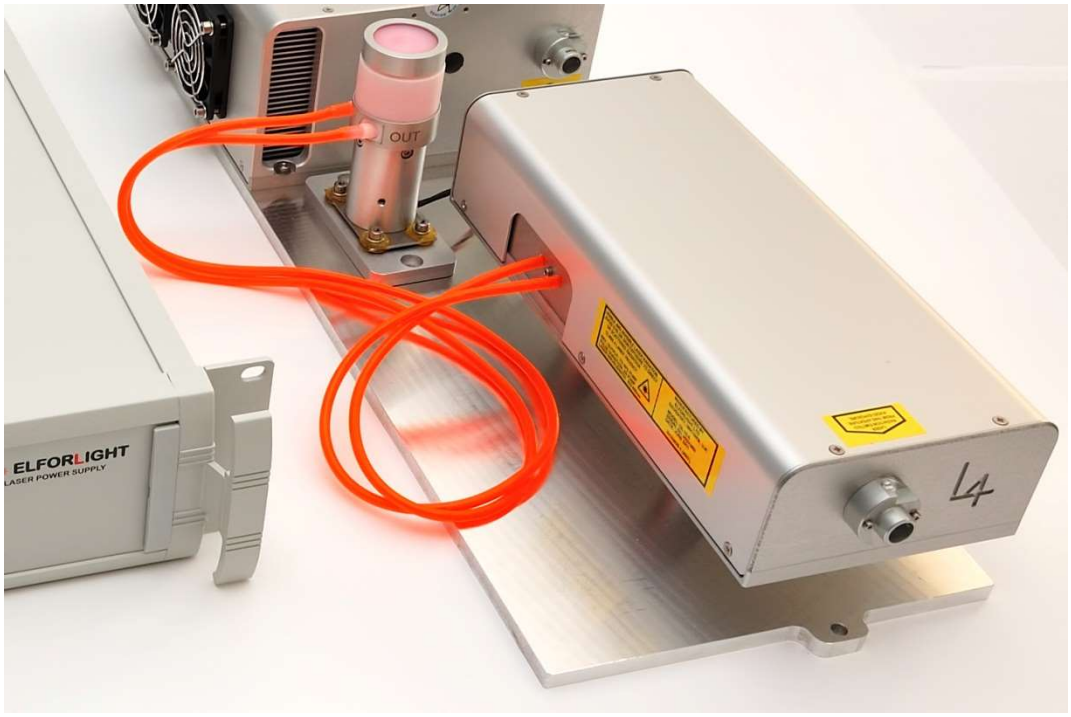
DL Series Dye Lasers



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Contents

1. Basic User Manual

1.1. Laser Safety

Refer to pump laser safety and operating instructions prior to operating the dye laser.

Elforlight dye lasers are designed and optimised to operate with FQS and SPOT lasers as manufactured by Elforlight. These Q-switched lasers have outputs at 532nm for dye laser pumping.

The dye laser operates at a range of wavelengths dependant on the dye used. All Elforlight dye lasers are set up and specified using Pyrromethene 597, which will give a laser output in the range 560 – 610nm.

Refer to dye manufacturer's instructions and precautions prior to handling and mixing a solution. Laser dyes and solvents are hazardous materials and necessary protective clothing and eye ware should be used when mixing dye, filling the reservoir and connecting the supply tubes.

The laser should be used in an enclosed area with access restricted to trained personnel. The area should be clearly labelled and the entrance marked with the class of laser.

Only trained personnel should be allowed to use the laser.

The key must be inserted in the key switch on the pump laser power supply front panel and turned to enable the laser to operate. The key is captive in the operational position. As such, the key should be removed from the laser when not in use, and / or unattended, and stored in a safe place.

Eye and skin exposure to direct or scattered laser radiation is hazardous and should be considered potentially extremely harmful.

Suitable eye protection should be worn at all times whilst laser output is possible.

The laser beam path should be terminated with a non-reflecting beam stop. Beam paths should be enclosed where possible, and should not be at eye level if practical.

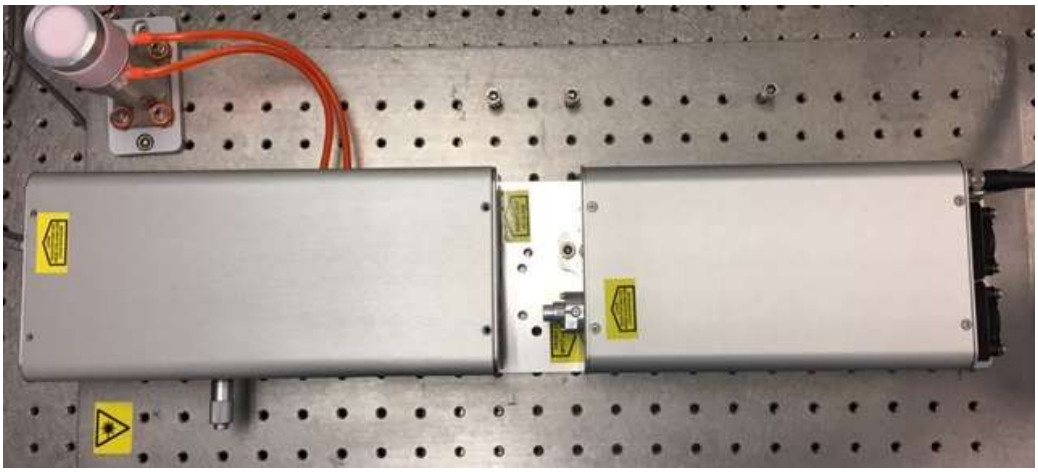
Care should be taken that all external mirrors and optics used are securely positioned and fixed to prevent movement. Care should be taken at all times to prevent stray reflections from surfaces.

1.2. Dye laser operation

The Elforlight dye laser is normally supplied with an Elforlight pump laser. The pump/dye laser combination will be pre-aligned in the factory and should need minimal alignment at installation.

Prior to operation a dye solution will be required. See Appendix 1 for mixing dye solution procedure.

For use with a SPOT laser, the SPOT head and PSU and dye laser head are shipped separately. A mounting plate is also provided to mount the dye and SPOT laser heads.



The position of the two heads, as factory tested, is marked by labels. Bolt down the SPOT and Dye laser heads to the plate using M6 bolts. (It will be necessary to take the lid off the dye laser to access the bolt holes). Align the edges of the heads to the edges of the plate. The heads could also be mounted directly to an optical table or breadboard with similar spacing.

With all components in place the pump laser should be switched on. The dye pump should be switched on and run while the pump laser is warming up.

On completion of 'warm up' open the manual shutter on the pump laser. Gradually increase the output of the pump laser until an output is achieved from the dye laser.

The output of the dye laser is controlled by adjusting the pump laser.

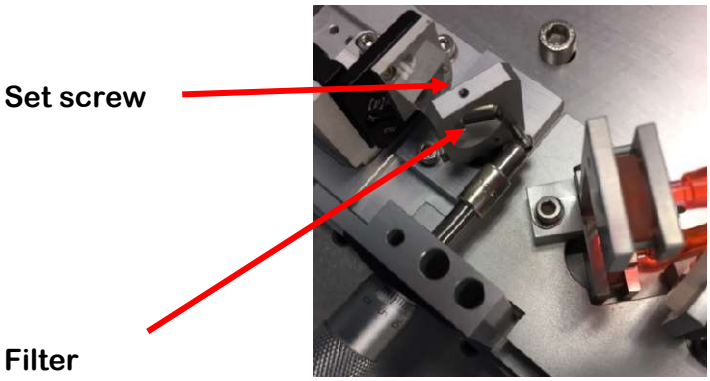
If the dye laser has a tuning option, adjustment can be made to select a specific wavelength.

Tuning Filters:

The dye laser is shipped with either one or two filters to cover the tuning range, depending on type of pump laser supplied.

One extends up to 589nm, and the other above 589 to 610nm or further.

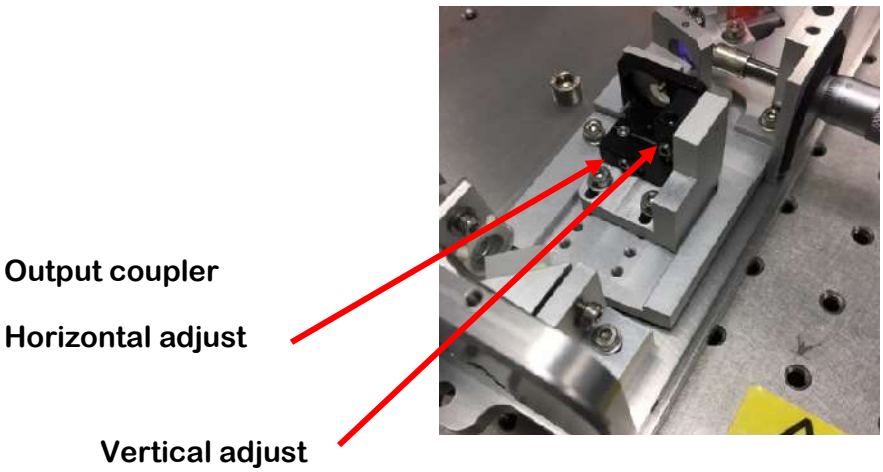
The filter is held in its mount with an M2 set screw, which takes a 0.9mm wrench.



To change the filter, whilst wearing gloves or finger cots, loosen the set screw and carefully remove the filter, then replace with the other filter, and gently nip the set screw. DO NOT overtighten as this may crack the filter.

The dye laser is tuned by adjusting the angle of the filter using the micrometer. The test data provides an approximate calibration of wavelength vs micrometer reading.

Alignment optimisation may be required, particularly upon first installation. Also, on changing repetition rates, the output coupler may need realigning in the vertical plane. A 1/16" Hex wrench is used.



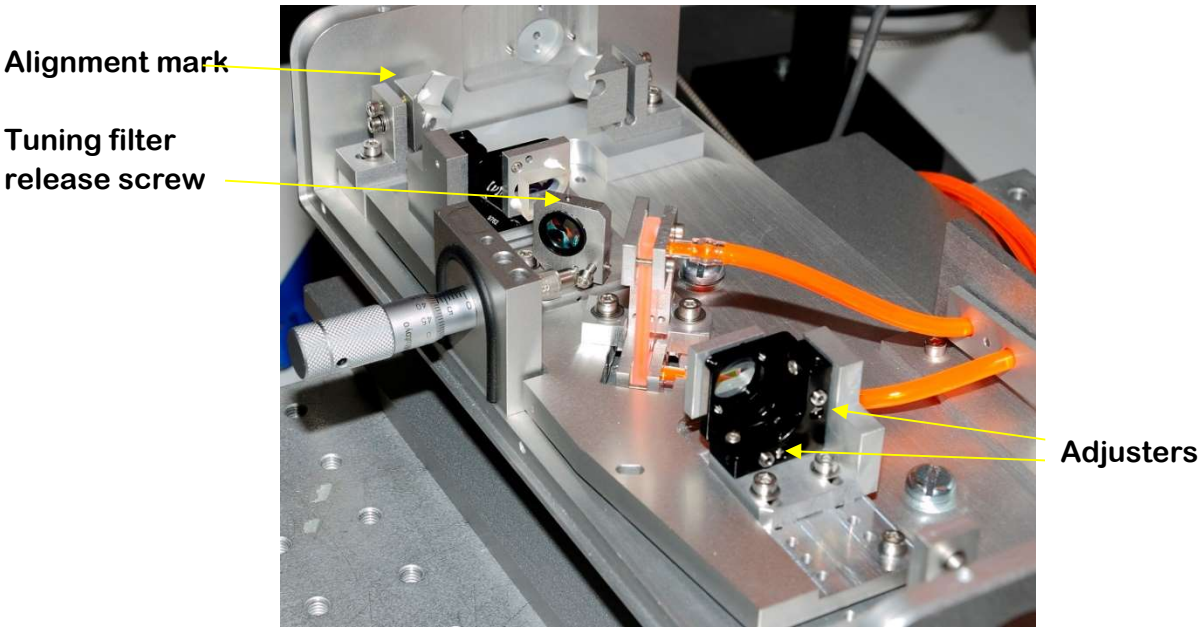
1.3. Dye laser alignment

Alignment procedure: Laser eye protection should be worn.

If the laser has been factory aligned with the same type of laser with which it is to be utilized, then the alignment should consist of simply bringing the pump beam into the dye laser centrally along the cavity. For the SPOT laser, this should be achieved by butting the dye laser input face against the SPOT laser output face. The SPOT shutter and beam expanding telescope assembly protrude through the dye laser input end face as in the above photograph.

For SPOT lasers, due to the short pulse width, the cavity is as short as possible, so the two mirrors are each positioned as close as possible to the dye cell.
The dye solution is to be made up per appendix 1 of the dye laser manual.
Butt the dye laser to the SPOT laser on a suitable flat surface such as an optical table. Circulate the dye. Reduce the pump diode current of the SPOT laser until it is just above threshold and run the laser at say 5kHz. This enables alignment of the beam with less risk to the eye. Check that the beam runs centrally through the dye cell and the tuning filter, which will place it approximately central on the rear mirror and output coupler.

Increase the SPOT current (power), and the dye laser should be seen to lase. The output can be optimized by adjustment of the output coupler and / or rear mirror of the dye cavity. Monitor the output power on a meter and adjust the mount(s) using a 1/16" Allan key.



If the laser does not lase, try removing the tuning filter: it can be released by loosening the set screw in the top of the mount (0.7mm Allan key). Take great care not to touch the optical surfaces of the filter – wear finger cots.

If the laser lases without the filter, peak up the alignment for maximum power then replace the filter, again with great care not to touch it.

If there is still no output, then the reflections of the green pump light can be used to check alignment of the cavity mirrors. Reduce the laser power to just above threshold. Check that the pump beam is central on the dye cell and to the height of the rear mirror and output coupler. If the laser is badly misaligned, it may be necessary to remove the first steering mirror and align the pump beam to the machined mark on the output end plate of the dye laser head using the focusing lens to steer the beam by translating the lens on its mount. This is achieved by loosening the screw holding the lens plate to the upright of the "L" bracket. If the pump beam does not penetrate the dye cell due to absorption, allow the dye to drain back to the reservoir (lower the reservoir and loosen the reservoir lid). Replace the first steering mirror.

Look for a back reflection from the output coupler towards the dye cell and the focusing lens. Adjust the output coupler to retro-reflect this reflection along the input path, overlapping with the pump beam at the lens. Look for a similar reflection from the input (rear) mirror and align this coincident with the output coupler reflection. Flow the dye again and increase the pump power. Lasing should be seen. Optimize by adjusting the output coupler and rear mirror by adjusting the mounts with 1/16" Allan keys.
Then carefully replace the tuning filter. Tuning is achieved by turning the micrometer screw, which rotates the filter. As the filter approaches normal incidence, the wavelength is increased.

Once lasing output is optimized, the steering mirrors can be adjusted to bring the output beam central to the output aperture and orthogonal to the end face. If specified, a beam expanding telescope can expand and collimate the output dye laser beam. This fits to the output end face. The BET may have a shutter built in, but this is generally not used if the pump laser has a shutter fitted.

Appendix 1 Dye Solution

The test dye is Pyrromethene 597. A solution should be prepared with 40mg of dye in 30ml of Ethanol.

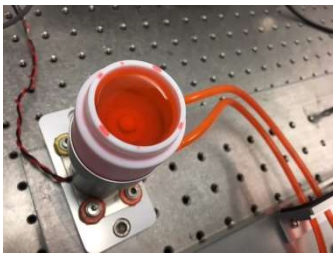
The dye tubes should be connected between the dye pump and the dye cell. Turn on the dye pump and ensure there are no leaks in the system. Check that there are no air bubbles in the system.

Open the pump laser shutter and allow a reduced level on pump light into the dye laser. Adjust the power level of the pump laser until there is an output from the dye laser. This will be the dye laser threshold. If a dye solution was supplied by Elforlight with the system, the concentration of the solution will have been optimised.

Dye concentration optimisation can be performed as below: -

Ensure the dye is flowing correctly in the system.
Set the pump laser to its specified energy level and repetition rate.
Monitor the energy level of the dye laser output.
Remove a quantity of the dye solution from the reservoir using a syringe.
Add a quantity of Ethanol using a syringe.
Check the dye laser output on the energy meter.
Repeat the process until an energy peak has been achieved.
Repeat the process until an energy peak has been achieved.

It may be necessary to top the reservoir level up (to the brim) with ethanol periodically (~day to day).

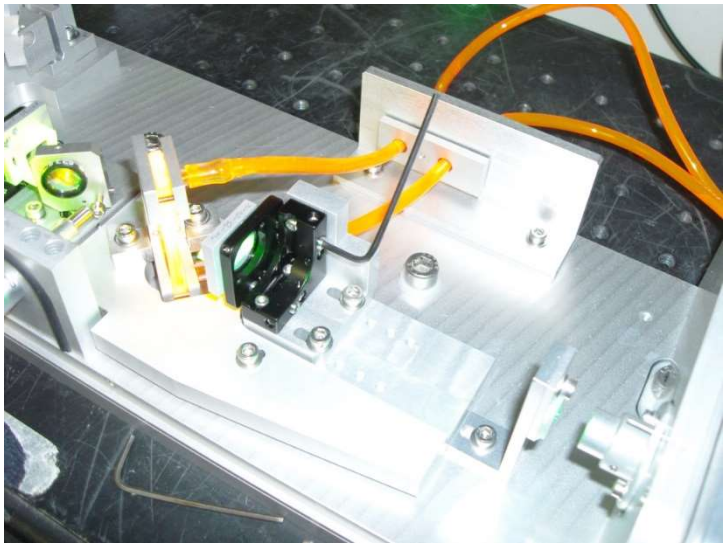


Appendix 2 Notes on operation with variable rep rates

The Elforlight dye laser pumped by a SPOT laser runs at repetition rates to 10kHz. The performance at higher rep rates degrades in terms of energy and beam quality due to inadequate exchange of dye molecules between pulses at higher repetition rates.

The specified energy of 5uJ with good Gaussian beam quality is typically achieved at up to about 4kHz. Further increase of repetition rate yields lower energy and the beam becomes almost "U" shaped, because the dye is flowing from the bottom of the dye cell to the top.

Because of the dye flow, the lasing dye molecules move in position, and so with change of repetition rate it is necessary to adjust the laser cavity in the vertical to obtain maximum pulse energy and best beam quality. This is achieved by using a 1.6mm (1/16") Allen wrench to adjust the vertical movement of the input mirror of the dye laser cavity, as shown below.



Monitor the laser power whilst making the adjustment to maximize the reading. This will approximate to best beam quality, but it is also possible to monitor beam quality on a suitable beam profiling system and adjust for the best beam.