Disinfection Solutions

Fighting Back Against the Virus

and Other Airborne Pathogens

UV Light is possibly the only technology that is both **<u>Defensive</u>** and **<u>Offensive</u>** when dealing with all strains of virus and bacteria in the air.

Immediate
<u>Defensive</u> Benefit

UV is an additional barrier to Coronavirus infection along with gloves, masks etc.

Immediate
<u>Offensive</u> Benefit

UV aggressively attacks virus inside the "Disinfection Zone" to kill the pathogen and reduce the viral load in the air over time.

<u>Long Term</u> Benefit

UV is effective against a wide range of disease-causing pathogens including Coronavirus, Noro-virus, Influenza, Measles, Legionella, Tuberculosis, Streptococcus plus others.

UV will reduce these pathogens and many more over the long term.

CERTIFIED
222.2
No. 187-20 867

manufactured by

WATER AIR
Wyckomar
UV PURIFICATION SYSTEMS

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What is UV and How Does it Work?

Ultraviolet (commonly referred to simply as UV) light when employed at a specific wavelength is a very efficient killer of virus and bacterial pathogens that can be contaminating water and also indoor air.

Since natural germicidal UV light from the sun is screened out by the earth's atmosphere, we must look to alternative means of producing UV light. This is accomplished through the conversion of electrical energy in a low-pressure mercury vapor "hard glass" quartz lamp. Electrons flow through the ionized mercury vapor between the electrodes of the lamp, which then creates UV light.

Filaments and arc in a UV lamp

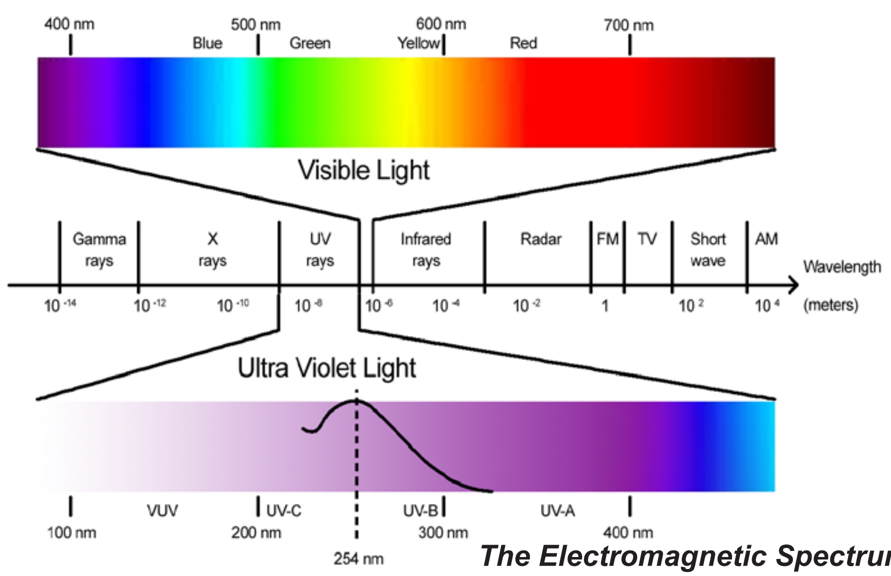
The Electromagnetic Spectrum

Ultraviolet light is one energy region of the electromagnetic spectrum, which lies between the x-ray region and the visible region. Wavelengths of visible light range between 400 and 700 nanometers (nm). UV itself lies in the range of 200 to 390 nm. Optimal UV germicidal action occurs at 254 nm.

As UV light penetrates through the cell, it causes a molecular rearrangement of the micro-organism's DNA, preventing it from reproducing. If the cell cannot reproduce, it is considered dead or "inactivated".

UV Fixture - A Simple Solution

In order to help sterilize indoor air, a UV fixture mounted on the wall will allow the indoor air to constantly pass over the lamp and through the "disinfection zone" multiple times and this results in a lowering of the viral and bacterial load in the air over time.



The Electromagnetic Spectrum

UV is effective against many common pathogens including

- Coronavirus (MERS-CoV, SARS-CoV, SARS-CoV 2)
- Rhinovirus
- Adenovirus
- Picornavirus
- Influenza A virus
- Herpes simplex virus
- Measles
- Norovirus
- Rotavirus
- *Neisseria meningitidis*
- *Mycobacterium tuberculosis*
- *Streptococcus pneumoniae*
- *Bacillus anthracis*

and many more

Recent studies suggest that UV light may help reduce COVID-19 transmission indoors

"We have been able to demonstrate that UV-C susceptibility constant Z, for SARS-CoV-2 is likely to be similar to that exhibited by SARS-CoV-1 and MERS-CoV viruses. Furthermore, we have found evidence suggesting that SARS-CoV-2 when suspended in air is reasonably easy to inactivate using UV light at 254nm. As such, this suggests that upper-room UVGI may have great potential as an intervention to inhibit the transmission of COVID-19 in buildings, especially in situations where achieving high ventilation rates might otherwise be impractical."

Upper-room ultraviolet air disinfection might help to reduce COVID-19 transmission in buildings.
by Clive B Beggs and Eldad J. Avital https://www.medrxiv.org

Using UV Light to Disinfect Indoor Air

Ultraviolet light at a specific frequency (254nm) is a very effective disinfectant against both virus and bacteria in both water and air. In fact UV is effective against a large list of pathogens.

To sanitize and help disinfect indoor air, we have developed a simple UV light fixture that can be deployed in many situations to help reduce the viral and bacterial load in the air, while operating silently and continuously over time.

The stainless steel fixture is mounted on the wall 7 feet or more from the floor – this is known as “upper-room-UV-germicidal-disinfection” and the UV lamp in the fixture creates a “disinfection zone” above the lamp.

As air in the room continually circulates, it will pass over the UV lamp and through the disinfection zone multiple times and this is the mechanism that provides the disinfection benefits.

Deploying UV Air Systems in the Hospitality Industry

The hospitality industry requires some creative solutions to help recover from the economic damage of the pandemic.

One such measure may be the installation of simple UV Lamp wall fixtures in common areas of the facility. UV lamps are commonly used in the disinfection of both water and air because UV light is an effective, efficient, chemical-free and inexpensive way to provide another barrier to pathogenic contaminants including virus and bacteria.

Providing an additional layer of protection for guests and staff is a common-sense measure that can help reassure customers that the facility is doing everything it can to help mitigate the effect of the pandemic on daily life.

These UV-Air systems may be deployed in care settings such as resident living spaces, hallways, kitchens etc. while the UV-Air1500 systems may be deployed in larger spaces such as common areas, classrooms, offices etc.

More than one unit should be used where room size, air-flow and traffic patterns warrant.

UV System - Operational Considerations

The systems require a replacement UV lamp annually. They are extremely simple to install, use and maintain. Wyckomar provides a one-year warranty on the fixture and a one-year pro-rated warranty on the UV lamp.

Suggested Areas of Application

Residential - Commercial - Institutional

Using UV fixtures distributed through the facility at key points such as reception, restaurants and banquet facilities, hallways, meeting rooms and other common areas makes sense as these are where people congregate. This also allows maximum flexibility for the facilities management to position UV disinfection systems where needed based on traffic flow patterns.

Focus on classrooms

Classroom installations are of particular importance as students and staff are in the room for extended periods of time regularly.

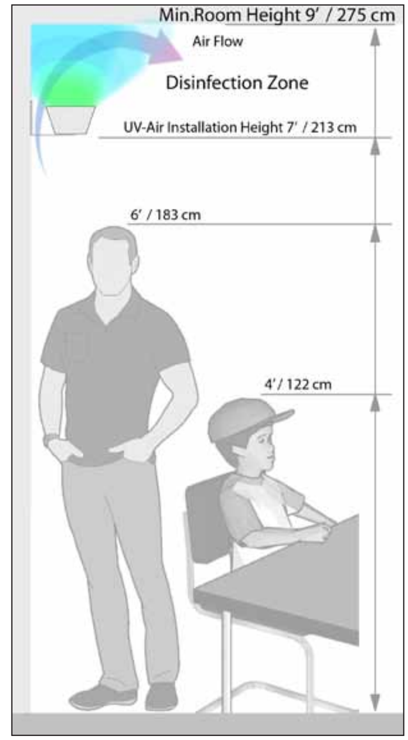
Focus on LTC

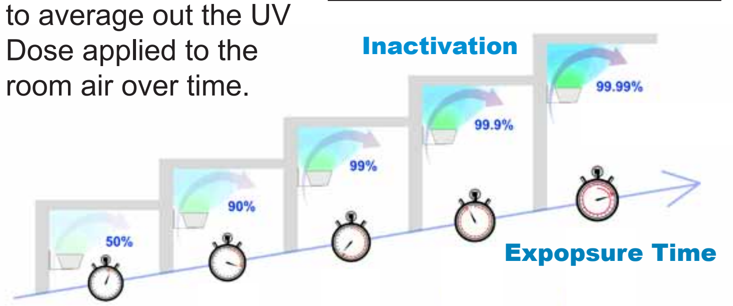
Residents and staff will benefit from reduced airborne pathogen load.

Disinfection Zone

As the air moves up and over the “Disinfection Zone”, the germicidal UV rays from the UV lamp attack any virus and bacterial pathogen in the air.

As the air passes the UV lamp multiple times during the day, the pathogens are hit with an accumulated UV Dose and this accumulating dose of germicidal UV light is the mechanism for viral load reduction in the air over time. Constant air circulation over the lamp will tend to average out the UV Dose applied to the room air over time.





Frequently Asked Question About GUV Disinfection

This information is provided by the Illuminating Engineering Society at ies.org

1. Can UV-C effectively inactivate the SARS-CoV-2 virus, responsible for COVID-19?

Yes, if the virus is directly illuminated by UV-C at the effective dose level. UV-C can play an effective role with other methods of disinfection, but it is essential that individuals be protected to prevent UV hazards to the eyes and skin. UV-C should not be used to disinfect the hands!

2. How does GUV (Germicidal UV) work to disinfect air?

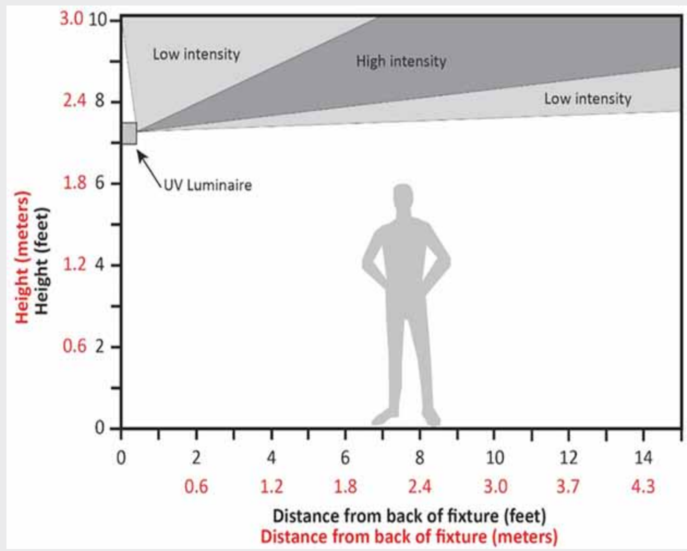
Commonly used GUV lamps generate predominantly 254-nm UV radiant energy, which is close to the peak germicidal wavelengths of 265 to 270 nm – both in the UV-C range, compared to the longer-wavelength ultraviolet (UV-A and UV-B) in sunlight. GUV radiant energy damages nucleic acids (DNA and RNA), thus preventing replication and leading to the death of virtually all bacteria and inactivation of all viruses—both DNA and RNA types. Bacteria and viruses vary somewhat in UV susceptibility, with environmental organisms, fungal spores, and mycobacteria being relatively harder to kill than more rapidly replicating and non-environmental microbes and most bacteria. But even fungi are effectively killed with high-dose UV, which is used, for example, to treat fungal contamination of air conditioning systems. GUV can be most effectively used to disinfect air in the upper room where ceiling height permits, but can also be used in ventilation ducts and room air cleaners, as noted. As explained below, upper-room GUV is considered the most effective application for room air disinfection, where feasible.

3. What is upper-room GUV?

Upper-room GUV is a safe means of air disinfection that is possible in rooms with high ceilings. In this method, specially designed and installed UV-C fixtures that irradiate only the air above 2.1 meters (7 feet) constantly disinfect the upper air volume. This is most effective when there is constantly mixed air by fans and HVAC ventilation, but even without strong ventilation or fans, air constantly mixes by movements and normal convective currents.

4. Why is upper-room GUV more effective than UV in ventilation ducts or in room air cleaners?

Upper-room GUV (see Figure) disinfects large volumes of room air (above occupants' heads) at once, resulting in high "equivalent" air changes per hour (ACH) in terms of air disinfection only—GUV does not dilute odors or CO_2, the main functions of building ventilation. Odor control and CO_2 removal are accomplished by relatively low levels of ventilation (1 to 2 ACH), but air disinfection requires much higher rates of ventilation (6 to 12 ACH), or the equivalent produced by upper-room GUV. Two hospital controlled studies [13, 14] have shown upper-room GUV to be about 80% effective against tuberculosis (TB) spread.



Even when GUV is confined to the upper room, good air mixing (ideally with low-velocity ceiling fans but easily accomplished by other types of forced-air ventilation) results in very high equivalent ACH in the lower, occupied space—estimated to be an additional 24 ACH in a South African study.[13]

[13] Mphaphlele M, Dharmadhikari AS, Jensen PA, Rudnick SN, van Reenen TH, Pagano MA, Leuschner W, Sears TA, Milonova SP, van der Walt M, *et al.* Institutional tuberculosis transmission. Controlled trial of upper room ultraviolet air disinfection: A basis for new dosing guidelines. Amer J Respir Crit Care Med. 2015;192(4):477-84.

[14] Miller SL. Upper room germicidal ultraviolet systems for air disinfection are ready for wide implementation (editorial). Am J Respir Crit Care Med. 2015;192(4):407-9.

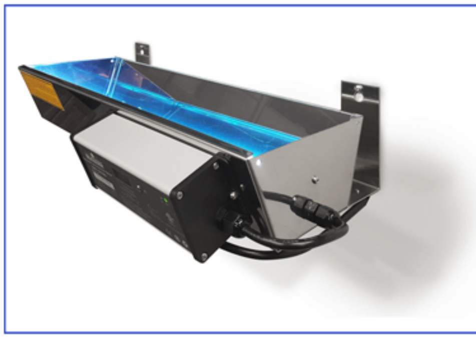
5. How long do virus particles and bacteria remain airborne?

This is important, but difficult to answer in a simple fashion and it depends on how the microbes were made airborne, e.g., from a sneeze or cough, or by being blown up from surfaces or dusted off clothes. The smallest particles (1- to 5-µm droplet nuclei) can remain airborne much longer than cough droplets—for many minutes or even hours.

Specifications — Model UV-Air250

Electrical	120 VAC 60 Hz
UV Lamp	RL-23/436T5 Low Pressure UVC
Certification	UV-Air Purification Device CSA 222.2 No. 187-20 & UL 867
Wattage	21 Watts
Ballast	4-BE-425-ECO-R with LED Display Visual / audible lamp-out-alarm, operation count
Shipping Size	24 x 9 x 6 inches (61 x 23 x 15,2 cm)
Weight	7 LBS (3,2 kg)
Installation	Wall Mounted
Maintenance	Change UV lamp annually - clean unit occasionally
Coverage Area	Approx. 120 - 150 sq ft / 11 - 14 m^2 per unit

Designed for moderate sized rooms, min. 9ft / 2,75m ceiling height
Not for open concept areas

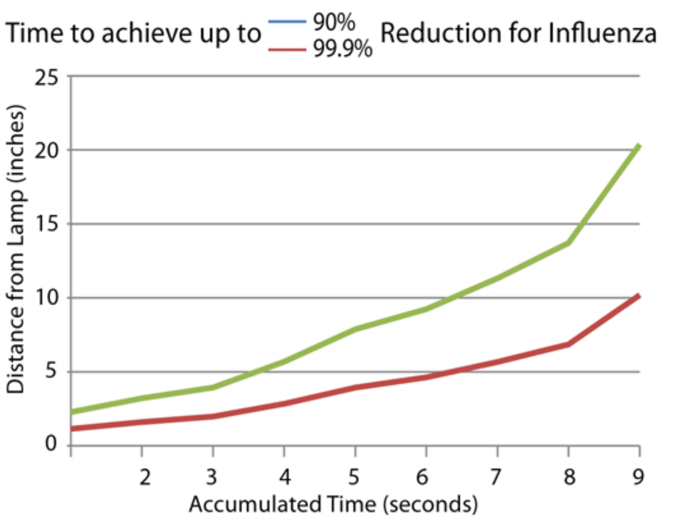


The UV-Air250 is a simple and very effective method of reducing the viral and bacterial load in the air that you breathe.

Indoor air can host many pathogens, including viral and bacterial contaminants, and the UV-Air250 is designed to continually provide effective UV disinfection 24/7 and the viral load in the air over time.

UV Efficacy against Virus and Bacteria

Germicidal UV light is effective at various distances in air.



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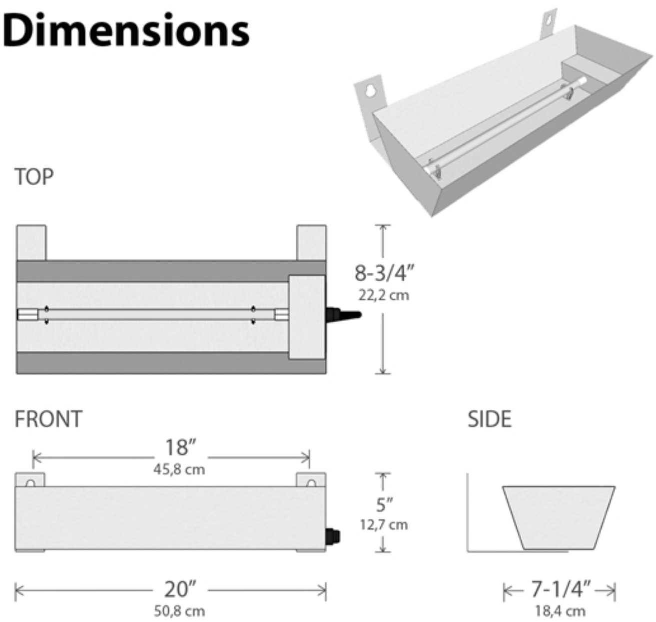


Applications

Sized for moderate Room Size. Use more than one when air flow, room size and traffic warrant.

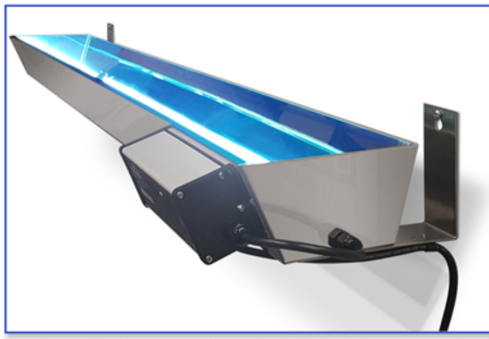
- Home and Cottage
- Office and Recreation Areas
- Professional and Medical Offices
- Hotels
- Retirement Homes
- Classrooms
- Restaurants
- Almost Anywhere

We Stand On Guard

Specifications — Model UV-Air1500

Electrical	120 VAC 60 Hz
UV Lamp	RL-110/1197T5 Low Pressure UVC
Certification	UV-Air Purification Device CSA 222.2 No. 187-20 & UL 867
Wattage	88 Watts
Ballast	4-BE800-ECO with LED Display Visual / audible lamp-out alarm, operation count
Shipping Size	53 x 11 x 6 inches (135 x 28 x 15,2 cm)
Weight	14 LBS (6,4 kg)
Installation	Wall Mounted
Maintenance	Change UV lamp annually - clean unit occasionally
Coverage Area	Approx. 500 - 625 sq ft / 46.5 - 58 m² per unit

Designed for larger sized rooms, min. 9 ft / 2,75 m ceiling height
Not for open concept areas

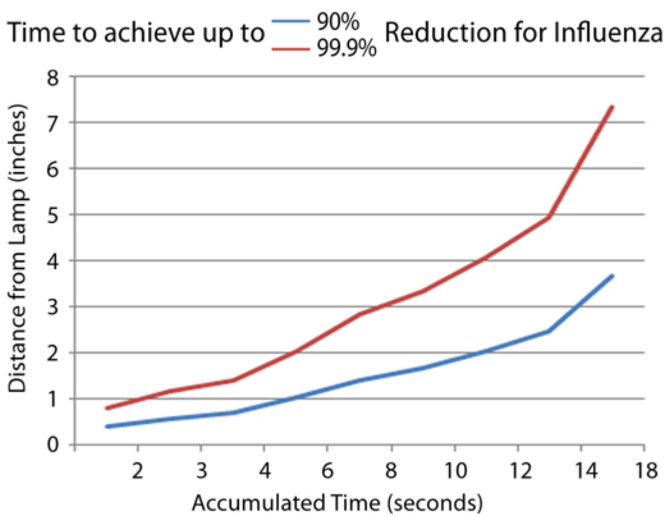


The UV-Air1500 is a very effective method of reducing the viral and bacterial load in the air.

Indoor air can host many pathogens, including viral and bacterial contaminants, and the UV-Air1500 is designed to continually provide effective UV disinfection 24/7 and to reduce the viral load in the air over time.

UV Efficacy against Virus and Bacteria

Germicidal UV light is effective at various distances in air.



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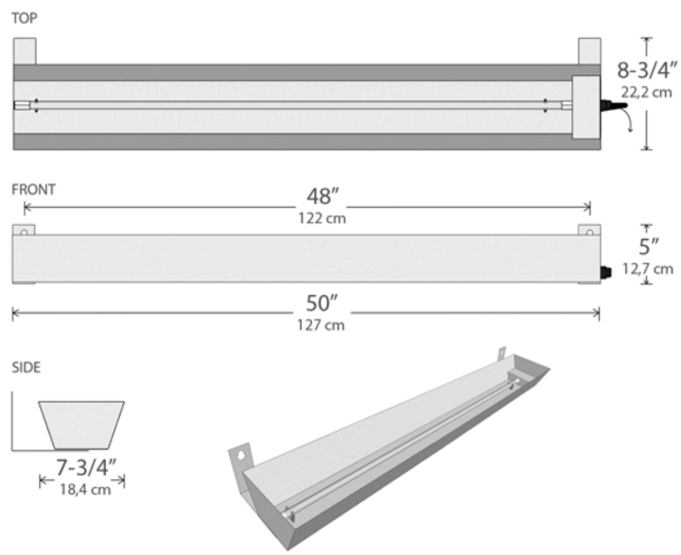
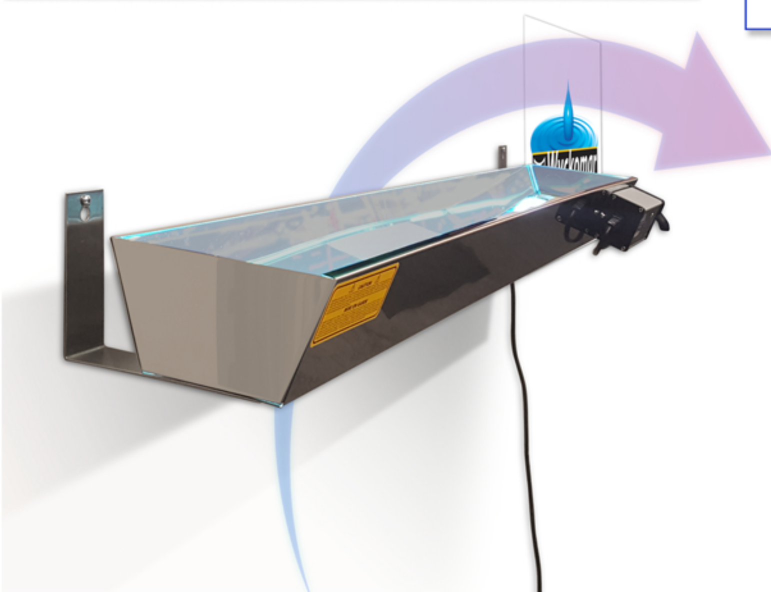




Applications

Use several units when air flow, room size and traffic warrant.

- Health Care Centres, including LTC
- Office and Recreation Areas
- Professional and Medical Offices
- Retirement Homes
- Classrooms
- Restaurants
- Hotels
- Unlimited Applications

We Stand On Guard

About the Company

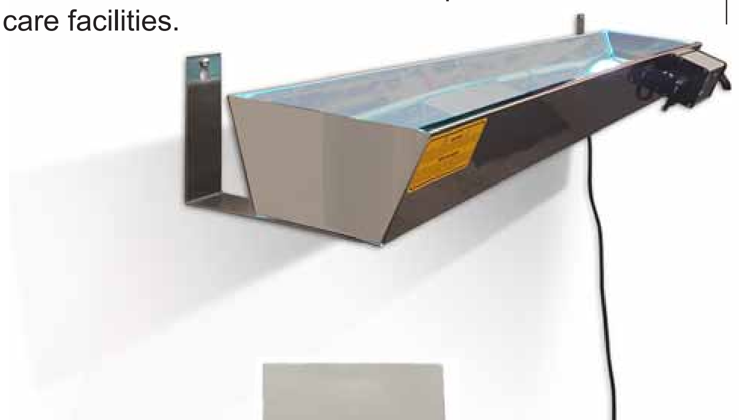
Corporate Profile

We are pleased to introduce Wyckomar Inc., a Canadian manufacturing company with more than 40 years of experience as a leader in the small systems sector of the global water purification industry. Our company currently exports from our main facility in Guelph, Ontario Canada to more than 45 countries worldwide.

Since 1978, Wyckomar Inc. has been manufacturing water disinfection equipment using ultraviolet (UV) light as the disinfection agent. UV has been used for decades in the water treatment industry and more recently throughout hospitals and other professions where air treatment is required to reduce the viral and bacterial load that may be present.

Wyckomar is now applying our 40+ years of experience in the UV industry to the task of helping to sanitize the air in homes, offices, workplaces, schools and care facilities.

The Wyckomar plant in Guelph, Ontario



MADE IN CANADA

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UV Inactivation Chart* (in mJ/cm²)

Organism	Type	Affiliated Disease, Contamination, Toxin	Dose log 2	Dose log 3	Dose log 4	Reference
Adenoviridae	Virus	Upper respiratory infections (most UV-resisitant virus known)		90	121	Meng and Gerba, 1996 / Gerba et al., 2003
Acanthamoeba spp. (cysts)	Protist	Amoebic keratitis and encephalitis		140		Maya et al, 2003
Aeromonas hydrophila	Bacterium	Tissue damage in humans (opportunistic pathogen)		3.9		Wilson et al, 1992
Agrobacterium tumefaciens	Bacterium	Crown Gall disease in Dicotyledons (Grapes, Berries, Fruits, Nuts)		8.5		
Aspergillus flavus (yellow green)	Fungus (Mold Spore)	Aspergillosis of the lungs, corneal infections		99		
A. glaucus (blue green)	Fungus (Mold Spore)	Allergenic		88		
A. niger (black)	Fungus (Mold Spore)	Otomycosis, Black mold on fruits and vegetables		330		
Bacillus anthracis	Bacterium	Anthrax		8.7	110	Coohill and Sagripanti, 2008
B. anthracis (spores)	Bacterium	Anthrax		46.2	620	Coohill and Sagripanti, 2008
B. megatherium (vegetable)	Bacterium	Infections, food poisoning		2.5		
B. megatherium (spores)	Bacterium	Infections, food poisoning		52	600	Coohill and Sagripanti, 2008
B. paratyphosus	Bacterium	non pathogenic		6.1		
B. subtilis (vegetable)	Bacterium	Ropiness in bread dough, food contamination		11		
B. subtilis (spores)	Bacterium	Ropiness in bread dough, food contamination		61	600	Chang et al, 1985 / Sommer et al, 1998
Campylobacter jejuni	Bacterium	Food poisoning, gastroenteritis		4.6	21	Coohill and Sagripanti, 2008
Chlorella vulgaris	Protist (algae)	Plant pathogen		22		
Clostridium tetani	Bacterium	Tetanus		23.1		Pasteur Institute, Paris
C. botulinum	Bacterium	Produces Botulin toxin		11.2		
C. perfringens	Bacterium	Food posoning (ex *C. welchii*)		75		Jacangelo et al, 2003
Coliphage	Virus	Bacteriophage that infects *E. coli*		6.6		
Corynebacterium diphtheriae	Bacterium	Diphtheria		6.5		
Coxsackie A	Virus	Hand, foot & mouth disease, conjunctivitis, herpangina		6.9		
Coxsackie B	Virus	Pericarditis, myocarditis, gastrointestinal distress	20.6	27		Battigelli et al, 1993 / Gerba et al., 2003
Cryptosporidium parvum	Protist	Cryptospiridiosis, gastrointestinal illness	2.5	12	25	Craik et al, 2001 / EPA, 2006
Cyanobacteria	Bacterium	(blue green algae)		700		Masschelein et al, 1989
Desulfovibrio spp	Bacterium	(sulfate-reduction bacteria) Contamination of oilfield process water		10		Hagan et al, 2011
Eberthella typhosa	Bacterium	Typhoid fever		4.1		
Entamoeba histolytica	Protist	Amoebiasis		84		
Enterococcus spp.	Bacterium	Indicator species for (recreational) water quality		30		Beltran and Jimenez, 2008
Escherichia coli	Bacterium	Food poisoning, gastroenteritis, meningitis		8.6		Sommer et al, 1998; Wilson et al, 1992
Fusarium oxysporum	Fungus	Plant pathogen (Fusarium wilt)		100		
Giardia lamblia (cysts)	Protist	Giardiasis (Beaver Fever, Traveller's Diarrhea)	2.1	11	22	Linden et al, 2002 / EPA, 2006
Hepatitis virus	Virus	Hepatitis, jaundice		15		US.EPA, 1999
Influenza virus	Virus	Influenza, respiratory infections		6.6		
Klebsiella pneumoniae	Bacterium			15	20	Giese & Darby, 2000
Legionella bozemanii	Bacterium	Pneumonia		3.5		
L. dumoffii	Bacterium	Pneumonia		5.5		
L. gormanii	Bacterium	Pneumonia		4.9		
L. longbeachae	Bacterium	Legionnaire's disease, pontiac fever		2.9		
L. micdadei	Bacterium	Influenza, Pittsburgh pneumonia		3.1		
L. pneumophila	Bacterium	Legionnaire's disease		3.8	9	Wilson et al, 1992
Leptospira interrogans	Bacterium	Leptospirosis (Weil's disease, canicola-, canefield-, 7-day fever)		6		
Listeria monocytogenes	Bacterium	Foodborne Listeriosis		40		
Micrococcus candidus	Bacterium			12.3		
M. sphaeroides	Bacterium			15.4		
Mycobacterium tuberculosis	Bacterium	Tuberculosis	10			Bohrerova et Linden, 2006
Mucor racemosus A	Fungus (Mold Spore)	Fungal plant pathogen, zygomycosis and fungal sinusitis in humans		35.2		
Naegleria fowleri (cyst)	Protist	Warm water pathogen		105		
Neisseria (Moraxella) catarrhalis	Bacterium	Otitis media, sinusitis, laryngitis		8.5		
Nematode eggs (Roundworm)	Parasite	Ascariasis, Appendicitis, Loeffler's Syndrome		92		
Oospora lactis	Fungus (Mold Spore)	Fruit rot (rapid decay of ripe fruits, potatoes), mold in dairy products				
Paramecium spp.	Protist			200		
Penicillum digitatum (olive)	Fungus (Mold Spore)	Fungal spoilage in fruits and vegetables		88		
P. expansum (olive)	Fungus (Mold Spore)	Postharvest decay of stored apples		22		
P. roqueforti (green)	Fungus (Mold Spore)	Producing harmful secondary metabolites (alkaloids + mycotoxins)		26.4		
Phytomonas tumefaciens	Bacterium	Crown Gall disease in Dicotyledons (Grapes, Berries, Fruits, Nuts)		8.5		
Polio virus	Virus	Poliomyelitis (Polio)		27		Snicer et al, 1998, Wilson et al, 1992
Proteus vulgaris	Bacterium	Infections (esp. sinus and respiratory, urinary tract)		6.6		
Pseudomonas aeruginosa (lab)	Bacterium	Hospital acquired infections, ear infection, dermatitis in pools & tubs		3.9		
Pseudomonas aeruginosa (env.)	Bacterium	Hospital acquired infections, ear infection, dermatitis in pools & tubs		10.5		
Pythium spp	Fungus	Plant pathogen (root rot)		100		
Rhizopus nigricans (black)	Fungus (Mold Spore)	Infections, allergetic reactions (known as breadmold)		220		
Rhodospirillum rubrum	Bacterium			6.2		
Rotavirus	Virus	Infections, severe diahorrea, gastroenteritis		26	36	Battigelli et al., 1993; Wilson et al., 1992
Saccharomyces spp	Yeast			13.2		
Salmonella enteritidis	Bacterium	Egg-associated Salmonellosis (fever, abdominal cramps, diarrhea)		7.6	10	Tosa and Hirata, 1998
S. paratyphi	Bacterium	Enteric fever		6.1		
S. typhi	Bacterium	Typhoid fever		30	50	Beltran and Jimenez, 2008 / Mayaet al. 2003
Sarcina lutea	Bacterium			26.4		
Serratia marcescens	Bacterium	Nosocomial (Hospital acquired) infections		6.2		
Shigella dysenteriae	Bacterium	Epidemic dysentery		4.2		Wilson et al., 1992
S. flexneri	Bacterium	Shigellosis, dysentery		3.4		
S. sonnei	Bacterium	Shigellosis		7		Chang et al., 1985
Staphylococcus aureus	Bacterium	Staph and nosocomial infections, toxic shock syndrome		7	10	Chang et al., 1986
S. epidermidis	Bacterium	Infections in catheters and prostheses		5.8		
Streptococcus hemolyticus	Bacterium	Strep throat		5.5		
S. faecalis	Bacterium	Endocarditis, bladder and prostate infection		8	11.2	Harris et al., 1987 / Chang et al., 1985
S. lactis	Bacterium			8.8		
S. pyogenes	Bacterium	Scarlet fever, toxic shock syndrome, flesh eating disease		8.8		
S. viridans	Bacterium	Mouth or gingivial infections, endocarditis		3.8		
Tobacco mosaic virus	Virus	Mottling and discoloration in plants		440		
Toxoplasma gondii	Protist	Toxoplasmosis		10		Ware, Swinburn et al., 2010
Vibrio cholerae	Bacterium	Cholera		2.2	2.9	Wilson et al., 1992
Yersinia enterocolitica	Bacterium	Yersiniosis (fever, abdominal pain, diarrhea		3.7	5	Wilson et al., 1992

*UV energy levels required at 254 nanometer wavelegth for 99% (log 2), 99.9% (log 3) and 99.99% (log 4)

Selected Reference Articles – Upper-Room Germicidal UV

Centers for Disease Control (CDC) - COVID-19 Focussed

https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation/uvgi.html

Dept. Health & Human Services - CDC

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

medRxiv.org

https://www.medrxiv.org/content/10.1101/2020.06.12.20129254v1

ATS Journals

https://www.atsjournals.org/doi/full/10.1164/rccm.201505-0927ED

ACS Publications

https://pubs.acs.org/doi/10.1021/acsnano.0c04596

NY Times

https://www.nytimes.com/2020/05/07/science/ultraviolet-light-coronavirus.html