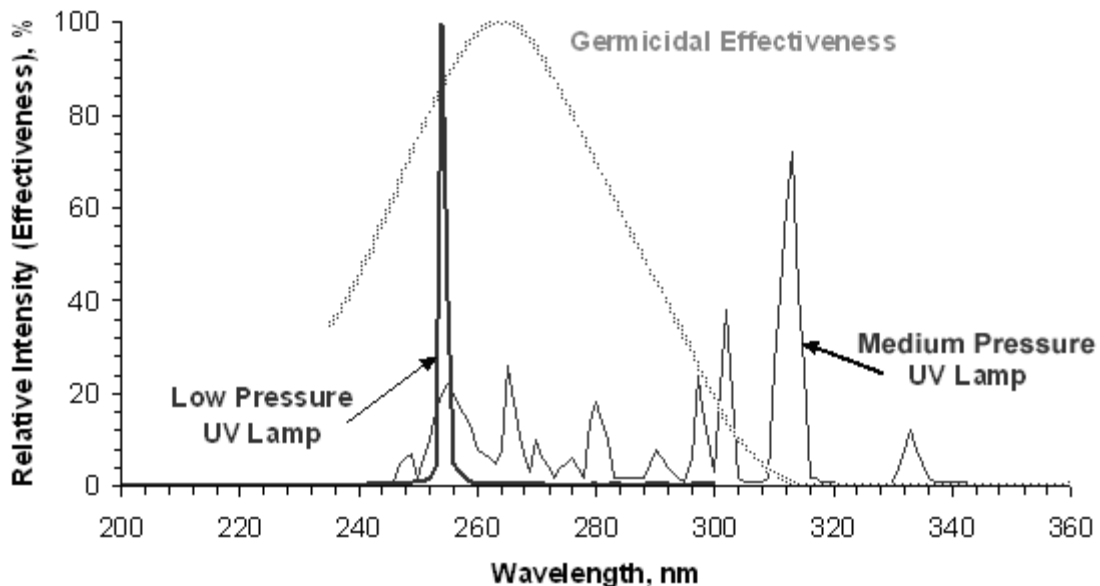


UVC Production by Germicidal UV Lamps

There are many types of lamps that artificially produce UV. There are UV lamps for tanning, for counterfeit money detection, blacklight stage lamps and lamps for mineral displays, lamps that produce Ozone and germicidal UV lamps. The focus of this document are the germicidal UV lamps, which emit shortwave UV light in the ultraviolet section of the specter also known as UVC or germicidal UV. There is more information on the nature of UV in the [UV Science Facts](#) section. Here we will discuss the artificial UV production by the different UV lamps and the specs of the different types of UV lamps. Many times people refer to the UV lamps as UV bulbs as in regular light bulb. Even though bulb is not the correct term, replacement bulb, UV bulb or bulbs are widely accepted in the industry as a reference to the UV lamps.

UV Lamps – History and Development

UV is artificially produced by mercury vapor low and medium pressure lamps. The low pressure lamps are most effective, because they emit most of the radiant energy in the germicidal wavelength of 253.7nm also known as the UVC part of the specter. This is the reason low pressure lamps are mostly used in germicidal UV applications. These lamps are sometimes called “amalgam” lamps because they contain solid amalgam “spots” (an amalgam is an alloy of mercury with another element, such as indium or gallium) that controls the mercury vapor pressure.



All lamps have secondary emissions, including small amounts of UVA, UVB, visible light (above 400nm wavelength) and heat. The blue glow of the germicidal UV lamps is not indicative to the effective germicidal output they produce – that could be only determined with a properly calibrated UV sensor and monitor.

As with all gas discharge lamps, the UV output of germicidal lamps is reduced when the temperature of the lamp surface deviates from the optimum. The performance data of the various lamp types and the influences of air or water cooling play an important part in an effective and reliable UV disinfection. If this is neglected it may lead to an inadequate

UV installation.

For effective UV disinfection not only the temperature but the transparency of the medium for UVC (253.7nm wavelength) is of great importance. The greater the energy lost through absorption, the less energy remains to kill microbes. Tests have shown that there is a reduction in the UV lamps disinfecting performance if there is a high humidity level. For the effectiveness of UV water purification systems transmittance of the water is very important.

It is important to take the reducing factors under consideration when sizing the UV lamps for an effective UV disinfecting process.

In air stream UV irradiation reflective materials with high UVC reflection properties should be used as these materials will multiply the UV efficiency of the germicidal lamps.

Development of UV disinfection lamps started in the early forties when Westinghouse began the development of the Cold Cathode lamps in an economical production. After that UVC lamps were tried out for disinfection everywhere – surfaces, goods, water and air. The early extensive testing still applies today as a basic knowledge, underlining the UV technology.

Types UV Lamps

Cold Cathode Germicidal UV Lamps

The Cold Cathode Germicidal UV Lamps are instant-start lamps with a cylindrical cold cathode type of electrode. These lamps are available in different sizes and may be operated either from single lamp transformers or in series through the medium of high voltage transformers.

The combination of Vycor glass tubing, used in most Cold Cathode lamps, and sturdy electrode construction make lamp life considerably longer than other types of lamps. Good ultraviolet maintenance is provided at lower temperatures and lamp life is unaffected by frequent starts.

Although the amount of radiant energy at 253.7nm wavelength emitted is the same for both high and low ozone lamps, the high ozone lamps use a special Vycor glass which transmits a controlled amount of radiation at 184.9nm, which wavelength produces ozone. Ozone has deodorizing properties and is in itself a bactericidal and fungicidal agent. However tests have shown that the Ozone has a negative health effect if used indoors so the use of Ozone producing lamps is not recommended for most applications.

The Vycor glass Cold Cathode ultraviolet germicidal lamp is the most economical type for the majority of general germicidal applications, because of its long life electrode and good glass maintenance.

Hot Cathode Germicidal UV Lamps

The Hot Cathode Germicidal UV Lamps are similar in their operation to the standard fluorescent lamps. The Hot Cathode lamp operates from a ballast or transformer and requires a device such as the glow switch starter to preheat the electrodes in order to

start the lamp. The electrodes, located at the ends of the lamp, are tungsten filaments coated with emission material and, under normal operation, govern the life of the lamp. In view of the fact that the life of the electrodes is shortened by frequent starts, the lamp life is rated according to the number of times the lamp is started. Operation at refrigerator temperatures may result in excessive lamp blackening and rapid depreciation in ultraviolet output. Starting of the Hot Cathode lamps at low temperature is sometimes unreliable and may require special equipment.

Slimline Germicidal Ultraviolet Lamps

The Slimline Germicidal Ultraviolet Lamp is an instant-start lamp, similar to the Slimline fluorescent lamp. The Slimline lamps are available in low, high and very high ozone types. The lamp life is governed by the electrode life and number of starts.

Because of their high initial ultraviolet emission and good maintenance, Slimline Germicidal ultraviolet lamps are well adapted for applications such as indirect air irradiation, conveyor lines, surface sterilization and other applications which require high intensity lamps.

High Output Germicidal UV Lamps

The most recent addition to the UV lamp line of products is the type of High Output germicidal UV lamps. The HO lamps are the consequent result of constantly applied know-how and the latest lamp manufacturing processes. High UV output over a great temperature spectrum, a long life and good behavioral patterns are the pointers for the High Output UV lamps. Only high quality raw materials are used in the lamp production. A fine tuning with the automatic electronic ballasts guarantees the lowest tolerance and a maximum UV stability.

With life duration of 12,000 hours and almost linear performance degradation the high output UV lamps are setting the standards for the development of high performance UV technology.

The most important factor in using germicidal UV lamp technology is the knowledge about their behavior under real working conditions (e.g. the effect of air stream cooling). It is definitely not just the lamp performance under laboratory conditions that count. Only in gaining this knowledge high quality disinfecting technology can be achieved.

Taking the example of air stream cooling the High Output lamps do show their real advantage. While classic UV lamps heavily depreciate under real working conditions inside an air duct, this is not the case with the High Output UV lamps.

Light Emitting Diodes (LED) UV Lamps

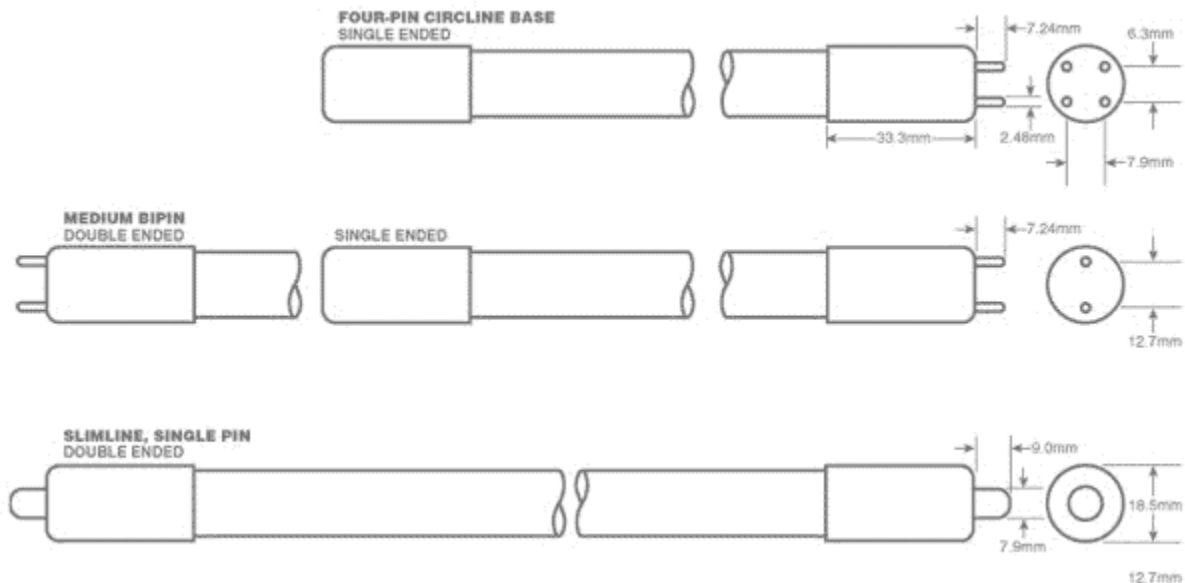
Recently a completely new technology for UV production started to emerge. This is the UV Light Emitting Diodes or UV LED lamps. The UV LEDs are the next generation UV producing devices that will compete with the established UV lamps. Some researchers claim that the UV LEDs have better characteristics surpassing the regular UV lamps. However at this time there is no UV LED equipment that can compete with the high output UV lamps in real world production conditions.

Lamp Shapes and Lamp Connectors

There are many lamp shapes: cylindrical lamps - like a glass tube, circular tube, multi-coiled tube lamps, U-shaped lamps, double tubes or by-axial lamps. The UV LED lamps are much smaller than the regular lamps and can be installed in spaces that do not permit installation of regular lamps.

All lamps are powered by ballasts that provide the starting electrical voltage to ionize the gas in the UV lamp and then limiting the current to the nominal level. Lamp ballasts can be either magnetic or electronic. The LED UV lamps do not require ballasts for their operation.

The lamps have different types of connectors at one or both ceramic ends. The connectors can be single-pin, double-pin or four-pin. The single and double pin connectors are located on both ends of the lamps, while the four-pin connectors are single connectors at one end of the lamp.



UV Lamps Aging

The decrease in UV lamp output over the typical lifespan of 8,000 - 12,000 hours can vary between 15-40%. The manufacturer should be consulted for information on the end-of-life output of UV lamps. The decrease in UV output should be accounted for in the design phase such that the lamp output does not decrease to a point where the air treatment system becomes ineffective. The most conservative approach is to size the system based on the end-of-life of the lamp UV output. Selecting lamps based on end-of-life UV output will avoid the lamps aging problem.

The lamps should be kept clean and free of dust at all times. If dust accumulates on the lamp it will absorb the UV and convert it to heat, therefore lowering the effectiveness of the UV lamp. Appropriate filtration of the air prior to the UV lamps is recommended.

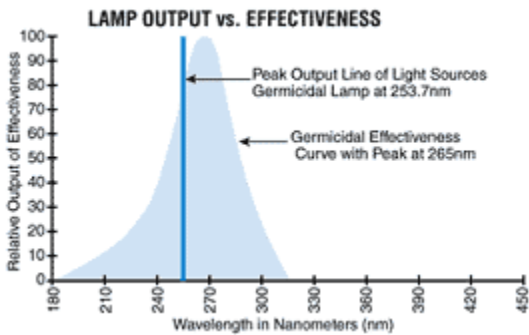
Germicidal ultraviolet lamps emit radiant energy in 253.7nm (C-Band ultraviolet or UVC) wavelength. The UVC energy photo-chemically reacts with the DNA and RNA of microorganisms - viruses, bacteria, mold and spores - sterilizing them. Germicidal UV lamps have an effective life of approximately 8,000 - 12,000 hours continuous use. American Air & Water, Inc. offers a 1 year pro-rated warranty on all germicidal UV lamps.

[More UV lamps information »](#)

The lamp will continue to emit blue light well after 12,000 hours, however their germicidal output deteriorates rapidly after that. For maximum germicidal effectiveness American Air & Water strongly recommends **annual lamp replacement**.

Lamp Length	Lamp Model	Lamp Description	Type UV Lamps	Lamp Base	UV Output	UV Intensity $\mu\text{W}/\text{cm}^2$ @1m
6"	GML370	Hot Cathode Lamp	PL-S9W/TUV	PL-S	2.4W UV	-
	GML180	Hot Cathode Lamp	G 4T5	T5/mini bi-pin	0.5W UV	5.4
	GML170	Hot Cathode Lamp	OZ4T5	T5/mini bi-pin	0.5W UV	5.4
9"	GML195	Hot Cathode Lamp	G 6T5	T5/mini bi-pin	1.0W UV	11
	GML190	Hot Cathode Lamp	OZ 6T5	T5/mini bi-pin	1.1W UV	11
12"	GML205	Hot Cathode Lamp	G 8T5	T5/mini bi-pin	1.6W UV	17
	GML125	Slimline Lamp	G12T5-1/2L/BP	T5/mini bi-pin	6.0W UV	66
	GML075	Slimline Lamp	G12T5-1/2VH/BP	T5/mini bi-pin	6.0W UV	66
	GML405	High Output Lamp	GPH357T5L/HO	Four-pin	8.5W UV	92
14"	AAWHO/14	High Output Lamp	GML600	Four-pin	12W UV	106
	UV Bulb HO	High Output Lamp	UVHOAL300AV/14	Four-pin	12W UV	106
16"	GML020	Cold Cathode Lamp	782 L 10	T5/single-pin	2.8W UV	28
	GML120	Cold Cathode Lamp	782 VH 10	T5/single-pin	2.8W UV	28
	GML060	Slimline Lamp	G10T5-1/2L	T5/single-pin	5.3W UV	55
	GML350	Slimline Lamp	G10T5-1/2L-4P	T5/four-pin	5.3W UV	55
	GML070	Slimline Lamp	G10T5-1/2VH	T5/single-pin	5.3W UV	55
	GML430	High Output Lamp	GSL406T5L/HO	Four-pin	10.0W UV	108
18"	GML210	Hot Cathode Lamp	G15T8	T8/medium bi-pin	3.6W UV	38
	GML215	Hot Cathode	G25T8	T8/medium bi-	5.0W UV	54

		Lamp		pin		
	GML410	High Output Lamp	GSL406T5L/HO	Single-pin	10.0W UV	100
22"	HOAL/22	High Output Lamp	GPH550T5/HO	Four-pin	18.1W UV	174
24"	GML435	High Output Lamp	GPH610T5L/HO	Four-pin	16.2W UV	175
	GML025	Cold Cathode Lamp	782 L 20	T5/single-pin	5.5W UV	52
27"	GML290	Cold Cathode Lamp	782 VH 20	T5/single-pin	5.5W UV	52
	GML325	Slimline Lamp	GSL591	T5/single-pin	-	-
	GML355	Slimline Lamp	S24T5-4P	T5/four-pin	-	-
	GML415	High Output Lamp	GSL610T5L/HO	Single-pin	16.2W UV	140
30"	GML030	Cold Cathode Lamp	782 L 25½	T5/single-pin	7.3W UV	75
	GML010	Cold Cathode Lamp	782 L 30	T5/single-pin	8.3W UV	73
	GML035	Cold Cathode Lamp	782 VH 29	T5/mini bi-pin	9.1W UV	80
	GML040	Cold Cathode Lamp	782 VH 30	T5/single-pin	5.2/8.3W UV	46 / 73
	GML220	Hot Cathode Lamp	G30T8	T8/medium bi-pin	8.3W UV	85
36"	GML005	Slimline Lamp	G36T6L	T5/single-pin	13.8W UV	120
	GML100	Slimline Lamp	G36T6L-4P	T5/four-pin	12.7W UV	110
	GML090	Slimline Lamp	G36T6VH	T5/single-pin	13.8W UV	120
	GML095	Slimline Lamp	G37T6VH	T5/single-pin	15.2W UV	124
	GML420	High Output Lamp	GSL843T5L/HO	Single pin	25.0W UV	195
	GML440	High Output Lamp	GSL843T5L/HO/4	Four-pin	25.0W UV	195
48"	GML425	High Output Lamp	GSL1148T5L/HO	Single pin	36.1W UV	250
	GML445	High Output Lamp	GSL1148T5L/HO/4	Four-pin	36.1W UV	250
	GML017	High Output Lamp	GXO64T5L H/O	Single-pin	46.0W UV	370
64"	GML015	Slimline Lamp	G64T5L	T5/single-pin	26.7W UV	190
	GML140	Slimline Lamp	G64T5VH	T5/single-pin	26.7W UV	190



	GML270	Slimline Lamp	G64T5L-4P	T5/four-pin	26.7W UV	190
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If you need assistance finding the right model replacement UV lamp, please contact us at 888-378-4892 or info@americanairandwater.com

Note: UV lamps contain mercury therefore must be properly disposed of as a hazardous waste in accordance with local, state and federal regulations or the lamps should be recycled. Please dispose of the used UV lamps properly or send them to American Air & Water and we will collect and send the lamps to a lamp recycling facility.

[UV lamps information »](#)

High Output Germicidal UV Lamps

The GML High Output germicidal UV lamps are specially designed to produce the highest amounts of UV radiation - above 90% of the total rated energy is at 253.7nm. This is the most lethal wavelength to microorganisms (see graph).

GML HO germicidal lamps are used extensively in air and surface purification applications in the food processing and beverage industries as well as medical and laboratory sterilization applications.

These lamps are specifically designed for air and surface irradiation in HVAC systems. They are an ideal choice for mounting close to the coil and drain pan areas to inhibit the growth of mold and mildew in these areas.

[Print UV Lamps Specs »](#)

