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DUO-220 Dye Laser

337220-00/01

Laser Science, Inc

8 E. Forge Parkway
Franklin, MA 02038
800-447-1020

User Manual

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The **DUO-220** is a Class IIIb laser device.

CE

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Chapter 1 – General Information

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1.1 General Information/Summary

The **DUO-220 Dye Laser Module** is a dual wavelength class III b laser device designed to be used with the **VSL-337ND-S** nitrogen laser. The device is configurable for dye laser output alone through tunable wavelength bands, or for the nitrogen laser output alone at 337 nm wavelength, or for dual wavelength output. In the dual wavelength configuration, both the 337 nm line and the selected dye laser line are simultaneously output from separate ports. The optical cavity in the dye laser module is a Littrow mount grating to mirror configuration, which uses customer selected dye solutions in sealed dye cells for tuning band selection. The dye laser output can be tuned from 360 nm through the visible spectrum and up to 700nm. A direct wavelength readout from the grating control micrometer is accurate to +_ 1nm.

The **DUO-220** dye laser module can be fitted with fiber optics for remote excitation or with a beam expander for collimating, spatial filtering, or focusing the beam. The dye laser output can be fed into a microscope for microbeam applications. Laser Science offers fiber optics, couplers, collimators, and laser to microscope adapters.

Feature Summary:

- Compact laser package conforms to small work spaces.
- No messy, bulky flowing dyes or coolers required.
- Output options for tunable visible laser lines or the 337nm UV line, or both, configurable with the turn of a dial.
- Laser cavity optimization for each dye solution via simple user control.
- Beam position is held to within 3 arc seconds when dye cuvettes are changed, by a specially designed Laser Science cuvette holder.
- The **DUO-220** is supplied with a dye cuvette, a stir bar, two 8-32 X .19 attachment screws, allen wrench and stir motor driver with appropriate line cord.

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1.2 Power Supply Dependent Variations

The **DUO-220** dye laser module has two power supply dependent variations:

- Part number 337220-00 (100-120 VAC, 50-60 Hz., <20mA)
- Part number 337220-01 (200-240 VAC, 50-60HZ., <10mA)

1.3 Applications

The **DUO-220** dye laser is designed for use in science, education and industry. Applications include:

- LIF (laser induced fluorescence)
- Fluorescence immunoassay
- Fluorescence microscopy
- Biological sample irradiation
- Microbeam experiments
- Microscopic ablation, microcutting and microsurgery
- Particle physics detector calibration
- Source laser for frequency doubling tunable UV light

1.4 Specifications

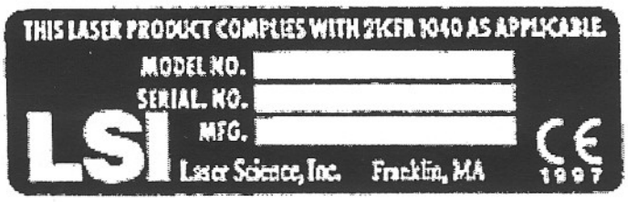
Spectral Range:	360-700nm or 337nm or both*
Spectral Bandwidth:	.3nm (360-700nm), 0.1nm (337 nm)
Repetition rate:	<1 Hz – 30 Hz
Pulse width, FWHM:	3 nsec (dye output, 4nsec for 337 output)
Pulse Energy:	>70 uJ at 500 nm
Pulse to pulse energy stability:	4% std. dev.
Peak power:	>23.3kW at 500 nm
Average power at 20 Hz.:	1.4mW at 500 nm
Beam size, nominal:	1.5 x 2 mm
Beam divergence, full angle:	4mrad
Dimensions, L x W x H:	4.9 x 7.7 x 8.8 in
Weight:	5 lbs. (2.3 kg.)

* With a customer-supplied beamsplitter installed.

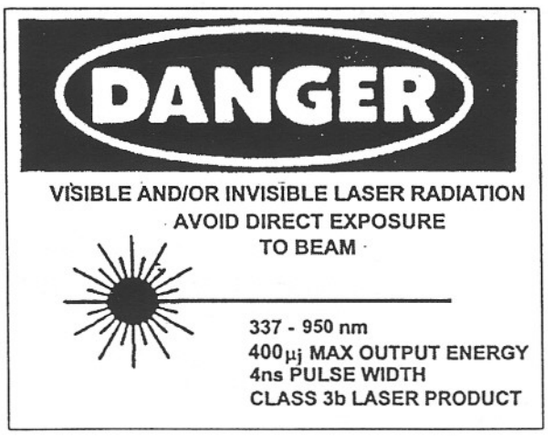
1.5 Labels and Warnings

Per requirements of various federal and multinational regulatory agencies, all labels and warnings displayed on or in the **DUO-220** dye laser are documented herein.

Certification and Identification



Class IIIb Laser



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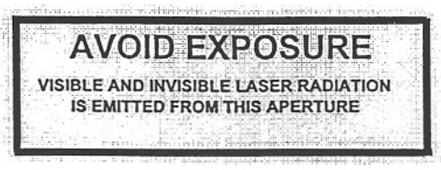
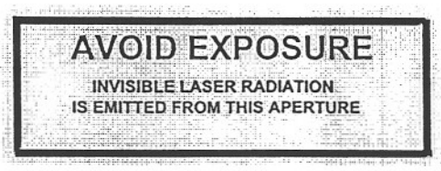
Aperture Warning





Access Panel, Safety Interlock and Operator Access warning

1.6 Compatible Accessories

Nitrogen pump lasers, variable attenuators, focusing optics, dye solutions, dye cells, laser-to-microscope adaptors, tunable frequency doubling modules, optical fibers and coupling systems are available for use with the **DUO-220**:

Part Number	Description
337201-00	VSL-337ND-S Nitrogen Laser, 110V
337201-01	VSL-337ND-S Nitrogen Laser, 220V
337300	UVS frequency doubling module, tunable from 220nm to 320nm

Dye Laser Accessories

Part Number	Description
337749	Variable Attenuator, decreases dye laser output to 2 – 55% of original
337920	Dye Cell, quartz, 1 cm square
337209	Magnetic Stir Bar for DUO Dye laser modules
337910	Beam Expander and Mount, expands, collimates, or focuses dye laser output
337911	1" Quartz Focusing Lens and Mount, for nitrogen or dye laser output
337912	3" Quartz Focusing Lens and Mount, for nitrogen or dye laser output

Dyes

Dyes are supplied in 20 ml lots of 0.001 M solution. The peak wavelength of each dye is listed for reference.

337816	LD-690 (696 nm)
337820	DCM (655 nm)
337824	Rhodamine 640 (653 nm)

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Dyes (continued)

Part Number	Description
337828	Rhodamine 590 (R-6G) (596 nm)
337832	Rhodamine 610 (625 nm)
337834	Rhodamine 560 (570 nm)
337836	Disodium Flourescein (550 nm)
337840	Coumarin 540A (505 nm)
337848	Coumarin 500 (470 nm)
337849	Coumarin 500 (500 nm)
337852	Coumarin 481 (481 nm)
337856	Coumarin 480 (470 nm)
337858	Coumarin 460 (472 nm)
337860	Coumarin 440 (445 nm)
337864	Stilbene 420 (425 nm)
337868	DPS (406 nm)
337872	PBBO (396 nm)
337876	BBQ (390 nm)
337878	Exalite 384 (384 nm)
337880	PPO 380 (380 nm)
337884	BPBD 365 (366 nm)
337888	PPO 365 (365 nm)
337892	Four dye set: DCM, Rhodamine 590, Coumarin 540A, and Coumarin 440 (337820, 337828, 337840, 337860)
337896	Five dye set: Same as 337892, plus BBQ (337876)
337898	Eight dye set: Coumarin 440, Coumarin 460, Coumarin 481, Coumarin 500, Coumarin 540A, Disodium Fluorescein, Rhodamine 560, and Rhodamine 590. Packaged for use with the UVS Frequency Doubling Module, 337300-xx (337860, 337858, 337852, 337849, 337840, 337836, 337834, 337828)

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Laser to Microscope Adapters

Part Number	Description
337600-XX *	VSL-LMA-A Ablation Adapter. Directly couples dye laser output and microscope epi-port. Optional laser stand.
337771-XX *	Optional laser stand for the VSL-LMA
337760	VSL-LMA-F Fluorescence Adapter. Couples dye laser output and microscope epi-port through a fiber.

Optical Fibers

Desired length in meters specified by "XX"

Part Number	Description
337709-XX	100 um diameter fiber. Bend radius one inch. SMA
337710-XX	200 um diameter fiber. Bend radius two inches. SMA
337711-XX	400 um diameter fiber. Bend radius three inches. SMA
337712-XX	600 um diameter fiber. Bend radius four inches. SMA
337713-XX	800 um diameter fiber. Bend radius eight inches. SMA
337714-XX	1 mm diameter fiber. Bend radius ten inches. SMA
337715-XX	Fluorescence Probe Fiber Bundle, 400 um. Transmission fiber probe end surrounded by fiber bundle to transmit fluorescence.
337716	Fluorescence Probe Fiber Bundle, 600 um. Transmission fiber probe end surrounded by fiber bundle to transmit fluorescence.
337717	Combined Fiber for Dual Wavelength Excitation. Two 400 um input fibers fused to a 600 um transmission fiber, 4 feet long.
337729-XX	100 um diameter fiber. Bend radius one inch. Ferrule
337730-XX	200 um diameter fiber. Bend radius two inches. Ferrule
337731-XX	400 um diameter fiber. Bend radius three inches. Ferrule
337732-XX	600 um diameter fiber. Bend radius four inches. Ferrule
337733-XX	800 um diameter fiber. Bend radius eight inches. Ferrule
337734-XX	1 mm diameter fiber. Bend radius ten inches. Ferrule

* ***Please contact sales for appropriate configuration number, which depends on the particular microscope.***

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Chapter 2 – Operating the Laser

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2.1 Safety Precautions

All persons who use the laser, or will be in the area where the laser is in use, should be aware of potential hazards associated with the equipment and the precautions to avoid injury.

Observe the following precautions when operating or servicing the laser:

- Before turning on the laser, don safety glasses or goggles appropriate for protection from laser radiation at 337 nm as well as the visible laser wavelength selected.
- This device can be configured to produce visible and invisible laser radiation. To prevent injury to your eyes, **never** look directly into the laser beam or directly at any specular reflections of the laser beam.
- Post warning signs at entrances and in prominent locations near the laser work area.
- Limit access to the work area to trained personnel.
- When possible, enclose all laser beam paths.
- Set up work stations so that the laser beam is not at eye level. (Set up a beam dump.)
- Be sure the beam attenuator on the VSL-337ND-S nitrogen pump laser is closed at all times when the laser is not operating.
- Maintenance and servicing of the laser should be done by trained personnel only.

2.2 Attaching the DUO-220 Dye Laser to the VSL-337ND-S Nitrogen Laser (Pump)

The **DUO-220** dye laser module should be attached to the VSL-337ND-S nitrogen laser for a stable dye laser configuration. (See the **DUO-220** Service Manual for instructions on how to attach the dye laser module to the VSL-337ND-S nitrogen pump laser.)

2.3 Laser Line Selection

The assembled laser pair allows access to both the UV nitrogen laser output and the visible laser beam, depending on the selector wheel setting. The selector wheel is set for the desired output by turning the thumb control on the top of the **DUO-220** cover. The number 1 wheel setting allows full-scale dye laser output and the number 2 setting allows full-scale nitrogen laser output. (See figure 1.) Other selection wheel positions are available for additional (customer–supplied) optics. For example, beamsplitters, which allow for simultaneous dye and nitrogen laser outputs in various ratios. For instructions on how to insert optical elements into the selector wheel, refer to the **DUO-220** Service Manual.

The dye laser tunable output wavelength band will be determined by the dye solution used. Laser Science has a full selection of dyes and cuvettes for use with the **DUO-220** laser, which cover specific laser bands from 360 nm to 700nm. The laser is tuned to a specific wavelength using a dial-up micrometer. The micrometer readout is in nanometers and is accurate to +- 1nm. **WARNING:** At no time should the tuning micrometer be turned past the 700nm mark. Doing so may jam the grating tuning mechanism.

2.4 Loading the Dye Cuvette

Provided with the laser is a small white magnetic stir bar. Insert the stir bar into the dye cell (cuvette) and recap it tightly. The cell wall should be free of fingerprints, smudges, etc. If necessary, the dye cell can be cleaned using methanol or propanol and soft lens tissue. Pull off the metal cap from the **DUO-220** dye laser module cover to expose the dye cell holder. The laser will automatically shutter the nitrogen pump beam when this cap is removed. The lettering [Q] in the upper corner of the dye cell cuvette should face the dye laser output aperture. (See Figure 2.) The dye cell should slide smoothly into the holder. DO NOT FORCE THE CELL INTO THE HOLDER. Light pressure on the cell is all that is required to push it fully in place. Replace the metal cap on the **DUO-220** cover.

2.5 Dye Laser Operation

WARNING: Laser protective eyewear is recommended whenever the dye laser or nitrogen pump laser is "ON."

Once the dye has been selected and the dye cuvette prepared and loaded into the cuvette holder, the laser is ready for operation. Turn the selector wheel setting to number 1 for dye laser operation. Turn the micrometer setting to 0 for 0-order reflection. Turn on the VSL-337ND-S nitrogen laser and open the beam shutter to allow optical pumping of the **DUO-220** dye laser. The dye laser output can easily be viewed using a white card, such as a business card, as a screen at a few inches from the output aperture. The typical dye laser output beam appears as a small bright spot, slightly elongated in the horizontal direction. A few fine diffraction

lines may appear close to the spot on either side. This is normal. You are now ready to dial the micrometer to the desired wavelength or tuning band.

2.6 Changing Dyes

When changing dyes or changing dye cuvettes in the **DUO-220**, slight differences in the absorption of the dye or the position of the focused pump laser beam in the dye may affect the laser output power as well as the appearance of the output spot. The **DUO-220** is provided with focus adjustment ability to correct for these small differences. Unless otherwise specified, the **DUO-220** is shipped with the focusing lens position optimally set for the Coumarin 500 green line (500 nm). Minor alignment correction of the pump laser focusing lens for other dyes is achieved by turning the lens adjustment screw (LAS) using a 3/32 allen wrench. This is a socket head screw accessible through the side panel of the **DUO-220** (see Figure 3.) When changing to a dye with a **higher** wavelength output, rotate the LAS **counter-clockwise** while monitoring the output beam. When changing to a dye with a **lower** wavelength output, rotate the LAS **clockwise**. When turning this adjustment screw, large diffraction lines above and below the main beam can be observed. The pump laser lens should be adjusted until the large diffraction lines JUST disappear from the output spot. For the most accurate positioning, an energy meter can be used to optimize the laser output.

If you do not obtain a single clear small spot at the output, the **DUO-220** dye laser may require additional alignment. Please refer to the **DUO-220** Service Manual for alignment procedure and tips.

2.7 The Dye Stir System

Laser power stability and energy extraction from the **DUO-220** dye laser can be enhanced if the dye is stirred during laser operation. This is especially critical for high repetition rate operation. The **DUO-220** is provided with a built-in stir motor. A small magnetic stir bar is provided with each **DUO** laser for use with the stir motor. The stir bar is inserted into the dye cuvette as described above. The stir motor driver is attached by cable connection to the side of the module, near the base. Note that the female end of the cable connector is keyed. The key lines up with the small black dot above the connector opening (see Figure 2). The stirring motor speed can be adjusted using the control knob on the stir motor driver.

IMPORTANT: In order for the dye stir system to work correctly, whenever a dye cuvette is inserted (or re-inserted) in the module, the stir motor must be turned "OFF" and then "ON" to the desired stir level before the laser is operated. Failure to re-start the stir motor after changing cuvettes can result in poor stirring action and diminished laser output energy levels.

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Index - Illustrations

Figure 1a

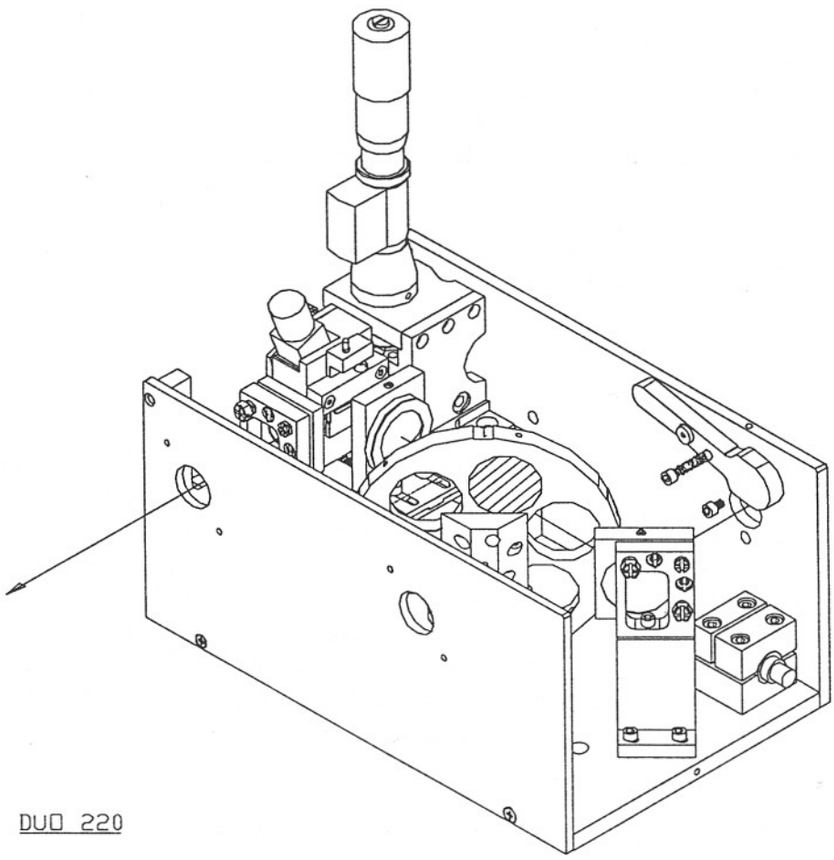

Figure 1a. Line selection Wheel position 1: Full scale Dye laser output

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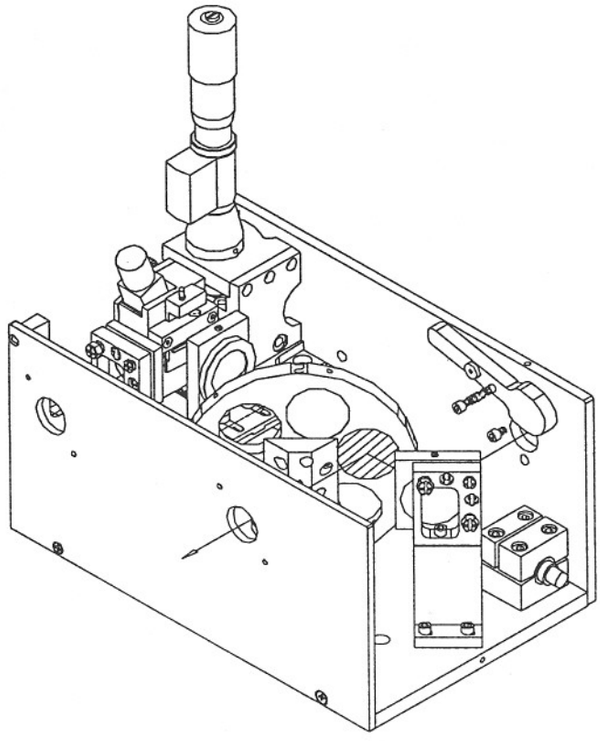

Figure 1b. Line selection Wheel position 2: Full scale Nitrogen laser output

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Figure 2

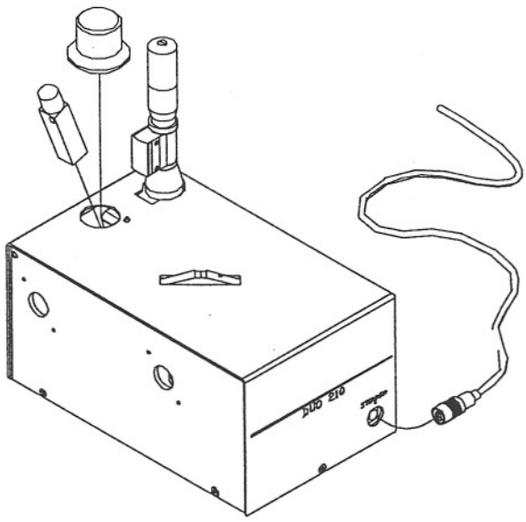

Figure 2.

Figure 3

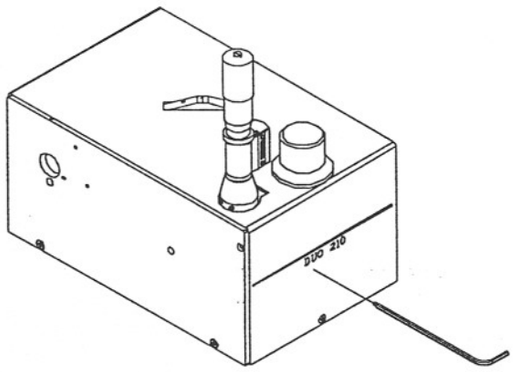

Figure 3.

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Figure 4

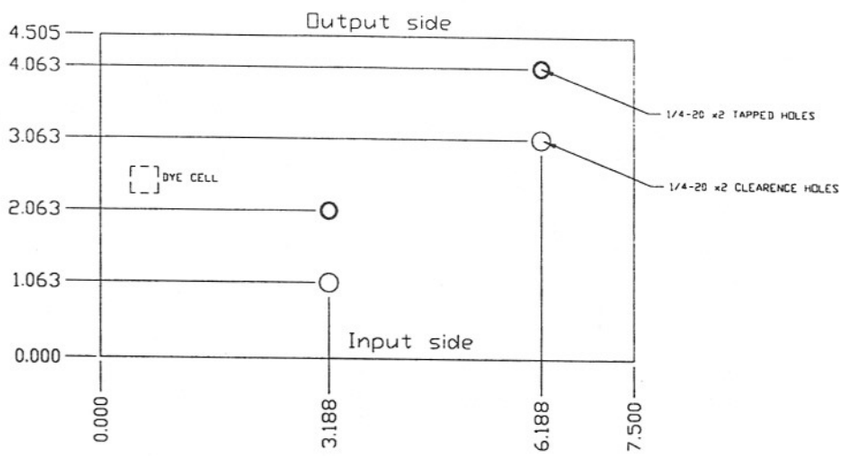

Figure 4
View of mounting holes from bottom

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Figure 5

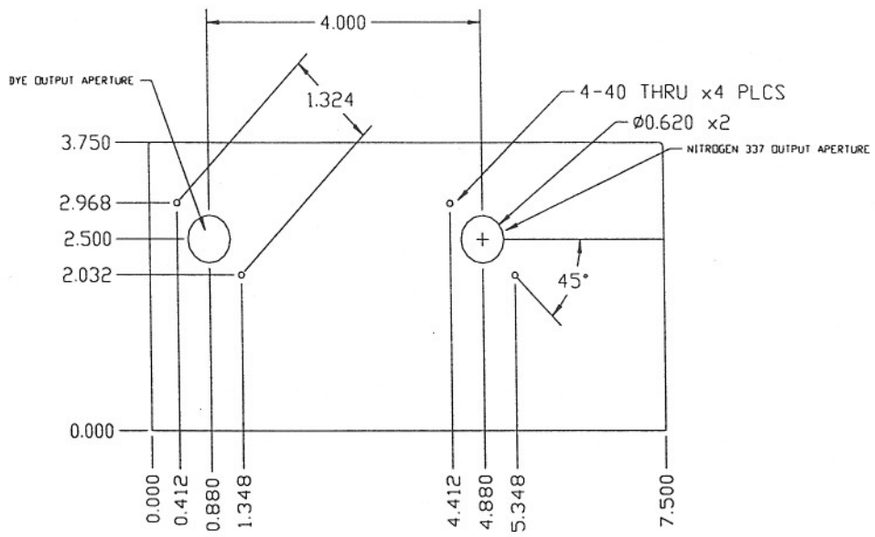

Figure 5
Output plate