Fitment Ultraviolet Germicidal UVC LED in existing Escalator

Project undertaken after NDA and Licence agreement with DRDO INMAS AND IIT – DELHI by:

ISO 9001:2008

DRDO INMAS

IIT –DELHI

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About Company

Olive Exports Pvt. Ltd.: A Brief Overview

Olive Exports Pvt. Ltd. With its brand name “OLIVE LED” is a MSME focusing on Research, Design, Development, Engineering, manufacturing and customization of energy saving LED-based lighting systems, all solutions for UVA, UVB & UVC LED based solutions and electronic component / products company. The working of company is driven by a deep sense of social responsibility and commitment. As a customer-centric company practicing the best management techniques in employee engagement, Olive has carved a place for itself in the highly competitive Indian LED-based lighting and UV product industry.

OLIVE is a truly responsible company working in the larger national interest developing and Indianisation of maximum possible products with the customer at its focus. Company has its strong R&D and design capabilities Company introduced innovative designs and modern technologies in its products with truly satisfying international experience and complies with all necessary regulations since its incorporation in 1994.

Some of Our Esteemed Clients

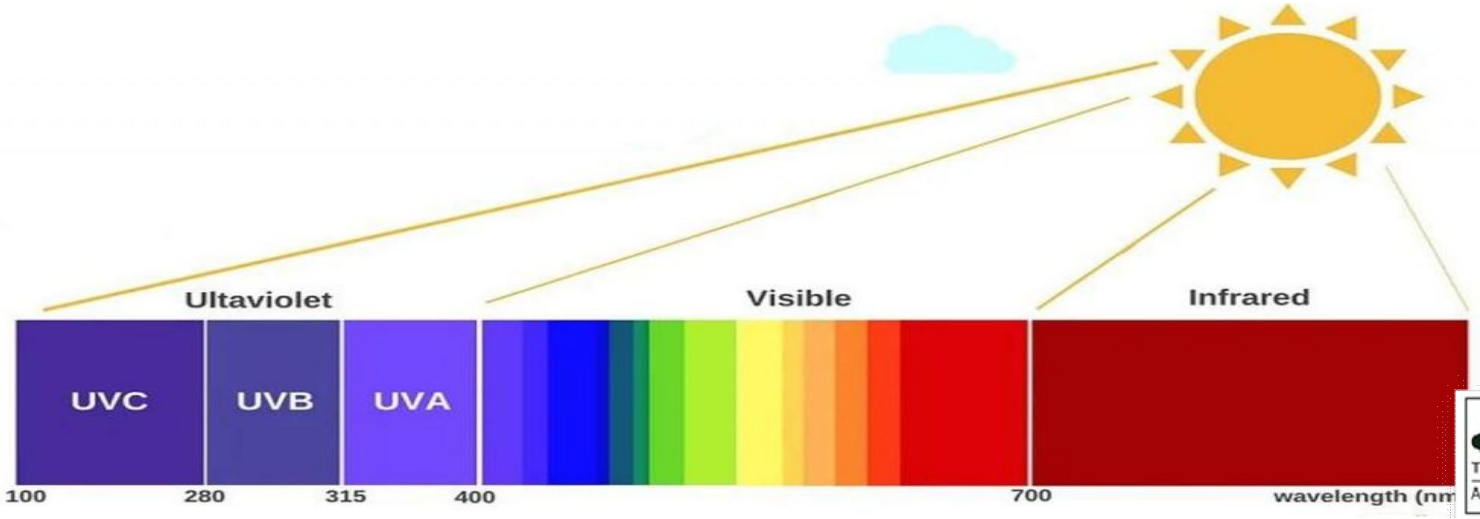
And many more.. Regards "OLIVE"

A Pandemic – COVID 19

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Thus there is a need to prevent importation of infection in workplace settings and to respond in a timely and effective manner in case suspect case of COVID-19 is detected in these settings, so as to limit the spread of infection.

People suffered very badly all over the world and everyone is trying to save himself by the means available. All the Government are working their level best and many type of prevention has been suggested from time to time i.e. Wear a mask - Save lives, wear a face cover, Wash your hands Keep a safe distance. The sanitization, Germicidal and sterilization sources were applied in every area but every alternate was carrying their limitation of use. Only one source of sterilization was best solution was available with UVC sterilization which was 99.99% assured and without any chemicals and residue.

UV radiation was discovered in 1801 when the German physicist Johann Wilhelm Ritter observed that invisible rays just beyond the violet end of the visible spectrum darkened silver chloride-soaked paper more quickly than violet light itself.



What is the difference between UVA, UVB and UVC?

The three types of UV radiation are classified according to their wavelength. They differ in their biological activity and the extent to which they can penetrate the skin. The shorter the wavelength, the more harmful the UV radiation. However, shorter wavelength UV radiation is less able to penetrate the skin.

Short-wavelength UVC is the most damaging type of UV radiation. However, it is completely filtered by the atmosphere and does not reach the earth's surface.

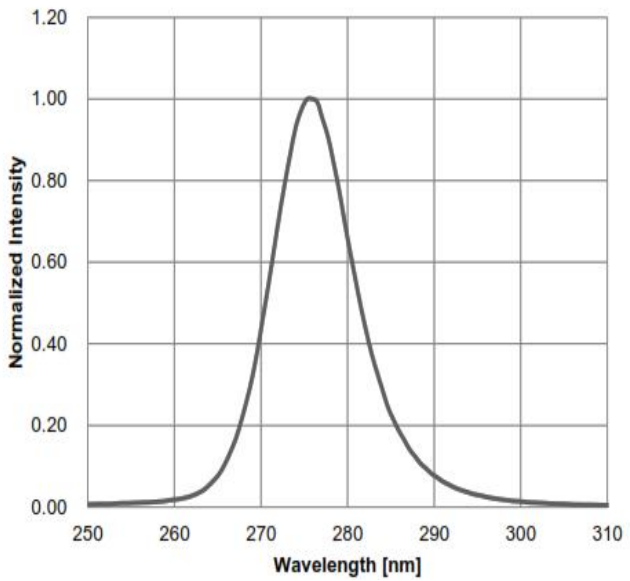
Medium-wavelength UVB is very biologically active but cannot penetrate beyond the superficial skin layers. It is responsible for delayed tanning and burning; in addition to these short-term effects it enhances skin ageing and significantly promotes the development of skin cancer. Most solar UVB is filtered by the atmosphere.

The relatively long-wavelength UVA accounts for approximately 95 per cent of the UV radiation reaching the Earth's surface. It can penetrate into the deeper layers of the skin and is responsible for the immediate tanning effect. Furthermore, it also contributes to skin ageing and wrinkling. For a long time it was thought that UVA could not cause any lasting damage. Recent studies strongly suggest that it may also enhance the development of skin cancers

Wavelengths of Solar & Atmospheric Radiation for meteorological applications

Short-wave	UV-C	100 - 280 nm	Emitted from the sun, totally absorbed by the earth's atmosphere before reaching the ground
	UV-B	280 - 315 nm	Emitted from the sun, 90% absorbed by the earth's atmosphere but biologically very active, causes sunburn
	UV-A	315 - 400 nm	Emitted from the sun, most reaches the ground but not biologically very active
	Visible	400 - 780 nm	Visible light from violet to red (colours of the rainbow)
Long-wave (infrared)	NIR	780 nm - 3 µm	Heat radiation from the sun
	FIR	3 µm - 50 µm	Heat radiation from the atmosphere, clouds, earth and surroundings

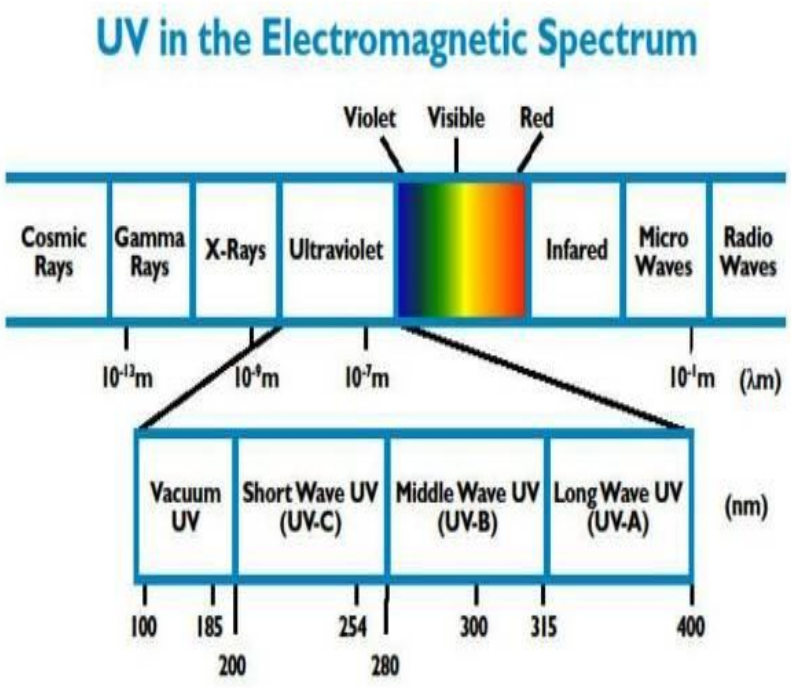
Fig 1. Spectrum, Ta=25°C, I_F=200mA

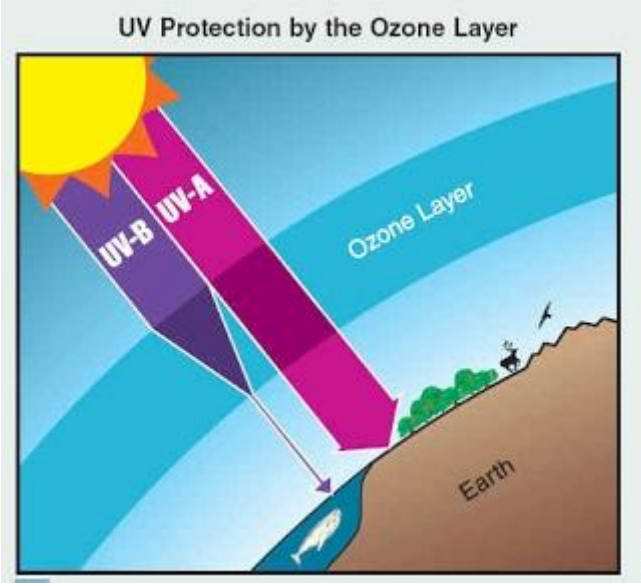


Introduction of UV LEDs

The first LEDs in the early 60s emitted infrared light. Over the years, it was possible to develop LEDs for shorter wavelength, higher energy radiation and today it stands at the beginning of the development of the UV spectral range. The main body of UV-LEDs consists of the semiconducting compounds GaN, InN and AlN and their mixed crystals. When current passes through specially doped layer sequences of these semiconductors a part of the electric current can be converted directly into UV radiation. Such semiconductor devices are known as light-emitting diodes or "LEDs". LEDs emit radiation only in a very narrow energy range around a central wavelength and their position (e.g., the number of atomic layers in the individual layers) can be used to selectively adjust the composition of the semiconductor material and the design. The composition of the various layers must be accurately taken and their thickness can be accurately adjusted to one atomic layer.

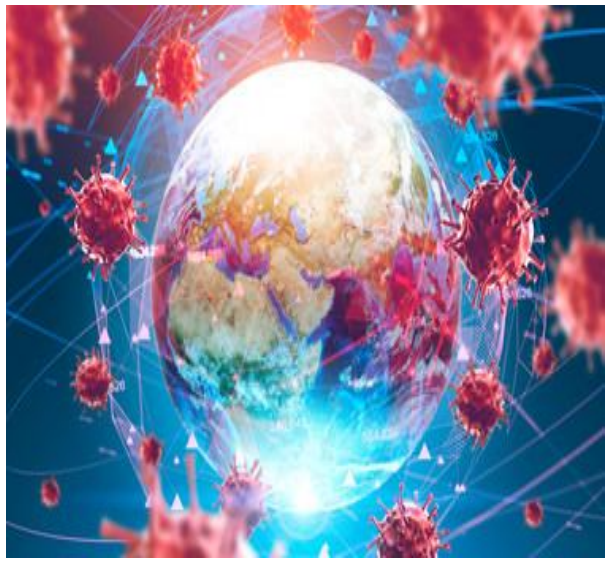
UV LEDs are only at the beginning of their development and consequently LED-based applications are still being created. The shorter the wavelength of the radiation, the higher are the scientific and technical requirements for the material development and LED device technology. Therefore, in general, power and efficiency of short-wave UVB / UVC LEDs are behind the LEDs that emit in the near-UV region.

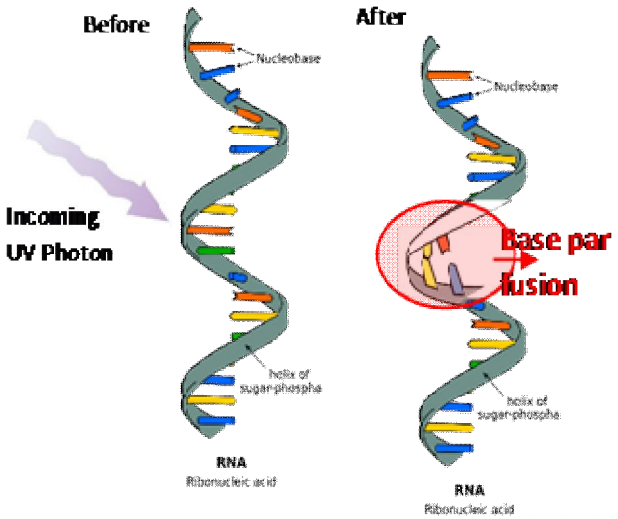




Advantages of UV LEDs

Emission wavelengths of UV-LEDs are adjustable on the composition of semiconductor materials
narrow-band emission without spurious peaks (e.g. noun wanted ozone production)
Radiation intensity electrically adjustable easy(i.e. power scales linearly with the current flow or is digitally controlled via TTL technology)
Generating short pulses(ms to a few10ns) easy to implement, so that e.g. new algorithms possible in metrology
Radiation of UV-LEDs can be tailored(e.g. point-like radiation sources for sensor applications)
compact design of the UV LEDs and UV photo detectors allows considerable free domain the design of the radiator modules or UV systems
Operating at low DC voltages and currents(i.e. operation with batteries or solar cells easily possible)
Durable and maintenance free
Immediate full function without preheating(important for the use of point-of-use systems for water disinfection)
do not contain toxic materials (such as heavy metals such as Hg)
no heat radiation in the emission direction(e.g. by treatment of heat-sensitive biological substances possible)
extremely robust, compact (e.g. no protection against glass breakage necessary, mobile use possible)
How it works: UVC radiation destroy the bacteria's





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How much UV light and time is needed to kill bacteria?

The dosage of **UVC** intensity and **exposure** time is usually measured in micro joules per square centimeter, or equivalently as microwatt seconds per square centimeter ($\mu W \cdot s/cm^2$). Dosages for a 90% **kill** of most **bacteria** and viruses range from 2,000 to 8,000 $\mu W \cdot s/cm^2$.The average **bacterium** will be **killed** in micro seconds.

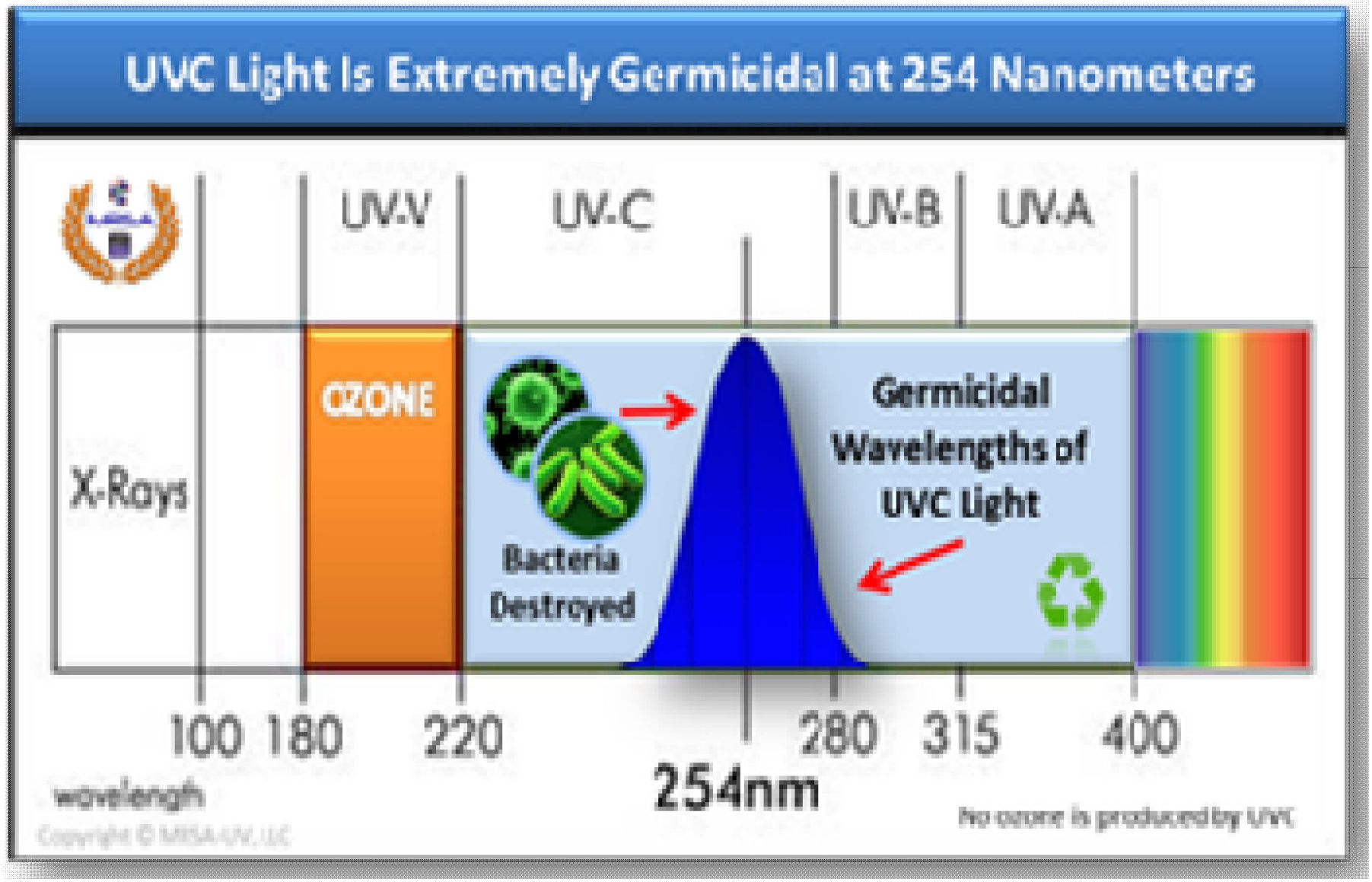
Table 1. Electro - Optical characteristic at 200mA

(T_a=25℃, RH=30%)

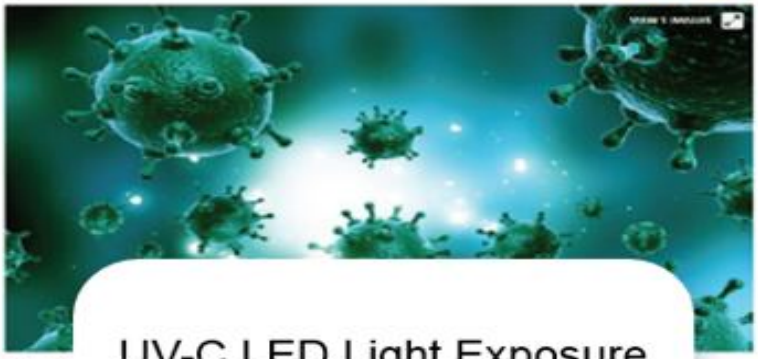
Parameter	Symbol	Value	Unit
Peak wavelength [1]	λp	275	nm
Radiant Flux [2]	Φe [3]	19	mW
Forward Voltage [4]	VF	7.0	V
Spectrum Half Width	Δ λ	10	nm
View Angle	2Θ1/2	120	deg.

Table 2. Absolute Maximum Rating

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Forward Current	I_F	-	-	250	mA
Power Dissipation	P_D	-	-	1.8	W
Operating Temperature	T_{opr}	- 30	-	60	℃
Storage Temperature	T_{stg}	- 40	-	100	℃
Thermal resistance (J to S) [5]	$R\theta_{J-S}$	-	24.2	-	℃/W



Human-safe ultraviolet light used to kill airborne viruses

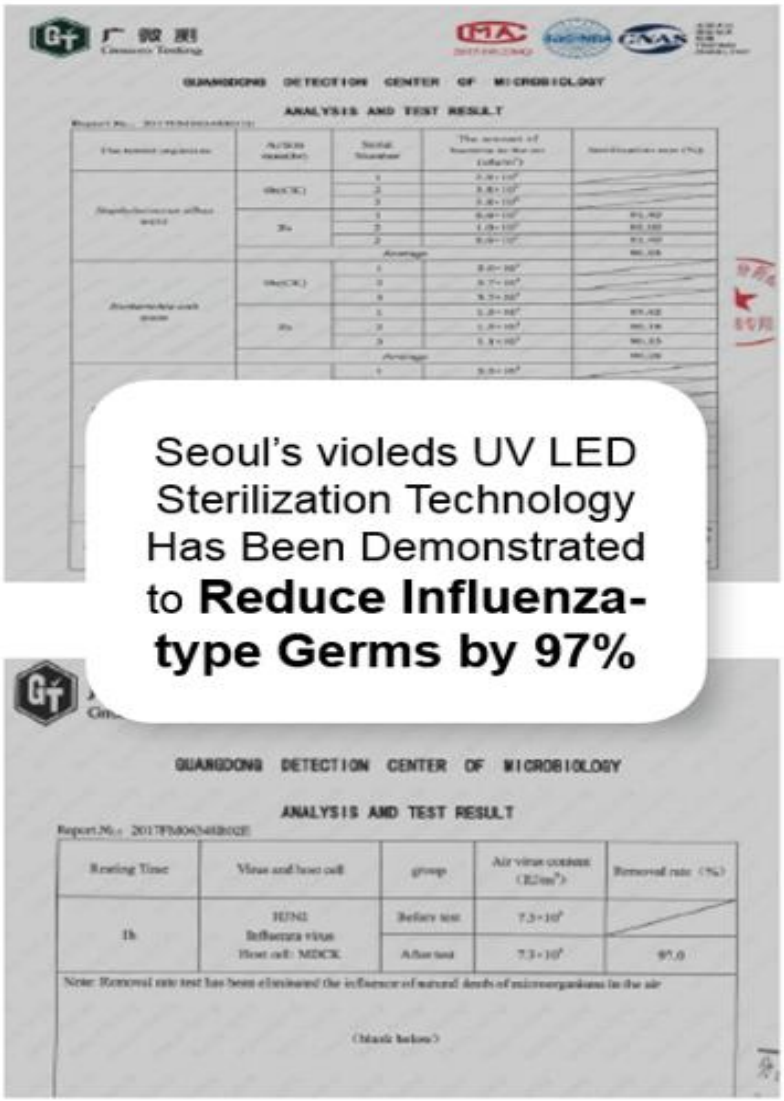


UV-C LED Light Exposure Has Been Shown to **Sterilize 90% of Coronavirus Germs**

Avian Influenza virus	ssRNA	25	0.09140						
Avian Leukemia virus (RSA)	ssRNA	831	0.00308						
Avian Sarcoma virus	ssDNA	229	0.01194						
B. subtilis phage 029	dsDNA	70	0.03268						
B. subtilis phage SPO2/12	dsDNA	106	0.02503						
B. subtilis phage SPP1	dsDNA	185	0.01161						
Bacteriophage PHI X	dsDNA	121	0.01679						
Bacteriophage F-specific	dsRNA	260	0.00756						
Bacteriophage MS2	ssRNA	182	0.01268			5	0.42400	7	0.34420
Bacteriophage Qβ	ssRNA	216	0.00950						
Borna virus	ssRNA	13	0.18420						
BLV	ssRNA	394	0.00634						
Borna virus	ssRNA	79	0.03320						
Bovine Calicivirus	ssDNA	95	0.02420						
Bovine Parvovirus	ssDNA	55	0.06580						
Canine Calicivirus	ssRNA	67	0.03450						
Canine hepatic Adenovirus	dsDNA	265	0.00869						
Cholera phage Kappa	dsDNA	834	0.00365						
Coliphage ID	ssRNA	510	0.00743						
Coliphage fd	ssDNA	23	0.09640						
Coliphage φ X174	ssDNA	25	0.09200			3	0.71000	4	0.53000
Coliphage fertilia	dsDNA	78	0.02955						
Coliphage PRD1	dsDNA	20	0.11500	87	0.02650				
Coliphage T1	dsDNA	14	0.16217						
Coliphage T2	dsDNA	8	0.28245						
Coliphage T3	dsDNA	10	0.23100						
Coliphage T4	dsDNA	13	0.17574						
Coliphage T7	dsDNA	28	0.08145			7	0.33000	10	0.24000
Coronavirus	ssRNA	21	0.11058			6	0.57700		

100mW UVC LED x 60sec / m2 -> 90% reduction of Corona virus

Source: Ultraviolet Germicidal Irradiation Handbook



Seoul's violeds UV LED Sterilization Technology Has Been Demonstrated to **Reduce Influenza-type Germs by 97%**

GUANGDONG DETECTION CENTER OF MICROBIOLOGY

ANALYSIS AND TEST RESULT

Reacting Time	Virus and host cell	group	Air virus content (PFU/m³)	Removal rate (%)
1h	H1N1 Influenza virus Host cell: MDCK	Before test	7.3×10^{5}	
		After test	7.3×10^{4}	97.0

Note: Removal rate test has been eliminated the influence of natural death of microorganisms in the air

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Source: Gmicro Testing

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Alternative UV sources

Currently the generation of UV radiation by excitation of gas discharges dominates technology. The most common are **low and medium pressure mercury (Hg) –vapor lamps.** Its housing is made of fused silica (quartz), partly because the necessary UV transmission, partly because of the high operating temperature. Low-pressure Hg lamps primarily show discrete emission wavelengths at 254 nm and 185 nm. Reach high conversion efficiencies (up to 40%), however, are limited in the power density.

With medium pressure Hg lamps, higher output powers can be achieved, however, the conversion **efficiencies are low (typically 15-30%).** The Hg-line spectrum widens in medium and high pressure lamps in the deep UV to a continuum and in addition shows discrete emission lines in the visible and UVA / UVB spectrum.

Mercury lamps require high voltages to operate and radiate toward the UV emission a lot of heat, for example, the surface temperature of medium pressure lamps from 600 to 950 oC. Moreover, these UV-radiation sources have very often residual intensities in the UVC range, which greatly restricts the medical application, because human skin has no protection mechanism. Besides Hg lamps and excimer lamps and excimer lasers for the generation of UV light can be used which are able to emit according to the used gas mixture at 193 nm, 222 nm, 248 nm, 282 nm, 308 nm or 351 nm. However, the efficiency of the excimer lamps is even lower (typically <15%) and the lifetime is restricted to a few thousand hours. Excimer lasers are extremely expensive and complex to operate and are therefore usually used for special medical applications. Even if gas discharge lamps currently represent the most common source of UV radiation, they have a number of disadvantages that set limits to their applications.

We developed a novel, compact upper-room ultraviolet germicidal irradiation system with light-emitting diode sources (UR-UVGI-LED) to enhance the disinfection of bio aerosols in an enclosed room space. Its effectiveness was evaluated and compared with the conventional upper-room ultraviolet germicidal irradiation system with mercury vapor sources (UR-UVGI-MV).

Escherichia coli, Serratia marcescens, and *Staphylococcus epidermidis* were atomized under the well-mixed condition and exposed to UR-UVGI-LED (or UR-UVGI-MV) device. The intensity output of the UR-UVGI-LED was also varied from 0% (no LED), 25%, and 50% to 100% to further evaluate the UR-UVGI-LED disinfection effectiveness under different power levels

The decay rates for UR-UVGI-LED ranged from −0.1420 ± 0.04 min^{-1} to −0.3331 ± 0.07 min^{-1} for *Escherichia coli*, −0.1288 ± 0.01 min^{-1} to −0.3583 ± 0.02 min^{-1} for *Serratia marcescens*, and −0.0330 ± 0.01 min^{-1} to −0.0487 ± 0.01 min^{-1} for *Staphylococcus epidermidis.*

It was noticed that the intensity level had a non-linear influence on the UR-UVGI-LED's performance. The decay rates achieved by the UR-UVGI-MV system were −0.3867 ± 0.08 min^{-1}, −0.4745 ± 0.002 min^{-1}, and −0.1624 ± 0.02 min^{-1} for *Escherichia coli*, *Serratia marcescens*, and *Staphylococcus epidermidis*, respectively. Hence, the disinfection performance of both UR-UVGI-LED and UR-UVGI-MV systems was comparable for *Escherichia coli* and *Serratia marcescens.* **These results demonstrate that the UR-UVGI-LED system has a high potential to be used as a safe and effective irradiated light source to disinfect indoor airborne pathogens**.

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广东省微生物分析检测中心

GUANGDONG DETECTION CENTER OF MICROBIOLOGY

分 析 检 测 结 果

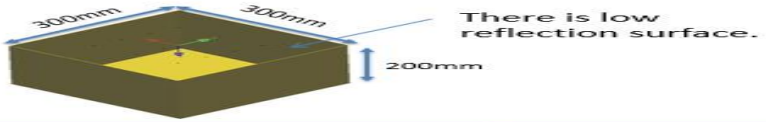
ANALYSIS AND TEST RESULT

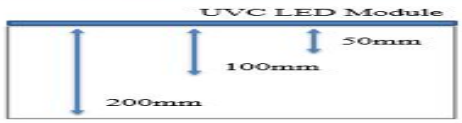
报告编号（Report №.）：2018SP5315R02

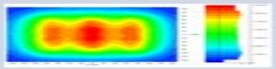
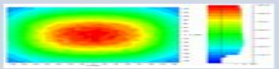
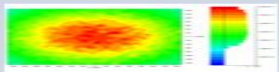
1. **作用时间：** 30min
2. **作用距离：** 距离 5mm 处
3. **测试结果：**

试验菌株	试验组别	试验组平均菌落数（cfu/片）	对照组平均菌落数（cfu/片）	杀灭率（%）	杀灭对数值（KL）
大肠杆菌（*Escherichia coli*）（8099）	1	＜5	2.3×10^{6}	＞99.99	＞5.69
	2	＜5	2.9×10^{6}	＞99.99	＞5.69
	3	＜5	2.2×10^{6}	＞99.99	＞5.69
	平均值		2.5×10^{6}	＞99.99	＞5.69
金黄色葡萄球菌（*Staphylococcus aureus*）（ATCC 6538）	1	85	3.6×10^{6}	99.99	4.64
	2	55	3.7×10^{6}	99.99	4.83
	3	70	3.9×10^{6}	99.99	4.72
	平均值		3.7×10^{6}	99.99	4.73
白色念珠菌（*Candida albicans*）（ATCC 10231）	1	1.0×10^{3}	1.8×10^{6}	99.95	3.29
	2	9.5×10^{2}	2.0×10^{6}	99.95	3.31
	3	9.5×10^{2}	2.1×10^{6}	99.95	3.31
	平均值		2.0×10^{6}	99.95	3.30

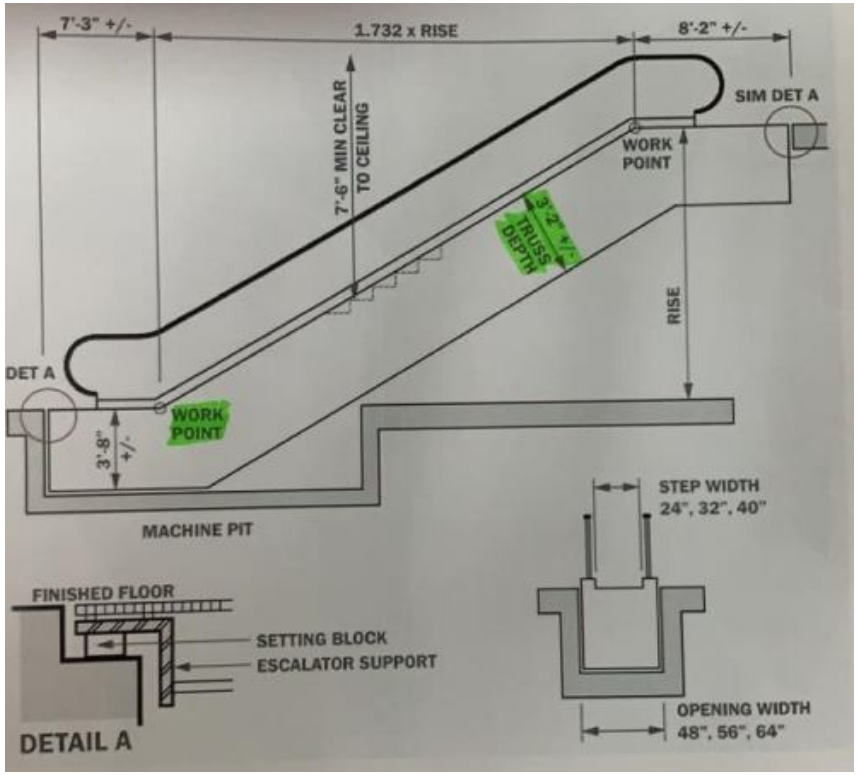
UVC Sterilization Box

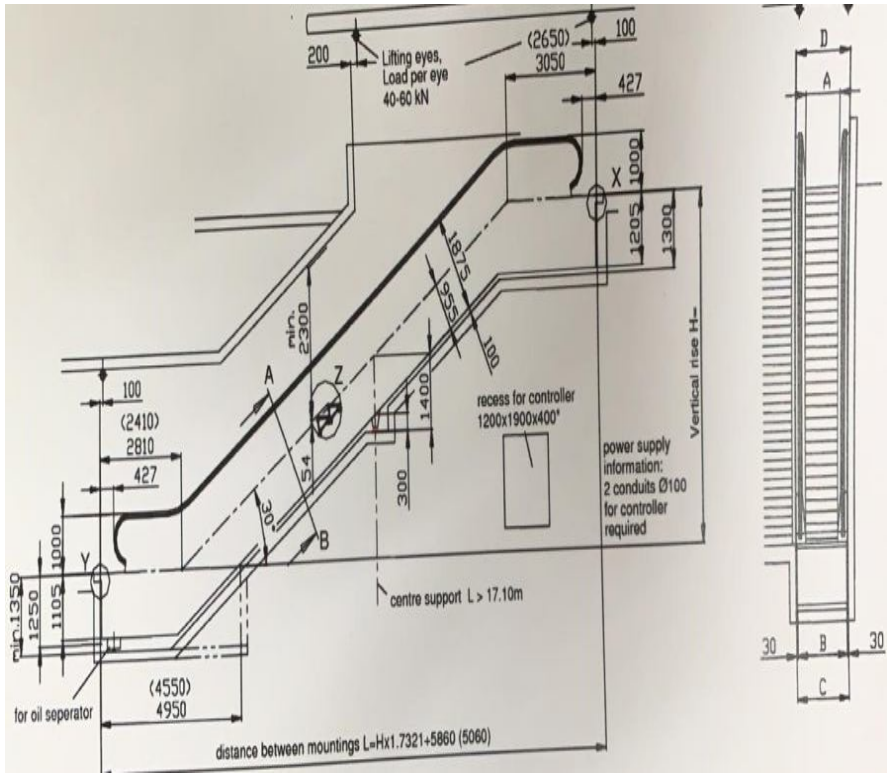




Sterilization Distance	50mm	100mm	200mm
Irradiance Distribution			
Max. Irradiance(mW/cm²)	0.241	0.155	0.069
Avg. Irradiance(mW/cm²)	0.114	0.085	0.046
Escherichia coli Sterilization Time(s)	58.1	77.8	144.2

DEVELOPMENT AND FITMENT of ESCALATOR HAND RAIL Project view:





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Olive LED is equipped with a latest and complete set up of the product manufacturing as mentioned above and the product was manufactured as per DRDO – INMAS AND IIT – DELHI JOINT efforts. The product was qualified as per technical, engineering and fitment parameters and trail test was pass after fixing on escalator in Barakhamba Metro station, DELHI METRO RAIL CORPORATION (DMRC DELHI) and it was fixed without any alteration in existing structure.

The trial was conducted on various speed of handrails and it was proved that the system was effective should be effective on multiple speed of the handrail. The design of the product has been developed in a very technical way so that the radiation should be covered on all four side of handrail and there should not be any small area should be left un-sterilized. We have equipped the product with all the required arrangement of fitment of heat sink, power supply which is taken from power supply of the escalator only. The UVC LED function will start only once the escalator is in working position. We have fixed all the indication LED system which can be checked anytime during the operation of the escalators.

The product has been designed keeping in mind the existing hand rail and its movements.
FITMENT modification / additional changes are possible.

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DESIGN CONCEPT

As discussed and decided to develop the prototype the design was conceptualized with sterilized the railing belt which is in the shape of C should be covered with almost all areas where hand touch is possible. We have decided the distance between hand rail and radiation source should be minimum so that maximum radiation can impact on the hand-rail surface and placement of LEDs should be in the manner that zero area should be left without radiation with the matrix system of LED where the distance between the LED in one row and between the row should be identical.

Aluminum Metal Property: While designing the product we have considered the metal properties and refection etc. into consideration so that the heat sinking and radiation should be good for long run. We have designed the product in aluminum so that holding strength and heat sinking and refection should be good.

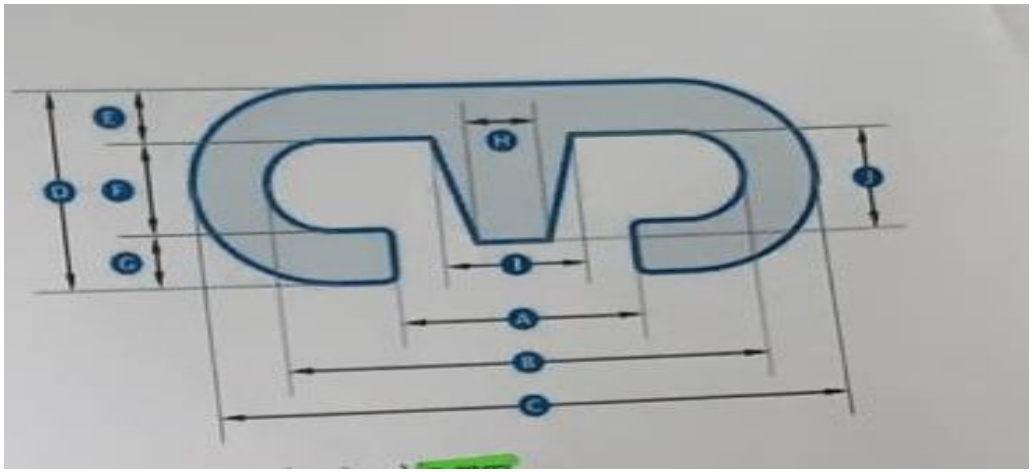
Mounting /fixing Arrangements: The design should be equipped with fixing arrangement of best possible hardware so that the complete module should be fixed properly covering the hand rail.

Actual photo of hand-railing

Mounting / fixing Arrangements:

The design should be equipped with fixing arrangement of best possible hardware so that the complete module should be fixed properly covering the handrail

DIMENSIONS

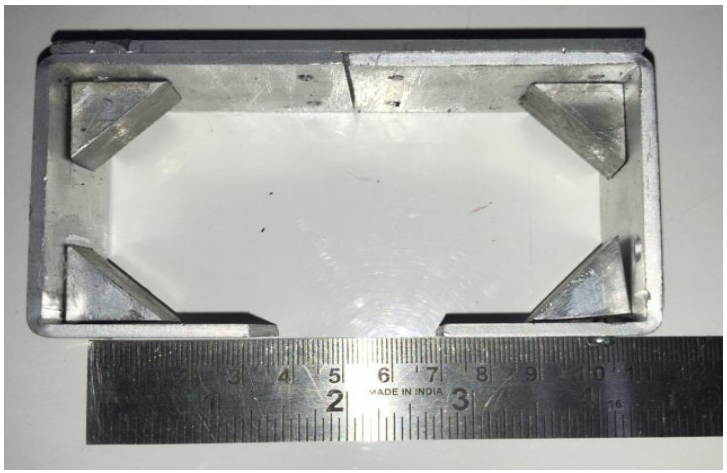


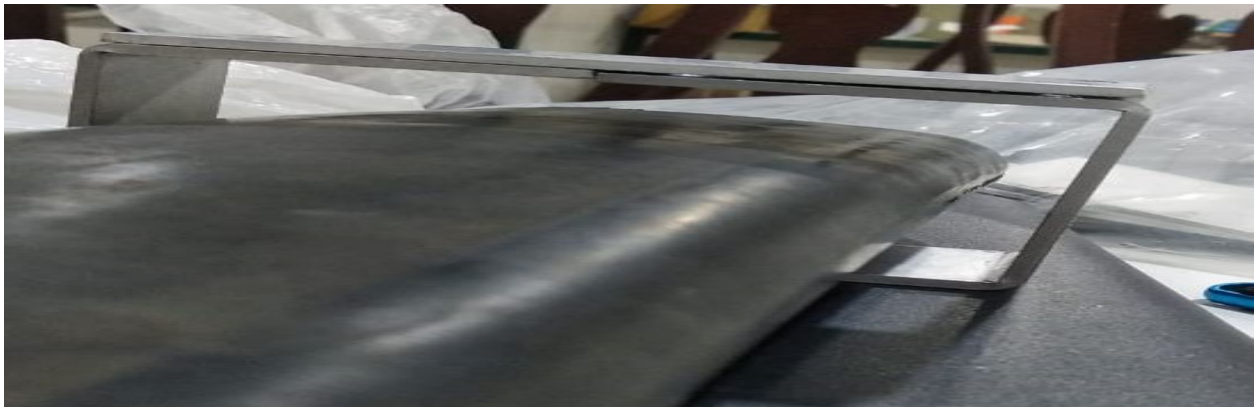
Electrical / connections/ indications

: The design will be provided with suitable power supply arrangement so that the operation of the UVC compartment can be run with indicating arrangement that the radiation is in working (putting the visible LED in UVC compartment) and power supply is on (putting the indicator etc.). There are possibilities to incorporate the more changes in the design according to requirements.

Pictures & Designs

Hand Railing view: ENCLOSURES AND DIMENSIONS
We have given perfect gap within hand-railing and LED





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UVC LED MODULE FOR HANDRAIL
HISTORY OF DEVELOPMENT

To make the product good covering all around we have put the heat sink and LED into 2 portions and both of these portion are joint thereafter with a common heat sink. In this way the product is producing radiation according to requirement in all area.

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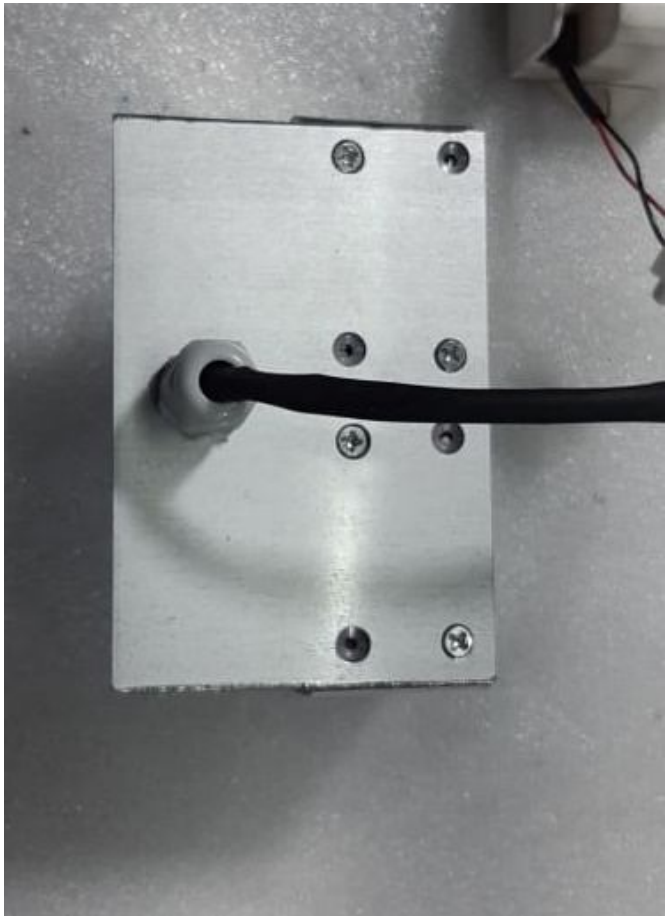
Sample - I



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Sample - II

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Sample - III

The above displayed development was the part of our R&D and there after we reached to a conclusions that the final product was good for the desired results.

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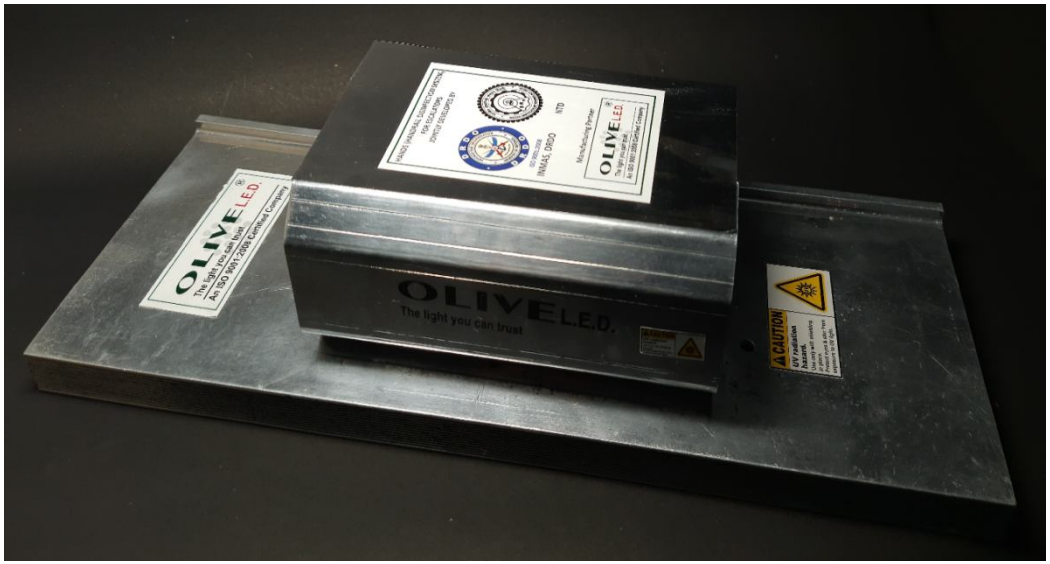
Technical parameters

Germicidal, Disinfection, Sterilization & Germ Killing Ultraviolet UVC LED system.
this product is 100% made in India concept used ultra violet (UVC) led with required 250-280 Nano-meter equipped with required design, this product can operated with 220v ac which is available everywhere.



In these above mentioned prototype samples we have used UVC 250-280nm LED which are qualifying the below mentioned criteria OF 12mW radiation per watt power. We have submitted the sample for your comments. Kindly let us know your comments so that we can modify the product to be used in final shape.

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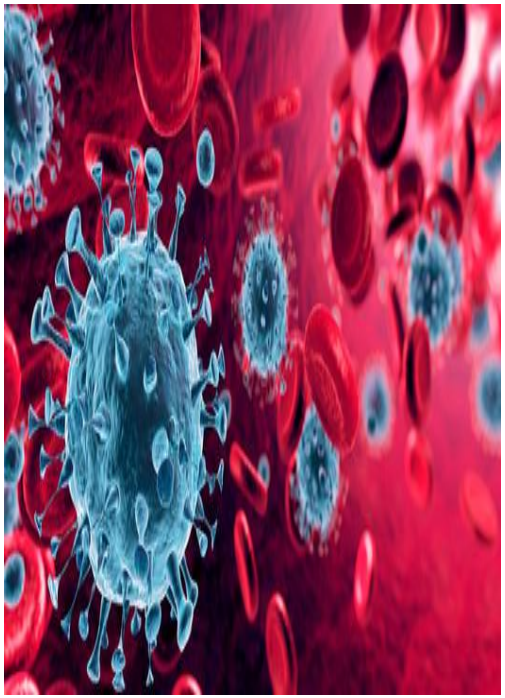
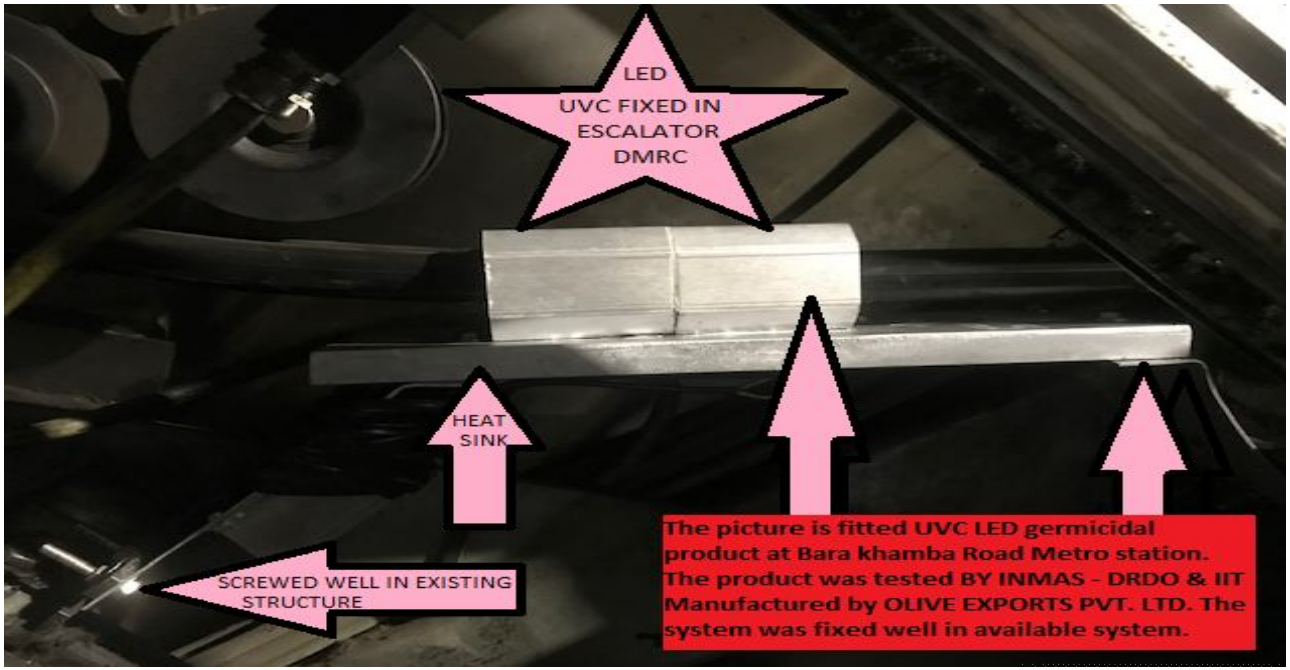
Technical Data Sheet

Dimension	**150MM X 110MM X 75MM**
Weight	1.5 Kg
Ingress Protection	IP-20
Accessories	ANUMINUM & Stainless Steel
Mounting	Fitted in bottom Escalator handrail
Power Cord	0.75mm² triple shield wire
Certificate	NABL, DRDO & IIT
Available wattages	30 watts
No. of LEDs	30 + 30 LED
Color Temperature/nm	250-280nm
Beam Angle	120°
Operating Temp.	-40°C to 60°C
Voltage Range	90V-270V AC
Power Consumption	As per sheet below
PF	>0.95
THD	<10%
Phase type	Single phase
Internal wiring	Teflon
Input wire	3 Core (Red Phase, Black Neutral, Green Ground)
Frequency	50Hz-60Hz
Efficiency	>85%
Illuminance Design	UVC LED
Life Span	>50000H
Storage Temperature	-25°C ~ +65°C(Best 25°C)

FINAL FITMENT ON HANDRAIL

We have designed the box with all required facility of Light indicator, Surge Protection Device, Earthen with miniature circuit breaker (MCB), AUTOMATIC Timer with escalator and operated on 230VAC with other input AC/DC optional to customize. We have kept the product ready for testing & certification of ULTRAVOILET NANO METER TESTING, RADIATION GENERATION AND EFFECT ON BACTERIA & VIRUS BASED ON AVAILABLE STUDIES.





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DIFFERENCE BETWEEN UVC LED & MERCURY

Category	UV LED CMS	RF mercury lamp CMS
Electrical power consumption	1 W	15 W
Electromagnetic interference (EMI)	Minimal	Large due to RF excitation
Weight	0.3 kg	3.5 kg
Dimension of the CMS system	10 cm × 8 cm × 3 cm	17 cm × 13 cm × 17 cm
Volume of the system	240 c.c.	3757 c.c.
UV emission power	~120 μW	~100 μW
UV power at the fibre tip	~16 μW	~11 μW
UV wavelength, central	257 nm	194 and 254 nm
UV wavelength, spread	12.5 nm	Doppler broadening
Fast modulation capability	Easy implementation by direct current modulation—intensity, pulse train frequency and phase, over large parameter space	Possible but more difficult
Charge management method	AC and DC	DC (AC feasible but need demonstration)
Charge management frequency	Out-of-signal band	In-signal band
Equivalent dynamic range	100 000	100
Charge management resolution	High	Low
Charge management speed	High	Low

COMPARISON OF UVC LED & CONVENTIONAL UVC MERCURY LAMPS

Performance comparison	Conventional MERCURY lamps	UVC LED
Spectral characteristics	Fixes & miscellaneous peaks	Adjustable and single
Intensity/unit area	Very low	Very high
The high frequency response	Minimum 5 minutes stability	millisecond
Overall dimensions	Enormousness	Suits to narrow space
Working current	Fixed	Adjustable
Working voltage	AC 100-220V	DC 4-10V
Radiation regulation	Not possible	possible
Life 30% decay	500 hours	30000 hours
Solid state	No	Yes
Design support	No	Yes
Pocket able	No	Yes
Battery backup	Very less	Very high

UVC can destroy the structure of bacteria's DNA so that the die immediately and cannot carry DNA replication, unable to reproduce thus achieving the purpose of sterilization of air, water and other fields. UVC radiation destroy the bacteria's DNA by killing. The dosage, a product of UV light intensity and exposure time, is usually measured in micro joules per square centimeter, or equivalently as microwatt seconds per square centimeter (µW. s/cm^2). Dosages for a 90% kill of most bacteria and viruses range from 2,000 to 8,000 µW. s/cm^2. UVC to kill bacteria in micro seconds.

Thanks for watching

PLEASE SUBMIT YOU QUERIES OR ANY PRODUCT / DEVELOPMENT REQUIRED.

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