

UVV

Resources

RLM*Xtreme*TM

UVC Lamps For Surface and Air Irradiation



The value of UV-C

UV-C is a low cost solution to disinfect cooling coils, drain pans and duct surfaces that have accumulated mold and bacteria growth. The technology disrupts a microorganism's DNA, triggering a chain reaction that leads to cellular death. Because the lamps operate continuously, biofilms are unable to regenerate, provided the UV-C source is properly maintained. This technology is frequently used to address many sources of poor indoor air quality that contribute to employee discomfort and absenteeism.

Contaminants, particularly the presence of fungi (mycotoxins), can trigger serious health problems to building occupants. As noted in an Applied and Environmental Microbiology study, "fungi have been found growing on air filters, insulation and cooling coils, as well as in ducts. The contamination often contributes to building related diseases, including both infectious diseases and hypersensitivity diseases such as allergic rhinitis, asthma and hypersensitivity pneumonitis. Also acute toxicosis and cancer have been attributed to respiratory exposure to mycotoxins. A building's HVAC system can also inadvertently transmit rhinoviruses (common cold), tuberculosis, measles, SARS and influenza.

As an added value, its ability to constantly clean the interior workings of the Ahu can extend the equipment's life for prolonged savings. Biofilms on coil fins adversely affect heat transfer to/from the airstream, if mechanical cleanings are incomplete or ignored, up to 25% of cooling capacity can be lost in as little as five years. Another factor is the lack of personnel or labor hours to routinely address coil maintenance. UV-C sources help restore an AHU to its original operating capacity.

The HVAC application of UV-C is nearly universal, including offices, schools, hospitals, correctional facilities, laboratories and assisted living facilities. UV-C represents a small investment (roughly 3%) relative to overall cost of AHU and are easy to retrofit. Building owners can achieve 10%-25% increase in HVAC efficiency by adding a UV-C device.

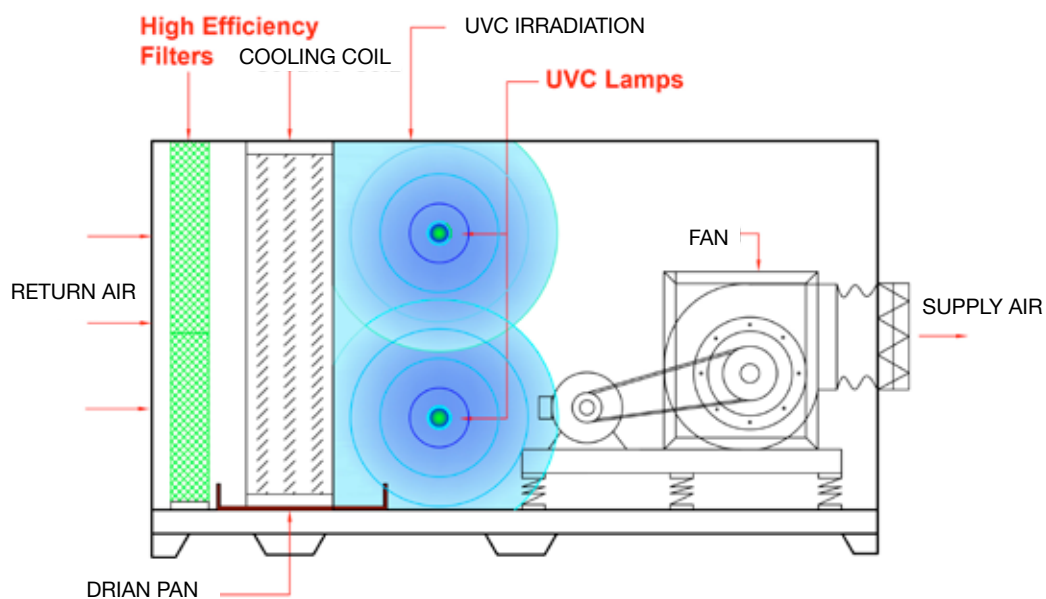
(adapted from ASHRAE Journal, Jan 2017, HVAC UV Germicidal Irradiation UV-C Fixtures, by Brian Rodgers, Dean Saputa, Associate member, ASHRAE)

Value – Lowest Cost of Ownership

Performance - High Output, Low mercury

Sustainability - Energy use, Coil Cleanliness and IEQ

Schematic of UV-C Lamps in AHU



Schematic Drawing for High Efficiency Filters & UVC for AHU Application



External view showing location of control box.

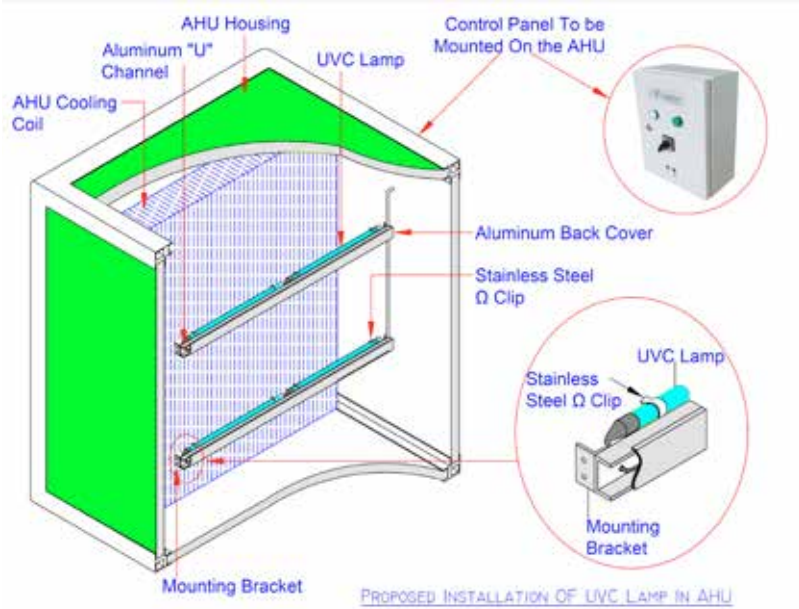
RLM Xtreme for AHU Application- AHU Type

RLM Xtreme is truly the easiest to install and service no matter the application. The UV-C lamps and ballasts are separated with only the UV-C lamps being installed inside the AHU.

The required lamps are installed on an aluminium skeletal structure secured to the AHU's internal frame support.

Adding to the ease and flexibility the ballasts and other electrical and electronic components (like LED lights showing lamp operation & optional BMS cards for remote monitoring of lamp and ballast) are housed in a UVC Control Panel outside the AHU, away from moisture and water contact. Wires looms connect the UV-C lamps and ballasts.

UVR's ballasts are UL listed Class P, Sound "A", Type 1 Outdoor, and with Thermal and Current Protection, and no PCB's.



Model	Lamp Dia	Length	Arc length	Power	Current	UV Output @1m, 21°C, 2.5m/sec	Lamp life (recommended by ASHRAE)
RLMXtreme 22	15mm/0.6"	546mm/22"	470mm/18.5"	58 watts	800mA	180uW/cm ²	9000 hours
RLMXtreme 33	15mm/0.6"	838mm/33"	767mm/30"	75 watts	800mA	265uW/cm ²	9000 hours
RLMXtreme 61	15mm/0.6"	1554mm/61"	1473mm/58"	145 watts	800mA	442uW/cm ²	9000 hours



UVR uses T5 High Output UV-C lamps 33" & 61" made from titanium quartz.



Building Management System (BMS) Cards for remote monitoring of each UVC lamp status / performance, via a set of NO/NC terminal for sending the signal to a remote location.



Encapsulamp's encapsulation contains and isolates lamp residues of gas, mercury and other contaminants in case of accidental lamp breakage. This allows UV-C lamps to be used in almost anywhere including pharmaceutical and food processing plants as well as health & medical care centres and nursing homes.



UV Report - UV-C Radio-metric Monitor provides Green, Yellow and Red Indicator light to alert operators of go/no go lamp status.



UVR UL Listed Ballast



Silicon Plug Gluv ensures water tightness & prevents electrical shorts from moisture and water.



UVC Control Box can house 2 to 9 ballasts and other related wiring, electrical and electronic components and terminals, including LED Lights to show the status of the UV-C lamps. The Control Box is installed outside the AHU, away from moisture and water exposure, especially during coil cleaning.

Right-Size – UV-C Lamps for AHU Coil Irradiation

In the 2011 and 2016 ASHRAE Handbook, the UV-C irradiance for coil maintenance is set at 50 to 100 microwatt/cm².

Specifying higher irradiance would be a waste of capital as well as maintenance and replacement costs.

The late president of UV Resources, Mr. Forrest Fencil (ASHRAE Fellow and Distinguished Lecturer on UVC for Coil Maintenance & other related topics) formulated the “Lamp Watts to Cooling Coil Area Ratio”, by applying the following 4 factors :

1. UV-C Lamp Output
2. Cooling Effects of UV-C Lamps
3. Intensity factor & Distance
4. UVC Reflectance

Right Size Formula

– Lamp Watt to Cooling Coil Surface Area (W x H of coil)

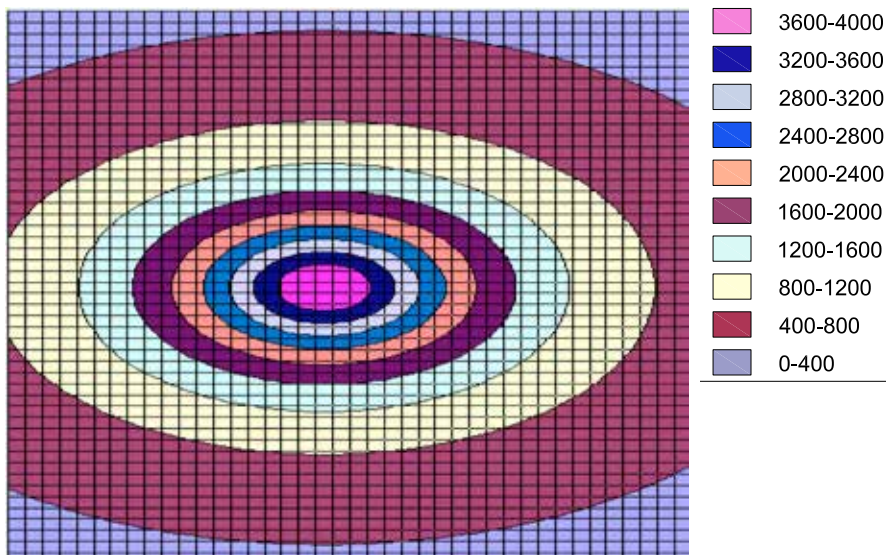
75-80 Lamp watts to irradiate One square meter of cooling coil surface or approximate

Or

7.5 lamp watts to irradiate one square ft of cooling coil Surface Area

That is a typical 846mm (33”) High Output T 5 UV-C lamp can irradiate one square meter of cooling coil whilst a typical 1550mm (61”) can irradiate two square meters.

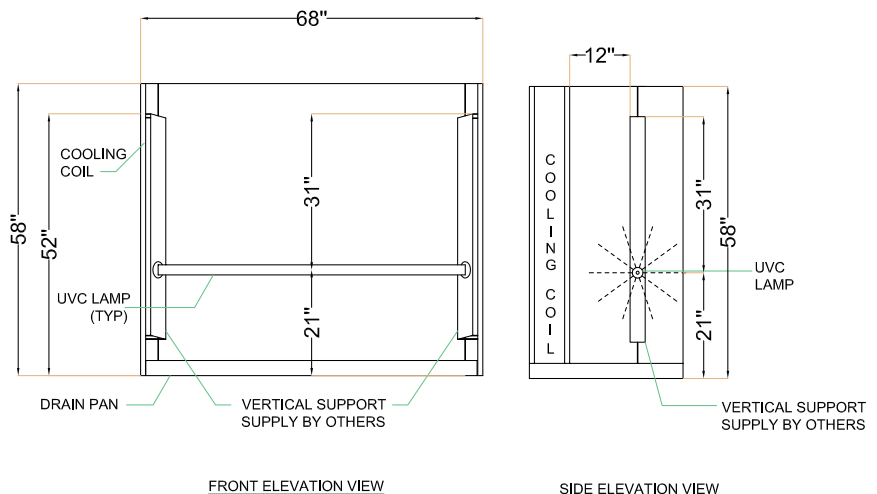
3rd Party Software Modelling



Maximum Surface Intensity
2550 μW/cm²

Average Surface Intensity
866 μW/cm²

Minimum Surface Intensity
232 μW/cm²



Software shows a minimum surface UVC intensity of 232 microwatt/cm² for a cooling coil of 68” x 52” (24.5 sq ft or 2.28 sq m with one 61” HO UVC Lamp of 145 watts), meeting ASHRAE’s guideline of 50-100 microwatt/cm², confirming UVR’s Right-Size formula. **UVR uses 3rd party mathematical modeling by Prof Wally Kowalski of Penn State University and author of UVGI Handbook.**

Case Study - Alantech Tower, Florida, USA.

UVR UV-C lamps installed at Alantech Towers (a 34 year old building) at Fort Lauderdale , Florida USA, to improve IAQ. An independent audit found that the Air Capacity of all 25 AHUs have increased by over 40% after the use of UV-C lamps and with lower pressure drop across the cooling coil. This indicates that the UVC irradiation cleared the severely choked coils. All AHUs experienced higher cooling loads. A summary of the test result is shown below and is available upon request.

AlanTech Tower UV Lighting Results Before /After			
AHU 5B South			
Record Data (Summarized)		1 st Reading (09/12/11)	2 nd Reading (01/17/12)
EMS	R.A.T	69.14%	68.89%
	S.A.T	54.17%	53.97%
	CHWV%	39.4%	33.7%
	Static Pressure	.83"	.89"
	VFD Output	91.37%	89.96%
	Outdoor Air		
	D.B.	79.8"	76.4"
	W.P.	75.7"	65.5"
	D.P.	74.4%	59.7%
→	Total Air (CFM)	10,699	15,708
	Coil ΔP"	1.08"	.781"
	Fan VFD Htz.	55.4	54.38
	Fan % Speed	92%	90.6%
	TMBH	388.978	420.102

Notes: 15,708 CFM (01/17/12) IS 46.8% greater air flow with 1.4% less fan speed

Calculation

1st Reading 10,699 CFM with a 1.08" coil ΔP. An air flow increase, under same conditions would have created a 2.32" ΔP, however actual is .871"

AlanTech Tower UV Lighting Results Before /After			
AHU 12B South			
Record Data (Summarized)		1 st Reading (09/12/11)	2 nd Reading (01/17/12)
EMS	R.A.T.	69.53%	69.2%
EMS	S.A.T.	53.04%	52%
EMS	CHWV %	24.56%	17.21%
EMS	Static Pressure	1.38"	1.51"
EMC	VFD Output	77.6%	80.57%
	Outdoor Air		
	D.B.	79.8"	76.4"
	W.P.	75.7"	65.5"
	D.P.	74.4%	59.7%
→	Total Air (CFM)	13,027	18,690
	Coil ΔP"	.525"	.661"
	Fan VFD Htz.	39.34	48.36
	Fan % Speed	65%	80%
	TMBH	362.893	497.360

Notes: 18,690 (01/17/12) is 43.5% greater than as (09/12/11) reading fan was operating at 22% greater.

Calculation

1st Reading 13,027 CFM at .525" coil ΔP. A 43.5% air increase would have coil ΔP calculate to 1.21". Actual coil ΔP was .661".

RLM Xtreme - UV-C Lamps for Ducted Installation – DUV Type



Benefits:

- Lowest cost of ownership of any UV-C system
- Meets all market requirements
- Most constant UV fluence
- Flexible and simple installation
- 360 Deg Irradiation

UVResources Ballasts and UV-C Lamps are reconfigured into Duct Mount Units (DUV Type) and are designed to be used in confined areas like Fan Coil Units (FCU) or in Air Conditioning Ducts. DUV units provide 360° irradiation. They use High Output lamps assembled with a ballast housing assembly that can be easily installed by opening a 50mm hole on the side of the FCU or duct. The housing is attached by means of self tapping screws on the exterior of the duct/FCU.

The UV-C lamp can be easily removed by opening the housing cover and releasing 4 retaining screws. The ballast is not disturbed during lamp change. DUV is truly the easiest to install and maintain. DUV units come with an On/Off switch with an LED Light. Building Management System (BMS) Card for each unit is available as an option.

Model	Housing Dimensions (W x H x D or thickness)	Lamp length	No. of lamps	Lamp type	Watts	Est. Dosage within GI duct, 23deg C. 1m straight@2.5m/s
DUV 1 x 22	250 x 155 x 90 mm	46mm (22")	1	T5 HO	58	2870 microwatt S/cm ²
DUV 1 x 33	250 x 155 x 90 mm	838mm (33")	1	T5 HO	75	3720 microwatt S/cm ²
DUV 2 x 22	490 x 155 x 90 mm	546mm (22")	2	T5 HO	116	5740 microwatt S/cm ²
DUV 2 x 33	490 x 155 x 90 mm	838mm (33")	2	T5 HO	150	7400 microwatt S/cm ²



Unlike UV-C for Coil Surface Irradiation, Air Disinfection requires a much higher intensity, from 1000 microwatt/cm² to 10,000 microwatt/cm², as mentioned in the 2016 ASHRAE handbook. Each DUV is designed to deliver an UVC dosage of 2800 to 7400 microwatt S/cm². More DUV can be added to further increase UV-C irradiance & dosage.

Summary of a UVC system Requirement

UV-C fixtures shall be designed for high moisture, HVAC conditions and for application flexibility sufficient to provide the specified irradiance on both the cooling coils and drain pans.

Power supplies shall be UL Listed as variable input (120–277 Vac \pm 10%) electronic types designed to facilitate PnP wiring of both inputs and outputs. They shall auto-match to the lamp to maximize lamp performance, installation flexibility, reliability and life.

UV-C lamps shall be Hot Cathode, T5 diameter High Output lamp, low pressure types, designed for HVAC use, and installed in sufficient quantity and in such a manner so as to meet the specified lamp Watts per square foot of surface area.

Safety Switching shall be supplied on all accesses to the UV-C fixturing plenum to de-energize the UV-C lights when accessed.

The UVC shall be sized in compliance to guidelines stated in 2016 ASHRAE Handbook on UVGI.

Local in situ test reports on microbial (fungi & bacteria) reduction of at least 90% to cooling coil surfaces must be submitted as proof of efficacy.

The UV-C system supplied shall be certified Green Building Product ( 2 ticks) under the Singapore Green Building Council.

Performance

The minimum UVC irradiance shall be of at least **100** microwatts/per cm² striking the entire surfaces at the plenum's sides, top and bottom. This is in compliance to 2016 ASHRAE Handbook on UVGI. Irradiance shall be verified by third party mathematical modeling.

The lamp plugs and lamp sockets of the UV-C lamps shall be protected by a Plug Gluv made of UV-C resistance material, to prevent lamp pin degradation and electrical shorts from exposure to moisture and water.

UVC Control Box

For ease of operation and safety in preventing electrical shortcircuiting, the UVC Power supplies (ballasts) & all electrical and electronic components shall not be installed inside the AHU. They shall be housed in an IP 55 UVC Control Box and installed on the external housing of the AHU.

The UVC Control Box shall house the following:

LED Indication Lights (indicating the performance of the individual UVC lamp.

An On/Off Switch (for safety, emergency & maintenance purposes).

Monitoring of UVC lamps

- a) There shall be a Centralised Signal Processing Card / BMS card to monitor the status of each UVC Lamp.
- b) It shall provide NO/NC (Normally Open / Normally Closed) dry contacts. The dry contacts is Normally Open and shall close should there be a fault with any UVC lamp, sending a signal to the Building Automation / Management System.
- c) The BMS card shall also provide LED Indication Signal for each UVC lamp. The LED shall be on the outside of the Control Box, for visual check. Should there be a fault in any UVC lamp, the LED signal shall not illuminate.

Optional Item:

b) Radiometer

The Radiometer housing shall be constructed of high performance industrial grade plastic impregnated with carbon black for structural integrity and UVC exposure. Mounting holes facilitate easy installation.

It shall have a highly visible ½ inch high LED readout of lamp performance in percent of rated output and real-time hours of lamp operation, that can be toggled to indicate either data.

It shall have a reset button to set lamp output to 100 % and lamp timer to zero hour (during lamp change-out).

There shall be a terminal block with screw down electrical clamping for NO, NC and C (common) and a 24 VAC power in connection using solid or stranded wire.

Softcopy available on demand or download from www.airverclean.com

ABOUT UV ..from various sectors..

GOVERNMENT

UVC Emitters/ Lamps

– “UVC Emitters/Lamps: Ultraviolet light (C band) emitters/lamps shall be incorporated downstream of all cooling coils and above all drain pans to control airborne and surface microbial growth and transfer.”

U.S. General Services Administration (GSA); Facilities Standards for the Public Buildings Service

Energy Savings

– A Pacific Gas & Electric (PG&E) study showed that a dirty condenser coil can increase compressor energy consumption by 30 percent.

Federal Energy Management Program Fact Sheet, U.S. Department of Energy, Energy Efficiency and Renewable Energy, by the Pacific Northwest National Laboratory May 2005

Bio-terror

– UVGI should be considered as a component of emergency preparedness plans for existing public buildings and a wide range of congregate settings.

The Application of Ultraviolet Germicidal Irradiation to Control Transmission of Airborne Disease: Bioterrorism Countermeasure, Philip W. Brickner, MD, Public Health Report/ March-April 2003 Vol. 118

INSTITUTIONAL

Efficacy of Ultraviolet Irradiation in Controlling TB

– Our data demonstrate that UVGI was able to inactivate air-borne bacteria spores and mycobacteria and significantly decrease their culturable cell concentrations.

University of Colorado, Boulder, Colorado for the CDC; October 14, 2002

Ability of Fan-Powered UVGI Disinfection to Inactivate Selected Airborne Bacteria

– We estimated that more than 99% of the bacteria irradiated (*Escherichia coli*, *Pseudomonas fluorescens*, *Serratia marcescens*, and *Micrococcus luteus*) were inactivated.

1994 Conference of the Society for Occupational and Environmental Health, NIOSH

UV in Schools

– This study concludes that the UVC technology is effective in reducing microbial growth on air conditioning cooling coils.

Improving Indoor Environment Quality and Energy Performance of California K-12 Schools, Project 3, Effectiveness of UVC Light for Improving School Performance, California Energy Commission, 2006

COMMERCIAL

Effect of Ultraviolet Germicidal Lights

– Operation of UVGI resulted in 99% reduction of microbial and endotoxin concentrations within the ventilation systems resulting in significantly fewer work related respiratory and mucosal symptoms.

The LANCET, Vol 362, November 29, 2003

Effectiveness of UV Light in Controlling Fungal Contamination

– With a 99% reduction of surface and “dispersed” microbes, UVGI can be effective in the reduction of fungal contamination.

Journal of Allergy and Clinical Immunology, Vol 103, No.1, pr. 2; January 1999



UVResources RLM Xtreme and DUV types are certified by Singapore Green Building Council under the Green Mark Products (two ticks, very good), **SGBP 2016-568.**

RLM and DUV types are promoted & marketed in collaboration with UV Resources, California, USA

