humans can occupy.

Q: Can UVB or UVA radiation inactivate the SARS-CoV-2 coronavirus?

A: UVB and UVA radiation is expected to be less effective than UVC radiation at inactivating the SARS-CoV-2 coronavirus.

- **UVB:** There is some evidence that UVB radiation is effective at inactivating other SARS viruses (not SARS-CoV-2). However, it is less effective than UVC at doing so and is more hazardous to humans than UVC radiation because UVB radiation can penetrate deeper into the skin and eye. UVB is known to cause DNA damage and is a risk factor in developing skin cancer and cataracts.
- **UVA:** UVA radiation is less hazardous than UVB radiation but is also significantly (approximately 1000 times) less effective than either UVB or UVC radiation at inactivating other SARS viruses. UVA is also implicated in skin aging and risk of skin cancer.

Q: Is it safe to use a UVC lamp for disinfection purposes at home?

A: Consider both the risks of UVC lamps to people and objects and the risk of incomplete inactivation of virus.

Risks: UVC lamps used for disinfection purposes may pose potential health and safety risks depending on the UVC wavelength, dose, and duration of radiation exposure. The risk may increase if the unit is not installed properly or used by untrained individuals.

- Direct exposure of skin and eyes to UVC radiation from some UVC lamps may cause painful eye injury and burn-like skin reactions. Never look directly at a UVC lamp source, even briefly. If you have experienced an injury associated with using a UVC lamp, we encourage you to report it to the FDA (/web/20210228071017/https://www.fda.gov/radiation-emitting-products/radiation-safety/report-problem).
- Some UVC lamps generate ozone. Ozone inhalation can be irritating to the airway.
- UVC can degrade certain materials, such as plastic, polymers, and dyed textile.
- Some UVC lamps contain mercury. Because mercury is toxic even in small amounts, extreme caution is needed in cleaning a lamp that has broken and in disposing of the lamp.

Effectiveness: The effectiveness of UVC lamps in inactivating the SARS-CoV-2 virus is unknown

because there is limited published data about the wavelength, dose, and duration of UVC radiation required to inactivate the SARS-CoV-2 virus. It is important to recognize that, generally, UVC cannot inactivate a virus or bacterium if it is not directly exposed to UVC. In other words, the virus or bacterium will not be inactivated if it is covered by dust or soil, embedded in porous surface or on the underside of a surface.

To learn more about a specific UVC lamp, you may want to:

- Ask the manufacturer about the product's health and safety risks and about the availability of instructions for use/training information.
- Ask whether the product generates ozone.
- Ask what kind of material is compatible with UVC disinfection.
- Ask whether the lamp contains mercury. This information may be helpful if the lamp is damaged and you need to know how to clean up and/or dispose of the lamp.

Q: Are all lamps that produce UVC radiation the same?

Not all UVC lamps are the same. Lamps may emit very specific UVC wavelengths (like 254 nm or 222 nm), or they may emit a broad range of UV wavelengths. Some lamps also emit visible and infrared radiation. The wavelengths emitted by the lamp may affect the lamp's effectiveness at inactivating a virus and may impact the health and safety risks associated with the lamp. Some lamps emit multiple types of wavelengths. Testing of the lamp can determine whether, and how much, other wavelengths the lamp puts out.

There is some evidence that excimer lamps, with peak wavelength of 222-nm may cause less damage to the skin, eyes, and DNA than the 254 nm wavelength, but long-term safety data is lacking. For more information see "Q: Where can I read more about UV radiation and disinfection?".

Q: What are the different types of lamps that can produce UVC radiation?

Low-pressure mercury lamp: Historically, the most common type of lamp used to produce UVC radiation was the low-pressure mercury lamp, which has its main (>90%) emission at 254 nm. Other wavelengths are also produced by this type of lamp. There are other lamps available that emit a broad range of UV wavelengths, but also emit visible and infrared radiation.

Excimer lamp or Far-UVC lamp: Type of lamp, called an "excimer lamp", with a peak emission of around 222 nm.

Pulsed xenon lamps: These lamps, which emit a short pulse of broad spectrum (including UV, visible and infrared) light have been filtered to emit mainly UVC radiation and are sometimes employed in hospital settings to treat environmental surfaces in operating rooms or other spaces. These are normally employed when no humans are occupying the space.

Light-emitting diodes (LEDs): Light-emitting diodes (LEDs) that produce UV radiation are also becoming more commonly available. Typically, LEDs emit a very narrow wavelength band of radiation. Currently available UV LEDs have peak wavelengths at 265 nm, 273 nm, and 280 nm, among others. One advantage of LEDs over low-pressure mercury lamps is that they contain no mercury. However, the small

surface area and higher directionality of LEDs may make them less effective for germicidal applications.

Q: Where can I read more about UV radiation and disinfection?

A: For general information about UV radiation, see Ultraviolet (UV) Radiation (/web/20210228071017/https://www.fda.gov/radiation-emitting-products/tanning/ultraviolet-uv-radiation).

For more technical details, see these reports and publications:

- Ultraviolet Air Disinfection (https://web.archive.org/web/20210228071017/https://media.ies.org/docs/standards/IES-CR-2-20-V1-6d.pdf) (https://web.archive.org/web/20210228071017mp_/http://www.fda.gov/about-fda/website-policies/website-disclaimer) (International Commission on Illumination: CIE 155:2003)
- Germicidal Ultraviolet (GUV) – Frequently Asked Questions (https://web.archive.org/web/20210228071017/https://media.ies.org/docs/standards/IES-CR-2-20-V1-6d.pdf) (https://web.archive.org/web/20210228071017mp_/http://www.fda.gov/about-fda/website-policies/website-disclaimer) (Illuminating Engineering Society Committee Report: IES CR-2-20-V1)
- Germicidal Efficacy and Mammalian Skin Safety of 222-nm UV Light (https://web.archive.org/web/20210228071017/https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5552051/#:~:text=We%20found%20that%20222%2Dnm,cytotoxic%20to%20exposed%20mammalian%20skin.) (Radiation Research: 187(4); 483–491)
- UVC Lamps and SARS-COV-2 (https://web.archive.org/web/20210228071017/https://www.icnirp.org/en/activities/news/news-article/sars-cov-2-and-uvc-lamps.html) (https://web.archive.org/web/20210228071017mp_/http://www.fda.gov/about-fda/website-policies/website-disclaimer) (International Commission on Non-Ionizing Radiation Protection: ICNIRP)
- The effect of 222-nm UVC phototesting on healthy volunteer skin: a pilot study (https://web.archive.org/web/20210228071017/https://iuva.org/resources/covid-19/Woods%20et%20al%202015%20-%20UV222%20Pilot%20Study%20Testing%20on%20Volunteers%20Skin.pdf) (https://web.archive.org/web/20210228071017mp_/http://www.fda.gov/about-fda/website-policies/website-disclaimer) (Photodermatology Photoimmunology Photomedicine: 31; 159–166)
- Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses (https://web.archive.org/web/20210228071017/https://www.nature.com/articles/s41598-020-67211-2.pdf) (https://web.archive.org/web/20210228071017mp_/http://www.fda.gov/about-fda/website-policies/website-disclaimer) (Scientific Reports: 10; 10285)

For questions about this page, contact 1-888-INFO-FDA or the Office of Health Technology 7: Office of In Vitro Diagnostics and Radiological Health (OIR)/Division of Radiological Health (DRH) at RadHealth@fda.hhs.gov (https://web.archive.org/web/20210228071017/mailto:RadHealth@fda.hhs.gov) (https://web.archive.org/web/20210228071017mp_/http://www.fda.gov/about-fda/website-policies/website-disclaimer).

FDA Regulation of UVC Lamps

Q: What is the FDA's role in the oversight of UVC lamps?

A: UVC lamps are electronic products. The FDA regulates electronic products that emit radiation (both non-medical and medical products) through the Electronic Product Radiation Control Provisions, which were originally enacted as the Radiation Control for Health and Safety Act (/web/20210228071017/https://www.fda.gov/radiation-emitting-products). Certain electronic products may also be regulated as medical devices. The FDA is responsible for regulating firms who manufacture, repackage, relabel, and/or import medical devices sold in the United States.

UVC lamp manufacturers are responsible for compliance with all applicable regulatory requirements, including Title 21 Code of Federal Regulations (CFR) Parts 1000 through 1004, and section 1005.25 (https://web.archive.org/web/20210228071017/https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPartFrom=1000&CFRPartTo=1005) and, as applicable, 21 CFR Chapter I, Subchapter H (https://web.archive.org/web/20210228071017/https://www.ecfr.gov/cgi-bin/text-idx?SID=ddd41dccad9ff625ca4d557ac1825baf&mc=true&tpl=/ecfrbrowse/Title21/21CIsubchapH.tpl). The radiological health regulations include reporting of Accidental Radiation Occurrences, notification to the FDA and customers of radiation safety defects, and designation of a U.S. agent for imported lamps. When a UVC lamp is regulated only as an electronic product, there are currently no specific FDA performance standards that apply.

Ultraviolet lamps intended for medical purposes, such as products that disinfect other medical devices or irradiate part of the human body, that meet the definition of medical device under section 201(h) of the Federal Food, Drug, and Cosmetic Act also typically require FDA clearance, approval, or authorization prior to marketing.

For further information, please see FDA's pages, "How to Determine if your Product is a Medical Device (/web/20210228071017/https://www.fda.gov/medical-devices/classify-your-medical-device/how-determine-if-your-product-medical-device)" and "Overview of Device Regulation (/web/20210228071017/https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance/overview-device-regulation)."

UVC radiation can cause severe burns (of the skin) and eye injuries (photokeratitis). Avoid direct skin exposure to UVC radiation and never look directly into a UVC light source, even briefly. If customers identify a problem with a UVC lamp, they can report it to the manufacturer and the FDA.

Consumers who are interested in learning more about the Environmental Protection Agency's (EPA's) role, may want to see EPA's page, Why aren't ozone generators, UV lights or air purifiers on List N? Can I use them to kill the COVID-19? (https://web.archive.org/web/20210228071017/https://www.epa.gov/coronavirus/why-arent-ozone-generators-uv-lights-or-air-purifiers-list-n-can-i-use-these-or-other)