R&M

LUMEN ELECTRICAL INC

UV-C Lighting

Product & commercial overview

Different types of ultraviolet radiation

There are **three types** of UV radiation, classified according to their wavelength.

UV-A

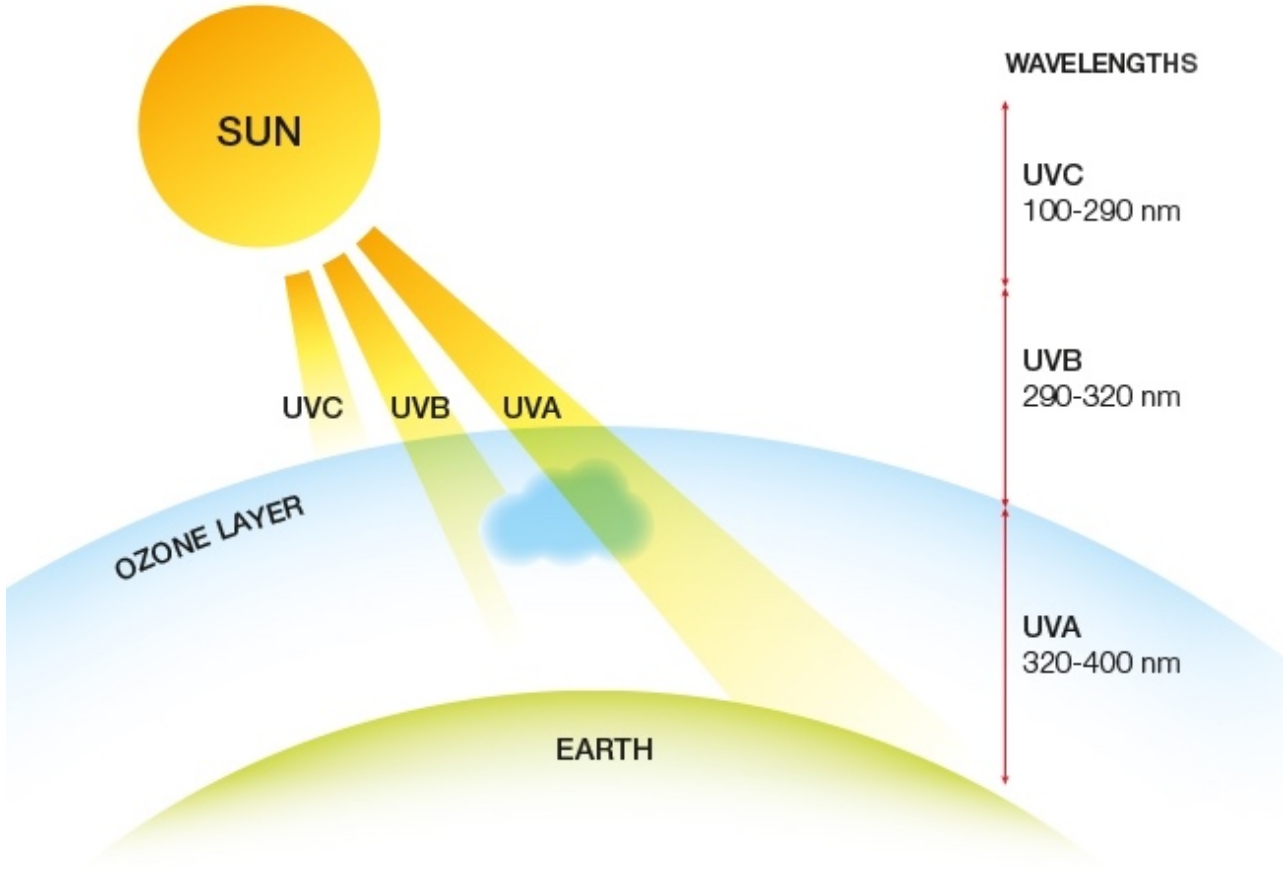
Accounts for approximately 95 per cent of the UV radiation reaching the Earth's surface. It can penetrate the deeper layers of the skin and is responsible for the immediate tanning effect.

UV-B

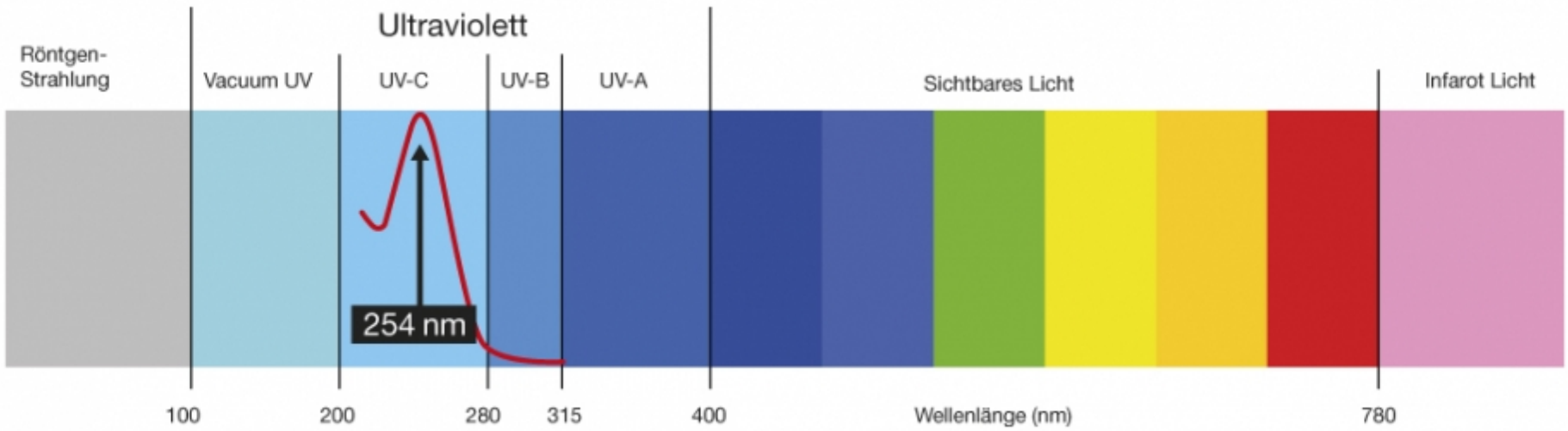
Is very biologically active but cannot penetrate beyond the superficial skin layers. It is responsible for delayed tanning and burning

UV-C

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



Disinfection with UV-C



- UV-C radiation with a specific wavelength of 253.7 nanometers breaks the DNA of bacteria, viruses and spores, meaning that they leave them harmless.
- There are no known pathogens resistant to UV-C. Which makes it applicable for disinfection purposes.
- UV-C disinfection is effective, fast and versatile

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- Direct exposure to UV-C radiation can cause a skin reaction like sunburn and damage the retina of your eye, so safe use is critical.
- UV-C technology has been used safely and effectively in hospitals and governmental buildings for more than 40 years for the purpose of surface and air disinfection.

Product availability & 2020 Roadmap…..

UV-C Batten

Application areas – Indoor general room/ surface/space cleaning:
Pharmacies, retail, gym, spa, industries, cleanrooms, industrial kitchens, restaurants, transport, hotel rooms, schools, universities, banks,

- Includes fixtures, safety devices, design and exposure time calculations

Available now

Once BioShift®

Large chamber

Small chamber

Application areas : Object / device cleaning
- Office and industry: mail rooms, reception, factories, distribution centers
- Retail & government: shared devices

Available now

UV-C Upper Air

Application areas – General air purification

All professional indoor applications:

Meeting rooms, retail, hotel rooms, schools, universities, banks, gyms, restaurants.

- Typically 1 unit per 4m x 4m area

Available August 2020

Mobile UV-C Trolley

Application areas : General room/ space cleaning

All professional indoor applications:
- Pharmacies, hotel rooms, schools, universities, banks, retail outlets, gym, spa, industries, cleanrooms, industrial kitchens, restaurants, transport

Available late 2020

BioShift® UVC Chamber

Customer insight:

- *"We would like to improve our biosecurity measures, and prevent our employees and customers getting in contact with virus and bacterial contamination. With the BioShift, we can disinfect objects that are likely to be contaminated, as multiple people have touched them."*

Key Benefit / USP / Claim:

- *Disinfection of small or large size objects*
- *Instant, trustworthy and proven disinfection*
- *Replaceable UV-C light sources*
- *Easy to use and control in a safe way*
- *Testing by a nationally recognized laboratory specializing in antimicrobial, biocidal and viricidal effectiveness showed that:*

- **Five minutes** of exposure to UV-C radiation in the BioShift® chamber resulted in the elimination of **>99.99% of common viruses and bacteria**

Reason to believe:

- *Safe and easy to use UV-C chamber, for cost effective and sustainable disinfection of objects.*

BioShift® specifications

	Small Chamber	Large Chamber
Input Voltage	110-240V / 50/60 HZ	110-240V / 50/60 HZ
Operating Power / Current	80W / 670 mA	520W / 5.20 A
Standby Power / Current	7W / 100 mA	20W / 300mA
Germicidal Bulbs / Lamps	20W (4 UV-C lamps)	40W (18 UV-C lamps)
Outside Mechanical Dimensions	29.5 L x 23 W x 23.6 H inches (750 L x 584 W x 600 H mm)	44.1 L x 21.1 W x 66.7 H inches (1119 L x 535 W x 1695 H mm)
Inside Mechanical Dimensions	20.9 L x 19.5 W x 19.5 H inches (530 L x 495 W x 495 H mm)	30 L x 46.5 W x 72 H inches (762 L x 1180 W x 1828 H mm)
Weight	110 lbs. (50 kg)	397 lbs. (180 kg)
Timer Setting	59 minutes, 59 seconds	
Output	254 nm UV-C	
Initial minimum irradiance	250 mJ/cm^2 (300 seconds, cold start)	
Operating	65°F (18°C) to 105°F (40.5°C) temperature, 10–95% humidity	
Storage	-20°F (-28°C) to 140°F (60°C) temperature, 10–95% humidity	
Rating	IP Rating 50 equivalent	

UVC Batten

Customer insight:

- *"We would like to improve our biosecurity measures, and prevent our employees and customers getting in contact with virus and bacterial contamination. With UV-C battens, we can disinfect spaces & surfaces that are likely to be contaminated, as multiple people have passed through or come into contact with them"*

Key Benefit / USP / Claim:

- *Intended to be used for the disinfection of the surfaces of objects other than medical devices*
- *Flexibility - ceiling or wall mounted fixtures that radiates UVC where & when needed, directly on the surface*
- *Instant, trustworthy and proven disinfection*
- *Replaceable UV-C light sources (lamps)*
- *Easy to install, use and control in a safe way*

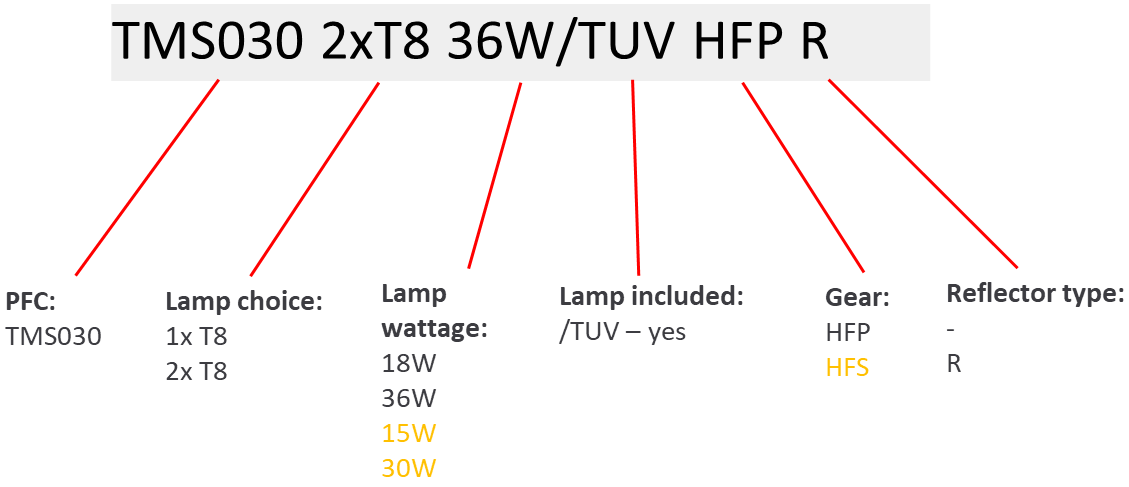
Reason to believe:

- *High flexible/simple solution when combined with safeguards & controls UV-C batten can provide a safe, cost effective way to disinfect a wide range of spaces & surfaces*

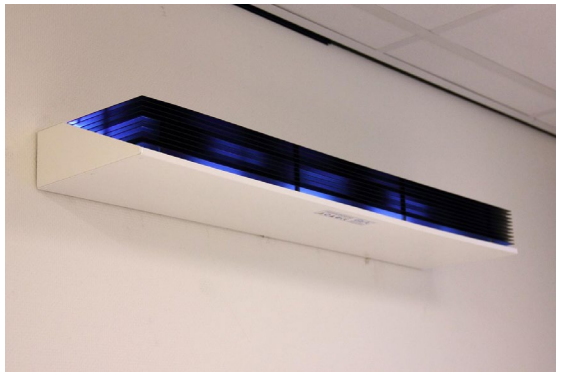
UV-C Battens specifications

Designation	TMS030
Light Source:	Philips TUV T8 18W Philips TUV T8 36W Philips TUV T8 15W (tbd) Philips TUV T8 30W (tbd)
Number of lamps:	1x TUV or 2x TUV
Lamp included:	Yes
Reflector choice:	Bare batten or with reflector
Gear:	High Frequency Performer (HFP)
Lifetime:	9000h - 90% UVC @ end of life
Connection:	Push-in connector (PI)
Housing material:	Aluminum
Reflector material	Aluminum
Color:	Alu
exposing angle:	Bare batten: 330° or reflector version: 120°
Ta:	25°C
Ingress protection:	IP20 [Finger-protected]
Mech. impact protection:	IK02 [0.2 J standard]
Protection class IEC:	Safety class I
Optimal temperature range:	+20 +40°C
Mounting:	Surface mounted or Wall mounted with adjustable bracket (tbd); tripod stand(tbd)
Certification:	DoC

12NC	EAN	Product description	Lamp type	Gear type	Reflector
910925867661	8719514109179	TMS030 1xT8 18W/TUV HFP	1x 18W TUV	HFP	No
910925867662	8719514109186	TMS030 2xT8 18W/TUV HFP	2x 18W TUV	HFP	No
910925867659	8719514109155	TMS030 1xT8 36W/TUV HFP	1x 36W TUV	HFP	No
910925867660	8719514109162	TMS030 2xT8 36W/TUV HFP	2x 36W TUV	HFP	No
910925867665	8719514109216	TMS030 1xT8 18W/TUV HFP R	1x 18W TUV	HFP	Yes
910925867666	8719514109223	TMS030 2xT8 18W/TUV HFP R	2x 18W TUV	HFP	Yes
910925867663	8719514109193	TMS030 1xT8 36W/TUV HFP R	1x 36W TUV	HFP	Yes
910925867664	8719514109209	TMS030 2xT8 36W/TUV HFP R	2x 36W TUV	HFP	Yes



Upper Air disinfection



Customer insight:

- *"We would like to improve our biosecurity measures, and prevent our employees and customers getting in contact with virus and bacterial contamination. The Upper air UV-C lighting solutions enables us to provide clean / disinfected air to reduce the risk for our customers and help build confidence to enter and use our buildings."*

Key Benefit / USP / Claim:

- *Intended to be used for the disinfection of the air within a given space/ room*
- *Flexibility - wall mounted fixtures that radiates UVC where & when needed, directly and only into the upper part of the ceiling – can be used in the high traffic / density spaces.*
- *Instant, trustworthy and proven disinfection*
- *Replaceable UV-C light sources (lamps)*
- *Easy to install, use and control in a safe way*

Reason to believe:

- *High flexible/simple solution which can provide a safe, cost effective way to disinfect the air within wide range of spaces & rooms*

Upper air solutions provide an ideal way to disinfect air while the space is still occupied

What is it…

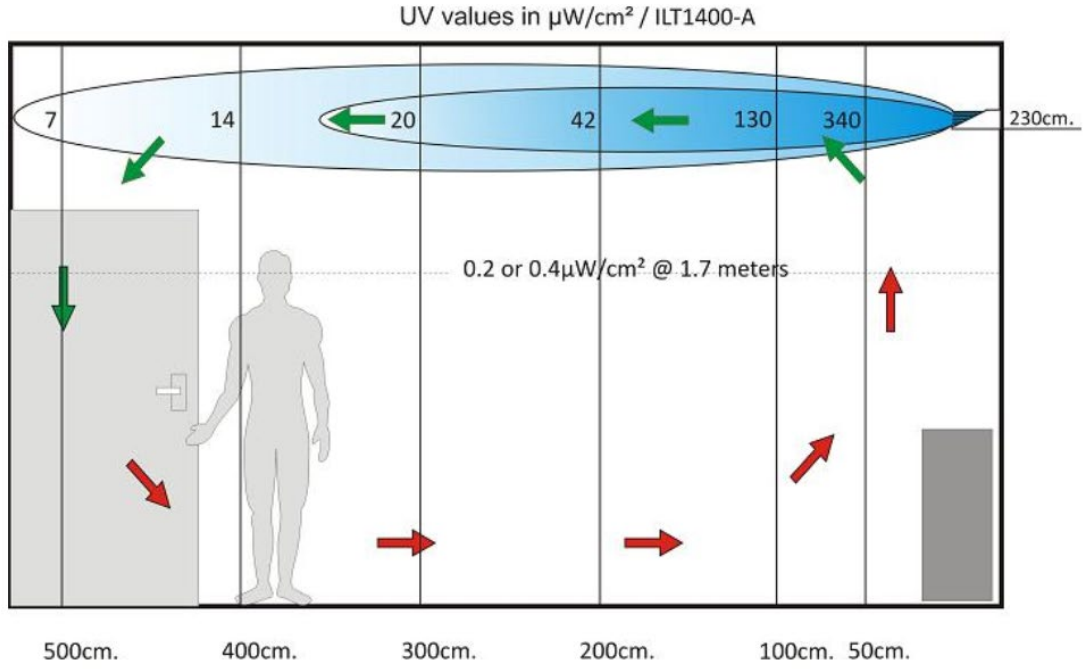
- UVC lamp in a specially designed device that projects UVC rays horizontally without wide dispersion

How does it work…

- When placed in the upper part of a room, typically about 2.3m, from the floor, it disinfects the air with powerful UVC
- Either by relying the natural convection in the room or combining with mechanical ventilation, it effectively neutralizes the pathogens in the air in the entire space

What are the benefits…

- An upper air solution can be used **while the room is still occupied, on a continuous basis**
- It has been proven to be **effective in healthcare settings to reduce exposure to viruses such as Tuberculosis** [1]
- It effectives results in cleaner air in the space, **equal to 18-24 air change per hour without additional HVAC capacity** or filters



[1] National Institute for Occupational Safety and Health [2009], *Environmental Control for Tuberculosis: Basic Upper-Room Ultraviolet Germicidal Irradiation Guidelines for Healthcare Settings*, 2009 -105

UV-C Trolley

Customer insight:

- *"We would like to improve our biosecurity measures, and prevent our employees, visitors & patients getting in contact with virus and bacterial contamination. The UV-C trolley solutions provides us with a flexible and effective way to clean spaces, rooms and surfaces."*

Key Benefit / USP / Claim:

- *Intended to be used for the disinfection of the surfaces of objects (other than medical devices)*
- *Flexibility – can be moved into different space - radiates UVC in 360 Degrees where & when needed, directly into the space and on the surfaces*
- *Instant, trustworthy and proven disinfection*
- *Replaceable UV-C light sources (lamps)*
- *Easy to install, use and control in a safe way*

Reason to believe:

- *High flexible/simple solution when combined with safeguards & controls the UV-C trolley can provide a safe, flexible cost effective way to disinfect a wide range of spaces & surfaces*

UV-C Trolley specifications (DRAFT)

Key specifications

- Safe features to include remote control, timer, presence detection, and lamp burning hours counter
- Rotational symmetric UV-C distribution
- 4 to 8 Philips TUV 36W lamps
- Special lamp glass filters out 185nm ozone-forming radiation
- Drivers for optimum performance of lamps
- 18K hours lifetime
- UVC resistant material
- Trolley system
- Expected irradiance values for 4 lamps configuration:

	Irradiance	**Time to get dose in minutes**				
	mW/cm2	40mJ/cm2	60mJ/cm3	100mJ/cm2	200mJ/cm2	300mJ/cm2
@1m	0.367	2	3	5	9	14
@1.5m	0.209	3	5	8	16	24
@2m	0.125	5	8	13	27	40

UV-C is harmful to eyes

UV-C is harmful to skin

Safety concerns

Motion/presence detection and auto switch off sensors

Operate only with proper protection equipment and shielding

It is visible whether UV-C lighting is on/off thanks to blue hue during operation

UV-C has limited penetration (walls, glass <3mm)

Safeguards

The best safeguards are proper application design in combination with dedicated installer and user training

Using UV-C in a safe way

- Like any disinfection system, **UV-C lamps and devices must be used properly to be safe**.

- UV-C light can cause a severe sunburn-like reaction to your skin and similarly, could damage the retina of your eye, if exposed. …this is very painful. It is therefore key, that lamps are always shielded from direct radiation.
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- All products need to **follow the standard product safety releases** and approbations.

- **No medical claims can be made**. Medical application needs clearance from Legal (local laws apply).

- **All products require at least -**
    1. An Instructional Safeguard AND
    2. A Time Safeguard OR an Equipment Safeguard OR a Containment Safeguard

- We strongly suggest our OEM customers communicate clearly the warnings on their website and applications, as we do on our leaflets. Disclaimers may apply.

Additional Safeguards per UV-C RG and per channel

UV-C devices belonging to UV-C Risk Group 0 **(UV-C RG 0)** require no safeguard.

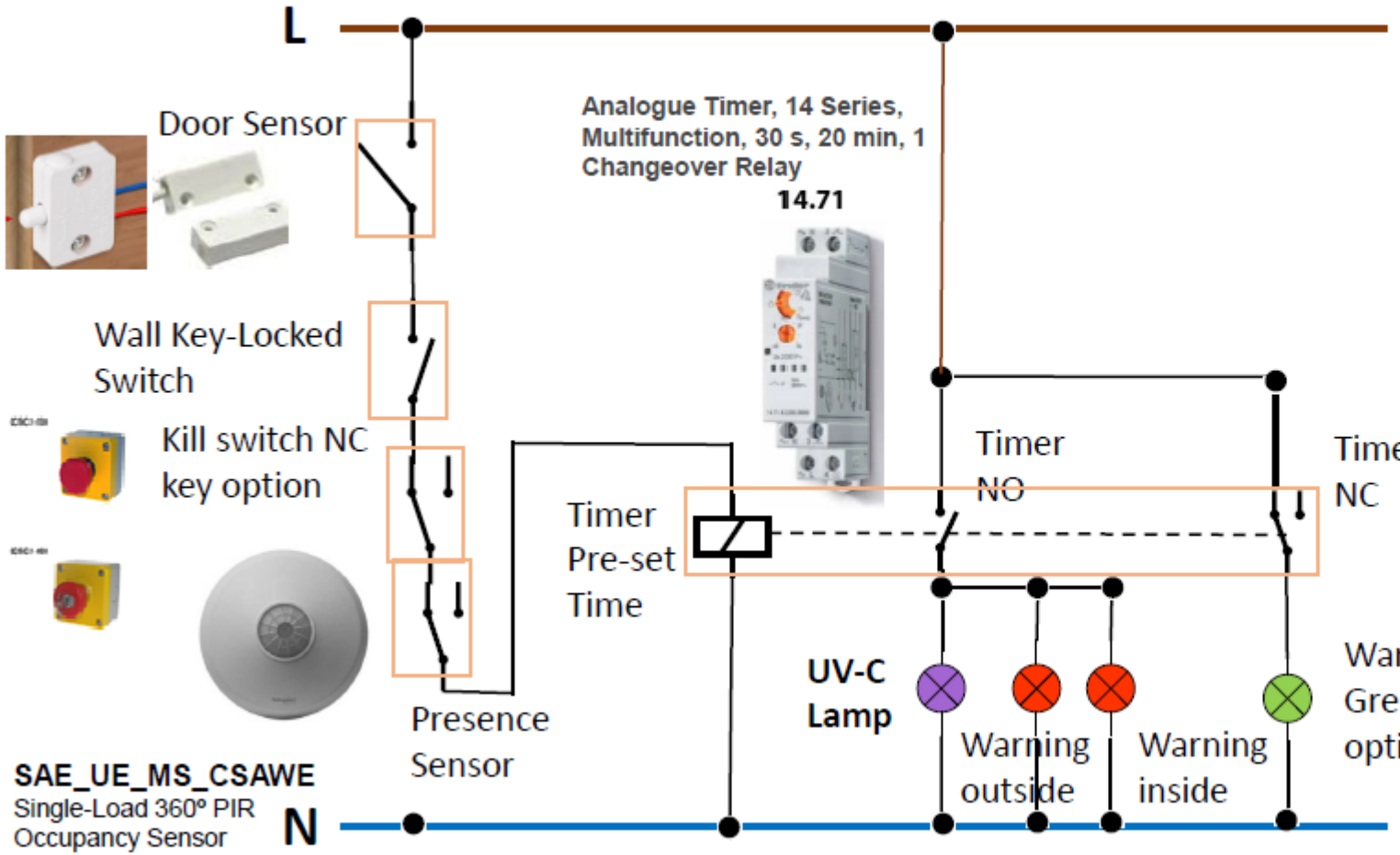
Devices which have an UV-C RG higher than or equal to 1 **(UV-C RG ≥ 1)** require **always an Instructional Safeguard AND** at least one of the **additional safeguards** set forth in Table below.

UV-C RG	Consumer Channel	Professional Channel	
		DIRECT SALES	INDIRECT SALES via VAP's, distributors
1	**Time Safeguard** ($t_{exposure}$ < 10000s) OR **Equipment Safeguard**	**Time Safeguard** ($t_{exposure}$ < 10000s) OR **Equipment Safeguard** OR **(Containment Safeguard** with a **Training Safeguard)**	**Time Safeguard** ($t_{exposure}$ < 10000s) OR **Equipment Safeguard** OR **(Containment Safeguard** with a **Training Safeguard** and a **Legal Safeguard)**
2	**Time Safeguard** ($t_{exposure}$ < 1000s) OR **Equipment Safeguard**	**Time Safeguard** ($t_{exposure}$ < 1000s) OR **Equipment Safeguard** OR **(Containment Safeguard** with a **Training Safeguard)**	**Time Safeguard** ($t_{exposure}$ < 1000s) OR **Equipment Safeguard** OR **(Containment Safeguard** with a **Training Safeguard** and a **Legal Safeguard)**
3	**Equipment Safeguard**	**Equipment Safeguard** OR **(Containment Safeguard** with a **Training Safeguard)**	**Equipment Safeguard** OR **(Containment Safeguard** with a **Training Safeguard** and a **Legal Safeguard)**

Safety 1st – R&M will ensure the right safety & controls design

Operation requirements: Ensure that there are no people in the room

Operation requirements: Lock the door before switching UV-C light on



Werma Signaltechnik
Signaallamp 200.100.00
Rood Continulicht 12 V/AC, 12 V/DC, 24 V/AC, 24 V/DC, 48 V/AC, 48 V/DC, 110

XALD144 - Keylock Switch, Off, SPST-NO, Harmony XALD Series, 2 Position, Screw Clamp, 6 A

R&M will define the dose & time required to eliminate the targeted pathogens

- The correct dose is based on intensity and time:

- UV-C light can only inactivate those micro-organisms that it hits with a sufficient dose. Therefore micro-organisms on surfaces that are hidden or in a shadow, will not be reached and therefore not be disinfected.

Currently we're developing a calculator that provides an indication about how many UV-C lamps are needed in your luminaire for a specific application

UV dose to obtain 90% killing rate		
Bacteria	**Dose**	**k**
Bacillus anthracis	45.2	0.051
B. megatherium sp. (spores)	27.3	0.084
B. megatherium sp. (veg.)	13.0	0.178
B. parathyphosus	32.0	0.072
B. suptilis	71.0	0.032
B. suptilis spores	120.0	0.019
Campylobacter jejuni	11.0	0.209
Clostridium tetani	120.0	0.019
Corynebacterium diphteriae	33.7	0.069
Dysentery bacilli	22.0	0.105
Eberthella typhosa	21.4	0.108
Escherichia coli	30.0	0.077
Klebsiella terrifani	26.0	0.089
Legionella pneumophila	9.0	0.256
Micrococcus candidus	60.5	0.038
Micrococcus sphaeroides	100.0	0.023
Mycobacterium tuberculosis	60.0	0.038
Neisseria catarrhalis	44.0	0.053
Phytomonas tumefaciens	44.0	0.053
Pseudomonas aeruginosa	55.0	0.042
Pseudomonas fluorescens	35.0	0.065
Proteus vulgaris	26.4	0.086
Salmonella enteritidis	40.0	0.058
Salmonella paratyphi	32.0	0.072
Salmonella typhimurium	80.0	0.029
Sarcina lutea	197.0	0.012
Seratia marcescens	24.2	0.095
Shigella paradysenteriae	16.3	0.141
Shigella sonnei	30.0	0.077
Spirillum rubrum	44.0	0.053
Staphylococcus albus	18.4	0.126
Staphylococcus aureus	26.0	0.086
Streptococcus faecalis	44.0	0.052
Streptococcus hemoluticus	21.6	0.106
Streptococcus lactus	61.5	0.037
Streptococcus viridans	20.0	0.115
Sentertidis	40.0	0.057
Vibrio chlolerae (V.comma)	35.0	0.066
Yersinia enterocolitica	11.0	0.209

UV dose to obtain 90% killing rate		
Yeasts	**Dose**	**k**
Bakers' yeast	39	0.060
Brewers' yeast	33	0.070
Common yeast cake	60	0.038
Saccharomyces cerevisiae	60	0.038
Saccharomyces ellipsoideus	60	0.038
Saccharomyces sp.	80	0.029
Mould spores		
Aspergillus flavus	600	0.003
Aspergillus glaucus	440	0.004
Aspergillus niger	1320	0.0014
Mucor racemosus A	170	0.013
Mucor racemosus B	170	0.013
Oospora lactis	50	0.046
Penicillium digitatum	440	0.004
Penicillium expansum	130	0.018
Penicillium roqueforti	130	0.018
Rhizopus nigricans	1110	0.002
Virus		
Hepatitis A	73	0.032
Influenza virus	36	0.064
MS-2 Coliphase	186	0.012
Polio virus	58	0.040
Rotavirus	81	0.028
Protozoa		
Cryptosporidium parvum	25	0.092
Giardia lamblia	11	0.209
Algae		
Blue Green	3000	0.0008
Chlorella vulgaris	120	0.019