tweezers

60000-M

ORIEL INSTRUMENTS

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SERIES Q
CONVECTIVE LAMP HOUSING

MODEL 60000

Please read these instructions completely before operating this equipment. If there are any questions or problems regarding the use of this equipment, please contact: ORIEL INSTRUMENTS - or - the representative from whom this equipment was purchased.

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Tell us about the problem you're experiencing.

How long have you been using the product?
Is this the first time you've experienced this problem?

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TABLE OF CONTENTS

I. INTRODUCTION

The 60000 Series Q is a modular, convectively cooled lamp housing with four output ports. The lamp base has external knobs to allow lamp position adjustment during operation in X,Y,Z directions.

Since the product is fanless, free of airborne noise, and accommodates light sources up to 100 W, the exterior has been designed with cooling fins to reduce heat through natural convection.

The 60000 accommodates 16 light sources with several mounting arrangements. The housing can be converted by the user to operate arc lamps, tungsten halogen, deuterium and IR sources. Tables 1 through 4 on the following pages show the appropriate interface kit and socket adapter for each lamp. Complete Series Q Housings with a choice of lamp (and mount) are available. See Volume II for specific configurations.

A number of accessories can be used in conjunction with the Series Q. One or more adjustable reflectors can be mounted on the output ports to maximize light output. Similarly, lens assemblies are available to collimate the radiation or reimage the source. Fig. 1 on page 4 shows the various configurations.

APPROPRIATE INTERFACE KIT AND SOCKET ADAPTERS FOR 60000 SERIES Q HOUSING

Source Type	Lamp Model No.	Required Components					
		Series Q Housing	Interface Kit Model No.	Socket Adapter Model No.	Power Supply		
					Basic Model	Fully Featured Model	Ignitor
DC Arc Lamps							
75 W Xe	6251	60000 Series Q Housing with 1, 2, 3 or 4 condensers and 1 or 2 rear reflector assemblies.	60010	60014	68806*	68805	68705 Universal
75 W Xe Ozone Free	6263		60010	60014	68806*	68805	68705 Universal
50 W Hg	6282		60010	60013	68806*	68805	68705 Universal or 68709 Soft Start
100 W Hg	6281		60010	60012	68805*	68805	68705 Universal or 68709 Soft Start
Pulsed Arc Lamps							
3.16 J Capillary Xe	6425	6000 Series Q Housing with 1, 2, 3 or 4 condensers and 1 or 2 rear reflector assemblies.	66016	60017		68825	
0.32 J Guided Xe Arc	6426		66015	60018		68825	
0.5 J Large Bulb Xe	6427		66017	60019		68826	
Quartz Tungsten Halogen Lamps							
10 W	6318	60000 Series Q Housing with 1 or 2 condensers and 1 rear reflector (with 1 condenser).	60020	60042 H 60045 V	68735	68830	
20 W	6319		60020	60042 H 60045 V	68735	68830	
50 W Short Filament	6332		60020	60043 H 60046 V	68735	68830	
50 W Long Filament	6337		60020	60043 H 60046 V	68735	68830	
100 W	6333		60020	60043 H 60046 V	68735	68830	

DC Deuterium Lamps							
30 W 30 W Ozone Free 30 W High Output	6316 63161 63163	60000 Series Q Housing wiith 1 condenser.	60023*** 60023*** 60023***			68840 68840 68840	
Pulsed Deuterium							
Pulsed Lamp	63170	60000 Series Q Housing with 1 condenser.	60024***			68845	
IR Sources							
IR Emitter Ceramic Element Low Cost IR Element Miniature IR Element	6363 6575 6580 6581	60000 Series Q Housing with 1, 2, 3, or 4 condensers.	60020 60020 60020 60020	60041 60048 60048 60048	68735 68838 68838	68830 68830 68830 68830	

(H) Lamp mounted horizontally. This mounting configuraion is best suited for imaging the filament onto vertical monochromator slits.
(V) Lamp mounted vertically.
* Has built-in ignitor.
** Required for arc lamp power supply without internal ignitor.
*** Includes socket adapter.

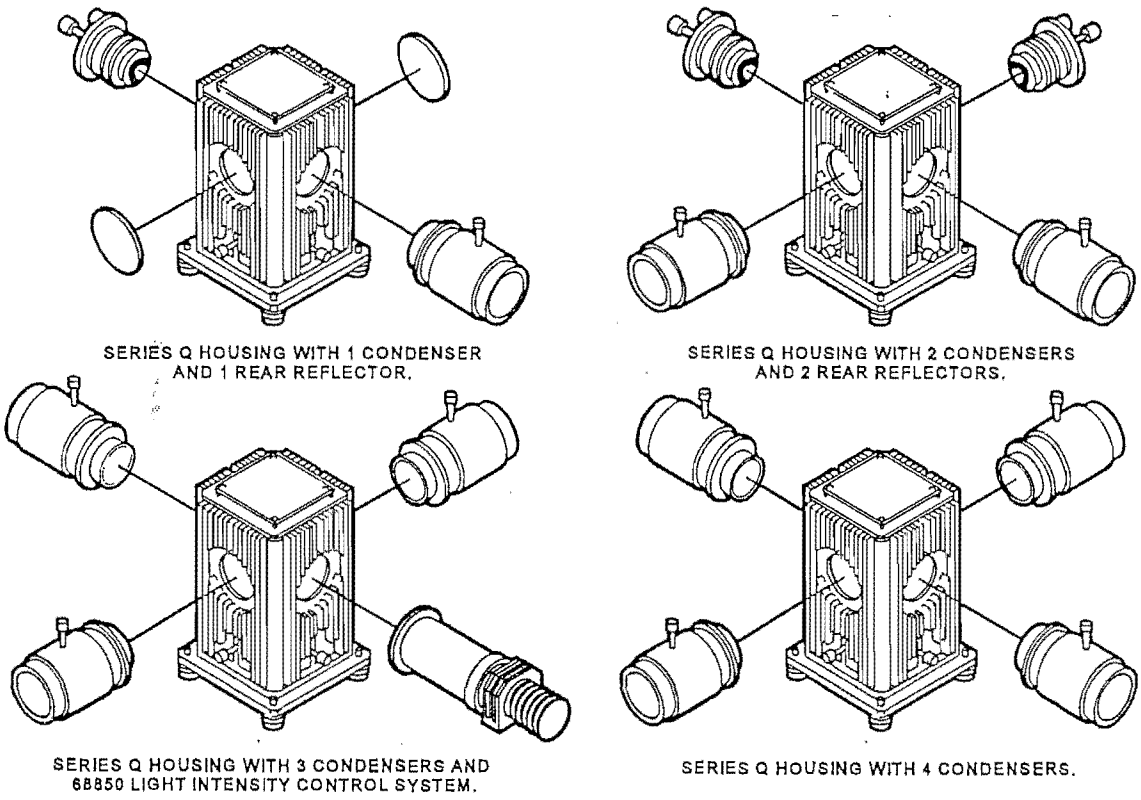


Figure 1 Various Light Collection Options for the Series Q Housing.

II. SAFETY CONSIDERATIONS

There are six hazards in the operation of the 60000 Series Q Lamp Housing. They are:

Radiation
Lamp explosion
Ozone
Electrical shock
EMI
Heat

II.1 RADIATION

The high intensity UV and VIS radiation of the arc (including deuterium) lamps can permanently damage the cornea, lens, and retina of the eye, even causing blindness. This damage may not be immediately apparent. The deep UV is absorbed in the cornea or eye fluids; focused VIS and NUV can damage the retina. Normal blink reaction to visible light may not be adequate protection, and a beam of invisible NUV (produced by spectral filtering) can be most dangerous as the blink response is not induced. UV radiation can also cause painful sunburn, and with prolonged exposure, serious burns.

Recommendations:

1. Never look directly into the output beam from an arc lamp housing.
2. Do not look at the specular (mirror) reflection of the beam.
3. Always wear UV protective eyewear or face mask, and gloves. (If your arms will be in and out of the beam wear long sleeves.)

II.2 LAMP EXPLOSION - XENON AND MERCURY ARC LAMPS

When xenon arc lamps are cold, they are under several atmospheres of pressure and may explode due to internal strains or physical abuse. When hot, xenon and mercury arc lamps have internal pressures of approximately 100 atmospheres and the possibility of violent explosion exists.

Fingerprints and other contaminants left on the lamp cause a deterioration of the envelope during operation and may lead to lamp explosion.

Recommendations:

1. Do not handle a bare arc lamp without safety goggles and adequate protection for exposed areas of skin.
2. Do not apply torque to the lamp envelope during installation or removal.
3. Do not touch the lamp envelope with your fingers.
4. Thoroughly clean the envelope after installation in the housing with alcohol or a dilute solution of detergent and water.

In normal operation lamp explosions are rare and only occur after many hundreds of hours of use. However, if the lamp envelope is stressed, explosion is more likely. Stress can occur from improper mounting or from deterioration of the lamp envelope.

II.3 OZONE

Ultraviolet light can photo decompose molecular oxygen with subsequent formation of O_3 - Ozone is a common pollutant at ground level in urban areas. Relatively low concentrations of ozone can cause nasal dryness and a burning sensation in the throat, headaches, nausea, and irritation of the mucous membranes.

A 150 W UV arc lamp can contribute more than 1 part ozone per million to the convective air stream. This may be of little consequence in a well ventilated area but some people are very sensitive to ozone and the long term effects are not well documented. Noticeable symptoms for most people appear at around 0.3 - 0.5 ppm.

Recommended maximum exposures are typically:

0.1 ppm for 8 hours exposure
2 ppm or a 2 hour exposure

Recommendation:

1. Use an ozone free lamp unless you need the shortwave UV.

Note: Ozone has an absorption in the UV. If ozone is created and built up in the optical path, particularly a long enclosed optical path, then the observed UV radiation level may change accordingly and lead to misinterpretation of lamp or sample performance.

II.4 ELECTRICAL

A high transitory voltage is used to ignite arc lamps. The lamp terminals have a potential difference of up to 200 V prior to lamp start.

Warnings:

1. *Keep personnel clear of all exposed terminals.*
2. *Before changing lamps or working on the system, disconnect input power and check the power supply voltmeter for zero voltage to be sure that internal capacitors are fully discharged.*
3. *Make sure all connections are securely made (and check the polarity) before starting a lamp.*
4. *Do not handle lamp leads during lamp ignition.*

II.5 EMI

Ignition of a xenon arc lamp requires high voltage/high frequency pulses. Mercury arc lamp can also be started in this way or by using a voltage ramp as in our 68709 "Soft Start" ignitor. In both cases a high current discharge follows. The ignition pulses particularly, but also the high starting currents, are sources of radiated and conducted electromagnetic interference. Good earthing, cable routing practice, and EMI shielding may be necessary to protect sensitive digital circuitry from these pulses.

Recommendations:

1. *Start the arc lamp before powering nearby computer systems.*
2. *Keep the computer away from the ignitor/power supply.*
3. *Use a different outlet and line for the computer and ignitor/power supply.*
4. *Contact Oriel for special cabling (for which there will be an additional expense) to reduce EMI/associated problems.*

II.6 HEAT

Depending on the total wattage dissipated in the housing, the fins and convective cap on top will get very hot. The lamp is also very hot after several minutes of operation, and remains hot for some time after being shut off.

Warning:

1. *With the exception of the thermally insulated knobs on the base, adjustable reflector and lens focus, never touch the lamp housing when in use.*
2. *Allow the housing to cool before touching the exterior or before accessing the interior.*
3. *Do not touch the lamp envelope and ends or adapters without allowing for enough cooling down time.*

III. GENERAL DESCRIPTION

The 60000 Series Q Lamp Housing is Oriel's most modular lamp housing. Fig. 2 on the following page shows the components available for the 60000 to convert it from an arc to incandescent to deuterium to ceramic element lamp housing. The four ports support condensers or rear reflectors. Fig. 1 on page 4 shows the various port configurations.

III.1 LAMP AND REFLECTOR ADJUSTMENTS

The location of the arc or filament changes from source to source due to normal manufacturing tolerances. The 60000 has precision independent X,Y, and Z external lamp controls to compensate for these variations. You can adjust the source 0.25 inches (6.4 mm) in any direction. Moving the source moves any subsequent image, and allows you to precisely set an image on a target. .
The rear reflector assembly, model 60005, has control knobs that provide X,Y, and Z adjustments for tilt and focus. The 60005 can be ordered from Volume II.

III.2 LAMP COOLING

The Series Q uses natural convection (air) cooling. This is acoustically quiet and vibration free so the lamp output is more stable than in fan cooled housings. Openings in the bottom and top of the housing allow air to enter and circulate through the housing without excessive light leakage. The ribbed exterior improves cooling of the lamp.

III.3 OPTIONAL CONDENSING LENS ASSEMBLIES

The 60000 does not come with a condenser. You can choose one of the following from Volume II:

60006 Condensing/Collimating Lens Assembly, F/1.5, UV grade fused silica
60007 Condensing/Imaging Lens Assembly, F/1.8, UV grade fused silica
60008 Condensing/Collimating Lens Assembly, F/0.85, molded Pyrex aspheric
60009 IR Condensing/Collimating Lens Assembly, F/1.1, Germanium
60076 Condensing/Collimating Lens Assembly, F/1, UV grade fused silica
60077 IR Condensing/Collimating Lens Assembly, F/1, Zinc Selenide

III.4 MOUNTING

The 60000 comes with four leveling feet. The feet allow 0.63 inch (16 mm) height adjustment. To mount directly to inch or metric optical tables, remove the feet and use the appropriate mounting holes. This puts the optical axis at 5.0 inches (127 mm) above the table. See Fig.3 on page 10 for a dimensional diagram.

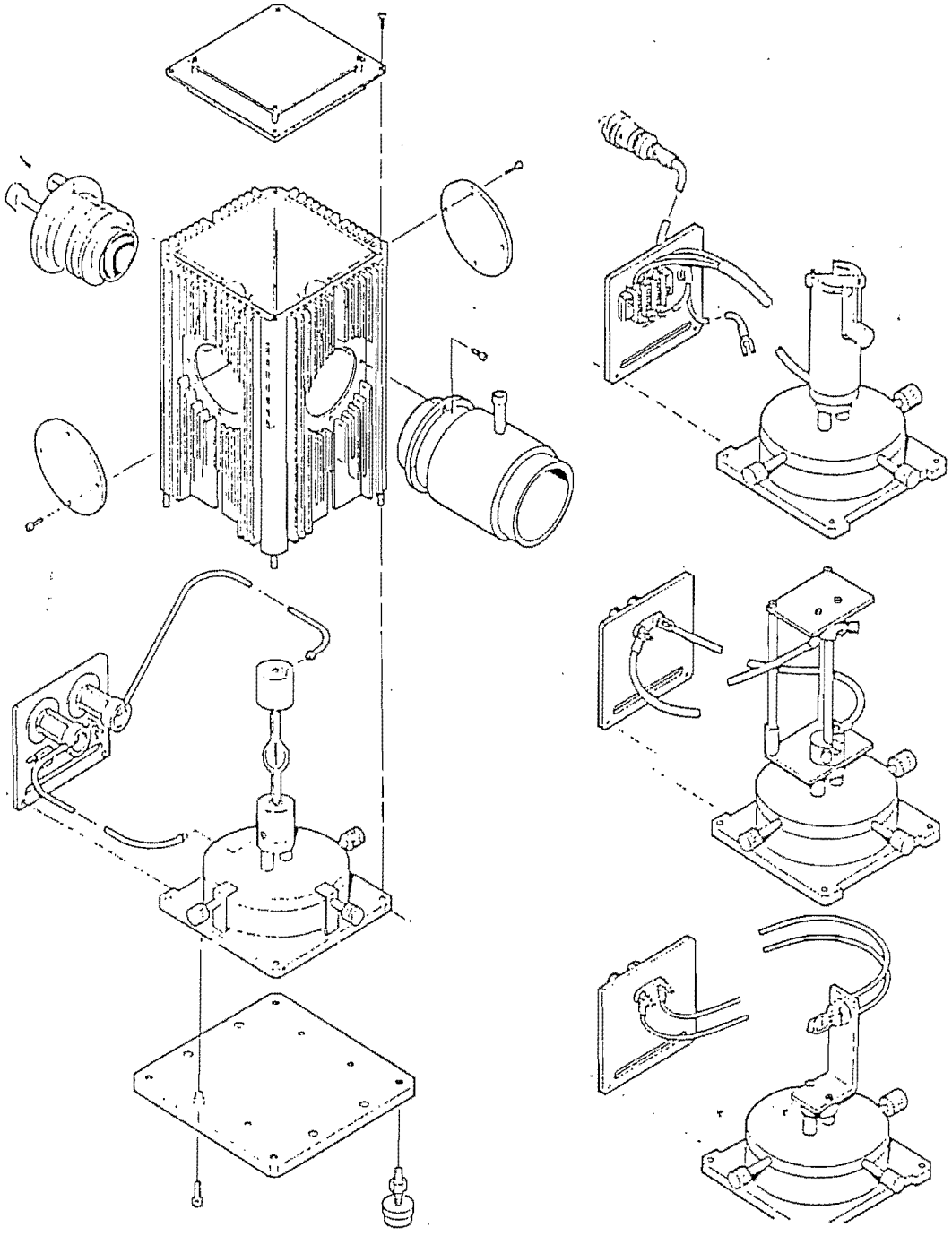


Figure 2 Series Q Housing and Components

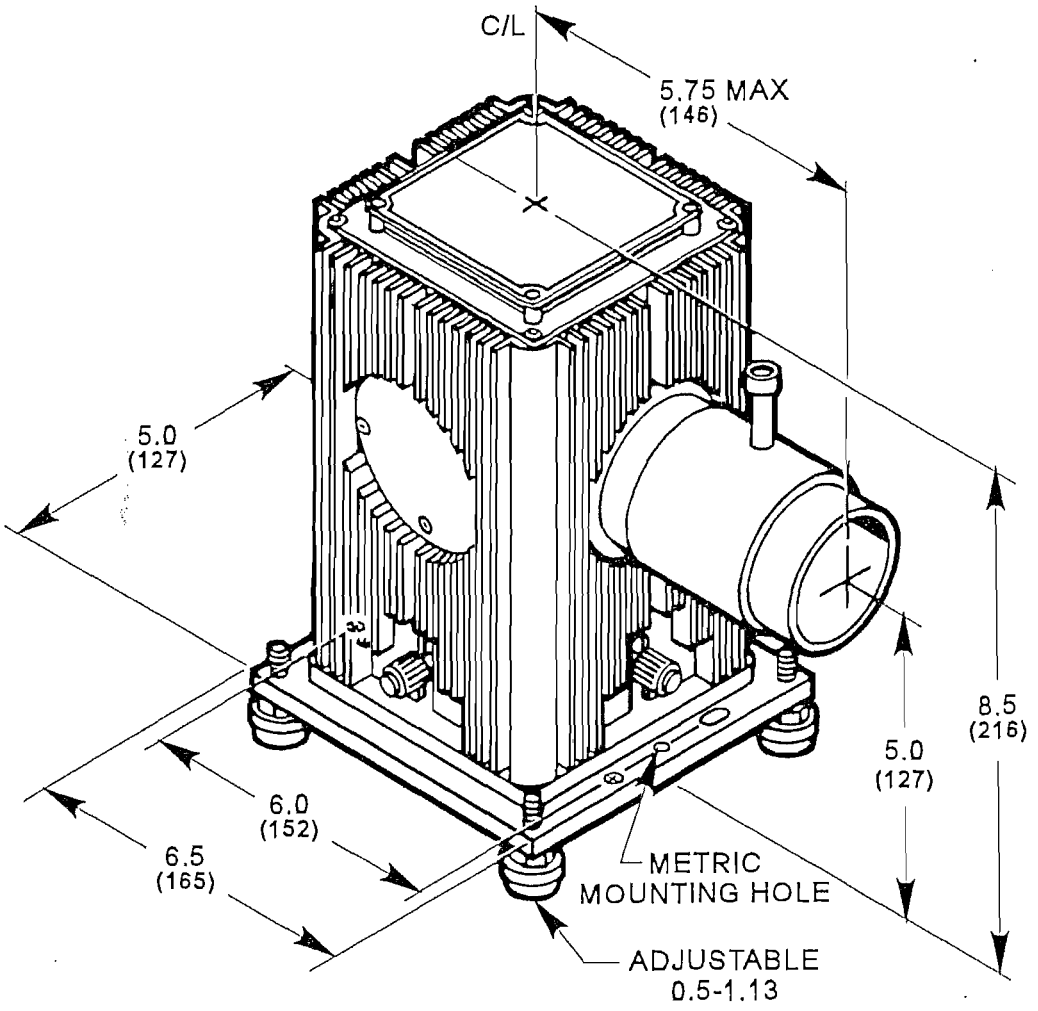


Figure 3 Dimensional Diagram

IV. CONFIGURATION OPTIONS AND ACCESSORIES

IV.1 INTERFACE KITS

You can operate arc, quartz tungsten halogen, deuterium lamps, and IR sources in the Series Q Housing by changing the interface kit and socket adapter. Tables 1 through 4 on pages 2 and 3 list the appropriate kits and socket adapters for each source.

All kits have a similar interface plates to the one shown in Fig. 4 for arc lamps; they are mounted as follows:

1. Partially loosen the (4) retaining screws, #1, and remove the upper housing shell by sliding it upward.

2. Secure the phenolic interface plate, #2, with the (2) socket head cap screws in the recess of the base, as shown in Fig. 4.

3. Follow the specific instructions on the following pages for each interface kit lamp and socket adapter listed below:

Interface Kit	Model Number	Page Number
DC Arc Lamps	60010	13
Pulsed Arc Lamps	60015	23
Large Bulb	60017	23
QTH and IR	60020	17
DC Deuterium	60023	19
Pulsed Deuterium	60024	22

Note: If you are installing an Arc Lamp, be sure to observe proper orientation as shown in Figure 6, page 15.

4. Lower the upper housing shell onto the base making sure the housing opening slides onto the phenolic interface plate, and the upper shell tabs "trap" the plate.

5. Insert the (4) grooved studs of the upper housing shell into the base and secure it by fastening the (4) retaining screws, #1.

Cable connections from the interface kit to the power supply are covered in the Interface Kit Manuals.

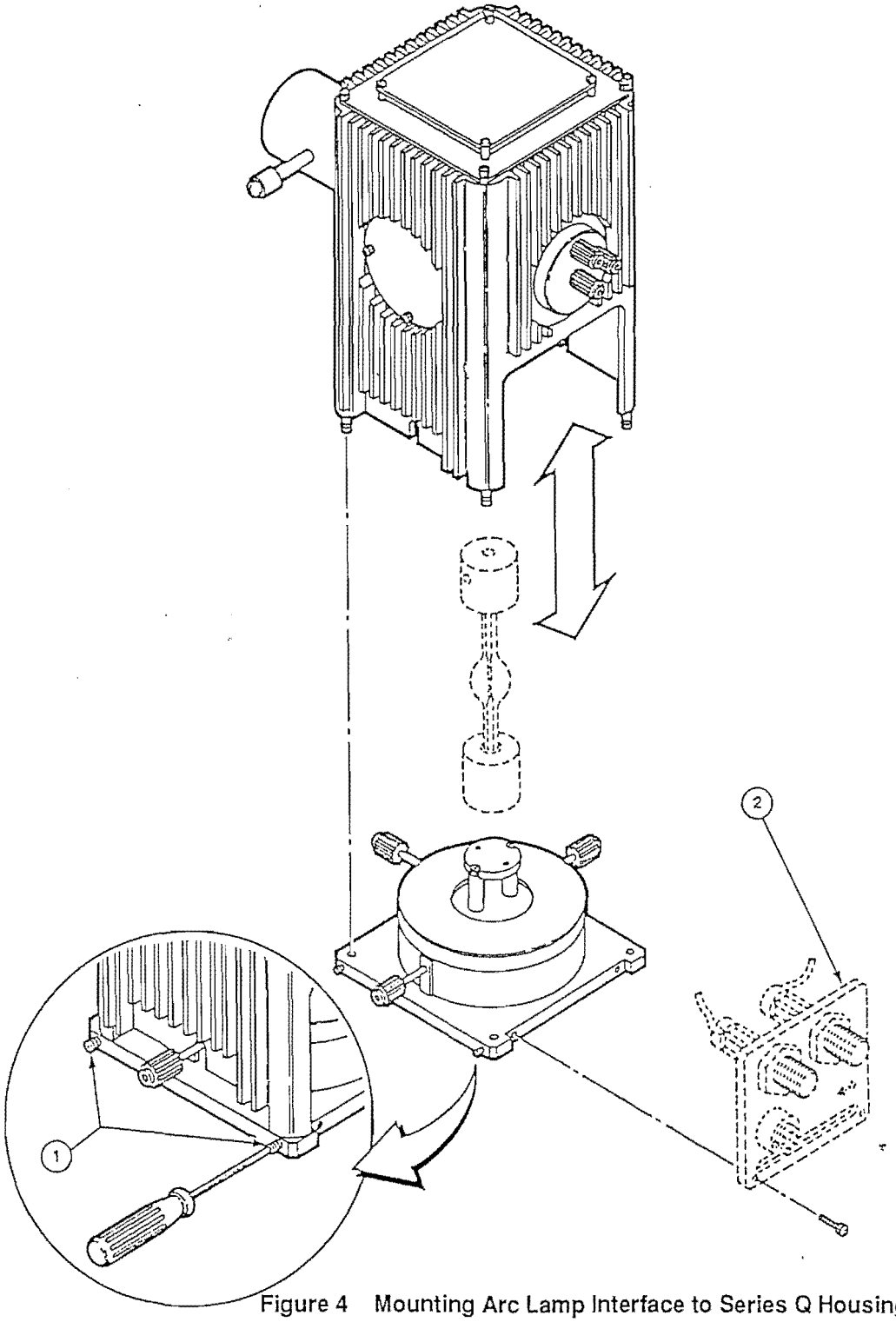


Figure 4 Mounting Arc Lamp Interface to Series Q Housing

V. ARC LAMP KIT

Arc lamp interface kit, Model 60010.

Socket adapter for:

100W Hg use Model 60012
50W Hg use Model 60013
75W Xe use Model 60014

To install these components and to make electrical connections, follow the steps listed below:

Interface Panel #60010 is designed for internal electrical connections to 75 Watt Xenon Lamps and 50 and 100 Watt Mercury Lamps.

V.1 INSTALLATION OF ARC LAMP INTERFACE KIT, MODEL 60010

(See Figure 5)

a) Place panel, item 1, on the recessed side of the XYZ positioner base.

b) Secure panel, item 1, with (2) screws #6-32 x 3/8, item 2 (enclosed).

V.2 INSTALLATION OF SOCKET ADAPTERS AND ARC LAMPS

(See Figure 5)

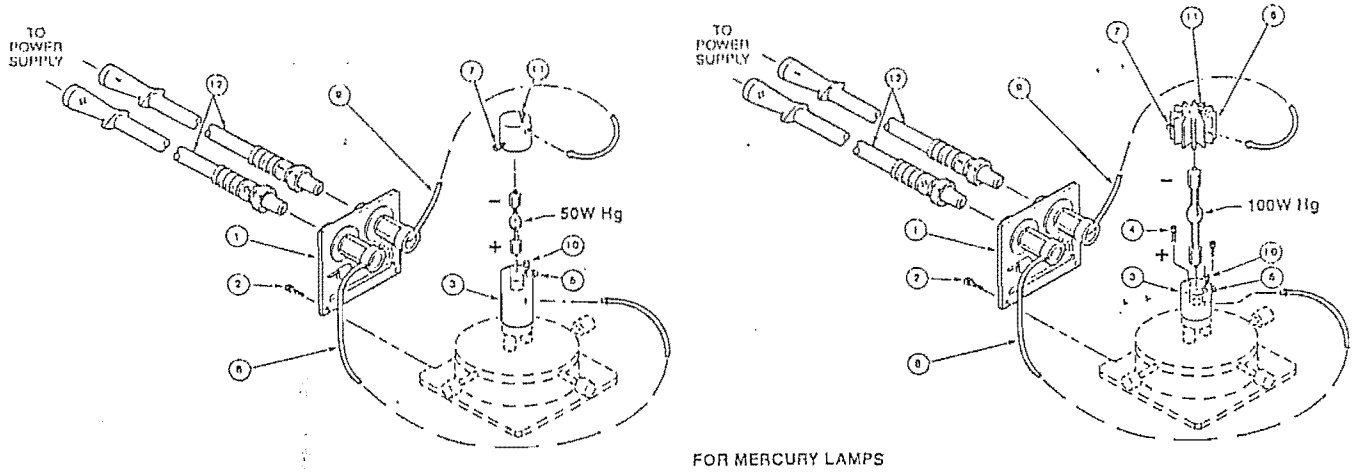
a) Install bottom socket adapter, item 3, using (2) screws #4-40 x 1/2, item 4 (enclosed).

For 100W Hg use Model 60012 Socket Adapter
For 50W Hg use Model 60013 Socket Adapter
For 75W Xe use Model 60014 Socket Adapter

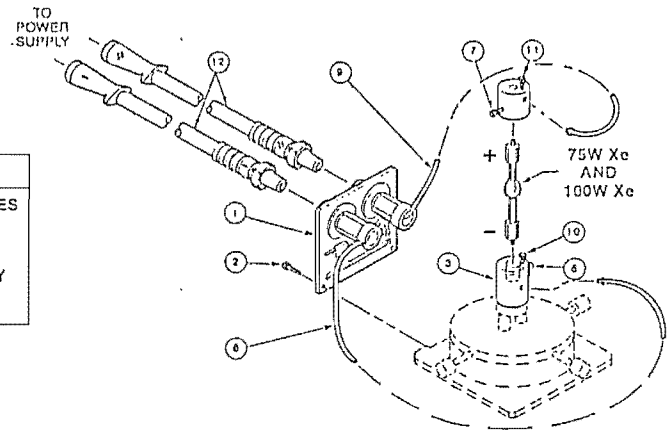
b) Install the bottom of the appropriate lamp into this terminal, secure the lamp using screw #4-40, item 5. (Use Allen wrench supplied with the Q-Housing, basic unit.)

c) Install the top terminal, item 6, on the top of the arcing lamp. (For 100W Hg, use the heat sink terminal with fins.) Secure top terminal, item 6, using socket head cap screw #4-40, item 7.

NOTE: All top and bottom terminals have labels for identification purposes, and the lamp must be in the correct orientation to avoid immediate damage. See Figure 6 to help identify the lamp.



FOR MERCURY LAMPS

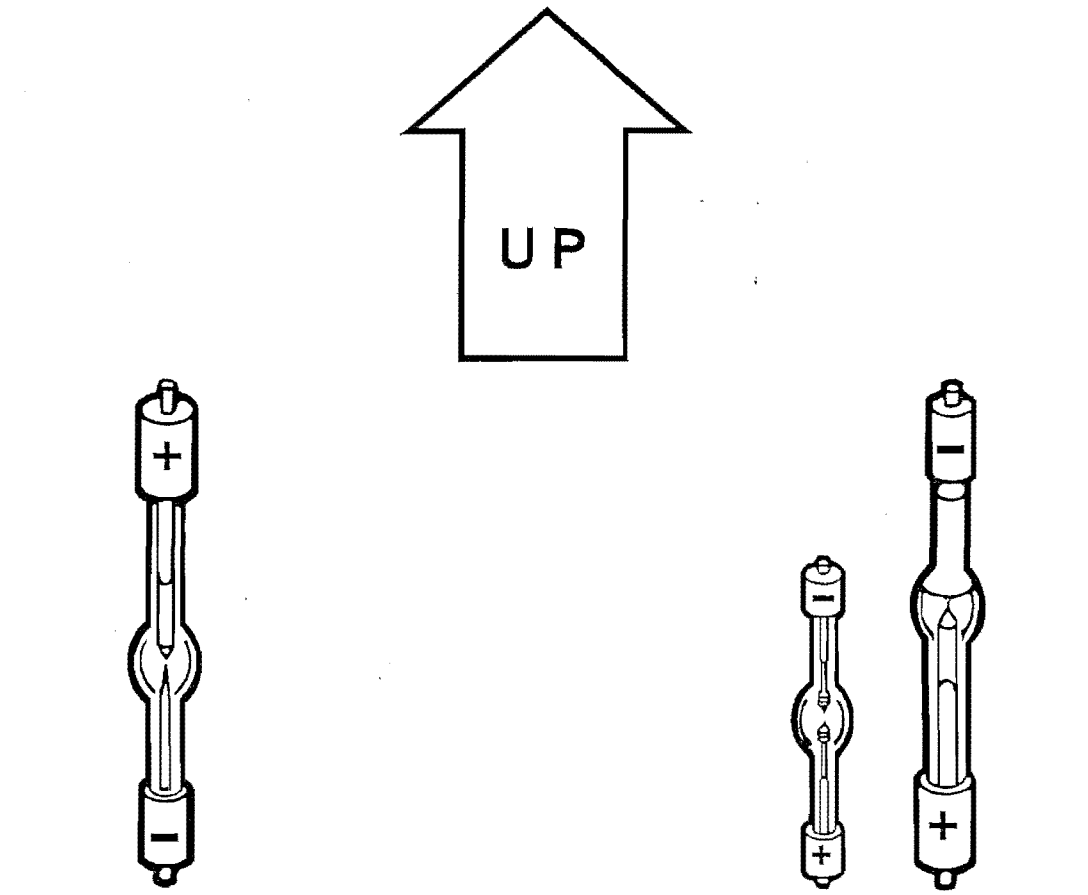


FOR XENON LAMPS

NOTE

MAKE SURE ALL ELECTRICAL CABLES ARE PROPERLY CONNECTED: POSITVE TO POSITIVE, NEGATIVE TO NEGATIVE, AND THAT THE LAMP TERMINALS ARE CORRECTLY ORIENTED AS SHOWN IN THE ILLUSTRATIONS.

Figure 5 - Interface Kit #60010



TYPICAL
XENON
LAMP

TYPICAL
MERCURY
LAMPS

ANODE UP

ANODE DOWN

Figure 6 - Arc Lamp Orientation

V.3 ELECTRICAL CONNECTIONS

a) Connect the cable, item 8, to the bottom terminal, item 3. Secure the contact using the socket hd cap screw #4-40, item 10.

b) Connect the cable, item 9, to the top terminal, item 6. Secure the contact using the socket hd cap screw #4-40, item 11.

c) Connect two H/V cables (negative and positive), item 12 to the appropriate connectors on the panel, item 1. Follow mark-up instructions on the exterior panel for polarity of the appropriate lamp..

V.4 REASSEMBLE Q-HOUSING SHELL.

(See 60000-M)

Continue with the instructions of section IV.1.4 to complete the installation.

VI. MOUNTING INSTRUCTIONS-MODEL #60020-INTERFACE KIT SOCKET ADAPTER & LAMPS

Interface Kit, Model 60020, is designed for internal electrical connections to:

a. tungsten halogen light sources
b. glowbar IR elements

The mount consist of the following components (see Figure 7):

a. Interface panel
b. Mounting hardware

To install the interface panel, follow the steps listed below:

Interface Panel, Model #60020 is designed for internal electrical connections to Tungsten Halogen Sources, Glow Bar IR Elements and IR Ceramic Glowers. The XYZ positioner shown in the Figure is not included.

VI.1 INSTALLATION OF THE LAMP INTERFACE KIT

Remove the shell from the Q-housing and install the panel as described in IV.1.1 and IV.1.2 Follow the instructions provided with the basic unit (60000-M).

VI.2 INSTALLATION OF SOCKET ADAPTER & QUARTZ TUNGSTEN HALOGEN LAMPS & IR ELEMENTS

a. Mount the socket adapter to the base of the XYZ stage with the two (2) #4-40 x 1/2 screws.
b. Connect the two leads to the previously mounted interface panel.
c. Make the electrical connections by connecting the fork lugs, item 3, to the appropriate power supply.

VI.3 REASSEMBLE THE Q-HOUSING SHELL

Continue with the instructions of Section IV.1.4 to complete the installation.

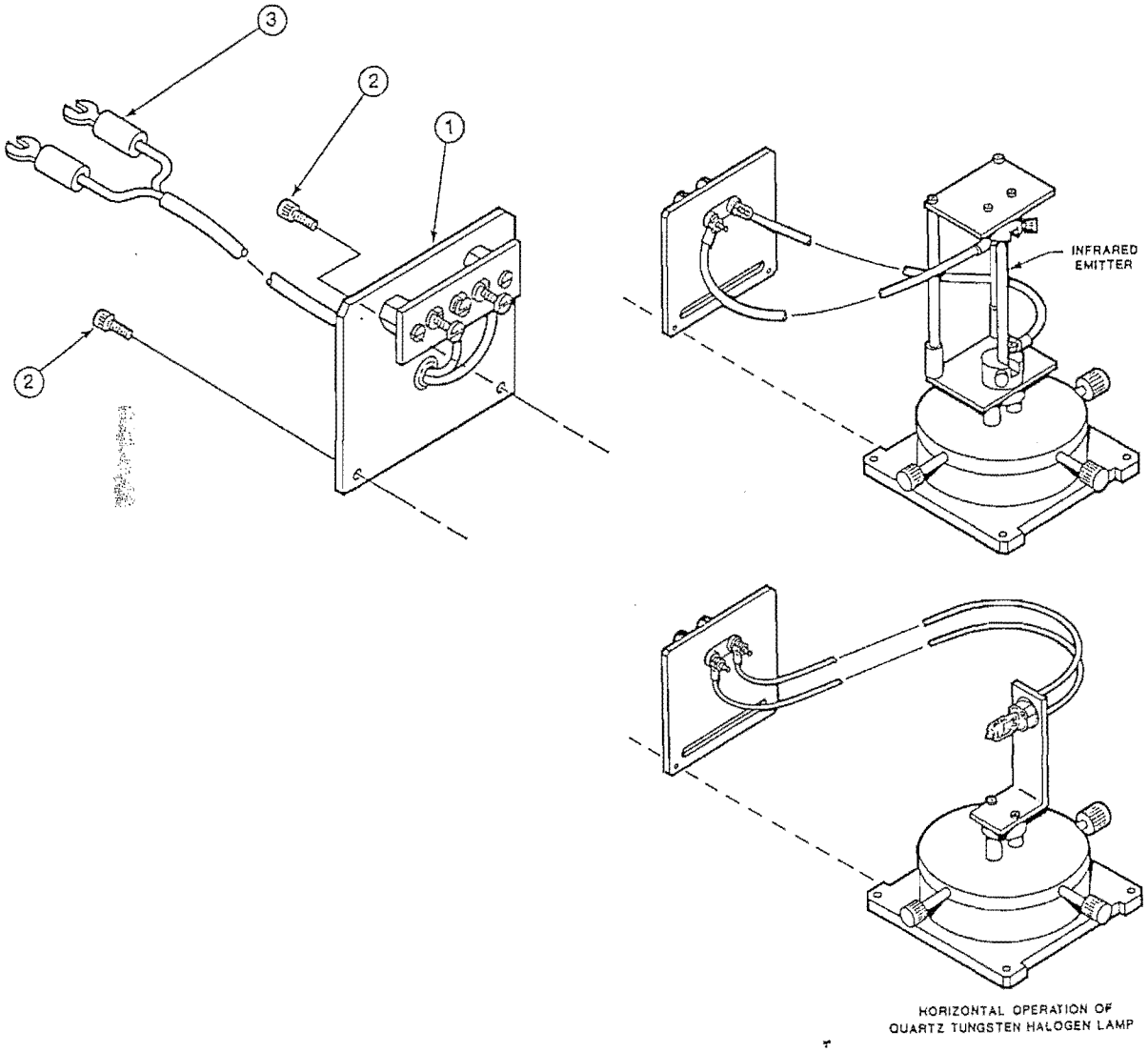


Figure 7 - QTH Glower Mounting Configuration

VII. MOUNTING INSTRUCTIONS - MODEL #60023 - INTERFACE KIT & LAMP MOUNT

Interface Panel #60023 is designed for internal electrical connections to DC Deuterium Lamps.
Note: The XYZ positioner shown with Figure 8 is not included with this kit.

The kit consists of the following components: (See Figure 8)

a. Deuterium Lamp Mount, item 1
b. Deuterium Panel Assembly, item 2
c. Miscellaneous mounting hardware

NOTE: The XYZ-Positioner shown in Figure XX is not included with this kit.

Follow the steps listed below to install the deuterium lamp mount (See Figure 1):

VII.1 INSTALLATION OF THE LAMP MOUNT AND DEUTERIUM INTERFACE PANEL

Attach the lamp mount and deuterium lamp assembly to the XYZ Positioner:

a. Place the lamp mount, item 1, on the mounting platform of the XYZ Positioner so that the Guide strips, item 3, are located opposite to the position where the deuterium panel, item 2, will mount. This position is shown in Figure 8.
b. Secure the lamp mount to the platform using the (2) #4-40 x 1/2 screws, item 4, enclosed.
c. Secure the deuterium interface panel, item 2, (as shown in Figure 8) using the (2) enclosed #6-32 x 3/8 screws, item 5.

VII.2 DEUTERIUM LAMP INSTALLATION

a. Place deuterium lamp into the U-shaped slot formed by the guides, item 3, in item 1. Position the three wires, as shown, in the base of item 1, and position the snout and window of the lamp between the guides.
b. Secure the lamp in place using the two retaining springs, item 6:

    i. Pinch the first spring near the free end between thumb and forefinger. Pass the spring over the lamp and slip the end loop of the spring over the set screw extending from the guide.
    ii. Repeat with the second spring.

c. Slide the lamp down until the window is approximately in line with line "L".

VII.3 ELECTRICAL CONNECTIONS

a. Connect the green lead from the power cable to the grounding screw, item 7, located on the base plate of the XYZ Positioner.
b. Connect the anode lamp lead (red) to the red wire contact on the terminal block, item 8. Connect the cathode lamp lead (black or blue) to the black/blue wire contact on the terminal block. Connect the filament lamp lead (blue) to the white/brown wire contact on the terminal block.

Note: If the cathode and filament lamp leads are both blue, their connections are interchangeable.

VII.4 REASSEMBLE THE Q HOUSING SHELL

Continue with the instructions of Section iv.1.4 to complete the installation.

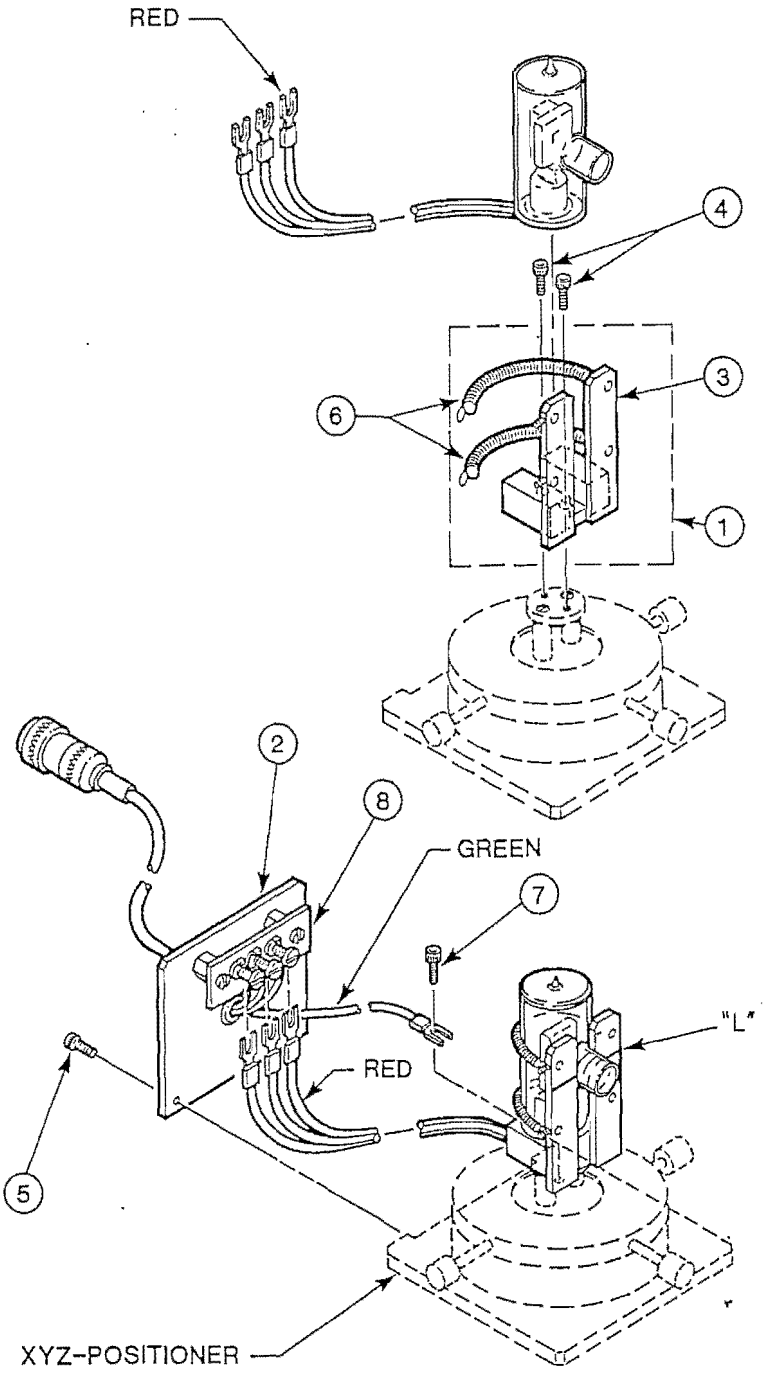


Figure 8 - Deuterium Lamp Mounting Configuration

VIII. MOUNTING INSTRUCTIONS-MODEL #60024-INTERFACE KIT-PULSED DEUTERIUM LAMP

1. Remove Q Housing Shell Item #10.
2. Place the pane, item 1, on the recessed side of X, Y, Z positioner base item 7.
3. Secure item 1 with (2) screws #6-32 X 3/8 long, item 5.
4. Attach the lamp mount, item 3, to the X, Y, Z positioner, item 7, as shown and secure with (2)screws #4-40 item 4.
5. Place deuterium lamp, item 8, onto the U-shaped slot of item 3 and secure with the two retaining springs item 9.
   A. Pinch the first spring near free end between thumb and forefinger. Pass spring over the lamp and slip the end loop of the spring over the set screw extending from the guide.
   B. Repeat with second spring.
6. Slide the lamp down.
7. Connect the wires of the lamp to item 2 as follows:

LAMP WIRE COLOR	ITEM 2 WIRE TERMINAL COLOR
Red	Red
Blue	Blue
Black	Black
Black (Dk Green)	Brown

If the lamp has 2 black wires, then connect one to blue if item 2. Connect item 6 to the base.

VIII.1 REASSEMBLE THE Q-HOUSING

Continue with the instructions of section IV.1.4 to complete the installation.

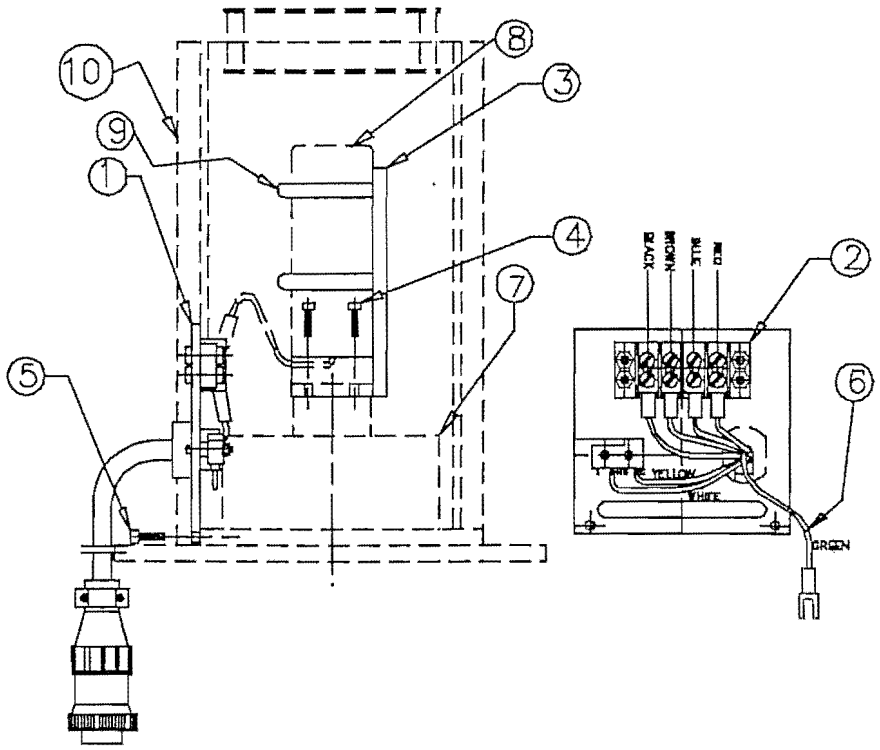


Figure 9 - Pulsed Deuterium Lamp Mounting

IX. MOUNTING INSTRUCTIONS -#60015 CAPILLARY AND GUIDED LAMP INTERFACE KIT

1. Remove the shell, item 1, from the Q-Housing. Follow the instructions previously described

2. Place the panel of the interface kit, item 2, the recessed side of the X, Y, Z positioner base, and secure with (2) screws #6-32 X 3/8 long, item 3.

3. Make the electrical connections, by connecting the fork lug, item 4, to the base (ground), of the X, Y, Z positioner and the 7 pin connector, of interface, item 2, to the power supply.

4. Reassemble the Q Housing shell panel.

   Continue with the instructions of Section IV.1.4 to complete the installation.

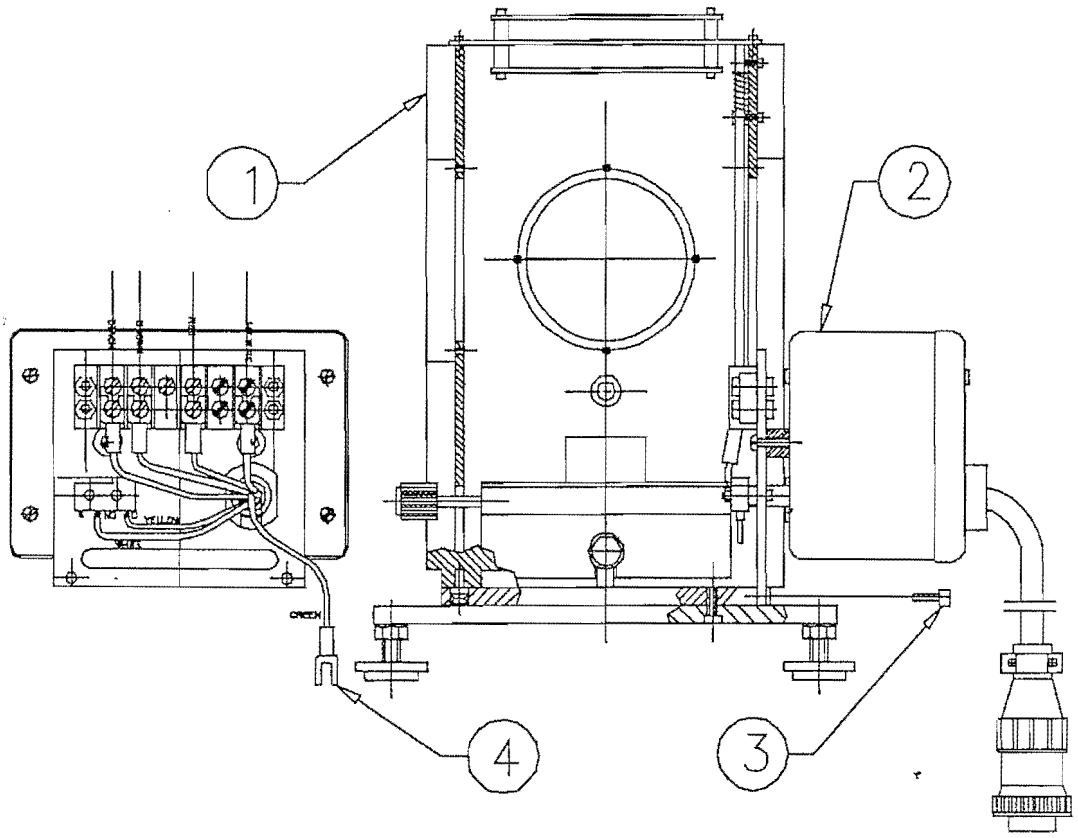


Figure 10 - Pulsed Arc Lamp Mounting

X. ADJUSTMENT OF LAMP, MIRROR AND LENS WITH THE 60005 REFLECTOR ASSEMBLY

X.1 GENERAL

In these housings, the optional 60005 Reflector Assembly collects radiation behind the source, increasing output by up to 60% with arc lamps. You can also get more output for QTH lamp. This option is not for use with Deuterium lamps or infrared sources.

The mirror is adjusted with respect to the lamp by three knobs located directly behind the mirror on the mounting plate. The knobs provide adjustments for X, Y, and Z for tilt and focus.

- CAUTION -

DO NOT LET THE MIRROR IMAGE OF THE ARC FALL ONTO EITHER ELECTRODE. OVERHEATING OF THE LAMP SEALS AND SUBSEQUENT LAMP EXPLOSION MAY RESULT.

X.2 ADJUSTMENTS PRIOR TO OPERATION

a. Before Ignition, roughly adjust the lamp position. Adjust the lamp so the arc gap lies approximately in the center of the condensing lens. This can be seen through the lens if the focusing lever on the lens is full back.
b. If you have appropriate safety equipment, ignite and warm up the arc lamp per the instructions in the ignitor/power supply manuals.

X.3 ADJUSTMENT DURING OPERATION

a. By adjusting the condensing lens, focus the output beam so an image of the arc appears on a wall or screen. Do not view UV images without safety glasses.
b. Adjust the lamp position to center the output in the condenser lens aperture. You can place a piece of paper over the condenser output and center the beam on the aperture.
c. Rotate the mirror knobs until a bright spot appears alongside the arc. (See Figure 11 on the following page.) This bright spot is a distorted image of the arc.
d. Place the mirror image over the main (directly) image (as in Figure 12 on the following page) or alongside, as desired. You may need to use iterative adjustments to keep a focused mirror image.
e. Focus the condensing lens as desired.

- CAUTION -

YOU CAN SUPERIMPOSE THE TWO IMAGES, BUT AVOID REIMAGING THE ARC HOT SPOTS ONTO THE ELECTRODES. THIS CAN CAUSE OVERHEATING OF THE LAMP.

If additional range of adjustment of the condensing lens is desired:

a. Remove the condensing lens assembly handle (take care to record the orderly assembly of its parts.)
b. Slide the inner lens barrel forward or back by hand until another tapped hole appears in the spiral slot.
c. Reassemble the handle into this new hole.

X.4 LAMP OPERATION AND COOLING

These arc lamps should be operated close to their rated power. Dropping the power below 80% of rated, can lead to unusual lamp performance, eventual instability, and shortened life. With mercury lamps it can also lead to cooling problems.

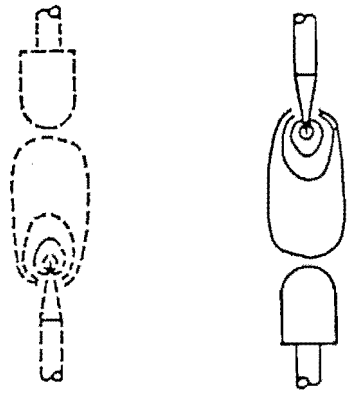


Figure 11 The electrodes as viewed on a screen in front of the condenser lens are inverted (right). The reflector image as a screen (left) is doubly inverted so the anode of a xenon or mercury (xenon) lamp appears on top.

Figure 12 Correctly positioned reflector overlays the inverted arc image on the arc gap. The image is the same size as the arc itself.

XI. LIGHT COLLECTION

Five different types of condensing lens assemblies are offered for the Series Q. Order them separately from Volume II. They are:

60006 F/1.5 Condensing/Collimating Lens Assembly
60007 F/1.8 Condensing/Imaging Lens Assembly
60008 F/0.85 Condensing/Collimating Lens Assembly
60009 F/1.1 Condensing/Collimating Lens Assembly
60076 F/1 Condensing/Collimating Lens Assembly, fused silica
60077 F/1 Condensing/Collimating Lens Assembly, zinc selenide

These lens assemblies are designed for efficient collection of light from the source. In order to get the best performance from the Series Q with a condenser, we first review some aspects of light collection and then describe how to set the lens position.

By moving the focusing lever on the condenser you can move the position of the condenser lenses to produce a diverging beam, "collimated beam" or to re-image the source. Most of the lens assemblies (except the 60007 F/1.8 condenser which produces a 1:1 image of the source) are designed for collimation rather than imaging. The lens shape and orientation are selected to minimize lens induced distortions (aberration) when the lenses are close to the position which produces a collimated beam (the collimating position). When you use them for imaging, there are two penalties; lens aberrations increase* and light collection is reduced. For imaging, the lens is moved further from the source, and so gathers less of the light emitted by the source within its aperture. The lens operates at a higher F/#.

*See Volume III for a comprehensive discussion on aberrations.

To simplify the discussion, we first describe the operation of an ideal lens and then some of the major results of aberrations.

X.1 COLLIMATED BEAMS

The usual concept of a collimated beam is a parallel cylinder of light. If the intensity is the same anywhere across a section of the cylinder, the beam is uniform. Unfortunately there is no source of a uniform, perfectly collimated beam.

Even expensive laser sources have some residual divergence, in the limit governed by the laws of diffraction, and they usually have non uniform though sometimes known intensity distributions.

Arc lamp sources with an ideal condenser lens in the collimating position produce beams which depend on the source size and intensity distribution.

A pinhole source at the focus of an ideal lens produces a beam which is close to the ideal collimated beam. In Fig.8 we show a second pinhole source a distance "d" from the first.

The beam from the second pinhole will also be collimated but at an angle arctan (d/F) with the first. Any extended source can be thought of as a whole set of touching pinholes. The beam after the lens is the sum of all the beams from all the pinholes. It will contain rays with angles up to D/F where D is the largest dimension of the source. The beam will have a divergence which depends on the sum of the light from all the points on the source. Obviously this divergence will depend on the size of the source and the intensity of the various "pinholes" or points on the source.

Most arc sources are non uniform and are not circular. Therefore, the divergence in one plane is not the same as that in the orthogonal plane. For most design purposes, the arc sizes quoted in Volume II and the lens focal length give a good guide to divergence.

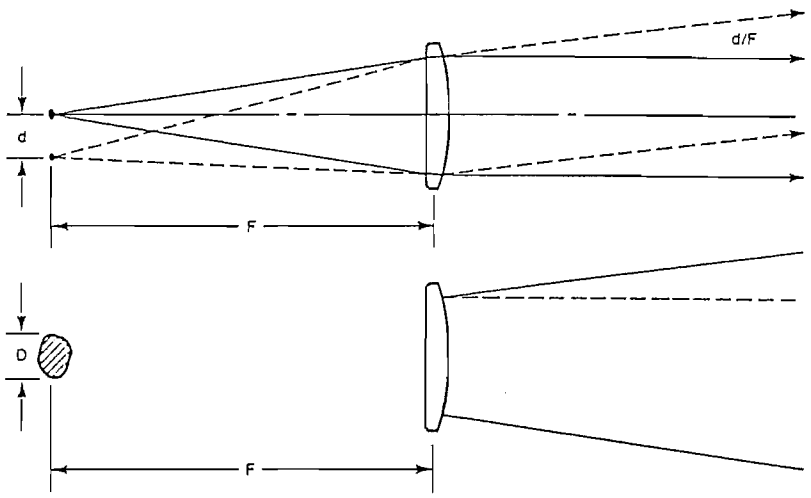


Figure 13 For most arc sources the divergence in one plane is not the same as that in the orthogonal plane.

X.2 IMAGING THE SOURCE

You can reimage the source with one of the collimating condensers by positioning the condenser further from the source using the focusing lever. Volume III describes imaging and provides the formula. As the condenser lens is moved out, the image moves in and becomes smaller. As already indicated, the lens collects less light as it is moved away from the source. Additionally, the convergence angle of the beam goes up as the image becomes smaller. This is not usually important for irradiance of a surface, but can be significant if the image is on the slit of a monochromator, optical fiber, or other optical system with limited acceptance angle. We normally use a secondary focusing lens to maximize the light through a slit or into a fiber optic.

Fig. 14 shows the higher convergence produced when creating a small arc image.

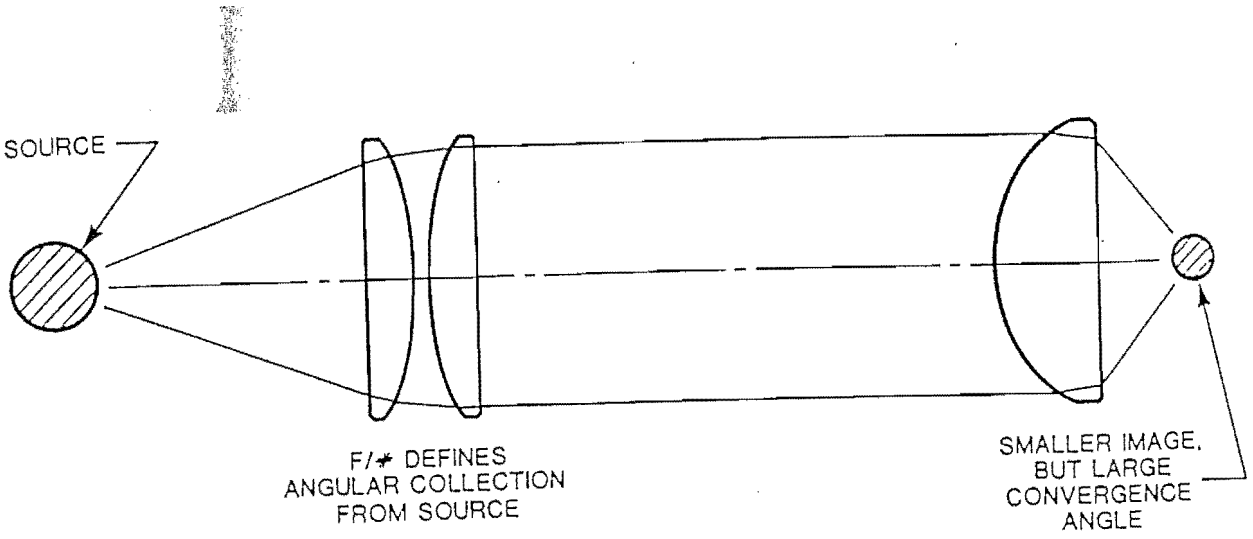


Figure 14 A source focused to a smaller image.

X.3 UNIFORMITY

Arc sources are not uniform and usually have an intensity peak near one electrode. Intensity contours shown in Volume II indicate arc uniformity. The collimated beam comes from pinhole sources which are not equally intense in addition to being spatially distributed. The result is a smooth, non-uniform beam with some divergence. Figure 15 shows a scan of optimally collimated beam in the vertical and horizontal planes. The source was a 200 W Hg arc.

Most arc sources are non uniform and are not circular. Therefore, the divergence in one plane is not the same as that in the orthogonal plane. For most design purposes, the arc sizes quoted in Volume II and the lens focal length give a good guide to divergence. For low divergence beams you should consider the small arc sources and, if necessary, use our Spatial Filter Assembly (Volume II).

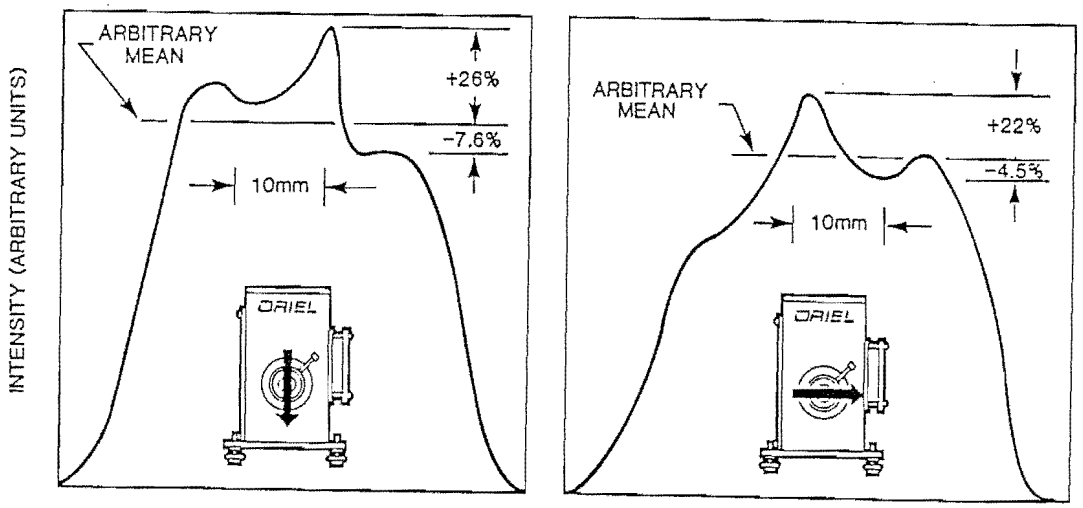


Figure 15 The collimate output of a 200 W Hg lamp in the vertical and horizontal planes.

X.4 REAL LENSES

The condenser lenses are intended for efficient light collection. They operate at low F/#s. As a result the single element F/0.85 and F/1 lenses suffer from severe aberrations, particularly spherical aberration. The doublet F/1.5 lens is somewhat better. Note that the collimated lenses perform best while collimating the light from the source.

X.4.1 SPHERICAL ABERRATION

This aberration results from the fact that the ideal lens, the aberration free lens, is not spherical in shape. With the exception of the aspheric (F/0.85) condenser, these condenser lenses, like most lenses, have spherical surface shapes for economic manufacturing. In general, spherical aberration is decreased by dividing the refraction, (light bending) as equally as possible between as many surfaces as possible. The lens shapes (plano-convex for the fused silica singlets) of our condensers and orientations minimize spherical aberration for the type of condenser and at the collimating position.

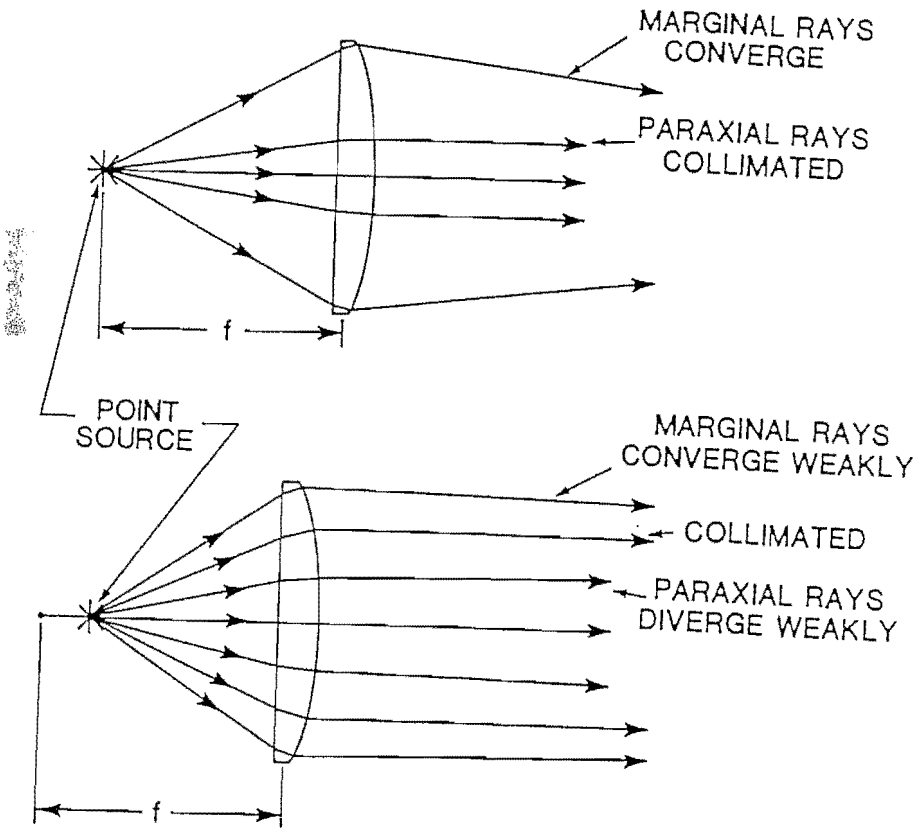


Figure 16 The marginal rays and the paraxial rays are collimated when the point source is at the paraxial focus, and the plano surface of the lens faces the point source.

Consider the simple plano convex lens collimating light from an ideal point source. With the plano surface towards the point source and the point source at the (paraxial) focus the marginal rays converge while the paraxial rays are collimated. (Fig. 16) This is due to spherical aberration. For the ideal, non spherical lens shape, the paraxial and marginal rays are all collimated. If the source is located about 1/4 f inside the focus, the paraxial rays diverge slightly and the marginal rays are almost collimated. This is often the optimum compromise for a single element collimating lens (and has the added advantage of collecting more light from the source).

The lens adjustment on these condensers allows the lens to be moved closer to the source than the paraxial focus. You can empirically find the best position for your system.

X.4.2 CHROMATIC ABERRATION

The term "chromatic aberration" describes the variation of lens focal length with color. (Fig. 17) This variation is due to the change in lens index of refraction (n) with wavelength. As the wavelength goes up, n goes down and the focal length increases.

This causes problems in producing multi-wavelength collimated beams, but is usually a second order effect compared with source and spherical aberration limitations. Chromatic aberration usually becomes more important when UV wavelengths are to be collimated. The reduction in focal length (f) for a fused silica lens from the visible value of f to 0.91 f at 250 nm may require a change of lens for optimum performance. Contact Oriel for details.

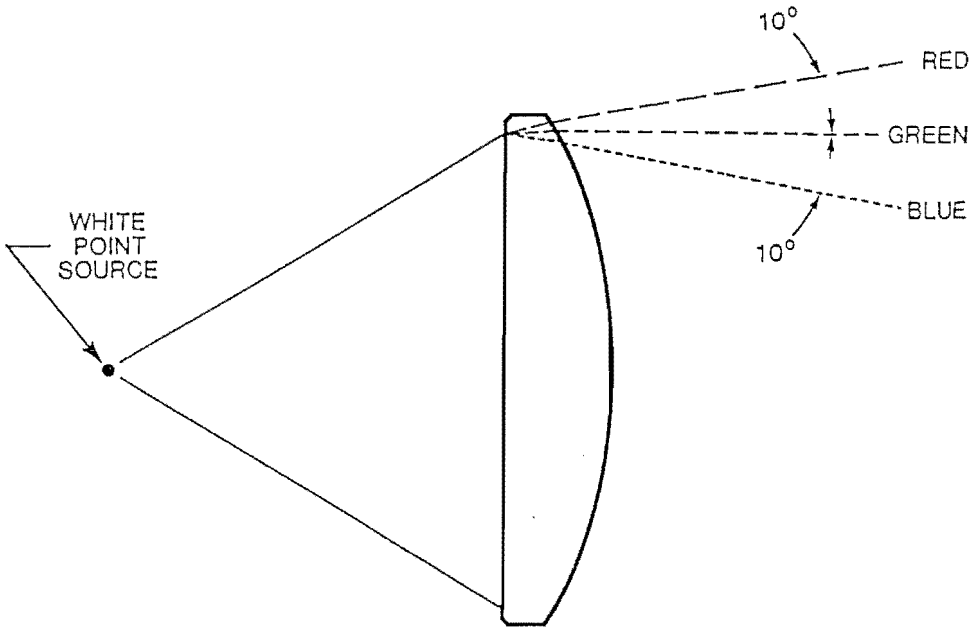


Figure 17 Chromatic aberration: different wavelengths are focused at different points.

X.5 HOW DO YOU POSITION THE CONDENSER TO GET A COLLIMATED BEAM?

You should image the source on the most distant wall in your laboratory (remembering appropriate safety measures) to get close to the collimation position. You can then move the lens barrel in a small amount for best collimation. If your wall is 2 meters away, a 1.3 mm adjustment is required. For 3 m and 4 m, the corresponding numbers are 0.8 and 0.6 mm.

XI ADDITIONAL OPTIONS FOR THE Q-HOUSING

X1.1 ADAPTER KIT FOR INTENSITY CONTROLLER SYSTEM

The ORIEL Model 68850 Intensity Control interfaces with several Oriel Power Supplies to maintain a constant light level regardless of lamp aging, line voltage variations, or changes in ambient temperature. The 68850 includes a temperature stabilized light sensing head, controller unit with readout, and three signal cables.

The Controller connects to the sensing head with two signal cables. The sensing head reads the real time light level of the source and converts the light signal to an electrical current. The current passes to the controller via the BNC cable. The controller will regulate the light level and control the arc lamp power supply through a third cable. See Figure 18.

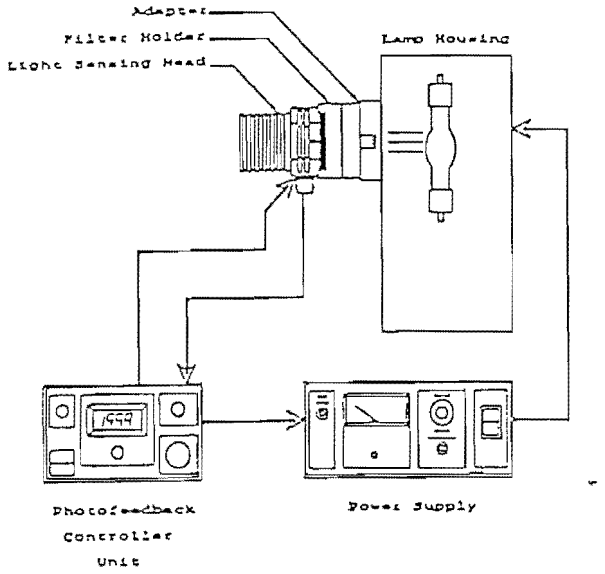


Figure 18 - Typical Intensity Controller System

X1.2 HEAT ISOLATOR ADAPTER KIT

The optional Oriel Model 68856 Adapter Kit mounts the sensing head with the filter holder (included) to the Oriel Q Series housing. See Figure 19 below.

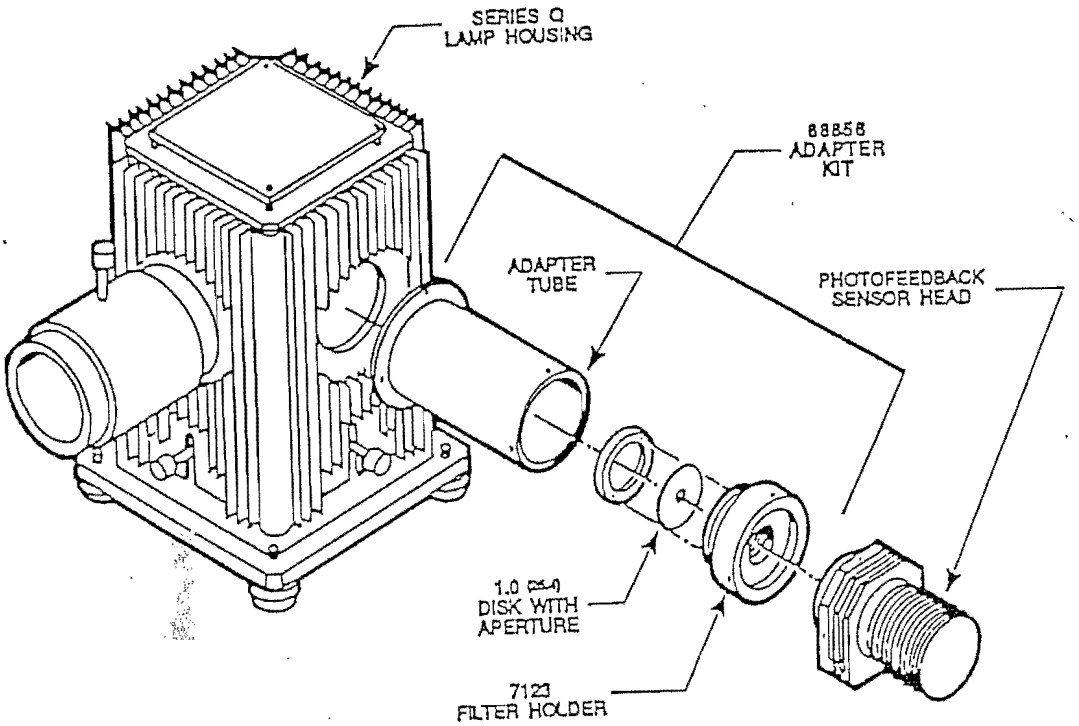


Figure 19 - 68856 Adapter Kit Mounting to the Q Series Housing

The Q housing transfers most of its heat out through the surface. Heat at the adapter mounting surface will adversely affect the photofeedback detector head. For this reason the 68856 Adapter Kit mounts the detector head to the end of a four inch length of PVC tube. This creates a thermal gradient from the housing to the detector head.

The 68856 includes a 7123 Filter Holder with a 1.0 mm and a 2.0 mm Aperture Disk to attenuate the beam hitting the photodiode. This is to insure that the light level applied to the photodiode does not exceed device specifications.

Note: This mounting technique will not work for Deuterium lamps since they do not have adequate side emission. A rod mounted sensing head used with a wedged beam splitter is the correct set up for a Deuterium lamp.

X1.3 ELECTRONIC SAFETY SHUTTER

The Oriel Model 71445 Electronic Safety Shutter may be used for timed exposures or to close off the beam when your source is not in use. You can mount the shutter to the condenser output of any of the condensing lens assemblies listed in Section III.3, or use a rod mount for an optical table. The Shutter Drive and interconnection cables are included. The Shutter Drive has TTL and Contact Closure inputs for interface with an Electronic Timer, Programmable Logic Controller, Computer or other triggering device.

XII. TROUBLESHOOTING

XII.1 INTRODUCTION

This section deals with procedures to follow if you encounter specific difficulties in operating the 60000 Series Q. Additional details for repairing the lamp housing circuitry are available from Oriel, but in general we do not advise attempting to work on the circuitry.

XII.2 PROBLEMS

Arc Lamp will not light after several repeated presses of the "lamp start button" on the power supply.

The most common problem experienced when using this Lamp Housing is difficulty in starting ab arc lamp. The problem may be in the Lamp Housing, in the Power Supply, in the Ignitor, or with the lamp. The following procedures should help you identify the problem area. If you cannot locate the source of the problem, and do not have other Lamp Housings or Ignitors/Power Supplies to interchange as a problem finding technique, we recommend you send **the complete system**, Ignitor, Power Supply, Lamp Housing and lamp to Oriel for diagnosis of the failure mode.

Recommended Procedures

1. Check that the Power Supply is operating - power breaker light, and fan.

2. Check that there is pre-ignition voltage available from the Power Supply.

3. Move the toggle switch on the Power Supply to the voltage position and check that there is an open circuit voltage of more than 100 volts. If not, check the interlock circuit. If there is no pre-ignition voltage then the interlock circuit may not be closed.

   First, check that the cover of the Lamp Housing is fully closed thus activating the door switch. This may cure the problem. If not, check the interlock fully. You can do this by using a shorted interlock plug to plug into the Power Supply. If you do not have a shorted plug, remove the plug from the Lamp Housing and short the terminals using wire. Check for pre-ignition voltage. If there is no voltage then there is a problem with the Power Supply. If the voltage is present using the shorted plug, but is not there when you connect the interlock to the Lamp Housing, then there is a problem with the Lamp Housing interlock circuitry.

   The simple circuit is located inside the Lamp Housing. After removal of all power (lamp and fan power), check inside the housing for a broken wire or thermostat which is jammed open.

   If you cannot trace the fault, contact Oriel for advice. Do not operate the Lamp Housing with a defeated interlock.

4. Check the main power connections to the Lamp Housing and Ignitor/Power Supply.

5. Check the lamp and the internal connections to the lamp.

   Remove the lamp and fan power from the Housing, open the Lamp Housing and check the lamp and the contacts for proper contact. You may need to remove the lamp and examine it. Assuming no catastrophic damage, check for cracks in the lamp or lamp stem. Examine the molybdenum strip conductors inside the lamp stem for continuity. Small breaks in these conductors will prevent lamp operation. Examine the electrodes for excessive "burn Back" or rounding. If the lamp has a trigger wire, check that it is properly attached.

6. Lamps do not reach the correct current/voltage.

   If a mercury lamp is not running at the correct temperature, it will not reach the correct current/voltage. If the lamp is running at its rated power but the lamp current is too high and the voltage is too low, the lamp is being overcooled. If the lamp is running at its rated power but the lamp voltage is too high and the current is too low, it is being undercooled.

   Recommended Procedures

   a. Remove any source of external forced air which may be cooling the lamp focusing.
   b. Check for proper physical orientation of lamp.

7. You cannot image the arc properly, some distance from the Lamp Housing.

   Normally you should be able to image the arc on a surface some feet or meters away from the Lamp Housing by simply adjusting the condenser lens position. You should also be able to adjust the lamp position to center the beam in the condenser barrel output aperture.

   Recommended Procedures

   a. If you still cannot image the arc, remove all power from the Lamp Housing, allow the lamp time to cool, and then check for a broken condenser lens.
   b Open the Lamp Housing and check the vertical lposition of the lamp. The arc gap should be positioned in the center of the reflecting mirror. If you have the appropriate adapters for your lamp you should be able to position it correctly. If not, call Oriel for further information.

8. You cannot image the arc close to the Lamp Housing.

   You should not have a problem imaging the arc some feet or meters away from the Lamp Housing. You may have problems imaging the arc close to the housing because the condenser lens adjustment does not allow the condenser to be located in an appropriate position. As you move the lens out, the image plane moves towards the lens. The closest image plane is determined by how far out you can move the lens.

WARRANTY AND RETURNS

WARRANTY

Oriel Instruments warrants that all goods described in this manual (except consumables such as lamps, bulbs, filters, ellipses, etc.) shall be free from defects in material and workmanship. Such defects must become apparent within the following period:

1. All products described here, except spare and repaired parts: one (1) year or 3000 hours of operation, whichever comes first, after delivery of the goods to buyer.

2. Spare parts: ninety (90) days after delivery of goods to buyer.

3. Repaired items: ninety (90) days after delivery of goods to buyer.

Oriel Instruments' liability under this warranty is limited to the adjustment, repair and/or replacement of the defective part(s). During the above listed warranty period, Oriel Instruments shall provide all materials to accomplish the repaired adjustment, repair or replacement. Oriel Instruments shall provide the labor required during the above listed warranty period to adjust, repair and/or replace the defective goods at no cost to the buyer ONLY IF the defective goods are returned, freight prepaid, to an Oriel Instruments designated facility.

Oriel Instruments shall be relieved of all obligations and liability under this warranty if:

1. The user operates the device with any accessory, equipment or part not specifically approved or manufactured or specified by Oriel Instruments unless buyer furnishes reasonable evidence that such installations were not a cause of the defect.

2. The goods are not operated or maintained in accordance with Oriel's instructions and specifications.

3. The goods have been repaired, altered or modified by other than Oriel authorized personnel.

4. Buyer does not return the defective goods, freight prepaid, to an Oriel repair facility within the applicable warranty period.

IT IS EXPRESSLY AGREED THAT THIS WARRANTY SHALL REPLACE ALL WARRANTIES OF FITNESS AND MERCHANTABILITY. BUYER HEREBY WAIVES ALL OTHER WARRANTIES, GUARANTIES, CONDITIONS OR LIABILITIES, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, WHETHER OR NOT OCCASIONED BY ORIEL'S NEGLIGENCE.

This warranty shall not be extended, altered or varied except by a written document signed by both parties. If any portion of this agreement is invalidated, the remainder of the agreement shall remain in full force and effect.

CONSEQUENTIAL DAMAGES -

Oriel Instruments shall not be responsible for consequential damages resulting from misfunctions or malfunctions of the goods described in this manual. Oriel's total responsibility is limited to repairing or replacing the misfunctioning or malfunctioning goods under the terms and conditions of the above described warranty.

INSURANCE -

Persons receiving goods for demonstrations, demo loan, temporary use or in any manner in which title is not transferred from Oriel, shall assume full responsibility for any and all damage to the goods while they are in their care, custody and control. If damage occurs which is unrelated to the proper and warranted use and performance of the goods, then the recipient of the goods accepts full responsibility for restoring the goods to their condition upon original delivery, and for assuming all costs and charges.

RETURNS

Before returning equipment to Oriel for repair, please call the Customer Service Department at (203) 377-8282. Have your purchase order number available before calling Oriel. The Customer Service Representative will give you a Return Material Authorization number (RMA). Having an RMA will shorten the time required for the repair, because it ensures that your equipment will be properly processed. Write the RMA on the returned equipment's box. Equipment returned without a RMA may be rejected by the Oriel Receiving Department. Equipment returned under warranty will be returned with no charge for the repair or shipping. Oriel will notify you of the cost of repairs not covered by warranty before starting out of warranty repairs.

Please return equipment in the original (or equivalent) packaging. You will be responsible for damage incurred from inadequate packaging, if the original packaging is not used.

Include the cables, connector caps and antistatic materials sent and/or used with the equipment, so that Oriel can verify correct operation of these accessories.