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Arc Lamp Housing

OPERATION MANUAL



Photon Technology International

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Arc Lamp Housing

OPERATION MANUAL

Photon Technology International

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PTI Standard Instrument Warranty

Warranty Period and Extent

Photon Technology International (PTI) warrants that its instruments will be delivered in a functional state and free from defect, and will meet stated specifications for a period of one (1) year. The warranty period will start on the date of shipment by PTI. In case of systems that include installation by PTI, the warranty will start from the date of installation or thirty (30) days after the shipping date, whichever is earlier.

This warranty is in lieu of all other warranties, expressed or implied, including, without limitation, the implied warranties of merchantability and fitness for a particular purpose, nor will PTI provide training on its use free of charge. PTI shall not be responsible for any liability, loss or damages, caused or alleged to be caused, by the system, as a result of use or operation including, without limitation, consequential damages and loss of profit.

Specific Exclusions and Limitations

1. It is recognized that the performance of consumable items will diminish as a function of use, and that it may be necessary to replace such items to restore the stated specifications. Consumable items (arc lamps, filters, cuvettes, lenses, etc.) are not covered by the warranty.
2. The original manufacturer's warranty will be maintained for major system components not manufactured by PTI (e.g. computers, printers, microscopes, cameras and components thereof).
3. Fiber optic bundles are not covered by the warranty.
4. The use of arc lamps not supplied by PTI (or approved in writing by PTI) will void PTI's warranty on all illuminator subsystem components.
5. If there is any evidence of physical contact with coated optics (e.g. fingerprints), the warranty on that item will be voided.
6. If the optical components are realigned by the customer without specific permission from PTI, the warranty will be voided. Please note that the customer is responsible for changing lamps and aligning the lamp after installation. Aligning the lamp will not void the warranty unless other exclusions are applicable (nos. 4 and 5).
7. Instrument systems that are not authorized to be installed by anyone other than PTI service personnel will not be warranted.
8. In case of systems that include installation as part of the original purchase, unpacking the instrument by anyone other than PTI personnel will void the warranty.
9. Moving systems to another site within a facility or to another location, without specific permission from PTI, will void the warranty.
10. Damage or loss caused by shipping is not covered by the warranty.
11. Damage caused by improper operation of the instrument will void the warranty.
12. Damage caused by equipment not purchased from PTI that is attached to the instrument is not covered by the warranty.
13. Warranty is valid only in the state, province or country of the original purchase.
14. Warranty is valid only on systems having a computer supplied by PTI.
15. Software upgrades performed on the PTI computer workstation (e.g., adding word processors, image editors, etc.) not authorized by PTI will void the warranty.
16. Hardware upgrades performed on the PTI computer workstation (e.g., adding network boards, sound cards, etc.) not authorized by PTI will void the warranty.

Warranty Returns

A Return Material Authorization (RMA) Number must be obtained from the PTI Service Department before any items can be shipped to the factory. Returned goods will not be accepted without an RMA Number. Customer will bear all shipping charges for warranty repairs. All goods returned to the factory for warranty repair should be properly packed to avoid damage and clearly marked with the RMA Number.

Warranty Repairs

Warranty repairs will be done either at the customer's site or at the PTI plant, at our option. All service rendered by PTI will be performed in a professional manner by qualified personnel.

Software

PTI makes no warranties regarding either the satisfactory performance of the software or the fitness of the software for any specific purpose. PTI shall not be responsible for any liability, loss or damages caused or alleged to be caused by our software as a result of its use, including, without limitation, consequential damages and loss of profit, nor will PTI provide training on its use free of charge.

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Safety Symbols Used In This Manual

(NOTE: Not all may be present in this manual)



(DANGER)

This symbol indicates the potential for serious bodily harm. Extreme care should be taken when performing the task and all warnings should be strictly adhered to. All possible steps should be taken to ensure safety.



(WARNING)

This symbol represents the potential for electrical shock and/or other bodily harm. Care should be taken when performing the task. There is also the potential for damage to equipment if warnings are not taken seriously.



(CAUTION)

This symbol represents the potential for equipment damage. The user is expected to use care when performing the task.



(RADIATION)

This symbol represents the risk of UV radiation. User must take all appropriate steps to protect eyes and exposed areas of the skin.

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Main Safety Precautions

UV PRECAUTIONS

Never look directly at an operating lamp; severe eye injury will result. Wear UV protective lenses, such as a welder's helmet, when working around operating lamps. Care should also be taken to ensure that exposed areas of the skin are protected.

If you need to look at the focused light from an arc lamp, e.g., at the entrance slit of an excitation monochromator, use welder's grade 5 (or higher) goggles to protect your eyes against intense UV light (Note: welder's grade 5 refers to the attenuation of the UV light. The amount of visible light transmitted by such goggles is not specified and may still be too intense to look at).

If you are working with a properly shielded lamp and not directly at the lamp or its focused beam, then you may use plastic lens glasses or safety goggles as these provide sufficient attenuation of scattered UV light.

Some compact arc lamps produce ozone that is considered toxic when at relatively high concentration levels.

HANDLING OF LAMPS

Because of the risk of lamp explosion, contact with lethal electrical current, and intense UV light, never operate an unshielded arc lamp. Only operate it inside the proper lamp housing.

Special storage packaging is used to transport compact arc lamps. Keep the lamp packaging until the lamp has been properly disposed of.

Compact arc lamps contain a highly pressurized gas, and present an explosion hazard ***even when cold***. Wear face protection, such as a protective face shield whenever handling lamps.

Never touch the quartz envelope with bare hands; such handling may lead to deterioration and premature failure of the arc lamp, and consequentially, a potential for the lamp to explode. Soft cotton gloves should be worn when removing and installing lamps.

Some lamps can only be mounted one way in the lamp housing since the anode (+) and cathode (-) have different diameters. However, some lamps have the same diameter anode and cathode that could lead to an orientation error. OBSERVE POLARITY!

The anode adapter should not put any mechanical stress on the lamp. It may be necessary to bend the electrical wire connected to the adapter slightly in order to relieve any stress on the lamp.

For lamps rated at more than 100 watts, failure to check for kinks in the water lines and leaks could result in flooding of the lamp housing, and presents explosion and electrocution hazards. Failure to maintain proper cooling may result in lamp damage and possibly lamp explosion.

In the rare case that a mercury lamp explodes and the mercury is released it is recommended that that all personnel should leave the immediate area **at once**, so that no mercury vapor is inhaled. The area should be ventilated for a minimum of 30 minutes. When the lamp housing has cooled any mercury residue should be picked up with a special adsorptive agent.

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IGNITER PRECAUTIONS

The igniter produces very high voltage levels that can be fatal. EXTREME CARE should be taken when operating the igniter.

Never operate an igniter without a lamp attached. Otherwise the voltage rises to a lethal level, and may cause damage to the igniter and power supply.

Do not open the power supply or igniter cases. High voltage is present, and there are no user-serviceable parts inside.

It is strongly recommended that the lamp power supply be connected to an isolated line supply to minimize electrical interference with other devices such as computers, photomultiplier detectors, etc. Also, physically position the power supply and igniter as far away as possible from computers, signal cables and other electrically sensitive items.

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1. Description

1.1 Introduction

The PTI Arc Lamp Housing is designed to accommodate a variety of Xenon, Mercury and Mercury-Xenon high pressure short arc lamps with power ratings from 75 to 200 watts. The housing features an f/4.5 elliptical reflector that provides highly efficient light collection. For lamps rated greater than 100 watts the lamp anode is water cooled via the anode adapter; access is provided for nitrogen purging to prevent ozone production. It may be operated in either vertical or horizontal positions, depending on the lamp in use.



Never look directly at an operating lamp; severe eye injury will result. Wear U.V. protective lenses, such as a welder's helmet, when working around operating lamps.

1.2 Power Supply

The lamp housing is compatible with all PTI lamp power supplies, but may be used with power supplies from other manufacturers. In either case, please refer to the lamp power supply manual for electrical connections and operating instructions.



Always turn off the Lamp Power Supply before disconnecting the lamp power supply from the lamp housing. High voltage arcing can occur between the igniter connectors and any nearby metallic objects, and cause personal injury.

1.3 Lamps

Compact Arc Lamps

High pressure gas discharge lamps having an arc length which is small compared with the size of the electrodes are called short arc or compact arc lamps. Depending on rated wattage and intended application, the arc length of these lamps may vary from about a third of a millimeter to about a centimeter. These lamps have the highest luminance and radiance of any continuously operating light source and are the closest approach to a true "point" source.

The envelope is made from optically clear quartz material of various grades and has a spherical or ellipsoidal shape. The grade of the quartz will determine the amount of ozone generated. The most widely used material for the electrodes is tungsten.

Most compact arc lamps are designed for DC operation. This results in better arc stability and substantially longer life. DC systems consist of an igniter and a regulated power supply. High

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voltage pulses (up to 50,000 volts) break down the gap between the electrodes, ionize the gas and heat the cathode tip to thermionic emitting temperatures.

Xenon Lamps
Xenon compact arc lamps are filled with several atmospheres of xenon gas. They reach 80 % of final output within 10 minutes or less of starting. The arc color is very close to daylight (6000 K). The spectrum is continuous in the visible range and extends far into the ultraviolet. A Xenon lamp exhibits strong lines in the near infrared between 800 and 1000 nm and some weak lines in the blue portion of the spectrum.

Xenon compact arc lamps are made with rated wattages from 75 to 30,000 watts and are available for operation in either a vertical or horizontal position. The breakdown voltage between the electrodes will run from 10 kV for a small lamp up to 60 kV or more for lamps rated 30 kW. The luminous efficacy of Xenon compact arc lamps is approx. 30 lumens per watt at 1000 watts, 45 lumens per watt at 5000 watts, and over 150 lumens per watt at 20 kW.

Mercury-Xenon Lamps
A Mercury-Xenon lamp contains a specific amount of mercury and a small amount of xenon added at a pressure exceeding one atmosphere. The xenon is necessary to facilitate starting and to sustain the arc until the mercury is fully vaporized; it also reduces the warm-up period. Normal warm-up time is 10 -15 minutes.

Mercury lamps are sensitive to cooling because the bulb temperature determines the vapor pressure. The lamp can be over-cooled to the point that full output in the mercury spectrum is never achieved. The cooling water should be ordinary tap water. Chilled water may decrease the operating voltage and interfere with the proper evaporation of mercury. In some cases, the mercury may not evaporate at all, causing unsuitable performance and shortened lamp life. The typical steady state voltage of a Mercury-Xenon lamp is higher than that of a xenon lamp. The output in the visible range consists mainly of four mercury lines and some continuum, due to the high operating pressure. A properly warmed lamp will show no significant trace of the xenon gas spectrum.

Mercury-Xenon lamps are available in wattages from 200 to 7000 watts. The luminous efficacy is approximately 50 lumens per watt at 1000 watts and about 55 lumens per watt at 5000 watts.

Tungsten Lamps
Technical lamps consist of a coiled tungsten filament mounted in a precision glass envelope. The envelope may have a vacuum or, more commonly, be filled with an inert gas such as argon or krypton. Typical technical lamp operating parameters are 2.5 to 12 volts and .02 to 1 amp. Color temperature ranges from 2,200 to 3,000 K; lamp life may be as high as 30,000 hours.

Tungsten-Halogen lamps feature a tungsten coil filament mounted in a quartz glass envelope that has been filled with an inert gas plus a trace of halogen (normally bromine). This gas creates the “halogen cycle”: tungsten that has evaporated from the filament combines with the halogen gas. Convection currents within the bulb carry this gas to the quartz wall where it is cooled and then

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returned to the proximity of the filament. The heat of the filament causes the tungsten and bromine to separate, and the tungsten is then deposited on the cold portion of the filament.

This regenerative process prolongs the life of the filament considerably, and also eliminates blackening of the bulb by preventing the evaporated tungsten from condensing on the envelope. The Halogen lamp color temperature runs from 2900 to 3400 K and are available in wattages from 10 to 250 at operating voltages from 6 to 24; lamp life ranges from 10 to 2500 hours. Luminous efficiency is approximately 22 lumens per watt.

Tungsten-Halogen lamps must be operated at voltages that maintain an envelope temperature between 250 and 350 °C. Cooler temperatures will not allow the halogen cycle to take place, thus causing bulb blackening and shorter life; higher temperatures will cause oxidation of the conductors and lead to premature lamp failure.

Lamp Emission Spectra

Below are typical lamp emission spectra for most common Xenon, Mercury and Tunsten lamps. All graphs represent percentage of spectral radiant intensity (Y-axis) vs. wavelength in nanometers (X-axis).

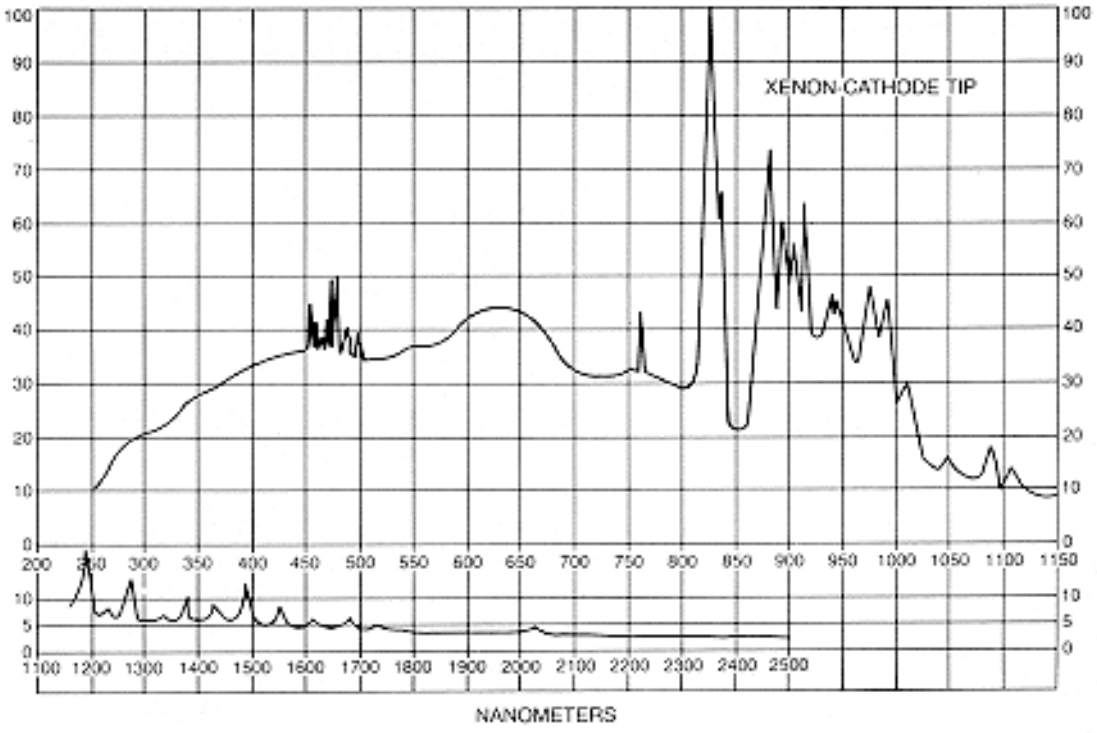


Figure 1 - Xenon arc lamp spectrum

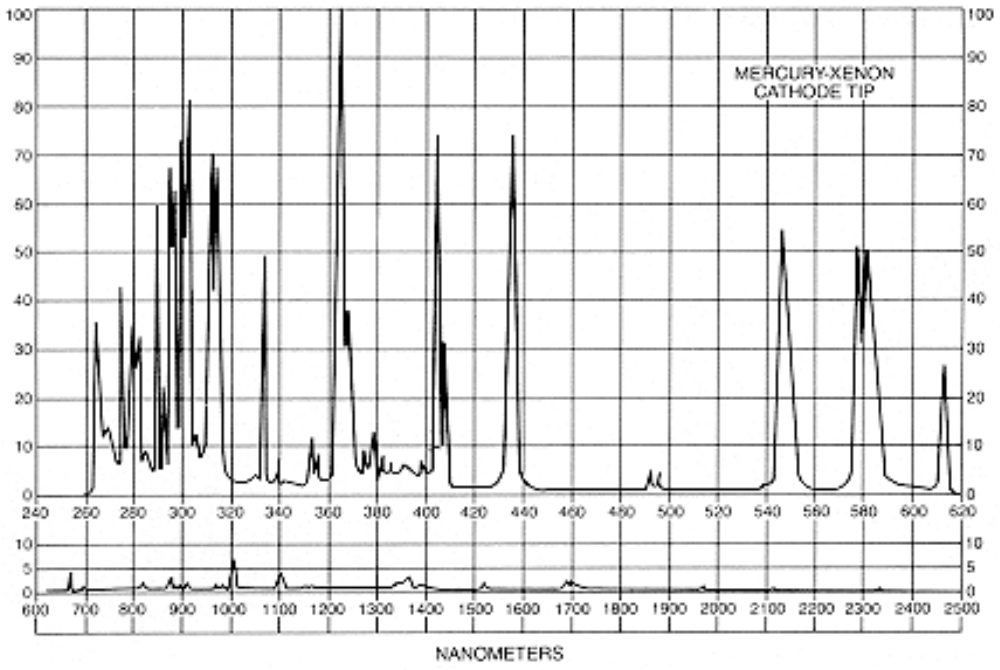


Figure 2 - Mercury-Xenon arc lamp spectrum

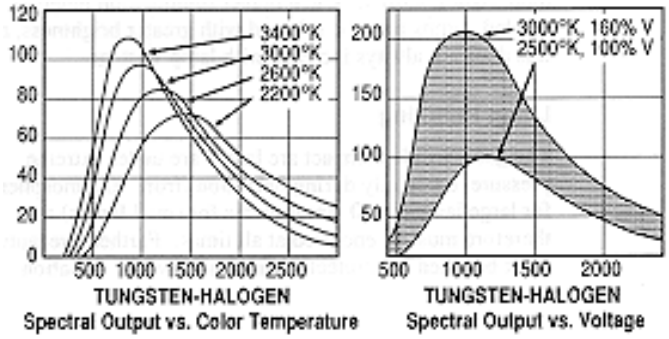


Figure 3 - Tungsten-Halogen lamp spectra

Recommended Lamps

The following lamps are recommended for use in the lamp housing, most of which are available from PTI. Anode and cathode adapters are required to accommodate the various lamps in the housing.

Mfr:	Lamp:	Adapter Required:
Osram	HBO 100 W/2 Hg	75/100 anode & cathode adapter
Ushio	UXL 75W Xe	75/100 anode & cathode adapter
Ushio	UXL 75W CLS Xe	75/100 anode & cathode adapter
Ushio	UXL 100D Xe Hg	75/100 anode & cathode adapter
Ushio	UXL 200H Xe Hg	150/200 13 mm anode adapter
Ushio	UXL 151H Xe	150/200 13 mm anode adapter

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Osram and Ushio anodes are different diameters which necessitate different anode adapters. Ushio 150 and 200 watt lamps do not require cathode adapters. PTI also offers tungsten lamps and adapters for use in the lamp housing.



Lamps purchased directly from other manufacturers may not meet our specifications for operation in the lamp housing and may cause permanent damage to the housing. Use of such lamps will void the warranty.

Take note that higher wattage lamps do not necessarily yield more light intensity. When higher illumination intensity is needed, lamps must be selected with greater brightness, and this does not always increase with wattage.

1.4 Lamp Handling



Compact arc lamps contain highly pressurized gas, and present an explosion hazard even when cold. Wear face protection, such as a protective face shield whenever handling lamps.

Special storage cases are provided to eliminate possible hazards during shipping and handling. Safety goggles and soft cotton gloves should be worn when removing and installing lamps. Never touch the quartz envelope with bare hands; such handling may lead to deterioration and premature failure. If accidentally handled, clean the lamp surface with an alcohol swab to remove any residue.



Never look directly at an operating arc lamp; severe eye injury will result. Wear U.V. protective lenses, such as a welder's helmet, when working around operating arc lamps.

Polarization

Some lamps can only be mounted one way in the lamp housing since the anode (+) and cathode (-) have different diameters, thus making accidental polarization reversal nearly impossible. However, some lamps have the same diameter anode and cathode, allowing room for error. Refer to the lamp manufacturer's data sheet for proper identification of the anode and cathode.

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Reversed polarization will result in immediate and permanent damage to the lamp electrodes. A lamp that has been fired with reversed polarization will have obvious physical damage to the electrodes. A damaged lamp will fire, but it will exhibit unstable performance and a severely shortened operating life.

1.5 Lamp Stability

Short term stability is measured over seconds, while long term stability is measured over minutes, hours, or even days.

Short term stability is affected by arc "wander," "flare" and "flutter." Arc wander is the movement of the attachment point of the arc on the cathode surface. Typically the arc moves around the conical cathode tip in a circular fashion, taking several seconds to move a full circle. Arc flare refers to the momentary change in brightness as the arc moves to an area on the cathode having a preferential emissive quality over the previous attachment point. Arc flutter is the rapid side-to-side displacement of the arc column as it is buffetted by convection currents in the xenon gas that are caused as the gas is heated by the arc and cooled by the envelope walls.

Arc wander and flare can be reduced by a slight decrease in the operating current. For example, a 75 watt xenon lamp rated at 5.4 amps may be operated at 4.5 amps for the first one or two minutes of operation, after which the current should be brought up to the specified normal operating level.

1.6 Lamp Life

The useful life of compact arc lamps is determined primarily by the decrease of luminous flux caused by the deposit of evaporated electrode material on the inner wall of the envelope. Frequent ignition accelerates electrode wear and hastens the blackening of the envelope. Average lamp life is based on approximately 20 minutes of operation for each ignition. The end of the lamp life is the point at which the UV output has decreased by approximately 25 %, the arc instability has increased beyond 10 %, or the lamp has ceased to operate under specified conditions. Lamps should be replaced when the average lamp life has been exceeded by 25 %.

As the lamp ages, the operating voltage will increase. The lamp current knob should be adjusted to maintain the operating power level until the maximum operating voltage is reached. At this time the lamp should be replaced.

Lamp life varies with different types. Check the manufacturer's specifications for the rated lamp life.

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2 Installation

2.1 Arc Lamp Installation

See also a technical movie clip on PTI's website http://www.pti-nj.com/technical.html, scroll to the bottom of the webpage and select **Installing Lamps in PTI Arc Lamp Housings(A-1010B).**



Compact arc lamps contain a highly pressurized gas, and present an explosion hazard ***even when cold***. Wear face protection, such as a protective face shield whenever handling lamps.



Because of the risk of lamp explosion, contact with lethal electrical current, and intense UV light, never operate an unshielded arc lamp. Only operate it inside the proper lamp housing.

The arc lamp, if ordered with the lamp housing, is boxed separately in its original packaging and must be installed before using the lamp housing.



Soft cotton gloves should be worn when removing and installing lamps. Never touch the quartz envelope with bare hands; such handling may lead to deterioration and premature failure of the arc lamp. If accidentally handled, clean the lamp surface with an alcohol swab to remove any residue.

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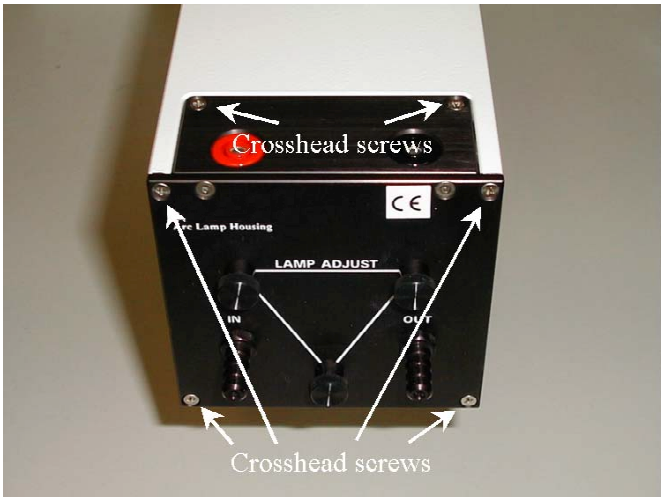


Figure 4 – Removing the Lamp Housing Back Plate

1. Remove the four cross-head screws on the back plate of the lamp housing and two on the top and slide the lamp assembly out (see figure 4).
2. Remove the setscrews from the small plastic bag that accompanies the lamp. For a 75 watt Xenon lamp, insert one setscrew (use a 0.050 inch hex key) in the cathode adapter and one in the anode cooler. For a 150 watt Xenon lamp, put two long setscrews in the cathode adapter and one short setscrew in the anode cooler (see Figure 5).
3. Align the evacuation nib with the notch in the collar behind the reflector.



Some lamps can only be mounted one way in the lamp housing since the anode (+) and cathode (-) have different diameters. However, some lamps have the same diameter anode and cathode that could lead to an orientation error.

Refer to the lamp manufacturer's data sheet for proper identification of the anode and cathode. Reversed polarization will result in **immediate and permanent** damage to the lamp electrodes. PTI will not warrant or replace a lamp that has been improperly mounted. A lamp that has been fired with reversed polarization will have obvious physical damage to the electrodes. A damaged lamp will fire, but it will exhibit unstable performance and a severely shortened operating life.

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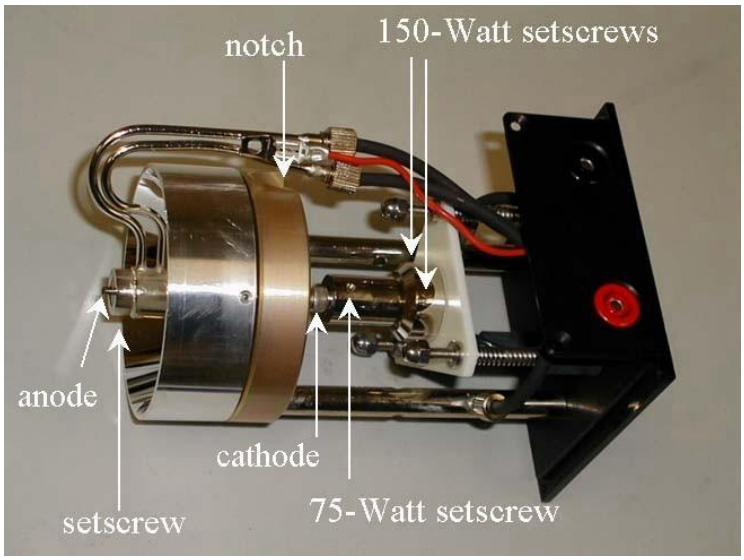


Figure 5 - Lamp Housing Connections

4. The 150 watt cathode adapter is made in one piece, whereas the 75 watt cathode adapter is made in two pieces, the smaller of which fits into the 150 watt cathode adapter. Insert the lamp cathode (-) into its proper cathode adapter. The evacuation nib on the lamp should be on the side of the central bulb away from the reflector, and should be aligned with the notch on the reflector collar (see figure 5). Tighten the setscrew(s) in the cathode adapter.

5. Slip the anode adapter over the lamp anode (+) such that the anode cooling tubes are aligned with the notch in the reflector. Without putting stress on the lamp, tighten the setscrew in the anode adapter.



The anode adapter should not put any mechanical stress on the lamp. It may be necessary to bend the electrical wire connected to the adapter slightly in order to relieve any stress on the lamp.

6. Be sure all water lines are snug. (75 watt Xenon and 100 watt Mercury lamps do not require cooling, so the water lines may be omitted.) Connect the water lines to the supply, start the water flow (~ 500 mL/min) and check all internal connections for leaks.



For lamps greater than 100 W, before connecting the coolant lines, open the housing and verify that internal hoses exist, are tight, and have no kinks. Then attach the coolant lines and check for leaks. If this check is not carried out, the lamp housing could flood with water and present explosion and electrocution hazards.

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7. Insert the lamp assembly into the housing, ensuring that the anode adapter faces the insulated inside corner (upper right hand corner when viewed from the back plate) of the housing (see figure 6). Tighten the six crosshead back plate screws securely.

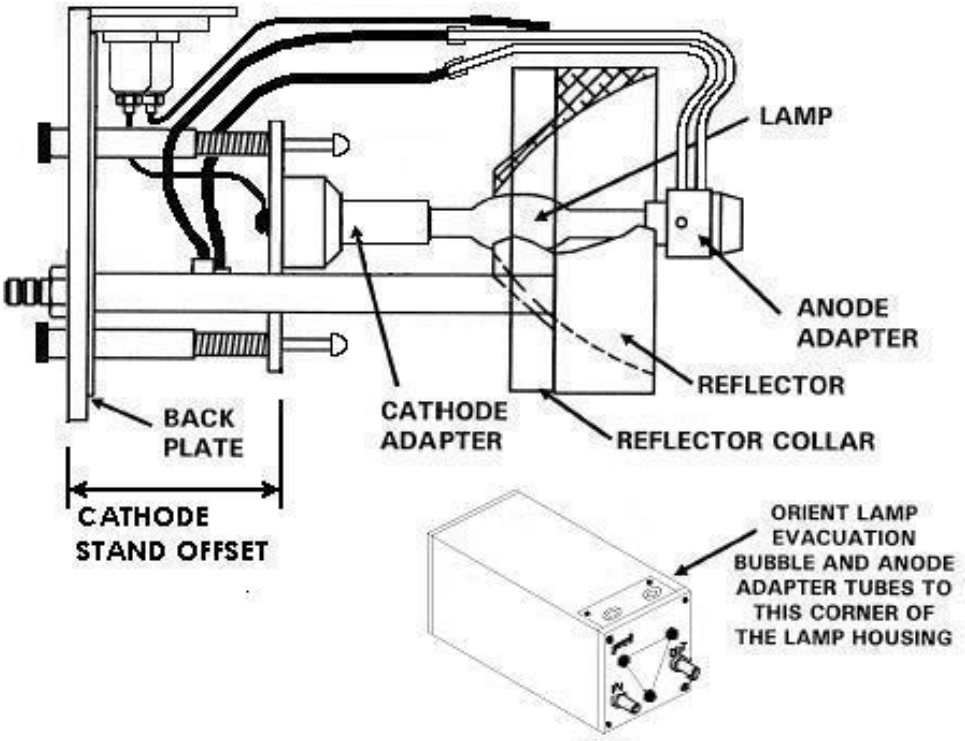


Figure 6 - Internal View, Arc Lamp Housing



Never operate an igniter without a lamp attached. Otherwise the voltage rises to a lethal level, and may cause damage to the igniter and power supply.

2.2 Attaching theIgniter to the Lamp Housing

The igniter is shipped from the factory unattached to the lamp housing. To attach the igniter to the lamp housing, follow these steps:

1. Observe the shielded red and black banana plugs on the bottom of the igniter and the same colored sockets on the lamp housing.

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2. Place the lamp igniter on top of the lamp housing such that the red and black shielded plugs on the bottom of the igniter fit into the same colored sockets on the lamp housing (see figure 7).

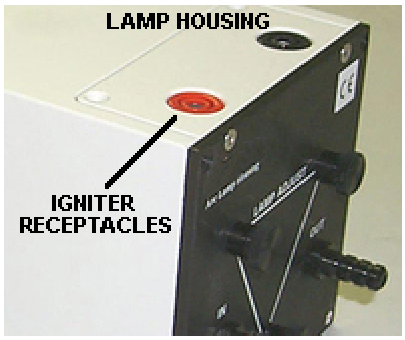


Figure 7 - Lamp Housing Igniter Receptacles

3. Slightly rock the igniter side-to-side while pushing down until the igniter is firmly in position and flat against the lamp housing.

4. Tighten the lock screw that is located on the top side of the igniter (see figure 8). It may help to slightly rock the igniter side-to-side while tightening the igniter lock screw. You should be able to turn it 3 to 4 turns. Do not over-tighten or you may strip the threads.

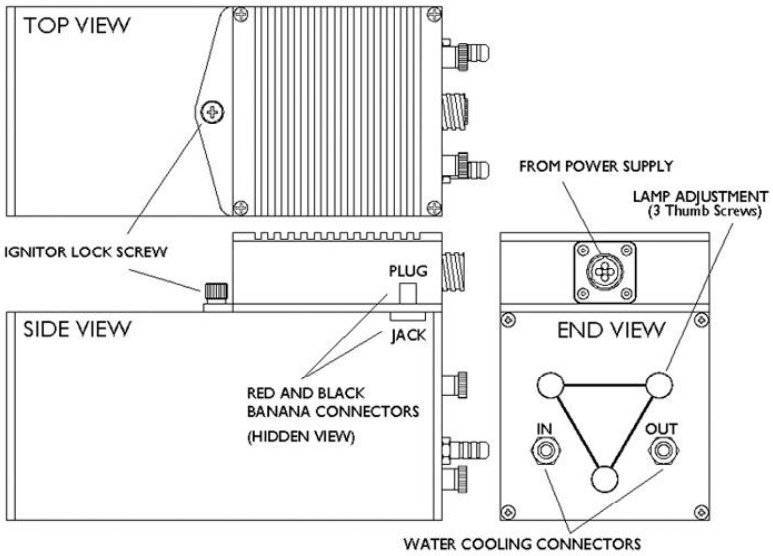


Figure 8 - Securing Igniter onto Lamp Housing

2.3 Tungsten-Halogen Lamp Installation

There are two types of tungsten-halogen lamps that fit in the lamp housing. The 100 watt horizontal filament has its filament perpendicular to the ellipsoidal axis of the reflector, while the 50, 75, or 90 watt axial filament lamps have the filament along the ellipsoidal axis. None of these models require water cooling.

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Although the tungsten-halogen lamps do not have a definite polarity, in the following description we still refer to the cathode adapter, cathode base and anode terminal wire because these lamps use the same lamp housing assembly.

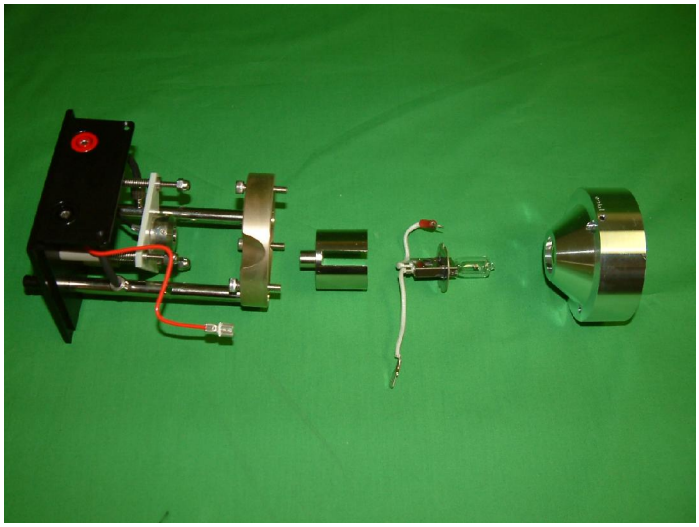


Figure 9 - 100 watt Tungsten-Halogen Lamp Parts

Soft cotton gloves should be worn when removing and installing lamps. Never touch the quartz envelope with bare hands; such handling may lead to deterioration and premature failure of the arc lamp. If accidentally handled, clean the lamp surface with an alcohol swab to remove any residue.

You will need:
0.050 inch hex key
1/16 inch hex key
#1 Philips screwdriver

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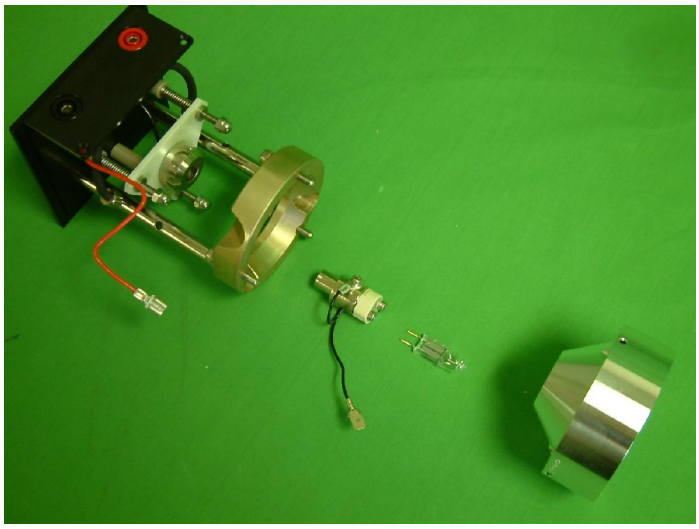


Figure 10 - 50, 75 or 90 watt Tungsten-Halogen Lamp Parts

1. Remove the reflector (see section 4.6, Replacing the Reflector)
2. Place the bulb into the socket base. The polarity does not matter.
    a. The 50, 75 and 90 watt axial filament lamps fit into a ceramic socket base on top of the cathode adapter (0.67 inches, 17.1 mm diameter) – push the lamp pins straight into the holes in the ceramic base.
    b. The 100 watt horizontal filament lamp comes as a bulb mounted in a socket base with a circular flange near the top of the socket base and two wires coming out of the bottom of the base, one ends in a ring terminal and the other wire ends in a flat rectangular terminal. Place the socket base in the cathode adapter (1.46 inches, 37.1 mm diameter) so the circular flange fits into the depression and the two wires come out on opposite sides of the cathode adapter. Screw in the two screws (M-3 8 mm) through the two indentations in the circular flange into the cathode adapter. Screw the ring terminal into the hole on the side of the cathode adapter.
3. Insert the cathode adapter through the reflector collar and into the cathode base mounted on the triangular plate. Align the cathode adapter so that the filament axis is vertical (parallel to the monochromator slit). Use a 0.050-inch hex key to tighten the two setscrews in the cathode base.
4. Push the flat rectangular terminal into the clip atttached to the red wire.
5. Reattach the reflector.
6. Insert the backplate assembly into the lamp housing and screw in the six screws.
7. Connect the red and black banana plug cables from the same colored terminals on the back of the lamp power supply to the same colored receptacles on the top of the lamp housing. The igniter is not used with the tungsten-halogen lamps.

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3 Operation



Never look directly at an operating arc lamp; severe eye injury will result. Wear U.V. protective lenses, such as a welder's helmet, when working around operating arc lamps.

3.1 Operating Range

Compact arc lamps should not be operated below 85 % or in excess of 110 % of rated current. Operation below the rated current results in arc instability and reduced lamp life. Operating lamps above the rated current is dangerous with the possibility of the lamp exploding. Always allow 10 - 15 minutes for proper warm-up of Xenon and Mercury-Xenon lamps.

The lamps recommended for use in the lamp housing are all specified for horizontal burning. Generally, Xenon lamps, 100 watt Mercury and 200 watt Mercury-Xenon lamps may be operated horizontally. Mercury lamps (other than the 100 watt) and Mercury-Xenon lamps (other than the 200 watt) are operated vertically. Refer to the lamp manufacturer's data sheet for the recommended lamp operating position. If you have any questions regarding lamp position please call PTI for technical assistance. Failure to mount the lamp properly may result in damage to the lamp, the lamp housing or the lamp power supply.

3.2 Lamp Cooling

Because of the high thermal load, natural convection cooling is insufficient for lamps rated greater than 100 watts. 75 watt Xenon and 100 watt Mercury-Xenon lamps do not require cooling. The anode temperature must not exceed 250 °C. Mercury lamps are more sensitive to proper cooling (air cooling or water cooling) and proper cooling is evident when the operating voltage after warm-up is within 10 % of lamp rating.



Failure to maintain proper cooling may result in lamp damage and possibly lamp explosion. 75-watt Xenon, 100 W Hg, and 100 W Hg-Xe lamps do not require cooling.

When applicable, proper cooling will assure long lamp life and stability. Chilled water should not be used; typically, room temperature tap water is sufficient to cool the lamp properly (note that in winter, some cold tap water can be as cold as 4 °C). Cooling the lamp prior to starting is not recommended, as condensation may form on the anode adapter making firing difficult if not impossible. For lamps that are water cooled, turn on the cooling water just prior to starting the lamp to test for adequate flow rate, turn the water off, start the lamp, then turn on the cooling water within 1 to 2 minutes after starting the lamp. The recommended flow rate is 500 ml/min.

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Cooling should be kept running for at least five minutes after the lamp has been shut off. Failure to maintain proper cooling may result in lamp damage and possibly lamp explosion.

When using ordinary tap water for lamp cooling, note that $CaCl_2$ or $MgCl_2$ condensates may form in the "water out" reflector support rod. Flushing the cooling system with vinegar or acetic acid once a month will prevent condensate build-up. You may also use a water recirculator with a 50:50 mixture of distilled water and antifreeze to cool lamps. However, such a recirculator should have a heat exchanger or fan so that the circulating fluid temperature does not exceed 45 °C.

The 50, 75 and 90 watt axial filament and 100 watt horizontal filament tungsten-halogen lamps do not require water cooling.

3.3 Lamp Life

(See also introduction section 1.6 Lamp Life.)
You should keep a log of lamp usage showing hours used, cumulative hours used, and operating power and voltage (after a 15 minute warm up time, or record the operating power and voltage before turning the lamp off).

When operating at 75 or 150 W, change the lamp display knob from watts to volts. A new USHIO 75 Xenon arc lamp operates at ~ 12.0 V. An operating voltage of 13.5 V or more indicates an old lamp that should be replaced.

A new USHIO 150 Xenon arc lamp operates at ~ 20.0 V. An operating voltage of 21.5 V or more indicates an old lamp that should be replaced.

The operating voltages for new OSRAM Xenon arc lamps vary from lamp to lamp. You should check your log of lamp usage to determine when the operating voltage has increased by ~ 1.5 V.

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4 Maintenance

4.1 Re-focusing the Lamp

See also a technical movie clip on PTI's website http://www.pti-nj.com/technical.html, scroll to the bottom of the webpage and select **Focusing Lamps in PTI Arc Lamp Housings.**

Re-focusing the lamp to maximize illuminator intensity is recommended after arc lamp replacement or any service to the excitation components of your instrument, or after every hundred hours of use.

The arc lamp housing uses an elliptical reflector to focus the light. The entrance slit of the excitation monochromator is at one focal point and the arc is at the other focal point. The reflector position and orientation is set at the factory and should not need any adjustment. The reflector defines the optical axis and the best system throughput is found when the arc lies at one focal point. Since no two arc lamps are identical and since it is impossible at best to perform a lamp installation or replacement without altering any adjustments, the lamp must be refocused after replacement. However, because the arc lamp was optimized at the factory or with a previous lamp the proper focus should be very close to that obtained by installing the arc lamp in the cathode base without any coarse adjustments having been done. I.e., only fine adjustment with the lamp adjustment thumbscrews should be necessary.

4.1.1 Fine adjustment

Fill a clean, 1 cm, quartz cuvette with distilled water, tap it to displace any bubbles adhering to the walls, and place it in the sample compartment. Where applicable, set the excitation monochromator to 350 nm, the emission monochromator to 397 nm, and all slits at 5 nm. Alternatively, you can use any stable fluorescent sample (i.e., one that does not photobleach).

Start a time-based experiment with a long time duration and shorter view window (e.g., 1000 seconds duration, but 100 seconds view window), and begin acquisition.

Sequentially turn each of the lamp adjustment thumbscrews (see figure 4 or 8) no more than ±90° (1/4-turn) while observing the fluorescence signal to achieve maximum intensity. If the intensity begins to drop, reverse the direction and turn back until the intensity peak is reached. If the intensity peaks at a quarter-turn, leave that adjustment screw and continue with the next adjustment screw. Adjust each of the lamp adjustment screws in turn and repeat the cycle of adjustment (adjust screw 1, then 2, then 3, then 1, then 2, then 3, etc.) until the signal is maximized, and then repeat the cycle once again. Stop when turning all three adjustment screws makes no further increase in intensity.



Make only progressive 1/4-turn adjustments on each of the three screws at a time. Larger turns may place excessive stress on the lamp and the lamp could explode as a result.

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4.1.2 Coarse adjustment

Use the following if there is indication that the illumination system may be severely out of alignment. Check the lamp focus on the excitation monochromator entrance slit. The spot size, when viewed with welder's goggles, should be approximately 3 to 4 mm in diameter. The spot should be centered on the slit both horizontally and vertically. You can check for vertical centering by closing the height slider so that the point of the wedge is at the slit and the spot should be centered at the height of the point.

The cathode adapter stand should be checked for proper coarse adjustment. Using an accurate caliper, adjust the distance between the outer surfaces of the cathode adapter stand and the lamp housing backplate (see figure 6), according to the table below.

PTI Lamp Type	Cathode Adapter Stand Offset
USHIO 75 W Xenon	53 mm (2.1 inch)
OSRAM 100 W Mercury	51 mm (2.0 inch)
USHIO 150 W Xenon	54.6 mm (2.15 inch)

You can check the quality of the image on the entrance focusing mirror in the excitation monochromator (standard monochromator or DeltaRAM). **CAUTION: Do not touch any of the optical surfaces inside a monochromator.** You should see a well defined "doughnut" of light that fills 80 – 100 % of the horizontal diameter of the mirror and a hole in the center of the doughnut that is about 20 % of the diameter. The doughnut hole should be circular and reasonably sharp. You may even be able to see one or two radial lines that are the shadow of the anode cooler and the ignition wire.

If the doughnut hole is very different than the above description or very misshapen (even showing more than one shadow area) then slightly move each of the lamp adjustment thumbscrews no more than ± 90° while observing the entrance mirror for improvement in the image. Often an adjustment of only 10° can dramatically alter the shape of the image. Repeat the lamp adjustment until a sharp doughnut image is obtained.

If the doughnut hole is too large, then clockwise adjustments of the thumbscrews usually improves the hole's appearance. If the hole is too small or non-existent and there is just a (circular) patch of light in the mirror, then counterclockwise adjustments of the thumbscrews usually bring about a hole. In this case the hole may start small, just a millimeter in diameter when first seen, and misshapen. Adjust each thumbscrew in turn to gradually enlarge the hole. Viewing the image in the monochromator is best done at wide slits, 5 nm or more. The image should be centered. Once an optimum shape is seen, narrow the slits to 1 nm. The whole image should still be seen, although dimmer. If either side of the image is cut off, then the reflector may be out of alignment (see section 4.5).

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4.2 Replacing the Arc Lamp



Compact arc lamps contain a highly pressurized gas, and present an explosion hazard *even when cold*. Wear face protection, such as a protective face shield whenever handling lamps.



The lamp will be extremely hot after use. Allow the lamp housing to cool for a minimum of 10 – 15 minutes after use.

See also a technical movie clip on PTI's website http://www.pti-nj.com/technical.html, scroll to the bottom of the webpage and select **Installing Lamps in PTI Arc Lamp Housings(A-1010B).**

1. Turn off the lamp power supply and disconnect the gray igniter cable from the igniter. You should wait until the lamp is cool, approximately 15 – 30 minutes, before continuing.
2. Remove the igniter from the lamp housing.
3. Remove the six Phillips-head screws on the back plate of the lamp housing and slide the lamp assembly out.
4. Using a 0.050 inch hex key, loosen the setscrew in the anode adapter and slide the anode adapter off the lamp. It may help to rotate the anode adapter side-to-side when doing so. Let the anode adapter hang to one side.
5. Using a 0.050 inch hex key, loosen the setscrew(s) in the cathode adapter and remove the lamp.
6. Insert the new lamp cathode into its proper cathode adapter. The evacuation nib on the lamp should be on the side of the central bulb away from the reflector, and should be aligned with the notch on the reflector collar (see figure 5). Tighten the setscrew(s) in the cathode adapter.
7. Slip the anode adapter over the lamp anode such that the anode cooling tube is aligned with the notch in the reflector. Without putting stress on the lamp, tighten the setscrew in the anode adapter.
8. Insert the lamp assembly into the housing, ensuring that the anode adapter leads face the insulated inside corner of the housing. Tighten the six back plate screws securely.
9. Attach the igniter to the lamp housing and the igniter cable to the igniter.
10. Follow the LAMP FOCUSING procedure, section 4.1.

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4.3 Proper Disposal of Old Arc Lamps

Mercury and Mercury-Xenon arc lamps

Mercury and Mercury-Xenon lamps should be disposed of as mercury containing hazardous waste. Place the used lamps in the original protective case and box, mark the box as "Hazardous waste – contains mercury, and glass contents under high pressure" and take it to a hazardous waste disposal facility. For more information, please go to www.lamprecycle.org.

Xenon arc lamps

You may keep the old Xenon arc lamp as a spare, or you may dispose of it in a careful and proper manner to prevent injury. Wrap the arc lamp in 5 to 6 layers of heavy paper towel, newsprint or heavy cloth, fold the ends of the paper over, and hit the center bulb with a hammer so that the bulb is broken. The Xenon gas that escapes is not poisonous and returns to the atmosphere. The remains of the lamp can be disposed of as broken glass and metal.

4.4 Replacing the 50, 75 or 90 watt Axial Filament Tungsten-Halogen Lamp

The lamp power (50, 75 or 90 watts) is printed on the base of the glass envelope.

You will need:
0.050-inch hex key

1. Remove the reflector (see section 4.6, Replacing the Reflector).
2. You do not need to remove the socket base or disconnect the wires attached to the socket base. Pull the old bulb straight out of the socket.
3. Push the new bulb straight into the holes in the ceramic socket.
4. Reattach the reflector.
5. Insert the backplate assembly into the lamp housing and screw in the six screws.

4.5 Replacing the 100 watt Horizontal Filament Tungsten-Halogen Lamp

You will need:
0.050 inch hex key
1/16-inch hex key
#1 Philips screwdriver

1. Remove the reflector (see section 4.6, Replacing the Reflector).
2. Pull the wire and flat terminal from the clip atttached to the red wire.
3. Using a 0.050-inch hex key, loosen the two setscrews in the cathode base.

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4. Pull the socket base and cathode adapter through the reflector collar.
5. Remove the screw holding the ring terminal to the side of the cathode adapter and remove the two screws holding the circular flange to the cathode adapter.
6. Remove the old bulb and socket base from the cathode adapter.
7. Place the socket base in the cathode adapter so the circular flange fits into the depression and the two wires come out on opposite sides of the cathode adapter. Screw in the two screws through the two indentations in the circular flange into the cathode adapter. Screw the ring terminal into the hole on the side of the cathode adapter.
8. Insert the cathode adapter through the reflector collar and into the cathode base mounted on the triangular plate. Tighten the two setscrews in the cathode base.
9. Push the flat rectangular terminal into the clip atttached to the red wire.
10. Reattach the reflector.
11. Insert the backplate assembly into the lamp housing and screw in the six screws.

4.6 Replacing the Reflector

1. Turn off the lamp power supply and disconnect the gray igniter cable from the igniter. You should wait until the lamp is cool, approximately 15 – 30 minutes, before continuing.
2. Remove the igniter from the lamp housing.
3. Remove the six Phillips-head screws on the back plate of the lamp housing and slide the lamp assembly out.
4. Using a 0.050 inch hex key, remove the anode adapter from the lamp and remove the lamp.
5. The reflector sits on three reflector adjustment (cap-socket) screws that are threaded through the reflector collar. The reflector is held in position by three setscrews that screw through the sides of the reflector against the reflector adjustment screws.

   Use a 1/16 inch hex key to loosen the three setscrews that hold the reflector to the reflector collar and pull the reflector straight away from the collar. Do not adjust the three cap-socket screws that are mounted in the collar.



DO NOT touch the reflector surface. If you do, rinse the spot on the reflector with isopropyl alcohol or acetone to dissolve the residue and immediately blow clean (oil and propellant free) dry gas (nitrogen or air) over the area to remove any remaining solvent. You may need to repeat this process. DO NOT wipe the reflector surface as this can easily scratch or damage the surface. Call PTI for assistance.

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DO NOT adjust the cap socket screws in the reflector collar as these adjust the alignment of the reflector.

6. New reflectors are usually shipped with the three set-screws installed. Look in the holes in the back edge of the reflector to see that the set screws will clear the threads of the cap-socket screws in the collar. You may have to back out the set screws a bit. Place the new reflector so the three holes in its back edge fit over the three cap-socket screws in the collar. Tighten the setscrews.
7. Slip the anode adapter over the lamp anode such that the anode cooling tube is aligned with the notch in the reflector. Without putting stress on the lamp, tighten the setscrew in the anode adapter.
8. Insert the lamp assembly into the housing, ensuring that the anode adapter leads face the insulated inside corner of the housing. Tighten the six back plate screws securely.
9. Follow the LAMP FOCUSING procedure, section 4.1.

4.7 Realigning the reflector

Normally the reflector is properly aligned at the PTI factory and should not have to be adjusted. However, if the reflector is replaced or if the lamp housing suffers a hard blow, then the reflector may need to be realigned.

1. Focus the lamp to achieve the maximum as in section 4.1
2. Observe the bright spot that is focused on the entrance slit to the excitation monochromator or the image on the entrance focusing mirror in the excitation monochromator. If the spot or image is not centered, then the reflector needs to be adjusted.
3. Turn off the lamp power supply. Wait until the lamp assembly has cooled, then remove the lamp assembly from the lamp housing.
4. The reflector sits on three reflector adjustment screws that are threaded through the reflector collar. The reflector is held in position by three setscrews that screw through the sides of the reflector against the reflector adjustment screws.
5. Use a 1/16 inch hex key to loosen the setscrew in the side of the reflector that you want to adjust. Use a 9/64 inch hex key to move the reflector adjustment screw in or out, thus tilting the reflector away from or toward the screw. Note that rotating the 9/64 inch hex key one-sixth of a turn moves the bright spot at the entrance slit approximately 1 mm. If you need to back off the reflector adjustment screw you often have to push the reflector back against the adjustment screw. Tighten the setscrew against the reflector adjustment screw.
6. Refocus the lamp. Repeat the above as necessary.

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4.8 Replacing the Anode Adapter

1. Turn off the lamp power supply and disconnect the gray igniter cable from the igniter. You should wait until the lamp is cool, approximately 15 – 30 minutes, before continuing.
2. Remove the igniter from the lamp housing.
3. Remove the six Phillips-head screws on the back plate of the lamp housing and slide the lamp assembly out.
4. Loosen the anode adapter setscrew (using a 0.050 inch hex key) and slip it off of the lamp.
5. Disconnect the wire to the anode adapter by gently pulling off the electrical connector.
6. Remove the cooling tubes from the frame by turning the knurled locking rings until they are free and then pulling the tubing off the connectors.
7. Attach the new anode adapter cooling tubes to the frame, tighten the knurled locking rings, and reconnect the electrical wire. Slip the anode adapter over the lamp anode and tighten the set-screw.



The anode adapter should not put any mechanical stress on the lamp. It may be necessary to bend the lead wire to the adapter in order to relieve any stress on the lamp.

8. If you will be water cooling the arc lamp, connect the water lines to the supply, start water flow and check all internal connections for leaks.
9. Insert the lamp assembly into the housing, ensuring that the anode adapter leads face the insulated inside corner of the housing. Tighten the six back plate screws securely.
10. Follow the LAMP FOCUSING procedure, section 4.1.

4.9 Replacing the Lamp Housing Window

Depending on the components purchased, the lamp housing holds the lamp assembly and is bolted to the adapter tube that in turn is bolted to the monochromator slit at the entrance to the excitation monochromator, such that the entrance slit of the excitation monochromator is at one focal point and the arc is at the other focal point of the elliptical reflector. The lamp housing window is mounted in a recessed groove in the endplate of the lamp housing between it and the adapter tube.

1. Turn off the lamp power supply and disconnect the gray igniter cable from the igniter. You should wait until the lamp is cool, approximately 15 – 30 minutes, before continuing.
2. Remove the igniter from the lamp housing.
3. Remove the backplate assembly from the lamp housing.

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4. Using a #1 Philips screwdriver remove the four screws holding the cover plate to the top of the adapter tube. Lift out the cover plate and set it aside.

5. It is easiest to replace the window if the adapter tube is removed from the excitation entrance monochromator slit housing.

   The spacer tube is held to the excitation monochromator by four Philips screws on the inside of its front plate. Remove these four screws. Note that these screws are screwed in tight and some steady force may be needed to initially loosen them. Use caution so that you do not strip the cross heads of these screws.

6. Pull the lamp housing and adapter tube away from the excitation monochromator.

7. Unscrew the foot from the bottom of the lamp housing.

8. To break apart the lamp housing from the adapter tube you may either place them horizontally on the table or vertically with the open end of the lamp housing down on the table. If you place them horizontally, lay some paper under the joint between the two tubes in case the window falls out when you separate them.

9. Holding the Philips screwdriver inside the adapter tube remove the four screws holding the adapter tube to the lamp housing.

10. Pull the adapter tube away from the lamp housing.

11. Place a sheet of paper against the window and tip the lamp housing so the window falls out.

12. Place the lamp housing upright so the window hole in the endplate is on top.

13. Place the new window in the recessed groove of the endplate.

14. Place the adapter tube on top of the lamp housing so the igniter side of the lamp housing and the cover plate hole of the adapter tube are on the same side.

15. Place one Philips screw in one of the screw holes beside the window and nearest the adapter tube cover plate opening and lightly screw it in. This will help align the other screw holes.

16. Place the other three screws in the screw holes around the window and screw them all in lightly.

17. Place the adapter tube and lamp housing on a flat surface (e.g., optical table) so that the bottom sides are coplanar. Tighten the screws holding the adapter tube to the lamp housing.

18. Screw the lamp housing foot into the hole on the bottom of the lamp housing nearest the window.

19. Place the four screws into the four holes in the adapter tube open endplate.

20. Place the lamp housing / adapter tube assembly up against the monochromator slit at the entrance to the excitation monochromator. Screw in each screw lightly, then tighten all four screws.

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21. Place the cover plate back on the adapter tube and screw in the screws.
22. Place the backplate assembly into the lamp housing and tighten the six back plate screws securely.
23. Attach the igniter to the lamp housing and the igniter cable to the igniter.

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5 Service Calls to PTI

Before calling for service, please review the **Troubleshooting** section. To aid our Service Department in discussing your questions, as well as to aid in the timely solution of any problems, please assemble as much as possible of the following information before calling PTI:

- Your instrument serial number, or as many other component serial numbers as possible
- Your instrument type and hardware configuration (and software version, if applicable)
- The date on which your instrument was installed
- As much detail as possible on the particular chain of events or circumstances that led to the problem. This information should include the complete instrument status and data gathering protocol.

Contact PTI Service at
Toll Free: 877-784-4349 US/Canada
Phone: 609 894-4420 Ext 115
Fax: 609 894-1579
Email: service@pti-nj.com

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6 Specifications

Lamp Housing (f/4.5 reflector)

Lamp power capacity:	75 to 200 watts
Weight:	1.9 kg (4.2 pounds)
Height:	101 mm (3.96 inches)
Width:	101 mm (3.96 inches)
Length:	210 mm (8.3 inches)
Window diameter (D):	65 mm (2.56 inches)
Window material:	quartz
Focal length (F):	379 mm (14.9 inches)
Focal point from lamp housing (X):	286 mm (11.3 inches)
Beam angle (α):	12.7°

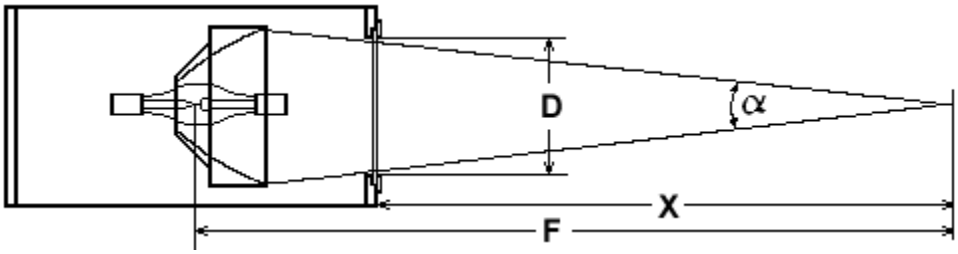


Figure 11 - Reflector vs. Focal Length

Adapter Tube (f/4.5 reflector)

Height:	101 mm (3.96 inches)
Width:	101 mm (3.96 inches)
Length:	276 mm (10.9 inches)

Foot - standard height for lamp housing and adapter tube
(when sold with a monochromator)**:** 38 mm (1.50 inches)

Igniter

Height (additional height when on Lamp Housing):	40 mm (1.57 inches)
Width:	101 mm (3.96 inches)
Length:	127 mm (5.0 inches)

(add at least 65 mm or 2.6 inches to the length when attaching the igniter cable)

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