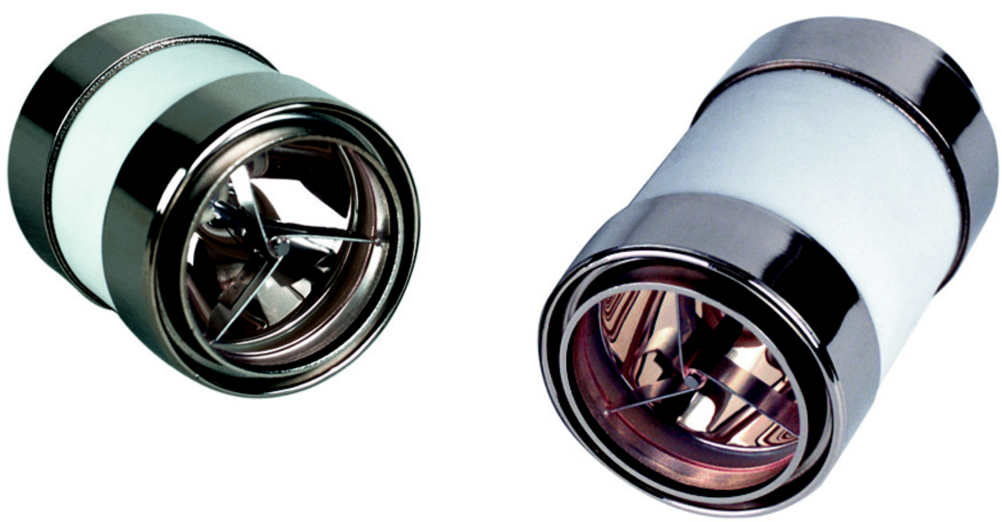
LUXTEL

A BRILLIANT CHOICE

CeraLux® Lamp
Technical Guide



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About CeraLux® Lamps

CeraLux lamps are short arc, high pressure, xenon lamps that have parabolic and elliptical reflectors integrated in the design. By having reflectors with this type of construction, our lamps can produce pre-aligned collimated or focused beams of high intensity white light. This white light is due to xenon gas' ability to emit UV, Visible and IR output that is closely matched to that of the sun (color temperatures of approximately 6000° K). The flat spectral output through these regions make them the best choice for visible applications and do not require color correction.

Compared to quartz type lamps, CeraLux lamps are safer because of the materials used and easier to work with due to the pre-focused reflectors. The rugged construction of these lamps incorporates high strength welds and brazed seals. They are designed for DC operation with instant "on" ignition. Unlike metal halide and mercury lamps, no warm-up time is required for the lamp to produce its superior white light. Another advantage is that no mercury or rare earth elements are used in our lamps, so there are no environmental or disposal issues.

CerLux xenon lamps from LuxteL have been designed to be exact replacement for existing ceramic xenon lamps, as well as optimized for the use of OEMs and other individual customers. They are used extensively in medical endoscopy, fiber optic illuminators, video projection, dental curing, dental bleaching and solar simulation.

The following sections will provide additional insights about the CeraLux brand of Ceramic Xenon Lamps. For additional information and product offerings visit our website at www.luxtel.net.

LAMP DESIGN

<u>Reflectors</u>
One of the key features of all standard CeraLux lamps is the reflector. Our reflector bodies are made of high grade alumina material and have a glazing that will produce and support a highly specular surface once coated. Reflectors are designed for collimated (parabolic) or focused (elliptical) output beams. The pre-determined location of the reflector focal points make it possible to precisely align electrodes within each reflector which leads to easy alignment of lamps in final use.

The alumina material can withstand extreme thermal and pressure loads. Metalized areas on the reflector support high strength braze seals between the ceramic and mating metal parts and are capable of withstanding tensile loads in excess of 10,000 psi.

CeraLux reflectors are coated with either silver or aluminum. Silver is the most common due to xenon lamps wide use in visible applications and the better reflectance of silver through the visible wavelengths. Aluminum is used on UV lamps due its improved reflectance in the wavelengths below 350 nm. Reference Figure 1 for reflectance comparison.

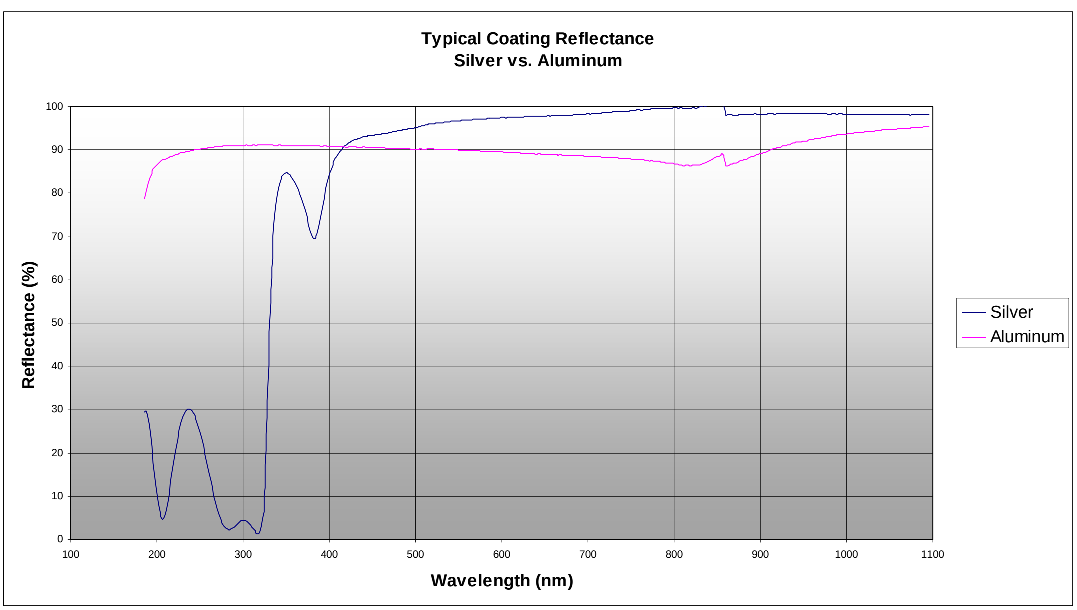


Figure 1

Coatings

A UV block coating is used on the window to filter unwanted UV output. Filtered lamps are designated by a F after the body size/type. (example: CL 300BF). The typical transmission of a UV coated window is shown in Figure 2.

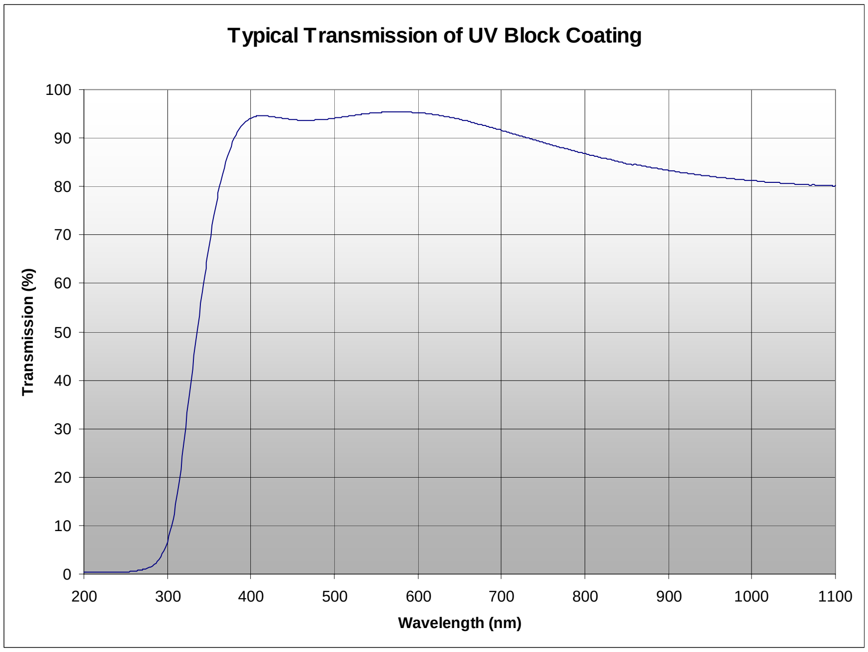


Figure 2

If it is desired to eliminate the infra-red (IR) output of the lamp, there are several options including the use of cold mirrors (IR passes through) or hot mirrors (IR is blocked). In the case of hot mirrors or other filters that may direct energy back into the lamp, precautions need to be taken for proper cooling. Thermal damage can be done to internal components if this energy is “added” back into the lamp. Consult LuxteL engineering for assistance to ensure proper operation. The transmission of a typical IR filter is shown in Figure 3.

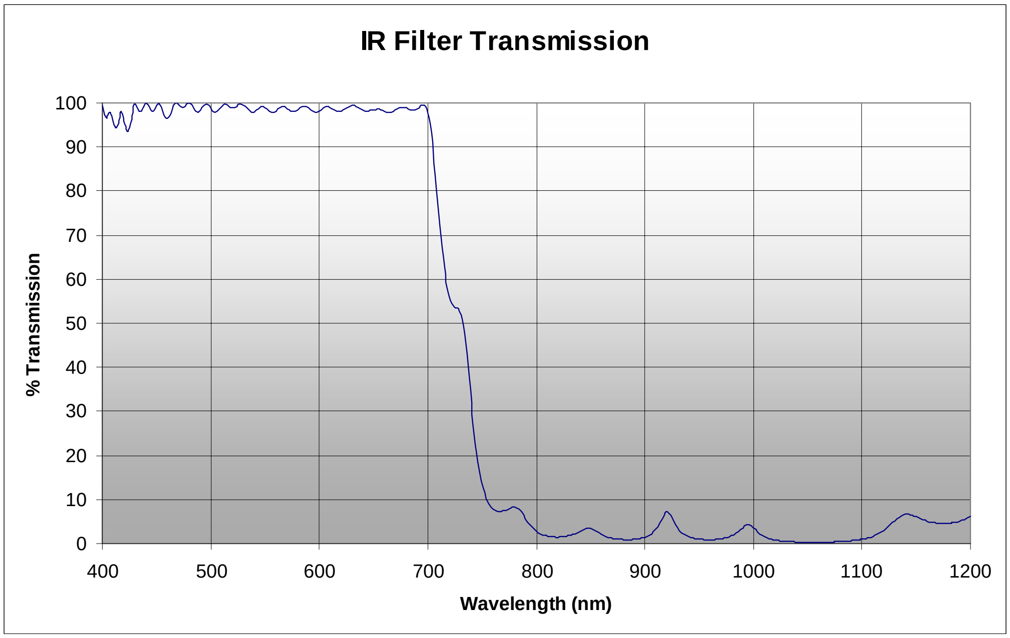


Figure 3

Electrodes

Lamp electrodes are made of tungsten, due to their high temperature and vapor pressure requirements. The electrodes must be capable of withstanding operating temperatures in excess of 1000° C.

The cathode is made of a doped tungsten to provide a low work function and promote the thermionic emission of electrons. Temperatures at the cathode tip are typically around 2000° C. The cathode tip is conical or pointed to provide a directed flow of electrons and allow for a more controlled arc origination. In some applications it is necessary to incorporate a groove (heat choke) near the cathode tip to assure the cathode tip maintains an adequately high tip temperature. Due to the elevated temperatures and energies, the cathode tip will erode and deteriorate over time.

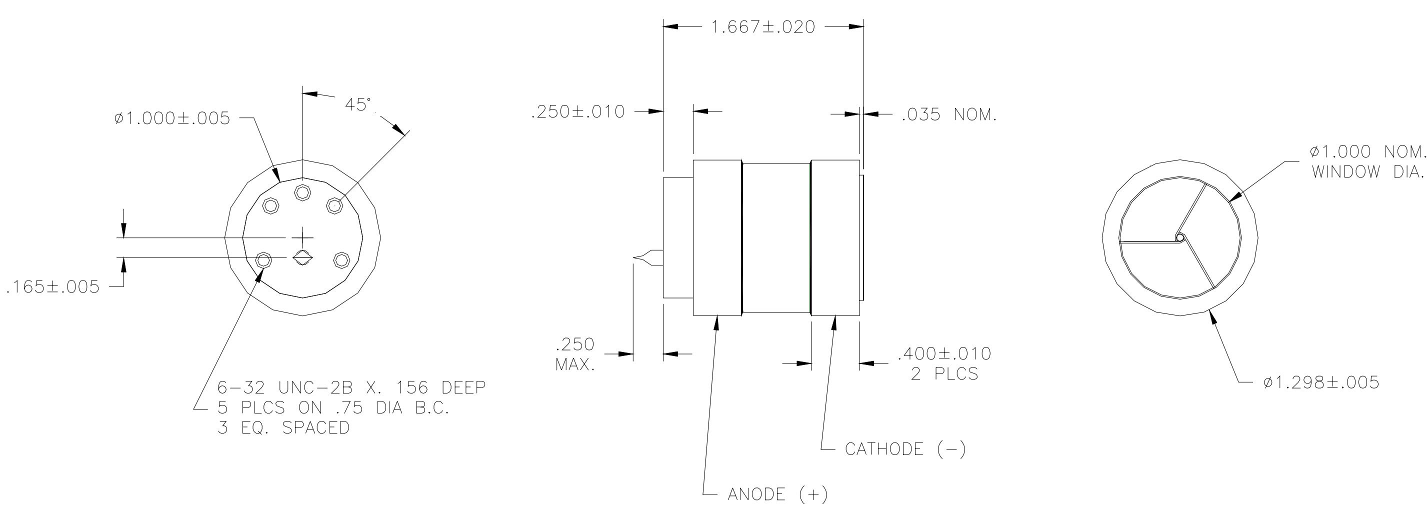
Anodes are made from pure tungsten and are larger due to the need to dissipate the thermal energy received by the arc. Typically, increased heatsinking is required on the anode end of the lamp - in the form of the lamp base and/or size of heatsink.

Construction/Hermetic Seals

CeraLux lamps incorporate several widely accepted and optimized seal techniques. They include high temperature brazing, welding and cold weld (pinch off) technology.

High temperature brazes are used for metal to metal, metal to ceramic and metal to sapphire seals. The sapphire and ceramic brazes are possible after the surfaces to be brazed have been coated and sintered with refractory materials. This type of brazing technology has been used for decades and promotes seal strengths in excess of 10,000 psi.

Some metal components are joined by means of tungsten inert gas (TIG) welding. This is done by actually melting the base metals in a controlled environment and letting it reform into a new solid state. The last seal is the cold weld or pinch off. This is when the fill tube of the lamp is compressed after filling the lamp to the proper gas fill pressure. Care should be taken because the pinch off tube is very sharp. This seal area should not be disturbed and care taken not to release the lamps' internal pressure by inadvertent damage.



Outline of Typical "B" Body Lamp

Window
The window of the lamp is a single crystal sapphire. Sapphire is used for its ability to be brazed, low coefficient of thermal expansion, good thermal conductivity and transmission properties. Typical sapphire transmissions are shown in Figure 3.
LuxteL uses a UV grade sapphire, meaning it shall not "brown" or discolor when exposed to UV radiation.

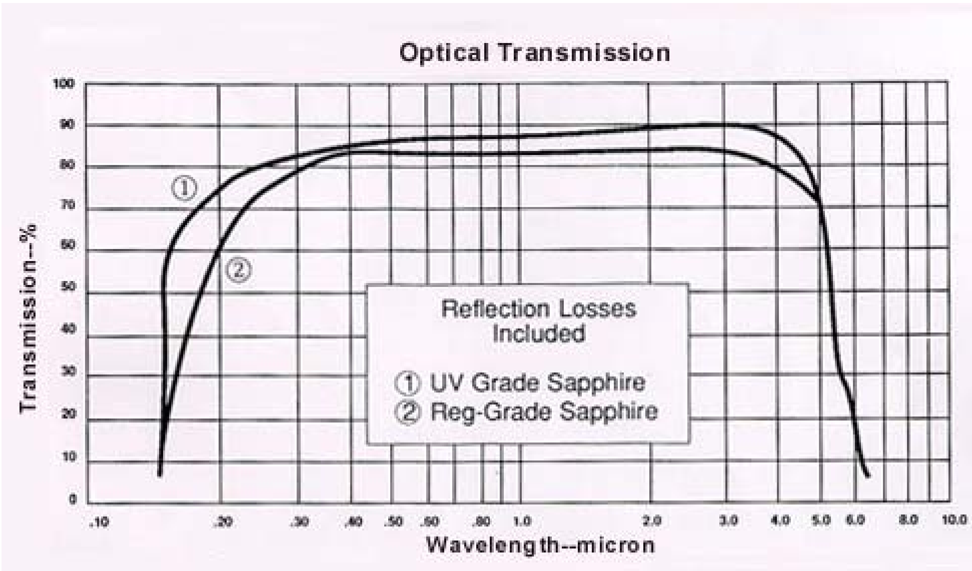


Figure 3

OPTICAL CHARACTERITICS

Spectrum
CeraLux lamps, like most DC xenon lamps, have a very stable spectrum. When the UV coating is applied to the window, the output below 300nm will not be present as previously shown. With a color temperature of 6000º K, it closely matches the spectral distribution of the sun. Figure 4 shows the relative spectral distribution of a filtered lamp.

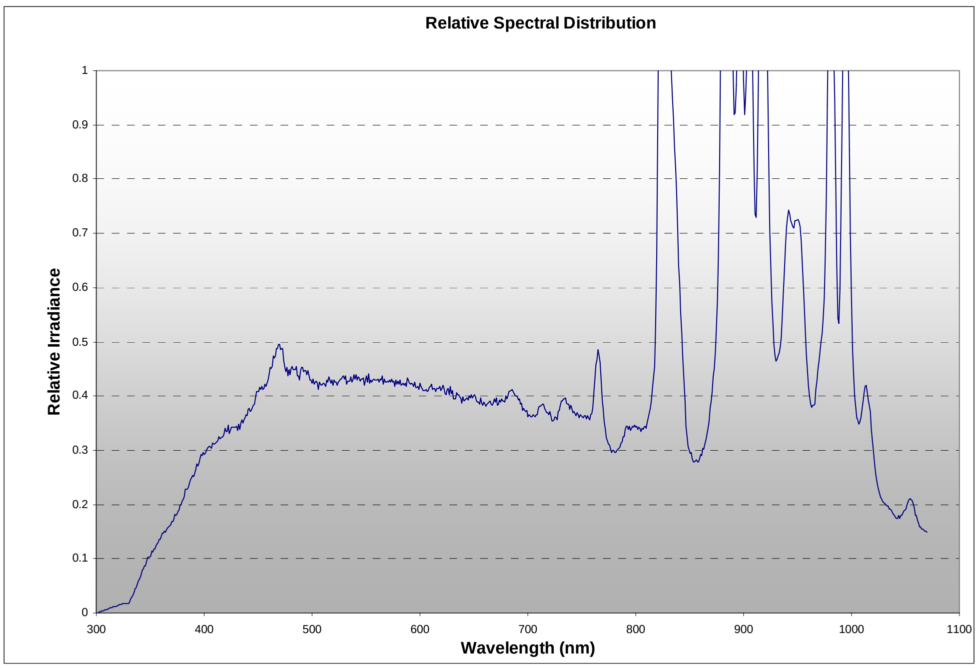


Figure 4

The Coloring Rendering Index (CRI) for xenon lamps is typically greater than 95, which allows CeraLux lamps to very accurately render colors as compared to daylight. These properties of spectrum and balanced light are typically independent of lamp power and life when operated within rated power ranges.

SAFETY

Ozone Generation
Xenon lamps produce radiant energy from approximately 140 nm to well into the infrared region. With a sapphire window that is capable of transmitting in the region of the UV wavelengths, ozone gas can be generated. Ozone is a gas that is produced by UV energy acting on oxygen (O_2), converting it to O_3. Ozone is toxic and can cause severe health problems if inhaled for long periods of time.

CeraLux lamps can suppress the production of ozone with the use of UV block coatings on the lamp window. To avoid ozone, or if UV wavelengths are not desired, select a filtered “F” lamp. If UV versions of lamps are chosen, they must be operated in an inert atmosphere or with the use of proper air exhaust or filtration. Consult your local safety and health guidelines on the limits of ozone exposure.

High Pressure
CeraLux lamps are filled to very high pressures, often greater than 200 psi at room temperature. This is why care and eye protection should always be exercised when handling lamps. Explosion hazards are possible, and most likely only when in operation. Failure to properly cool lamps is the most common cause of lamp failures. Internal lamp pressures can double under normal conditions and greatly exceed that if improperly cooled.

Light Levels
Skin and eye damage can occur due to the UV and IR output of xenon lamps. Whenever possible, use a filtered, “F” non-UV lamp. UV blocking eye protection should be worn when using lamps that produce UV radiation. Never look directly into a lamp or get in the path of the output beam. Severe burns and eye damage can occur even after output has been coupled into a fiber guide or other system optics.

Thermal
Never touch a lamp during operation. Lamp surfaces can reach upwards of 200º C. Secondly, due to the IR output of the lamp, it is capable of producing severe burns. Exercise caution with output of lamps at all times and never handle a lamp until is has cooled.

High Voltage
High voltage hazards are presented by the ignition and boost voltages needed to start the lamps. Ignition voltages typically are in excess of 20 kV and may be as high as 40 kV. Carefully read all operation manuals when lamps are used in OEM lightsources before servicing.

Disposal
CeraLux lamps contain no hazardous materials such as mercury or rare earth elements. Lamps may be disposed of safely once the internal pressure of xenon is released.

To release internal pressure, do the following:
1. Wear safety glasses.
2. Firmly grasp the lamp and cut or twist the pinch off seal at the rear of the lamp. The gas will be heard escaping.
3. The lamp may be disposed in normal trash.

OPERATIONAL GUIDELINES

Cooling

Thermal compound **must be used** between mating areas of the lamp and heatsink surfaces to assure the best possible heat conduction without arcing. Absence of thermal grease and improper installation of lamps in heatsinks result in the majority of failed lamps during operation. Refer to LuxteL instructional guides for proper installation of lamps and heatsinks.

Adequate cooling is the single most effective way to increase lamp life. Forced air-cooling is the most effective method for lamps operated under 300 watts. Proper cooling is easy with the use of aluminum heatsinks available from LuxteL. These heatsinks also act as the electrical connections.

An adequately cooled system will produce lamp temperatures under 150º C. The hottest part of the lamp is the top center of the ceramic body. Unlike some other lamp types, CeraLux lamps are not affected by overcooling. Therefore, reducing the lamp temperature and system temperature will extend its useable life.

Connections

Electrical connections are easily made when using LuxteL heatsinks. The heatsinks mount directly to the lamp, are placed in a UL 94 V0 rated nylon housing and secured with brass connectors. These brass connectors are chosen to accept standard high current banana jacks or their equivalent. Many models of LuxteL lamps are designed with threaded mounting holes in rear (anode end) of the lamp. When using the mounting holes, the heatsink can be mated with the rear of the lamp for thermal transfer and electrical connection. Care must be taken at all times to avoid damage to the pinch off seal at the rear of most lamps.

If not using LuxteL brand heatsinks, care should be taken to not apply excessive clamping force to the outer bands or window area of the lamp. Enough force should be applied such that the lamp cannot be rotated. No clamping forces should be applied to the ceramic portion of the lamp. Reference individual lamp data sheets for additional further information.

Lamp Stability

One of the observable effects of arc wander is called “flicker”. This is the slight movement of the arc on the cathode surface. This movement may be sudden quick changes or take a more modulated form (20-40 Hz). The resulting peak to peak instability is typically less than 5% and is related to total lamp output. A more severe case of flicker, called “flashing” or “flaring”. This is when the output changes to a different level for a short period of time (typically a few seconds) and then returns. It is caused by the arc moving to a another area on the cathode due to a preferred emissive spot or possibly due to damaged areas of the cathode.

The most noticeable effect that takes place in a lamp is “shimmering”. The convection currents created by the xenon gas within the lamp cause refraction of light and movement of the arc column. Shimmer can be removed in applications where the output is mixed or fed into an integrator.

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