

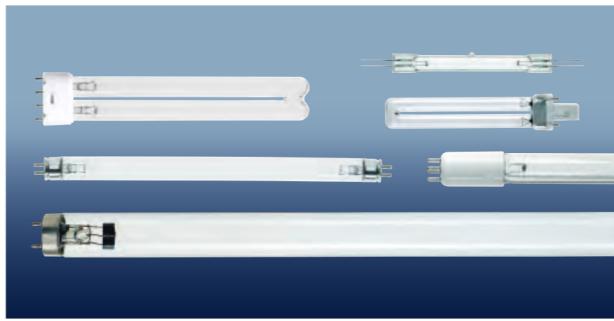


# UV-C PURITEC® HNS® germicidal lamps

Technical Information

SEE THE WORLD IN A NEW LIGHT

**OSRAM** 



# OSRAM PURITEC® HNS® germicidal lamps

**are low-pressure lamps that emit mercury line radiation mainly in the short-wave ultraviolet range. They are the highly promising eco-friendly alternatives to chemical purification processes. OSRAM offers many different lamps for effective disinfection in a wide range of applications. They do not use any chemicals and are environmentally friendly. They are available in different sizes and outputs to suit different requirements.**

#### Key features:

- high UVC irradiance
- long life

The main lines in the spectrum are at 254 nm and 185 nm. Ultraviolet light, which has a wavelength of less than 240 nm, produces ozone. This high-energy radiation can pass through the quartz glass used for ozone-generating lamps. If ozone is not required then special glass or appropriate types of quartz are used. They are transparent for the radiation that kills micro-organisms but do not let ozone-generating radiation through. HNS® lamps are manufactured as undoped lamps and as amalgam-doped lamps. The undoped lamps achieve their optimum wall temperature of 40 °C at an ambient temperature of around 25 °C. The amalgam lamps, on the other hand, typically reach temperatures around 100 °C and are less sensitive to ambient temperature.

#### Areas of application

##### Air purification in:

- hospitals
- doctors' practices
- clean rooms
- offices with or without air-conditioning systems
- storage rooms
- rooms with frequent public access
- animal stalls

##### Water purification and cleansing in:

- private households
- community water works
- mobile stations (camping, outdoor activities)
- swimming pools and aquariums
- ultra-pure water systems

- food processing
- sewage systems

##### Surface disinfection:

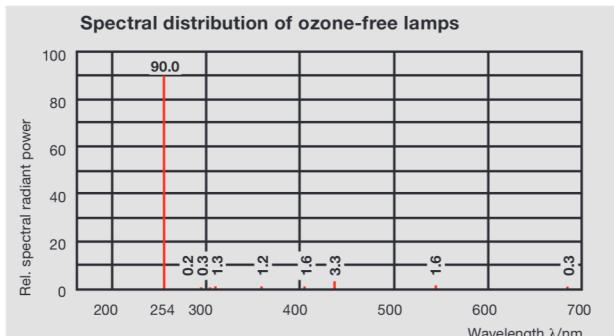
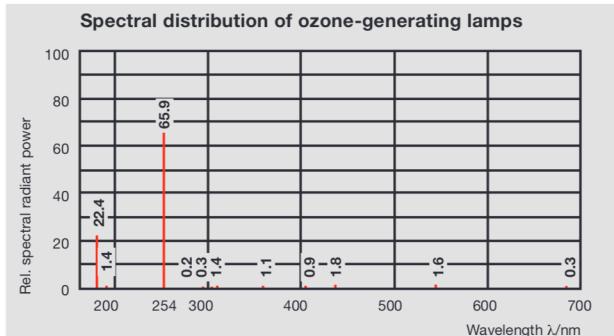
Packaging of pharmaceuticals and food, in aseptic zones and for set of instruments

**Odor elimination:**  
with the aid of the ozone-generating version or air-conditioning systems, storage rooms and extracted air

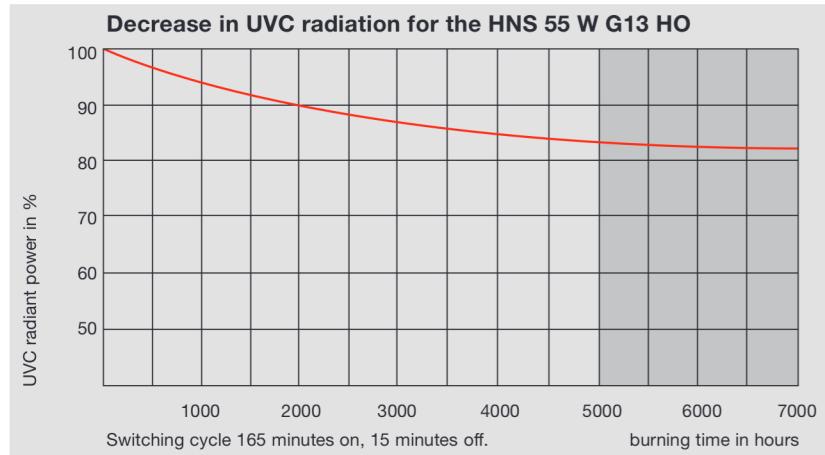
##### Erasing of Eproms

(semiconductor memory):  
with the aid of UVC radiation

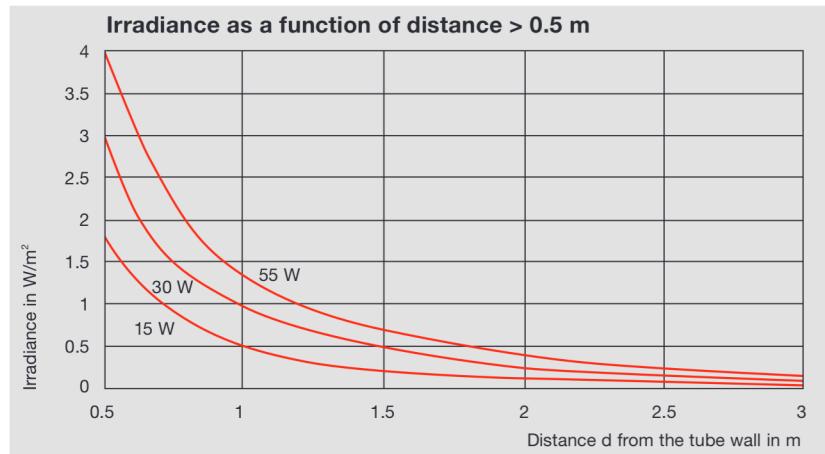
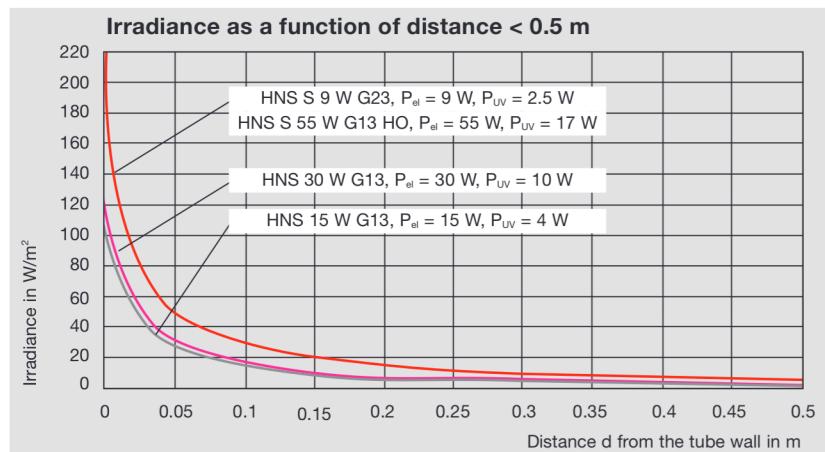
#### Spectral power distribution



## Lifetime radiation behavior



## UVC irradiance for tubular PURITEC® HNS® germicidal lamps

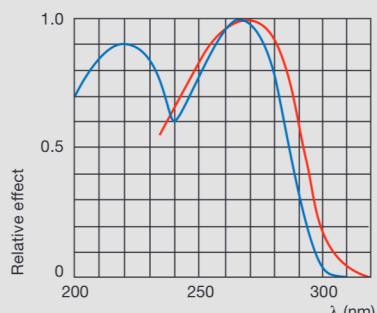


## Biological effect

**Elimination of bacteria:** The anti-bacterial effect of the PURITEC® HNS® lamp is based on the very close match between its maximum radiation at 254 nm and the spectral function  $s(\lambda)_{ba, rel}$  for killing bacteria.  
(DIN 5031-10: 2000-03)

## Functions

- General elimination of bacteria
- Deactivation of escherichia coli



**Warning:** The radiation from PURITEC® HNS® lamps poses a health risk. It can cause conjunctivitis and erythema (sunburn) after only brief exposure. The skin and eyes must be protected against direct exposure. Suitable protective clothing must therefore be worn in rooms that do not offer direct protection.

In enclosed rooms, ozone-generating lamps may produce ozone concentrations that are hazardous to health. If germicidal lamps are used to sterilize rooms in which food is kept the relevant food regulations governing the use of germicidal lamps must be followed.

# Radiation Doses for Inactivating Various Microorganisms

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/m<sup>2</sup>). 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.

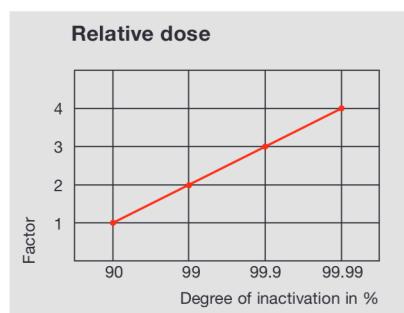
<b>Bacteria</b>		<b>Pseudomonas aerug.</b>	<b>35 (15-55)</b>	<b>Paramyxovirus</b>	<b>35 (15-55)</b>
<b>Bacillus (vegetative)</b>	<b>32 (13-58)</b>	Pseudomonas aeruginosa	55	Sindbis virus	55
Bac. anthracis	45	<b>Salmonella</b>	<b>43 (21-80)</b>	Newcastle Disease	15
Bac. Megatherium	13	Salm. typhimurium	80	<b>Orthomyxovirus</b>	<b>35</b>
Bac. paratyphosus	32	Salm. enteritidis	40	Influenza	35
Bac. subtilis	58	Salmonella typhi	21	<b>HIV (Lentiv.)</b>	<b>1438 (600-2400)</b>
<b>Bacillus (spore)</b>	<b>118 (11-365)</b>	<b>Serratia marcescens</b>	<b>32 (7-85)</b>	HIV (HTLVIII)	600
Bac. Megatherium	27	<b>Shigella paradysenteriae</b>	<b>17</b>	HIV (Sup T1)	1450
Bac. subtilis	120	<b>Staph</b>	<b>44 (18-110)</b>	HIV (H9)	2400
Bac. anthracis	45	Staph. albus	18	HIV (PHA-stim. PBL)	1300
Bac. subtilis (ATCC6633)	365	Staph. aureus	26	<b>Phages</b>	
Bacillus subtilis	11	Staph. epidermidis	110	<b>Bacteriophage</b>	<b>152 (65-310)</b>
Bac. subt. spore ATCC6633	152	<b>Strep.</b>	<b>36 (18-65)</b>	Bac. subt. phage SP02c12	150
<b>Campylobacter jejuni</b>	<b>29</b>	Strep. hemolyticus	22	Bac. subt. phage SPP1	195
<b>Clostridium tetani</b>	<b>130</b>	Strep. lactis	62	Bac. subt. phage Ø 29	70
<b>Coryneb. diphtheria</b>	<b>34</b>	Strep. viridans	20	Bacteriophage F specific	292
<b>Citrob. freundii (ATCC8090)</b>	<b>42</b>	Strep. faecalis (ATCC29212)	65	Coliphage f2	310
<b>Enterob. cloaca (ATCC13047)</b>	<b>64</b>	Strep. faecalis	55	Staph. phage A994	65
<b>Escherichia coli:</b>	<b>45 (7-58)</b>	Strep. pyogenes	22	<b>Yeasts</b>	<b>59 (23-100)</b>
Escherichia coli	30	Strep. salivarius	20	Oospora lactis	50
Escherichia coli (in air)	7	Strep. albus	18	Saccharomyces cerevisiae (baking yeast, brewing yeast)	33-100
Escherichia coli (in water)	54	<b>Vibrio</b>	<b>24 (8-39)</b>	Saccharomyces ellipsoideus	60
Escherichia coli ATCC 11229	25	<b>Yersinia enterecolitica</b>	<b>15</b>	Saccharomyces sp.	80
Escherichia coli ATCC 25922	30	<b>DNA-Viruses</b>		Torula sphaerica (in milk and cream)	23
Escherichia coli K 12 AB 1157	58	<b>Parvovirus</b>	<b>35 (30-40)</b>	<b>Fungi</b>	<b>713 (130-3000)</b>
Escherichia coli B/r ATCC 12407	53	Bov. parvovirus	40	Aspergillus glaucus	440
<b>Klebsi. pneumonia. ATCC4352</b>	<b>42</b>	Kilham rat virus	30	Aspergillus flavus	600
<b>Legionella</b>	<b>15 (4-26)</b>	<b>HCC (Dog hepat. Adenov)</b>	<b>265</b>	Aspergillus niger	1320
Legionella dumoffii	24	<b>Herpes virus</b>	<b>57 (15-165)</b>	Aspergillus niger (pasta)	1500
Legionella gormanii	26	Pseudorabies virus	70	Aspergillus amstelodami (meat)	700
Legionella micdadei	15	Herpes simplex MP str.	67	Candida parapsilosis	220
Legionella longbeachae 1	12	Herpes simplex MP str.	15	Cladospor. herbarum (cold stores)	500
Legionella longbeachae 2	10	Herpes simplex, type 1	165	Mucor racemosus	170
Legionella oakridgensis	22	<b>Vaccinia</b>	<b>18</b>	Mucor mucedo (meat, bread, fat)	600
Legionella micdadei	18	<b>RNA-Viruses</b>		Oospora lactis	50
Legionella jordanis	11	<b>Picornavirus</b>	<b>72 (36-186)</b>	Penicillium chrysogenum (fruit)	500
Legionella wadsworthii	4	Poliovirus	110	Penicillium roquefortii	130
Legionella pneumophila	25	Poliov type 1 Mahoney	67	Penicillium expansum	130
Legionella bozemanii	20	Poliov	133	Penicillium digitatum	440
<b>Leptospira</b>	<b>20 (8-28)</b>	Poliov type 1	36	Rhisopus nigricans	1100
Leptospira biflexa	23	Poliov Mahoney	45	Rhizopus nigricans (cheese)	1100
Leptospira illini	8	ECBO	80	Scopulariopsis brevicaulis (cheese)	800
Leptospira interrogans	28	Coxsackiev	186	<b>Protozoa</b>	<b>600-1000</b>
<b>Micrococcus</b>	<b>80 (61-100)</b>	<b>Reovirus</b>	<b>102 (48-163)</b>	<b>Algae</b>	<b>3000-6000</b>
Micrococcus candidus	61	Reovirus type 1	48	Green algae, blue algae, diatoms	
Microc. sphaeroides	100	Reov type 1 (Lang str)	163		
<b>Neisseria catarrhalis</b>	<b>44</b>	Rotav	159		
		Rotav SA11	65		

## Radiation doses for deactivating various micro-organisms

The table shows that the radiation dose increases as the organisms become more complex. A greater degree of deactivation calls for a higher dose. The total dose required is the product of the value in the table for 90% deactivation and the value for the relative dose.

### Example of 99.9% deactivation of escherichia coli:

Table value 90%:	30 Ws/m <sup>2</sup>
Factor:	3
Total dose:	90 Ws/m <sup>2</sup>



## Air purification

PURITEC® HNS® lamps efficiently destroy harmful micro-organisms in the air, such as bacteria, viruses, spores, yeasts, algae, protozoa and fungi. Direct or indirect disinfection is used depending on the personal protection requirements.

**Indirect disinfection:** The disinfection effect in a room is achieved by using convection to move the micro-organisms in the air into the range of the radiation, where they are then deactivated. In the case of indirect disinfection an appropriate aluminum fitting must be provided to ensure that the radiation is shielded at the bottom and reflected up to the ceiling. UV-absorbent ceiling and wall coating is required. People in the room are then not exposed to any danger. Forced circulation of the air in the room can accelerate the disinfection rate.

Indirect disinfection is also used in air recycling, air-conditioning and humidifying equipment. In ventilation ducts it is best to position the lamps beyond the dust filter in the direction of air flow. For air conditioning and ventilation systems it makes sense to install the lamps in radiation chambers.

**Direct disinfection:** Direct disinfection is possible in rooms in which there are no animals and no people, unless they are wearing appropriate protective clothing. No additional reflectors are needed for direct disinfection. It is best however to provide the walls with highly reflective finishes.



## UV reflectance of various materials

Material	Reflectance %
AL: untreated surface	40-60
AL: polished surface	60-89
AL: deposited on glass	75-85
Anodized aluminum	65-75
Stainless steel	25-30
Tinplate	25-30
Chrome plate	35-40
White oil-based paint	3-10
White emulsion paint	10-35
Aluminum paint	40-75
Zinc oxide paint	4-5
Black glaze	5
White glaze	5-10
White plaster, lime	40-60
Magnesium oxide	75-88
Calcium carbonate	70-80
Canvas	15-20
Wallpaper, ivory, glossy	30
Wallpaper, white	20-30

## Water purification

PURITEC® HNS® germicidal lamps are the chemical-free alternatives for purifying water in domestic and public settings. They are used in large permanent installations, for example in public water works, and as mobile equipment for example in motorhomes. They are also used for disinfecting swimming pools and waste water.

Wherever possible, the lamps should be installed in the flow of water.

Their effectiveness depends on the composition of the liquid. Salts, organic matter and other ingredients greatly reduce the depth of penetration of UV radiation. This must be taken into consideration in the geometrical design of water purification systems.

**For information:** For distilled water, UV irradiance reduces to 10% of the initial value at a distance of approx. 3 m. OSRAM offers assistance with calculations.

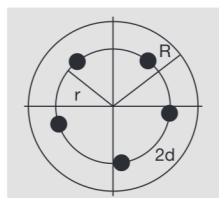
**Project planning example:** The number of PURITEC® HNS® lamps required can be determined by answering the following four questions:

- Which micro-organisms are involved?
- What is the required degree of deactivation?
- What is the flow rate?
- What are the dimensions of the vessel?



### Calculation method:

- The answers to the first two questions and the relative dose from the diagram on page 5 give the irradiation dose  $H$  in  $\text{Ws/m}^2$ .
- The minimum irradiance  $E$  is given as  $E = H \times \Phi / (3.14 \times R^2 \times L)$  where the flow rate  $\Phi$  is in  $\text{m}^3/\text{s}$ ,  $R$  is the radius and  $L$  the length of the irradiation area in m (for cylindrical volumes).
- The maximum distance  $d$  between the material to be irradiated and the nearest lamp is given in the "UVC irradiance" diagrams on page 3.
- The lamps are arranged on the circumference of a circle with radius  $r = R - d$ .
- The distance between two adjacent lamps on the circumference of the circle is  $2d$ .
- The number  $n$  of lamps on the circumference of the circle is  $n = 3.14 \times (R - d) / d$ .



### Sample calculation for water purification

#### Micro-organism:

Escherichia coli in water

Degree of deactivation: 99.9%

#### Irradiation dose:

$$H = 3 \times 54 \text{ Ws/m}^2 = 162 \text{ Ws/m}^2$$

#### Flow rate:

$$\Phi = 270 \text{ m}^3/\text{h} = 0.075 \text{ m}^3/\text{s}$$

#### Dimensions of the irradiation area:

$$R = 0.5 \text{ m}; L = 0.9 \text{ m}$$

#### Minimum irradiance:

$$E = H \times \Phi / (3.14 \times R^2 \times L)$$

$$E = 17 \text{ W/m}^2$$

The distance is given by the irradiance diagram on page 3:

$$d = 0.12 \text{ m (HNS 30 W)}$$

#### Number of lamps:

$$n = 3.14 \times (0.5 - 0.12) / 0.12$$

$n = 10$  (HNS 30 W), which have to be arranged uniformly along the circumference of a circle with radius

$$r = R - d = 0.38 \text{ m.}$$



## Surface disinfection

For packaging pharmaceuticals and food, in aseptic zones in hospitals and for surface disinfection of equipment the infected objects are exposed directly to UV radiation. The efficiency of the radiation can be increased considerably by reflectors (white Teflon or polished aluminum).

### Project planning example

#### Conveyor belt application

##### Questions:

- Which micro-organisms are involved?
- What is the required degree of deactivation?
- What is the distance between the lamp and the material to be irradiated?
- What is the length and speed of the conveyor belt?

##### Method:

- The answers to the first two questions and the relative dose from the diagram on page 5 give the irradiation dose  $H$  in  $\text{Ws/m}^2$ .
- The distance between the material to be irradiated and the PURITEC® HNS® lamps gives the irradiance  $E$  that can be achieved with a lamp in accordance with the diagrams on page 3.
- The conveyor belt length and speed gives the dwell time per lamp segment. The required number of segments is the conveyor belt length divided by the lamp length (approx. 1 m for HNS® 30 W and 55 W).
- The irradiation dose  $H_{\text{seg}}$  per lamp segment is the irradiation dose divided by the number of lamp segments.
- The required radiation dose  $H_{\text{seg}}$  per segment divided by the irradiation time per segment gives the required irradiance per segment  $E_{\text{seg}}$ .

This number of lamps multiplied by the number of segments gives the total number of lamps required.

#### Sample calculation for surface disinfection

##### Micro-organism:

Penicillium chrysogenum (mold)

Degree of deactivation: 99%

##### Irradiation dose:

$$H = 2 \times 500 \text{ Ws/m}^2 = 1000 \text{ Ws/m}^2$$

Planned distance between the lamps and the material to be irradiated 0.2 m

##### Irradiance:

(HNS 55 W, page 3)

$$E = 17 \text{ W/m}^2$$

With suitable reflectors it is possible to almost double the irradiance in the direction of the material to be irradiated, i.e. approx.  $35 \text{ W/m}^2$ .

##### Conveyor belt length to be irradiated:

4 m (lamp length approx. 1 m, therefore 4 lamp segments.)

##### Speed of the conveyor belt:

0.5 m/s

##### Dwell time of the material per lamp segment:

2 s

##### Irradiation dose per lamp segment:

$$H_{\text{seg}} = 1000 \text{ Ws/m}^2 / 4 = 250 \text{ Ws/m}^2$$

##### Irradiance per segment:

$$E_{\text{seg}} = 250 \text{ Ws/m}^2 / 25 = 125 \text{ W/m}^2$$

##### Number of lamps:

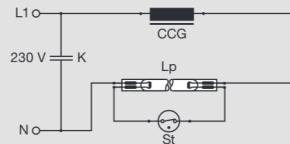
$$n = 125 \text{ Ws/m}^2 / 35 \text{ W/m}^2$$

$n = 4$  lamps  
per segment

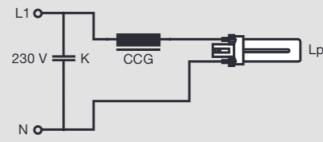
For 4 segments the total number of lamps is  $16 \times \text{PURITEC}^\circledR \text{ HNS}^\circledR 55 \text{ W}$ .

## Wiring

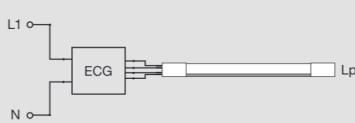
### PURITEC® HNS®



### PURITEC® HNS® S G23



### PURITEC® HNS® CONSTANT



CCG: Conventional control gear;

ECG: Electronic control gear;

Lp: Lamp;

N: Neutral conductor;

L1: Phase;

St: Starter;

K: PF correction capacitor

**Operating instructions:** In the case of PURITEC® HNS® S G23, the starter for ignition on line voltage is integrated in the base. ECG operation is recommended for amalgam lamps.

**Note:** The calculations are intended only to highlight the physics involved.

Separate calculations and tests are required for each project.

## **Global presence.**

OSRAM supplies customers in around 150 countries.

- 73 companies and sales offices for 111 countries
- 38 countries served by local agents or OSRAM GmbH, Munich

## **OSRAM associated companies and support centres.**

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Azerbaijan	Mexico
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