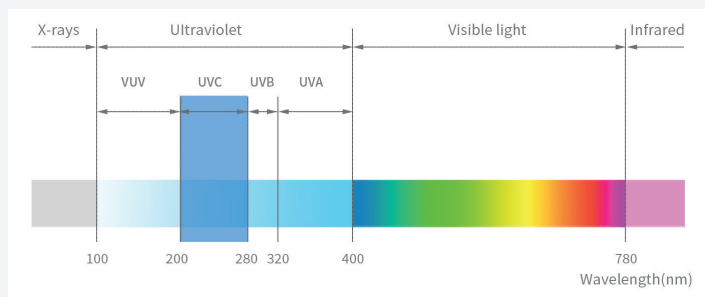


## What is UVC?

UVC is short wavelength ultraviolet radiant energy. It forms part of the non-visible segment of the photobiological ultraviolet spectral band, between 200 and 280 nm.



## Why can't I see UVC light?

The electromagnetic spectrum contains wavelengths of light which are both visible and invisible. UVC is in the short wavelength end of the spectrum and is invisible to the human eye. Therefore, although no visible light is being emitted it is still described as Ultraviolet Light.

## Why does GOLDENSEA UV use UVC in its products?

One of the key properties of the UVC spectral bandwidth is that its radiant energy, when placed in line of sight of a given surface, causes viruses, bacteria and mold spores to become inactive. UVC is therefore referred to as germicidal ultraviolet irradiation (GUVI)

## Is the use of UVC, as an effective germicidal tool, new?

No, in fact there GUVI has been studied since the late 19th century with focus on UVC from around 1930. In 1935 scientists proved through demonstration the ability of UVC irradiation to effectively inactivate airborne microorganisms. In the 1970's UVC irradiation was proven to reduce TB infection. Since the early 1990's there has been further focus on the efficacy and safety of UVC products as a way to inactivate viruses and bacteria and it is a proven, useful tool in this respect.

## Is UVC effective at destroying/ inactivating harmful micro-organisms?

Multiple scientific reports show high efficacy rates in the reduction of harmful micro-organisms when used in accordance with manufacturer instructions. For example:

"Implementation of this "no-touch" technology in various hospitals has documented a sustained reduction in surface microbial contamination, reduced cross contamination, and a reduced spread of multi-drug resistant bacterial infections. In the study of Liscynesky et al. [15], in rooms of patients with confirmed C. difficile infection (CDI), 32 out of 238 (13%) high-touch surfaces were positive after bleach disinfection and only 1 out of 238 (0.4%) was positive after UVC-treatment (the computer keyboard) at 254 nm emitted by 3 connected devices run for 45 min." [Evaluation of an Ultraviolet C (UVC) Light-Emitting Device for Disinfection of High Touch Surfaces in Hospital Critical Areas, Beatrice Casini et al, Sep 24 2019]

## What about COVID 19. Will GOLDENSEA UV products inactivate this virus?

YES! Following extensive research by Signify and the University of Boston, it has been shown that UVC is effective at inactivating the Sars-CoV-2 virus which causes Covid 19. This study highlights the effectiveness of using UVC irradiation in the fight against Covid 19. [Link to source.](#)

## What harmful micro-organisms can I expect GUVI to destroy/inactivate?

GUVI has been proven to destroy or inactivate the following micro-organisms. Relevant dose and neutralization efficacy rates are listed in the table below.

Microorganisms	Dose J/m <sup>2</sup> (99.99%)	Dose J/m <sup>2</sup> (99.90%)	Dose J/m <sup>2</sup> (99.00%)	Dose J/m <sup>2</sup> (95.00%)	Dose J/m <sup>2</sup> (90.00%)
<b>Coronavirus</b>					
Coronavirus	28	21	14	9.1	7
Berne virus (Coronaviridae)	28	21	14	9.1	7
Canine coronavirus (CCV)	116	87	58	37.7	29
SARS coronavirus CoV-P9	160	120	80	52	40
Murine coronavirus (MHV)	412	309	206	133.9	103
SARS coronavirus (Hanoi)	536	402	268	174.2	134
SARS coronavirus (Urbani)	964	723	482	313.3	241

Microorganisms	Dose J/m <sup>2</sup> (99.99%)	Dose J/m <sup>2</sup> (99.90%)	Dose J/m <sup>2</sup> (99.00%)	Dose J/m <sup>2</sup> (95.00%)	Dose J/m <sup>2</sup> (90.00%)
<b>Bacteria</b>					
Bacillus anthracis	180.8	135.6	90.4	58.76	45.2
B. megatherium sp. ( spores)	109.2	81.9	54.6	35.49	27.3
B. megatherium sp. (veg.)	52	39	26	16.9	13
B. paratyphosus	128	96	64	41.6	32
B. subtilis	284	213	142	92.3	71
B. subtilis spores	480	360	240	156	120
Campylobacter jejuni	44	33	22	14.3	11
Clostridium tetani	480	360	240	156	120
Corynebacterium diptheriae	134.8	101.1	67.4	43.81	33.7
Dysentery bacilli	88	66	44	28.6	22
Eberthellatyposa	85.6	64.2	42.8	27.82	21.4
Escherichia coli	120	90	60	39	30
Klebsiella terrifani	104	78	52	33.8	26
Legionella pneumophila	36	27	18	11.7	9
Micrococcus candidus	242	181.5	121	78.65	60.5
Micrococcus sphaeroides	400	300	200	130	100
Mycobacterium tuberculosis	240	180	120	78	60
Neisseria catarrhalis	176	132	88	57.2	44
Phytomonas tumefaciens	176	132	88	57.2	44
Pseudomonas aeruginosa	220	165	110	71.5	55
Pseudomonas fluorescens	140	105	70	45.5	35
Proteus vulgaris	105.6	79.2	52.8	34.32	26.4
Salmonella enteritidis	160	120	80	52	40
Salmonella paratyphi	128	96	64	41.6	32
Salmonella typhimurium	320	240	160	104	80
Sarcina lutea	788	591	394	256.1	197
Serratia marcescens	96.8	72.6	48.4	31.46	24.2
Shigella paradysenteriae	65.2	48.9	32.6	21.19	16.3
Shigella sonnei	120	90	60	39	30
Spirillum rubrum	176	132	88	57.2	44
Staphylococcus albus	73.6	55.2	36.8	23.92	18.4
Staphylococcus aureus	104	78	52	33.8	26
Streptococcus faecalis	176	132	88	57.2	44

Microorganisms	Dose J/m <sup>2</sup> (99.99%)	Dose J/m <sup>2</sup> (99.90%)	Dose J/m <sup>2</sup> (99.00%)	Dose J/m <sup>2</sup> (95.00%)	Dose J/m <sup>2</sup> (90.00%)
<b>Bacteria</b>					
Streptococcus hemoliticus	86.4	64.8	43.2	28.08	21.6
Streptococcus lactus	246	184.5	123	79.95	61.5
Streptococcus viridans	80	60	40	26	20
Sentertidis	160	120	80	52	40
Vibrio cholerae (V.comma)	140	105	70	45.5	35
Yersinia enterocolitica	44	33	22	14.3	11

Microorganisms	Dose J/m <sup>2</sup> (99.99%)	Dose J/m <sup>2</sup> (99.90%)	Dose J/m <sup>2</sup> (99.00%)	Dose J/m <sup>2</sup> (95.00%)	Dose J/m <sup>2</sup> (90.00%)
<b>Yeasts</b>					
Bakers' yeast	156	117	78	50.7	39
Brewers' yeast	132	99	66	42.9	33
Common yeast cake	240	180	120	78	60
Saccharomyces cerevisiae	240	180	120	78	60
Saccharomyces ellipsoideus	240	180	120	78	60
Saccharomyces sp.	320	240	160	104	80

Microorganisms	Dose J/m <sup>2</sup> (99.99%)	Dose J/m <sup>2</sup> (99.90%)	Dose J/m <sup>2</sup> (99.00%)	Dose J/m <sup>2</sup> (95.00%)	Dose J/m <sup>2</sup> (90.00%)
<b>Mould Spores</b>					
Aspergillus flavus	2400	1800	1200	780	600
Aspergillus glaucus	1760	1320	880	572	440
Aspergillus niger	5280	3960	2640	1716	1320
Mucor racemosus A	680	510	340	221	170
Mucor racemosus B	680	510	340	221	170
Oospora lactis	200	150	100	65	50
Penicillium digitatum	1760	1320	880	572	440
Penicillium expansum	520	390	260	169	130
Penicillium roqueforti	520	390	260	169	130
Rhizopus nigricans	4440	3330	2220	1443	1110

Microorganisms	Dose J/m <sup>2</sup> (99.99%)	Dose J/m <sup>2</sup> (99.90%)	Dose J/m <sup>2</sup> (99.00%)	Dose J/m <sup>2</sup> (95.00%)	Dose J/m <sup>2</sup> (90.00%)
<b>Virus</b>					
Hepatitis A	292	219	146	94.9	73
Influenza virus	144	108	72	46.8	36
MS-2 Coliphase	744	558	372	241.8	186
Polio virus	232	174	116	75.4	58
Rotavirus	324	243	162	105.3	81

Microorganisms	Dose J/m <sup>2</sup> (99.99%)	Dose J/m <sup>2</sup> (99.90%)	Dose J/m <sup>2</sup> (99.00%)	Dose J/m <sup>2</sup> (95.00%)	Dose J/m <sup>2</sup> (90.00%)
<b>Protozoa</b>					
Cryptosporidium parvum	100	75	50	32.5	25
Giardia lamblia	44	33	22	14.3	11

Microorganisms	Dose J/m <sup>2</sup> (99.99%)	Dose J/m <sup>2</sup> (99.90%)	Dose J/m <sup>2</sup> (99.00%)	Dose J/m <sup>2</sup> (95.00%)	Dose J/m <sup>2</sup> (90.00%)
<b>Algae</b>					
Blue Green	12000	9000	6000	3900	3000
Chlorella vulgaris	480	360	240	156	120

## How does UVC destroy/ inactivate bacteria and viruses?

When UVC irradiation comes into contact with a micro-organism it causes a photochemical reaction as the radiation is absorbed. Damage to the micro-organism's DNA ensues. Principally the action of the absorption of the photon makes the microbe unable to replicate.

## What about COVID 19. Will GOLDENSEA UV products inactivate this virus?

As Covid 19 is so new there are still more tests which need to be done, although recent research at Columbia University in the US suggests that exposure to UVC radiation is an effective way of inactivating the virus.

As Covid 19's structure is similar to other related coronaviruses, including MERS, there is nothing to suggest that UVC generated by GOLDENSEA UV products will not be an effective tool to combat Covid 19. UVC is proven to be highly effective at inactivating known viruses such as MERS and SARS which are related to Covid 19.

## What does GOLDENSEA UV use to generate UVC radiation from its products?

GOLDENSEA UV employs low pressure (Hg) mercury discharge lamp tubes. The tubes are made by Philips and Osram. These tubes output UVC irradiation at 253.7nm, which is near the maximum microbicidal activity rated at between 260- 265nm. This makes the lamp tubes GOLDENSEA UV uses excellent choices for this GUVI purposes.

## Does UVC radiation from GOLDENSEA UV units result in any by-products?

No, unlike other disinfection methods such as chlorination, UVC disinfection does not produce any known by-products such as residue etc. According to Philips (lamp tube manufacturer) no residual phenomena have been found following the disinfection process.

## What do I need to do to disinfect an area?

Place your GOLDENSEA UV product so that it provides maximum exposure to the surfaces you want to disinfect. Use the correct GOLDENSEA UV product and set the appropriate time for the size of the area you want to disinfect. Remember to place the unit on a stable and secure surface. Remember that areas not directly in the line of sight of the GOLDENSEA UV unit may not be disinfected. GOLDENSEA UV recommends using multiple units in an area if 'shadow lines' are present.

## Will my GOLDENSEA UV product destroy/ inactivate all harmful micro-organisms in a given area?

GOLDENSEA UV products placed in direct line of sight with the surface to be disinfected and set to the appropriate time for said area are designed to destroy/ inactivate upto 99.9% of micro-organisms in the GUVI's path. However, GOLDENSEA UV recommends that GOLDENSEA UV products are used in conjunction with other disinfection protocols for a whole area approach and to ensure the highest levels of disinfection.

## What should I do if the area I want to disinfect has multiple objects in it, therefore making it difficult to have direct line of sight on all surfaces?

Very few spaces requiring disinfection have clear lines of sight in all areas. Therefore, GOLDENSEA UV recommends using multiple units positioned in different areas of the room to ensure increased levels of disinfection. Remember, GOLDENSEA UV recommends that GOLDENSEA UV products are used in conjunction with other disinfection protocols for a whole area approach and to ensure the highest levels of disinfection.

## **How long will it take for my GOLDENSEA UV product to disinfect my area?**

This is dependent on the model of GOLDENSEA UV product (which defines the power of the GUVI it emits) and then the time the product is on for. Please refer to the user manual or product brochure of the product where we list the time/ area for disinfection for each product.

## **Is UVC technology safe?**

Misuse of products and improper installation may result in the UVC products being unsafe. Always follow the directions laid out in the user manual.

UVC is very well researched and well understood. Compared with UV-A and UV-B, both of which are present in sunlight, UVC presents little penetration into deeper layers of skin. In fact UVC primarily impacts and is absorbed by the outer dead layer and outer skin. The current daily safe limit for 253.7 exposure over an 8 hour period is 6 mJ/cm<sup>2</sup> [American Conference of Governmental Industrial Hygienists. 2020 Threshold Limit Values and Biological Exposure Indices] This compares with 10 minutes of exposure to sunlight with a UV index of 10.

However, exposure to UVC can cause temporary skin and eye irritation/ redness and longer exposure can cause burns. When using ultraviolet disinfection lamps, people, animals and plants MUST not be in the disinfection area. Objects may exhibit accelerated ageing, in a similar way that objects are aged when left in direct sunlight. After using ultraviolet light, the area must be ventilated for at least 10 minutes.

GOLDENSEA UV has multiple safety circuits built into all of its products to reduce and avoid the risk of incorrect use resulting in injury.

## **What safety circuits has GOLDENSEA UV designed in its products?**

All direct exposure GOLDENSEA UV products have the following safety circuits.

1. All products have a delayed start circuit. After the user switches on the lamp, it will not ignite for a period of 30 seconds to 3 minutes (depending on the product).
2. During delayed ignition an audible and visual alarm will be present providing the user with warnings to leave the immediate area.
3. Every unit has LED indicators showing the user the state of the product- ready for use, preparing to engage and be engaged. (Solid green, flashing red, solid red)
4. Every unit is fitted with an omnidirectional motion detector. As soon as the motion detector identifies motion, the product will immediately power down resulting in no UVC irradiation
5. Every unit is fitted with a tilt sensor which automatically powers down the product should the unit topple over when unattended.

## **Is it ok to be in the same room as a GOLDENSEA UV product when it is in operation?**

NO. Humans and animals must never be in the same room as a UVC emitting product when it is in operation. All GOLDENSEA UV products come fitted with an omnidirectional motion detector. As soon as the motion detector identifies motion, the product will immediately power down resulting in no UVC irradiation

## **Do I need to wear protective clothing when handling GOLDENSEA UV products?**

Due to the protection circuits employed in GOLDENSEA UV products, the operator should never come into contact with a product, when it is

irradiating UVC. However, it remains best practice for an operator to always wear protective eyewear, nitrile gloves and clothing (tightly woven) which covers all exposed skin.

When replacing the lamp tubes, the power to the product must always be physically unplugged from the wall and the operator should wear protective eyewear, nitrile gloves and clothing (tightly woven) which covers all exposed skin.

## **I am using a GOLDENSEA UV product inside a room with windows. Will UVC radiation be dangerous to people/ animals standing on the other side of the window glass?**

No. Almost 100% of UVC radiation is blocked by glass used in windows, which are made from various compounds, one of which is Cerium (IV) Oxide which blocks UVC. The glass used in the lamp tubes is quartz glass containing only a single component of silicon dioxide which allows UVC radiation to pass through. This is why UVC passes through the glass tube and not the glass window. More information can be found here <http://www.iuva.org/UV-FAQs>

## **Does UVC radiation emitted by GOLDENSEA UV products travel through other materials?**

This depends on the chemical composition of the material in question. Some clear plastics will allow for transmission of UVC while others will not. However, for effective transmission of UVC the composition of the surface needs to be as pure as possible (hence why quartz glass containing only a single component of silicon dioxide is used to make the lamp tubes) meaning that most clear surfaces are not efficient for transmitting UVC them.

Opaque surfaces and tightly woven materials (i.e. where the UVC radiation has no direct line of sight to the sub surface) are also effective at blocking UVC radiation.

## **I am using a GOLDENSEA UV product inside a room with other materials. Will the UVC irradiation cause materials to degrade?**

In general, UV degrades materials such as paint, colours in fabrics and some plastics. Polypropylene (PP) and low-density polyethylene (LDPE) are plastics which are particularly impacted by UVC (and UVA/B) irradiation. Polyester (for example) is far more resistant to UV exposure. Similar degradation of materials also occur when exposed to UV radiation found in sunlight for prolonged periods of time.

The shorter wavelength of UVC may damage plants.

GOLDENSEA UV recommends that all sensitive objects and plants be removed from rooms prior to UVC disinfection.

## **What is the life of the lamp tubes used in GOLDENSEA UV product?**

The lamp tubes used in GOLDENSEA UV product have an effective life of 9,000 hours

## **Does the lamp tube output at peak efficiency throughout its life or does it reduce in efficiency over its life?**

As the lamp tube is used, its output will gradually decay. At 9000h of use (the max effective life) the radiant illuminance will decay to between 90% and 80% of the original value.

## **Can I measure the radiation output of a GOLDENSEA UV product?**

Yes, you can either use UV reactive strips or a radiation meter (for example an Everfine U20 to measure the radiation output.

## **Should I clean the tubes in my GOLDENSEA UV product?**

For maximum efficiency we recommend wiping the tubes down with a damp soft clean cotton cloth to clean any dust on the surface. It is also possible to rub the surface of the lamp tube with a small amount of alcohol.

## **What should I do if a lamp tube breaks?**

UVC lamp tubes contain mercury, which is toxic. Should a lamp tube break, turn off the fixture and unplug the power (if plugged in), open all windows and ventilate the room. Only handle the broken tube while wearing nitrile gloves.

## **Can I replace broken lamp tubes in my GOLDENSEA UV product with any make of lamp tube?**

You must only use the lamp tubes listed in the product manual for the particular product you are needing to replace.

## **How do I dispose of broken lamp tubes?**

You must not dispose of broken lamp tubes in general waste disposal. All GOLDENSEA UV lamp tubes must be disposed of according to your local city, county, state or central government hazardous waste guidelines.

## **Where can I learn more about UVC?**

There are many resources available online and here are some links

<https://media.ies.org/docs/standards/IES-CR-2-20-V1-6d.pdf>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3292282/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6801766/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2789813/>

<https://www.ies.org/standards/committee-reports/ies-committee-report-cr-2-20-faqs/>

<https://www.ies.org/standards/committee-reports/>