

# WHITEPAPER: UV DISINFECTION FOR Air Duct Systems



## The Issue: Germs in the Ducts

Bacteria, viruses, and mold may be present in the air ducts of our homes, offices, and industrial environments. These contribute to numerous airborne illnesses, asthma, and allergies. Since EPA estimates<sup>1</sup> that we spend 90% of our time indoors, we are at high risk for picking up these germs. HVAC units will also pull in microorganisms and fungi from outside and carry those through air ducts, expelling them through the vents.

The common cold and the flu are the most frequent illnesses spread in the home. According to the CDC, most adults catch 2–3 colds each year.<sup>2</sup> Both are highly contagious. When someone coughs or sneezes, millions of microbial particles are released into the air. Some of these microbes are picked up on air currents and inhaled by others. Others either remain airborne, land on objects, or are invisibly transported through the HVAC system’s ducts.



**“Conditions in HVAC systems can promote the growth of bacteria and mold-containing biofilms on damp or wet surfaces such as cooling coils, drain pans, plenum walls, humidifiers, fans, energy recovery wheels, and filters.”**

ASHRAE, 2019 ASHRAE Handbook<sup>3</sup>



## How UV-C Works

UV light is made up of three wavelength ranges (UV-A, UV-B, and UV-C). UV-C lamps emit wavelengths at 254 nm, which destroy the DNA of harmful microorganisms and hinder their ability to multiply. Treated microbes eventually die off, making homes and other facilities safer, healthier, and even more efficient.

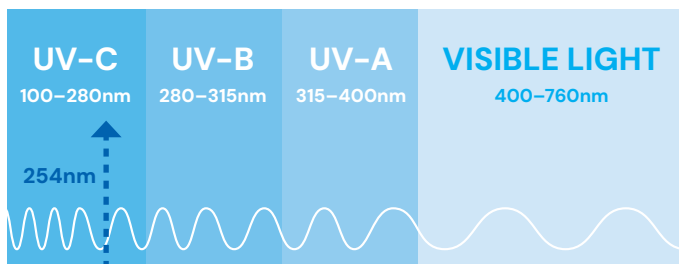


Figure 1: A Portion of the Electromagnetic Spectrum

## Documented Evidence

Studies show a clear correlation of reduced microorganisms after UV-C treatment. An extensive Canadian study cited in the respected medical journal *The Lancet* found a reduction of 99% of microbial and endotoxin concentrations in an office ventilation system following proper use of an installed air duct UV-C apparatus.<sup>4</sup> As a result, those participating in the study showed a significant reduction in symptoms such as headaches, coughs, congestion, and respiratory issues. In a Penn State University study, UV disinfection was found to enhance cooling coil energy performance.<sup>5</sup>



**From our results, UVGI could be installed in most existing North American office buildings to resolve work-related symptoms due to HVAC microbial contamination in about 4 million workers.**

*The Lancet, “Effect of ultraviolet germicidal lights installed in office ventilation systems on workers’ health and wellbeing”<sup>4</sup>*



## UV-C Doses

The bacteria and viruses below that are commonly found in HVAC systems can be inactivated by the accompanying UV-C doses. Millijoules per square centimeter (mJ/cm<sup>2</sup>) is the measurement of energy produced by germicidal UV lamps over a certain amount of time.

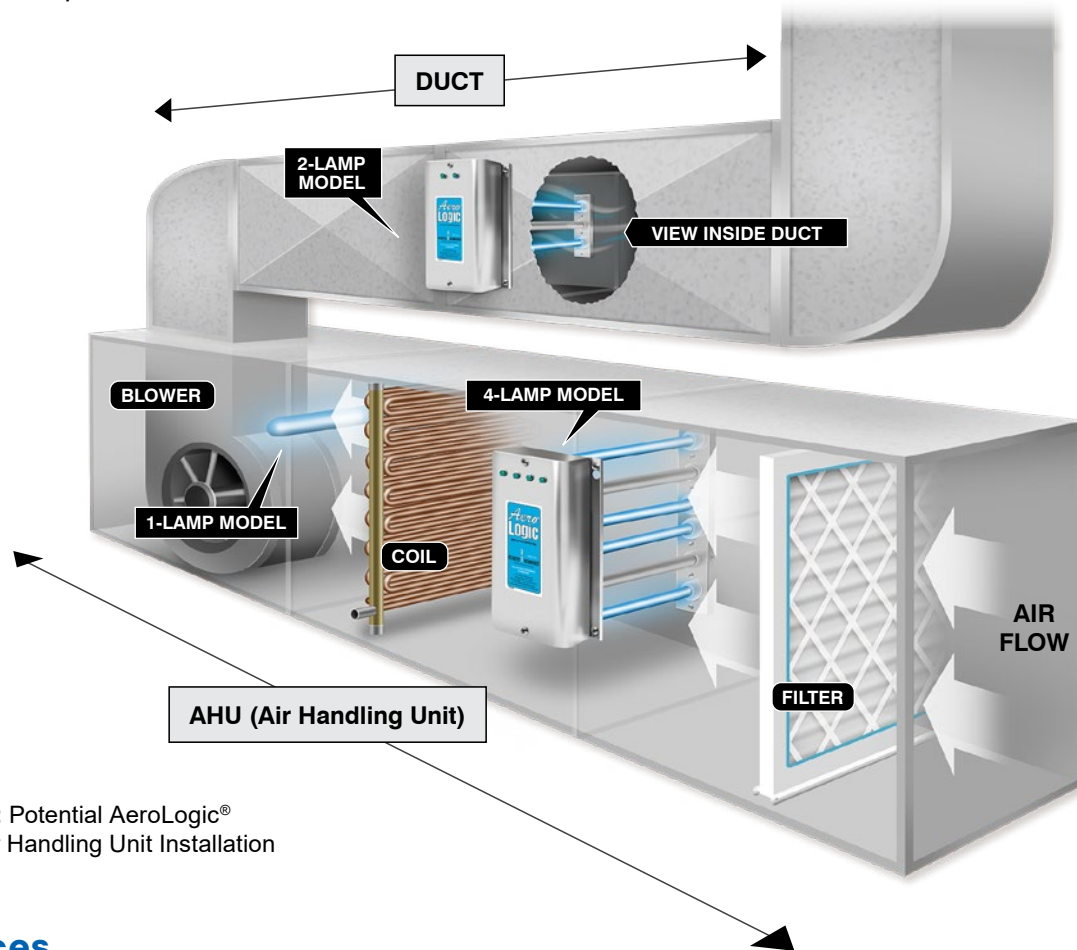
Microorganism	UV Dose (mJ/cm <sup>2</sup> )
<i>Adenovirus</i>	4.50
<i>Influenza</i>	6.60
<i>Morbillivirus hominis</i>	4.40
<i>Streptococcus</i>	.80
<i>Coxsackie</i>	6.30
<i>Tuberculosis</i>	10.0
<i>SARS-CoV-2</i>	5.0

Table 1: UV-C Doses to Neutralize Microbes

## Installation

AeroLogic® models can be easily installed inside HVAC systems by a professional or homeowner. While they can be installed anywhere within the HVAC system, we recommend it be mounted perpendicular to airflow and directed at the condenser coil for best results, as that is where mold and fungus tend to grow and thrive. In-duct systems are most efficient when installed in a long straight run allowing at least 0.25 seconds of UV exposure.<sup>3</sup>

Placement of the unit in relationship to the coil (upstream or downstream) has a direct correlation to the in-duct temperature and as a result may affect the efficiency of the lamps. Operation in facilities where people are always present (hospitals, prisons, etc.) should be continuous; in commercial buildings, it should only be run during hours of building occupancy to maximize ballast and lamp life. The use of filters is helpful to protect the lamps from dust and debris accumulation which may reduce UV output over time.



**Figure 2:** Potential AeroLogic® Duct / Air Handling Unit Installation

## Sources

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3. ASHRAE. *2019 ASHRAE Handbook—HVAC Applications*. [https://www.ashrae.org/file%20library/technical%20resources/covid-19/i-p\\_a19\\_ch62\\_uvairandsurfacetreatment.pdf](https://www.ashrae.org/file%20library/technical%20resources/covid-19/i-p_a19_ch62_uvairandsurfacetreatment.pdf)
4. The Lancet. *Effect of ultraviolet germicidal lights installed in office ventilation systems on workers' health and wellbeing: double-blind multiple crossover trial*. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(03\)14897-0/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(03)14897-0/fulltext)
5. ScienceDirect. *Effectiveness of an ultraviolet germicidal irradiation system in enhancing cooling coil energy performance in a hot and humid climate*. *Energy and Buildings*. Volume 130, October 15, 2016, pages 321–329. <https://www.sciencedirect.com/science/article/abs/pii/S0378778816307605>



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