ENGMOTION

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Steril-ONE by Engmotion

AUTOMATED UV-C DISINFECTION LINE

The Engmotion Steril-ONE line incorporates a series of devices dedicated to sanitizing sensitive sites through Ultra-Violet Germicidal Irradiation (UVGI) technology of short-wave UV-C ultraviolet radiation.

The UV-C (Ozone Free) lamps used by our devices have a wavelength of 254 nm, certain wavelengths (wavelength of 254 nm) attacks the molecular bonds of the DNA of the micro-organisms, destroying them, rendering them harmless or preventing their growth and reproduction. All lamps do not emit ozone to prevent what may be the harmful effects of ozone decontamination.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recommends ultraviolet germicidal irradiation as a strategy to address the transmission of COVID-19 disease (ASHRAE 2020). Similarly, the IUVA (International Ultraviolet Association), believes that UV technology plays an important role in fighting the spread of the virus.

The Steril-ONE line devices are designed and constructed of sanitizable and highly reflective materials, in such a way as to increase the effectiveness of the treatment by reflecting on mirrhd and electro-polished surfaces of AISI 304L Stainless Steel or 6082-T6 aluminum alloys.

Steril-ONE S-Robot

Sanitization environments:
dental clinics, hospital rooms, nursing homes, companies without too many architectural barriers.

Need:
rapid execution of sanitization.

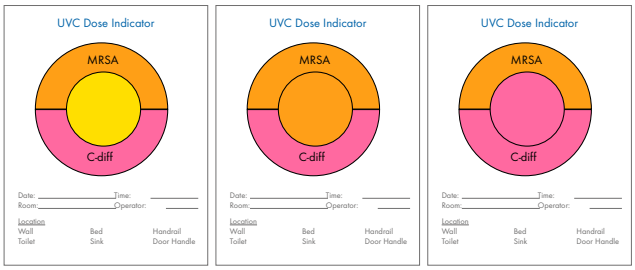
Steril-ONE S-Robot is a hand-held device with a high sanitizing power
The Steril-one S-Robot is portable manually with a sanitizing system consisting of 8 UVC germicidal lamps, at 254 nm. The lamps do not emit ozone, thus not requiring a subsequent aeration of the room.
The sanitization time varies between 8 and 20 minutes depending on the room to be sanitized, the room volume can be logged by the user or, in some versions, is automatically calculated by the intelligent system on board of the machine. As a reference, the 8 Philips lamps robot version with 17.5 UVC W each (electric power 55W) sanitizes a 25 sq.m room in about 10 minutes.

The sterilization process must take place in an empty room, in absence of people and animals.

The machine is equipped with a human presence recognition system and an acoustic warning for the decontamination cycle start. A WiFi IoT system allows remote control and monitoring of the device, as well as for remote programming of routes and activation times. Sanification report download is available from the web app. For the verification of room sanitization, single use UVC indicators are available.

SAFETY FEATURES

- 360° Panasonic motion detectors. In case of motion detection during the disinfection cycle, the UVC lamps are switched off immediately.
- Adjustable sterilization start delay
- Emergency stop button
- LEDs indicating device status



UV DOSE REQUIRED

Several viruses, including aerosol-carried respiratory viral pathogens such as SARS and avian influenza viruses, are susceptible to UV-C doses between 1.5 mJ/cm2 and 17 mJ /cm2 (dose required to achieve a log10 reduction factor R = 3 - 99.9% kill) [9,10]. UV-C light is capable to inactivate at least two coronaviruses (SARS-CoV-1 and MERS-CoV) that are near-relatives of the COVID-19 virus [11,12]. According to the International Ultraviolet Association (IUVA), taking into account current data and empirical evidence, the average UV dose for R=1 inactivation of the virus SARS-CoV-2 (causing COVID-19) is 6.7 mJ/cm2 [13]. Although there are no specific data available for SARS-CoV-2, the value for R=3 inactivation dose for a wide range of tested viruses lies between 20 mJ/cm2 and 80 mJ/cm2 [14]. Eickmann et al. show that a dose of 50 mJ/cm2 is enough for log10 factor R=3 for SARS-CoV-1 [15], which is closely related to SARS-CoV-2.
If we choose the required dose value (mJ/cm2) it is possible, once a square room dimensions (in meters) are known, to calculate the exposure time T (in minutes):

room size (m)	d (m)	dose required – direct irradiation (mJ/cm2)				
		12	25	50	100	150
		Time required (minutes)				
2 x 2	1.4	0.6	1	3	5	8
5 x 5	3.5	2	5	9	19	28
10 x 10	7.1	6	12	25	50	75

Table – time needed to achieve the required dose, knowing the room size (most distant point)

EXAMPLE OF CALCULATION

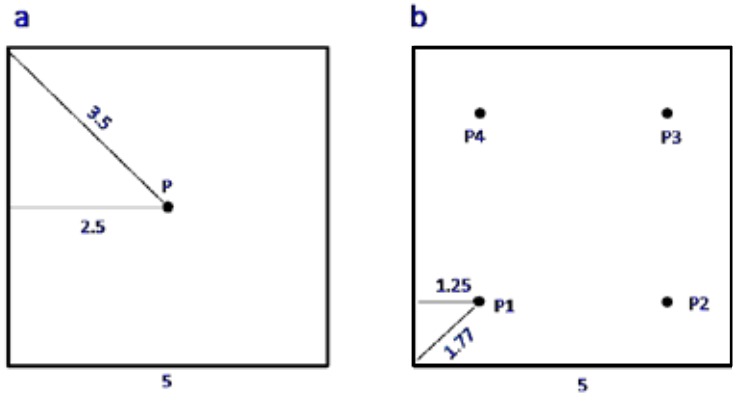
It is possible of simulate the case of a Steril-ONE S Robot treating a 5x5 m room. The dose required is set to 50 mJ/cm2. Two possibility are envisioned:

1. Empty room. No objects obstructing the lamps' line of sight. Steril-ONE is placed in the center of the room (point P in Figure 4a) Treatment time is set to T = 10 minutes.
2. Room with objects obstructing line of sight. It is possible to move the device in 4 different points (P1, P2, P3 and P4 in Figure 4b) and set a treatment time T = 2.5 min for each position.

In case (1), after a single 10' treatment, the four corners (d = 3.53 m) are exposed of a UV dose of 50 mJ/cm2; the central part of the walls (d = 2.5 m) to a dose of 76.5 mJ/cm2.
In case (2), after four 2'30'' cycles, the corners are exposed to a cumulative UV dose of 57 mJ/cm2; the central part of the walls to 77.8 mJ/cm2.

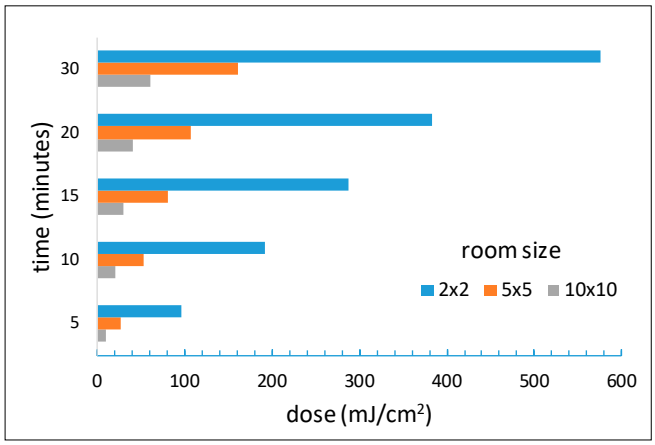
Figure 4 – (a) device in the center of the 5x5 room for 10' treatment time; (b) device moved in 4 different points, for 2'30'' treatment time each. Distances are in meters.

References

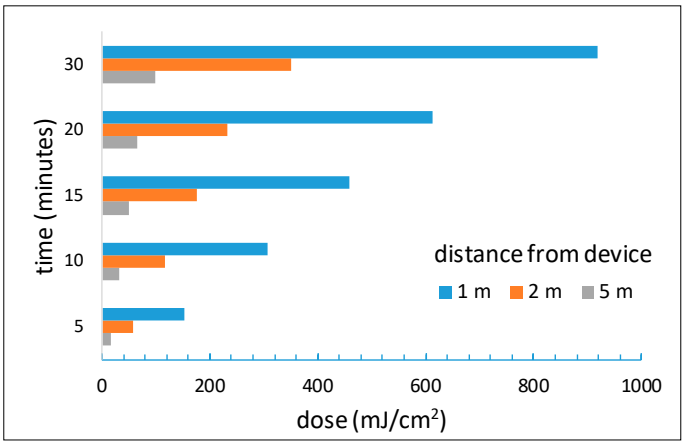


distance (m)	Irradiance (mW/cm²)	Dose - 1' (mJ/cm²)	Dose - 2' (mJ/cm²)	Dose - 5' (mJ/cm²)	Dose - 10' (mJ/cm²)	Dose - 20' (mJ/cm²)	Dose - 30' (mJ/cm²)
0.2	4.78	287	573	1433	2866	5732	8598
0.5	1.34	80	160	401	802	1604	2406
1.0	0.51	31	61	153	306	612	918
1.5	0.29	17	35	87	174	348	522
2.0	0.19	12	23	58	117	234	350
2.5	0.14	9	17	43	86	171	257
3.0	0.11	7	13	33	66	133	199
4.0	0.07	4	9	22	45	89	134
5.0	0.05	3	7	16	33	65	98
10.0	0.02	1	2	6	12	25	37
15.0	0.01	1	1	4	7	14	21

Irradiance values and doses for different exposure times, as a function of distance from UV sterilizer. Doses > 50 mJ/cm2 are highlighted in green; doses > 25 mJ/cm2 are highlighted in yellow



Treatment time for a known square room size



Treatment time for a known surface distance

Steril-One S Robot **Standard version**

Dimensions	1480 mm H X 540 mm X 540 mm
Total weight	40 Kg
Electric consumption	AC 220 V, 50 Hz, 700 W max.
UVC lamp dimensions	Diameter 28 mm – H 900 mm
Lamp lifespan	9000 h (recommended replacement at 6000 h of operation to maintain maximum efficiency)
UVC Radiation power	17,5 W/lamp (electric power 55 W)
N° of lamps	8
Cycle and start delay times setup	Guided by APP
Sanitization time of 25 sq.m (indicative)	10 minutes with 8 lamps
Control	WIFI/APP

Fields of Application

Main targets of use, considering the ongoing covid-19 epidemic, are definitely:
- Emergency rooms, hospitals, clinics and medical clinics, operating rooms, ambulances
- Protected residences for the elderly, multi-functional residences, RSA, dormitories
- Kindergartens, Schools

Furthermore:
- Dental clinics, Orthodontics, Medical Clinics of various degrees and destination
- Veterinary clinics and Doghouses
- Gyms, Fitness centers, Beauty centers
- Hotels, Receptions and rooms, Restaurants and kitchens, Canteens, Bars
- Public bathrooms
- Companies, Offices, Production plants, Warehouses
- Malls and Supermarkets
- Transport means, Buses and Taxis, Ships and Boats, Trains, Railway Stations, Planes and Airports, Subways

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