Ultraviolet lamps.

In today's society, tailor-made UV radiation is state-of-the-art technology. It disinfects water and surfaces, hardens paints, adhesives and plastics, exposes printing plates and helps recognise forgeries, decayed foods and hairline cracks in workpieces. Last, but not least, UV radiation can be used very effectively for advertising purposes and for special effect illumination in theatres, discos and bars.

The range

- PURITEC®
  The low-pressure UV lamp for disinfection.
- ULTRA-VITALUX®
  The UV lamp with a spectrum close to sunlight.
- SUPRATEC
  The powerful UV light source for industrial applications.
- RALUTEC 71 and 78
  Compact low-pressure lamps with blue light and UVA radiation.
- HQV lamps (UV)
  UV high-pressure lamp with black glass bulb.
- L lamps (UV)
  UV low-pressure lamp with black glass.

OSRAM PURITEC® lamps.
OSRAM PURITEC® lamps are low-pressure mercury discharge lamps which mainly emit shortwave UV radiation. They are the advanced and environment-friendly alternative to chemical disinfection.

OSRAM offers a variety of lamps for effective, chemical-free and environment-friendly disinfection in many important areas. Lamp size and performance vary according to the task at hand.

They are characterised by
- high UVC radiation output.
- long life.

The main lines of the spectrum lie at 254 nm and 185 nm. UV radiation with wavelength below 200 nm transforms oxygen into ozone. The quartz material of the ozone-producing lamps also lets this specific energetic radiation pass. If ozone production should not be desired special kinds of glass or quartz are employed. These are still transparent for the sterilising radiation for disinfection but absorb the ozone generating radiation.

Lamp types.
PURITEC® lamps are manufactured un-doted up to 55 W and doted with amalgam up to 200 W. They are available as U-shape compact lamps with bayonet base and as linear lamps with wire, 2-pin or 4-pin base. They are also available as complete systems ready to connect. Un-doted lamps reach their optimal bulb wall temperature of 40 °C at an ambient temperature of 25 °C. Amalgam lamps reach 100 °C typically and, therefore, are less sensitive to varying ambient temperatures.

Fields of application

Air disinfection in:
- Hospitals.
- Surgeries.
- Clean air rooms.
- Offices with and without air-condition.
- Storage spaces.
- Highly frequented service areas.
- Animal stables.

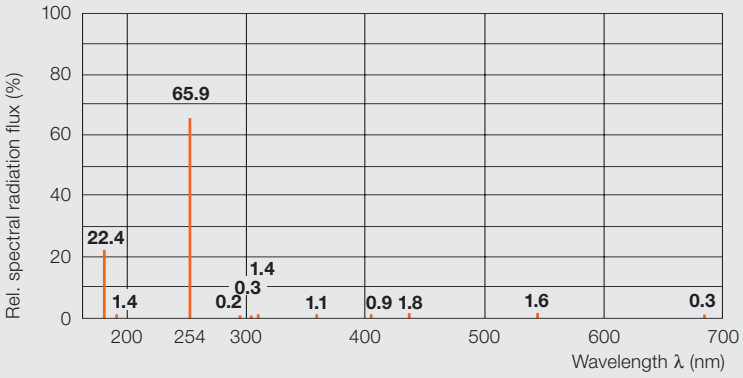
Disinfection and cleaning of water in:
- Private households.
- Municipal waterworks.
- Mobile stations (camping and outdoor).
- Swimming pools and aquaria.
- Water purification plants.
- Food processing.
- Sewage works.

Surface disinfection:
Packing process of pharmaceuticals and foods, in sterile areas and for sterilising equipment.

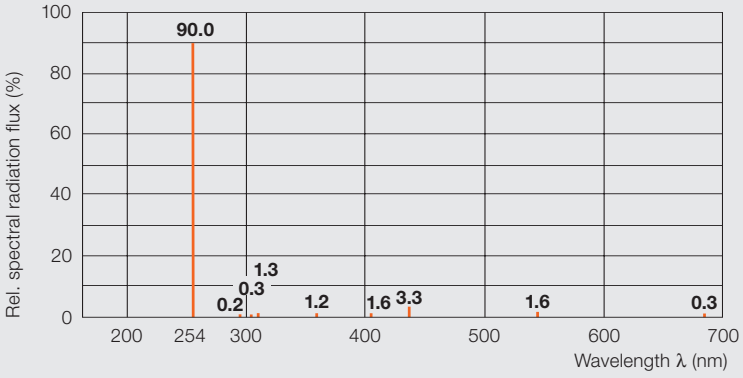
Odour removal:
Using the ozone-forming version for air-conditioning, storage rooms and extract air.

EPROM erasing:
Using UV-C radiation to erase data from programmable memory chips.

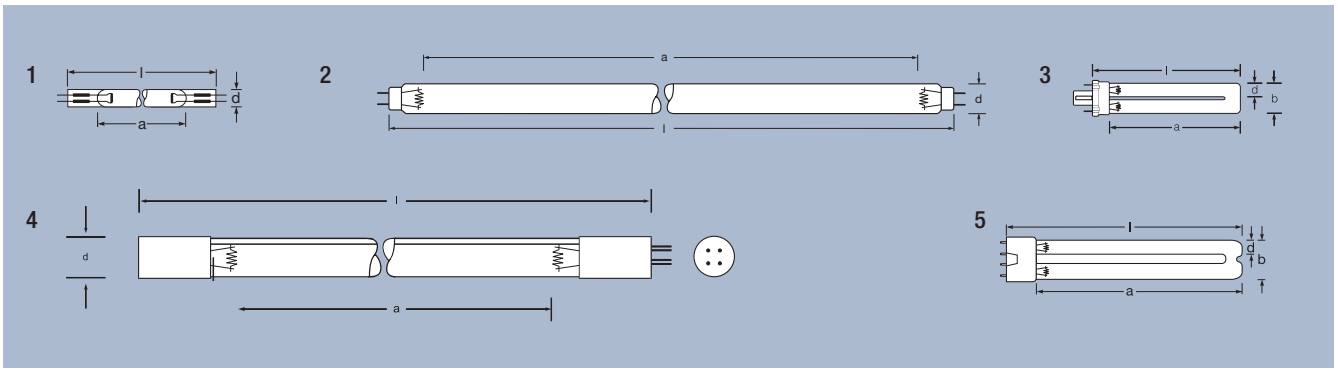
Spectral distribution of ozone-generating lamps



Spectral distribution of ozone-free lamps



OSRAM PURITEC® SPECIFICATIONS



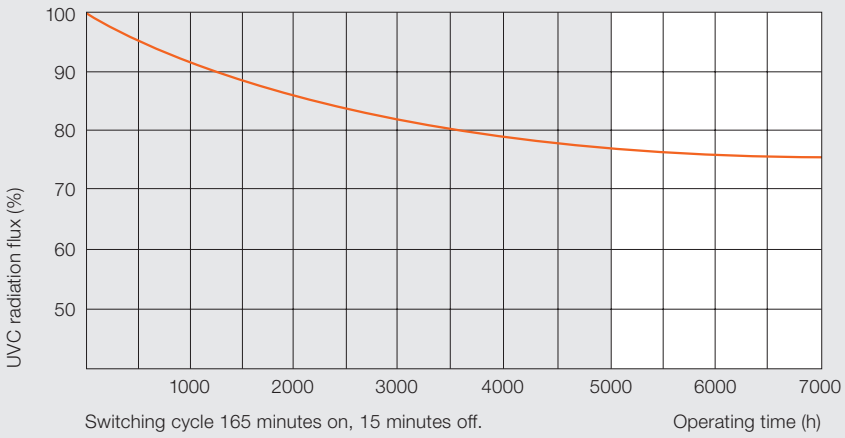
Type reference	Product no. (EAN code)	Mains voltage V	Wattage W	Nominal current A	UVA radiation power 254 nm, W	Dimension l, mm	Dimension a, mm	Dimension b, mm	Dimension d, mm	Operating position*	Base	Starter	Economic lifetime, h	Figure	Box quantity, pcs.
PURITEC® UV low-pressure lamps, ozone-free															
HNS 6 W OFR	4008321**054166**	230	6	0.15	1.7	210.5	154	–	15.5	s180	G5	RS11	6,000	2	50
HNS 7 W OFR	4050300**941202**	230	7	0.18	1.9	115	95	28	13.0	s180	G23	integr.	8,000	3	10
HNS 8 W OFR	4008321**054197**	230	8	0.17	2.5	287	230	–	15.5	s180	G5	RS11	6,000	2	50
HNS 9 W OFR	4050300**941226**	230	9	0.18	2.5	145	125	28	13.0	s180	G23	integr.	8,000	3	10
HNS 11 W OFR	4050300**941240**	230	11	0.16	3.6	215	195	28	13.0	s180	G23	integr.	8,000	3	10
HNS 15 W OFR	4008321**054227**	230	15	0.30	4.9	436	354	–	25.5	s180	G13	RS11	8,000	2	20
HNS 16T5 OFR	4008321**058027**	230	14	0.40	3.0	287	206	–	15.5	s180	4pin	RS11	7,500	4	45
HNS 25 W OFR	4008321**054258**	230	25	0.60	6.9	436	351	–	25.5	s180	G13	RS11	8,000	2	20
HNS 30 W OFR	4008321**054289**	230	30	0.36	13.4	893	808	–	25.5	s180	G13	RS11	8,000	2	10
HNS 36T5 OFR	4008321**058058**	230	39	0.43	12.0	846	762	–	15.5	s180	4pin	RS11	9,000	4	10
HNS 55 W OFR	4008321**054319**	230	55	0.77	18.0	893	808	–	25.5	s180	G13	RS11	8,000	2	10
HNS 64T5 OFR	4008321**058089**	230	65	0.43	25.0	1,554	1,474	–	15.5	s180	4pin	RS11	9,000	4	25
HNS-L 18 W OFR	4008321**054340**	230	18	0.38	5.5	225	195	40	20.0	s180	2G11	RS11	8,000	5	25
HNS-L 24 W OFR	4008321**054371**	230	24	0.34	8.5	320	290	40	20.0	s180	2G11	RS11	8,000	5	25
HNS-L 36 W OFR	4008321**054401**	230	36	0.44	12.0	415	386	40	20.0	s180	2G11	RS11	8,000	5	25
PURITEC® UV low-pressure lamps, ozone-generating															
HNS 5 W OZON[1)]	4008321**913067**	230	5	0.19	1.5	116	81	–	11.3	s180	none	RS11	3,000	1	20
HNS 12 W OZON[1)]	4008321**913081**	230	12	0.17	4.5	360	325	–	11.3	s180	none	RS11	3,000	1	25
HNS 55 W OZON	4008321**913104**	230	55	0.77	18.0	895	835	–	26.0	s180	G13	RS11	8,000	2	6
PURITEC® UV amalgam lamps, ozone-free															
HNS 120 W OFR	4008321**913128**	230	120	2.15	43.0	895	825	–	19.0	s180	4pin	–	12,000	4	5
HNS 190 W OFR	4008321**913142**	230	190	2.25	65.0	1,280	1,210	–	19.0	s180	4pin	–	12,000	4	5

Operation with appropriate ballast for fluorescent lamps, apart from[1)] with 13 W ballast.
Further types, as well as lamp data sheets, are available on request.

* see page 15

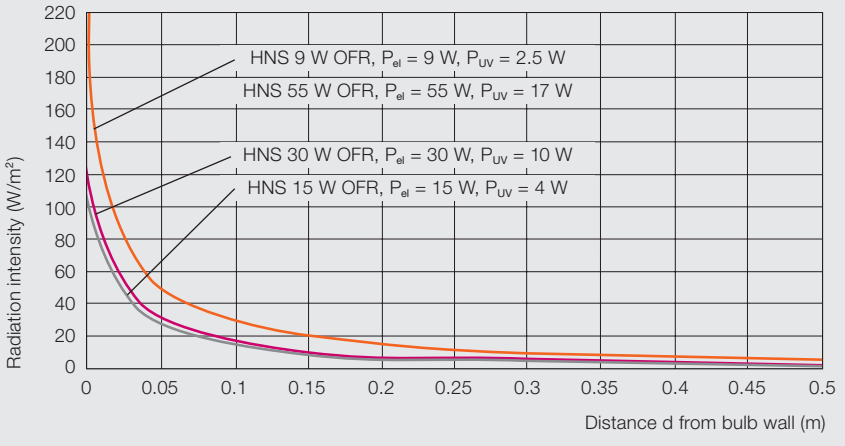
Radiation characteristics over lifetime

Reduction of UVC radiation; example: HNS 55 W OFR

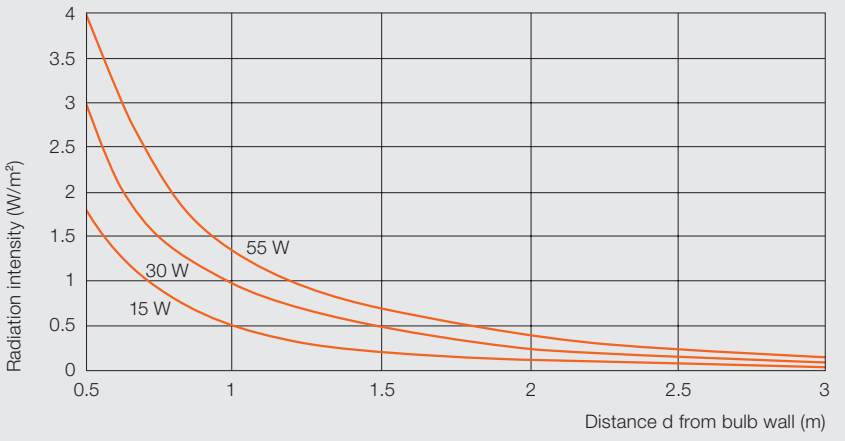


UVC radiation intensity in linear PURITEC® lamps

Radiation intensity as a function of distance < 0.5 m



Radiation intensity as a function of distance > 0.5 m

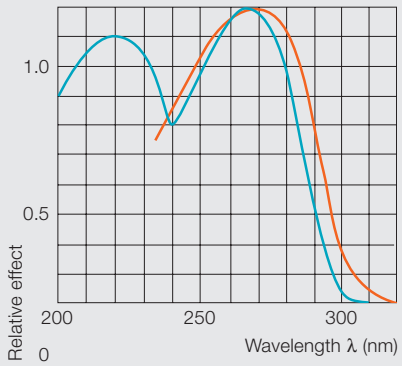


Biological effect

Killing of bacteria

The efficiency of the PURITEC® lamps is a result of the very good accordance of its maximum radiation at a wavelength of 254 nm and the spectral effectiveness function $s(\lambda)_{ba, rel}$ for killing bacteria (DIN 5031-10: 2000-03).

Efficiency



Warning

Operating UVC lamp emits UVC radiation. UVC radiation damages eyes and skin. Operate the UVC lamp within the UVC-LPF system only.

If the water should be used as drinking water please be aware that nondegradable harmful substances like heavy metals or pesticides can not be eliminated.

In enclosed rooms, ozone-generating lamps can cause dangerously high levels of ozone which are harmful for the health. If food storage rooms are irradiated, the relevant regulations about the use of sterilising radiation have to be followed.

Radiation doses for inactivating various micro-organisms.
The following values relate to an inactivation rate of 90 % at a wavelength 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 average figures for the respective families of microbes. Figures 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
Bacillus subtilis	11
Bac. subt. spore ATCC6633	152
Campylobacter jejuni	**29**
Clostridium tetani	**130**
Coryneb. diphtheria	**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 ATCC 12407	53
Klebsi. pneumon. ATCC4352	**42**
Legionella	**15 (4–26)**
Legionella dumoffi	24
Legionella gormanii	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)**
Leptrospira biflexa	23
Leptrospira illini	8
Leptrospira 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
Strep.	**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**
Herpes virus	**57 (15–165)**
Pseudorabies 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 (48–163)**
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
Orthomyxovirus	**35**
Influenza	35
HIV (Lentiv)	**1,438 (600–2,400)**
HIV (HTLVIII)	600
HIV (Sup T1)	1,450
HIV (H9)	2,400
HIV (PHA–stim. PBL)	1,300

Phages

Bacteriophage	**152 (65–310)**
Bac. subt. phage SP02c12	150
Bac. subt. phage SPP1	195
Bac. subt. phage Ø 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 (130–3,000)

Aspergillus glaucus	440
Aspergillus flavus	600
Aspergillus niger	1,320
Aspergillus niger (pasta)	1,500
Aspergillus amstelodami (meat)	700
Candida paraposilosis	220
Cladospor. herbarum (cold stores)	500
Mucor racemosus	170
Mucor mucedo (meat, bread, fat)	600
Oospora lactis	50
Penicillium chrysogenum (fruit)	500
Penicillium roquefortii	130
Penicillium expansum	130
Penicillium digitatum	440
Rhisopus nigricans	1,100
Rhizopus nigricans (cheese)	1,100
Scopulariopsis brevicaulis (cheese)	800

Protozoa

600–1,000

Algae

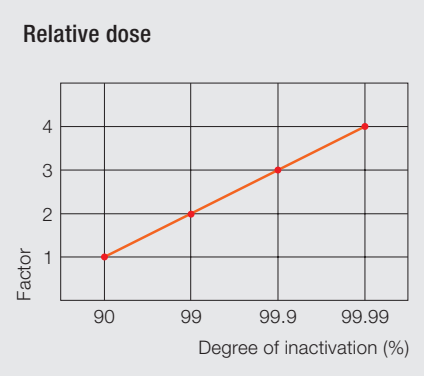
3,000–6,000

Green algae, blue algae, diatoms

Radiation doses for inactivating various micro-organisms.
The above table shows that the dose increases with higher complexity of the organisms. A higher degree of inactivation requires a higher dose. The total dose required is the product of the value for 90 % inactivation given in the table multiplied by the relative dose factor.

Example: 99.9 % inactivation of escherichia coli.

90 % value from table:	30 Ws / m²
Factor:	3
Total dose:	90 Ws / m²



Air disinfection: PURITEC® lamps efficiently destroy harmful micro-organisms in compartment air, such as bacteria, viruses, spores, yeasts, algae, protozoa and fungi. Disinfection can be effected directly or indirectly.

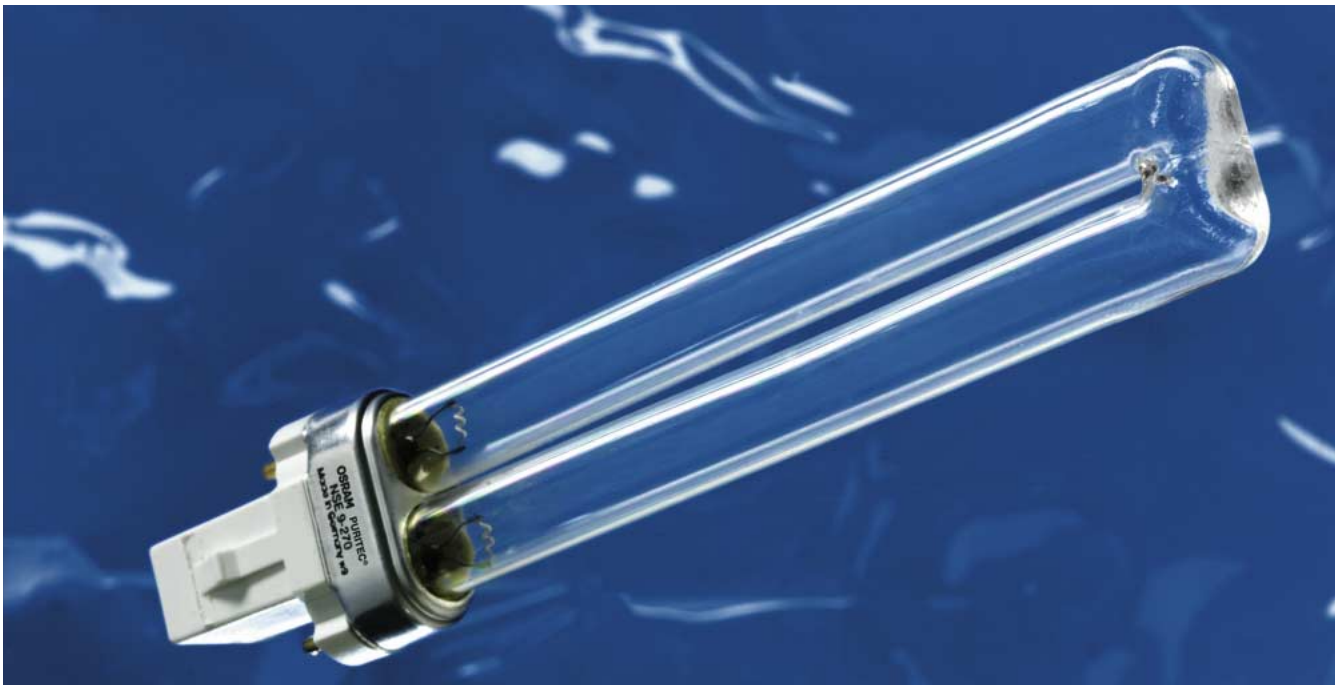
Indirect disinfection: The sterilising effect is achieved by bringing micro-organisms in the room air within reach of the radiation through convection, thereby inactivating them. Indirect disinfection requires an aluminium reflector under the disinfection lamp to ensure that the area beneath the lamp is screened from the emitted radiation which is, in turn, reflected towards the ceiling. This requires UV-absorbent ceiling and wall paint. Ventilating the room air may improve the effect of disinfection. Indirect disinfection is also used in air exchange, air-conditioning and humidification equipment.

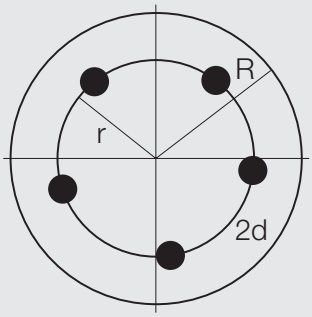
In air ducts, the lamps are usually positioned after the dust filter in the flow direction. The installation of radiation chambers is advisable for air-conditioning and humidification plants.

Direct disinfection: Direct disinfection is possible in rooms which are not occupied by persons without adequate protective clothing or animals. Additional reflectors are not necessary. It is recommended that the walls are highly reflective.

UV reflectivities of some materials

Material	Reflectivity %
AL: untreated surface	40 – 60
AL: polished surface	60 – 89
AL: vapour coated on glass	75 – 85
Anodised aluminium	65 – 75
Stainless steel	25 – 30
Tin plate	25 – 30
Chrome plate	35 – 40
White oil paint	3 – 10
White watercolour	10 – 35
Aluminium paint	40 – 75
Zinc oxide paint	4 – 5
Black enamel	5
White enamel	5 – 10
White gypsum, lime	40 – 60
Magnesium oxide	75 – 88
Calcium carbonate	70 – 80
Canvas	15 – 20
Ivory wallpaper, glossy	30
White wallpaper	20 – 30





Water disinfection.
PURITEC® disinfection lamps are the chemical-free alternative to private and public water treatment. They can be used both in stationary large-scale applications, e.g. in water works or in mobile applications, e.g. for camping. Other applications include disinfection of pools and sewage.

The radiation of the lamps have to reach the water flow. The compact U-shaped PURITEC® lamp is particularly suited for low water flow rates and volumes. The linear PURITEC® lamp is used for higher water flow rates. The disinfection efficiency depends on the composition of the fluids. Salts, organic substances and other components restrict the penetration depth of the UV radiation.

Please note: in distillized water, the UV radiation intensity falls to 10 % of the initial value after about 3 m. OSRAM provides help for project calculation.

This has to be considered in the construction of water disinfection plants.

Project example.
The number of PURITEC® lamps required depends on:
- Which micro-organism?
- What degree of inactivation?
- What flow rate?
- What container dimensions?

Calculation steps.
- The radiation dose *H* in Ws/m^2 can be calculated from the first two questions and the relative dose from the graph on page 7.
- The required minimum radiation intensity *E* can be calculated using the equation $E = H \times \Phi / (3.14 \times R^2 \times L)$ where Φ is the flow rate in m^3/s, *R* the radius and *L* the length of the irradiation space in m (for cylindrical volumes).
- The maximum distance *d* of the material to be irradiated from the nearest lamp follows from the graph of “UVC radiation intensity” on page 5.
- The lamps are positioned around a circle with radius $r = R - d$.
- The distance between two neighbouring lamps on the circle is $2d$.
- The number of lamps, *n*, on the circle is given by $n = 3.14 \times (R - d)/d$.

Calculation example for water disinfection

Micro-organisms
Escherichia coli in water
Degree of inactivation: 99.9 %

Radiation dose
H = 3 x 54 Ws/m² = 162 Ws/m²

Flow rate
F = 270 m³/h = 0.075 m³/s

Dimension of the irradiation space
R = 0.5 m; L = 0.9 m

Minimum radiation intensity
E = H x Φ / (3.14 x R² x L)
E = 17 W/m²

The distance is given by the radiation intensity diagram (page 5)
d = 0.12 m (HNS 30 W OFR)

Number of lamps
n = 3.14 x (0.5 – 0.12) / 0.12
n = 10 (HNS 30 W OFR), to be arranged equidistant along a circle with radius r = R – d = 0.38 m.

Surface sterilisation.
During packaging of drugs and food, in sterile areas in hospitals and for sterilising equipment surfaces, contaminated objects are directly exposed to UV radiation. The radiation efficiency can be significantly increased through the use of reflectors (white teflon or polished aluminium).

In assembly lines, linear PURITEC® lamps are preferredly used, whereas in closed systems or disinfection equipment the compact U-shaped PURITEC® lamps are mainly used.

Project example assembly line application questions.
- Which micro-organism?
- What degree of inactivation?
- What distance between lamp and product?
- What length and speed of conveyor belt?

Calculation steps.
- The radiation dose *H* in *Ws/m²* can be calculated from the first two questions and the relative dose from the graph on page 7.
- From the distance between the product and the PURITEC® lamps, the graphs on page 5 provide the radiation intensity, *E,* which is achievable with one lamp.
- The length and speed of the assembly line determine the exposure time for each lamp segment. The required number of segments is the length of the assembly line divided by the length of the lamp (about 1 m for PURITEC® 30 W and 55 W).
- The radiation dose per lamp segment, H_{seg}, is the radiation dose divided by the number of lamp segments.
- The required radiation intensity per segment, H_{seg}, is the required radiation dose, E_{seg}, per segment divided by the radiation time per segment.
- The required radiation intensity divided by the radiation intensity of one lamp, *E,* is the required number of lamps per segment. This number of lamps multiplied by the number of segments is the total number of lamps required.

Calculation example for surface disinfection

Micro-organisms
Penicillium chrysogenum (fungus), degree of inactivation: 99 %

Radiation dose
H = 2 x 500 Ws/m² = 1,000 Ws/m²
Planned distance between lamps and product is 0.2 m

Radiation intensity
(HNS 55 W OFR, page 5) E = 17 W/m²

Through the use of suitable reflectors, it is possible to approximately double the radiation intensity in the direction of the product, i.e. about 35 W/m².

Length of conveyor belt to be irradiated
4 m (lamp length about 1 m, therefore 4 lamp segments.)

Speed of conveyor belt: 0.5 m/s

Exposure time of the product per lamp segment: 2 s

Radiation dose per lamp segment
H_{seg} = 1,000 Ws/m$_2$/ 4 = 250 Ws/m²

Radiation dose per segment
E_{seg} = 250 Ws/m² / 2 s = 125 W/m²

Number of lamps
n = 125 Ws/m² / 35 W/m²
n = 4 lamps per segment
For 4 segments, a total number of 16 PURITEC® HNS 55 W OFR lamps are required.

Writing notes

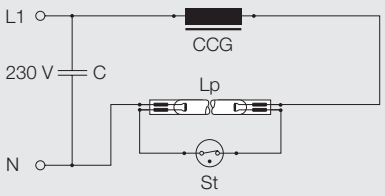
CCG: Conventional control gear
ECG: Electronic control gear
Lp: Lamp
N: Neutral
L1: Phase
St: Starter
C: Capacitor

Operating notes
In the PURITEC® HNS G23, the mains voltage ignition starter is integrated in the base. Operation with ECG is recommended.

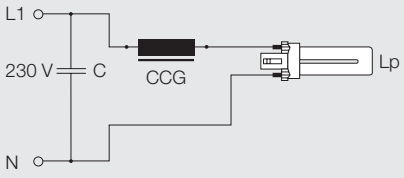
Note
These calculations only serve as examples.

Each individual project has to be calculated and tested separately.

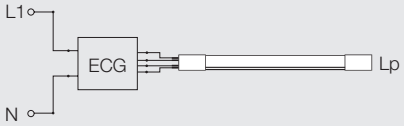
PURITEC® HNS



PURITEC® HNS G23



Amalgam Lamp with ECG



ULTRA-VITALUX®

The light from this special lamp is similar in its composition to the complete radiation mixture of natural alpine sunlight. It is generated by a tungsten filament and a high-pressure lamp. The special glass bulb of the ULTRA-VITALUX® lamp is fitted with an internal reflector which focuses the radiation. By a special doted glass the outcoming UVA and UVB radiation is defined.

A significant advantage of this lamp is its easy handling. It has an E 27 base which allows it to be used without additional equipment wherever there is a 230 V mains voltage supply.

Due to its sun-like radiation spectrum, the ULTRA-VITALUX® lamp is particularly well suited to simulating the sun in industrial material testing. In many production fields, this testing of materials and equipment is an important part of quality assurance.

The total irradiation of natural sunlight on the earth's surface with the sun in zenith position is approximately 1 kW/m². This average is achieved by evenly arranging 16 lamps per square metre of the area to be treated (distance between bulb and material to be irradiated about 50 cm). The yearly average of solar irradiation at a latitude of 50° north is about 200 W/m².

The high proportion of UV radiation in the spectrum of this lamp also makes it a useful accessory for hardening plastics (polymerisation). The application of UV lamps has greatly simplified the handling of plastics and adhesives.

Under regular room illumination the plastic material can be handled and processed for almost any period of time. It can then quickly be hardened under UV irradiation.

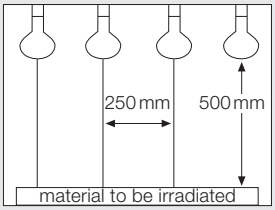
Because of its advantages – simple handling and low costs – ULTRA-VITALUX® is now used extensively for this application in workshops, in mobile equipment for repair work and for hobby activities.

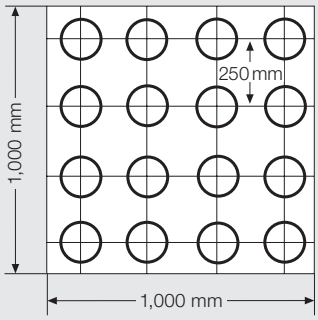
ULTRA-VITALUX® has also found entry into the electronics industry. Because of its high UV yield and its simple handling, the lamp is frequently used for exposing UV-sensitive photoresistant in the production of circuit boards.

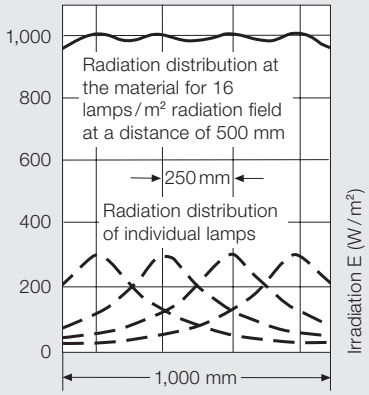
Security advices

Operating UVC lamp emits UVC radiation. UVC radiation damages eyes and skin. Operate the UVC lamp within the UVC-LPF system only.
If the water should be used as drinking water please be aware that nondegradable harmful substances like heavy metals or pesticides can not be eliminated.

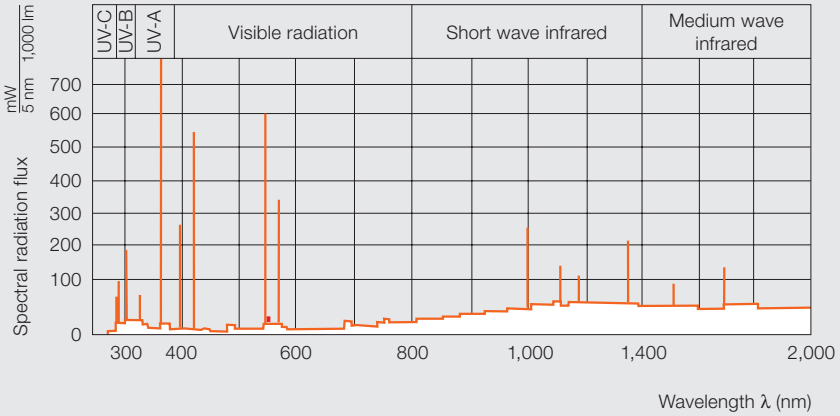
Test field with 16 ULTRA-VITALUX® lamps







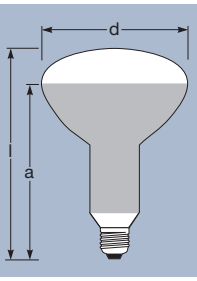
Spectral radiation distribution



Illuminance and irradiance of the ULTRA-VITALUX® lamp

(Distance = 0.5 m)

Operating time illuminance		UVB 280 – 315 nm	UVA 315 – 400 nm	Visible 380 – 780 nm
h	lx	W/m²	W/m²	W/m²
1	14,400	3.0	13.6	41.4
500	13,700	1.8	11.0	39.0
1,000	10,800	1.1	7.3	29.7



Type reference	Product no. (EAN code)	Mains voltage V	Wattage W	Angel of radiation	Dimension l, m	Installed length a, nm	Diameter d, nm	Operating position*	Base	Ignitor	Economic lifetime, h	Box quantity, pcs.
ULTRA-VITALUX® UV high-pressure lamp												
ULTRA-VITALUX	405030**003313**	230	300	30°	185	150	127	s180	E27	not required	1,000	6

The lamp specification sheet is available on request.

*see page 15

SUPRATEC

This high-performance halogen metal halide lamps were developed specifically for industrial applications. A particular combination of metal halides generates strong radiation in the UVB range (280 – 315 nm) and especially in the UVA range (315 – 380 nm). The quartz bulb absorbs UV radiation below 250 nm and thus no ozone is generated.

The spectral radiation profile of the lamp corresponds almost exactly with the reaction profile of photosensitive plastics. This offers the plastics industry a powerful emission-free and ecologically clean hardening method.

Advantages.

- Labour and time-consuming task of mixing different substances becomes obsolete.
- No restriction on handling times prior to irradiation.
- Irradiation causes immediate hardening, increasing productivity.
- No material loss through premature hardening.
- Simplified production processes.
- Low energy consumption.

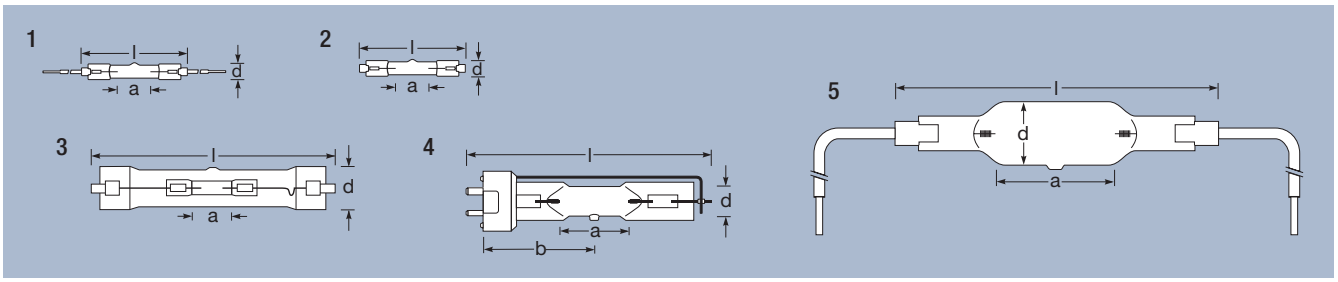
Other applications of the powerful UV sources include exposure of film material and printing plates in the printing industry, as well as artificial weathering and ageing of materials in test laboratories.

Intensive UV radiation has significant advantages for material tests using fluorescent excitation.

SUPRATEC lamps are particularly well suited for integration into production processes and mass production. The standard range comprises 150 W, 400 W, 500 W, 600 W, 800 W, 1,000 W and 2,000 W lamps.

Applications.

- Large-scale hardening of plastic parts, e.g. deep-drawn components or plastic veneers.
- Hardening of lacquers and paints.
- Exposure of diazo film material and print layouts.
- Modern adhesive technology.
- Artificial material ageing.



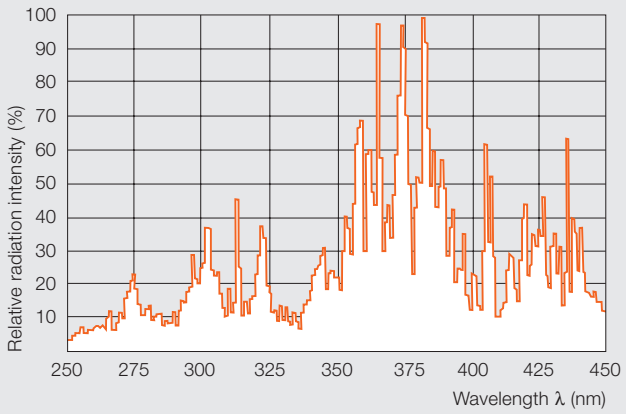
Type reference	Product no. (EAN code)	Base	Mains voltage V	Wattage W	Lamp current A	UVA radiation power 315–400 nm, W	UVA radiation power 280–315 nm, W	Dimension l, mm	Dimension a, mm	Dimension b, mm	Dimension d, mm	Operating position*	Ignitor, kV	Economic lifetime, h	Figure	Box quantity, pcs.
SUPRATEC UV high-pressure lamp, dual base																
HTT 150-211L	4008321**912824**	wire	230	165	1.5	22	6	59.5	10	–	10	p30	4.0	1,000	1	25
HTT 150-211	4008321**912848**	R7s	230	165	1.5	22	6	57.6	10	–	10	p30	4.0	1,000	2	25
HAT 150-221	4008321**912862**	R7s-24	230	170	1.5	22	5	132	10	–	23	s180	4.0	1,000	3	12
HTC 400-221	4008321**912886**	R7s	230	460	4.0	95	25	104	33	–	14	s180	4.0	1,000	2	25
HTC 600-221	4008321**912909**	KU10s	230	580	5.0	110	28	106	45	–	14	s180	4.0	1,000	1	25
HTC 1000-221	4008321**912923**	R7s	230	1,000	9.0	230	55	141	48	–	28	s180	4.0	800	5	25
HTC 2000-327	4008321**912947**	KX10s	400	2,000	9.0	480	110	174	72	–	28	s180	4.0	800	5	25
HTC 2000-347	4008321**912961**	KX10s	400	2,000	9.0	490	60	174	72	–	28	s180	4.0	800	5	25
HTC 2000-349	4008321**912985**	KX10s	400	2,000	9.0	490	70	210	104	–	28	s180	4.0	800	5	25
SUPRATEC UV high-pressure lamp, single base																
HSC 400-221	4008321**913005**	GY9.5	230	460	4.0	90	22	114	33	51	14	s180	4.0	1,000	4	25
HSC 500-221	4008321**913029**	GY9.5	230	570	5.0	110	28	116	32	53	16	s180	4.0	1,000	4	25
HSC 1000-221	4008321**913043**	GYX9.5	230	1,000	9.0	210	40	139	30	74	25	s180	4.0	800	4	25

Additional types and individual lamp specification sheets are available on request.

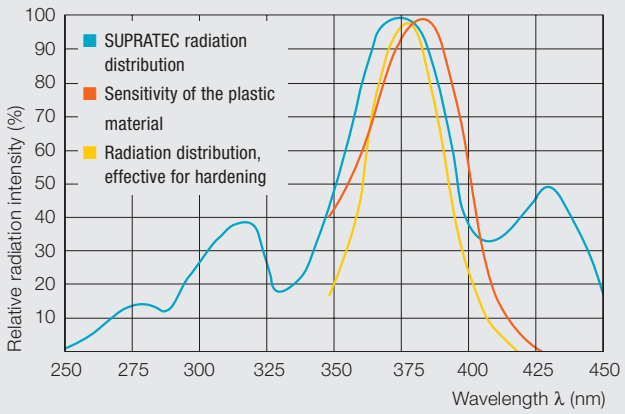
*see page 15

Spectral radiation distribution

Spectral radiation distribution

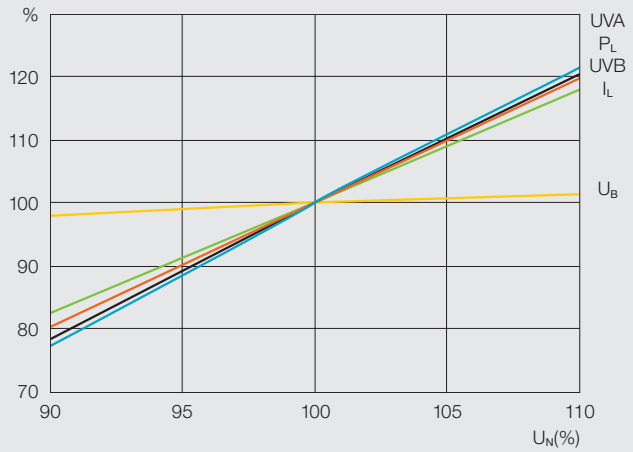


Effective radiation distribution

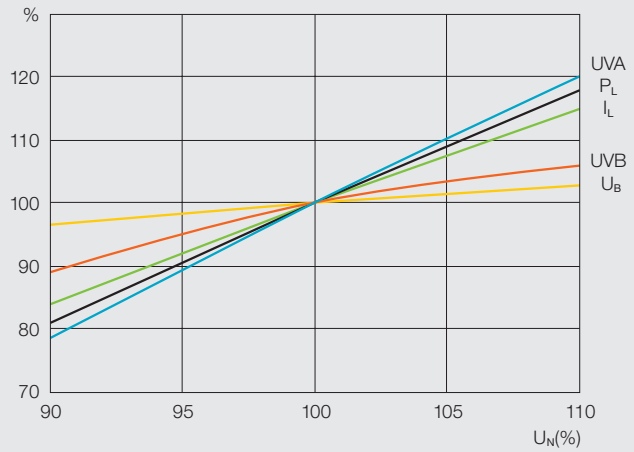


Operating characteristics.

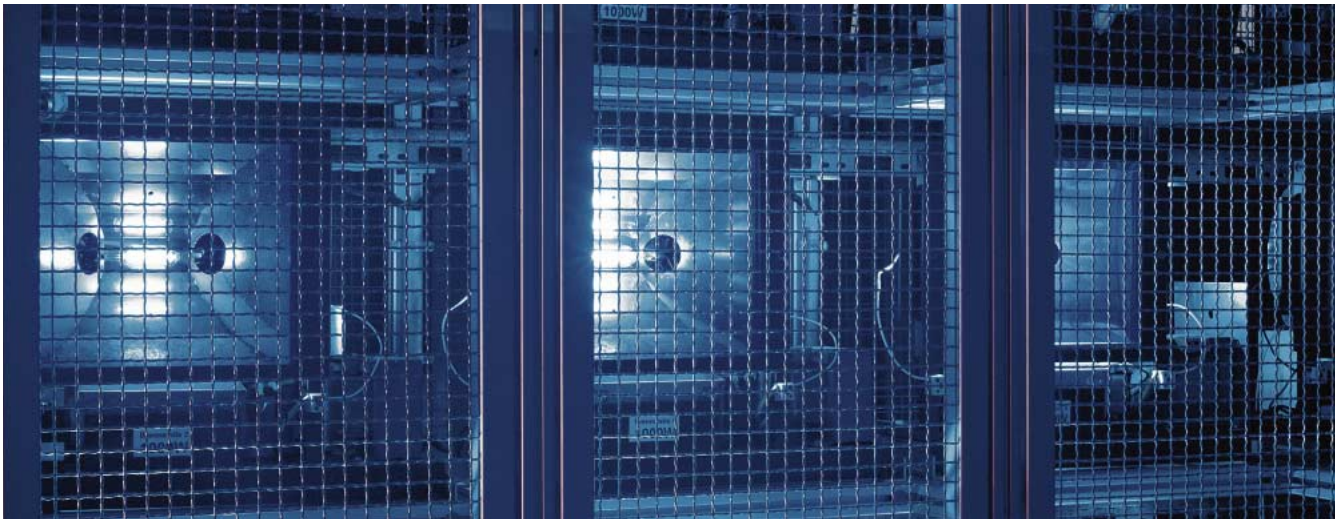
SUPRATEC HTC 400-221



SUPRATEC HTC 1000-221

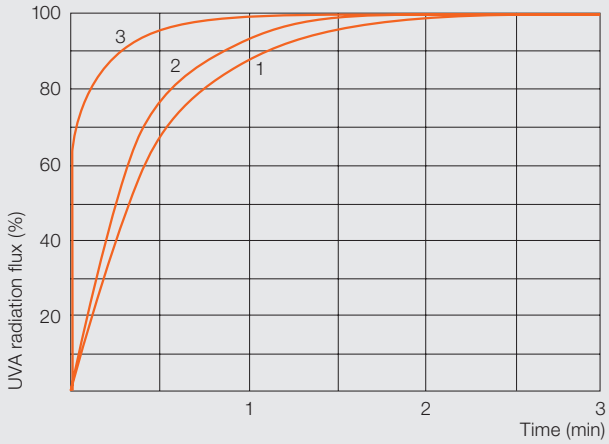


These relationships are valid for an ambient temperature of 40 °C. Radiation flux: UVA 315 – 400 nm; UVB 280 – 315 nm; PL: lamp power, IL: lamp current, UB: operating voltage, U_N: mains voltage



Operating notes.

Start-up behaviour



1: cold lamp (1,000 W)
2: cold lamp (400 W)
3: increased from half load (400 W and 1,000 W)

Operating temperatures

The following limit operating temperatures must be observed for SUPRATEC lamps:

- Pinched seal temperature: 350 °C.
- Bulb temperature: minimum 650 °C, maximum 950 °C.

The electrical and radiation data vary with the bulb temperature. The highest UV radiation flux is reached at a bulb temperature of 850 °C.

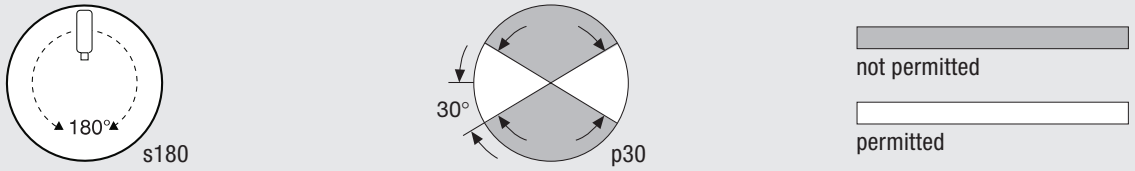
Warning

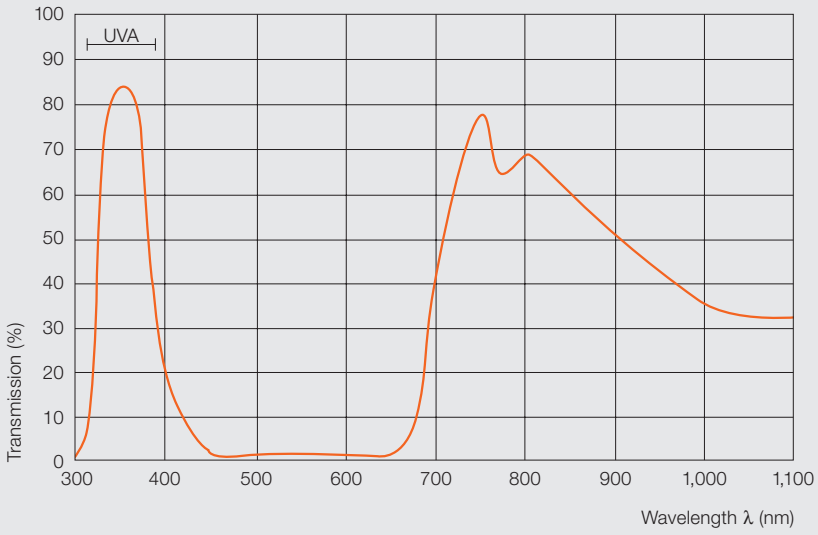
SUPRATEC lamps emit UV radiation of high intensity which can cause sunburn (in extreme cases risk of skin cancer) and conjunctivitis (eye inflammation). Skin or eyes must not be exposed to direct or reflected unfiltered radiation! Operate in closed fixtures only.

SUPRATEC lamps do not generate ozone. Special safety measures are therefore not required. The SUPRATEC quartz bulb must not be touched with bare fingers. Any fingerprints must be removed with alcohol prior to initial operation.

Installation notes.
Observe permissible installation position! The lamps become very hot during operation and are pressurised. Therefore, the lamps should be installed in enclosed equipments which are admitted for these purposes. This prevents the discharge of hot glass splinters if a bulb breaks.

Operating position.

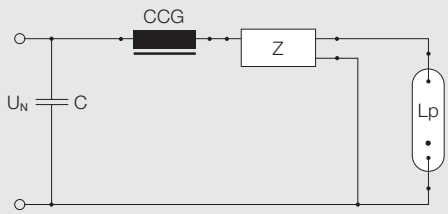




Example: spectral transmission curve of a frequently used filter (DESAG UVISOL '95).
Other DESAG filters for UV applications are, for example, M-UG 2 and type 322.

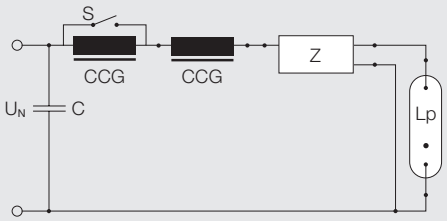
Control notes.

SUPRATEC 150 W – 2,000 W, standard connection

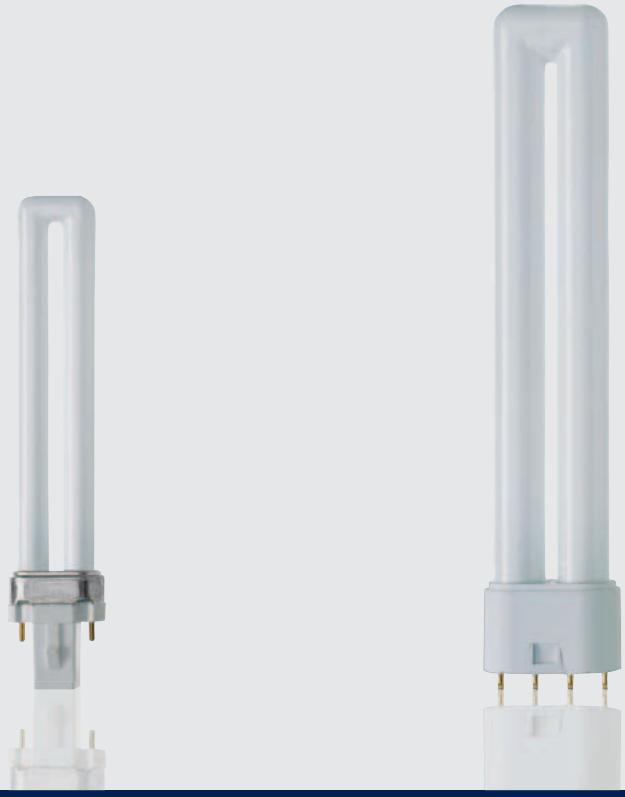


CCG: Conventional control gear, Z: ignitor,
C: power factor correction capacitor, Lp: lamp,
U_N: mains voltage, S: switch

SUPRATEC 150 W – 2,000 W, half-load connection



Switch open: half-load operation
Switch closed: full-load operation



LIGHT COLOURS 71 AND 78

RALUTEC compact low-pressure lamps in light colours 71 and 78.

RALUTEC compact lamps are low-pressure mercury discharge lamps. An electric field between electrodes stimulates the emission of energy intensive UV radiation from mercury vapour in a glass tube. A fluorescent material on the inside of the glass converts this UV radiation into light with the desired spectrum.

The difference between RALUTEC compact low-pressure lamps in special light colours and conventional compact fluorescent lamps lies in the application of special fluorescent materials. The energy intensive UV radiation is effectively converted into blue radiation or into long wave UV radiation.

RALUTEC 71.
This lamp emits light in the visible, blue spectral range of 400–550 nm. Because there are no health risks associated with this lamp, even during professional use over a whole day, and due to its ease of operation, it is an ideal tool for the polymerisation of blue-sensitive plastics, adhesives, lacquers and paints, even for layer thicknesses of more than 1 mm.

Example applications for RALUTEC 71 are torches or mobile plastic hardening equipment for car or boat repairs.

RALUTEC 78.
This lamp very effectively emits long wave UVA radiation in the range 350–400 nm. The spectral radiation profile is close to the reaction profile of photosensitive plastics.

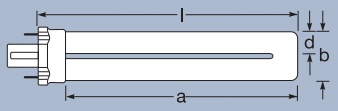
RALUTEC 78 is therefore particularly well suited for hardening modern plastics, adhesives and lacquers – emission-free and environment-friendly.
It is a simple, compact and user-friendly solution with low energy consumption.

In addition to its application for the polymerisation of plastics, the convincing properties of the RALUTEC 78 lamp also make it applicable in other modern technology areas. It has, for example, become a common tool for stimulating fluorescence in scientific investigations or as a source of UV light in the production of circuit boards.

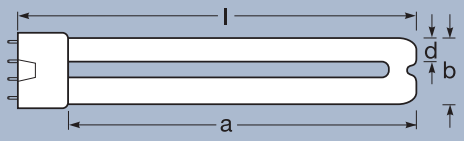
The stimulation of fluorescence is also used to recognise bank note and credit card forgeries. Here, black glass filters are applied for increased contrast (for example MUG 2 from DESAG-Schott).

Further applications light colour 71 and 78.
- Dissociation of bilirubin.
- Hardening of plastic dental fillings.
- Surface sealing in the production of dental spares.
- Cosmetic nail shaping.
- Insects pitfalls.

RALUTEC



RALUTEC long



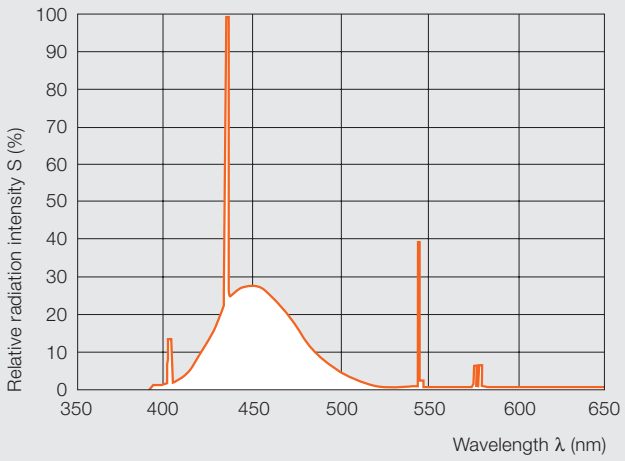
Type reference	Product no. (EAN code)	Wattage W	Nominal current A	UVA radiation power 350 – 400 nm, W	UVA radiation power 400 – 550 nm, W	Dimension l, mm	Dimension a, mm	Dimension b, mm	Dimension d, mm	Operating position*	Base	Economic lifetime, h	Box quantity, pcs.
RALUTEC, base G23													
RALUTEC 7 W/78	in preparation	7	0.175	1.4	–	115	97	27	12	s180	G23	1,000	50
RALUTEC 9 W/71	in preparation	9	0.170	–	2.3	145	127	27	12	s180	G23	1,000	50
RALUTEC 9 W/78	in preparation	9	0.170	1.7	–	145	127	27	12	s180	G23	1,000	50
RALUTEC 11 W/78	in preparation	11	0.155	2.3	–	215	197	27	12	s180	G23	1,000	50
RALUTEC long, base 2G11													
RALUTEC long 18 W/71	in preparation	18	0.370	–	4.2	225	197	38	12	s180	2G11	1,000	10
RALUTEC long 18 W/78	in preparation	18	0.370	2.8	–	225	197	38	12	s180	2G11	1,000	10

Individual lamp specification sheets are available on request.

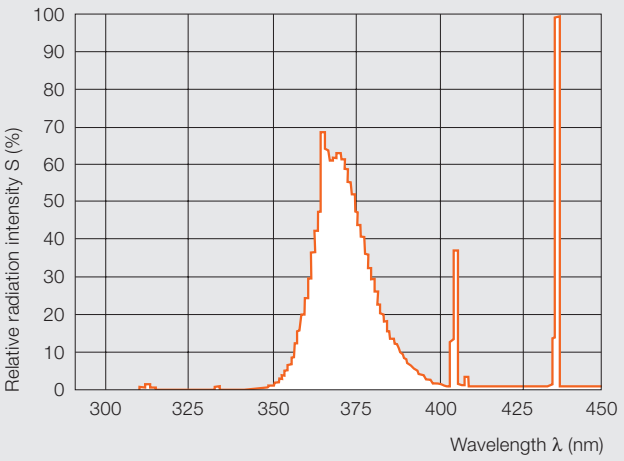
*see page 15

Spectral radiation distribution.

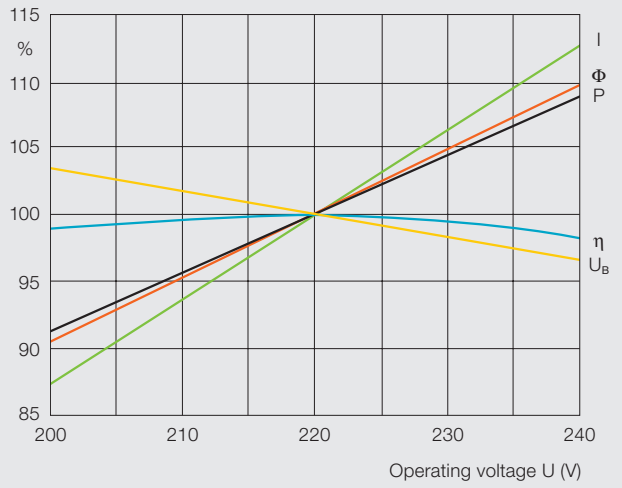
RALUTEC, light colour 71



RALUTEC, light colour 78

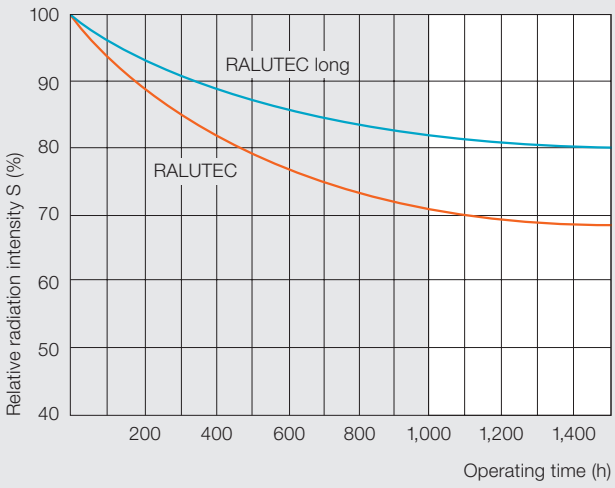


Start-up behaviour



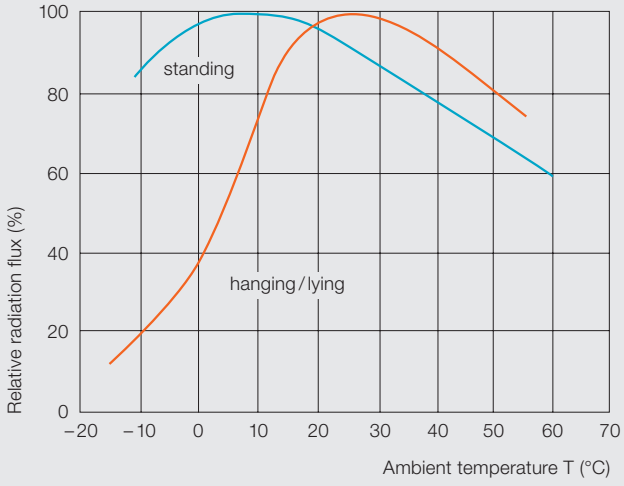
I: lamp current; Φ: luminous flux; P: lamp power; η: luminous efficacy; U_B: operating voltage

Radiator decrease



It shows the radiation decrease based on a switching frequency of 165 minutes on, 15 minutes off. The operating life of RALUTEC lamps in light colours 71 and 78 is 1,000 hours

Temperature characteristics of the radiation flux



The curves are for a freely burning lamp in still air

Biological effects

Ultraviolet radiation has various biological effects on humans and animals. Some of the most important ones are listed below.

- **Direct pigmentation.**
- **Long-term pigmentation.**
- **UV erythema (sunburn).**
- **Conjunctivitis (eye inflammation).**
- **Risk of skin cancer.**

The various photobiological effects on humans depend on the spectral composition and the radiation dose.

The threshold values for different radiation effects are given below. The photobiologically active radiation dose, H_{biol}, which just causes a noticeable reaction, is called the threshold radiation dose or the threshold value, $H_{S,\,biol}$.

The following values are taken from DIN 5031-10: 2000-03. The NIOSH (US National Institute for Occupational Safety and Health) threshold value is also given for comparison.

- $H_{S,\,Pigmentation}$: 100,000 J/m²
- $H_{S,\,CIE\ Erythema}$: 200 – 450 J/m²
- $H_{S,\,Conjunctivitis}$: 50 J/m²
- $H_{S,\,NIOSH}$: 30 J/m²

Biological effects of UV radiation

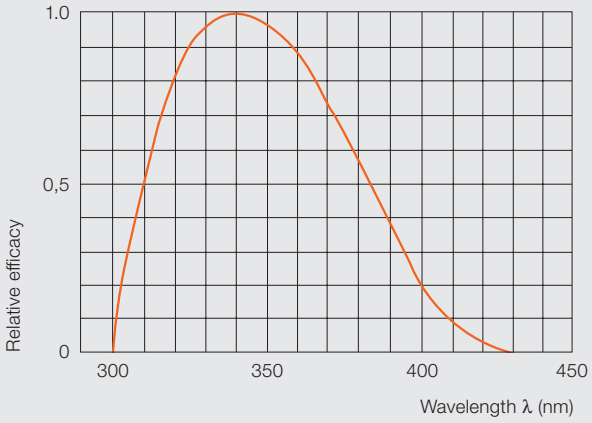
Additional regulations exist for maximum permissible radiation doses in the workplace in the UVA range (320 – 400 nm).

The following applies in Germany:
The radiation dose must not exceed 1 J/cm².
H < 1 J/cm² = 1 Ws/cm²

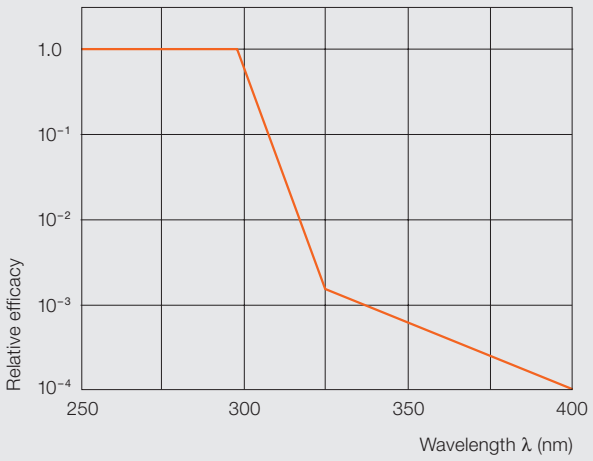
This means that the maximum permissible irradiance in the workplace for exposure times of up to 1,000 seconds must be less than 1 mW/cm².

For comparison: the irradiance at a maximum sun altitude of 60° is 4 mW/cm² in the UVA range.

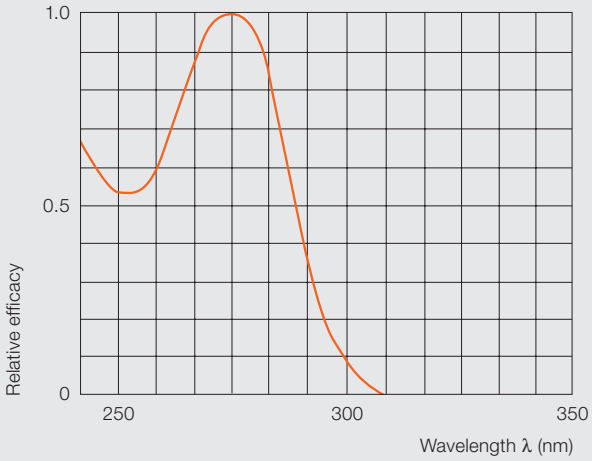
Efficacy function of direct pigmentation



Efficacy function of direct pigmentation



Efficacy function of conjunctivitis



The following table shows the irradiance values and threshold times for RALUTEC lamps. The values are based on a distance of 0.5 m from the lamp. The values in brackets show the threshold value for direct skin contact.

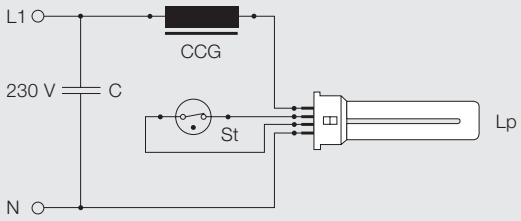
	RALUTEC 9W/71		RALUTEC 9W/78		RALUTEC long 18W/78	
UVA irradiance in mW/cm²						
Range 315 – 380 nm	0.0004	(0.09)	0.06	(12)	0.14	(15)
Range 315 – 400 nm	0.0007	(0.15)	0.07	(14)	0.16	(18)
Threshold time in hours						
Direct pigmentation	> 2,000	(18)	60	(0.28)	24	(0.20)
CIE UV-erythema, action curve	> 2,000	(4)	300	(1.40)	125	(1.10)
Conjunctivitis	> 2,000	(87)	> 2,000	(280)	> 2,000	(100)
NIOSH	> 2,000	(2)	130	(0.60)	55	(0.50)

Biological effect

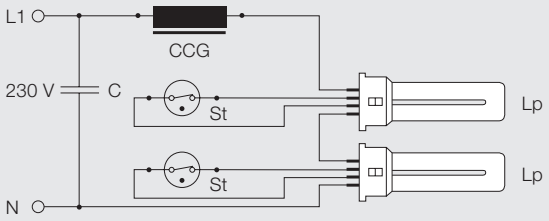
Conclusion
Threshold times are never exceeded with light colour 71. For light colour 78, the threshold values are not exceeded for irradiation times of up to 15 minutes. The threshold value for erythema (sunburn) is reached only after more than one hour, even with direct skin contact. At distances of more than about 50 cm the operation of RALUTEC lamps is harmless, even over a complete 8-hour working day.

Connection notes
As with all discharge lamps, the operation of RALUTEC compact low-pressure lamps requires suitable ballasts. RALUTEC lamps with the 2-pin base G23 come with an integrated starter and an interference suppression capacitor. Two lamps can be connected in series if a suitable ballast is used. RALUTEC long have a 4-pin base 2G7 or 2G11. They are suitable for operation with both conventional control gears and electronic control gears, e.g. Quicktronic® and Accutronic® (for 12 and 24 V operation) from OSRAM. Conventional operation requires an additional starter RS51 for series connection.

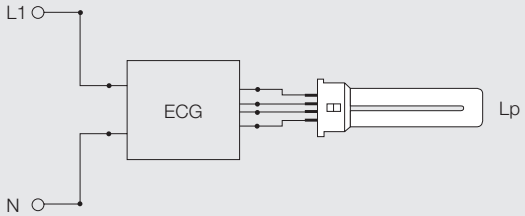
Single connection 1 lamp with CCG and starter



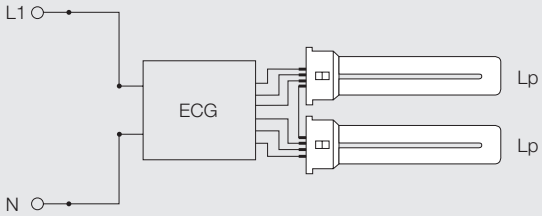
Series connection 2 lamps with CCG and starter



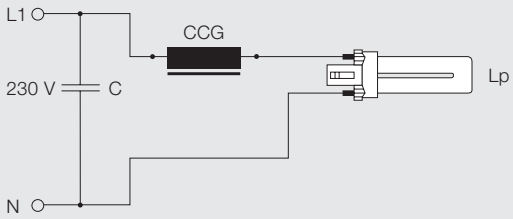
Single connection 1 lamp with ECG



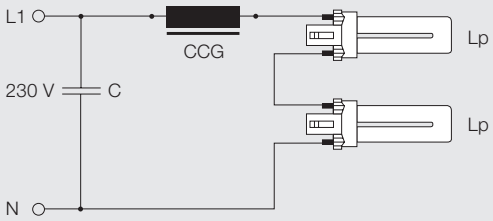
Series connection 2 lamps with ECG



Single connection 1 lamp with CCG



Series connection 2 lamps with CCG



CCG: conventional control gear
ECG: electronic control gear
C: power factor correction capacitor
Lp: lamp
N: neutral
L1: phase
St: starter

Lamp type	Base	Controllable	Single connection	Series connection	ECG
RALUTEC 7, 9 W	G23	no	yes	yes	no
RALUTEC long 18 W	2G11	yes	yes + RS11 o. RS73	yes + RS51 o. RS72	yes

The use of electronic control gears offers a number of advantages, including energy savings, flicker-free ignition, flicker-free operation, and the option of 12 V or 24 V operation.
Only the 4-pin lamps RALUTEC long are suitable for operation with electronic control gear (ECG).

HQV lamps (UV) and L lamps (UV) black light lamps

Black light lamps have come to be indispensable helpers of optical enrichment in many fields of application. UV lamps with black glass bulbs are used to stimulate fluorescence. Different materials convert invisible UV radiation into visible light.

Both the high-pressure lamp HQV lamp (UV) and the low-pressure lamp L lamp (UV) in light colour 73 generate long wave UV radiation in the range 320–400 nm, which is invisible for the human eye. The black glass bulb absorbs the remaining small portion of visible radiation, which further enhances the contrast.
The irradiance values of the two lamps are quite different. At a distance of 1 m from the centre of the lamp they are:

- HQV lamp (UV) about 0.3 W/m².
- L lamp (UV) NL 18W/73 about 0.5 W/m².
- L lamp (UV) NL 36W/73 about 1 W/m².

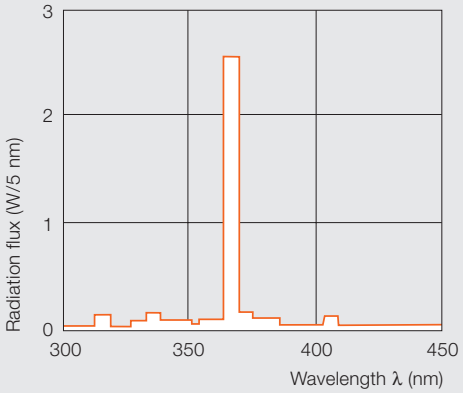
Black light lamps have become invaluable accessories for many applications or for optical enhancements.

Applications.

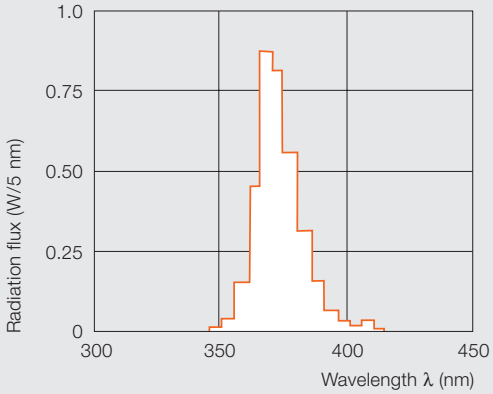
- **Materials technology.**
  Material testing with fluorescent solutions (e.g. hairline cracks in engine shafts).
- **Textile industry.**
  Analysis of materials, e.g. composition and type of wool admixtures.
- **Food industry.**
  Recognition of quality deviations in foods, partial decay of fruits (particularly oranges), meat, fish, seeds, etc.
- **Criminology.**
  Recognition of forged or amended documents, forged bank notes, cheques or paintings; recognition of blood traces.
- **Postal service.**
  Efficient operation of letter stamping machines; authenticity of stamps.
- **Illumination.**
  Special illumination effects for theatre and opera stages, cabarets, variety theatre, discos and bars.
- **Other applications.**
  Advertising, design of shop windows, agriculture, mineralogy, testing of precious stones, art history, palaeography, diagnostics, etc.

Spectral radiation distribution

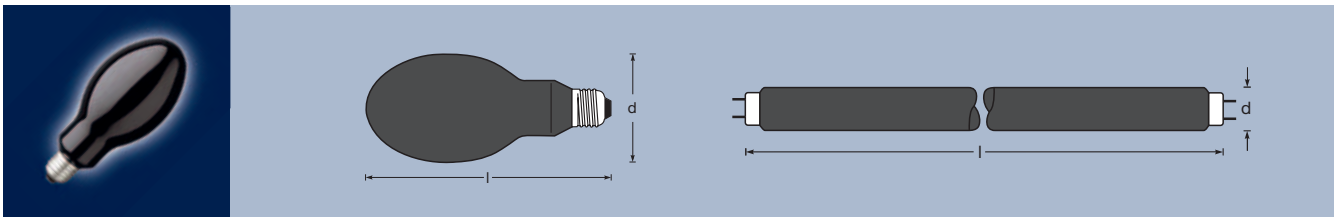
HQV lamp (UV) HQV 125



L lamps (UV) NL 18/73



HQV LAMPS (UV) AND L LAMPS (UV) SPECIFICATIONS



Type reference	Product no. (EAN code)	Mains voltage V	Base wattage W	Nominal current, A	UVA radiation power; W	Dimension l, mm	Dimension d, mm	Operating position*	Base	Starter	Economic lifetime	Box quantity, pcs.
HQV lamps (UV)												
HQV 125	4050300**015125**	230	125	1.15	3,0	,170	75	s180	E27	–	2,000	12
L lamps (UV)												
L 18/73	4008321**054685**	230	18	0.37	3.0	,590	26	s180	G13	RS11	2,000	25
L 36/73	4008321**054715**	230	36	0.44	7.5	1,200	26	s180	G13	RS11	2,000	25

Individual lamp specification sheets are available on request.

*see page 15

Biological effect

Permissible irradiation times per day for a freely burning L lamps (UV) L 36/73 black light lamp according to ACGIH and DIN 5031-10: 2000-03 at certain distances from the lamp:

Threshold time	at a distance of 10 cm	at a distance of 100 cm
Skin and eyes (ACGIH)	3 h	44 h
CIE UV erythema effect (sunburn)	8 h	115 h
Conjunctivitis (eye inflammation)	45 h	583 h

The limit according to ACGIH (American Conference of Governmental Industrial Hygienists) is based on a total effect curve. This is a model describing all UV effects on the skin and eyes, and is therefore a very restrictive limit.

Conclusion

According to current standards and state of the art, UV exposure limits are not exceeded for the freely burning lamp under normal operation conditions, i.e. there is no known health risk.
The same applies for the HQV lamp (UV) high-pressure lamp HQV 125, except that the operation of a HQV lamp (UV) with a damaged or missing outer bulb is dangerous and therefore not allowed.

Connection notes

The HQV lamp UV is operated with 230 V AC current, with a conventional control gear for a 125 W mercury high-pressure lamp (nominal current 1.15 A). Starters and normal fluorescent lamp ballasts are required for the operation of L lamps (UV) fluorescent lamps.

Quality as a permanent process.

To convert the thought of quality into action, this is for OSRAM the motor for its success. Very important factors for reaching the high-quality standards – parts of our lamps are manufactured here, the know-how of the development of production processes up to the construction of the machinery – are provided in our enterprise and are always up to date.

Thus OSRAM is able to manufacture products of high quality, which starts with the individual fabrication of small quantities up to the fabrication of big series.

The quality management is on an excellent level. The aim of the staff is to maintain this level by acting consciously every day. The certification according to DIN ISO 9001 is at the same time a confirmation as well as a further motivation – OSRAM is a guarantor for quality.

OSRAM environment.
Quality and environmental protection belong together! Active protection of the environment is a basis in our society for securing the future and a part of our responsibility for the following generations – in the private field as well as in the business field.

OSRAM sees itself responsible for protecting the environment by saving and carefully using natural resources. Already in 1991, this corporate policy was laid down in the guiding principles for environmental protection. In its core statement, the company committed itself to the protection of the environment. In 1997, this type of ecological management was inspected in accordance with the EG Eco Audit Regulation and certified in accordance with DIN EN 14001.

CERTIFICATE

DNV ZERTIFIZIERUNG UND UMWELTGUTACHTER GMBH
certifies that the company

OSRAM

at the location
Hellabrunner Str. 1
D - 81536 München
with the sites and remote locations as listed in the annex
has established a
quality and environment managementsystem
in conformity with

EN ISO 14001 : 1996 and EN ISO 9001 : 2000

This Certificate is valid for:

Development, production and sales of lamps and control gears as well as components and machines for the manufacturing of lamps

This Certificate is valid until:
2007-08-31

Certificate-Registration-No.:
CERT-11256-2001-AE-ESN-TGA

Essen, 2004-11-17
N. Kim
Manager

TGA-ZM-004/92-00
TGA-ZM-41-96-10

Essen, 2004-11-17
G. Herbst
Lead Auditor

This Certificate replaces the edition of 2003-12-17 and the following Sub-Certificates belong to this Main-Certificate:
CERT-11258-2001-AQ-ESN-TGA and CERT-11253-2001-AQ-ESN-TGA.

General statements

The technical design data are in accordance with DIN and IEC.

The manufacturer does not take any responsibility for damage to persons or property in case of unsuitable operation or handling of the product.

Operating data and dimensions are valid within the usual tolerances.

On request, models not specified herein, in addition to different bases and voltages, are available.

Sale and delivery are effected in accordance with the OSRAM Terms of Delivery and Payment valid on the day of conclusion of contract.

Packing units offer economical advantages to the purchase and logistic department. Please match your quantity volume accordingly.

Technical changes and terms of delivery are reserved.

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