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Care222® UV Light Disinfection* Technology
Frequently Asked Questions

1. **What is the Care222 far-UVC disinfection lamp?**
   The Care222 far-UVC disinfection lamp from Ushio America is a krypton-chloride excimer lamp that operates in the photobiological ultraviolet spectral band known as UVC and employs a short pass filter to remove all but a narrow band of 222 nanometer (nm) UV light, which is capable of inactivating viruses and bacteria[1] on indoor surfaces and in air in occupied and unoccupied spaces.

2. **What is an excimer lamp?**
   Excimer lamps are a source of UV light, specifically an arc discharge light source with a special chamber filled with noble gas, completely mercury-free and without electrodes. The Care222 excimer lamp technology allows for a lower temperature operation compared to other conventional lamps and fast on/off times with no-warm-up required.

3. **What is different about the Care222 far-UVC disinfection lamp for use in the reduction of pathogens[1] and why is the filter important?**
   Results from laboratory testing and clinical studies[5] suggest that the filtered 222nm far-UVC light emitted from the Care222 far-UVC disinfection lamp will not cause burns to human skin or damage to eyes when used with appropriate parameters because it minimally penetrates into the biologically sensitive nucleus of human cells. Yet, the 222nm wavelength easily penetrates and inactivates a wide range of pathogens including bacteria and viruses[1], because of their microscopic dimensions. The short pass filter removes UV wavelengths that would potentially penetrate the living tissue in skin or beyond the tear layer in eyes.

4. **Is Care222 technology effective against SARS-CoV-2?**
   In a 2020 study, Hiroshima University confirmed that under laboratory conditions, a dose of 3 mJ/cm^2 of 222nm UVC irradiation, with an exposure time of 30 seconds, inactivated 99.7% of SARS-CoV-2on a surface[3]. Ushio's Care222 UVC disinfection lamp was placed 24 cm above the surface of the plates in which the viral samples were placed. The Care222 far-UVC disinfection lamps are also effective against a wide range of other bacterial and viral pathogens[1].
   Reference: *Kitagawa, Hiroki. (2020). Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination.* DOI: 10.1016/j.ajic.2020.08.022

5. **How does 222nm far-UVC light inactivate pathogens[2]?**
   The 222nm far-UVC light penetrates the outer layers of the pathogen structure to render it harmless through disrupting the nucleic acids (DNA and RNA), resulting in the disruption of vital functions, stopping the ability of the pathogen to replicate.

6. **Why can 222nm far-UVC light be used in occupied spaces?**
   Because 222nm far-UVC light can be effective against wide range of bacterial and viral pathogens[1] in relatively low doses, it can be used in occupied spaces and still fall within current exposure guidelines for human occupancy, as established by the American Conference of Governmental Industrial Hygienists (ACGIH®).

7. **What is potentially harmful about other germicidal UV wavelengths?**
   Certain wavelengths more easily penetrate the biologically sensitive nucleus of human cells and more deeply penetrate tissues than at 222nm, potentially causing short- and long-term damage. Eyes and skin are more sensitive to longer wavelengths in the UVC range (above 230nm to 280nm) and in the shorter UVB wavelengths (280 to 315nm). Above 315nm and into the UVA range, eyes and skin are less sensitive. ACGIH establishes guidelines for acceptable levels of exposure for all germicidal UV wavelengths.

8. **Do other germicidal lamps have the same capability as filtered excimer lamps?**
   No. Filtered excimer lamps using 222nm far-UVC light require relatively small doses of radiant energy to inactivate bacterial and viral pathogens[1] while also avoiding penetration of the living tissue in skin or beyond the tear layer in eyes[5]. The 254-274nm wavelength range is much more problematic for direct view exposure and levels of exposure with potentially adverse health effects are much more quickly reached. See the ACGIH guidelines for additional information about the level of UV exposure that a typical worker can be exposed to without adverse health effects.

   Germicidal lamps generating 254-274nm UV wavelengths can be used in **upper room** germicidal UV applications for occupied spaces when properly designed and maintained to mitigate the health hazards of direct exposure. A newer method of reducing active pathogens in the air is using concealed 254nm in onboard air fixtures and luminaires. Systems with 254-274nm UV sources have also been historically used to treat spaces when they are unoccupied or in applications that avoid human exposure such as in air handling equipment or water filtration systems.

   While acceptable for use in occupied spaces, germicidal lamps in the 405nm UV wavelength range are effective against a range of bacterial pathogens (at significantly higher doses than required with the 254-274nm UV wavelengths), but are not as effective against viruses as lamps with lower-range UVC wavelengths[6].

9. **How will the Care222 far-UVC disinfection technology be used in luminaires (and why in lighting)?**
   Acuity Brands far-UVC products incorporate the Care222 excimer lamp into a module that includes dosing electronics. Because lighting is necessary for occupied spaces, integrating Care222 far-UVC disinfection modules into lighting systems where reduction of pathogens[1] is desired makes practical sense. Using luminaires as a delivery system

allows facilities to take advantage of locations where power is already distributed. This enables the disinfection technology to be added as a layer of functionality to necessary illumination using the luminaire's intelligent control capabilities. Acuity Brands plans to seamlessly incorporate the Care222 far-UVC disinfection modules in familiar luminaires and stand-alone products from its lighting brands such as Mark Architectural Lighting™, Lithonia Lighting®, Healthcare Lighting®, and others.

10. **How effective is 222nm far-UVC in inactivating bacteria/viruses when compared to other UV technologies?**
    The level of reduction of specific pathogens will depend upon the dose delivered, measured in mJ/cm^2, which is a measure of radiant energy per unit area. Since the dose is an energy quantity, effectiveness[1] against a particular pathogen will depend on both the irradiation quantity and time of exposure.

    Effectiveness of inactivation of particular bacteria and viruses[1] is measured in either log reduction or percentage. A 3-log reduction is equivalent to a 99.9% reduction in the applicable active pathogens. At 222nm, relatively small doses over time are needed to inactivate bacteria and viruses to achieve the 3-log reduction of such active pathogens on the surface that is in contact with the UV light.

    In contrast, the 254-274nm range of UV wavelengths, while also effective at inactivating bacteria and viruses, requires generally somewhat higher doses of radiant energy (UV light) directed at most pathogens to achieve equivalent reductions. Moving into the 405-430nm range, these wavelengths are effective against a range of bacterial pathogens at even higher doses of UV light, but are not effective against viruses[4].

11. **What is the science/research behind the 222nm far UVC wavelength?**
    Columbia University's David Brenner, PhD, and his team developed a patented approach using shorter wavelengths in the UVC range that selectively kill bacteria and inactivate viruses[1] without damaging human cells/tissues, permitting prolonged human exposure. Dr. Brenner is the Higgins Professor of Radiation Biophysics in Radiation Oncology and Director of the Center for Radiological Research at Columbia University Medical Center. One system discussed in connection within this approach uses the 222nm far-UVC generated by filtered KrCl (222nm) excimer lamps. Multiple studies[5] show that such usage of the specified radiated energy provides the anti-microbial advantages of conventional 254nm UV lamps, while avoiding reaching into the sensitive cells in the skin epidermis or the eye lens .

12. **What are some of the potential applications?**
    When used in Acuity Brands fixtures and luminaires, the technology will offer supplemental pathogen control[1] treatment in all types of high-interaction applications, including offices, conference rooms, meeting spaces, classrooms, public restrooms, restaurants/hospitality, performing arts and sports events, public transit, retail, health clubs, and healthcare settings.

13. **Do all UV wavelengths have the same effectiveness?**
    No. Some wavelengths require lower doses to inactivate a particular pathogen, while others may not be effective at all against that pathogen[2].

14. **Do all UV wavelengths have the same safety issues?**
    No. The 222nm wavelength inactivates viruses and bacteria at energy levels that do not penetrate living tissue in skin or beyond the tear layer in eyes, allowing the space to remain occupied during use. 254 and 274nm wavelengths do reach the sensitive cells in the skin epidermis and the eye lens; requiring that the space be evacuated during use, used in upper room germicidal UV applications or in concealed applications.

15. **The lifecycle of UVC sources appears very short. How frequently will the Care222 lamp module need to be replaced?**
    The Care222 lamp module is warranted for 2 years or 1500 hours of active operation, whichever comes first. Complete Acuity Brands UV Lighting warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions. While this sounds like a relatively short period of time, the Acuity Brands products operate the lamp intermittently utilizing electronics to appropriately dose the space at a level of exposure that meets the ACGIH guidelines. Actual dosing times are programmed to be around 100 minutes per 24-hr day, or less. With a rated lifetime of 3,000 hours and taking into consideration the actual dosing times, the expected operating lifetime is approximately 5 years or more. In other words, expected time to replace modules as part of system maintenance under normal operation would be every 5 years. Since many dose times are programmed to be shorter than 100 minutes per 24-hour day, the time between module replacement for system maintenance could be longer than 5 years, depending on the specific programming implemented in the electronics for the specified/installed fixture. To facilitate system maintenance, the Care222 lamp module is field-serviceable.

16. **Are 222nm LEDs available?**
    The technology to manufacture a 222nm LED light source does not currently exist outside the laboratory. It is possible that LEDs or other light sources may become technically and economically feasible for 222nm UV light disinfection applications.

For a full list of FAQs please click here

Footnote References

[1] *Refer to product specification sheets at www.acuitybrands.com/UV-Products for efficacy claims and claim substantiation regarding specific products and pathogens.*

[2] *Wladyslaw Kowalski. (2009). UVGI for Air and Surface Disinfection. Ultraviolet Germicidal Irradiation Handbook. DOI: 10.1007/978-3-642-01999-9_15*

[3] *The references listed below apply to SARS-CoV-2, providing data on inactivation under specific test conditions. Level of inactivation in application will be based on dose/distance/time as delivered from a specific UV technology/product and will vary based on environmental conditions of the installation.*

- *Storm, Nadia. (2020). Rapid and complete inactivation of SARS-CoV-2 by ultraviolet-C irradiation. DOI: 10.21203/rs.3.rs-65742/v2*
- *Kitagawa, Hiroki. (2020). Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination. DOI: 10.1016/j.ajic.2020.08.022*
- *Jureka, Alexander S. (2021). Pulsed broad-spectrum UV light effectively inactivates SARS-CoV-2 on multiple surfaces. DOI: 10.1101/2021.02.12.431032*

[4] *Maclean M, McKenzie K, Anderson JG, Gettinby G, MacGregor SJ. 405 nm light technology for the inactivation of pathogens and its potential role for environmental disinfection and infection control. J Hosp Infect. 2014;88(1):1-11. doi*: 10.1016/j.jhin.2014.06.004

[5] UV Published Research References

**All references to "disinfection" are referring generally to the reduction of pathogenic bioburden and are not intended to refer to any specific definition of the term as may be used for other purposes by the U.S. Food and Drug Administration or the U.S. Environmental Protection Agency. Reduction of the pathogenic bioburden is a function of fixture run time, distance to the UV light source, airflow, room size and/or other factors, and the level of reduction will vary within a specific space. Neither the disinfection technology as incorporated in Acuity Brands products nor the products themselves are intended for use as a medical device or for the disinfection of medical devices.*