SYLVANIA

Germicidal lamps

SYLVANIA

MICRO-ORGANISMS

INTRODUCTION

Sylvania covers the full spectrum of Germicidal UV-C lamps, from the smallest compacts to the longest T5 and the most powerful high pressure types. Their primary application is the disinfection and sterilisation of water, air and surfaces. Germicidal lamps remain unparalleled in their efficiency for the destruction of bacteria, viruses, mould spores and other micro-organisms.

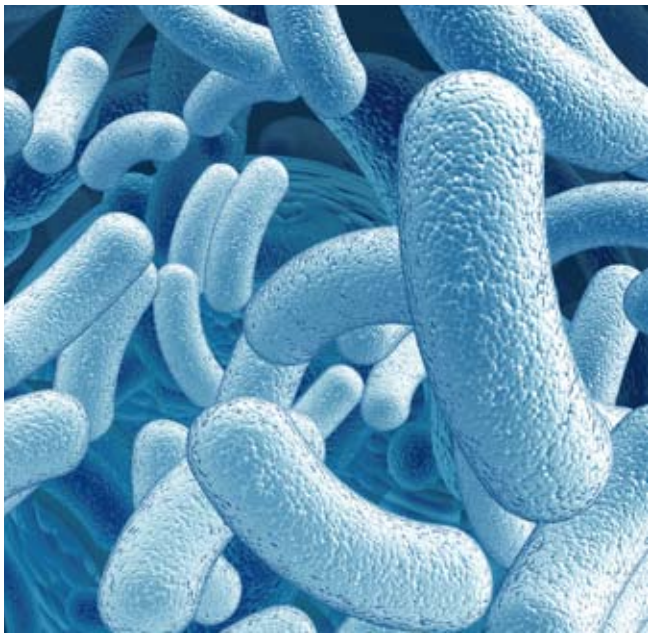
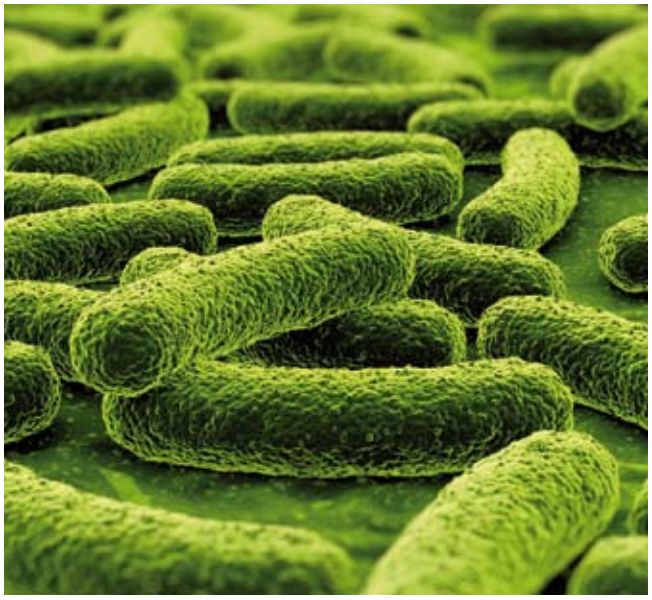


Illustration of the bacillus microorganisms



Example of bacteria

MICRO-ORGANISMS

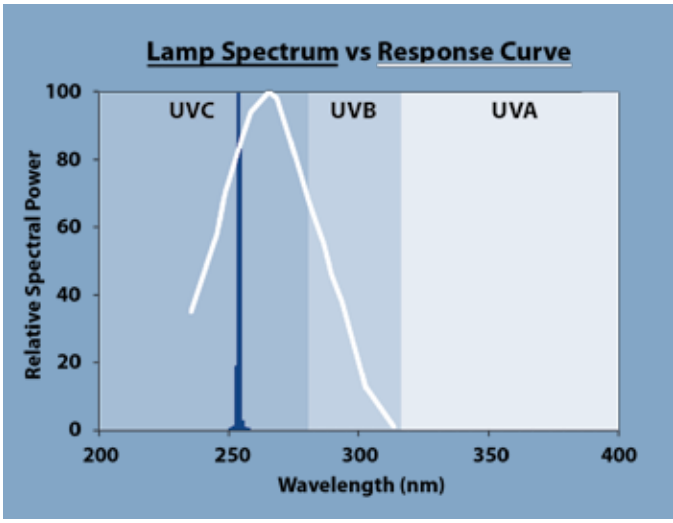
Micro-organisms are classified separately from plants and animals because of their tiny dimensions. While some are essential for life, i.e. in the human digestive system, others can lead to serious diseases and man faces a constant battle against their multiplication. Traditional techniques such as pasteurisation or the use of preservatives only lead to a reduction in the total quantity of micro-organisms. Alternative methods involving moist or dry heating, filtration and use of chemical agents can also have some effect, but irradiation by Germicidal lamps is considered by far the most effective. The short wavelength UV-C rays destroy their DNA, thereby preventing cells from dividing and effectively killing them. There are three distinct kinds of micro-organisms:

Bacteria / bacterial spores: May be single-cell or multi-cellular organisms, which multiply extremely rapidly. Found in air, water, soil, plants/animals and particularly rotting organic matter. Although high temperatures and dryness can temporarily prevent their multiplication, bacteria will return to life once normal conditions are resumed.

Moulds / Yeasts: A broad variety of multi-cellular organisms (moulds) or single-cells (yeasts) which exist almost everywhere. Most moulds are saprophytic (feeds on dead organic matter) and are responsible for enormous food spoilage. Some are parasitic (survives on a living host). Yeasts multiply by sprouting and are widely used in the production of bread and alcoholic beverages.

Viruses: Extremely small parasitic organisms which do not multiply themselves, but survive by taking over a host cell. Responsible for some of the most widespread human diseases such as influenza, the common cold, measles, chicken pox, mumps and warts, and have devastating effects in the animal kingdom such as foot-and-mouth disease, avian/swine flu etc. Plants can also be attacked by viruses.

THE GERMICIDAL ACTION OF UV-C RADIATION



The Germicidal Action Spectrum diagram reveals that the optimal wavelength for the destruction of DNA is 265nm. An electrical discharge through mercury vapour produces intense radiation very near to this peak, at 253.7nm, where the Germicidal efficiency is about 85% of the theoretical maximum. UV-C mercury lamps are thus extremely effective in killing micro-organisms.

Low Pressure lamps are the most efficient and are manufactured in the form of linear or compact fluorescent lamps, but without any fluorescent coating and a special UV-C transmitting glass tube. Peak performance is attained when the bulb temperature is around 40°C, which corresponds to an ambient temperature of 25°C. Lower or higher temperatures will both result in falling UV-C levels. In case the lamp is exposed to an air flow which may have a cooling effect, it is desirable to use HO (High Output) types which are loaded at higher wattage than normal, to maintain optimal bulb temperatures even in colder environments.
High Pressure lamps are slightly less efficient but have the advantage of producing extremely intense radiation over a small area. For instance, typical high pressure lamps are loaded above 100 Watts per centimetre of discharge length whereas low pressure versions achieve less than 1 W/cm.

The total UV-C output of a lamp is specified in Watts (W) and the irradiation density is expressed in W/m². A certain dose level is needed to kill each kind of micro-organism, this dose being a function of time (seconds) and power (Watts). For instance, a low UV power over a long period of time can have the same effect as a higher power for a shorter duration. The unit of energy is the Joule (J), which is equivalent to Watts per Second. 100J could be delivered by 1W for 100 seconds, or 100W for 1 second, or even 20W for 5 seconds, etc.

Dose levels needed to kill a particular micro-organism are expressed in Joules per square metre (J/m²). Some are tougher than others and require more UV-C to kill them. The table on Page 6-7 indicates the dose level needed to destroy 90% of the population.

DIRECTIONS FOR USE

- The radiation from these lamps is very harmful to eyes and skin. Always protect your eyes and skin against radiation.
- Germicidal lamps must only be used in appropriate equipment and applications.
- When using UV-C emitting lamps, the official reference guides and the current industrial safety guideline must be followed.
- Maximum Permissible Exposure Time (MPET) can be established for a given range of wavelengths.
  For example: 1 minute/day at a distance of 30cm.
- Germicidal lamps emit UV-C radiation and must not be used for general lighting purposes.

AIR PURIFICATION

Air is easy to purify because it is quite transparent to UV-C, allowing it to penetrate and kill floating bacteria which are responsible for many airborne infections. Direct irradiation methods can be based on ceiling mounted lamps which are energised whilst the room is unoccupied, upward radiation mounted safely above eye height, or concealed downward radiation to sterilise floors. Alternatively, Germicidal lamps may be mounted within air ducts of the ventilation system which has an advantage that high UV doses can be given, because the lamps are out of view. Portable stand-alone units which draw in air, purify it and then expel back into the room are becoming increasingly popular.

GERMICIDAL LAMPS APPLICATION TABLE

	T5 Short	T8 linear	T5 Long	Lynx-S	Lynx-L
Air					
Upper air		•	•	•	•
Airconditioning		•	•	•	•
Cooling coils		•	•		•
Dish dryer		•			
Water					
Municipal drinking water			•	•	
Municipal waste water			•		
Residential drinking water	•				•
Ultra pure water			•		
Process water			•		
Swimming pools & Spas			•		
Agricultural recycling			•		•
Ponds	•	•		•	•
Aquaria	•			•	
Surfaces					
Food processing			•		
Packaging			•		

WATER/LIQUID PURIFICATION

Liquids are more challenging to purify because they tend to absorb some of the UV-C themselves. To design suitable equipment the absorption coefficient needs to be known, as well as the flow rate and dose. Some examples of absorption coefficient for various liquids are given in the table.

Drinking Water: Germicidal sterilisation is increasingly being used in municipal water installations to circumvent the ecological impact of chlorine, and because filters cannot catch all micro-organisms. It is also employed in smaller scale residential installations, and in many water cooler-dispensers.

Swimming Pools: The use of a UV-C purification unit can realise significant cost savings, by reducing the use of chlorine by up to 50%.

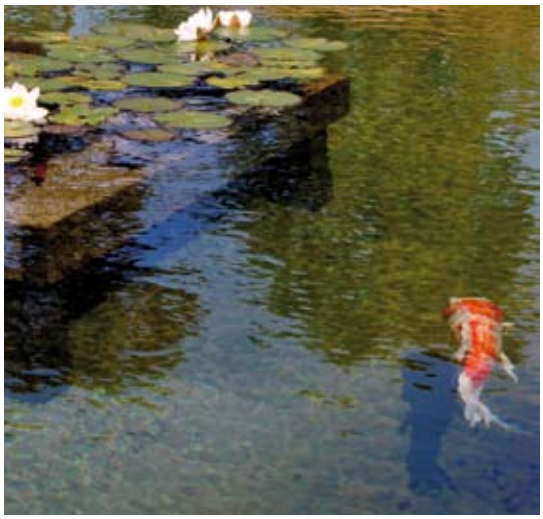
Ponds & Aquaria: A closed-loop system which circulates the water over a germicidal lamp a few times per day not only reduces parasites, but substantially reduces the build-up of algae.

SURFACE PURIFICATION

Requires high intensities, so lamps should be mounted as close as possible to the surface for disinfection. A high uniformity of irradiance is essential, ensured by a professional optical system for distribution of the radiation, so that no areas are left untreated.

Examples of absorption coefficients

Liquid	Absorption Coefficient
Drinking Water	0,02-0,1
Distilled Water	0,007-0,01
Clear Sirup	2-5
Beer	10-20
White wine	10
Red wine	30
Milk	300



RADIATION DOSES FOR INACTIVATING VARIOUS MICRO-ORGANISMS

The following values relate to an inactivation of 90% at a wavelenght of 254 nm, where UV radiation is particularly effective against bacteria. The radiation dose H is defined as UV power x time/irradiated area **(Ws/m²)**. Values in bold are mean values for the respective families of microbes. Values in brackets show the range of values found in the literature. Additionally, individual examples of the microbe families are listed.

Bacteria	
Bacillus (vegetative)	**32 (13-58)**
Bac. anthracis	45
Bac. Megatherium	13
Bac. paratyphosus	32
Bac. subtilis	58
Bacillus (spore)	**118 (11-365)**
Bac. Megatherium	27
Bac. subtilis	120
Bac. anthracis	45
Bac. Subtilis (ATCC6633)	365
Bacillius subtilis	11
Bac. subt. spore ATCC6633	152
Campylobacter jejuni	**29**
Clostridium tetani	**130**
Coryneb. diphteria	**34**
Citrob. freundii (ATCC8090)	**42**
Enterob. Cloaca (ATCC13047)	**64**
Escherichia coli :	**45 (7-58)**
Escherichia coli	30
Escherichia coli (in air)	7
Escherichia coli (in water)	54
Escherichia coli ATCC 11229	25
Escherichia coli ATCC 25922	30
Escherichia coli K 12 AB 1157	58
Escherichia coli B/ r ATCC12407	53
Klebsi. Pneumon. ATCC4352	**42**
Legionella	**15 (4-26)**
Legionella dumoffi	24
Legionella gromanii	26
Legionella micdadei	15
Legionella longbeachae 1	12
Legionella longbeachae 2	10
Legionella oakridgensis	22
Legionella micdadei	18
Legionella jordanis	11
Legionella wadsworthii	4
Legionella pneumophila	25
Legionella bozemanii	20
Leptospira	**20 (8-28)**
Leptospira biflexa	23
Leptospira illini	8
Leptospira interrogans	28
Micrococcus	**80 (61-100)**
Micrococcus candidus	61
Microc. Sphaeroides	100
Neisseria catarrhalis	**44**
Pseudomonas aerug.	**35 (15-55)**
Pseudomonas aeruginosa	55
Salmonella	**43 (21-80)**
Salm. Typhimurium	80
Salm. Enteritidis	40
Salmonella typhi	21
Serratia marcescens	**32 (7-85)**
Shigella paradysenteriae	**17**
Staph	**44 (18-110)**
Staph. albus	18
Staph. aureus	26
Staph. epidermis	110
Streptococcus	**36 (18-65)**
Strep. haemolyticus	22
Strep. lactis	62
Strep. viridans	20

Strep. faecalis (ATCC29212)	65
Strep. faecalis	55
Strep. pyogenes	22
Strep. salivarius	20
Strep. albus	18

Vibrio	**24 (8-39)**

Yersinia enterecolitica	**15**

DNA-Viruses

Parvovirus	**35 (30-40)**
Bov. Parvovirus	40
Kilham rat virus	30

HCC (Dog hepat. Adenov)	**265**

Herpers virus	**57 (15-165)**
Pseudorable virus	70
Herpes simplex MP str.	67
Herpes simplex MP str.	15
Herpes simplex, type 1	165

Vaccinia	**18**

RNA-Viruses

Picornavirus	**72 (36-186)**
Poliovirus	110
Poliov type 1 Mahoney	67
Poliov	133
Poliov type 1	36
Poliov Mahoney	45
ECBO	80
Coxsackiev	186

Reovirus	**102 (18-163)**
Reovirus type 1	48
Reov type 1 (Lang str)	163
Rotav	159
Rotav SA11	65

Paramyxovirus	**35 (15-55)**
Sindbis virus	55
Newcastle Disease	15

Ortomyxovirus	**35**
Influenza	35

HIV (Lentiv)	**1438 (600-2400)**
HIV (HTLVIII)	600
HIV (Sup T1)	1450
HIV (H9)	2400
HIV (PHA-stim.PBL)	1300

Phages

Bacteriophages	**152 (65-310)**
Bac. subt. phage SP02C12	150
Bac. subt. phage SPP1	195
Bac. subt. phage diam. 29	70
Bacteriophage F specific	292
Coliphage f2	310
Staph. Phage A994	65

Yeasts	**59 (23-100)**
Oospora lactis	50
Saccharomyces cerevisiae (baking yeast, brewing yeast)	33-100
Saccharomyces ellipsoideus	60
Saccharomyces sp.	80
Torula sphaerica (in milk and cream)	23

Fungi	**713 (130-3000)**
Aspergillus glaucus	440
Aspergillus flavus	600
Aspergillus niger	1320
Aspergillus niger (pasta)	1500
Aspergillus amstelodami (meat)	700
Candida paraposilosis	220
Cladospor. Herbarum (cold stores)	500
Mucor racemosus	170
Mucor mucedo (meat, bread, fat)	600
Oospora lactis	50
Pencilium chrysogenum (fruit)	500
Pencilium roquefortii	130
Pencilium expansum	130
Pencilium digitatum	440
Rhisopus nigricans	1100
Rhizopus nigricans (cheese)	1100
Scopularipsis brevicaulis (cheese)	800

Protoza	**600-1000**

Algae	**3000-6000**
Green algae, blue algae, diatoms	

GERMICIDAL LINEAR

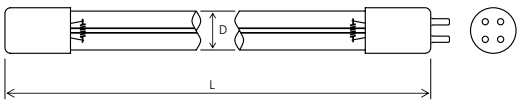
FEATURES

- These lamps consist of a tubular glass envelope and emit more than 85% of their energy in the UV-C ultraviolet radiation with a peak at 253.7nm for germicidal action
- Shape, electrical characteristics and lighting circuits are similar to general fluorescent lamps
- The majority of germicidal lamps operate most efficiently in still air at an ambient temperature of 25°
- All lamps are Ozone free
- A protective coating on the inside of the lamp limits the depreciation of the UV-C output

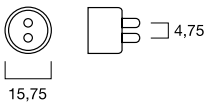
APPLICATIONS

- Residential drinking water units
- Stand alone air purifiers
- Wall mounted air purification units
- Ponds & Aquaria

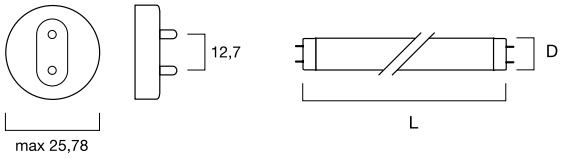
FOUR PIN (FIG. Nr 3)



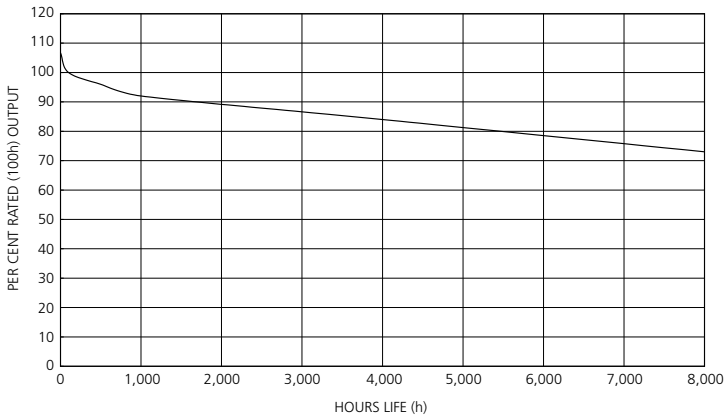
G5 (FIG. Nr 1)



G13 (FIG. Nr 2)



ULTRAVIOLET RADIATION AS RELATED TO THE LIFE
G30W-T8



Ordering Code	Item description	Watt (W)	Voltage (V)	Current (A)	UV-C output W at 25°C	UV µW/cm² at 1m	Cap	Cap Figure Nr	L (mm)	D (mm)	Life (hrs)	Packing Quantity
0002328	G4W T5	4	30	0,162	0,8	8,3	G5	1	136	16	6000	50
0002216	G6W T5	6	44	0,147	1,7	17,7	G5	1	212	16	6000	50
0000501	G8W T5	8	56	0,170	2,5	26	G5	1	288	16	6000	24
0000507	G11W T5 HO	11	37	0,330	2,2	23	G5	1	212	16	8000	50
0000508	G16W T5 HO	16	50	0,350	3,2	33	G5	1	288	16	8000	50
0025016	G11W T5 HO 4-pin	11	37	0,330	2,2	23	Four Pin	3	227,5	16	8000	45
0025017	G16W T5 HO 4-pin	16	50	0,400	3,9	33	Four Pin	3	319,5	16	8000	45
0002482	G10W T8	10	46	0,230	2,7	28,1	G13	2	330	26	6000	20
0000502	G15W T8	15	55	0,300	4.9	50,5	G13	2	437	26	8000	24
9000526	G25W T8	25	46	0,600	6.9	71,8	G13	2	437	26	8000	24
0000503	G30W T8	30	99	0,365	13.4	135	G13	2	894	26	8000	24
0000504	G36W T8	36	103	0,430	15.5	156	G13	2	1199	26	8000	12
0002208	G55W T8	55	83	0,770	18	194	G13	2	894	26	8000	24
0002217	G58W T8	58	100	0,670	20	202	G13	2	1500	26	5000	12
9002500	G20W T10	20	58	0,360	7,5	76	G13	2	590	34	8000	10
9002327	G40W T10	40	106	0,420	19,8	200	G13	2	1199	34	8000	10

GERMICIDAL COMPACT

FIG. Nr 1

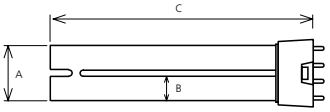
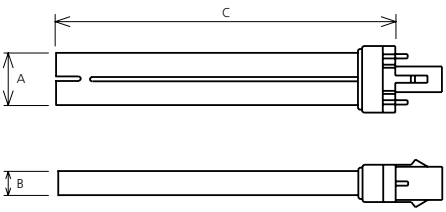


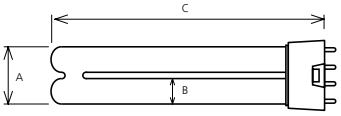
FIG. Nr 2



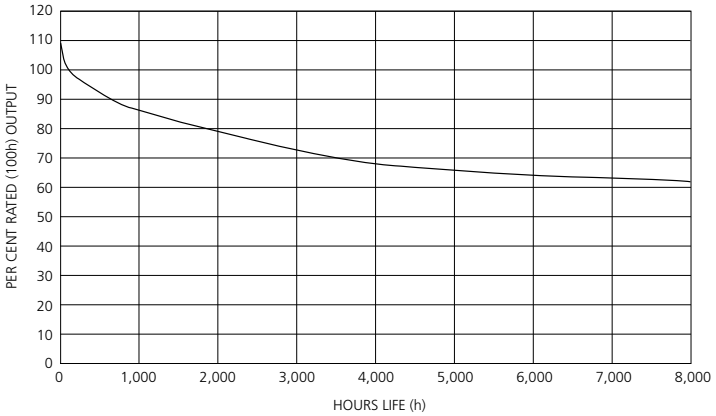
FEATURES

- These lamps have all the benefits of linear germicidal lamps, but have also a very compact design. This allows for compact fixture design. As they are single ended, replacement is very easy
- The HO (High Output) lamps are most efficient in air purification installations, as they are wind chill corrected
- Shape, electrical characteristics and lighting circuits are similar to general lighting compact fluorescent lamps
- The majority of germicidal lamps operate most efficiently in still air at an ambient temperature of 25°
- All lamps are Ozone free
- A protective coating on the inside of the lamp limits the depreciation of the UV-C output

FIG. Nr 3



ULTRAVIOLET RADIATION AS RELATED TO THE LIFE
G11 LYNX-S



APPLICATIONS

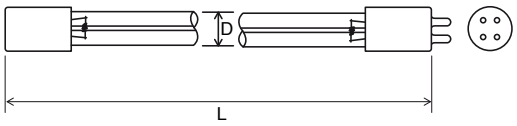
- Residential drinking water
- Pond water
- Induct air treatment units
- Stand alone air purifiers

Ordering Code	Item description	Watt (W)	Voltage (V)	Current (A)	UV-C output W at 25°C	UV µW/cm² at 1m	Cap	Figure Nr	L (mm)	D (mm)	Life (hrs)	Packing Quantity
0025046	G5W Lynx-S	5	35	0,180	1,5	16,4	G23	2	85	28	8000	50
0025050	G9W Lynx-S	9	59	0,170	2,4	32,9	G23	2	145	28	8000	50
0025012	G9W Lynx-SE 4-pin	9	59	0,170	2,4	32,9	2G7	3	145	28	8000	50
0025051	G11W Lynx-S	11	89	0,160	3,0	41,1	G23	2	215	28	8000	50
0025047	G13W Lynx-S	13	59	0,285	3,6	49,3	GX23	2	170	28	8000	50
0025049	G18W Lynx-L	18	58	0.375	5.5	75,0	2G11	1	225	40	8000	25
0025048	G36W Lynx-L	36	106	0.435	12.0	164,5	2G11	1	415	40	8000	25
0025045	G55W Lynx-L	55	103	0.540	17.0	233,0	2G11	1	533	40	8000	25
0025013	G35W Lynx-L HO*	35	55	0,850	11,0	105,0	2G11	1	225	40	9000	25
0025014	G65W Lynx-L HO*	65	82	0,800	19,0	166,0	2G11	1	415	40	9000	25
0025015	G90W Lynx-L HO*	90	115	0,800	27,0	250,0	2G11	1	533	40	9000	25

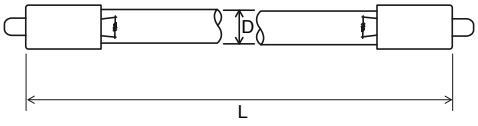
* When used with electronic ballast 25KHz HF

GERMICIDAL LINEAR T5 LONG

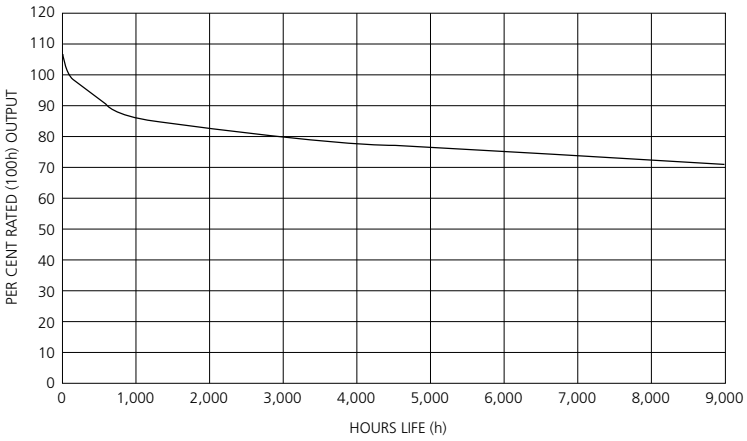
FOUR PIN (FIG. Nr 1)



SINGLE PIN (FIG. Nr 2)



ULTRAVIOLET RADIATION AS RELATED TO THE LIFE
G64 T5 L 65W 4-PIN



FEATURES

- These lamps have a smaller diameter than the conventional, linear T8 lamps
- Lamps consist of a tubular glass envelope and emit more than 85% of their energy in the UV-C ultraviolet radiation with a peak at 253.7nm for germicidal action
- They exist in single pin or with four pins at one end for easy handling
- The majority of germicidal lamps operate most efficiently in still air at an ambient temperature of 25°
- In air purification installations the HO (High Output) versions are most efficient , as they are wind chill corrected
- All lamps are Ozone free
- A protective coating on the inside of the lamp limits the depreciation of the UV-C output

APPLICATIONS

- Municipal water treatment systems
- Swimming pool applications
- Residential drinking water systems
- Air treatment units

Ordering Code	Item description	Watt (W)	Voltage (V)	Current (A)	UV-C output W at 25°C	UV µW/cm² at 1m	Cap	Figure Nr	L (mm)	D (mm)	Life (hrs)	Packing Quantity
0025005	G36 T5 L 40W 4-Pin *	39	115	0,425	12	125	Four pin	1	845	16	9000	10
0025006	G64 T5 L 65W 4-Pin *	65	250	0,425	25	260	Four pin	1	1556	16	9000	24
0025009	G36 T5 L 40W Single Pin *	39	115	0,425	12	125	Single Pin	2	845	16	9000	10
0025010	G64 T5 L 65W Single Pin*	65	250	0,425	25	260	Single Pin	2	1556	16	9000	24

* When used with conventional magnetic ballast 50 Hz

GERMICIDAL HIGH PRESSURE VHO

FIG. Nr 1

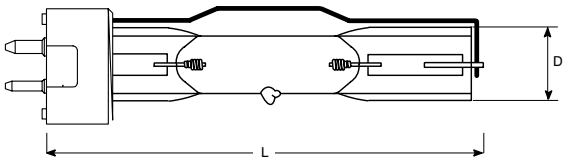
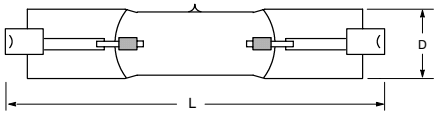


FIG. Nr 2



FEATURES

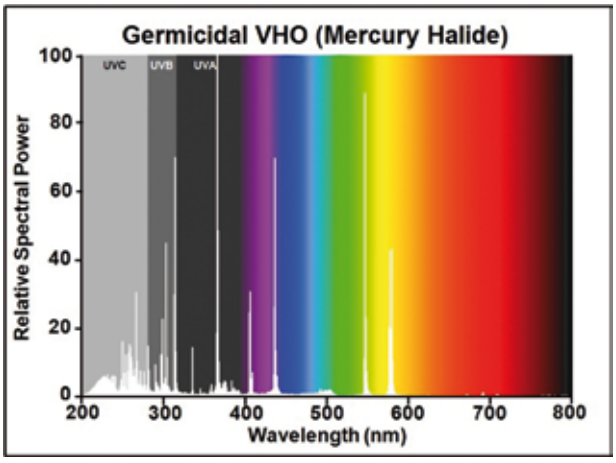
- Germicidal VHO – lamps consist of a double ended quartz discharge tube filled with mercury.
- Power concentration is 120 Watts per cm of arc length (low pressure tubes are < 1W per cm).
- Extremely high UV-C concentration levels are possible.
- Lamps have a self cleaning halogen feature which results in improved UV-C maintenance.
- Forced air ventilation is required to remove the ozone produced with VHO lamps

APPLICATIONS

- Used in a wide range of photochemical processes
- Label printing
- Disinfection of municipal waste water
- Curing of lacquers, paints and inks
- In combination with black glass filters for fluorescence excitation
- Artificial material aging
- Exposure of diazo film material and print masters

DIRECTIONS FOR USE

- The radiation from these lamps is very harmful to eyes and skin. Always protect your eyes and skin against radiation
- The lamps may only be operated in enclosed systems.
- Cannot be used for general lighting purposes
- Max. permissible bulb temperature is 950°C
- Max. permissible pinch temperature is 350°C



Ordering Code	Item description	Watt (W)	Voltage (V)	Current (A)	UV-A µW/cm² at 1m	UV-B µW/cm² at 1m	UV-C µW/cm²	Cap	Figure Nr	L (mm)	D (mm)	Life at > 50% UV-output (hrs)	Packing Quantity
0024206	G4/120 SE VHO	400	125	3,5	300	250	400	GY9.5	1	103	14	2000	10
0024207	G4/120 DE VHO	400	125	3,5	300	250	400	R7s	2	104	14	2000	10