



Ramp Focal Gauge for Laser Cutters/Engravers

Instructions Manual

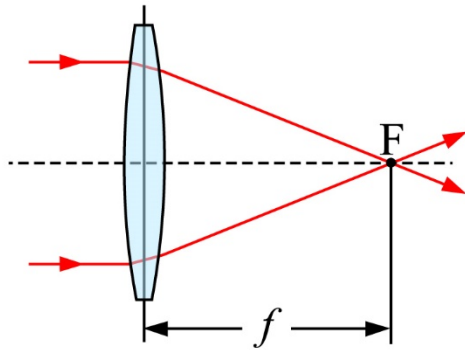
Revision 2.2

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Introduction

In laser cutting and engraving process, it's crucial to focus your beam to the smallest possible point on the material for best results. This smallest point is called focal length of the lens. As wide beam of light (in case of CO2 lasers it's infrared) goes thru the lens, converges and concentrates at some point "F" away from the middle of the lens at distance "f".



When you get your machine it usually already has a lens and it will specify its focal length. In most cases it's 2" lens (50.8mm).

However, knowing your lens focal length is not enough because lens is installed inside laser head some distance away from tip of the nozzle. So focal length of the lens doesn't help us much in this case, since we really interested in how far to position tip of the cone from the material. Sure, if you know exact distance of lens from the tip ("Ft") you can calculate distance from nozzle to material ("Fm") by subtracting it from your focal length (i.e. $F_m = f - F_t$).

However, in most cases laser operators will find out focal distance in experimental way.

One such way is to keep adjusting height of the z-table, firing laser and checking dot size, until it appears smallest. This takes a while and very imprecise.

Much better way is to use so called "ramp test". One will perform ramp test by placing a piece of wood sloping down (hence the ramp) and burning a long line as laser head moves over it. Then you would inspect this line and see at which point it looks the thinnest. Then you would move your laser over this point and measure distance to the tip of the laser head.

Developed at Lensdigital LLC, Ramp Focal Gauge, greatly improves and simplifies this method by making it much easier and convenient to measure your laser focal distance. You will NOT need calipers, rulers or any other tools, as this gauge will show you results in clear text.

This gauge will work with any laser, and any lens!

Quick Start

Let's very quickly see what's included and how the process works and then we'll cover it in more detail.

What's included in package

- Plastic Ramp Focal Gauge
- Several (1/8" thick) wooden inserts (you can always make more, template is included)
- Downloadable RDWorks or Lightburn template file
- Downloadable DXF template file

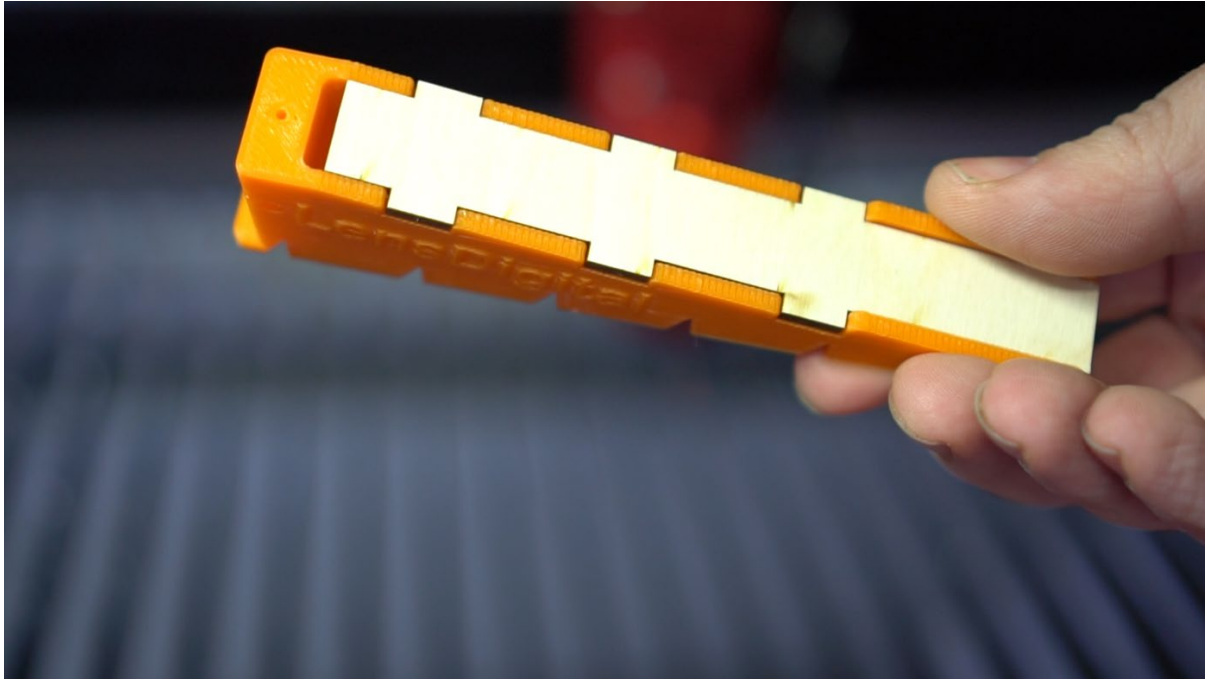
Quick process overview

1. First you load new wooden insert into the plastic gauge.
2. Then you position your laser head directly over indicator hole, and lower it until head is slightly above the gauge (at fixed offset of 0.5mm).
3. Load provided RDWorks (or Lightburn) template into laser and engrave indicator lines and numbers.
4. Gauge will clearly show you distances burned into wood. Thinnest and cleanest one will be the number you can use as your focal distance. Plus offset.
5. Make a distance reference tool/jig out of piece of plywood or acrylic using handy online gauge generator: http://lensdigital.com/misc/maker/generate_gauge.html (or just cut a simple square)
6. Using distance square, you made, find out your autofocus offset or simply use it for manual focusing.

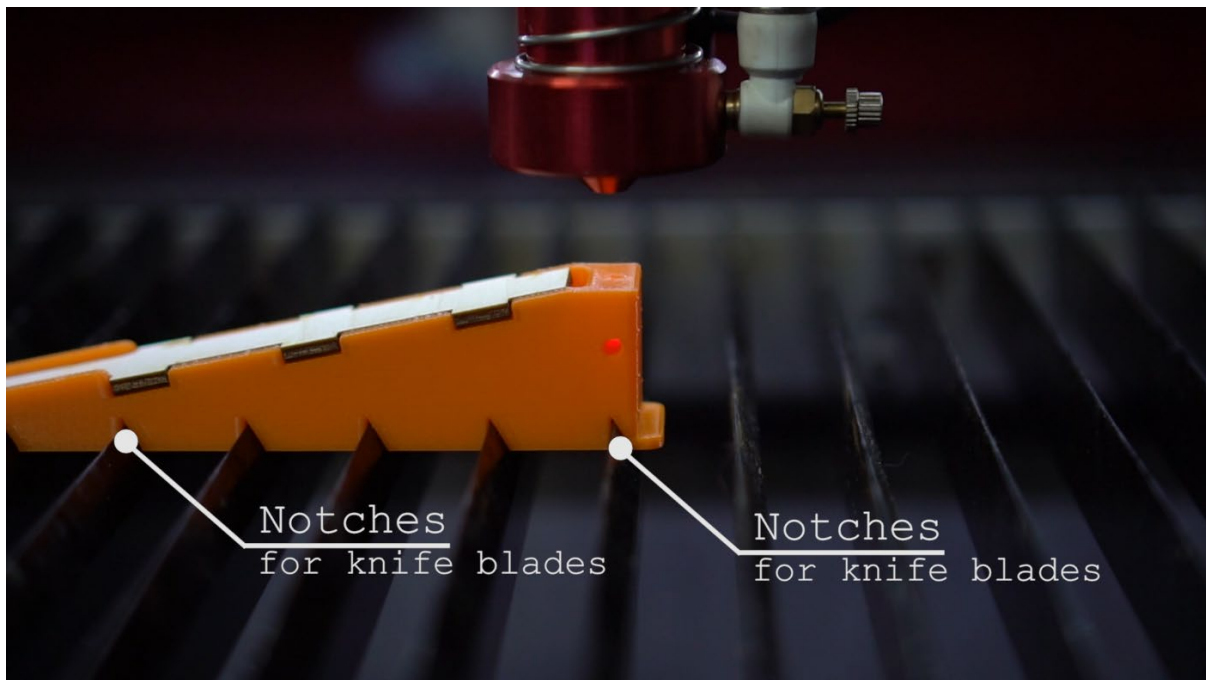
Now let's look into the process in detail...

Detailed Instructions

Install and position gauge



First install wooden insert into the gauge, make sure it's all the way in.



Place insert on your laser table lengthwise. If your table has “knife blades”, gauge will snap into them securely. If your “blades” face in opposite direction from what shown on the picture, no worries, you’ll just use “flipped” template (it will engrave left to right). If you don’t have “knife blades” just place it on

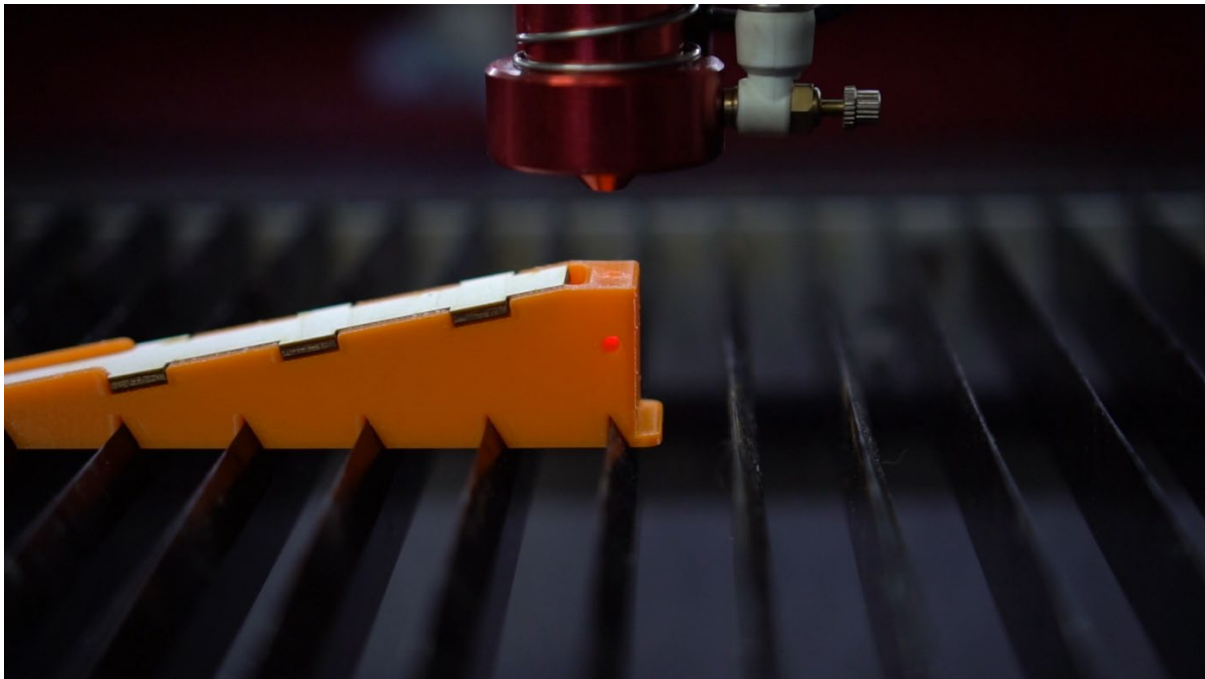
something flat. Make sure to align it with “Y” movement (right to left if looking from the front) of the laser head.

If your laser has an autofocus probe that will get in the way of gauge like one on this picture



you can turn gauge 90 degrees to align with “Y” (a.k.a. vertical) movement. Any direction (up/down or left/right) will work, we have template for them all! But for simplicity of this tutorial we going to show how to use it in “right to left” placement.

Lower your laser bed from control panel until you have enough clearance to position gauge under laser head.

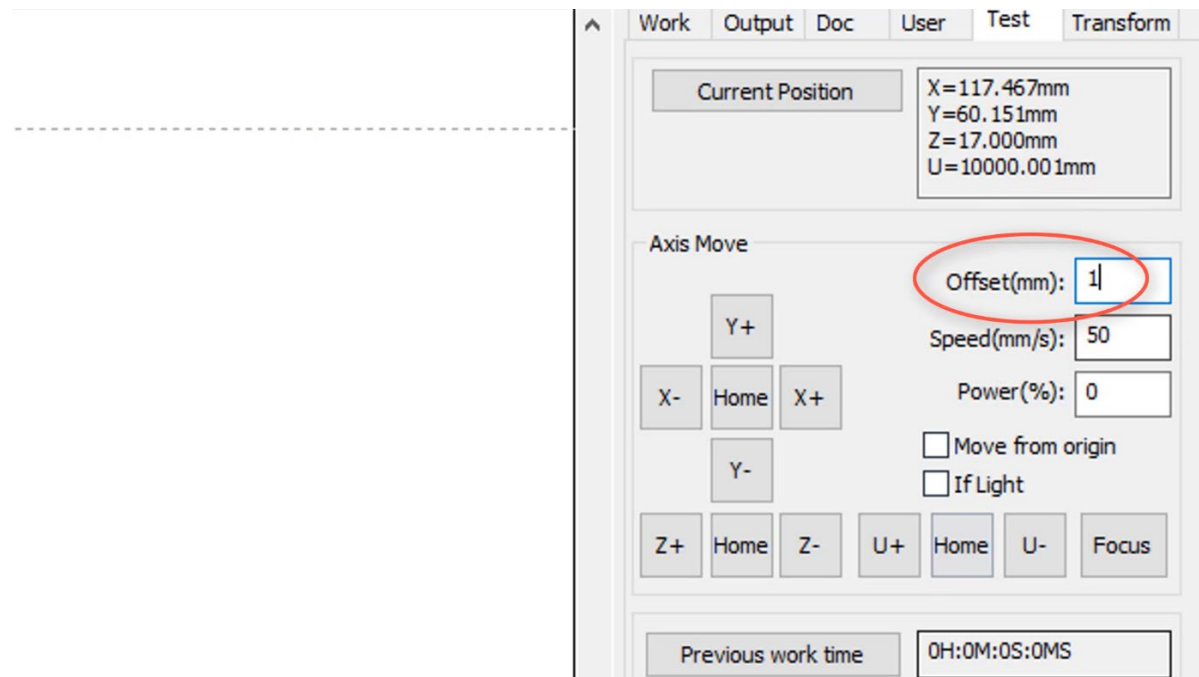


Move your laser head until beam is roughly near the top hole of the gauge.

Do not use your laser's control panel for rest of the positioning. Instead use "test" tab in RDWorks (or “Move” tab in Lightburn) to precisely position laser head.

Use RDWorks or Lightburn to manually position laser head

RDWorks/LaserWorks 8.x



Navigate to **Test** Tab.

Current position button will read and show location of your laser head.

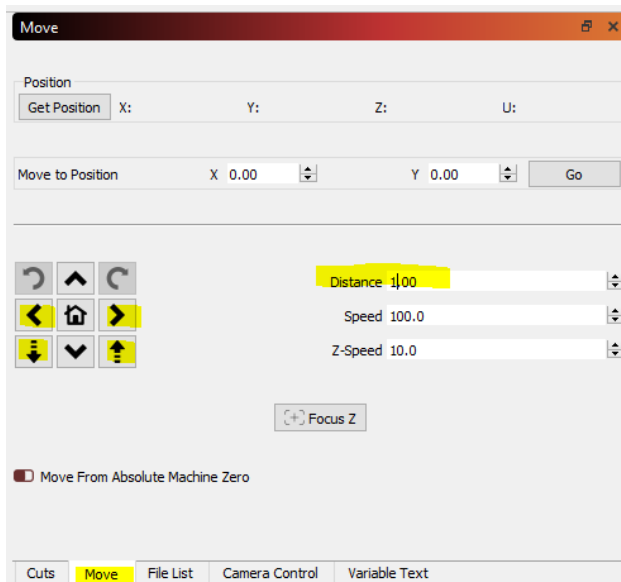
Offset value will control how far each press of the button takes you.

X- and **X+** move head left and right, and **Y+** and **Y-** will move it backwards or forward.

Z+ will move bed down, increasing distance from laser head. **Z-** will move bed up decreasing distance.

Once you positioned red beam to be exactly in the top hole (and side indicators light up with reflected red laser), adjust Z height until laser head barely touches top of the plastic gauge.

LightBurn



To control your laser from Lightburn navigate to “Move” tab.

Get position button will read and show location of your laser head.

Distance value will control how far each press of the button takes you.

< and > move head left and right.



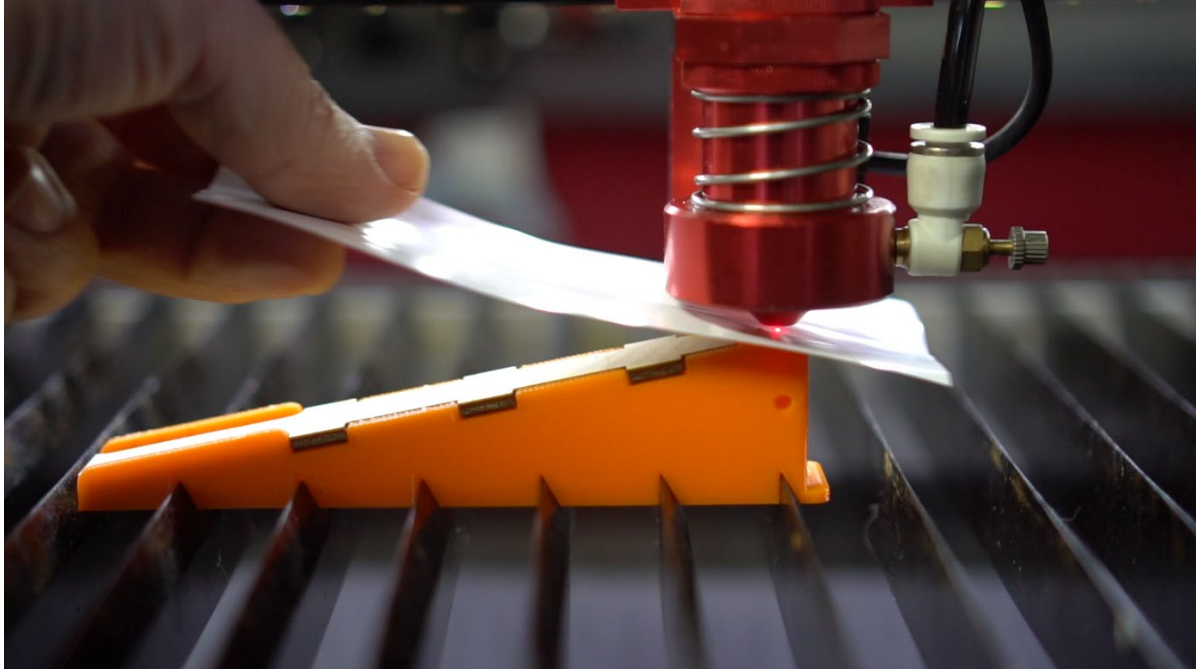
will move bed down, increasing distance from laser head.



will move bed up decreasing

distance.

Once you positioned red beam to be exactly in the top hole (and side indicators light up with reflected red laser), adjust Z height until laser head barely touches top of the plastic gauge. Change Distance value to move in smaller increments. For example, when you get really close to the gauge, change distance to 0.2 mm



Use piece of paper to check height. If you feel head starting to touch paper stop. If it's holding paper strongly back off by a very small amount like 0.2 mm.

Final Position Adjustment and Offset

Before we continue, I'd like you to understand purpose of OFFSET.

Ideally, tip of your laser head should touch top platform of the gauge to get most accurate result.

However due to physical construction of the tool, laser head will bump into wood piece and knock it off.

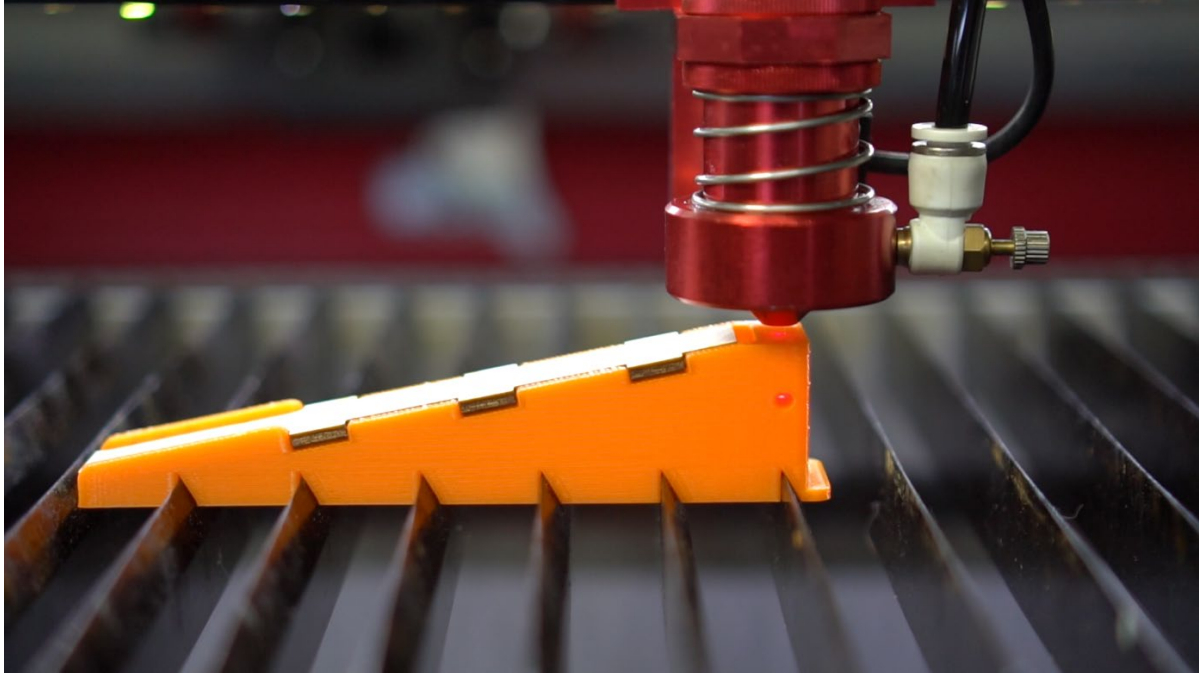
So, you have to lift head just a little bit (half a millimeter). Don't worry, we'll take this offset into account when we get final result.

Second (very rare) use of OFFSET is when you have a longer focal length lens like 3-inch or 4-inch.

Because gauge can only go up to about 22mm vertical distance, it will not be enough for longer focal distance of such lens (unless you using special longer nozzle), so in case like this you will raise your head by some large offset distance (like 60mm) and then add this offset number to the result you got (i.e. $20+60 = 80$ mm). But most lasers (like Boss) come with longer nose cones for these longer lenses so you probably won't have to deal with offsets like these.

Now that you know what offset is for, let's continue with setup.

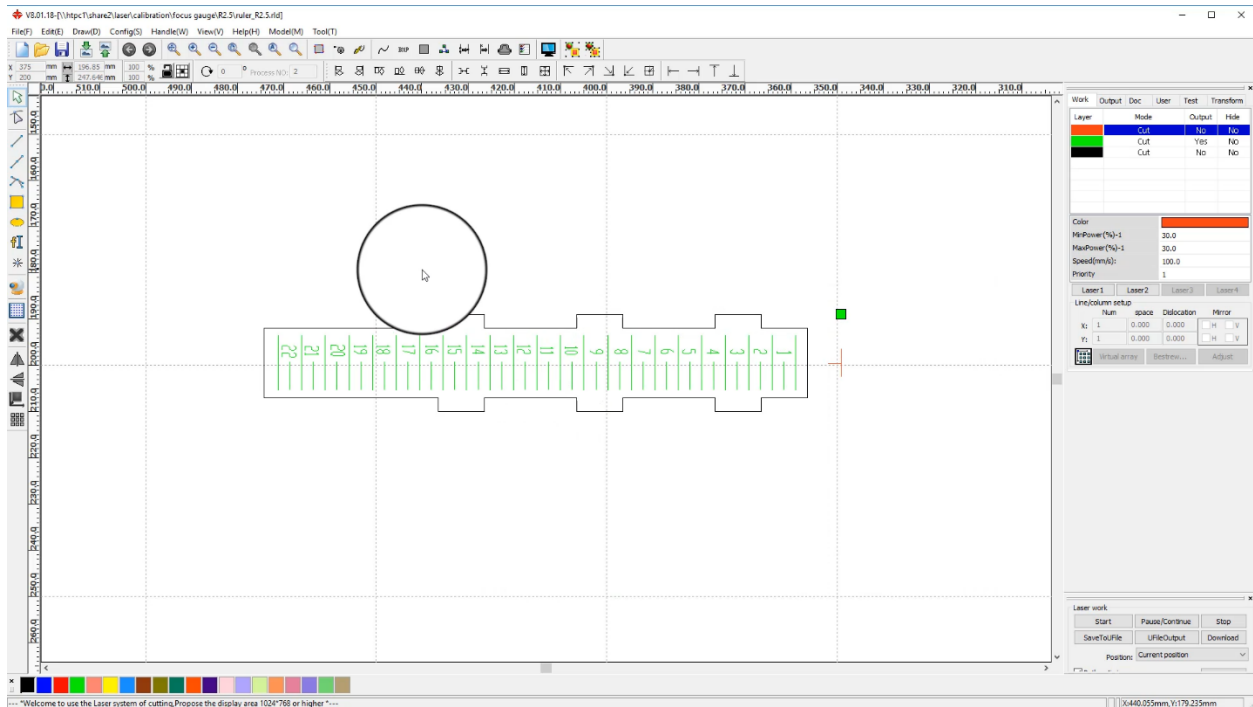
Once head is in correct position **lift it by half a millimeter**, so it doesn't catch wooden insert. Don't worry, we'll take this 0.5mm offset into account at the end of the process!



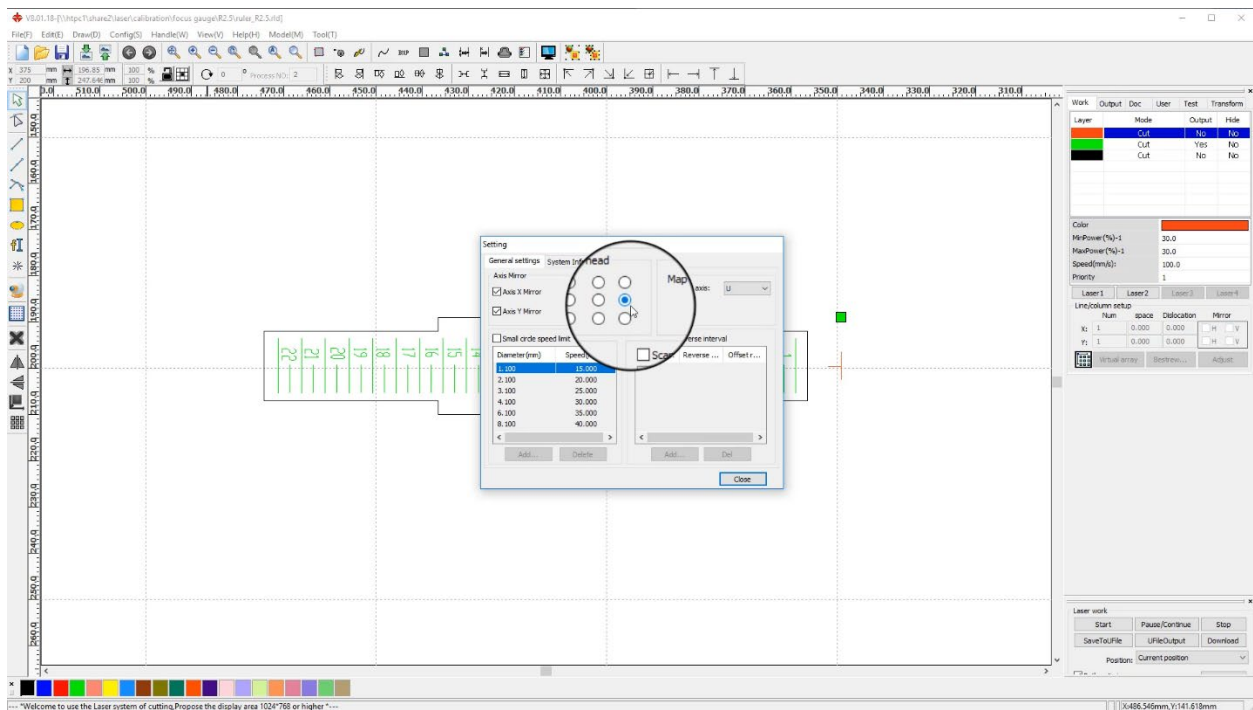
Hit **Origin** button on your control panel to set starting position here.

Prepare template in RDWorks.

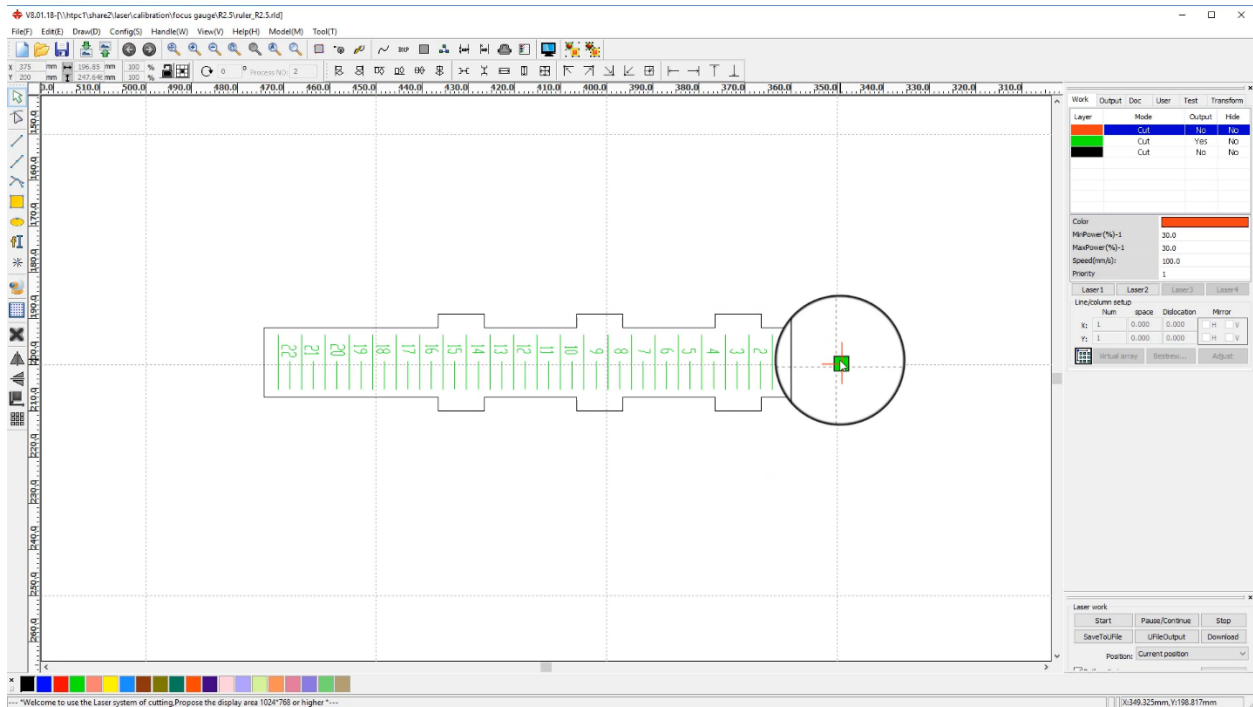
(We'll show how to use both RDWorks and Lightburn templates)



Load provided rld file. If for some reason your version of RDWorks can't open this file, you will need to import provided DXF and change layers as shown below.

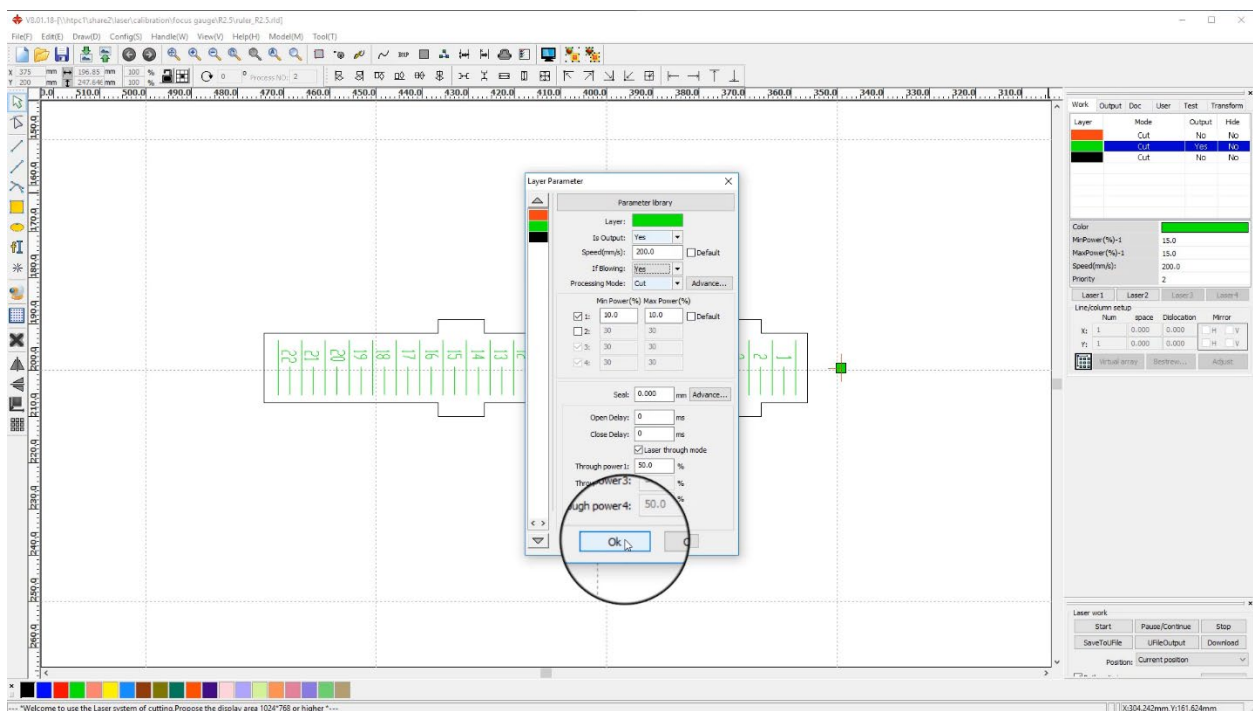


First let's change Laser Head **origin** by going to **Config Menu** and clicking on **Settings**. Choose mid right point and close.



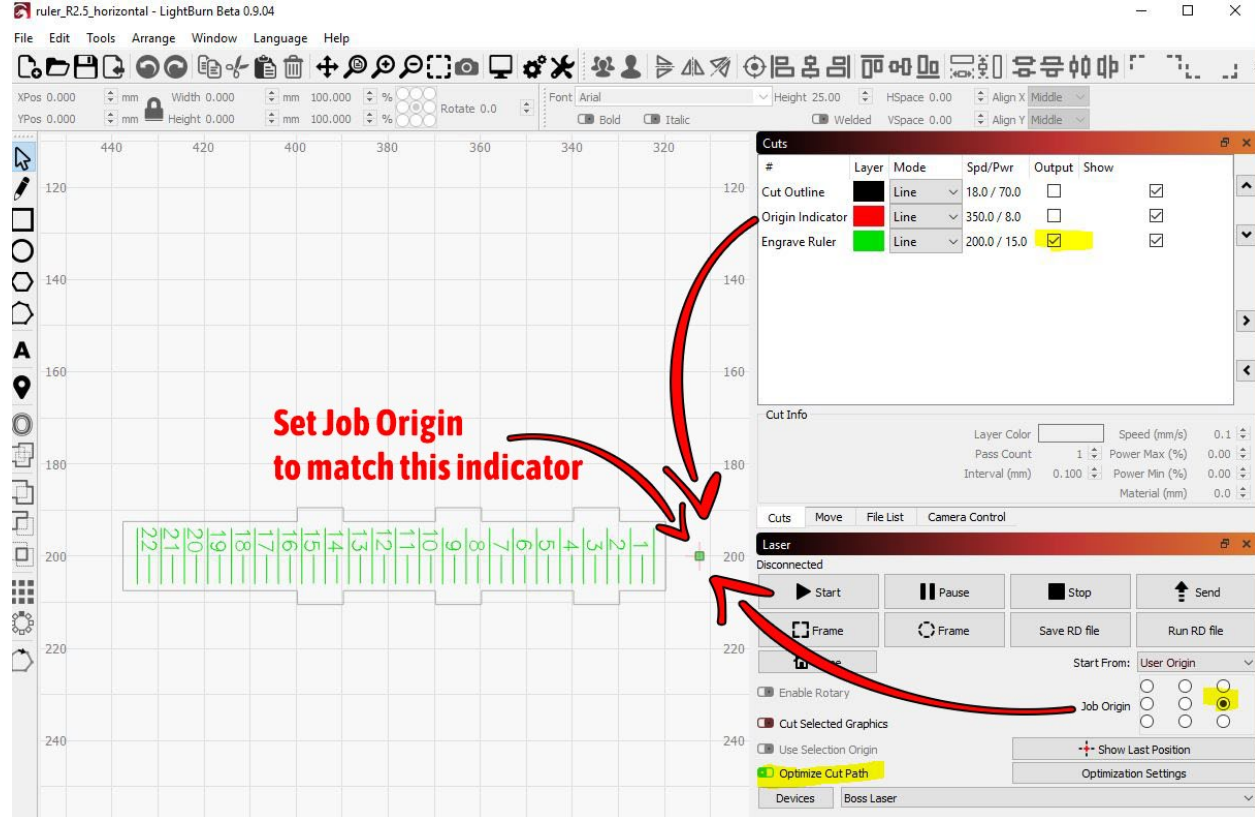
This will start engraving process from the correct point in your file at the middle of red mark.

Closer look at the layers.



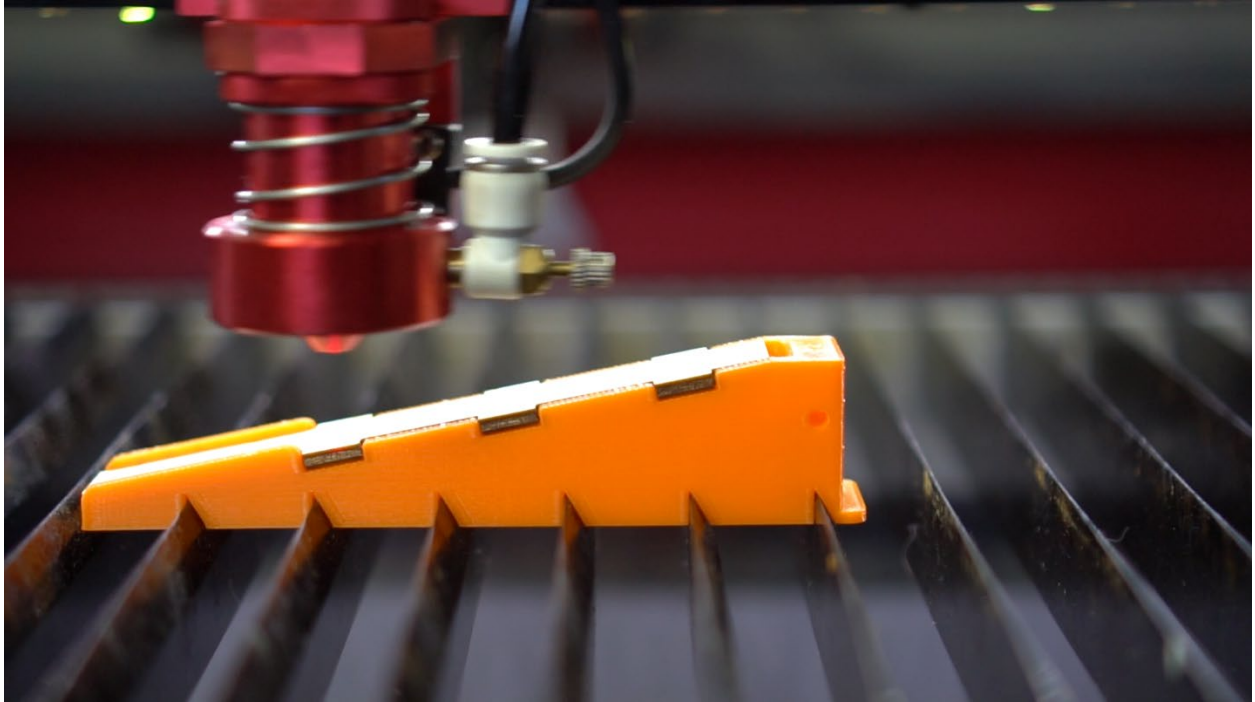
Output on all but **green** layer should be turned off. **Red** layer is needed to position laser head correctly before it starts moving. Green is the ruler lines and numbers that will be engraved.

If you are using Lightburn similarly match Job origin to align with Origin Indicator mark, as shown in below pic:

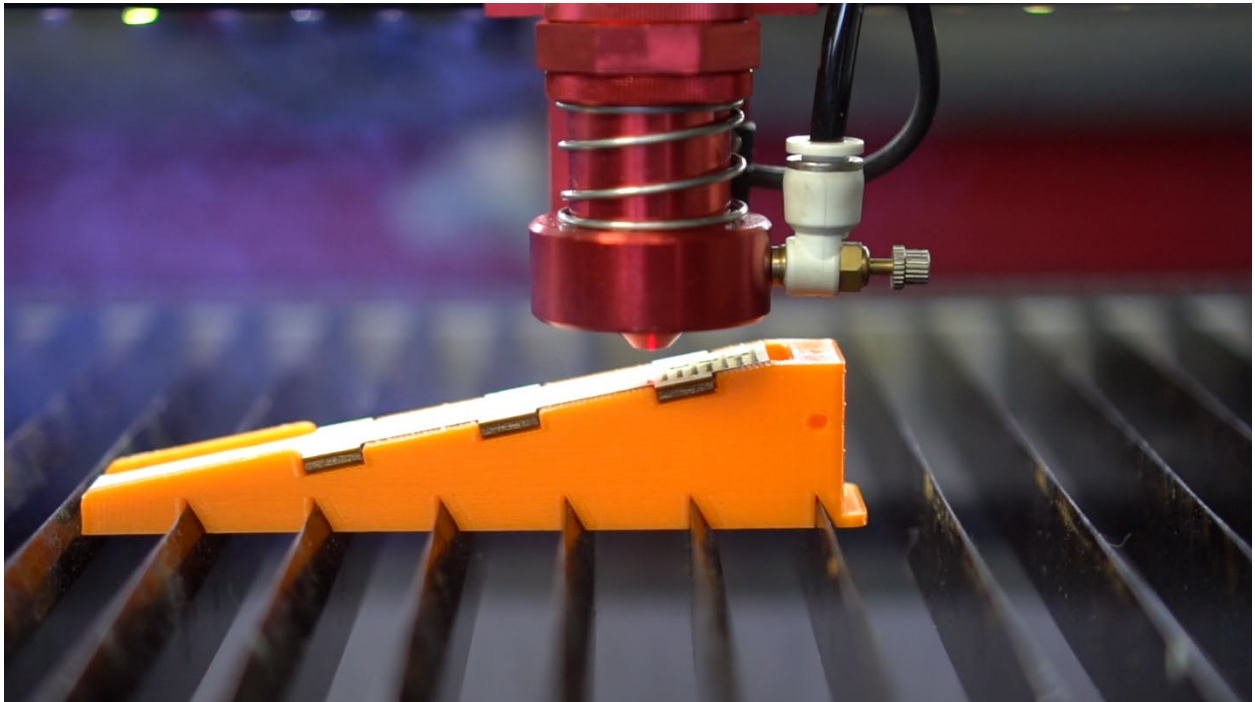


Depending on power of your laser, you should set it to a very **fast speed** and **lowest possible power** just so it marks the wood without cutting into it. 200 speed with 10% power is a good starting point.
IMPORTANT: Even though we “engraving” text, we want to use “Cut” settings instead of “Scan”.

Black layer is outline of the insert. Enable it only if you want to cut out new one (don't forget to turn off output of other layers if you cutting).



Load file into your machine and do a quick frame test. Make sure laser outlines wooden insert perimeter only!



Start engraving process.

After it's done take a close look at the gauge.



Analyze Results

Number and lines that are thinnest and clearest are your focal distance. (Lines between numbers are half millimeter marks).

Also don't forget half a millimeter offset we used when we lifted laser head during alignment. Just add 0.5 to your focal distance.

For example, let's say you have 2.5-inch lens, and 16 to 17 numbers show cleanest engraving. Pick 16.5 and add 0.5, and you get 17mm. This is your focal distance.

Setting up Autofocus for your machine

Unfortunately, you can't simply load resulting number as autofocus offset into machine memory. Different machines move differently in Z axis. One machine when set to 20 mm will move 20 mm up or down, and then another one will move 15 or 10 mm. We haven't found a way to calibration this movement either (unlike X or Y step calibrations). But don't worry, we can still find out and set correct autofocus distance for your machine, and I should only take few minutes!

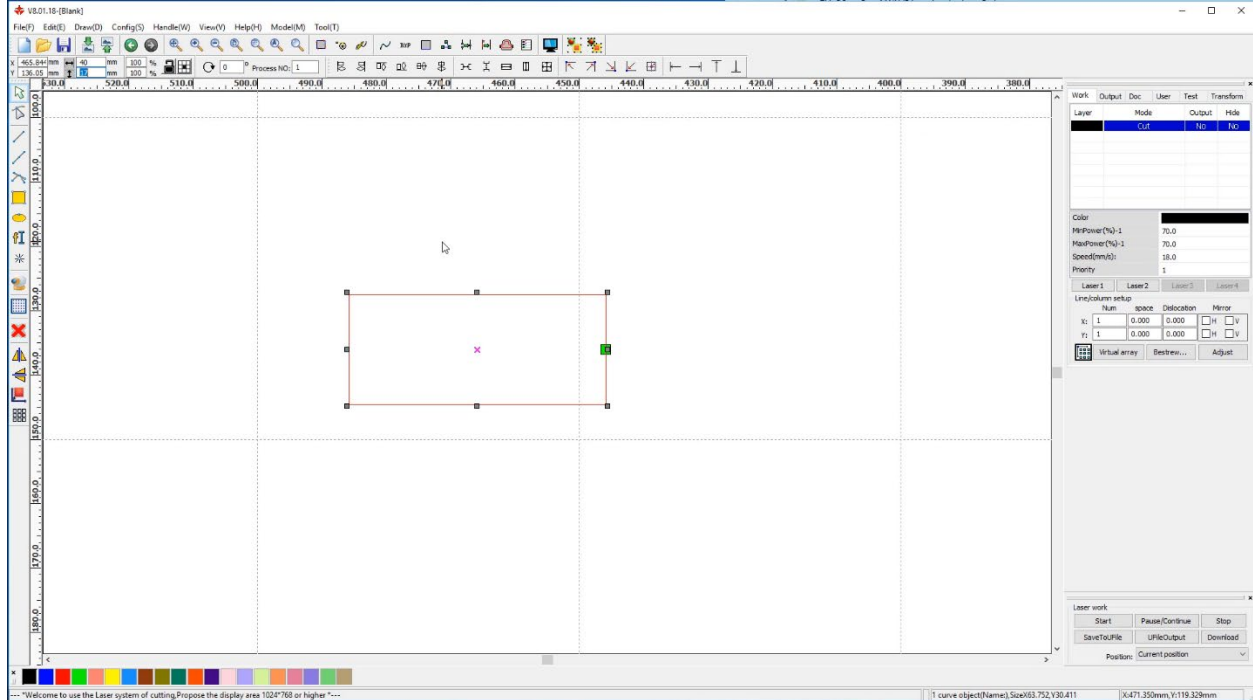
First step is to make a manual distance gauge, which is basically a square piece of cardboard, wood or acrylic that you will cut on your laser. Use any thickness material you want, just make sure its height is exactly the number your got in previous step (actual focal distance).

NEW METHOD!

We've made a handy online generator for manual gauge! Just visit:

<https://bit.ly/2DBmYlb> and enter your focal distance result in the input box and program will automatically generate DXF file for you! Or if you prefer older method follow instruction below.

Old Method:

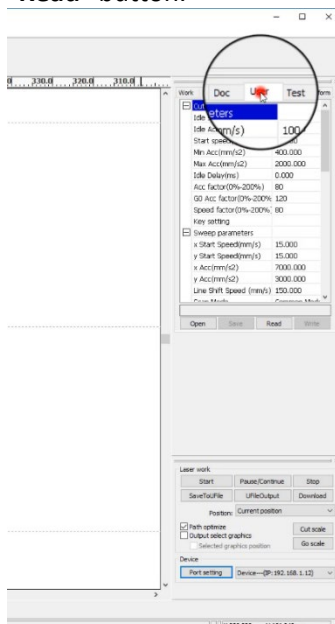


Also keep in mind laser kerf. Laser always burns a little extra from material. If you are cutting square 10x10 mm you will actually get something slightly smaller, maybe 9.7x9.7mm. Take this into account.

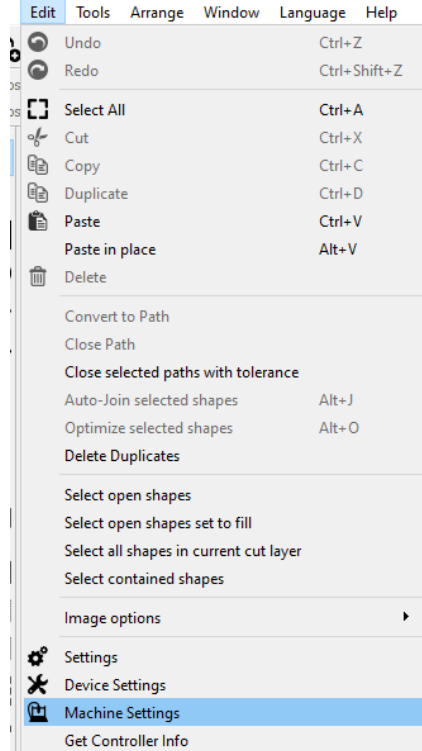
Now that you made your personalized distance gauge, let's adjust machine's autofocus until this gauge fits under tip of the nozzle.

Here's how to do this:

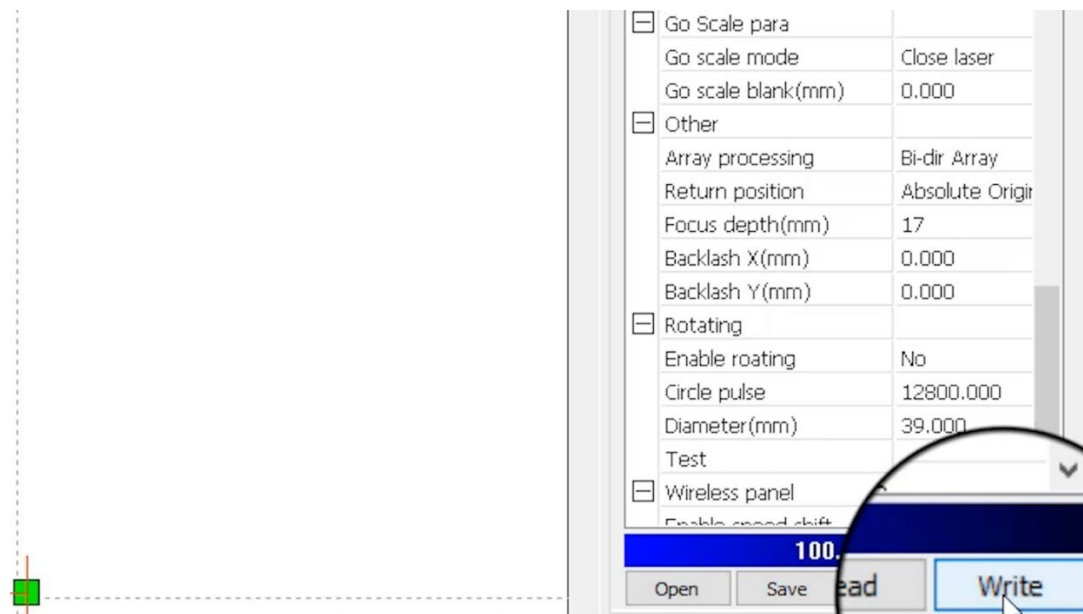
1. Input Focal distance that you got from focal gauge:
You can do it by going to **User** tab in RDWorks. Load settings from machine first by pressing "**Read**" button.



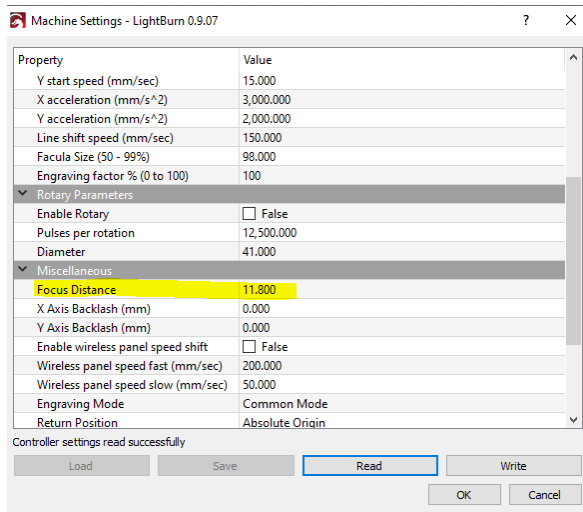
If you are using Lightburn go to Edit -> Machine Settings



In RDWorks find and change Focus Depth settings to your value. Press **“Write”** button to save settings.



In Lightburn under “Miscellaneous” find and change “Focus Distance” value to your number and click “Write” button.



Now do Autofocus on a flat piece of material. Your laser machine will do its thing and you will see “Z” value will change to your focal distance.

Now take the personalized gauge you made and see if it fits under the nozzle tip. Raise or lower nozzle as needed until gauge fits perfectly under it. Look at the current “Z” value. This is the value you can now plug into machine’s memory as Focus Distance!

Here’s practical example:

Using Ramp Gauge, you got number 17 as clearest. You added 0.5mm offset and got your focal distance as 17.5 mm. This is actual distance from nozzle to the material.

You drew a square 17.8 mm (17.5mm + 0.3 mm kerf) high by 40 mm wide (any width would work) in your laser program and cut it from 1/8” plywood. It should come out 17.5 mm tall. You entered this number as Focal Distance into your machine, did autofocus and discovered that laser head lowered much lower than 17.5mm. Your cutout doesn’t fit under laser head but at least few millimeters.

Using “jog” controls in laser program you lowered your bed by 3.5 mm and at this point you can slide your cutout piece of plywood under nozzle’s tip and it fits there perfectly. Screen will read current Z value as 21 mm. This is how far machine actually need to move to reach height of 17.5 mm. Put this number as focal distance setting and write to the memory.

Now when you try autofocus again, you will see that your plywood piece fits perfectly. Even tho machine thinks it moved table by 21 mm it actually did so by 17.5 mm in real life. But that doesn’t matter as long as we got autofocus to work for us!

At this point not only, you set correct Autofocus distance, but also made a manual focusing jig!

Optional Fine tuning.

Focal gauge will show you focal distance that's pretty good but not absolutely perfect. Use this value as starting point and fine tune your focal distance by raising or lowering your laser head by 0.2 mm and

engraving some vector text and comparing results. Write down setting that provides cleanest text. For example, if you got value of 17mm using focus gauge you might find that at 16.8mm you get even crispier results. 16.8mm will be your ideal focal distance.

Support

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