

# Effectiveness of UVC Light to Mitigate Coronavirus (COVID-19)

## What are Coronaviruses?

Coronaviruses (CoV) are a family of enveloped viruses that were first discovered in the 1960s. Coronaviruses are most commonly found in animals, including camels and bats, and are not typically transmitted between animals and humans. However, six strains of coronavirus were previously known to be capable of transmission from animals to humans, the most well-known being SARS-CoV (Severe Acute Respiratory Syndrome Coronavirus), responsible for a large outbreak in 2003, and MERS-CoV (Middle East Respiratory Syndrome Coronavirus), responsible for an outbreak in 2012. COVID-19 is caused by a coronavirus, which was initially named 2019-novel Coronavirus, or 2019-nCoV. On February 12, 2020, International Committee on Taxonomy of Viruses named the virus SARS-CoV-2, or Severe Acute Respiratory Syndrome Coronavirus-2. The Committee determined that this coronavirus was the same species as SARS-CoV, the virus that caused a global outbreak of a respiratory illness in 2003, but a different strain, hence the designation “2”.

Source: <https://www.cdc.gov/coronavirus/2019-ncov/faq.html>

## Government / Industry Recommendations for Airborne Infection Control

### CDC

Interim Infection Prevention and Control Recommendations for Patients with Confirmed Coronavirus Disease 2019 (COVID-19) or Persons Under Investigation for COVID-19 in Healthcare Settings.

[https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html?CDC\\_AA\\_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Finfection-control.html](https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Finfection-control.html)

CDC recommends the use of Ultraviolet Germicidal Irradiation (UVGI) as one of the effective technologies to minimize the spread of airborne microorganisms.

### 7. Implement Environmental Infection Control

- Detailed information on environmental infection control in healthcare settings can be found in **CDC’s Guidelines for Environmental Infection Control in Health-Care Facilities** (<https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm>) and **Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings** [section IV.F. Care of the environment, <https://www.cdc.gov/infectioncontrol/guidelines/isolation/index.html>].

- <https://www.cdc.gov/infectioncontrol/pdf/guidelines/environmental-guidelines-P.pdf>

#### c. Ultraviolet Germicidal Irradiation (UVGI)

As a supplemental air-cleaning measure, UVGI is effective in reducing the transmission of airborne bacterial and viral infections in hospitals, military housing, and classrooms, but it has only a minimal inactivating effect on fungal spores.<sup>223-228</sup> UVGI is also used in air handling units to prevent or limit the growth of vegetative bacteria and fungi. Most commercially available UV lamps used for germicidal purposes are low-pressure mercury vapor lamps that emit radiant energy predominantly at a wave-length of 253.7 nm.<sup>229, 230</sup> Two systems of UVGI have been used in health-care settings – duct irradiation and upper-room air irradiation. In duct irradiation systems, UV lamps are placed inside ducts that remove air from rooms to disinfect the air before it is recirculated. When properly designed, installed, and maintained, high levels of UVGI can be attained in the ducts with little or no exposure of persons in the rooms.<sup>231, 232</sup> In upper-room air irradiation, UV lamps are either suspended from the ceiling or mounted on the wall.<sup>4</sup> Upper

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## ASHRAE Guidance

ASHRAE has developed proactive guidance [ashrae.org/COVID19](https://www.ashrae.org/COVID19) to help address coronavirus concerns with respect to the operation and maintenance of HVAC systems. These include ASHRAE’s recently approved position document on airborne infectious diseases and links to the latest practical standards and guidelines.

ASHRAE recommends the following strategies of interest to address disease transmission: dilution ventilation, laminar and other in-room flow regimes, differential room pressurization, personalized ventilation, source capture ventilation, filtration (central or unitary), and **UVGI (upper room, in-room, and in the airstream)**.

## How Does UV Air Disinfection Help Combat Coronaviruses?

Coronavirus is highly susceptible to germicidal UV irradiation. The table below shows that the susceptibility of coronavirus to UV is greater than 3 times compared to the influenza (common cold) virus.

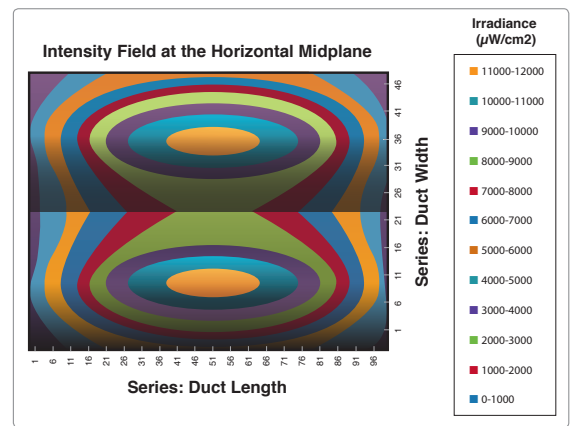
| Airstream Disinfection   |       |               |                           |
|--------------------------|-------|---------------|---------------------------|
| Microbe                  | Type  | Diameter      | UV Dose for 90% Reduction |
|                          |       | $\mu\text{m}$ | $\mu\text{J}/\text{cm}^2$ |
| Coronavirus (incl. SARS) | ssRNA | 0.11          | <b>611</b>                |
| Influenza A virus        | ssRNA | 0.098         | <b>1935</b>               |

Ref: Walker, Chris & Ko, Gwangpyo. (2007). Effect of Ultraviolet Germicidal Irradiation on Viral Aerosols. Environmental science & technology. 41. 5460-5

## Delivering the Correct UV Dose for Coronavirus

The application challenge is to ensure the targeted organism is exposed to sufficient UV dose in the available space and time of UV exposure.

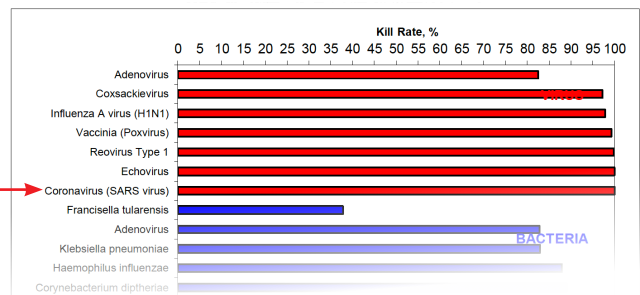
To ensure the proper dose is applied, our proprietary software is used to model the lamp quantity and system arrangement needed for the specific application. The output of this modeling produces a very detailed report showing intensity distribution and kill rates. Factors impacting dose include: spatial constraints, airflow volume, speed, temperature, and UV device geometry and intensity.



Output Example of Engineering Modeling Software

An example of the model output for a typical air handler is incorporated as reference within the “References-1.PDF” file titled “UVDI Airstream Model for Coronavirus.PDF”.

**Coronavirus (SARS virus)**  
**> 99% Kill Rate!**



## Third-Party Validation of UVC Effectiveness

UVDI has also conducted independent third party validation of UV efficacy against airborne bacteria and viruses, where MS2 macrophage was used as a surrogate for all viruses.

|                                | Test Organism                           |   |                      |
|--------------------------------|---|---|----------------------|
|                                | Spore bacteria<br>(Bacillus atrophaeus) | Vegetative bacteria<br>(Serratia. marcescens) | Virus<br>(MS2 phage) |
| <b>Inactivation Efficiency</b> | <b>71%</b>                              | <b>&gt; 99.98%</b>                            | <b>98%</b>           |

Ref: Foarde, Karin & Koglin, Eric (2006). Biological Inactivation Efficiency by HVAC In-Duct Ultraviolet Light Systems, National Homeland Security Research Center.

# UVDI V-MAX™ Air Disinfection for HVAC Systems



## In-Duct Air Disinfection System

- Designed for duct-mounting parallel to the airstream providing optimum UV exposure
- Fixtures can be mounted internally or externally on the duct
- Configurable to meet airstream kill rates up to 99% - backed by computational models to ensure performance
- Prewired lamp connection reduces installation time
- Low power consumption with universal voltage input
- Available in 21", 33", 48" and 61" lamp lengths



## AHU Air Disinfection System

- Easy to install in both existing and new equipment
- Scalable design to fit any plenum size
- Lamps can be easily mounted on vertical supports
- Configurable to meet airstream kill rates up to 99% - backed by computational models to ensure performance
- Minimal space required for installation
- Negligible pressure drop
- Low power consumption with universal voltage input
- Available in 21", 33", 48" and 61" lamp lengths

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