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UNIVERSAL ARC LAMP HOUSING
MODELS 66000 THROUGH 66005
66010 THROUGH 66013
66028 AND 66046

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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I. INTRODUCTION

This manual covers the Oriel 50 to 500 watt(W) Universal Lamp Housings with internal ignitors. We divide them into two categories: housings for 50W to 250W short arc lamps, and housings for 200 to 500W lamps.

50W to 250W Lamp Housings:

66000 Lamp Housing with no condenser
66001 Lamp Housing with F/1.5 condenser
66002 Lamp Housing with F/1 condenser
66003 Lamp Housing with F/0.85 condenser
66004 Lamp Housing with F/0.7 glass/fused silica condenser
66005 Lamp Housing with F/0.7 fused silica condenser

200W to 500W Lamp Housings

66010 Lamp Housing with no condenser
66028 Lamp Housing with F/1.5 condenser
66011 Lamp Housing with F/1 condenser
66046 Lamp Housing with F/0.85 condenser
66012 Lamp Housing with F/0.7 glass/fused silica condenser
66013 Lamp Housing with F/0.7 fused silica condenser

The housings have the same basic design and differ in the condensing lens assembly and fan. With the appropriate socket adapter you can interchange between Hg, Xe and Hg(Xe) lamps of different power. An ignitor is built into the top of the lamp housing. This reduces RF interference and eliminates the need for a stand alone ignitor.

These lamp housings are designed to operate with Oriel Power Supplies. Table 1 on the next page shows the appropriate socket adapter for each lamp and which power supply you should use.

TABLE 1 Appropriate Socket Adapters and Power Supplies for Oriel Lamp Housings

	Lamp			Power Supply	
Lamp Housing	Type	Model No.	Socket Adapter	Type	Model No.
50 to 250W	75 W Xe	6251	66150	50-200 W Universal	68805
	75 W Xe OF	6263	66150	50-200 W Universal	68805
	150 W Xe	6253	66151	50-200 W Universal	68805
	150 W Xe UV	6254	66151	50-200 W Universal	68805
	150 W Xe OF	6255	66151	50-200 W Universal	68805
	150 W Xe	6256	66152	50-200 W Universal	68805
	50 W Hg	6282	66158	50-200 W Universal	68805
	100 W Hg	6281	66150	50-200 W Universal	68805
	200 W Hg	6283	66153	50-200 W Universal	68805
	200 W Hg(Xe)	6291	66152	50-200 W Universal	68805
	200 W Hg(Xe) OF	6292	66152	50-200 W Universal	68805
200 to 500 W	200 W Hg	6283	66144	50-200 W Universal 200-500 W Hg	68805 68810
	350 W Hg	6286	66161	200-500 W Hg	68810
	500 W Hg	6285	66162	200-500 W Hg	68810
	300 W Xe	6259	66160	200-500 W Xe	68811
	300 W Xe OF	6258	66160	200-500 W Xe	68811
	400 W Xe	6260	Not Required	200-500 W Xe	68811
	200 W Hg(Xe)	6291	66157	50-200 W Universal 200-500 W Xe	68805 68811
	200 W Hg(Xe) OF	6292	66157	50-200 W Universal 200-500 W Xe	68805 68811
	500 W Hg(Xe)	66142	66159	200-500 W Xe	68811

II. SAFETY CONSIDERATIONS

SUMMARY OF HAZARDS

There are six hazards in the operation of systems employing these lamp housings. They are:

Radiation
Lamp Explosion
Ozone
Electrical Shock
EMI
Heat

The interlock system is designed for your safety. Do not defeat the interlocks.

A. RADIATION

The high intensity UV radiation of these 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 UV, VIS and NIR can damage the retina. Normal blink reaction to visible light may not be adequate protection, and a beam of invisible UV or NIR (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 of a housing when operating a lamp.

2. Never look at a specular (mirror) reflection of the beam, even for short periods of time.

3. Use the interlock system to prevent access to a working lamp.

4. Always wear UV safety eyewear or face mask, and protective clothing for exposed areas of skin.

B. LAMP EXPLOSION

When cold, xenon and mercury(xenon) arc lamps are under several atmospheres of pressure and are subject to explosion due to internal strains or to physical abuse. When hot, all lamps are under a pressure of close to 100 atmospheres and subject to violent 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. Fingerprints and other contaminations left on the lamp cause a deterioration of the envelope during operation and may lead to lamp explosion.

4. Thoroughly clean the envelope with alcohol or a dilute solution of detergent and water after installation in the housing.

5. Cover the aperture of the housings without condensers, before operation.

C. OZONE

Shortwave ultraviolet light photolyses oxygen to produce ozone. This is emitted in the cooling air stream of the lamp housing. There is no simple way of predicting the ozone concentration (or its impact on you) e.g., operation in a small enclosed area may lead to high concentrations. Operation of the same system in a large, well ventilated laboratory may not be a problem. Recommended maximum exposures are typically:

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

A very sensitive nose can detect 0.015 ppm. 1 ppm produces a strong and obnoxious odor. As a rule of thumb, if you can easily smell ozone, the level is too high for prolonged exposure.

Recommendations

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

2. Operate the system in a large ventilated area.

3. Use an Ozone Eater™, found in our Volume II catalog.

D. ELECTRICAL SHOCK

A high (>20 kV) transitory voltage is used to ignite the lamp. Lamp current is up to 22 amperes. Additionally, line voltage is supplied to the housing to power the fan and elapsed timer. This line voltage will still be present even when the power supply is disconnected from the housing.

Recommendations

1. Keep personnel clear of all exposed terminals.
2. Before relamping or working on the system, disconnect the input power to the lamp housing from the line, turn off the power supply 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 the lamp leads during lamp ignition.

E. EMI

Ignition of an arc lamp requires high voltage high frequency (100's of kHz) pulses. A high current dump (kHz discharge) follows. Both of these are sources of electromagnetic interference, both radiated and conducted. Good earthing and 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 at least 6 feet away from the ignitor/power supply.
3. Use a different outlet and line for the computer and ignitor/power supply.

F. HEAT

Arc lamps become very hot after only minutes of operation, and remain very hot for up to 10 minutes after shut off.

Recommendations

1. Do not touch the lamp with your bare hands for at least 10 minutes after shut off.

III. GENERAL DESCRIPTION

These lamp housings are lightweight but rugged. They are excellent choices for most low to medium power laboratory lamps. You can mount them to optical tables, rails, or benches. Various models with different condensers are available. With the complete line of optical accessories described in Volume II, you can filter, focus, and steer the output to fit your application.

Both types of lamp housings described in this manual (50 to 250 W and 200 to 500 W), use the same shell. The 200 to 500 W models have a more powerful fan to ensure correct operating conditions for the higher wattage lamps, and a different mounting block to accept the larger lamps.

A. LAMP AND REFLECTOR ADJUSTMENTS

The position of the arc (relative to the terminals which secure the lamp) varies slightly from lamp to lamp. This is because of normal arc lamp manufacturing tolerances. These lamp housings have adjustments to place the arc of a new lamp in the same position as that of the lamp being replaced. Three fine controls position the reflector. Then, independent tilt controls position the arc horizontally and vertically. The reflector and its controls travel with the vertical and horizontal controls. This eliminates the need for iterative lamp-reflector adjustments. See Fig. 1 on page 8 for location of adjusters.

B. BUILT-IN IGNITOR

The housings described in this manual have an ignitor built into the top of the housing. Short arc lamps require a high voltage spike, up to 40 kV for Xe lamps, to ignite. Having the ignitor built into the lamp housing minimizes unwanted radiated or conducted RFI.

C. LAMP COOLING

The built in fan and housing baffles maintain the proper operating temperature for arc lamps, when operated in normal laboratory ambient. Overheating due to blocking of the cooling vents or an inoperative fan, activates a thermostat interlock which disables the power supply.

The cooling fan can be operated on 110 or 220 volts AC line. The housings have an AC connector which is designed to accept universal IEC style power cords. The housings are supplied with a power cord. If the power cord is not compatible with your wall socket, replace the plug at the end of the power cord. Check that the line select switch (below the fan, see Fig. 2) is in the appropriate 110/220V position before plugging the line cord into the nearest available AC outlet.

The fan has two modes of operation. In the normal mode, the fan turns on when the lamp is ignited and stays on for ten minutes after the lamp has been turned off, so that the lamp cools down. In the mercury mode, the fan does not turn on until the lamp has been has been on for 2.5 minutes, allowing the lamp to warm up quickly. The same ten minute turn off delay is in effect.

The fan mode is selected by means of a jumper located on the circuit board behind the fan. See Figure 2 for details on the jumper setting. Changing the jumper setting requires removal of the fan. When the housing is cool, unplug the power cord from the housing, remove the four nuts that hold the fan to the housing and then pull off the fan (it may be convenient to unplug the fan from the housing). The jumper is placed on the left and center posts for normal operation and the right and center posts for Hg only. Reassemble being sure that the fan and power cord are reattached prior to usage.

D. SAFETY AND MONITORING FEATURES

These lamp housings incorporate safety interlocks. When used with an Oriel Power Supply the lamp automatically shuts off if the housing door is opened or the housing overheats. If you use your own power supply, we strongly recommend that you utilize this low voltage interlock system for safety. See Fig. 2 on page 9 for location of interlock.

E. ELAPSED TIME INDICATOR

The Elapsed Time Indicator (ETI) is a convenient way to monitor the time that a lamp has been running. Arc lamps deteriorate with usage and should be replaced after the rated life to avoid rapid reduction in output and potential dramatic lamp failure. See Oriel Volume II or the lamp manufacturer's literature for information on lamp life. Typically the ETI would be reset each time the lamp is changed.

The ETI is a 6 digit LCD meter located on the side of the housing just above the fan. The time accumulates, in one-tenth hour increments up to 99,999.9 hours, whenever the lamp is running and the AC line is connected to the lamp housing. An hourglass symbol at the left of the display flashes when the lamp is on. The accumulated run time is saved when power is removed from the lamp housing. The ETI can be reset to 0.0 hours by momentarily pressing the reset switch located below and to the right of the ETI.

F. HOUSINGS WITHOUT CONDENSING LENSES

The 66000 and 66010 Lamp Housings do not have a condenser, and therefore have a large aperture in the front of the housing. Block this aperture with your own condenser or a plate before operating the lamp.

G. MOUNTING

The lamp housings are supplied with four adjustable feet for free standing use. They allow 0.63 inch (16 mm) height adjustment. You can also mount the housing to tables, carriers, or translators with tapped holes on 1 inch or 25 mm centers. To do this you should remove the feet and use the three mounting points and screw slots. If you have a flat enough surface you can unscrew the three mounting pads and use the baseplate directly. See Fig. 3 on page 10 for baseplate dimensions.

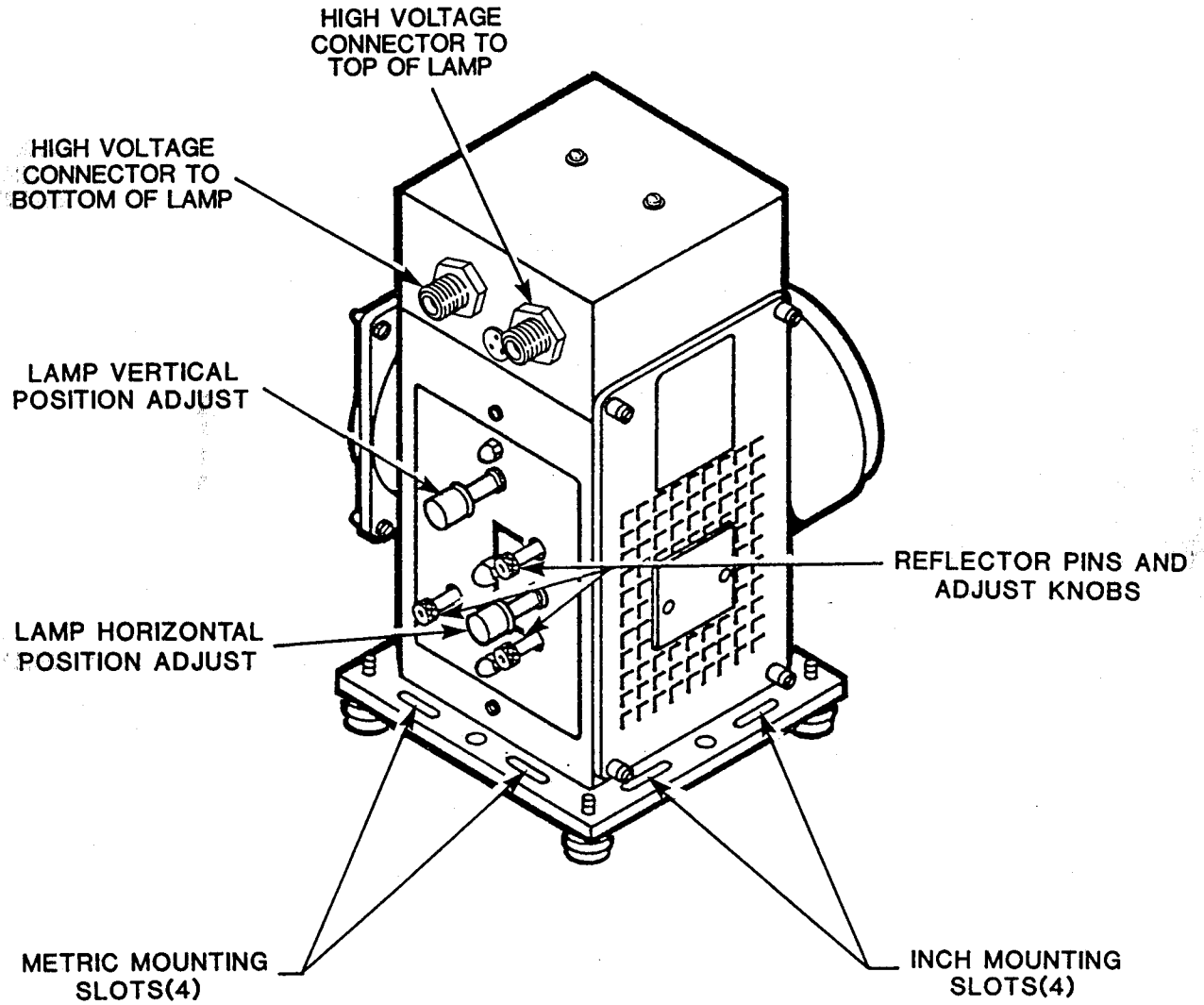

Fig. 1 Lamp And Reflector Adjustments

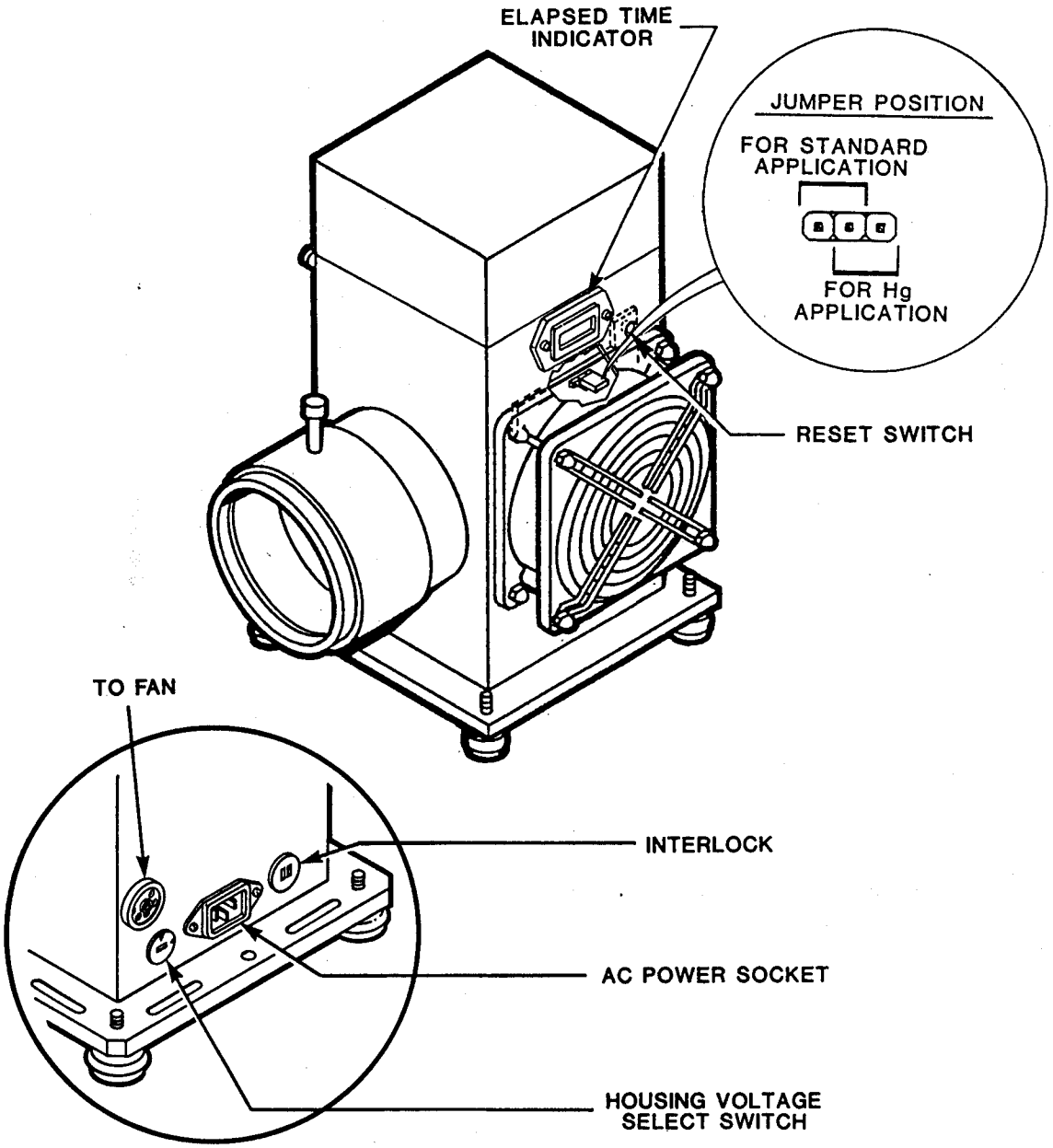

Fig. 2 Safety Interlock And Electrical Sockets

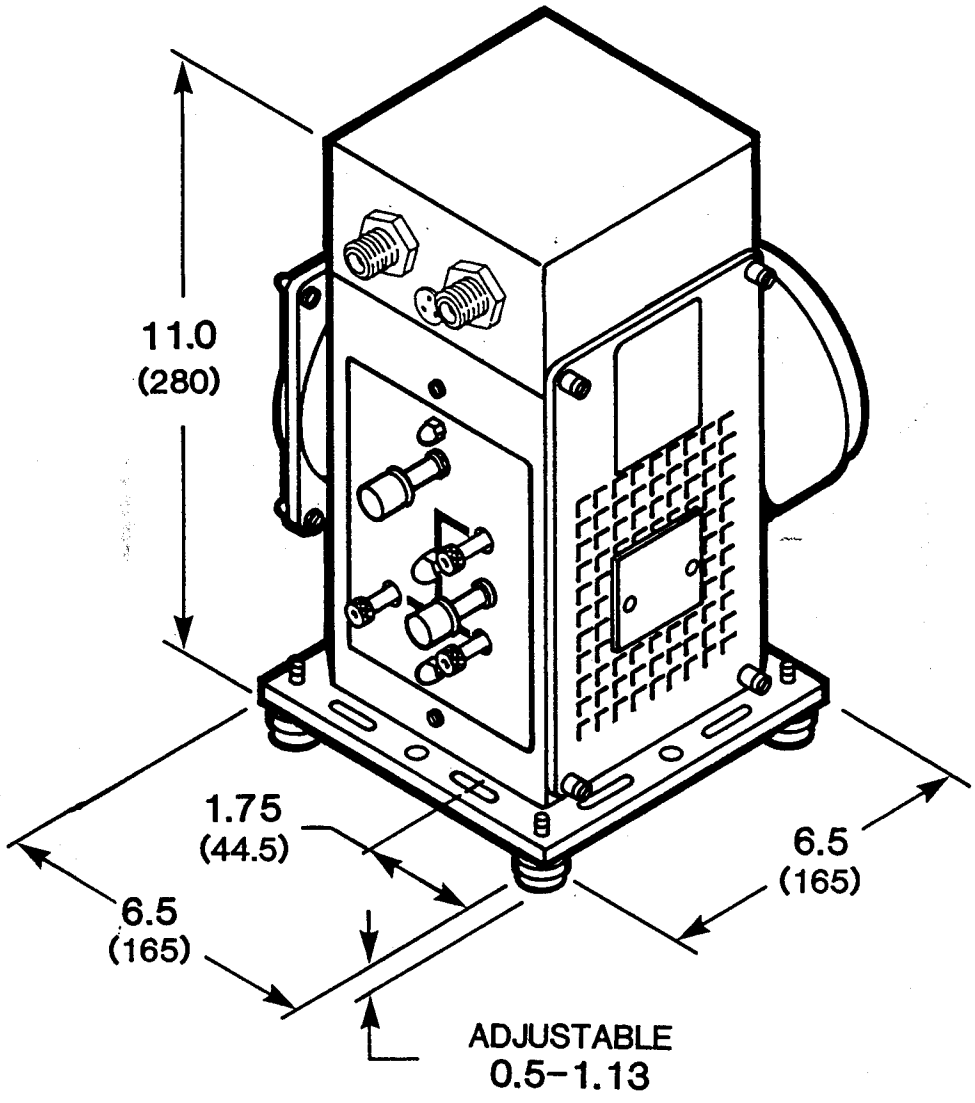

Fig. 3 Dimensional Diagram

IV. LAMP INSTALLATION & INITIAL OPERATION

1. Check that there is no electrical service to the housing and that the lamp power supply is off and discharged.

2. Put on safety goggles and gloves.

3. Unscrew the four thumb screws on the side of the housing and remove the access door.

4. Determine which orientation is correct for the lamp. For xenon and mercury(xenon) lamps, the anode (+ve) is at the top. For mercury lamps the anode (+ve) must be at the bottom. You can identify the anode by a + stamped on the lamp base. Any lamp identification writing or numbers will be the correct way up when the lamp is held in the correct operating orientation. See Fig. 4 on page 13 for a diagram.

5. Install the appropriate adapter(s) on the lamp terminal(s). Depending on the lamp type, these socket adapters are fastened to the lamp terminals by set screws or by a threaded connection.

   If the lamp is supplied with knurled nuts, remove the bottom nut and discard before installing the socket adapter. One of the knurled nuts will be used to secure the wire lug to the top terminal.

6. Connect the top hanging lead to the top terminal, using either the knurled nut supplied with the lamp, or the knurled set screw supplied with the top adapter.

7. Set the lamp position adjusters at approximately mid range. Move the adjusters while watching the bottom mounting block to find mid range. Place the bottom terminal (with adapter) into the bottom mounting block. Adjust the lamp vertically so the arc gap lies approximately in the center of the mirror, then tighten the knurled set screw on the side of the mounting block.

8. After the lamp is in position, clean the envelope with alcohol and lint free tissue. Fingerprints left on the lamp may cause the lamp to explode when lit.

9. Replace the side access door and tighten the knurled thumb screws.

10. Connect the lamp cables between the lamp housing and the rear of the power supply. +ve cable to "top" for xenon and mercury(xenon); +ve cable to bottom for mercury lamps. Read the Power Supply Instruction Manual before operation.

- C A U T I O N -

BE SURE THE LAMP IS POSITIONED WITH THE PROPER ELECTRODE ON TOP AND THE LEADS ARE CONNECTED TO THE PROPER OUTPUT CONNECTORS OF THE POWER SUPPLY. OPERATION WITH THE WRONG POLARITY WILL IMMEDIATELY DESTROY THE LAMP.

It is important to re-check the lamp cabling to the lamp housing. If you are operating the lamp housing for the first time or changing lamp type, ***DO IT NOW.*** It may save you a lamp. Incorrect connection will result in rapid destruction of the lamp.

11. Connect the interlock and ignitor drive cables between the lamp housing and the rear of the power supply.

12. Connect the fan power cord to a 110 or 220 V AC line. Make sure the line select switch (located below the fan) is in the appropriate 110/220V position before plugging the fan in.

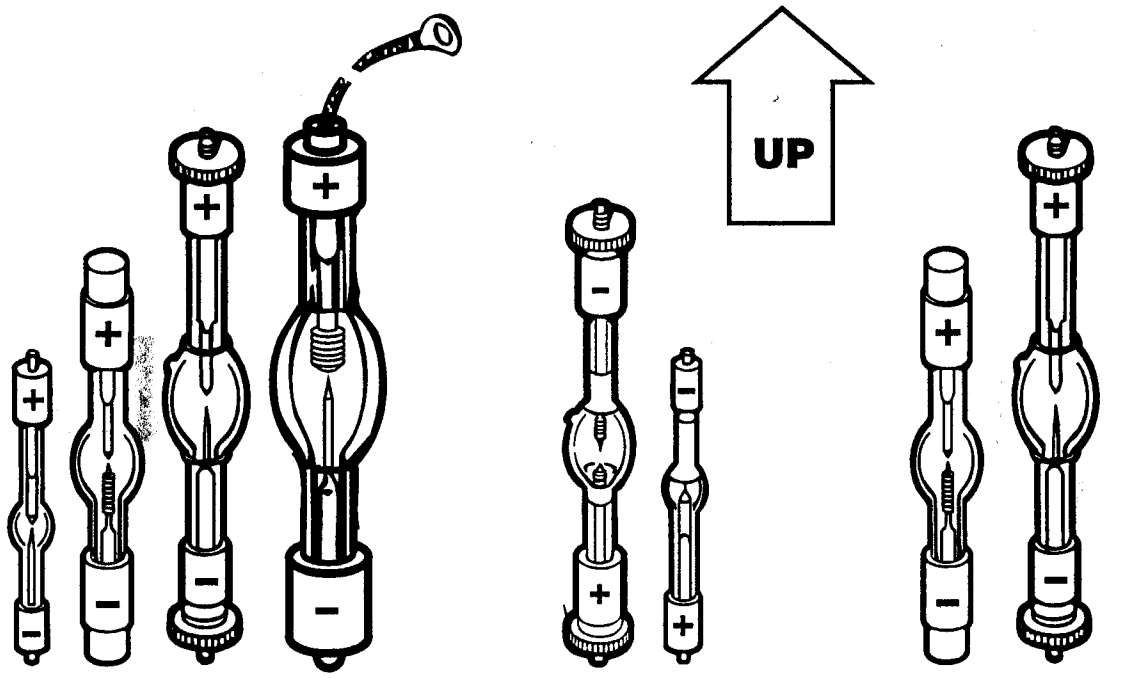

Fig. 4 Correct Operating Position Of Arc Lamps

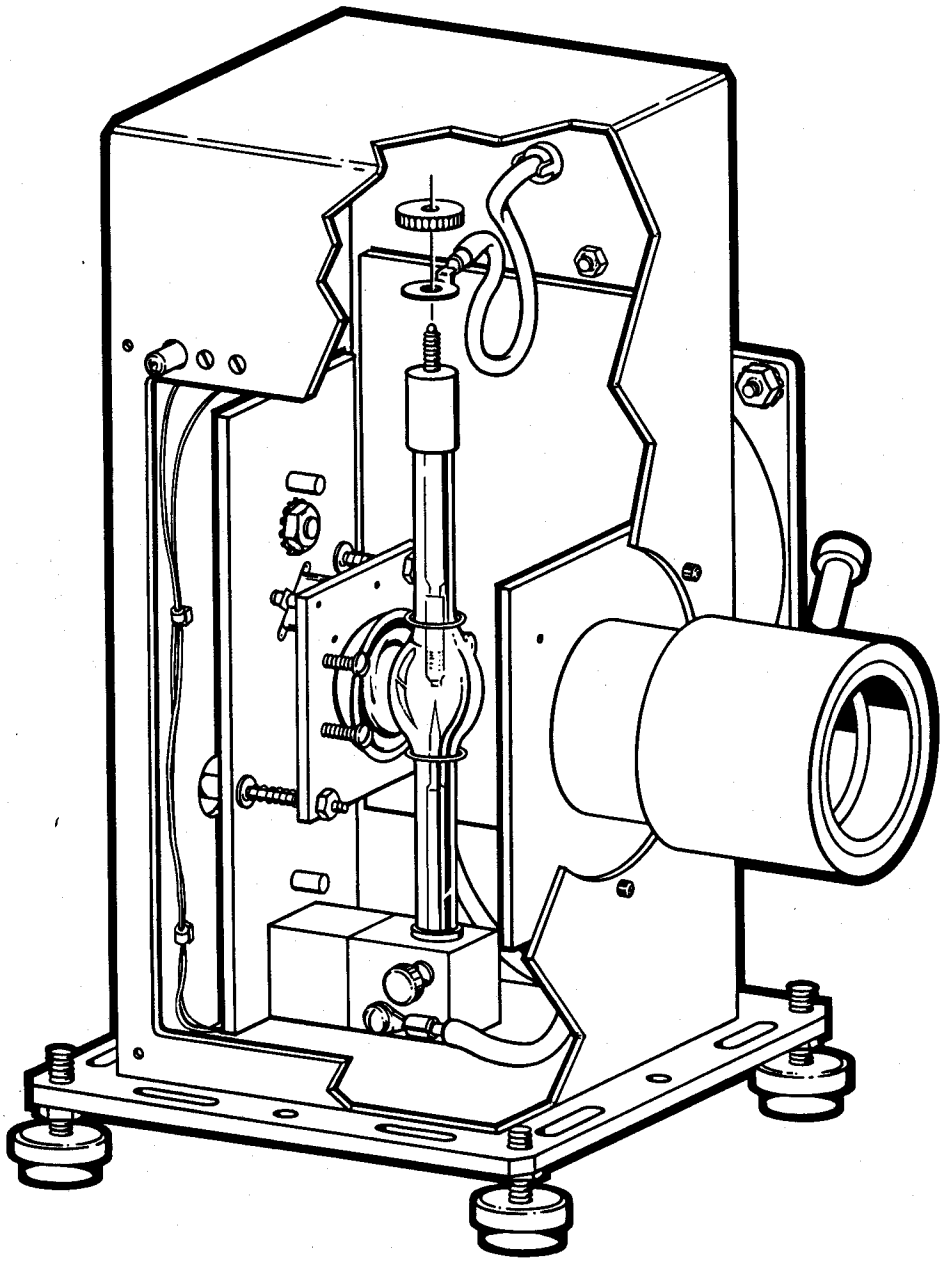

Fig. 5 Arc Lamp Inside Housing

A. ADJUSTMENT OF LAMP, MIRROR AND LENS

1. General

In these housings, the spherical mirror behind the lamp creates an inverted arc image which can be placed onto or near the lamp arc to increase the output beam intensity. The condensing lens collects radiation from both the arc and the mirror image of the arc.

The mirror is adjusted with respect to the lamp by three knobs (smaller) located directly behind the mirror on the back of the housing. The lamp and mirror in unison are adjusted by a vertical and horizontal adjust knob (larger) in the same area. See Fig. 1 on page 8 for location.

- C A U T I O N -

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

2. Adjustments Prior to Operation

a. Before ignition, roughly adjust the lamp position with the horizontal and vertical adjustment knobs. 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 power supply manual.

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 Fig. 6 on page 17). This bright spot is a distorted image of the arc.

Focus the image by rotating all three screws in the same direction concurrently (this translates the mirror back or forth). When focused you will see an inverted image of the arc, about the same size as the arc.

d. Place the mirror image over the main (direct) image (as in Fig. 7 on page 17) or alongside, as desired. You may need to use iterative adjustments to keep a focused mirror image.

- W A R N I N G -

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

e. Focus the condensing lens as desired.

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. By hand, slide the inner lens barrel forward or back until another tapped hole appears in the spiral slot.

c. Reassemble the handle into this new hole.

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.

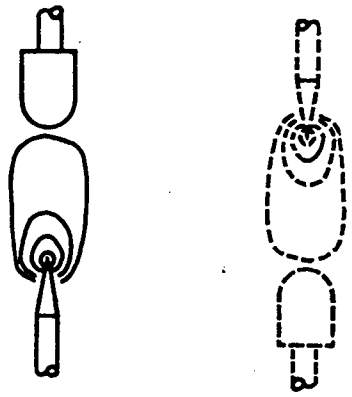

Fig. 6 The electrodes as viewed on a screen in front of the condenser lens are inverted (right). The reflector image as a screen (left) is doubly inverted so the anode of a xenon or mercury (xenon) lamp appears on top.

Fig. 7 Correctly positioned reflector overlays the inverted arc image on the arc gap. The image is the same size as the arc itself.

B. COOLING

1. Xenon and Mercury (Xenon) Lamps

Xenon and mercury (xenon) lamps are not sensitive to cooling. The fan ensures that the lamp terminals and housing skin are at safe temperatures. You can operate 75 W xenon lamps with the fan turned off but not higher rated lamps. These lamps should be run with the fan mode set to normal and without any special baffling.

2. Mercury Lamps

Mercury lamps include a small amount of mercury and one of the inert gases as a "starter" gas. The lamp starts as a inert gas arc lamp and then mercury becomes vaporized.

Initially the operating voltage is low and the current high, characteristics of an inert gas arc. As the mercury vaporizes, it starts to dominate the discharge. The arc voltage increases and the current drops to the correct operating level. Sometimes there will also be a sudden change in operating voltage as the arc position moves towards the end of the warm-up phase.

The final operating conditions of a mercury arc lamp and how the lamp warms up to these conditions depends critically on the cooling of the lamp. If the lamp is **overcooled** it will take a long time to warm up, and will run at higher current and lower voltage than it should. The light output and lamp life will be reduced. Note that it is preferable to run these lamps with the fan mode set to Hg for faster warming up of the lamp. This quicker warm up does not, however, prevent overcooling. Conversely, the normal fan mode will only result in slower warm up times and will neither cause overcooling nor prevent undercooling.

If the lamp is **undercooled**, the lamp will warm up quickly, but excessive temperature can damage the lamp seals and lead to destruction. The operating current and voltage of an undercooled lamp are similar to those of a properly cooled lamp. The thermal interlock in these housings prevents undercooled operation. Make sure the interlock is connected.

These Lamp Housings are designed to operate a variety of lamps in normal laboratory ambient. Mercury lamps from different manufacturers differ somewhat in their operating characteristics, and 100 watt mercury lamps have different requirements from 200 watt lamps.

With the fan running it is possible that a mercury lamp will be overcooled and stabilized at lower voltage and higher current than the optimum values. Mercury lamps have varying cooling requirements. You may need at attach the baffle plate (supplied) to the lamp housing fan in order to maintain proper air flow. Table 2 on page 19 shows which lamps require a baffle, and Fig. 8 on page 20 shows the installation. To install the baffle plate:

a. Remove the four screws holding the finger guard, and remove the finger guard.

b. Install the baffle plate as shown in Fig. 8, using the four screws from the finger guard. After installing the baffle, recheck the current and voltage characteristics. This information is available in the Volume II catalog.

TABLE 2 Lamp Housing Baffles for Hg Lamps

Housing Type	Lamp Type	Operate Fan	Use Baffle
50 - 250 W	50 W Hg 100 W Hg 200 W Hg	No Yes Yes	No Yes No
200 - 500 W	200 W Hg 350 W Hg 500 W Hg	Yes Yes Yes	Yes No No

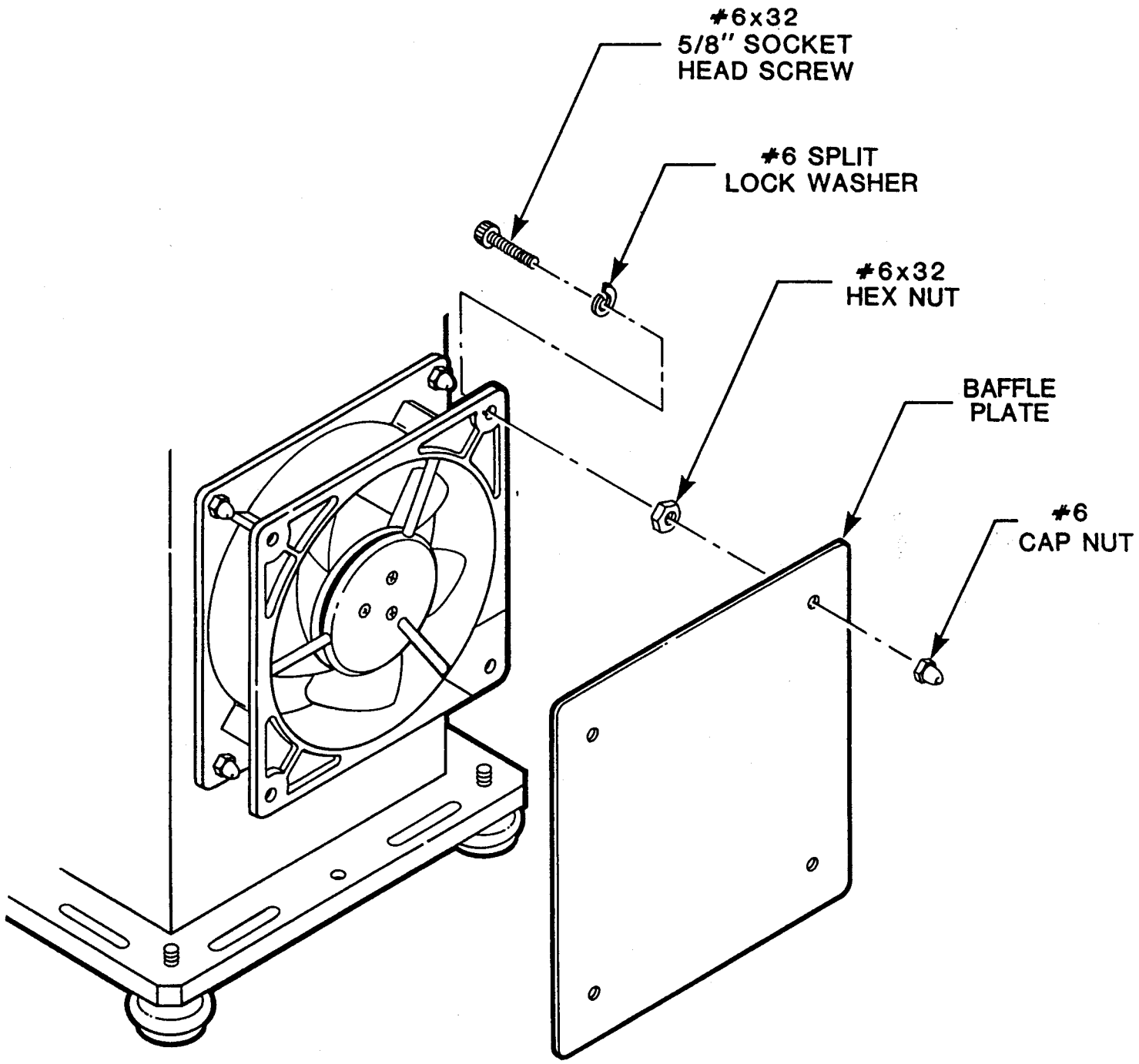

Fig. 8 Installation of Baffle Plate

V. LAMP HOUSING OPTICS

Three different types of condenser lenses are available on these Lamp housings. You can check the lens type on your housing from the listing:

66000 and 66010	No condenser
66001 and 66028	F/1.5 condenser
66002 and 66011	F/1 condenser
66003 and 66046	F/0.85 condenser
66004 and 66012	F/0.7 glass/fused silica condenser
66005 and 66013	F/0.7 fused silica condenser

The lenses were designed for efficient collection of light from the arc. In order to get the best performance from your Lamp housing, we first review some aspects of light collection and then describe how to set the lens position.

By moving the focusing lever you can move the position of the condenser lenses to produce a diverging beam, "collimated beam" or to re-image the arc. The lenses in these housing 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 arc, and so gathers less of the light emitted by the arc within its aperture. The lens operates at a higher F/#.

***See Volume III for a comprehensive discussion on aberrations.**

If you need to image the arc close to the Lamp Housing, or equivalently, produce a small image of the arc, then it is more efficient to use the condenser in the collimating position and use a secondary focusing lens to create the image.

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

A. 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. 9, we show a second pinhole source a distance "d" from the first.

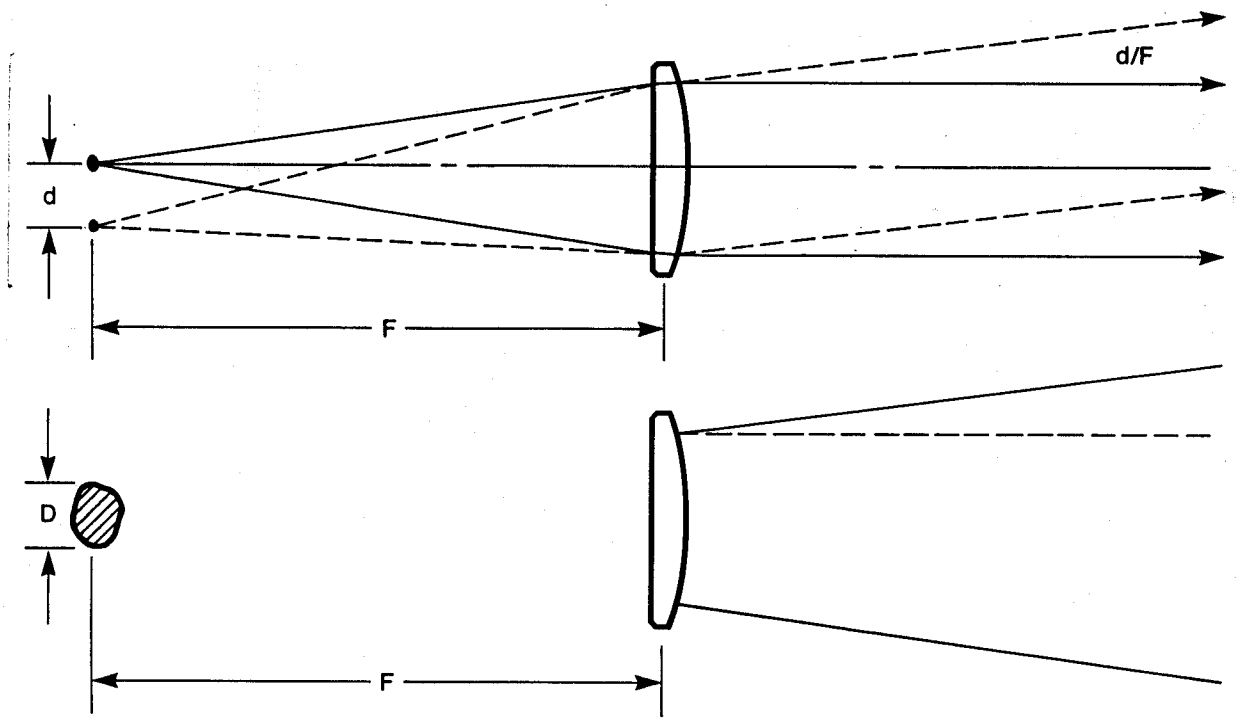

Fig. 9 For most arc sources the divergence in one plane is not the same as that in the orthogonal plane.

The beam from the second pinhole is 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 arctan (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. For low divergence consider the small arc sources and, if necessary, our Spatial Filter Assembly (Volume II).

B. 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. Fig. 10 shows a scan of a collimated beam in the vertical and horizontal planes. The source was a 200W Hg arc lamp.

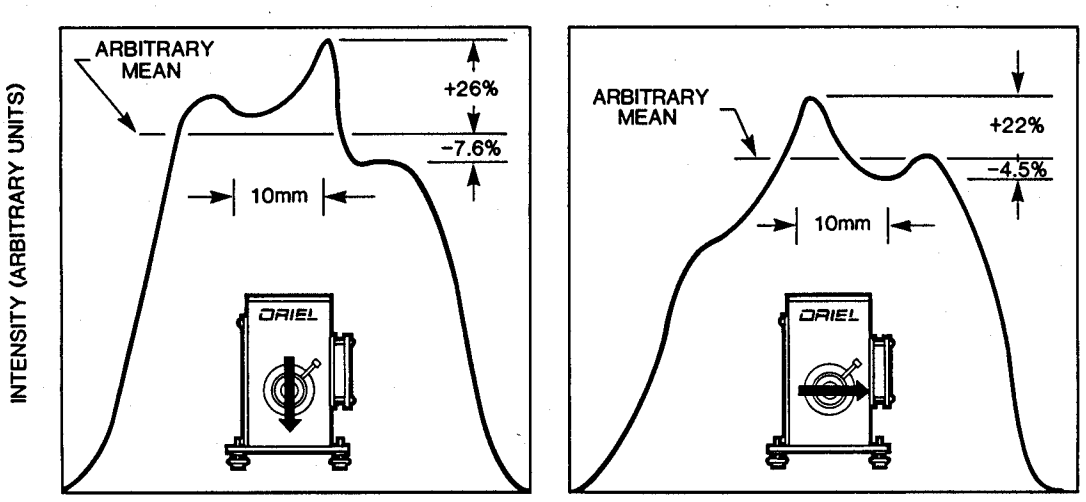

Fig. 10 The collimated output of a 200W Hg lamp in the vertical and horizontal planes.

C. IMAGING THE ARC

You can reimage the arc by positioning the condenser further from the arc using the focusing lever. Volume III describes imaging and provides the formulae. 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 arc. 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. 11 shows the higher convergence produced when creating a small arc image.

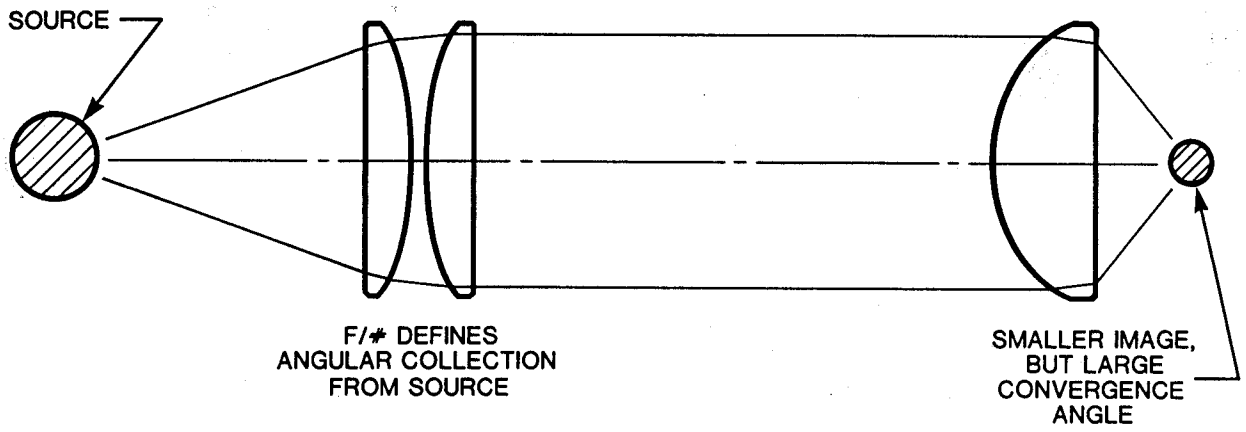

Fig. 11 A source focused to a smaller image.

D. 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, while the four element Aspherabs™ are almost free from spherical aberration. Note that all the lenses perform best while collimating the light from the source.

1. Spherical Aberrations

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 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. The F/0.7 Aspherab™ multi-element lens assembly practically eliminates this aberration by balancing the effects between lenses.

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. 12). 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 lamp housings allows the lens to be moved closer to the source than the paraxial focus. You can empirically find the best position for your system.

The F/0.7 Aspherab™ condensing lenses combine negligible spherical aberration and low F/#, and should be used at focus for critical collimating applications.

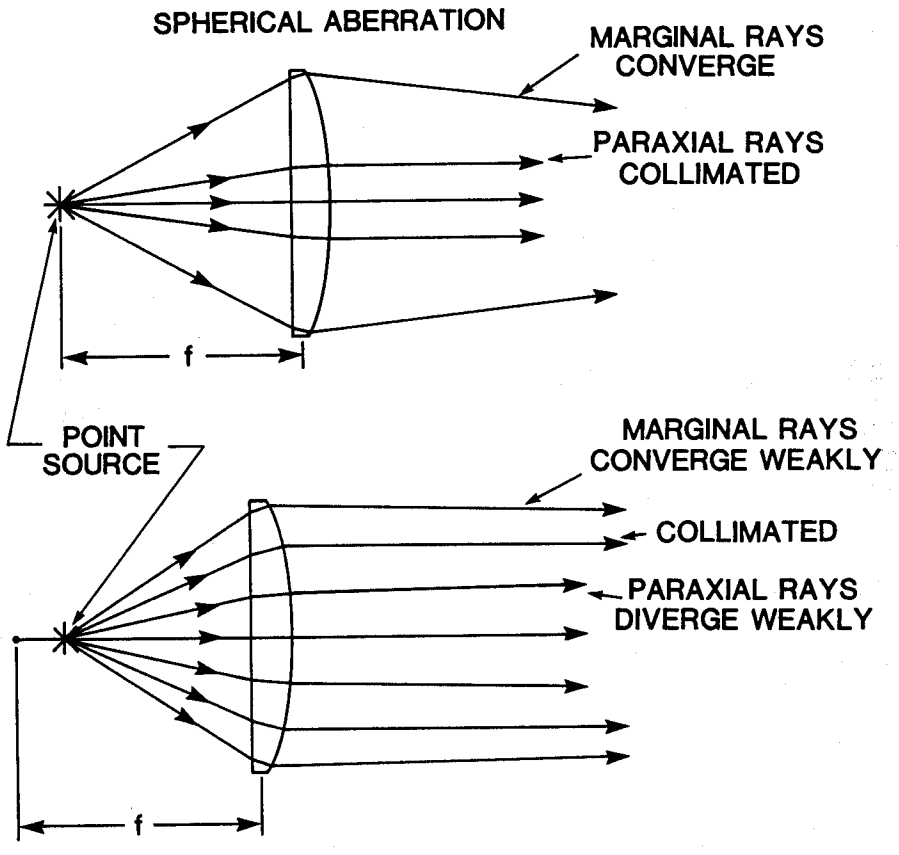

Fig. 12 The marginal rays and the paraxial rays are collimated when the point source is at the paraxial focus, and the plano surface of the lens faces the point source.

2. Chromatic Aberrations

The term "chromatic aberration" describes the variation of lens focal length with color (Fig. 13). This variation is due to the change in the 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 significant only when deep UV wavelengths are collimated. The refraction in f (focal length) 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.

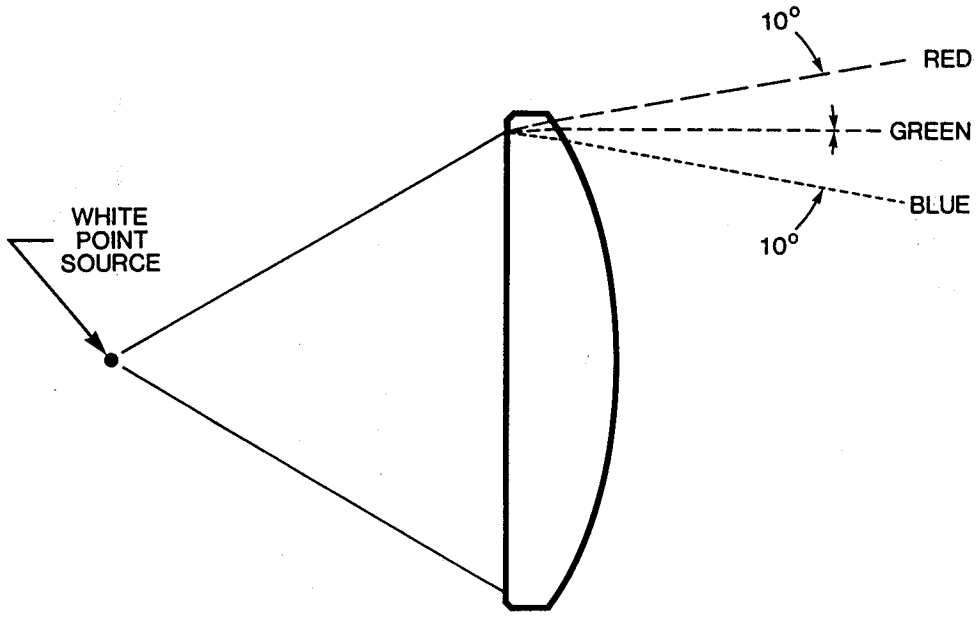

Fig. 13 Chromatic Aberration: different wavelengths are focused at different points.

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

You should image the arc 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.

VI. CIRCUIT DESCRIPTION

Electronic circuitry is located in the lamp housing to perform three functions: ignite the arc lamp, control the cooling fan, and run the elapsed time indicator. A fourth function, which is non-electronic, is the interlock circuit which disables the power supply output whenever the access door is open, or the temperature inside the housing is excessive.

A. IGNITION CIRCUIT (Reference Schematic 68860-3-1001)

The ignition circuit assembly is located in the top of the lamp housing under the cap. The power supply outputs are connected to the secondaries of T1, which in turn are connected to the lamp terminals. The ignitor creates a high voltage pulse (20kV) on each lamp lead to accomplish the lamp breakdown.

The signal from the ignitor drive (a nominal 100 Vp-p, 25 kHz square wave) is rectified (D11, L1, R3, C13) and then regulated (LM340T24, C12) to 24 VDC which drives the inverter, stepping the voltage up to 600 Vrms, 30 kHz. The high voltage multiplier charges up the capacitors (C10, C11) until the spark gap (SC) breaks down, dumping the energy stored in those capacitors, limited only by R2, into the primary winding of T1 which, in turn, couples this energy onto the lamp leads.

B. COOLING FAN CONTROL CIRCUIT (Reference Schematic 66000-3-1001)

The fan control circuitry is located on the printed circuit board mounted in back of the fan.

The AC mains voltage is applied to the printed circuit board at J1-1 and J1-4, fused by F1 and F2, and then routed off the board via J2-2 and J1-5 to the line voltage select switch S1. The position of S1 determines whether the fan windings are in parallel (110 VAC) or series (220 VAC). The mains voltage is also rectified, filtered, and regulated by R8 (for 110 VAC, R8 and R9 for 220 VAC), D1 - D4, C1 and VR1 to create a 12 VDC supply.

When power is applied to the lamp housing, the phototransistor Q1 is off and R1, R2 and C2 reset the counter, U1, driving the U1-DOUT low. Counter U2 now has its reset low and its set is pulled high temporarily (by the power on reset circuit comprised of Q2 and its associated components). This drives U2-DOUT high, turning on Q3 and energizing the relay K1 so that the fan is disabled. The connection from U2-DOUT to U2-CINH prevents U2 from counting. U2 has a built in oscillator circuit, controlled by R6, R7 and C4 which provides a clock to U1-IN1.

U1 is maintained in the reset mode until the lamp is ignited and Q1, which is looking at the lamp, turns on. The reset is removed from U1, allowing it to count the pulses on IN1. When U1 has timed out, U1-DOUT will go high disabling U1 through its CINH. Depending on the setting of JP1, U1-DOUT will go high either immediately ("standard") or after 2.5 minutes ("Hg only"). When U1-DOUT goes high, U2 is reset so that U2-DOUT goes low, turning off Q3 and turning the fan on.

When the lamp is turned off, U1 reset goes high, driving U1-DOUT low and permitting U2 to count. After 10 minutes DOUT U2 will go high, the relay will again be energized, and the fan will turn off.

C. ELAPSED TIME INDICATOR DRIVE CIRCUIT (Reference Schematic 66000-3-1031)

The Elapsed Time Indicator circuitry is located on the printed circuit board mounted in back of the fan.

The +12 VDC and ground are applied to the ETI whenever the lamp housing is plugged in. Q1 is off when the lamp is off, holding Q4 off and keeping the enable to the meter low. The meter display is on but time is not being accumulated. When the lamp is on, Q11 is on, Q4 is on and the ETI is enabled and counting. Closing the circuit board mounted switch S1 resets the meter to 0.0.

D. INTERLOCK CIRCUIT

The interlock circuit consists of the series loop of door switch S2 and thermostat S3. They are connected to a 2-pin connector J5, which in turn is connected to the power supply.

Whenever the interlock circuit is opened,the output drive from the arc lamp power supply is disabled. When this happens, any DC voltage on the filter capacitors discharges through both internal and external resistance paths, and the ignition drive waveform is disabled.

The interlock circuit is opened whenever the side access door is opened (S2) or whenever the temperature inside the lamp housing becomes excessive (S3) (125° C).

VII. TROUBLESHOOTING

A. INTRODUCTION

This section deals with procedures to follow if you encounter specific difficulties in operating these Lamp Housings. 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 as this could expose you and your equipment to the high ignition voltage.

B. PROBLEMS

1. Lamp will not light after several repeated presses of the "LAMP START" button.

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

Recommended Procedures

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

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

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.

c. Check the Interlock Circuit

First, check that the door 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.

d. Check the main power connections to the Lamp Housing and Power Supply.

e. Check the ignitor connections.

f. Check the lamp and the internal connection to the lamp.

Remove the lamp and fan power from the Housing, open the Lamp Housing and check the lamp and that the contacts are properly tight. You may need to remove the lamp and examine it. Assuming no catastrophic damage, then 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, then check that it is properly attached. If it is a xenon or mercury(xenon) lamp, and it does not have a trigger wire, and you would like to attach one, follow these procedures:

Use a high temperature nichrome wire, AWG 28, with an OD of 0.315 mm.

Wearing cots or gloves loop the wire around the top of the lamp envelope, (A) in Fig. 14, twisting the end securely.

Bring the wire down the side of the envelope, (B), nearest to the vacuum "fill/breakoff" mark. Keep the wire snug against the glass.

Loop the wire around the snug of the envelope (C).

Continue this wire, keeping it snug against the glass, down the side of the envelope. Wrap tightly around bottom ferrule and twist the end to ensure it does not slide.

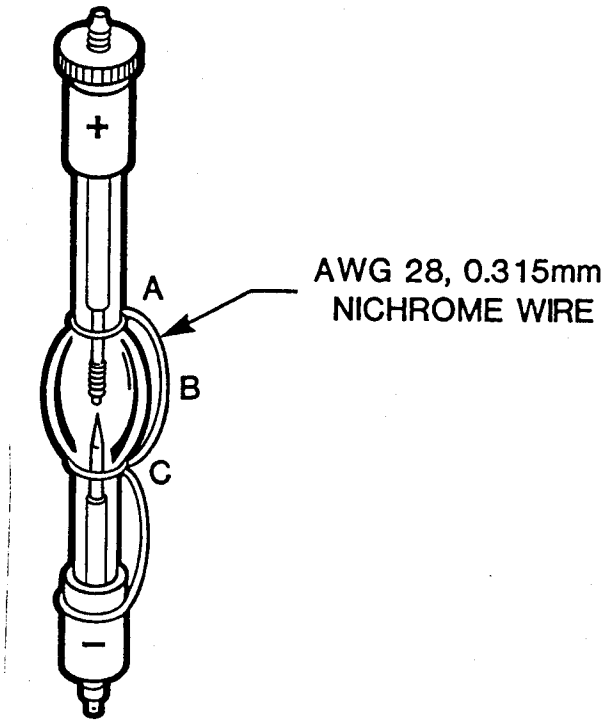

Fig. 14 Starter wire installation on Xe lamp.

g. Check for ignition.

If all the connections are properly made and the lamps seems fine, then place a piece of paper near the output of the condenser lens and if possible darken the room. Use safety goggles and view the paper while pressing the "LAMP START" button. What you see will help isolate the problem.

Dim flash, and brief snapping noise indicates that the ignitor is breaking down the lamp, but that the main capacitor in the power supply is not dumping. This indicates that the power supply ignitor drive circuit is working but there is inadequate break down, due either to a problem with the DC output section of the power supply, or a lamp problem.

A brighter flash indicates that the ignitor is breaking down the lamp and the power supply is dumping the output capacitor, but that the power supply is failing to sustain the discharge. The ignitor is operating properly, the lamp or power supply are suspect.

No flash, and no "snap" at all indicates the ignitor or the power supply ignitor circuitry is not working. The ignitor itself, the cabling to the power supply, or the drive circuitry in the Power Supply is at fault. You can check for ignitor drive signal from the power supply by monitoring the plug at the Lamp Housing end of the ignitor drive cable. Detach the cable from the Power Supply and connect a high impedance AC voltmeter across the pins shown in Fig. 15, on the rear of the Power Supply. When you press the "lamp start button", the meter should register some tens of volts. The exact value depends on the meter impedance and how it arrives at the root mean square value displayed. If the voltage is present then the Lamp Housing Ignitor is malfunctioning. If the voltage is not present then the power supply ignitor drive circuitry is malfunctioning. Depending on the test results, either the Lamp Housing or the Power Supply should be returned to Oriel for repair or replacement.

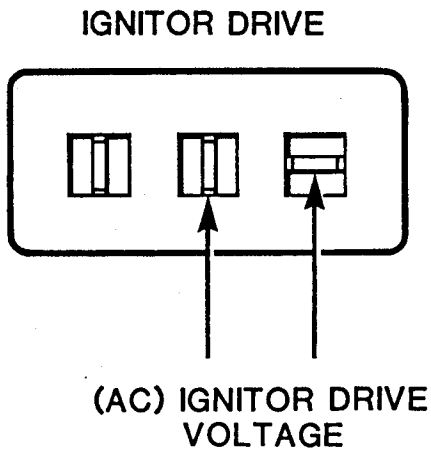

Fig. 15 Ignitor Drive Plug

h. Lamp Housing Fan does not operate properly.

The Lamp Housing Fan is driven by lamp operation and does not start immediately when power is applied. Lighting the lamp will start the fan (delayed by 2.5 minutes in the "Hg" mode). The fan will run until ten (10) minutes after the lamp has been turned off. In most cases, running the Lamp Housing without fan operation can be dangerous; check Table 2 on page 19 for exceptions. Any malfunction of the fan circuit should be remedied immediately.

Recommended procedure

Check that the Lamp Housing power cable is connected correctly, has the correct voltage, and that the line voltage select switch is set correctly. If the fan still fails to operate properly, contact Oriel for further assistance.

i. Elapsed Time Indicator does not operate properly.

The ETI will display the accumulated lamp running hours whenever the Lamp Housing has AC power applied. The meter will count all the time that the lamp is running. Accumulation is indicated by an hourglass symbol at the left of the display.

Recommended procedure

Check that the Lamp Housing power cable is connected correctly, has the correct voltage, and that the line voltage select switch is set correctly. If the ETI still fails to operate properly, contact Oriel for further assistance.

2. Mercury 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 Procedure

a. Check that the fan is baffled as described in the section of lamp cooling, page 18.

b. Check that there are no obstructions to airflow in front of the fan.

3. 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 Procedure:

a. If you 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. Open the Lamp Housing and check the vertical position 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.

4. 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.

Recommended Procedure

a. There are three tapped holes in the lens barrel to allow you to change the lens adjustment range. Remove the handle, carefully noting the location of each small part, and reassemble it with the screw in a different position to change the focus range. For reimaging close to the Lamp Housing, the screw should be in the hole closest to the front (output) of the lens barrel. Note that using a secondary focusing lens is often a better approach.

VIII. SCHEMATICS

The following drawings are included in this manual:

Schematics:

66000-3-1001 Arc Lamp Housing

66000-3-1031 Fan and ETI Control

66860-3-1001 Ignitor

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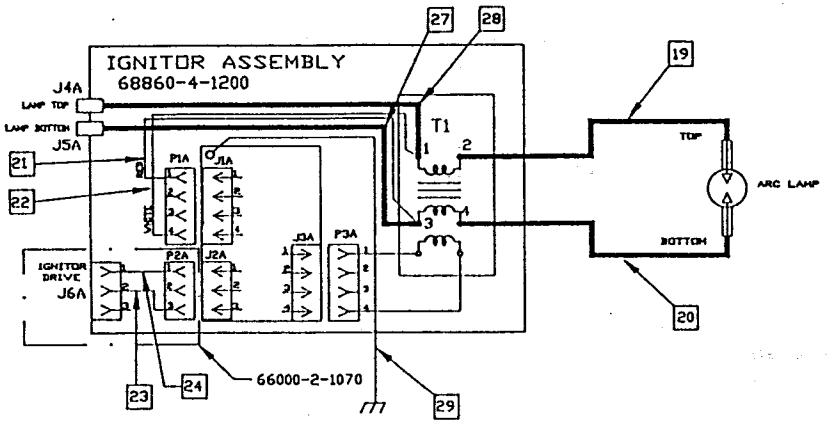

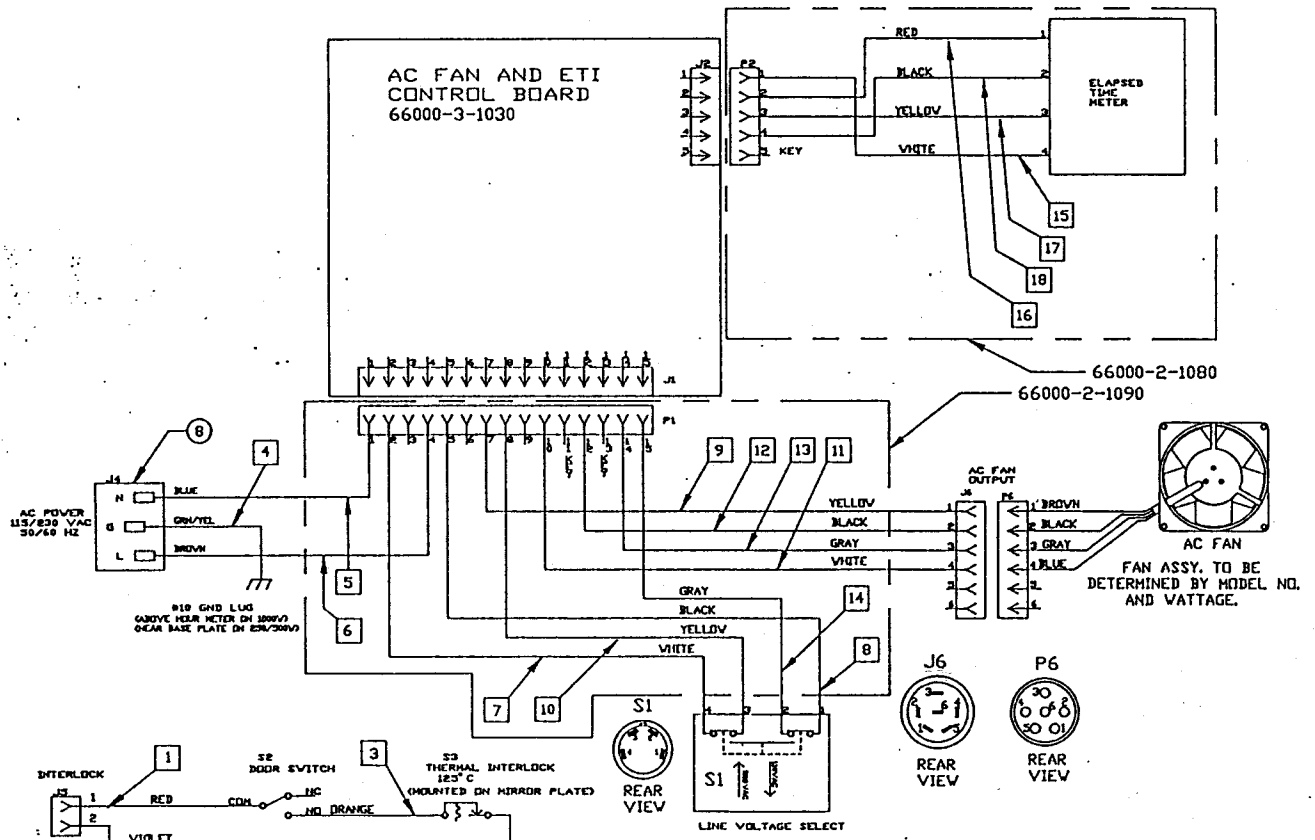

WIRE RUN LIST SEE 66000-1-1021

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ORIEL CORPORATION
STRATFORD, CONNECTICUT

TITLE
SCHEMATIC
ARC LAMP HOUSING
250W/500W/1000W

DRAWING NO
66000-3-1001

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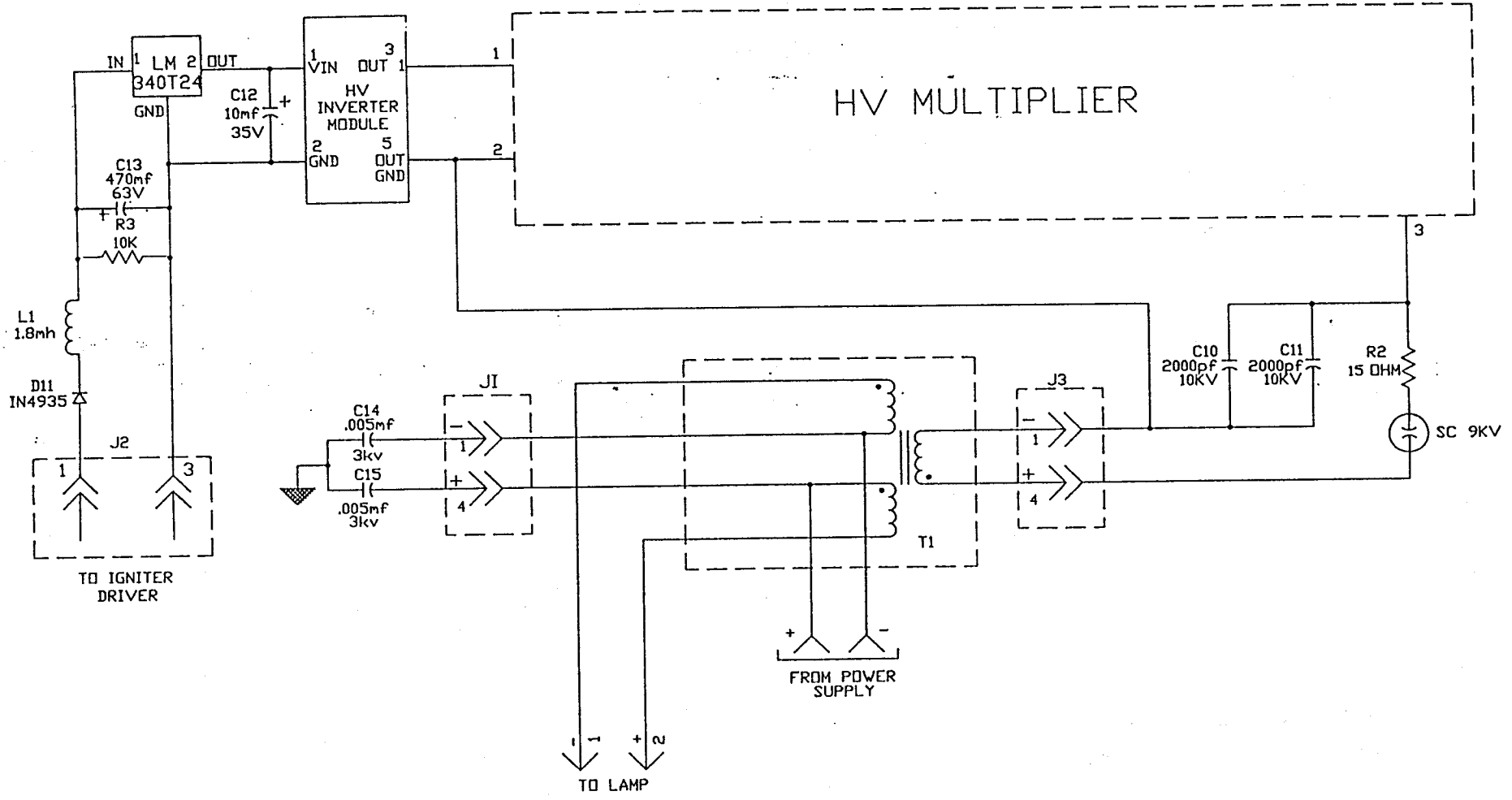

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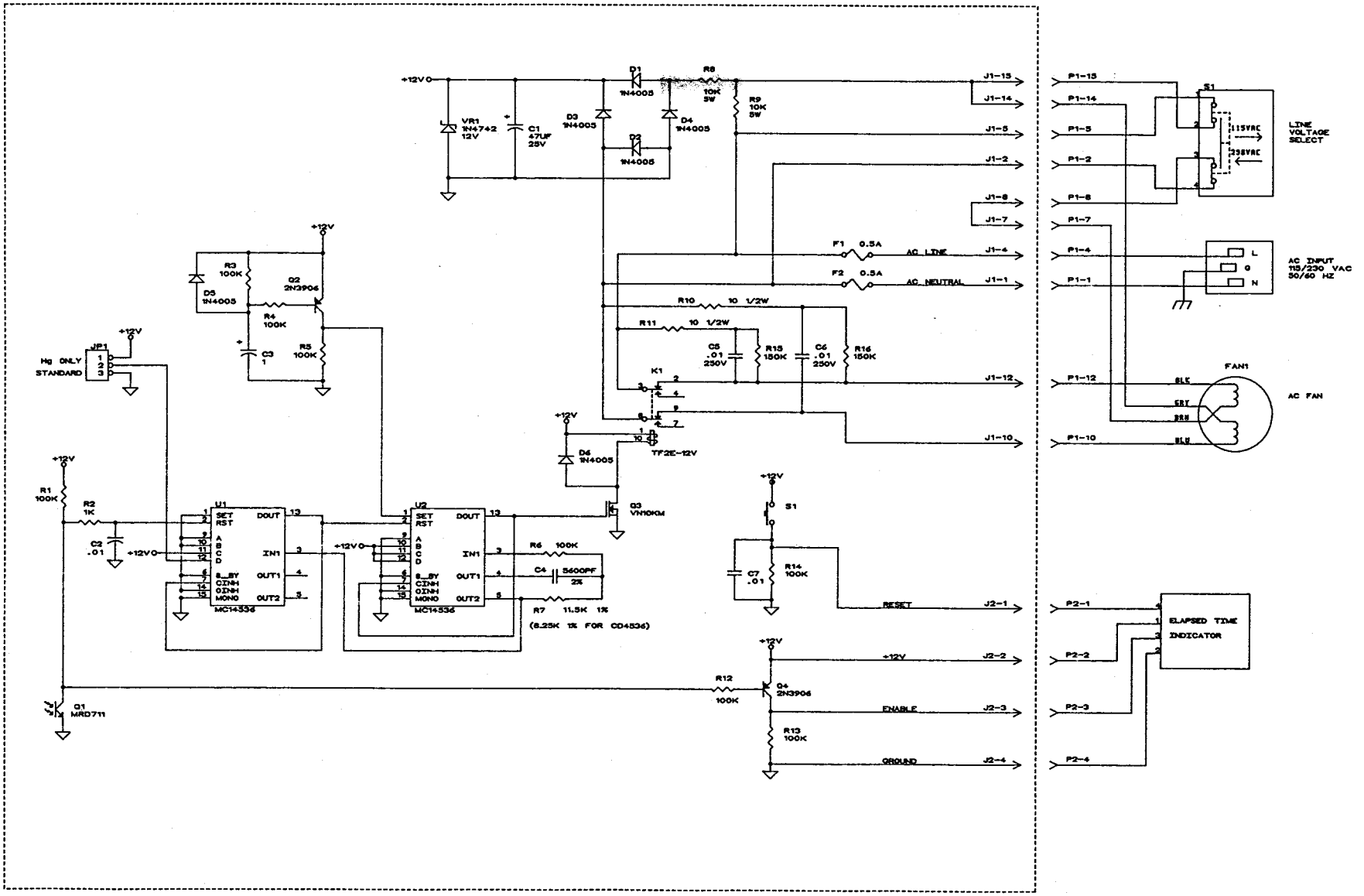
AC FAN AND ETI CONTROL BOARD



ORIEL CORPORATION
250 LONG BEACH BLVD.
STRATFORD, CT 06497
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Title		
AC FAN AND ETI CONTROL BOARD SCHEMATIC		
Size: C	Document Number: 66000-3-1031	REV: A
Date: January 6, 1993	Sheet: 1 of 1	

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.