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125mm SPECTROGRAPH

MODEL 77400

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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WARRANTY AND RETURNS

I. INTRODUCTION

OVERVIEW

ORIEL's MS125J is a unique spectrograph especially designed for today's demanding spectroscopy requirements.

MS125J has been created specifically to be compatible with diode array detectors, and has a flat focal field for use with diode arrays up to 1 inch (25 mm) long. A calibrated micrometer drive for changing wavelength and a wide variety of gratings allow great versatility in the selection of wavelength ranges. Optional fiber optic light guides or camera 35 mm focussing lenses allow you to take instantaneous spectra almost anywhere.

The optical arrangement of MS125J was optimized by computer in order to squeeze the highest performance from the smallest possible instrument. This instrument has a low F/number of 3.7, a focal length of 120 mm, variable wavelength ranges, interchangeable gratings, minimal coma, and a flat focal field, all in a neat compact unit which you can hold on your hand!

MS125J is a unique instrument. The asymmetric five-sided shape is a solid aluminum casting for high strength and stability. The optical design uses a crossed optical arrangement and a 100 degree angle separating the input and exit faces. MS125J relies on high precision components in order to achieve its excellent specifications and compact design. There are no optical adjustments in the construction of MS125J and therefore no possibility of anything requiring realignment. There are also special ribs which are cast in position to baffle unwanted light paths and capture stray light reflections.

MS125J has also been made with ease of use as a prime objective. Convenient tapped holes on the casting exterior, on one side and on the bottom, and optional coupling blocks enable the MS125J to be easily mounted directly onto optical tables, rods or just about anywhere. A wide variety of gratings is available to cover many spectral ranges, the gratings are kinematically interchangeable within seconds, and no re-calibration is necessary. Even the cover is easy to detach; once the screws are removed, a special recess in the housing enables a finger nail, coin or screwdriver to be used to flip off the lid.

SPECIFICATIONS

Design	Crossed Czerny-Turner
F/number	3.7
Focal length	120 mm
Stray light	0 - 0.1%
Grating type	Plane, (ruled or holographic)
Grating mount	Clip, Kinematic
Drive	Micrometer, calibrated
Wavelength accuracy	1 nm over full range (with 1200 l/mm grating)
Wavelength reproducibility	1 nm with standard micrometer 0.1 nm with digital micrometer (with 1200 l/mm grating)
Focal Plane	15 mm from, and parallel to face
Optical axis height	1.78 inch, (45.2 mm)
Dimensions	approx. 6 x 6 x 3 inch (150 x 150 x 80 mm)
Weight	3.3 lb, (1.5 kg)

FEATURES

- ! Wide flat field spectrograph for diode arrays.
- ! 125 mm focal length.
- ! F/3.7.
- ! 0.4 nm typical resolution with 1200 l/mm grating as spectrograph (50 μ m slit).
- ! Kinematically interchangeable gratings.
- ! Wide selection of grating dispersions and blazes.
- ! Calibrated micrometer drive (sine drive).
- ! Small, compact and designed to be easily mounted.
- ! Extensive baffling for low stray light.
- ! No re-entrant spectra with 1200 l/mm grating.
- ! Internal filter holder.
- ! No alignment - Shock proof.
- ! Retrofittable for motor drives.

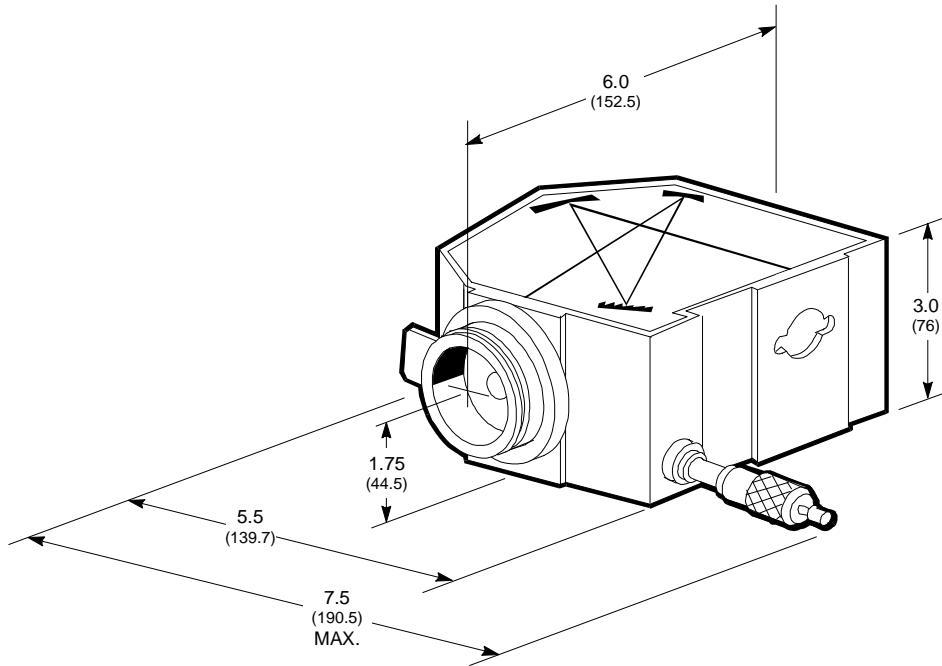


Figure 1 depicts a dimensional drawing of MS125J

II. DESCRIPTION & DETAILS

SPECTROGRAPHS

MS125J was designed specifically for use with diode arrays and CCDs up to 1 inch long. Although many monochromators are used with diode arrays, they are often unsuited for the task.

True spectrographs should differ from converted monochromators in several important ways:

- ! The focal field should be flat, not curved, since the image should be in focus all along the diode array, or CCD detector.
- ! The focal field should ideally be parallel to the exit face of the spectrograph, otherwise the detector would have to be tilted to preserve the correct focus along its length.
- ! The focal field should retain the same numerical aperture from one edge to the other. Therefore the exit mirror should be sufficiently wide to prevent loss of the beam intensity along the focal field, and there should be no shadowing due to walls or other objects in the light path.
- ! The extended mirror can increase the likelihood of stray light and re-entrant spectra, the optical design and position of baffles should reduce or eliminate these possibilities.

MS125™ only requires the addition of slits and a grating to be ready for use.

When it is used with a diode array detector or CCD, the detector needs to be correctly positioned at the focal plane. The focal plane is parallel to, and 15 mm from the mounting surface of the housing. If MS125J is used with ORIEL diode array detectors, a flange is supplied with each detector which will bolt onto MS125J. Flanges for detectors from other manufacturers can also be obtained from ORIEL.

GRATINGS

ORIEL offers several gratings which enable you to pick not only the wavelength of interest at optimal efficiency, but also the length of the wavelength range the diode array will 'see' at any one time (the diode array bandpass). The gratings are supported on a precision holder which simply clips into the grating mount. They can be easily interchanged without the need to realign the spectrograph. Table 1 lists the available gratings. You will find efficiency curves for most gratings in our Grating Booklet. If you do not have one, please call a Sales Engineer for a complementary copy. Special gratings are available upon request.

TABLE 1

Model No.	Blaze Wavelength (nm)	Type	Groove Spacing (1/mm)	Array Bandpass (nm/inch)	Resol (nm)	Spectral Range (nm)
77454	405	Holo.	3600	48	0.12	180-420
77419	250	Holo.	2400	76	0.2	180-625
77420	400	Holo.	2400	90	0.2	230-625
77421	500	Holo.	1800	80	0.3	300-840
77410	250	Holo.	1200	180	0.4	200-650
77411	350	Ruled	1200	180	0.4	300-1250
77412	750	Ruled	1200	180	0.4	450-1250
77413	200	Ruled	600	350	0.7	180-500
77414	400	Ruled	600	350	0.7	250-1300
77415	750	Ruled	600	350	0.7	450-2500
77416	350	Ruled	400	530	1.0	200-800
77417	500	Ruled	400	530	1.0	300-1200
77422	300	Ruled	300	670	1.5	200-750

The available gratings for the MS125J spectrograph, the primary wavelength ranges, the bandpass over the diode array, and typical resolution for a 1024 element diode array of 25 μm wide elements and 25 μm entrance slit.

Figure 2 shows two spectra of a mercury pen light taken using a 1024 element diode array with 25 μm elements. The top spectrum was taken using a 400 l/mm grating, and the bottom spectrum using a 1200 l/mm grating. Note the difference in wavelength range, and effective resolution.

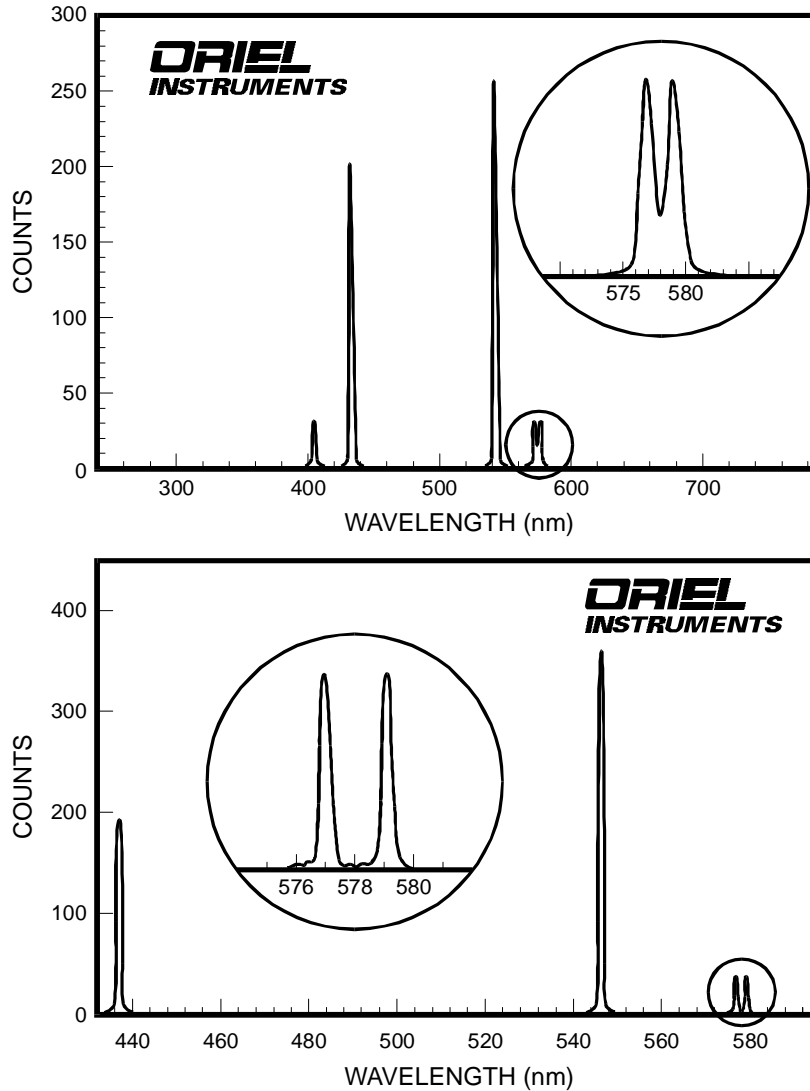


Figure 2 Emission spectra from a 6035 Hg lamp measured with two different gratings and a 1024 element diode arra. (TOP) 400 1/mm grating. (BOTTOM) 1200 1/mm grating.

SLITS

The resolution is dependent on the entrance slit width, the dispersion, and the element width of the diode array, (since the element is effectively an exit slit). Spectral resolution for a diode array spectrograph is usually accepted as being limited by the bandpass over at least two elements. For the smallest slits aberrations can play a role in limiting the resolution.

The exceptional flat field and minimal optical aberrations of MS125J means that the resolution is very nearly constant across the entire focal plane. With a 25 μm entrance slit and 1024 element array, the resolution is better than 50 μm across the entire field.

Four spectrograph input fixed slit sizes are available, 25 μm , 50 μm , 100 μm and 200 μm ; all are 3 mm high. Increasing the width of the entrance slit proportionately increases the light intensity at the grating, but degrades the system resolution. The light baffle near the entrance port minimizes the stray light due to a source with a too high an aperture (low F/#), the baffle is optimized for use with diode arrays 2.5 mm high. Table 2 lists the available slit sizes and limiting resolution.

Although large aperture fixed slits, multiple fixed slit holders, and variable slits can be used with the MS125J Spectrograph, it is recommended that in order to obtain the maximum resolution a 25 μm fixed slits be used.

TABLE 2
THE AVAILABLE SLITS FOR THE MS125J SPECTROGRAPH

Model No.	Slit Width (μm)	Slit Height (mm)	Resolution (nm)*
77220	25	3	0.4
77221	50	3	0.6
77223	100	3	0.9
77224	200	3	1.4

* Typical resolutions measured with a 1024 diode array with 25 μm elements and a 1200 l/mm grating.

MULTIPLE FIXED SLITS

The Multiple Fixed Slit Assembly (#77408) consists of eight slits on a rotating disc, the slits must be changed manually, with a positive detente to ensure precise repeatability of each slit position. This model also has a sliding wedge aperture to allow the slit height to be adjusted. A flange on the outside of the slit assembly permits the mounting of all Oriol 1.5 Series (46 mm) accessories.

VARIABLE SLITS

Variable slits (#77407) are smoothly adjustable from 0 to 3.2 mm. The minimum precision slit width is about 50 microns. The bandpass ranges from 1 nm to 40 nm when using the 1200 line/mm grating. Calibration marks provide adjustment every 0.1 mm. Slit height is adjustable from 1 mm to 12 mm using a sliding wedge aperture. Note that a flange on the outside of the slit assembly allows mounting of Oriol 1.5 Inch Series.

Note: Some light leakage may occur at the zero position, so these slits should not be used as a shutter.

IMPORTANT TIPS FOR PROPER SLIT INSTALATION:

- The slit should always be inserted with its reflective side facing out (for example, towards the light source or the detector.)
- If the slit entrance is located on the right side of the slit holder, then the slit should be inserted with the notch located in the upper left corner.
- If the slit entrance is located on the left side of the slit holder, then the slit should be inserted with the notch located in the lower right corner (this will keep the reflective side facing out). Figure 3 illustrates the correct slit insertion from the left side of the slit holder .

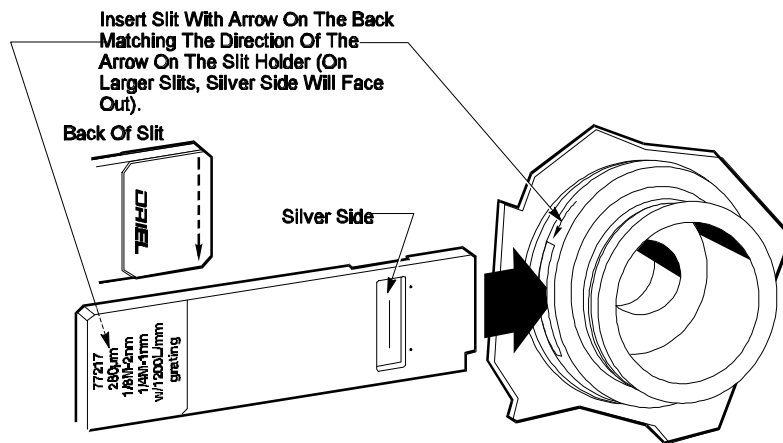


Figure 3 Insertion of Fixed Slits

III. MOUNTING AND ASSEMBLY

MOUNTING

MS125J is easily mounted to a variety of surfaces. There are four ways of mounting it:

- ! Three 1/4-20 tapped holes spaced 1 inch apart are located under the casting. These holes are aligned perpendicularly to the input optical axis, and along the output optical axis.
- ! The center 1/4-20 tapped hole under the casting is located at the junction of the input and output optical axes, and is suited for rod mounting the unit.
- ! Two 1/4-20 tapped holes, two inches apart, are located on one side of the casting, parallel to and at the same optical height as the input optical axis.
- ! MS125J can be conveniently mounted using the 1.5 inch diameter (46 mm) male flange of the entrance slit holder.

A set of coupling blocks are available for mounting the spectrograph onto surfaces with 1/4-20 or M6 tapped holes. These very useful blocks (#11832) enable two components, each with 1/4-20 (or M6) tapped holes, to be fastened together while maintaining exact alignment in two dimensions. The displacement in the third plane is one inch (25.4 mm). The precision blocks are ideal for mounting MS125J to an optical table or vertical bracket. See the Accessories section further information.

MS125J needs no realignment when either slits or gratings are interchanged.

FIXED ENTRANCE

The entrance slit holder is held in precise position by two screws through the front of the slit holder.

MULTIPLE FIXED SLITS AND VARIABLE SLITS

The entrance fixed slit holder and variable slits are correctly located by a pin in the front face of MS125J . They are held in place by a set screw which is accessible from the underside of MS125J and which clamps the tube of the slit holder in place.

DETECTORS

Oriel provides detector mounting flanges for our InstaSpecJ line of PDA's, CCD's and ICCD's. For your convenience, Figure #4 illustrates the mounting hole pattern for the MS125J .

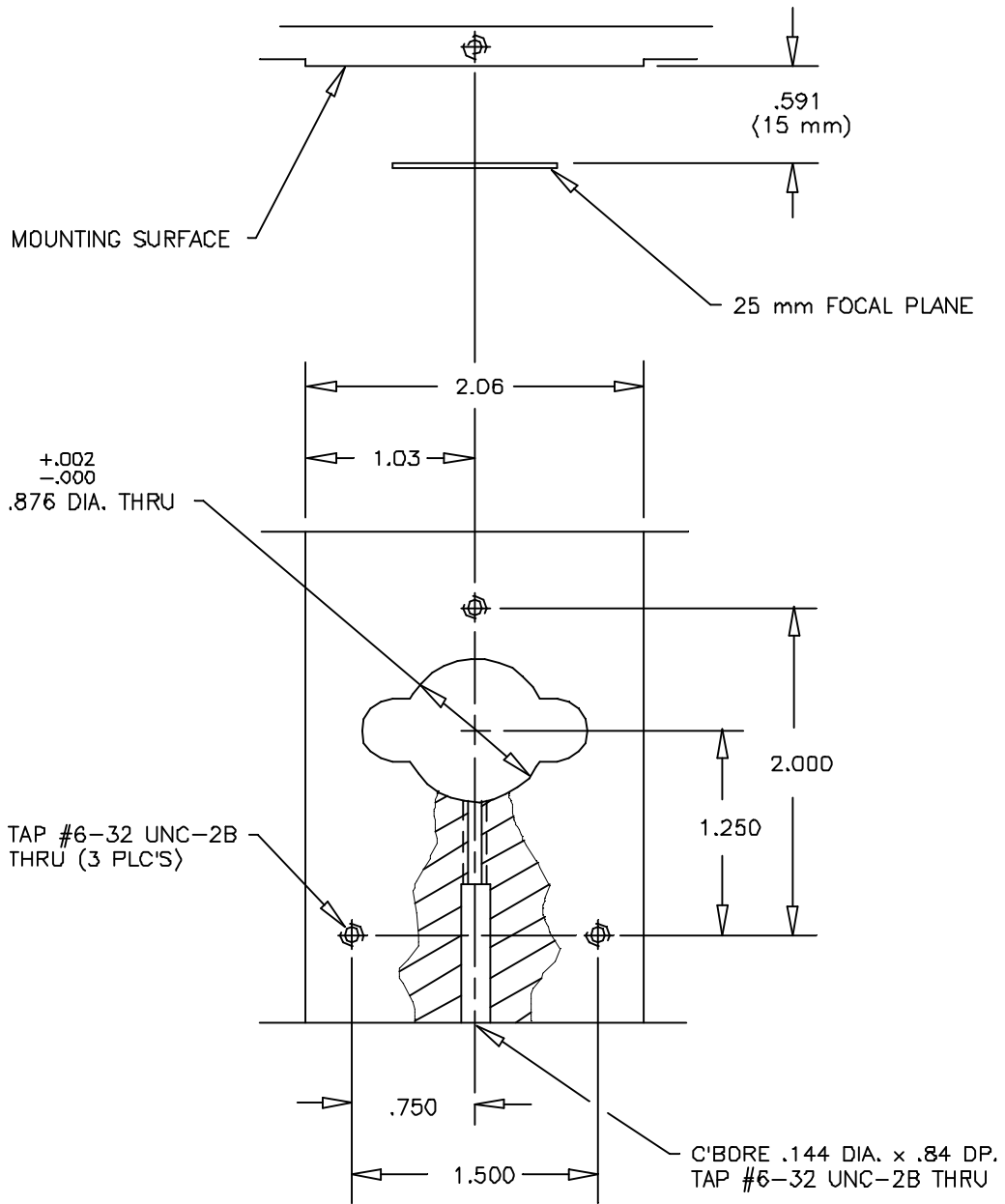


Figure 4 Mounting Face of MS125J

IV. WAVELENGTH DRIVE

Selecting a particular center wavelength is very easy with the MS125J 's calibrated micrometer drive. For a 1200 l/mm grating, each division on the micrometer body marks 50 nm while the vernier scale at the end of the micrometer is divided further into 1 nm increments. For other gratings a simple scaling factor must be applied to the micrometer calibration. The scale factor is calculated by dividing "1200" by the lines per mm of your grating. To set the instrument in nm simply divide the wavelength you would like by this scale factor.

For example:

- TASK:** Set a 600 l/mm grating to center wavelength of 546 nm.
- Step One:** Scale factor = $1200 / 600 = 2$
- Step Two:** Micrometer setting = $546 \text{ nm} / 2 = 273$
- Step Three:** Roll the micrometer out past 5 of the marks on the body, 250. Then carefully roll the adjustment knob to three divisions past the major "20" mark on the vernier scale. $250 + 20 + 3 = 273$.

Once set, the micrometer drive can be locked by rotating the knurled ring close to the body of the spectrograph. CAUTION: do not attempt to adjust the micrometer with the knurled ring in the "locked" position.

Since the micrometer drive itself is very reliable, the wavelength accuracy for the MS125J with a 1200 l/mm grating is +/- 1 nm. The unidirectional repeatability is also 1 nm.

For the most accurate wavelength calibration of your PDA, CCD, or ICCD use a line source, such as the Oriol 6333 Hg(Ar) Spectral Calibration Lamp, and the InstaSpec software. This will allow accurate calibration across the full array. Details of this method are given in the InstaSpec manual.

V. INTERCHANGING GRATINGS

All gratings used in the monochromator are mounted on a precision V block so that the plane of the grating surface is accurately positioned relative to the optical axes. This makes it possible to obtain repeatable values when mounted gratings are interchanged.

To interchange gratings:

1. Loosen the cover screws and remove cover.
2. Remove grating carefully. **DO NOT TOUCH THE GRATING SURFACE.**
Hold the grating tab with fingers of one hand and sharply pull the grating away from the grating mount. If the mounting springs are a little tight then use two fingers of the other hand to pry back the two spring clips as you remove the grating.
3. Insert the new grating.
Hold the grating tab with fingers of one hand and gently push the grating into the grating mount. If the mounting springs are a little tight then use two fingers of the other hand to pry back the two spring clips as you insert the grating.
4. Replace the monochromator cover and tighten the cover screws.

VI. CALIBRATION & OPTICAL ALIGNMENT OF YOUR SYSTEM

For optimum results MS125J should be optically coupled with the illuminating source (or an illuminated sample) in such a way that the maximum radiant power is transmitted through the slit. This condition can usually be optimized by the appropriate choice of source size and coupling optics. Pages 230 to 235 of Oriel's Volume II catalog show how the optical throughput of a spectrograph or monochromator can be calculated and give suggestions for its optimization.

A large number of optical accessories are available for configuring your optical system, ranging from sample compartments to fiber optics, and integrating spheres to ellipsoidal and parabolic reflectors. See the Oriel Volume II catalog for full information.

Oriel's Model 6035 (with 6047 Power Supply), a low pressure pencil type mercury lamp, is a convenient general purpose source for both aligning and checking wavelength.

<<<< CAUTION >>>>

DO NOT EXPOSE THE EYES TO DIRECT RADIATION FROM THIS LAMP WITHOUT GLASS SHIELDING. The short wave U.V. will cause painful burns to the outer layer of the eye.

Mercury and Helium-Neon lines and their multiples useful for wavelength calibration:

253.7	U.V. - U.V. Detector only**
365.0	U.V. - U.V. Detector only
404.7	Visible (Faintly) - Violet
407.8	Visible - Violet
507.3	2nd order U.V. line
546.1	Visible - Green
632.8	Visible - Helium-Neon laser
730.0	2nd order U.V. line
760.9	3rd order U.V. line
809.4	2nd order - Violet (dim)
871.6	2nd order - Blue

** [Filtered out if you use a glass shield.]

If this source is unavailable, a white light source such as a filament lamp with lens (or focusing mirror) to image the source onto the slit and fully illuminate the grating can be used. If a source with substantial short wave UV is used (such as a Xenon lamp) take care that a glass slide is placed in the path for protection. Because this source is a continuum, the only wavelength setting that can be used or checked is 000.0 (i.e., the zero order or specular reflection from the grating).

Small variations in wavelength are easily corrected using the calibration feature of the CCD or diode array software. If your spectrograph is badly out of calibration, please call a Sales Engineer for assistance.

Optical alignment is of even greater importance for spectrographs than for monochromators. If the alignment is not correct peaks can be asymmetrical in shape, and the resolution can be degraded from optimal.

For precise optical alignment a suggested procedure is as follows:

1. Set up a small helium neon laser on the optical bench or table, and using a target make sure that the beam is parallel to the bench and along the required optical axis. The laser should not be adjusted from now on.
2. Set the grating to zero order, (0 on the micrometer). Set up MS125J so that the laser beam enters a narrow slit and exits through the center of the exit port. The height of the beam relative to the slit should be unchanged.
3. If you are using a focusing lens, place the lens in the optical path and adjust the height and displacement so that the laser beam is undeviated. If you are using reflective optics to focus light onto the entrance slit, make sure that the light is similarly directed through the entrance slit along the optical axis.

VII. MS125J ACCESSORIES

HIGH EFFICIENCY FIBER OPTIC LIGHT GUIDES

ORIEL offers three light guides specifically dimensioned for use with MS125J. These have a compact bundle at one end, and a single array of fibers forming a 100 μm 'slit' at the exit end. These highly efficient guides allow light to be channeled into MS125J without the spectrograph or monochromator having to be placed in alignment with the source.

Two of these light guides have a 0.6 mm bundle of 100 μm fibers at one end, and a 2.5 mm x 100 μm 'slit' at the other, one guide is made of silica and the other of high grade glass. The silica light guide (#77403) is optimal for light below 350 nm, and the glass fiber optic guide (#77402) is excellent for use in the visible and near infrared.

The third light guide (#77404) is made of glass and is bifurcated, with a 0.6 mm input bundle at one end, a 2.5 mm x 100 μm 'slit' of fibers at the exit end, and a probe consisting of two concentric bundles (Figure 2). This bifurcated fiber is especially useful for reflectance and fluorescence measurements, and can also be used for absorbance measurements. All light guides are 1 m in length.

MONOCHROMATOR EXIT HOLDER

MS125J can easily be converted for use as a monochromator. This simply involves the removal of the diode array and mounting flange, and attachment of the monochromator exit slit holder (#77409), plus an exit slit. This can be done in seconds.

WARRANTY AND RETURNS

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. If goods are not returned to Oriel Instruments, and user chooses to have repairs made at their premises, Oriel Instruments shall provide labor for field adjustment, repair and/or replacement at prevailing rates for field service, on a portal-to-portal basis.

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. This provision shall not apply to any accessory, equipment or part which does not affect the safe operation of the device.
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 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 malfunctioning 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 while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, 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 repairs not covered by warranty, with the cost of the repair, before starting the work.

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.