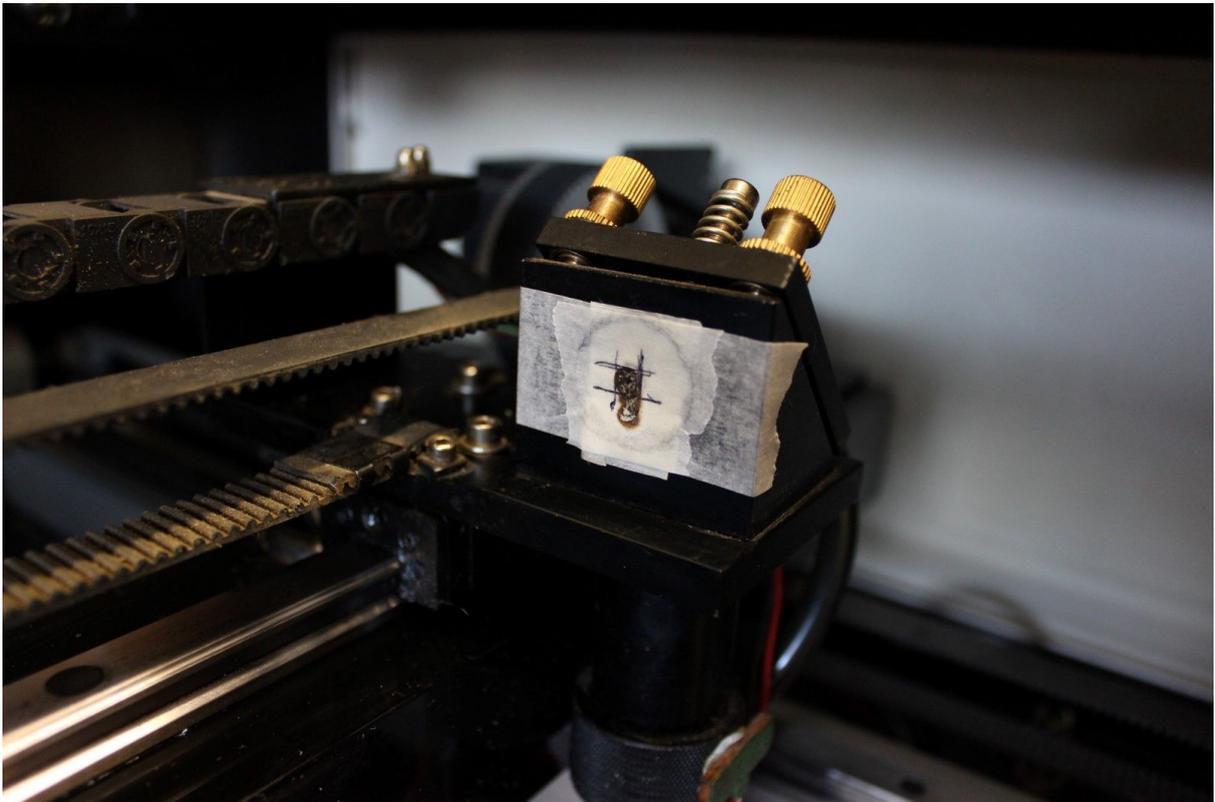


Just Add Sharks

 Laser Cutters for the Evil Genius 



Laser Beam Alignment

Version 0.1, February 9th 2016

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WARNING!

- Never open access panels without disconnecting power
- Do not circumvent the safety cut-out switch or operate the machine with access doors open
- Never run the laser cutter unattended
- Always vent material smoke or vapour to a suitable external outlet or filter system
- Only use laser-safe materials which do not contain chlorides and formaldehydes

Introduction

The machines from Just Add Sharks use a flying optic configuration for the laser cutting. This means the laser tube remains static at the back of the machine and the laser beam is directed to the cutting head by a series of mirrors. Over time these mirrors may move slightly causing the machine to lose cutting power.

This guide will walk you through the process of aligning the mirrors to ensure maximum cutting performance. The first time you approach this it can be a very daunting and challenging task so it is recommended that you read through this procedure and attempt some of the steps before it is required.

The process can be considered in four separate parts,

Checking the alignment: Working out if the laser needs to be aligned or not.

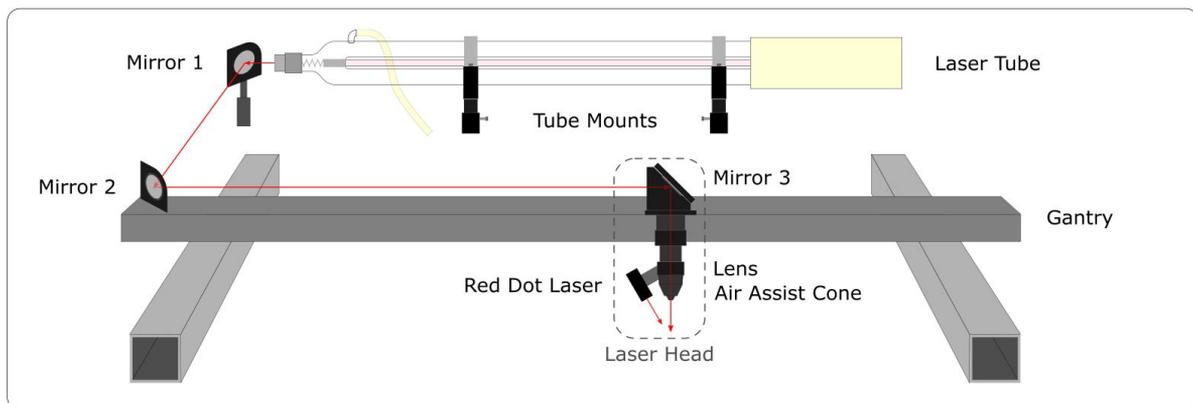
Aligning the mirrors: Making sure the mirrors are angled correctly.

Aligning the tube: Making sure the beam is heading into the mirrors correctly.

Vertical alignment: Making sure the cuts are perpendicular to the material.

Laser Terminology

This document will use the following terminology to talk about the various parts of the laser cutter.



Laser Tube: The large glass tube housed under the rear lid of the laser.

Tube Mount: The two adjustable brackets that hold the laser tube in place.

Gantry: The large metal box section that moves front to back in the machine.

Laser Head: the assembly that moves left to right on the gantry.

Mirror 1: In the rear left hand side of the machine, the first mirror the laser hits.

Mirror 2: Mounted on the left of the gantry, the second mirror the laser hits.

Mirror 3: Mounted on the laser head, the third mirror the laser hits.

Lens: Mounted inside the laser head, focuses the beam onto the workpiece.

Air Assist Cone: Funnel air around the laser beam and onto the workpiece.

Red Dot Laser: Mounted on the air assist cone, is a visible beam indicator.

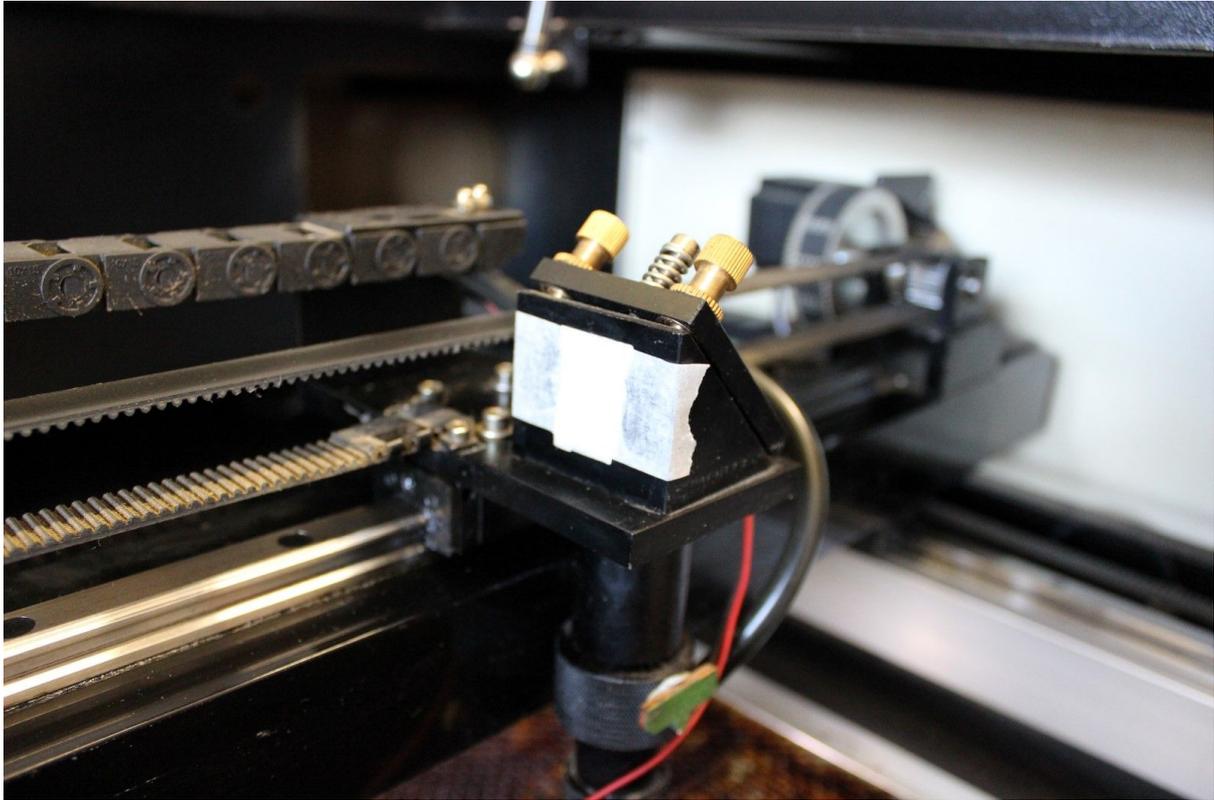
Simple Alignment Test

If you notice that your laser cutter appears to have lost power or it is not cutting correctly in one particular corner of the work bed then the machine may have moved out of alignment, this simple test can be used to check if your machine needs realigning. The laser cutter, chiller, pumps and fans should all be on to perform this test.

Tear off a small strip of masking tape and fold it over onto itself 2-3 times so it has no sticky side showing. Tear of another strip of tape and stick the folded wad into the middle of it. This gives you a target you can shoot at with the laser beam. The folded wad is thick enough that it won't instantly burst into flames and the middle is non sticky so that it can be placed over mirrors without leaving a mark.

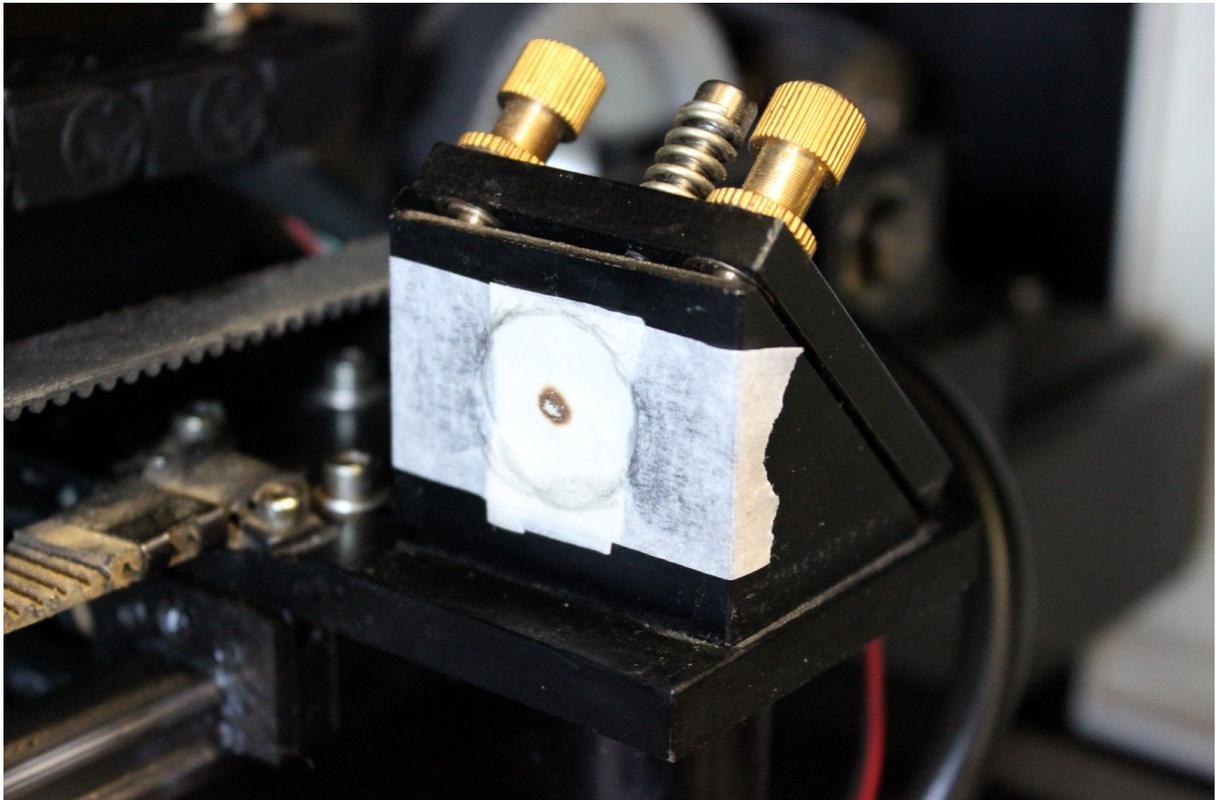


Place the target tape over the hole, in front of mirror 3.



Close the lid on the laser cutter, drive the laser head to the top right hand corner (or press the 'Datum' button).

To test fire the laser you can press the 'Laser' button on the control panel. The laser will fire for as long as the button is held down, so only press it briefly until you see a mark appear on the target tape. If you hold it on for too long you can set the tape on fire. If you feel the target tape is getting too badly burned from the test dots you can just put another layer of tape over the top. Keep building up tape layers as required, with thin tape you can still see the dots from the previous layers.

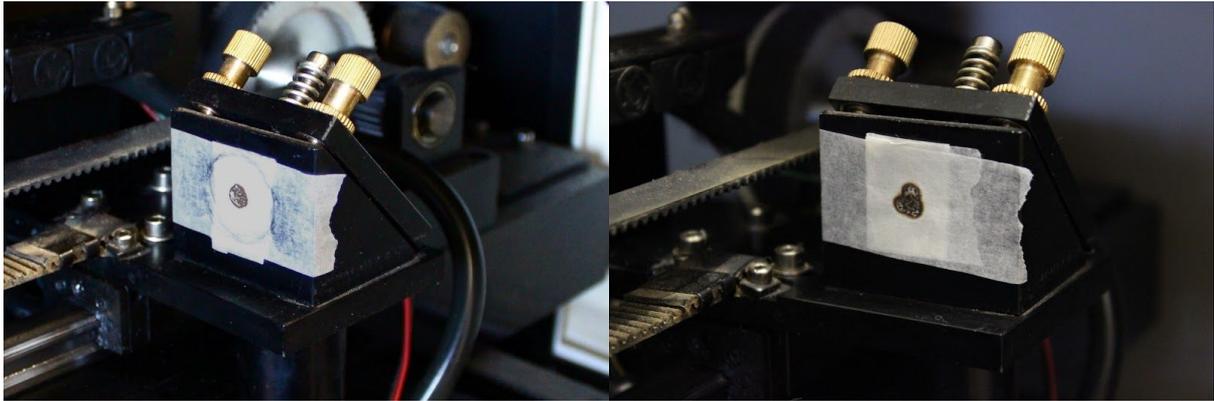


Drive the laser head to the front, right hand corner of the work bed and create another test dot on the target tape. Repeat this for the front left and back left corners of the work area and then return the head to the top right hand corner so you can see the marks produced.



The image on the left shows the marks made by a laser that is aligned, the four dots are almost indistinguishable from each other. The image on the right shows the marks made from a laser that needs alignment.

It is most important that these four dots are in the same location on the target tape. If the dot is same position but not in the centre of the tape this means that the mirrors are aligned but the laser tube is not and you can skip to the tube alignment section of this document.



The principle of alignment

The 3 mirrors in the laser cutter are all very similar and are adjusted in exactly the same way.

The mirror is held in the middle of the mount with a small retaining ring (there is a tool in the toolbox if you need to remove a mirror).

There are 3 adjustment bolts (brass) in the different corners of the mirror mount, these have locking knots which should be tight against the frame, these prevent the bolts from turning on their own as the laser cutter moves around.

There are 2 long bolts (steel) with springs over them, these hold the mirror tight against the adjustment knobs.

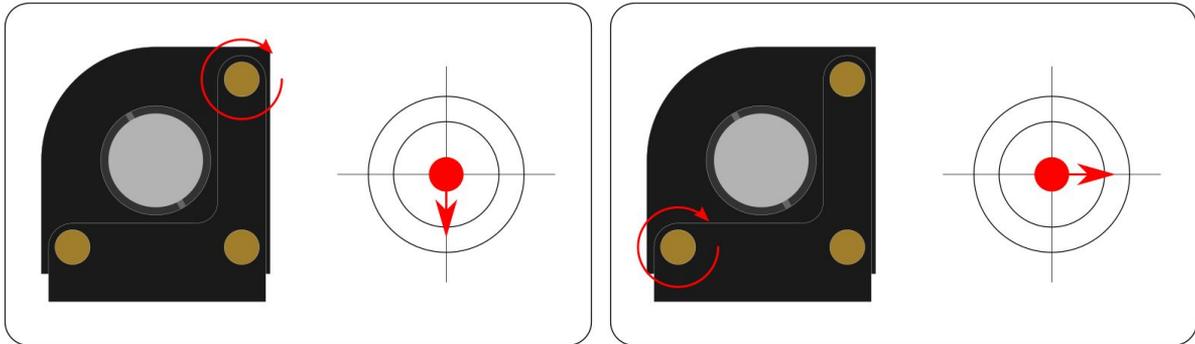


When you adjust the angle of the mirror you affect where the laser beam will hit the next mirror in the chain. A piece of target tape attached in front of the next mirror will show the test dot in a new position after adjustment.

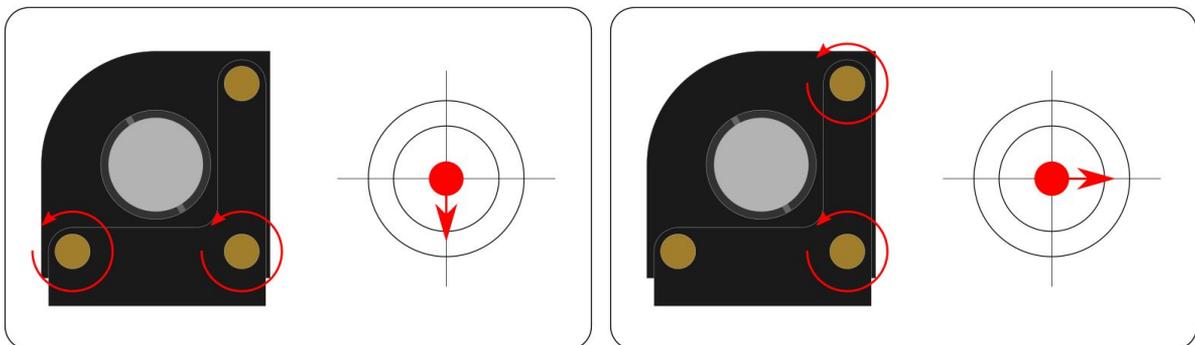
Adjustments should be made to the mirror when the target is as far away as possible, small changes in the mirror are magnified over the distance and the alignment will be more accurate.

If you turn the top knob half a turn to the right, clockwise, you will see the new test dot position is a few mm lower than it was before. Turn the knob half a turn back to the left (anticlockwise) and the test dot will go back to its original position. The left hand adjustment bolt will do the same, but it moves the laser

left and right. Don't forget to loosen the retaining nut before adjustment and tighten it again once you have finished.



There is another way to make the same adjustment. If you turn both of the bottom knobs half a turn to the left you will notice the test dot move a few mm lower. You have to make sure that you turn both knobs the same amount otherwise you will move the laser beam left or right at the same time.



Knowing how much to turn each knob is key to aligning your laser, the more often you do it the easier it will become. If the dot doesn't move far enough or it moves in the wrong direction you can just try it again. Don't forget to keep adding tape if the target is looking burnt.

Go to your laser now and try this...

Put the gantry halfway between the front and back of the machine,

Drive the cutting head to the far right hand side.

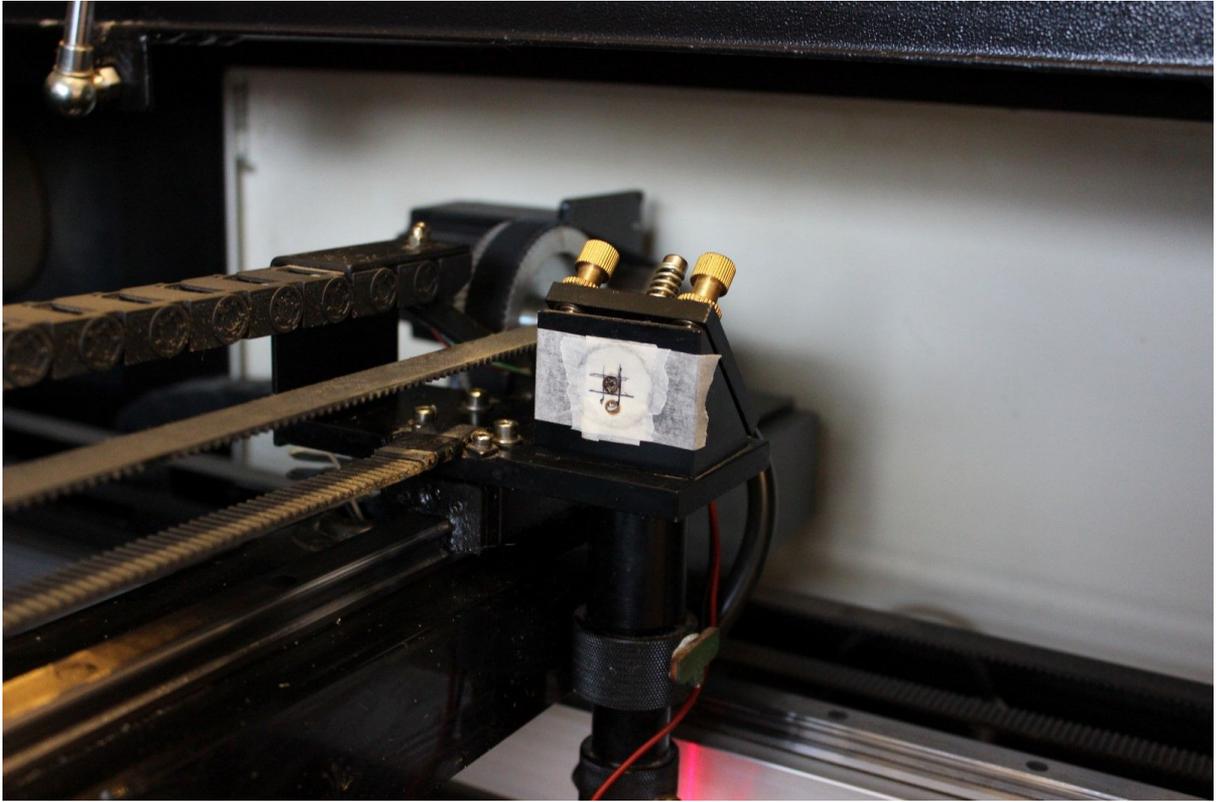
Place a piece of target tape over the hole in front of mirror 3.

Fire a single test dot at the tape and mark with a biro so you know where the laser beam started.

Turn the top adjustment knob of mirror 2 half a turn to the right and see where the new dot appears.

Slowly turn the knob back until the dot is in the same position again.

Mirror 2 to Mirror 3 is a good place to practice this adjustment because they are both easily accessible from the front of the machine.



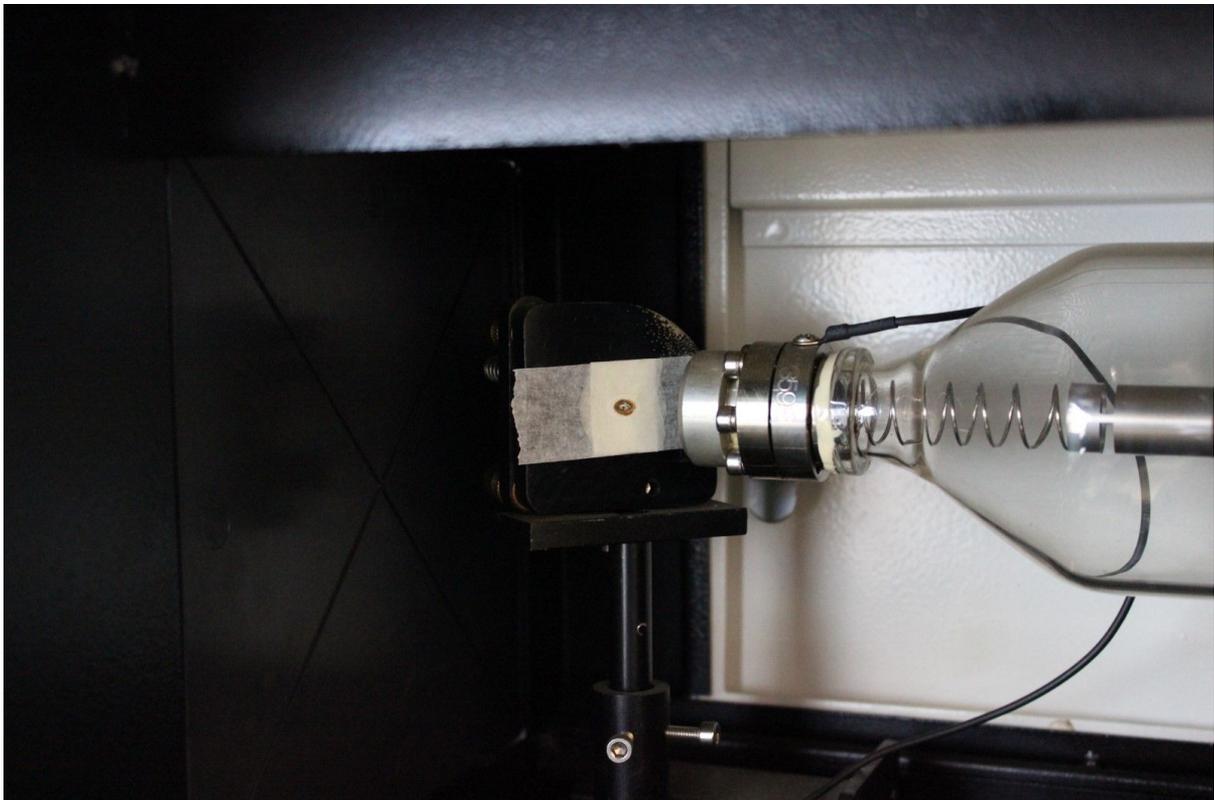
Aligning the Mirrors

There are 3 mirrors in the laser cutter, alignment should be done on each mirror in order. Any adjustments made will affect all the mirrors that are further down the laser path, so changes made to mirror 1 will affect mirrors 2 and 3.

Tube to Mirror 1

Testing mirror 1 is very simple, fold up some target tape and stick it down in front of mirror 1. When you push the 'laser' button you should get a dot on the tape roughly in the middle of mirror 1. The dot should be a nice oval shape, which is formed when the circular beam hits the mirror at an angle.

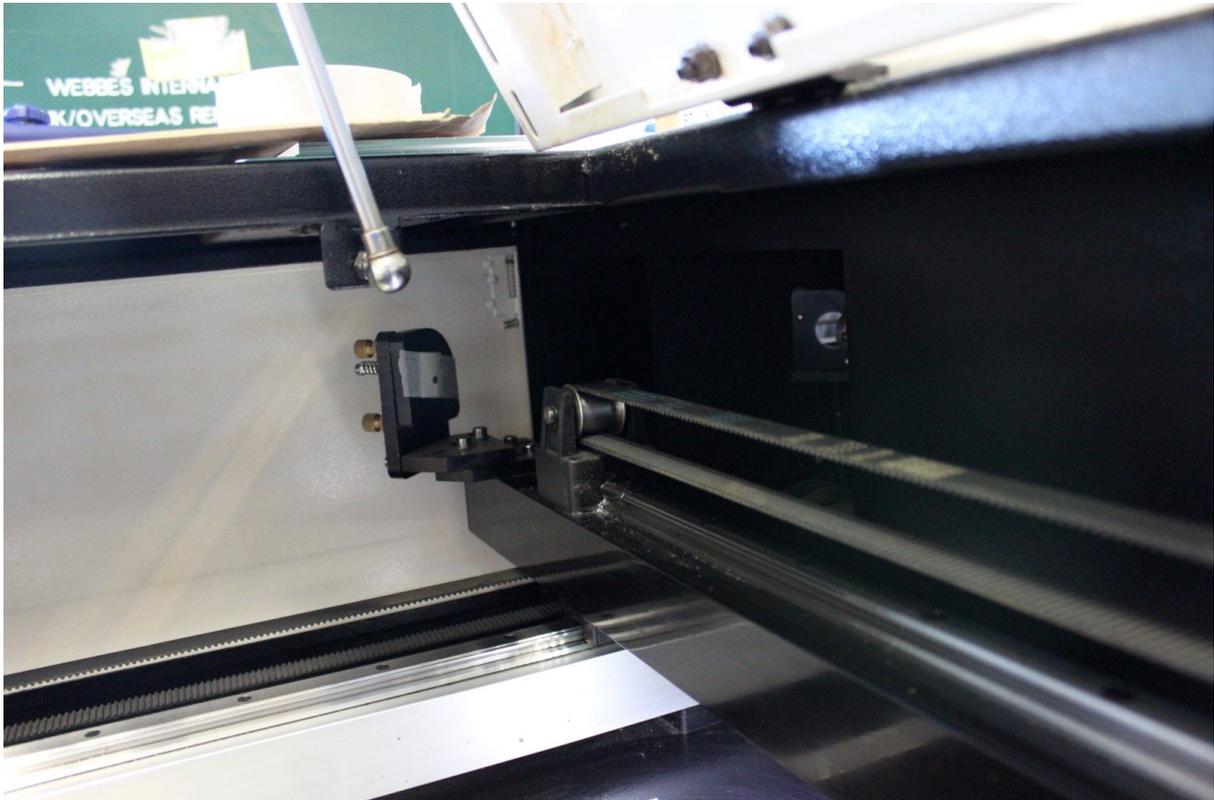
This test can often be done without going round the back of the laser, you can simply reach back and apply the tape to the mirror.



If the dot does not hit near the middle of the tape you may need to adjust the height of laser tube which is covered later in this document. If the dot is within 10mm of the middle you may still be successful aligning the mirrors without a tube adjustment.

Mirror 1 to Mirror 2

Mirror 2 is fixed on the left hand side of the machine and it only moves forward and backward. Fold up some target tape and attach it in front of mirror 2. Drive the laser head all the way to the back of the machine and press the 'laser' button to get a dot on the tape, take note of where this dot is.



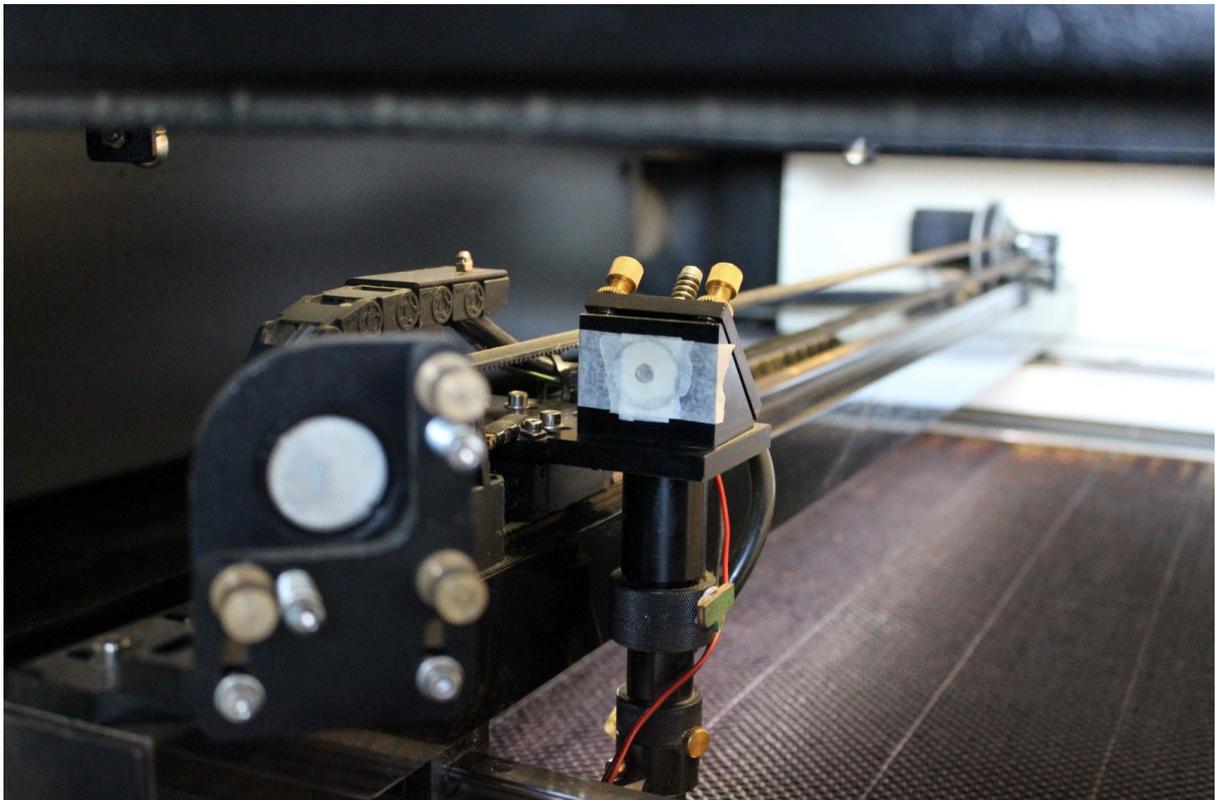
Drive the laser head to the front of the machine and put a second dot on the target tape. The two dots should be in the same position when the machine is aligned. The mirror can be adjusted from the front of the machine but if you are uncertain it is easier to be standing behind the machine looking forward.



Adjust mirror 1 until the dot is in the same location both front and back. It does not matter if this dot is not exactly in the middle of mirror 2. Don't forget to add layers of tape if the target starts to burn.

Mirror 2 to Mirror 3

Mirror 2 to 3 is almost exactly the same as Mirror 1 to 2, just a bit easier to access. Fold up some target tape and attach it over the hole in front of mirror 3. With the gantry in the middle of the laser (front to back) drive the laser head all the way to the left of the machine and press the 'laser' button to get a dot on the tape, take note of where this dot is.



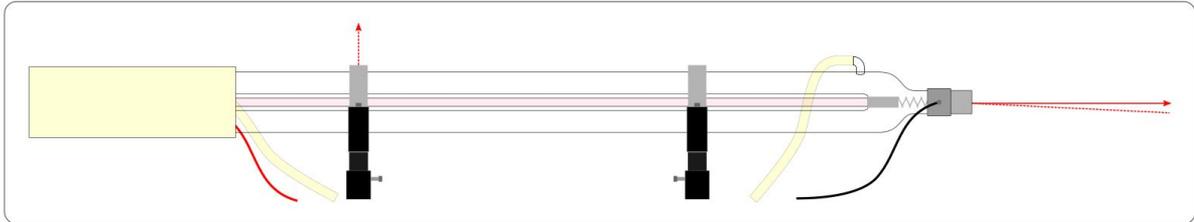
Drive the laser head all the way to the right hand side of the machine and fire again. Adjust mirror 2 until the dot is in the same position at both the left and right hand side of the machine. Again, it is more important that this dot is in the same position rather than in the middle of the hole.



Hopefully by this point you can move the laser cutter to all 4 corners of the work bed and have the test dot appear in the same location. If the dot is in the same position it means the mirrors are aligned and you can move ahead to the vertical alignment. If the dot is not in the middle you will now need to align the laser tube.

Tube Alignment

If the mirrors are aligned but the dot isn't in the centre of mirror 3 you can make the final adjustments by actually changing the way the laser tube shines the beam into mirror 1. The laser tube is supported by two mounting brackets, these brackets are fully adjustable and can be used to adjust the laser tube.



There are 2 screws in the side of each tube bracket, when these are loosened the bracket is able to slide up and down as well as left and right. Lifting the bracket at the rear of the tube will make the laser beam drop down. Moving the rear bracket left will move the test dot to the right.



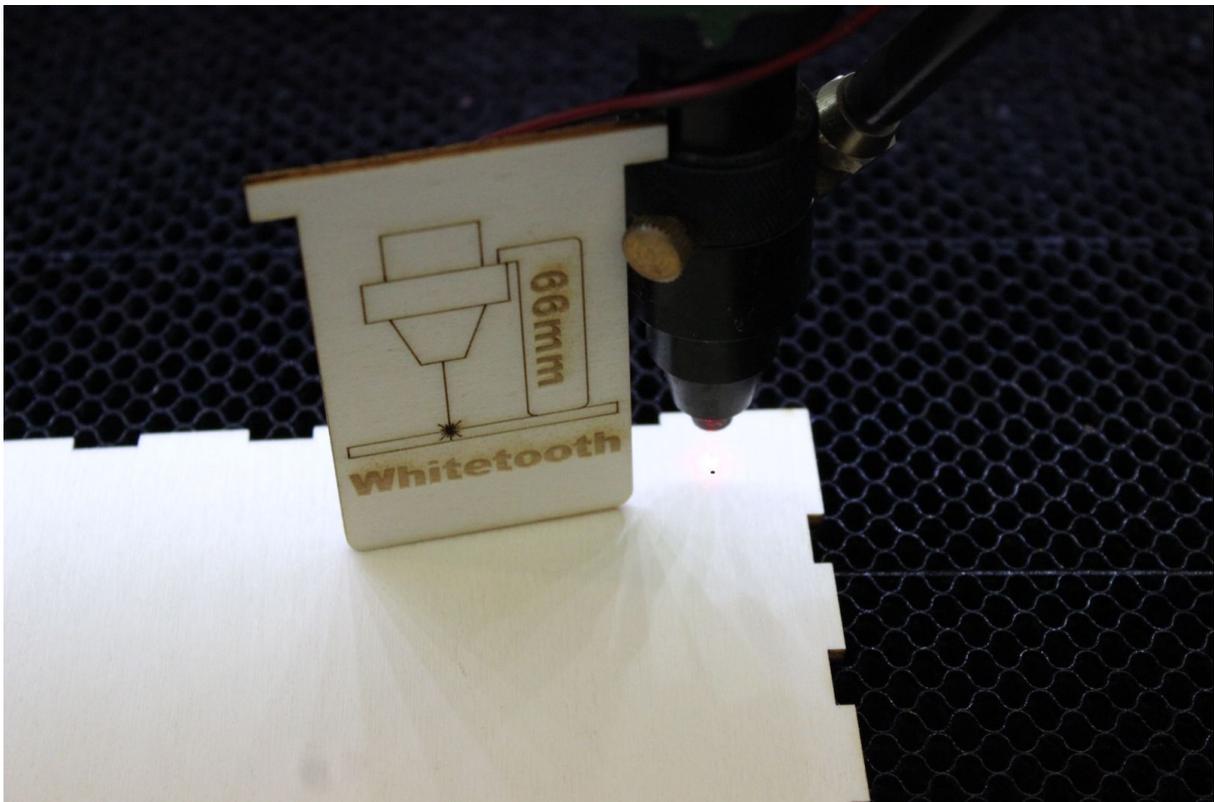
To align the laser with the centre of mirror 3, put a piece of target tape in front of mirror 3 and drive the laser head to the front right hand corner. This position is furthest from the laser tube so any movements will be amplified across the distance. Adjust the angle of the tube until the test dot is right in the middle of the hole. You can effectively ignore mirror 1 and 2, if the dot needs to be lower on the target tape raise the back of the tube into mirror 1.

Vertical Alignment

The final stage is to make sure that the beam is perpendicular to the material, this will give you a nice vertical cut. The process is very similar to the other alignments except this time instead of using target tape you need to fire dots into some scrap material.

Use the height tool so set the laser cutter to the correct height above the scrap material. Fire the laser to create a dot on the material, this is the close test dot that the machine will be aligned towards.

This is a good time to check the red dot alignment. The red dot should be pointing at this single test dot, manually adjust the red dot until it is pointing at the cutting dot.



Drop the Z axis down 100mm and fire another test dot. This dot will be much wider due to the way the beam expands as it goes through the focusing lens. If second dot is centred around the first dot then the laser beam is vertical. You can adjust the screws on mirror 3 to move the laser beam to the right position. The two dots should be in the same location when the Z axis is up or down.



Vertical alignment can be a bit tricky. It is possible to adjust the beam so much that it hits the air assist cone before it gets to the material. If you lose the laser beam entirely you can remove the air assist cone to see where the beam is actually going. It's also worth remembering that any adjustment can be undone by simply turning the adjustment knob back in the opposite direction.

Conclusion

If you have followed these steps correctly you should now have a well aligned laser cutter. These machines are very good at keeping their alignment but you should check to make sure it is still aligned with every 40 hours of use.