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Germicidal UV-C & Airborne Kill

AIRBORNE VIRUSES

1. Does UV-C kill the COVID-19 Coronavirus?
2. Can UV light mitigate the spread of airborne viruses?
3. Can COVID-19 spread through HVAC ducts?

AIRSTREAM DISINFECTION

4. How does germicidal UV-C “On-The-Fly-Kill” work?

UPPER-ROOM UV-C

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6. How much area can an Upper-Room UV-C fixture treat?
7. How much would it cost?

1. Does UV-C kill the COVID-19 Coronavirus?

Researchers don't yet know if UV-C can kill COVID-19 as this particular strain has not yet been studied. Although the germicidal UV-C waveform (253.7 nm) is effective in killing other varieties of coronaviruses, such as SARS and MERS, scientists do not yet know about the impact of UV-C on COVID-19.

Research has shown that exposure to UV-C is a practical and cost-effective method of inactivating airborne viruses, mycoplasma, bacteria, and fungi on surfaces¹. Overall, UV-C is a supplemental and extremely effective approach to fighting infectious diseases².

Predictive-modeling can determine specific dosage rates required to kill individual bacteria, viruses or spores depending on how easily UV-C energy is absorbed by each. For example, viruses are susceptible to UV-C inactivation including Influenza, Measles, SARS and Smallpox.

¹ <https://fas.org/irp/doddir/army/pam385-69.pdf>

² <https://www.ncbi.nlm.nih.gov/pubmed/20569852>

2. Can UV light mitigate the spread of airborne viruses?

The Ultraviolet Germicidal Wavelength (UV-C or UVGI) kills all known-microorganisms including bacteria, viruses, molds and other pathogens—even antibiotic-resistant superbugs. ASHRAE states that the UV-C wavelength can kill **90% or more** of all microorganisms living on HVAC air ducts and evaporator coils, depending on UV-C intensity, length of exposure (aka residence time), UV lamp placement and lamp life cycle.

Operating 24/7/365, upper-room germicidal fixtures can inactivate microbes in under a second including measles, mumps, TB and cold viruses. In fact, ASHRAE's [Position Document on Airborne Infectious Diseases](#) identifies just three proven methods of controlling airborne infection: ventilation, particle filtration and germicidal UV-C energy³.

Airborne microorganisms exposed to germicidal UV-C undergo an exponential decrease in population similar to that produced by ventilation and other disinfection methods⁴.

3. Can COVID-19 (or other viruses) spread through HVAC ducts?

Based on the information available from authorities, coronaviruses can be transmitted via air and direct contact⁵. Researchers have found the COVID-19 virus can live in the air for several hours and, on some surfaces, for as long as two to three days⁶. Therefore, it could be presumed that HVAC systems can, inadvertently, broadcast the infection and amplify its spread. Facility managers should consider employing both upper-air UVGI and in-duct or coil HVAC germicidal fixtures to ensure the greatest mitigation practical for controlling microbes and airborne microorganisms in communal spaces.

UV-C's ability to decontaminate the air flowing through a building's HVAC system can be most beneficial where communicable diseases are more common, such as office buildings, schools, healthcare settings, municipal offices, etc. An improperly maintained HVAC system in these environments can promote disease transmission as it recirculates those same germs throughout the building. Conversely, installing UV lamps, with their ability to destroy airborne viruses, bacteria and mold spores, can prevent disease transmission and/or cross-contamination.



Coil Irradiation
(lamps spaced
at 36" centers)

Airstream Disinfection
(lamps spaced
at 4" centers)

While every application should be individually modeled, typically 30-lamp-watts/square foot are recommended for airstream disinfection. (The 4-inch center spacing shown here would yield 72-lamp-watts /square foot, or more than twice the rate required).

³ <https://www.ashrae.org/File%20Library/About/Position%20Documents/Airborne-Infectious-Diseases.pdf>

⁴ <https://www.cdc.gov/niosh/docs/2009-105/pdfs/2009-105.pdf?id=10.26616/NIOSH-PUB2009105>

⁵ https://www.researchgate.net/publication/284691618_SARS_Coronavirus_UV_Susceptibility

⁶ <https://www.medrxiv.org/content/10.1101/2020.03.09.20033217v1.full.pdf>

4. How does germicidal UV-C “On-The-Fly-Kill” work?

In-duct germicidal UV-C systems are installed in air-handling units or air distribution systems to inactivate microorganisms and disinfect moving airstreams “on the fly”—as well as on HVAC surfaces. Germicidal UV-C kills 90% or more of all microorganisms living on HVAC air ducts and evaporator coils, depending on the lamp intensity (dose) and the length of exposure.

The operational factors that most directly impact airstream disinfection rates are:

- **Time/Intensity.** The volume and velocity of air traveling through an HVAC system significantly impact the length of exposure to the germicidal wavelength (residence time)—a higher volume of air and/or faster-moving air requires greater intensity (more UV-C lamps).
- **Lamp location.** Because cold air reduces the output of UV-C lamps and high RH affects pathogen susceptibility to UV-C, on-the-fly airstream disinfection applications are more effective when installed on the upstream side of the coil. In fact, moving UV-C lamps from 55-degree temperatures (typical of downstream) to 75-degree (typical of upstream) can increase a UV-C lamp’s output by 40%. On-the-fly disinfection can be accomplished downstream of the coils; however, this would require an increase in UV-C intensity (i.e. more lamps).
- **Reflectivity.** UV-C energy’s effectiveness is multiplied (see chart) as it bounces off of the top, bottom, and sides of a plenum surface. Certain surfaces like aluminum can allow more UV-C energy to reflect and “stay in play” versus being absorbed by the surface. Most cooling coil fins are made from aluminum, which also assists in overall reflectivity.

Metal	UV-C Multiplier
Stainless Steel	1.40
Galvanized steel	1.50
Aluminum	1.75

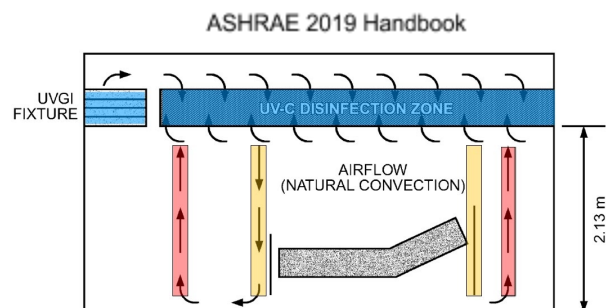
Upstream/Downstream of Coil

For example, to keep cooling coils free from mold and bacteria, lamps might be installed on the downstream side of a coil surface, spaced every 30- to 40-inches of coil height (this equates to roughly 7.5 lamp watts per square foot). Here, since the coil is stationary, the exposure time to UV-C is 24/7/365, so the UV-C intensity can be lower.

However, for a moving airstream, UV-C intensity must increase significantly due to the decrease in time that the potential pathogen will be exposed to the UV-C energy. Greater UV-C dosage can be achieved by increasing the number of lamp watts per square foot (this equates to roughly 30 lamp watts per square foot on the downstream side of the coil). This can be accomplished by using “fixtureless” UV-C systems for 360-degree irradiation and/or decreasing lamp-row-spacing, for example, to 12-inch centerlines of coil height. When designing an “on-the-fly” kill application, we recommend modeling the intended design to ensure adequate germicidal dosage.

5. How does Upper-Room/Upper-Air UV-C Work?

Upper-room germicidal UV-C fixtures—ideal for infection control—work by interrupting the transmission of airborne infectious diseases in high traffic areas such as healthcare emergency rooms, patient waiting areas, surgical suites, as well as communal areas such as cafeterias, classrooms and churches. As convection or mechanical air currents lift airborne infectious agents into a room's upper-air, they are exposed to UV-C irradiation, which breaks the bacteria or virus DNA chain and renders it incapable of replicating and killing it. Operating 24/7/365, upper-room germicidal fixtures can inactivate microbes in under a second including measles, mumps, TB and cold viruses.



Typical Elevation View of Upper-Room UV Applied in Hospital Patient Room

Wall-mounted UV-C fixtures use baffles to direct the UV-C energy upward and outward ensuring that no UV-C energy enters below seven feet into the occupied portion of the room.

Kill ratios of up to 99.9% on a first-pass basis have been modeled and concentrations are further reduced by each subsequent pass of recirculated air ("multiple dosing").

6. How much area can an Upper-Room UV-C fixture treat?

Germicidal coverage from an upper-room germicidal UV-C fixture varies depending on lamp-wattage and fixture/reflector design.

UV Resources has two fixtures, the GLO Upper-Room fixture treats 225 sq. ft. (roughly 15ft out and 7.5ft from either side, or 15ft X 15ft), while a smaller GLO 150 Upper-Room fixture treats up to 150 sq.ft. (roughly 8ft. out and 9ft. across either side of the fixture).

7. How much would it cost to add Upper-Room/Upper-Air Germicidal UV-C fixtures to a 60ft x 40ft waiting room?

Calculating the total fixture cost per square foot of space is relatively easy. In simple terms, the GLO fixture can cover 225 sq. ft., therefore, at list price, the cost would be \$4.65 per square foot. Therefore, to add a mitigation layer in a space with roughly 2,500 sq.ft. (60ft x 40ft) where there is a threat of infectious disease spread, would cost $\$4.65 \times 2,500 = \$11,600$ (list price) or 11 GLO fixtures.



GLO Upper-Air Germicidal UV-C Fixture

Industry's Highest Ultraviolet Dose:

The powerful **GLO** and **GLO 150** Upper-Room Germicidal Fixtures provide the industry's greatest amount of Ultraviolet-C energy fluence, or dosage, to kill airborne viruses and bacteria, making them the best choice for airborne infection mitigation.

The wall-mounted GLO fixtures exceed the performance guidelines from the U.S. Centers for Disease Control and Prevention (CDC) for hospital and healthcare applications⁷.



Inactivate Airborne Viruses:

The ultraviolet germicidal (UVGI) energy kills all known microorganisms, including bacteria, viruses, molds and other pathogens. Operating 24/7/365, the high-output upper-air fixture inactivates microbes when exposed to UV-C energy, including measles, mumps, TB and cold viruses.

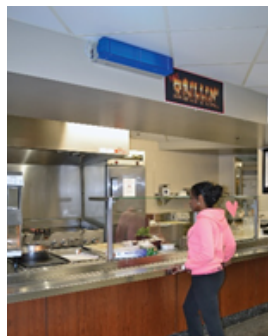
Best-In-Class Design:

- Exclusive, high spectral parabolic reflector boosts output as much as 350% compared to conventional designs
- Proven technology effective in killing all airborne microorganisms
- Efficient, low cost, microbial risk reduction for any setting
- Patent-pending design installs quickly and easily

⁷ <https://www.cdc.gov/niosh/docs/2009-105/pdfs/2009-105.pdf>.

HEALTHCARE:

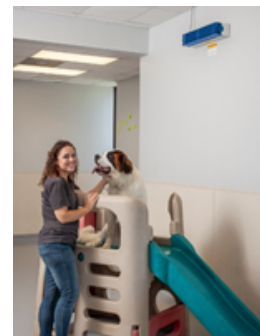
- ER Waiting Rooms
- Intensive Care Units
- Operating Rooms
- Urgent Care Clinics
- Doctor and Dental Offices
- Nursing Homes/ Extended Care Facilities

MANUFACTURING

- Clean Rooms
- Pharmaceutical Labs
- Bakeries/ Food Manufacturing
- Meat/Dairy Processing

INSTITUTION:

- Schools /Universities
- Sports Arenas
- Laboratories
- Prisons/Jails
- Emergency Shelters

BUSINESS:

- Daycare
- Veterinary/ Kennels
- Food courts

PRODUCT	GLO™	GLO™ 150
Model	GLO-22-120-277	GLO150-120-277
Part Number	P/N 4182-4000	P/N 4182-4001
Electrical	120-277V 50/60 Hz, single phase	120-277V 50/60Hz, single phase
Lamp Watts	25 Lamp Watts	8 Lamp Watts
Germicidal Output	407 $\mu\text{W}/\text{cm}^2$ @ 1M	125 $\mu\text{W}/\text{cm}^2$ @ 1M
Coverage	±225 sq. ft. (15ft. out & 7.5ft. across either side of fixture)	±150 sq. ft. (8ft. out & 9ft. across either side of the fixture)
Dimensions	23.3"(W) x 6.4"(H) x 4.4"(D)	14.5"(W) x 6.4"(H) x 4.4"(D)
Applications	<ul style="list-style-type: none"> • Waiting rooms • Surgical suites • Cafeterias • Child care centers • Laboratories 	<ul style="list-style-type: none"> • Patient screening rooms • Primary care exam rooms • Dental office • Restrooms • Veterinary exam areas

RLM Xtreme In-Duct Germicidal UV-C Fixture

Up to 2X Ultraviolet Energy: 3

The RLM Xtreme fixtureless UV-C lamp system generates up to twice the ultraviolet irradiation levels as fixtured lamp systems, making it one of the most effective germicidal irradiation solutions available today.

Near Universal Application:

With the industry's highest UV-C fluence (dosage) and easy mounting options, the near-universal applicability of the RLM Xtreme is ideal for high-volume coil irradiation and on-the-fly treatments. The system can ship as an "All-in-One" package with four of the most popular fixturing components in a single order.

Standard Lamp Lengths:

The RLM Xtreme's unique LampClamp™ and Dual LampHolster™ allows UV lamps to "slip-in" place so they overlap one another, thereby reducing the cost to stock multiple fixtures and lamps.

Best-In-Class Design:

- Plug-and-play UL-Listed power supplies
- Unique LampClamp™ to securely hold the lamp in place
- EncapsuLamp™ FEP-protected lamps against accidental lamp breakage (shipped standard with all RLM Xtreme systems)
- Heavy-gauge powder-coated galvanized steel and NEMA-rated power supply housing
- Remote monitoring of all lamp/power supplies
- Easily configurable to fit into most any plenum



All-in-One Package

PRODUCT	RLM Xtreme™
Electrical	120-277V 50/60 Hz, single phase
Lamp Watts	145 Lamp Watts (61-inch) 75 Lamp Watts (33-inch)
Germicidal Output	460 $\mu\text{W}/\text{cm}^2$ @ 1M (61-inch) 240 $\mu\text{W}/\text{cm}^2$ @ 1M (33-inch) EncapsuLamp™ FEP-protected lamps
Applications	<ul style="list-style-type: none">• Hospitals• Office Buildings• Schools/Universities• Hospitality• Government• Food Production