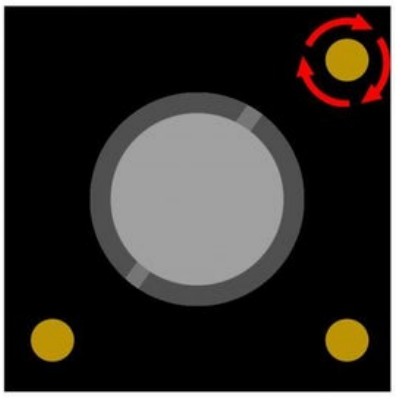
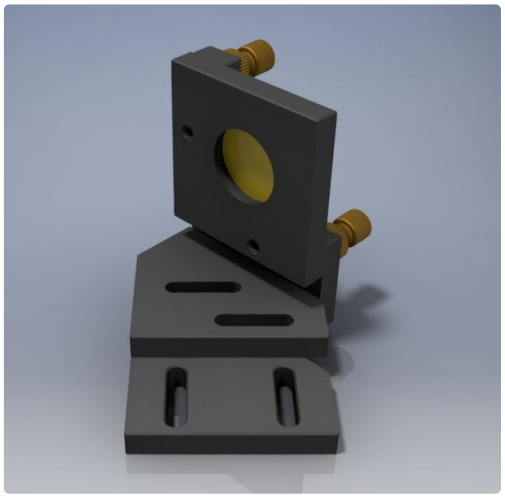
CO2 Laser Engraver Beam Alignment

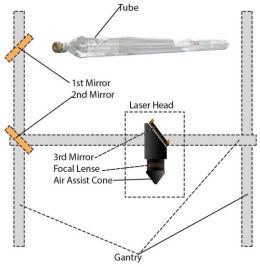
by WarrenA19

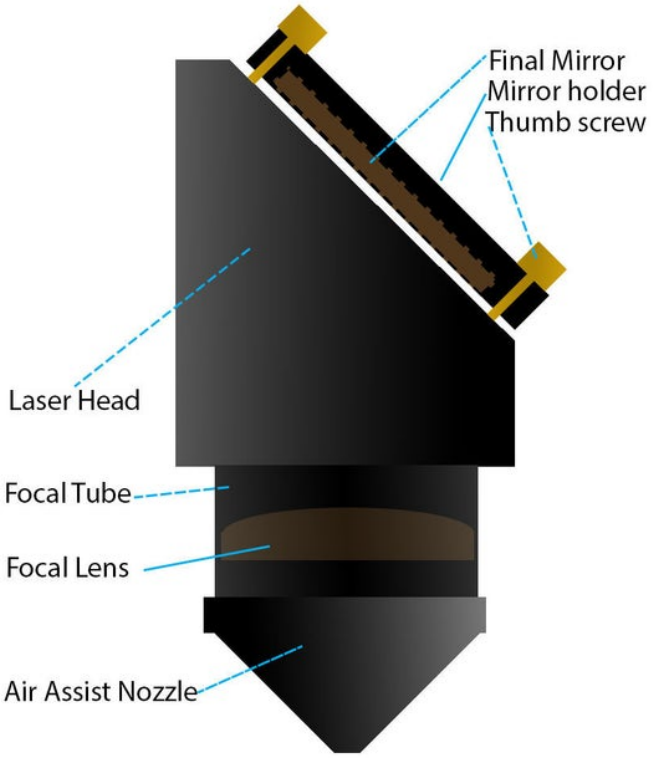
This guide has been written and provided by ATKLASER
The original version can be found here CO2 Laser Engraver Beam Alignment

Laser beam alignment can be a daunting task, but it shouldn't have to be. First-time users find it overwhelming and often give up and accept unsatisfactory alignment. Alignment shouldn't be a task that you avoid, it gets easier with repetition. Bad alignment can cause a number of problems; reduced cutting power, overheating lens/mirrors, in extreme cases even areas of the machine where the beam will not exit the air assist nozzle.









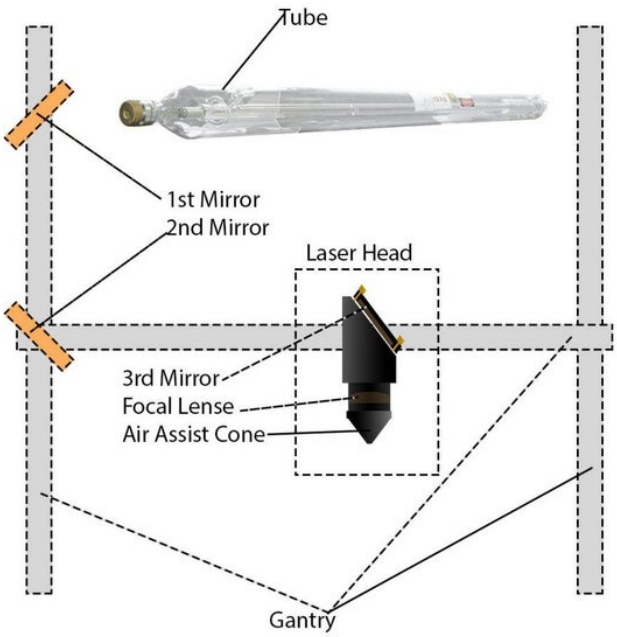
Step 1: Introduction

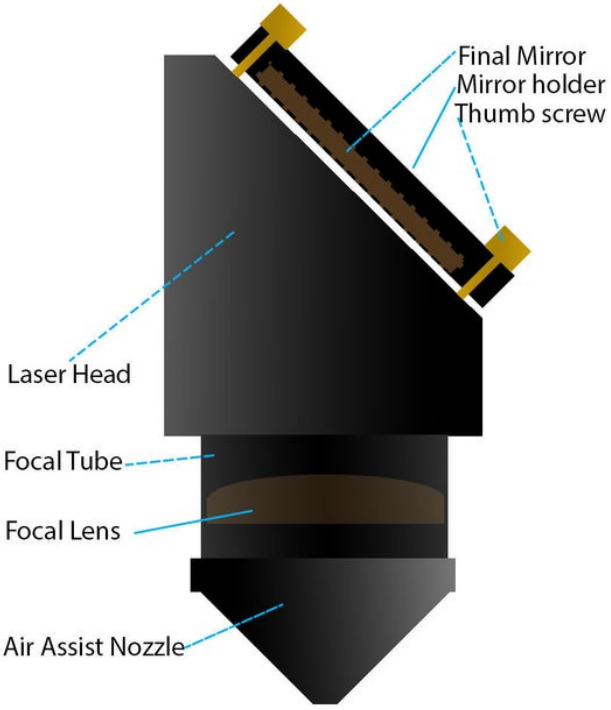
Laser beam alignment can be a daunting task, but it shouldn't have to be. First-time users find it overwhelming and often give up and accept unsatisfactory alignment. Alignment shouldn't be a task that you avoid, it gets easier with repetition. Bad alignment can cause a number of problems; reduced cutting power, overheating lens/mirrors, in extreme cases even areas of the machine where the beam will not exit the air assist nozzle.

Step 2: Safety Precautions

Never fire a co2 laser with the protective doors openNever circumvent safety circuits to allow the machine to operate with the door open. Never place tape directly on mirrors, the adhesive can damage the coating. Always ensure water cooling and ventilation is active when firing the laser.

Step 3: CO2 LASER ENGRAVER OPTICAL SYSTEM TERMINOLOGY





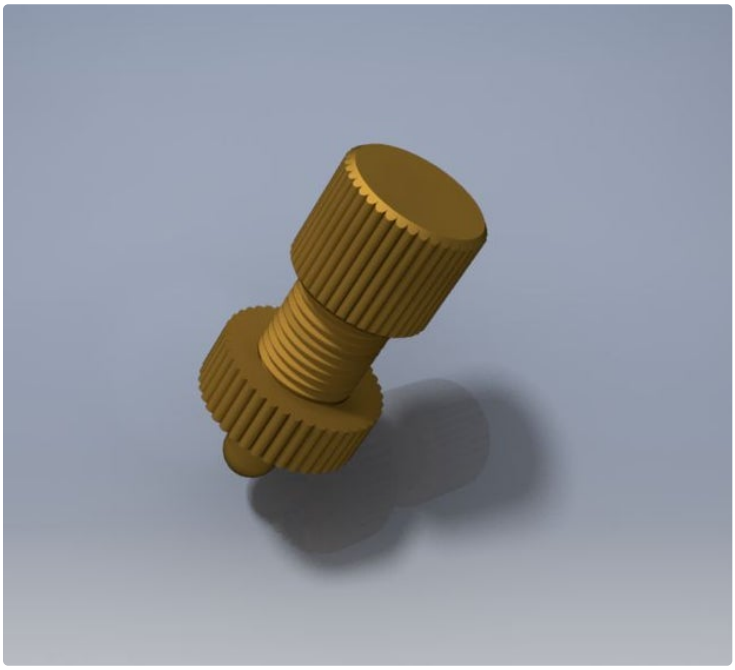
Step 4: TARGET TAPE

When testing alignment the best medium i have found is regular painters tape (masking tape). Fold a piece of tape a few times to make padded square, place this square over the target mirror. Use a fresh piece of tape to secure the target tape pad. Use a pen and ruler to find the mirror center and mark.Use a low power setting when setting alignment, i tend to use around 15% power this usually requires a 1-2 second pulse to mark the tape.Do not let the adhesive directly touch the mirror as this can damage the coatings.

Even better still is to make a couple of 20mm acrylic circles with a target engraved into them. These targets should pop into the mounting if they are cut to the correct size and tolerance.

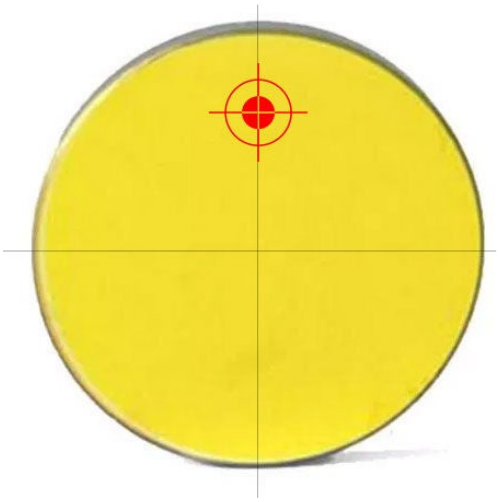
Step 5: ADJUSTING THE MIRRORS

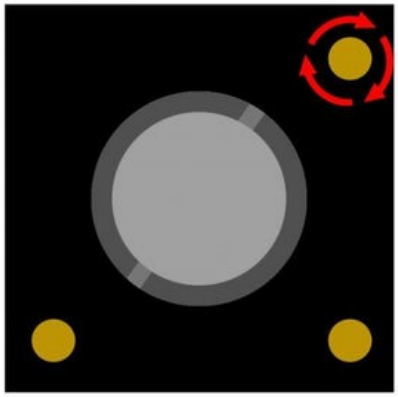
On the rear of each mirror is three thumbscrews, these screws when turned clockwise will push the mirror mounting out adjusting the angle of the mirror. The below images show the effect of adjusting each screw and the expected result at the target. The screws can be turned counter-clockwise to adjust the alignment in the opposite direction.



Step 6: SPOT IS TO HIGH

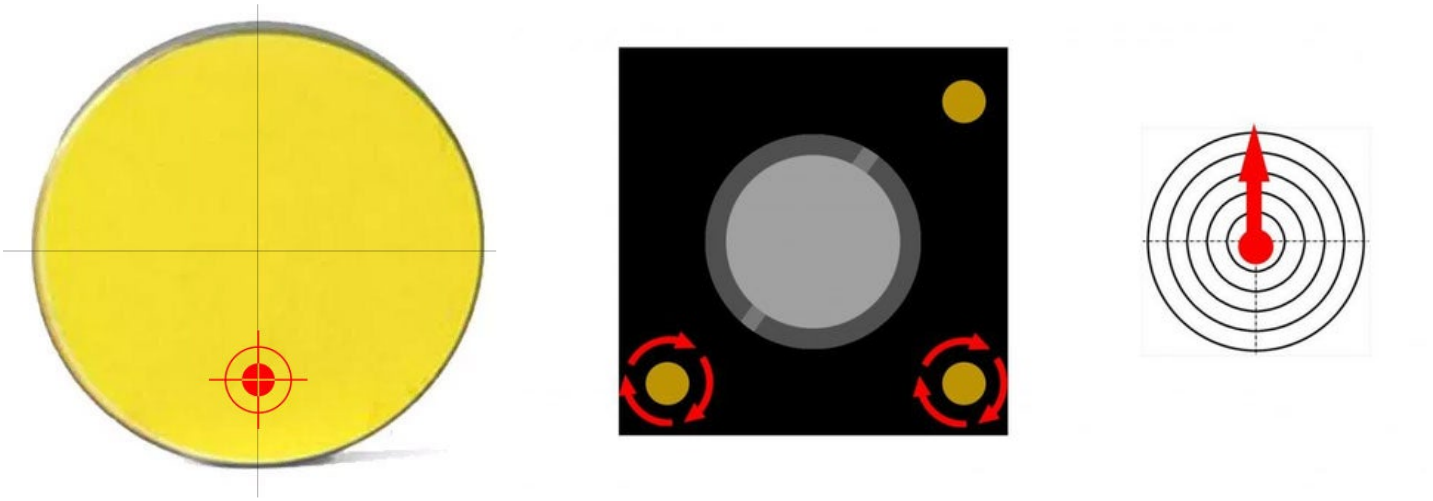
Turn the thumbscrews as indicated below to adjust the spot position on the next mirror.





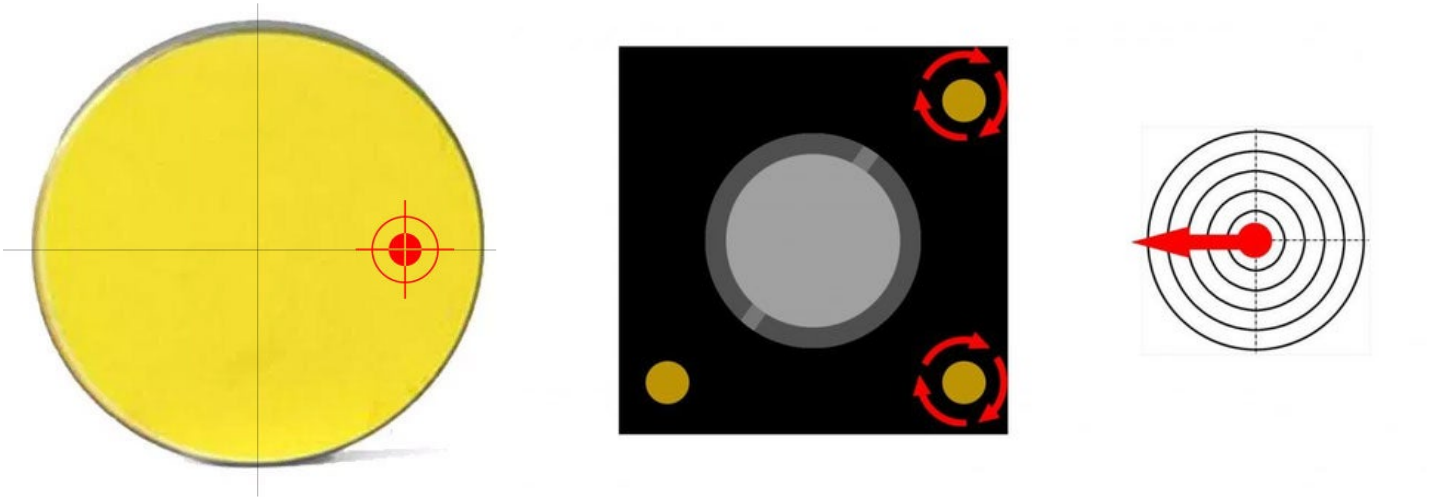
Step 7: SPOT IS TO LOW

Turn the thumbscrews as indicated below to adjust the spot position on the next mirror.



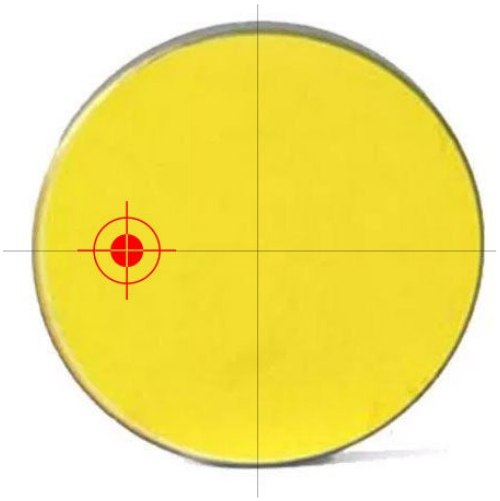
Step 8: SPOT IS TO FAR RIGHT

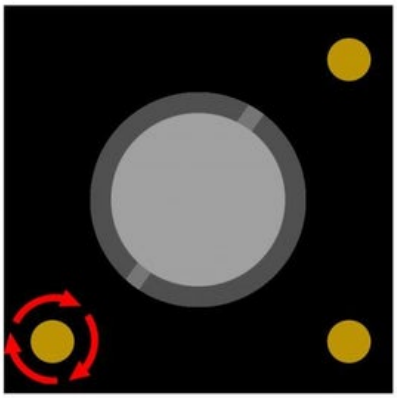
Turn the thumb screws as indicated below to adjust the spot position on the next mirror.

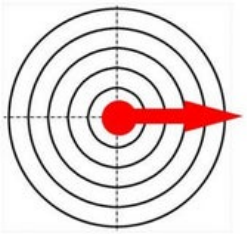


Step 9: SPOT IS TO FAR LEFT

Turn the thumbscrews as indicated below to adjust the spot position on the next mirror.







Step 10: FAR AND NEAR FIELD ALIGNMENT

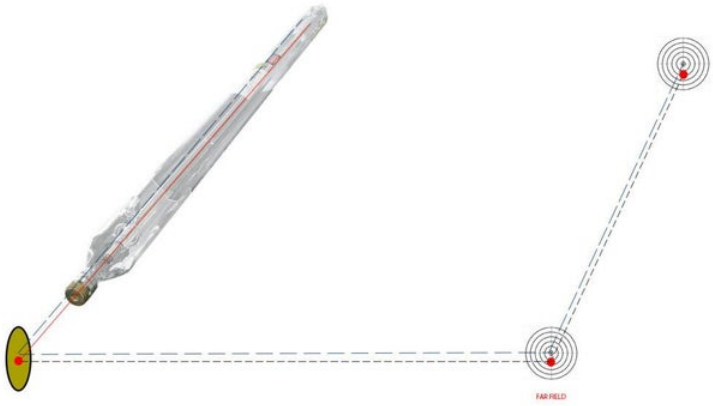
Far-field alignment should always be done prior to the near field. Adjust the angle of the mirror to get the beam spot to hit the center of the next mirror when the mirrors are at their furthest distance apart. When you move the mirrors closer together does this spot move up or down? If so you're near field alignment is out. Near field, alignment is achieved by changing where the spot hits the mirror you are trying to adjust. This is achieved by adjusting the alignment of the previous optic.

The diagram above shows an example of a mirror arrangement that has been adjusted to get the spot to hit center when the mirrors are closest (near field). You can see at far-field the beam exits this mirror at an angle hitting high on the 2nd mirror. This is due to the spot hitting low on the first mirror. If the beam is not hitting the 1st mirror at the correct position, 100% alignment across the entire machine will never be achieved.

Step 11: Adjusting the Tube Position

If both near field and far-field alignment cannot be achieved with the beam spot hitting center you must adjust the tube position.

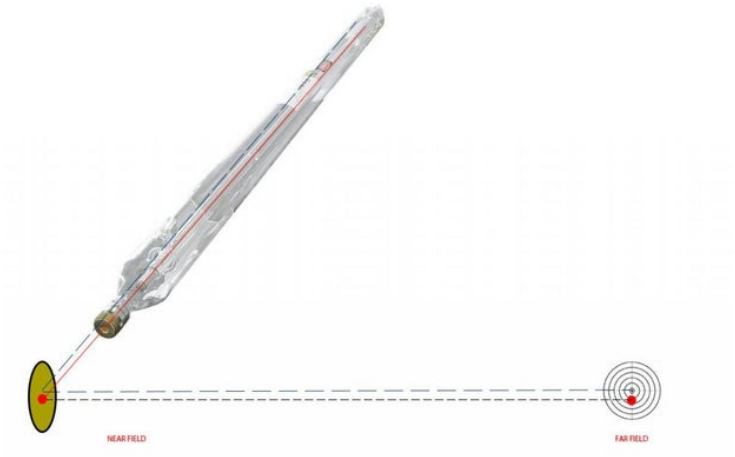
My method of alignment is very different from any I have ever seen. I find it to be the quickest and easiest to logically complete. It consists of aligning all the mirrors to ensure the beam hits the same position both near and far regardless of its relation to the center. This method will align your optics 100% parallel to your gantry. You can then move the position of the spot in relation to the center by adjusting the position of the tube.



Step 12:

The above image shows the 1st mirror aligned so the beam always hits the same spot on the second mirror both near and far field. This ensures the beam is running parallel to the gantry. But the beam spot is hitting about 3mm below the center, what's the solution?

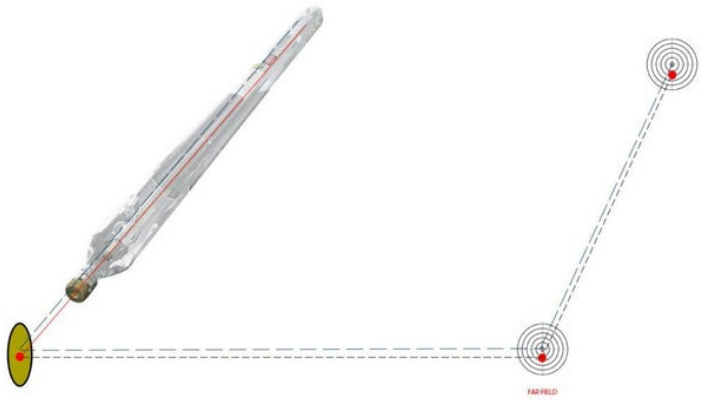
The tube must be raised 3mm raising the entire beam path, the beam will now follow the blue line on the above image.



Step 13: HORIZONTAL BEAM ALIGNMENT

Once the 1st and 2nd mirror have been adjusted so the spot hits the same position on the final mirror both near and far. Adjustments can be made to the position of the tube to raise or lower this spot. Raising the spot position at the first mirror should make an equal movement on the final mirror. If your spot is hitting to the left or right on the final mirror you must adjust the 1st mirror mounting, at the base of the mounting slacken off the 2 3mm hex head bolts. Now slide the mounting in the desired direction, make very slight adjustments. After adjusting the position of this mirror mounting you will probably have to make slight adjustments to the alignment of the first mirror.

Now your horizontal beam alignment is complete. It is now time to focus on the vertical beam alignment.

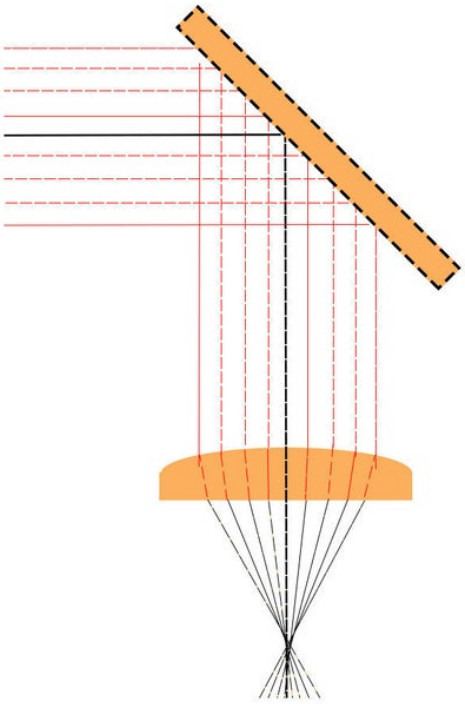


Step 14: VERTICAL BEAM ALIGNMENT

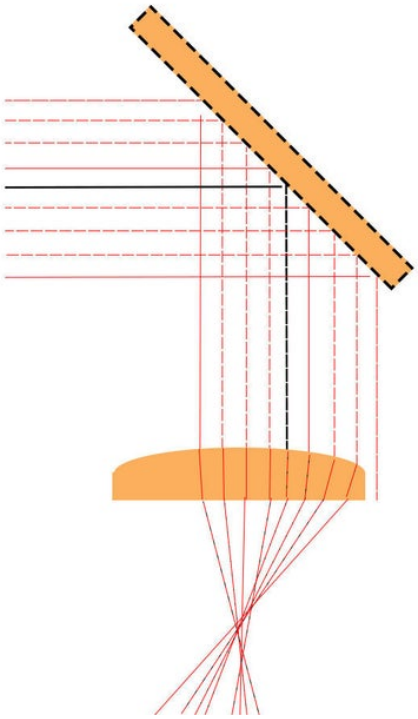
The incorrect vertical alignment will cause your machine to cut at an angle. This causes the machine to require more power to cut the same material. Not to mention the visual implications.

The following steps are my method of achieving vertical alignment. First ensure the focal height of the laser head is correct. Pulse fire the laser onto a suitable piece of wood. Lower the Z-axis 100mm to cause the laser to become out of focus. (Do not move the wood test piece)Pulse the laser again, it may require you to pulse for longer due to the lens being out of focus. You should now have a large spot centered around the smaller spot. Adjust the thumbscrews to center the larger spot around the small spot. If at any point you begin to hit the air assist nozzle and lose the laser beam, turn the adjustment back anticlockwise. You can remove the air assist nozzle if the above step doesn't work to help you achieve vertical alignment.

Step 15: Correct Vertical Beam Alignment



Step 16: Incorrect Vertical Beam Alignment



Step 17: Credits to ATKLASER for Writing the Guide

Atklaser is a repository of knowledge for laser engraving hobbyists
Be sure to check out the laser blog for more laser engraving how to guides

Atklaser is based in the UK and is a great source for replacement laser engraving parts and upgrade components
Be sure to check out the shop.

Thanks