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Overview UV-lamps

Doping and quartz types in UV medium pressure lamps

Medium pressure UV lamps are mainly installed where uv-reactive paints or coatings are used. Photo initiators within the substances are exposed to UV radiation thus creating a reaction between the ink and the lacquer called polymerization. In addition to paints and coatings, industrial UV radiation is used in many other fields, e.g. in materials testing, photochemistry and also for disinfection of material surfaces, air and water.

In the following areas UVH lamps are mainly applied:

- Graphic arts industry
- Wood industry
- Electrical Industry

The main advantages of the UV processes are:

- The materials are free of solvents and therefore environmentally friendly
- The timing of the cure can be freely defined
- The uv cure is instantaneous, therefore high production speeds can be achieved

UV medium pressure lamps can be manufactured with lengths between 40 mm and 2800 mm and are available for capacities up to 60 kW.

The following pages give a brief overview of the common market of medium-pressure UV lamps, its doping and models. Please contact us if you have special requirements for your application. In almost all cases, we can offer a solution.

Content:

1. UV ranges

The electromagnetic spectrum ranges from cosmic rays (1023 Hz) to low-frequency signals (e.g. alternating currents, acoustic). The UV radiation is a small part of the electromagnetic radiation.

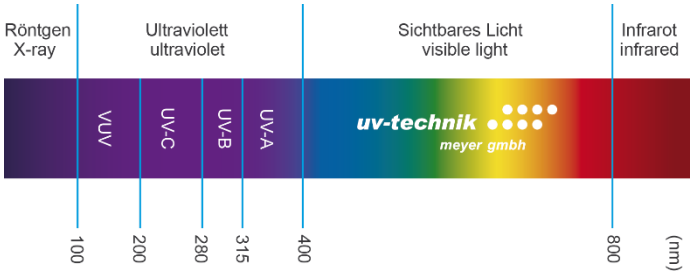


Fig. 1: An excerpt from the electromagnetic spectrum

The range of the UV radiation according to DIN 5031-7 is defined as follows:

UV-C	= 100 to 200 nm (vacuum-UV)
	= 200 to 280 nm (far UV)
UV-B	= 280 to 315 nm
UV-A	= 315 to 400 nm (in DIN only defined to 380 nm, in practice often down to 400 nm)
UV-VIS	= 400 to 450 nm (395 to 445 nm are; defined in DIN)
Light (VIS)	= 380 to 780 nm (in practice often between 400 to 780 nm)

2. Construction of a UV medium lamp

A UV lamp is composed of:

- The quartz glass tube
- The seal with melted in electrodes on both sides (the so-called sealing)
- The caps with connections or contacts

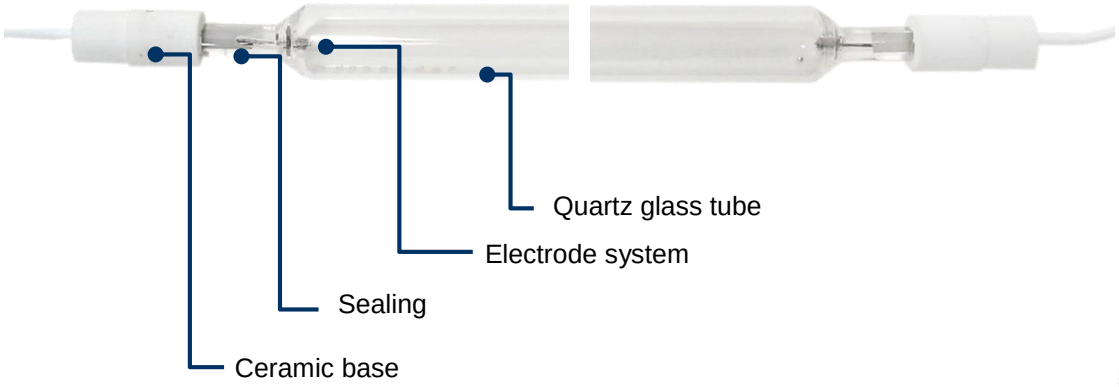


Fig. 2: Construction of a UV medium pressure lamp

Fig. 3: Examples of electrodes.
The electrodes have a diameter of a few millimeters. They have a length range from a few millimeters up to about 10 mm. The choice of the optimal electrode mainly depends on the emitter current.

2.1 Cap types

UV medium pressure lamps on both ends must be located with mostly ceramic caps. These are available in different designs. If desired, the cable length can be custom defined. The same applies for the connection

Fig 4: Connection types

The most common types are shown below:

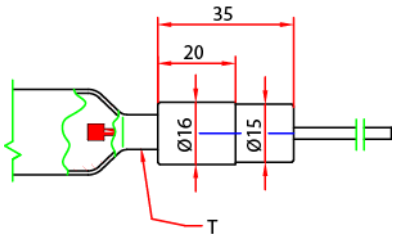
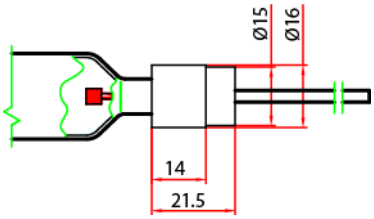
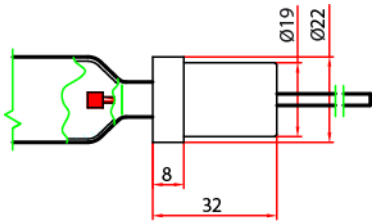
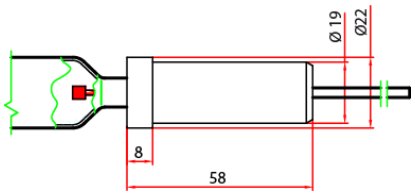
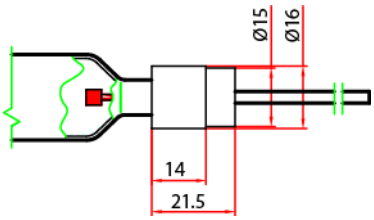
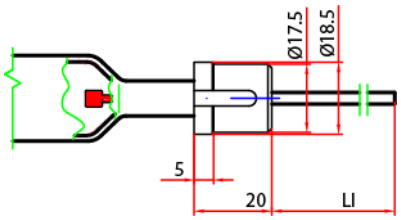
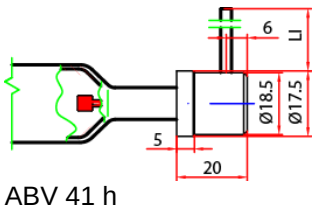
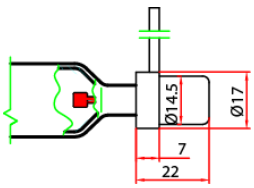
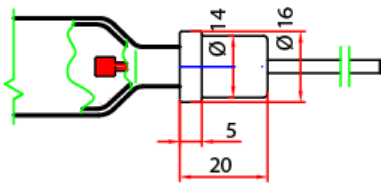
Cap examples		
 ABV 14	 ABV 16	 ABV 18
 ABV 19	 ABV 26	 ABV 41 a
 ABV 41 h	 UVT 13	 UVT 17

Fig. 5: Examples of cap types. Please contact us if you require a different cap type

2.2 Quartz glass types

The spectrum emitted by the lamp is determined by the filling (i.e. Hg or possibly additional doping, see ch.3) and the quartz glass used. To filter out the short-wave UV radiation, doped quartz glass types are used. Hereby ozone-less (Y) or ozone-free (Z) lamps can be constructed. Ozone-free lamps play especially a role where it is needed to cure with long-wave UV radiation and where the cooling air / outgoing air of the lamp goes inside the room instead of extracting to the outside.

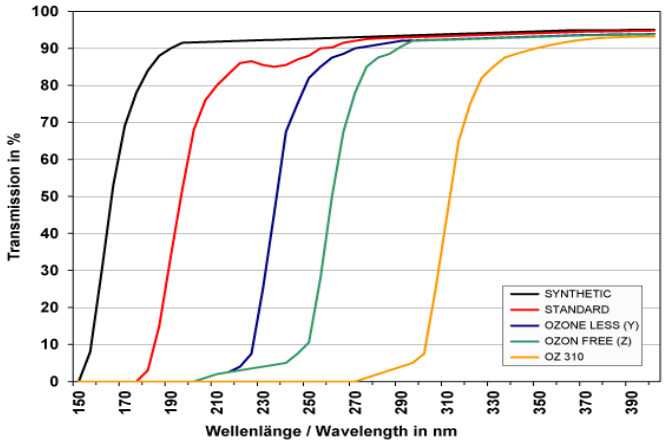


Fig. 6: Transmission curves of different types of quartz glass in the warm condition

Quartz glass types	
No letter or no second or third letter	ozone producing (standard)
Y	ozone less
Z	ozone free
S	synthetic; strengthened ozone production; with inert gas – higher UV-C emission
Q	QZ 310; for special use

2.3 Typical lamp tube diameters

Listed are the specific capacities in W/cm, depending on the outer diameter of the radiator tube. These figures are typical values that are often encountered in practice for air-cooled systems. But there are applications where these specific capacities are exceeded. In these cases, the cooling has to be adjusted to maintain the best source temperature between 700 ... 900 °C. The table below will only give an example.

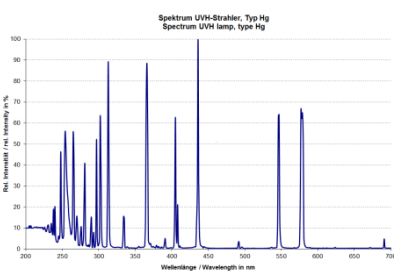
External diameters of lamp tubes in mm	**Typical specific lamp power in W/cm**
∅ 16	… 60
∅ 19	80 (…100)
∅ 22,5	100…120
∅ 24,5	120…150
∅ 26,5	160 (…170)
∅ 28,5	… 240
∅ 30	… 300
∅ 40	… 600 special applications (“Jumbo-lamps“)

3. UV-Spectra

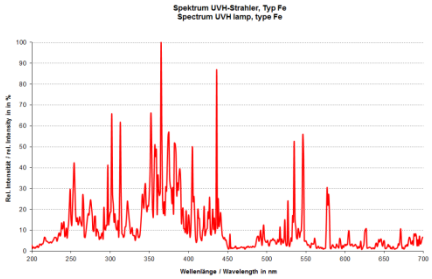
UV medium pressure lamps are gas discharge lamps. They contain amongst the ignition gas (Ar), liquid mercury, which in operation produces in its gaseous state, the plasma.
Medium pressure UV lamps emit when operating a so-called discontinuous spectrum (also called line spectrum), a spectrum that has separate (discrete) points of increased intensity, so-called spectral lines.

3.1 Doping

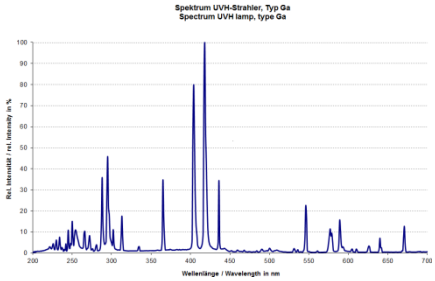
Most often, the spectrum of mercury (Hg) is used. Doped UV lamps have additional metals or metal iodides as a filling. The most common additives are iron (Fe) or gallium (Ga):



Spectrum Hg



Spectrum Fe



Spectrum Ga

The nature of the spectrum is often identifiable by the lamps designation. It is composed of one or two letters (in exceptional cases even up to three). The first letter (if 3, the 2nd letter) refers to the filling. The last letter in the lamps title indicates the quartz glass (see below).

Fillings	
Hg (Standard)	Mercury
F	Iron
G	Gallium
P	Lead
T	Thallium
X	Bismut

Notes:
- All types of quartz glass can be combined with all fillings.
- Ozone-less means that this quartz glass ONLY during the startup (cold state) produces ozone. When it has reached operating temperature, a Y-lamp never produces ozone (at least with the usual measuring instruments, such as Draeger test tubes, ozone is not detectable anymore).

3.2 Energy distribution of lamps with different spectra

These physical values listed are approximate values.

Type		**Typical lifetime**		**Energy distribution (in relation to the electric power)**				
				UV-C	**UV-B**	**UV-A**	**UV-VIS**	**Licht**
Hg		100%		15%	8%	7%	5%	15%
Y		100%		13%	8%	6%	5%	15%
Z		100%		5%	8%	6%	5%	16%
F		50%		7%	5%	17%	6%	16%
FZ		50%		2%	5%	17%	6%	16%
G		80%		7%	8%	5%	17%	24%
GZ		80%		2%	8%	5%	17%	24%