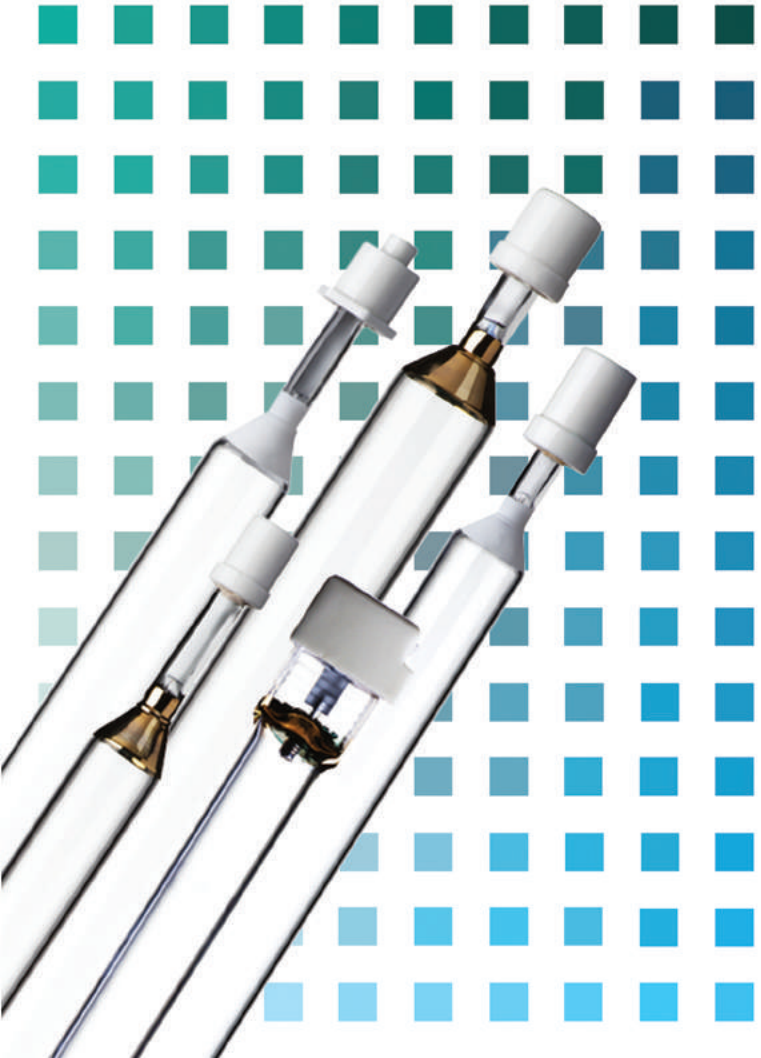

ALPHA-CURE

Specialists in UV Technology

# ULTRAVIOLET LAMP TROUBLESHOOTING GUIDE

# UV TECHNOLOGY GLOSSARY

**GLOBAL OFFICES:**

UNITED KINGDOM – CHINA – AUSTRALIA – FRANCE – GERMANY


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# ABOUT US

Established in 1996 Alpha-Cure is committed to delivering industry advancements in ultraviolet lamp design and technology, in partnership with leading system manufacturers throughout the world. Our dedicated R&D departments continuously develop and introduce new and improved products to our extensive portfolio, ensuring the highest level of customer satisfaction and support.

By 2005 the company had expanded considerably enabling a second sales and manufacturing facility in China. Since the birth of Alpha-Cure Asia, production output capabilities have doubled, facilitating around the clock working and dispatching from both sides of the globe.

In January 2013 Alpha-Cure increased the size of its R&D department with the recruitment of two new graduate UV R&D engineers and a brand new research & development lab.

# PRODUCT PORTFOLIO

We're proud to have gained global recognition for delivering the highest quality product, each lamp individually handmade, developed using the most advanced components and cutting-edge manufacturing processes.

Our product range includes bespoke lamp designs to meet our customer's exact requirements with vast selections of ceramic and metal end caps and lead terminations. Power outputs range from 80W/cm, up to 550 watts per cm with arc lengths of up to four metres.

Manufactured utilising the highest grade vacuumed baked quartz available in the market, ultra-high purity noble gases and mercury reaching levels of 99.995%, our customers recognise Alpha-Cure as worldwide experts in our field.



# OVERVIEW - BAD UV CURING RESULTS

When a UV lamps stops curing within the UV system, it's generally down to a number of common occurrences. These general issues result in decreased output of UV light intensity, primarily due to the deterioration of the lamp and the transparency of the quartz body.

UV radiation can no longer pass through the quartz wall, due to devitrification and the deteriorated electrodes are no longer capable of sparking a plasma arc. Longer wavelengths transmit through the quartz body fairly easily but shorter wavelengths are absorbed in ageing or poorly maintained UV lamps.

# ULTRAVIOLET LAMP - TROUBLESHOOTING GUIDE




# DEVITRIFICATION/ CLOUDING

## PROBLEM:

The basis of natural "devitrification" occurs when quartz converts back into a crystalline structure which acts as a very poor UV transmitter. This process occurs after surface contamination and is accelerated when the UV lamp becomes too hot. Devitrification appears as many white spots on the surface of the quartz body, which causes a reduction of quartz transparency to UV light.

## PREVENTION:

- Ensure lamp is clean before running the lamp and operated in a dust free environment
- Ensure lamp is run at correct volts and amps and that the UV system is properly cooled




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# MIRROR COATING

## PROBLEM:

Over-cooling results in a combination of tungsten from the electrode and mercury, condensing onto the inside of the lamp ends giving it a mirror coated effect.

## PREVENTION:

- Alpha-Cure's UV lamp ends are coated with heat reflective materials such as; gold, platinum, silver & white paint, to keep the lamp shoulders hot. Contrary to popular belief white paint is actually the best reflective coating to retain heat within the lamp
- The system is producing too much cool air that isn't being properly circulated evenly along the length of the lamp. Remember to keep lamp shoulder temperature above 600°C
- The UV lamp is not running at the correct power for prolonged periods, UV lamp operators should seek professional advice in this instance




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# BLACK ENDS/ ELECTRODE EROSION

## PROBLEM:

Although tungsten has a high melting point, natural "blackening" occurs during the lifetime of a UV lamp, due to very high arc temperatures operating between each electrode. During normal operation the electrodes start to erode and the tungsten material starts to sputter depositing on the inside of the quartz body. When the transparency of quartz body is compromised, UV output potential is significantly reduced.

## PREVENTION:

- Alpha-Cure uses a "special material" coating on the end of the electrode to prolong the life of the electrodes
- This process can be avoided by simply not switching the UV lamp on and off in between print runs, the biggest surge of current (increased loading) on the electrode happens at ignition. To avoid this, most UV system manufacturers design a standby mode, which means keeping the lamp running at 50% (and increasingly lower than this) even when not in use during the production shift, to avoid switching the lamp on and off (power cycling)






# BOWING/ DEFORMATION

## PROBLEM:

The UV Lamp has overheated due to poor air circulation within the UV System, this is more common with longer lamps due to increased requirement for airflow across a larger surface area. Overheating of the lamp body softens the quartz which starts to sag under gravity or deforms from pressure differences.

## PREVENTION:

- Keep lamps below 850°C
- Adjust airflow and cooling around the lamp, ensure your cooling system is fully functioning
- If possible to do so, rotate the UV lamp by 180° weekly




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# EXTERNAL CONTAMINATION

## PROBLEM:

External contamination of a UV lamp happens when foreign contaminants such as finger prints or spray from powders, paper dust and ink, stick onto the outside surface of the quartz body. Sometimes contamination even occurs where the system reflector itself has come into direct contact with the lamp. These contaminants cause detivtrification (recrystallization) on the quartz body, as such UV radiation is no longer able to pass through.

## PREVENTION:

- Clean UV lamps frequently using isopropanol wipes
- Always wear gloves when handling lamps and exert caution whilst cleaning and changing them




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# CAP & SEAL DAMAGE

## PROBLEM:

If a UV lamp is exposed to a current overload, or excessively high temperatures, the electrical connection can break down. Over current situations are generally due to power supply faults, not a fault in the lamp design itself. The electrical connections at the end of each UV lamp are designed to withstand temperatures of no more than 250°C. This problem causes electrical arching between the lamp and the lamp holder, which can result in a hole being burnt through the cap, destroy the lamp and potentially even damage the UV system.

## PREVENTION:

- Ensure the right UV lamp is chosen for your power supply and that the power supply is operating correctly
- Keep ceramic cap and seal below 250°C
- Ensure the lamp is correctly placed within the lamp head

Inspect caps for damage before placing into the system




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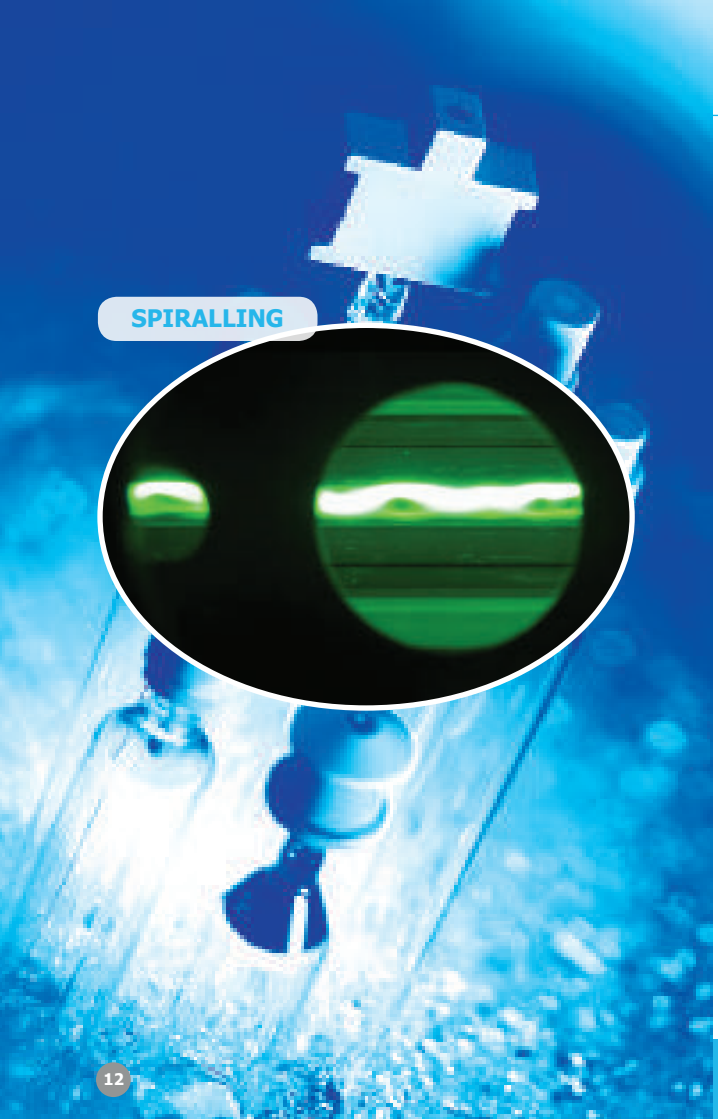
# CONTAMINATED AIRFLOW

**PROBLEM:**

In compressed air cooling systems, airflow contamination occurs, this causes spot devitrification, donated by the alignment of the cooling holes within the uv system reflector.

**PREVENTION:**

- Ensure compressed air is suitably clean and dry



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# SPIRALLING

## PROBLEM:

Spiralling is when the plasma arc is no longer wall stabalised. The plasma arc spirals out of control, repeatedly hitting the inside surface of the lamp body, softening the quartz.
Risk of spiralling is higher when:

- Running a lamp on a constant wattage transformer (with secondary series capacitors)
- More prevalent on lamps over 1m in length
- The UV lamp in the system is not a standard mercury but a doped lamp (gallium or iron)
- The lamp operates at a higher voltage

## PREVENTION:

- If this is a common occurrence, consider changing the transformer




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# LEAKING

## PROBLEM:

In the unlikely event the UV lamp doesn't strike out of the box, it is possible this is due to leaking – which means air is entering into the lamp envelope. The only way to confirm this technical issue, is by using a high frequency lamp tester. A constricted purple or blue arc, or no discharge at all, indicates there may be a small leak in the seal, which is unlikely to be visible to the naked eye.

## PREVENTION:

- Sadly no prevention, return lamp to manufacturer




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# DIRTY/DISTORTED UV REFLECTORS

## PROBLEM:

There are many different types of reflectors installed in various UV systems, from plain aluminium to extrusions, fabrications and dichroic coatings. Around 60% of UV radiation that hits the substrate is actually reflected UV, loss of radiation causes significant loss of UV curing results. As such it is imperative that system reflectors are maintained and cleaned regularly. Poorly focused / distorted reflectors are also a very common reason for UV systems failing to cure.

## PREVENTION:

- In most circumstances cleaning your system reflectors regularly with alcohol / isopropanol wipes will ensure good UV reflection
- If 100% certain your UV reflector is not coated or polish finished such as dichroic reflectors, you can use an abrasive rubber block to gently remove the dirt
- If UV reflectors are beyond cleaning or misshapen they must be replaced immediately




# UV LIGHT BELOW FULL INTENSITY

## PROBLEM:

If UV light falls below full intensity, the UV lamp will not reach the necessary levels required for the curing of inks, adhesives and varnishes. Similarly with other processes such as the disinfection of air and water or surface treatment.

## PREVENTION:

- Many of the UV lamp troubleshooting issues mentioned within this technical guide, will cause UV light intensity to fall below full intensity
- To ascertain if the UV lamp is not producing full intensity UV light, perform a simple test with UV test strips




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# UV LAMP TRIPPING OUT

## PROBLEM:

Lamps operate at high voltages, if they are too close to any metal work or humidity is high, an earth fault can occur, as the arc jumps to ground. Most control systems will instantly trip out.

## PREVENTION:

- Ensure the lamp is correctly positioned
- Check UV reflectors are not distorted/too close to the lamp body




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# INKS/COATINGS ADHESIVES - POORLY FORMULATED

## PROBLEM:

Ultraviolet curable inks, coatings and adhesives when not properly mixed can lead to unequally distributed photo-initiators, which can negatively effect the curing results.

## PREVENTION:

- Ensure all UV inks, coatings, adhesives are mixed thoroughly before application so that the photo-initiator is uniformly dispersed




ULTRAVIOLET LAMP TROUBLESHOOTING GUIDE

# HOW TO ENHANCE THE LIFETIME OF A UV LAMP

## PROBLEM:

Natural degradation of UV output occurs during the lifetime of a lamp. There is no significant natural loss however of UV output / degradation under 1,000 operating hours. Apart from ensuring a UV lamp is purchased from a top quality manufacturer, the lifetime of a lamp is very much dependent on the environment in which it is ran.

## PREVENTION:

- A consistent maintenance programme and the right operating environment can dramatically increase the lifetime of UV lamps. Under ideal operating conditions customers have reported gaining an additional 4,000 - 6,000 operating hours by simply following a rigorous lamp and UV system maintenance programme
- Lamps should be replaced after 1000-1500 hours depending on the application and industry. Some industries such as cosmetics and pharmaceuticals religiously change lamps every 1000 hours, as they cannot risk loss of UV intensity. To measure loss of UV intensity use UV sensitive labels, test strips, or in more detail using instruments such as UV power maps

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# ULTRAVIOLET TECH GLOSSARY

A comprehensive list of UV industry related terms and their definitions.

## CONTENTS

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## ULTRAVIOLET TECH GLOSSARY

### CONFORMAL COATING:

A protective non-conductive dielectric layer that is applied onto the printed circuit board assembly to protect the electronic assembly from damage due to contamination, salt spray, moisture, fungus, dust and corrosion caused by harsh or extreme environments.

### DEVITRIFICATION:

Crystallisation of a formerly non-crystalline (amorphous) glass such that its ability to transmit a range of electromagnetic radiation (e.g. UV) is greatly reduced.

### DICHROIC:

Describes materials with the property to selectively reflect or transmit a particular wavelength range. Dichroic UV reflectors that reflect less long wavelength radiation such as IR are called “cold mirrors” while those that reflect more are called “hot mirrors”.

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# ULTRAVIOLET TECH GLOSSARY

## DIELECTRIC:

An electrical insulator that can be polarised by an applied electric field.

## DIELECTRIC STRENGTH:

The maximum electric field a material can withstand intrinsically before it breaks down and becomes a conductor of electricity.

## DISCHARGE TUBE / UV LAMP

Is a lamp envelope containing electrodes, a starting gas that is ionised by an electric field and other additives. The additive atoms / ions are excited to high energies and emit a UV photon as they return to their ground state.

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## ULTRAVIOLET TECH GLOSSARY

### DOPED LAMP:

Also known in the industry as a metal halide lamp, contains an additive, such as gallium or iron, to alter the spectral output in order to cure different types of inks / coatings / adhesives.

### ELECTRIC ARC:

An electric current involving an ionised gas, such as argon, leading to the formation of a plasma arc.

### ELECTRIC FIELD:

In simple cases, the electric field between two points is the voltage between those points divided by the distance between them.

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## ULTRAVIOLET TECH GLOSSARY

### ELECTRICAL BALLAST / CHOKE / TRANSFORMER:

A device to prevent excess current into a lamp and can also assist in lamp ignition.

### ELECTROMAGNETIC SPECTRUM / RADIATION:

The entire range of all possible electromagnetic radiation. This includes gamma rays, X-rays, ultraviolet, visible light, infra-red, microwaves and radio waves.

### GROUND STATE:

The lowest energy state of an electron.

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# ULTRAVIOLET TECH GLOSSARY

## HALOGEN:

Chemical elements in Group XVII of the periodic table, including fluorine, chlorine, bromine, iodine and astatine.

## INFRA-RED (IR)

The band of the electromagnetic spectrum ranging between 750nm to 1mm.

## ISOPROPYL (ISOPROPANOL) ALCOHOL:

A colourless and relatively non-toxic alcohol. It evaporates quickly and can dissolve various oils, so is useful for cleaning quartz cooling tubes, UV reflectors and UV lamp bodies.

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## ULTRAVIOLET TECH GLOSSARY

### METAL HALIDE:

A chemical compound involving a metal and a halogen.

### MOLYBDENUM:

A silvery metal with the chemical symbol Mo and atomic number 42.
It has the sixth-highest melting point of any element. It is frequently used for making steel alloys as well as in the seal for UV lamps due to its relatively low thermal expansion and high electrical conductivity.

### NANOMETRE (nm):

A term used in industry to measure specific wavelengths of the electromagnetic radiation spectrum - One billionth of a metre, 1 millimetre = 1000th of a metre, 1 micrometre = 1000th of a millimetre, 1 nanometre = 1000th of a micrometre

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## ULTRAVIOLET TECH GLOSSARY

### NOBLE GASES:

Chemical elements in Group XVIII of the periodic table with similar properties such as being odourless, colourless and of low reactivity. This includes helium, neon, argon, krypton, xenon and radon.

### PHOTO-INITIATOR:

A compound that undergoes chemical reaction(s) when subjected to electromagnetic radiation.

### PHOTOPOLYMERISATION:

Is a process of reacting monomer molecules together in a chemical reaction to form polymer chains or three-dimensional networks.

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# ULTRAVIOLET TECH GLOSSARY

## QUARTZ:

A glass-like material made of silicon dioxide ($SiO_2$) with various different forms.
It has low thermal expansion and a very high melting point of around 1665°C.
The 'fused quartz' form transmits UV very effectively.

## SPECTRAL ENHANCEMENT:

Moving the electromagnetic radiation output of the UV lamp, by doping with certain additives. This may include increasing the intensity of the radiation, or shifting the range of wavelengths (nm) of the radiation.

## TRANSFORMER:

An electrical device used to step-up or step-down the voltage of alternating currents.

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## ULTRAVIOLET TECH GLOSSARY

### TUNGSTEN:

Is a chemical element with the chemical symbol W and atomic number 74. Tungsten and its alloys are used in numerous applications such as light bulb filaments, and it is used to make UV lamp electrodes owing to having the highest boiling point of any metal.

### TUNGSTEN ELECTRODES:

A conductor through which electricity enters a UV lamp.

### UV COATING:

Refers to treatment of a substrate with UV radiation to cure the surface or protect the underlying material from its harmful effects.

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## ULTRAVIOLET TECH GLOSSARY

### UV CURING:

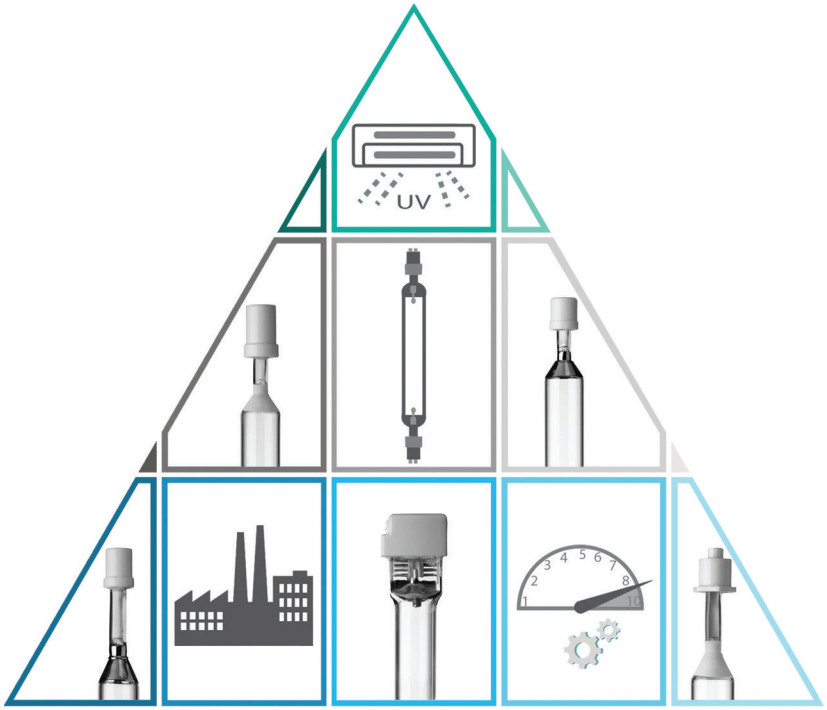
Is a photochemical reaction (photopolymerisation) when specialised coatings are exposed to UV light they cure, instead of relying on heat and time to evaporate carriers like in solvent-based coatings.

### WAVELENGTH:

A property of electromagnetic radiation – by altering the wavelength (nm) you can cure / disinfect various types of substrates.

### WEEE:

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) is the European Community directive 2002/96/EC on waste electrical and electronic equipment (WEEE).

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