

Documentation of Laser Cutting Machine

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1 Machine Description

1.1 Machine Parts

The laser cutter machine is shown below. Figure 1 indicates top door/lid, material tray, knife pallet, control panel and operating panel. Apart from these, the machine comes with some accessories. They are :

1. **Chiller:** Chiller is used for the cooling the laser tube. See Figure 3.
2. **Air compressor:** This is used to reduce the dust, residue and smoke effects on the lens and its pressure helps to reduce burr, carbon dust particles on material while cutting or engraving. Look at Figure 4.
3. **Exhaust pipe:** This is used to remove gases inside the cabin of working area which is connected to exhaust blowers. Look at Figure 5.
4. **Honeycomb:** It is an optional attachment for cutting small characters or design and for not letting it fall down in scrap tray. Look at Figure 6.

1.2 Name Plate details

Machine Functionalities: Laser Cutting and Laser Engraving.

Machine Number: 1506

Model Size: 3x2

CO₂ Power: 100 W

Voltage: 220 V

Mfd Date: Nov 21.

Weight: 300 kg.

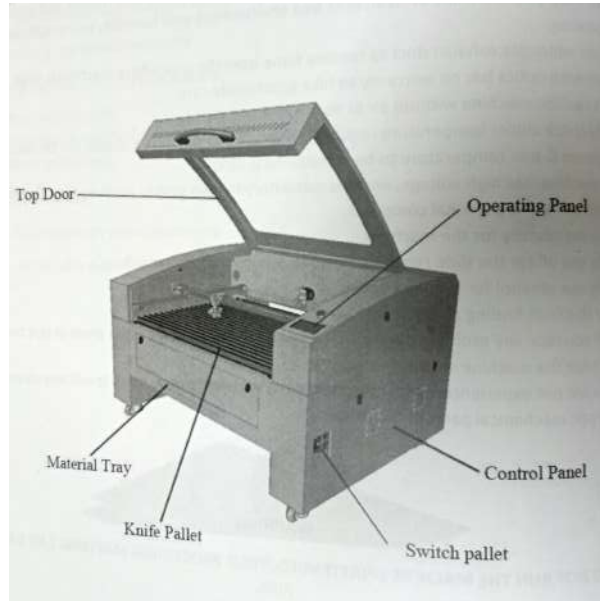


Figure 1: Laser Cutter



Figure 2: Laser Cutter



Figure 3: Chiller



Figure 4: Air Compressor



Figure 5: Exhaust Pipe



Figure 6: Honeycomb

2 Operating Procedure

2.1 Software

To generate U file we will be using **LaserCAD** software. LaserCAD is a laser motion control software running in **Windows** developed by Shenzhen Trocen Automation Technology Co., LTD. This software allows us to design structures which we can cut or engrave using laser cutting machine, using this software we can control the laser motion and specify different parameters like power and speed of the laser.

In this section we will look about how to download LaserCAD on your local Windows machine, how to use it to create U file with example and step by step guide.

2.1.1 Downloading LaserCAD

- LaserCAD is available on official website of the developer Trocen. Visit website <http://www.sztrocen.com/>
- Navigate through services, then software, then download the available LaserCAD version zip file.
- In case facing difficulties you can directly visit the following link <http://www.sztrocen.com/m/support.php?cid=28>, but website is subject to change.
- Once you download the zip file then extract it and run the Setup.exe.
- In case windows defender is on then the .exe file will not run directly instead a dialogue box will be shown for user to warn about the unrecognized app.
- Don't worry you are safe! click on 'run anyway' to run the setup file. Following dialogue box will appear as shown in figure. 7.

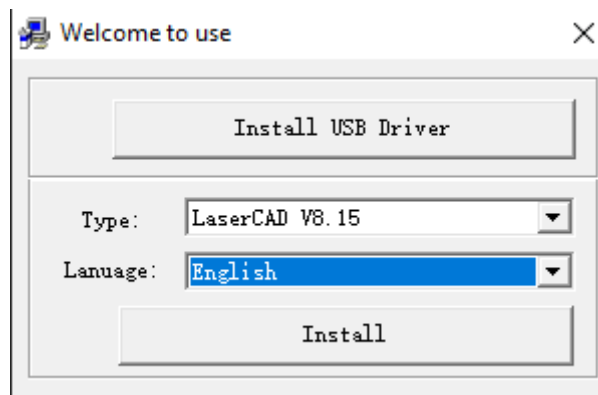


Figure 7: Setup dialogue box

- Select the type as whatever latest version of LaserCAD is available, select language as English and then click on Install.
- In the next pop up mention the folder path in the 'Install Path' where you want to install this software and click on OK button.
- It will take few seconds to install. Once completed browse to the directory where software is installed and then browse through LaserCAD, then AWCPPrograms and then run the LaserCAD.exe file to launch the software.
- This completes the installation process, figure 8 is the view of the software.

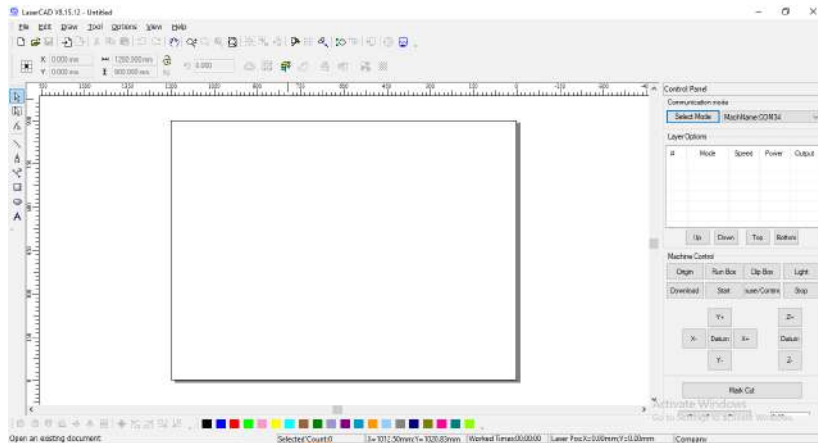


Figure 8: LaserCAD software

2.1.2 Getting started with LaserCAD

- LaserCAD UI is easy and simple to understand. You can simply hover on the icons to know the the functionality of that icon.
- Documentation of this software is available on the official website, you can download it from <http://www.sztrocen.com/m/support.php?cid=29>. Read the respective sections of this document if you want to explore this software in depth.
- However this laser cutting manual is not about the operation of LaserCAD software. Objective of this section is to get familiar with the process of going from design idea to the U file.
- In this section one simple example design called SPACER. We will go through design steps one by one and generate U file which can be feed to the laser cutting machine.
- What is SPACER? and what is the need of it?. Focal length of convex lens at the nasal tip of laser machine is 6mm, so before we cut or engrave, we must ensure that the distance between the tip and the material surface is approximately 6mm.
- One way to ensure this is to have a material of 6mm thickness which can be placed in between the tip and the material and then adjust the vertical height of the tip such that the tip slightly touches the inserted 6mm thick material. We have named this material as SPACER.
- In this section we will be designing this. We have an acrylic sheet of 6mm thickness, from which we will cut a circle on which we will engrave the name SPACER. This circle is our final product.
- Lets get started with the design. Launch the software by running LaserCAD.exe application file.

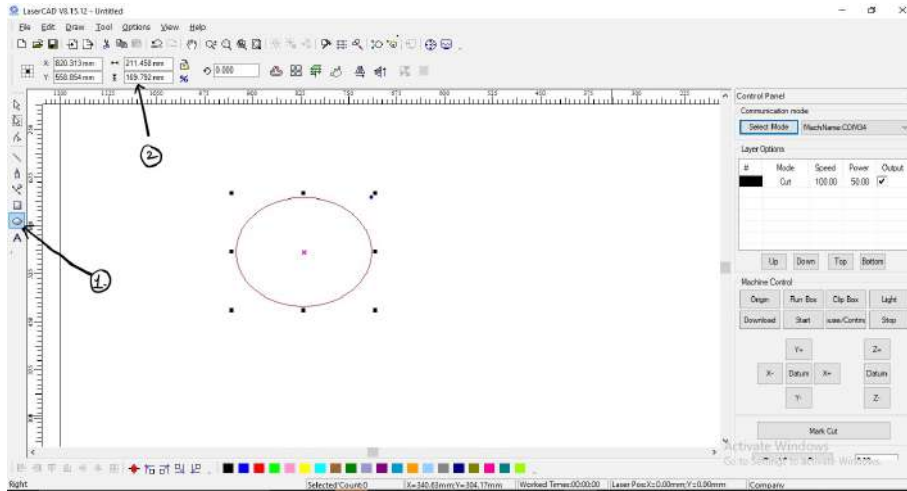


Figure 9: Creating circle

- As shown in the figure. 9 on the left side click on the ellipse icon, then click on the canvas where you want to draw your design, hold the click and drag to draw the ellipse.
- Once you release the click then you can set the width and height of ellipse as 45mm as shown by pointer 2 in figure.

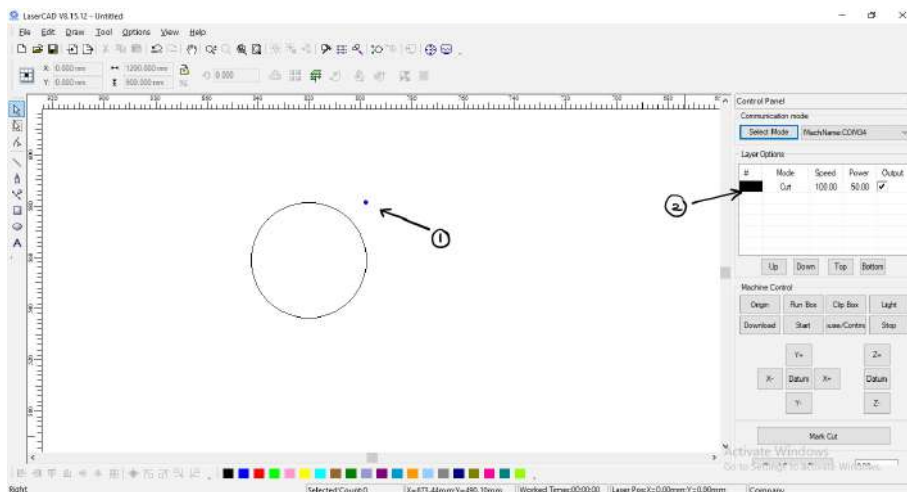


Figure 10: Circle created with origin as reference

- Once you set the parameters a circle will be formed in canvas of diameter 45mm. Referring to the figure. 10, notice the blue dot pointed by pointer 1, this dot is the origin of our design, which means that when we upload this design on Laser machine, the tip of the laser will always be pointing to this point.
- Once we start the machine all the coordinates for the motion will be calculated with respect to this point. Also once the circle is drawn 'Layer options' in the control panel is updated as pointed by pointer 2.
- The color of our circle is black and so the color represented in the 'Layer options', the mode is by default cut.
- Every color can be associated with only one type of the mode. Since now black color is used to select cut mode, then everything we want to cut should have the color black only.

- Now depending on the material we are using and the mode we want to use, we need to specify the power and speed at which laser machine should operate.
- Double click on the 'Layer options' pointed by pointer 2, following dialogue box will be opened as shown in figure. 11.

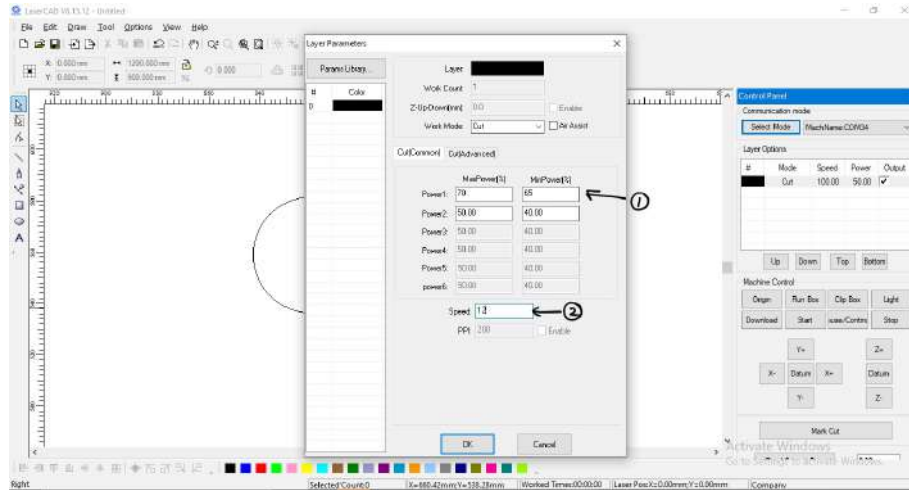


Figure 11: Modifying layer parameters

- Every material have standard values for power and speed. Refer section 2.3 figure 51 to know the power and speed values.
- By referring it modify the parameter values as shown in the figure. 11 and then click on OK. Notice the 'Layer options' data is updated.

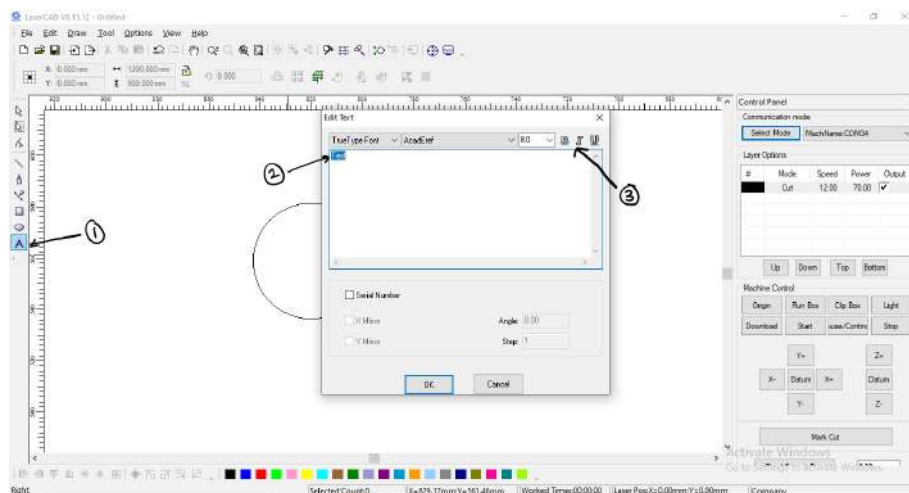


Figure 12: Adding text to the design

- Now we want to engrave the name SPACER on this circle, so for that we need to write the text with desired font style and size.
- Referring to the figure. 12, click on the 'Draw Text' icon as pointed by pointer 2, then double click inside the circle where we want to engrave the name.
- Edit Text dialogue box will appear as shown in figure, edit the text and write SPACER, select the options of bold (B) and italic (I) and then click on OK.
- You can change font style and size according to your choice if needed

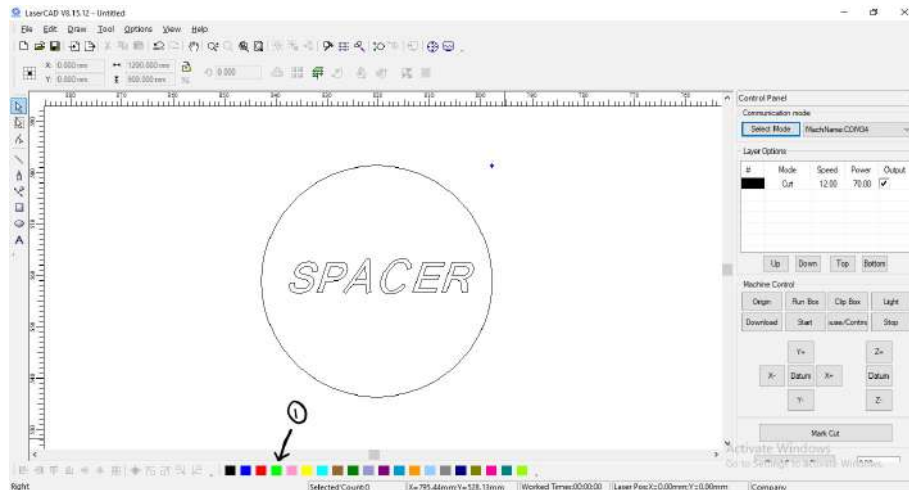


Figure 13: Modifying color for engrave layer

- Notice the color of text SPACER as shown in figure. 13. It is black in color.
- As we earlier have considered black color for cut mode this means that even SPACER text shape will also be cut but this is not what we want, we want to engrave this text not cut it, so we must change the color of the text.
- First select the text by left click and then hold and drag across the text to form a selection rectangle, once selected then click on any color from the color bar as shown in figure by pointer 1. In this we have selected green color.
- Notice once you select the color, Layer options section is updated with new green color layer, by default mode is cut but we want to engrave SPACER name not cut it so to change the layer parameters double click on that layer option to open the 'Layer parameter' dialogue box as shown in figure 14. From now on-wards everything which is needed to be engraved must be colored in green.

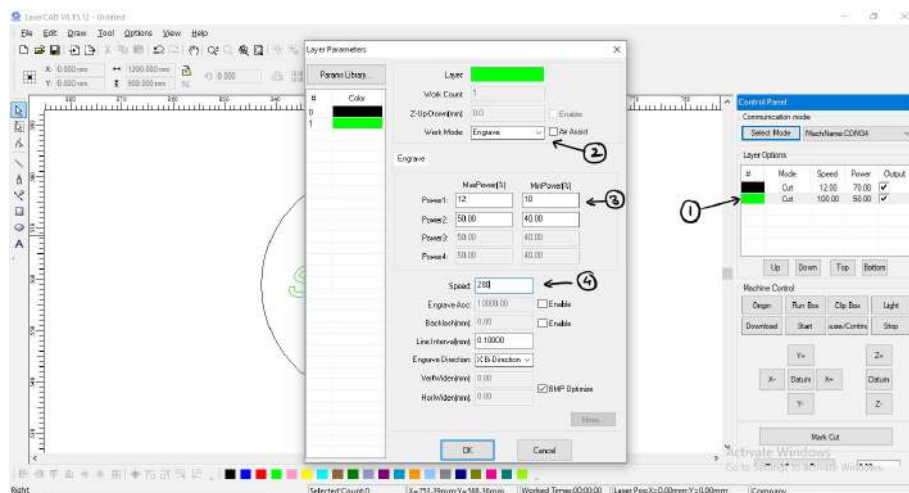


Figure 14: Modifying layer parameters of text

- Select work mode as engrave as shown in figure 14 by pointer 2, change the power1 section and speed to the values shown in figure, ignore all other parameters and then click on OK, notice the parameters are updated in 'Layer options' section.
- Congrats, we have completed our design. In order to upload this design on laser cutting machine we need to download the U file, click on the Download button in control panel under machine control section as shown in the figure 15.

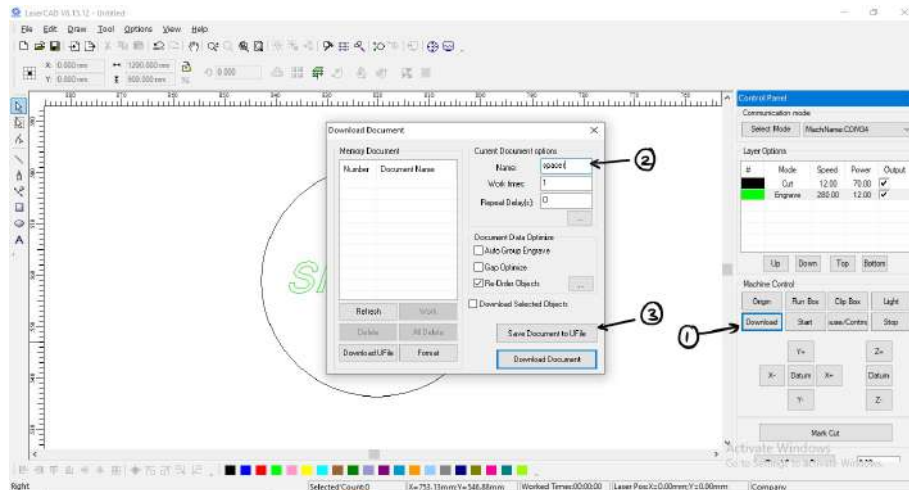


Figure 15: Downloading U file

- Name the current document as spacer and then click on the 'Save Document to UFile' button, select the directory to save the file.
- We are done with the LaserCAD software, in the following sections we will see how to create a case using laser machine and how to upload this UFile on laser cutting machine and get it working.

2.1.3 Getting started with case making

- Making of case using laser machine is one of the common application. In the previous subsection we designed SPACER, now in this section we will get familiar with the procedure to design a casing, for example we will design an open case as a holder of our SPACER.
- To create case design we will be using website called <https://www.makercase.com/>, open the website and you probably will see the following webpage as shown in figure 16.

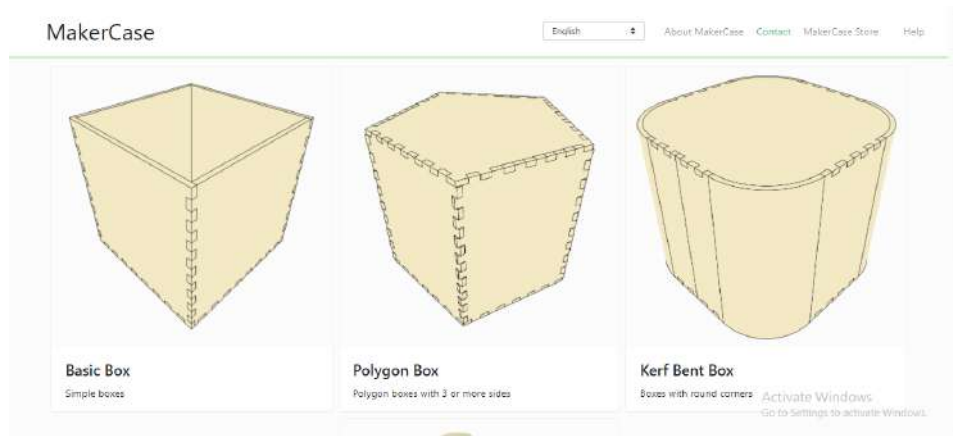


Figure 16: Web-page of maker case

- You can explore there are many different designs available on this very simple to use website. For our design we will use simple box.
- Click on the Basic Box and you will see the page as shown in figure 17.

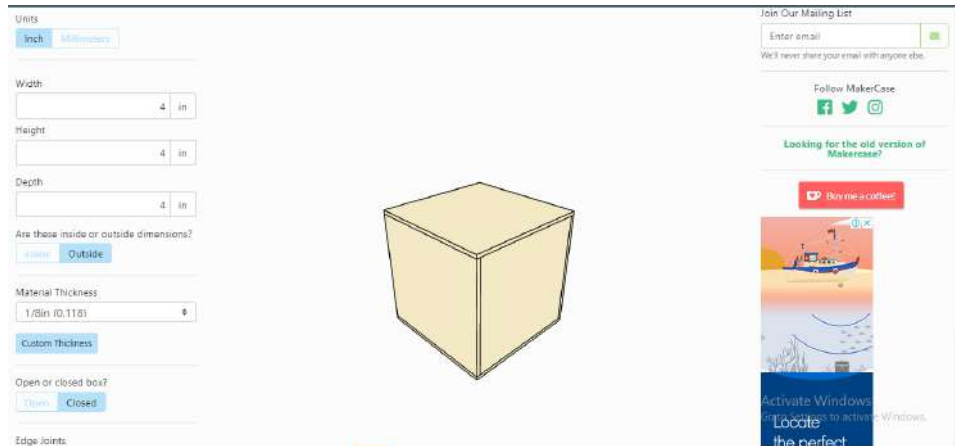


Figure 17: Web-page after selecting Basic Box

- These are the by default values. We want to design this case to hold our SPACER which is circular with 45mm diameter, so let's keep the width and depth (i.e., length) as 50mm and height to be 15mm. These dimensions are internal.
- As shown in the figure 18, first select the units as Millimeters and modify dimensions, then select inside option as dimension, select material thickness according to the material which is available with you, in this design we used 3mm thick material, if thickness value is not in the drop down menu then you can click on Custom Thickness button and set the value, select open box option.

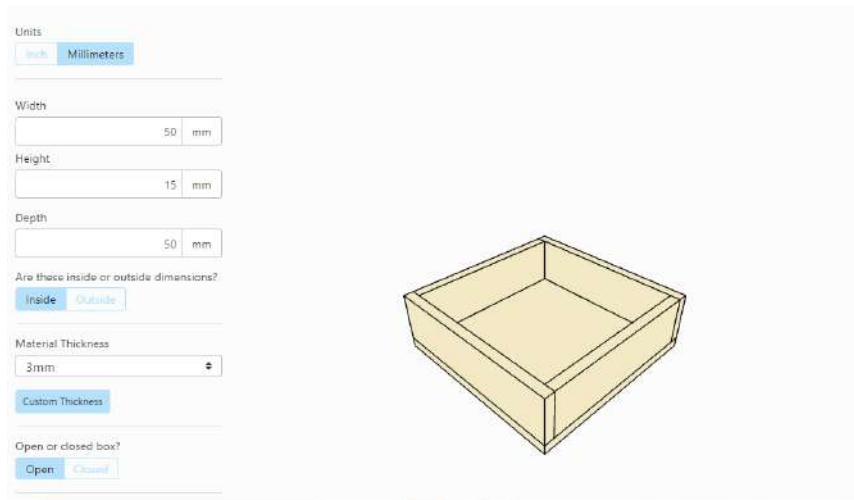


Figure 18: Modifying box parameters

- Now in order to have proper grip we need to select one of the options from the Edge Joints, select Finger and the desire Finger Size and then click on the 'Download Box Plans' button. You will see the following dialogue box as shown in figure 19.



Figure 19: Downloading DXF file

- Disable the panel labels and select the combine panel layout option, then click on 'Download DXF' button. Save the file at desired directory.
- Launch LaserCAD software and import this dxf file for editing. To import go to files and then select import.
- After importing, workplace will look like the following figure 20.

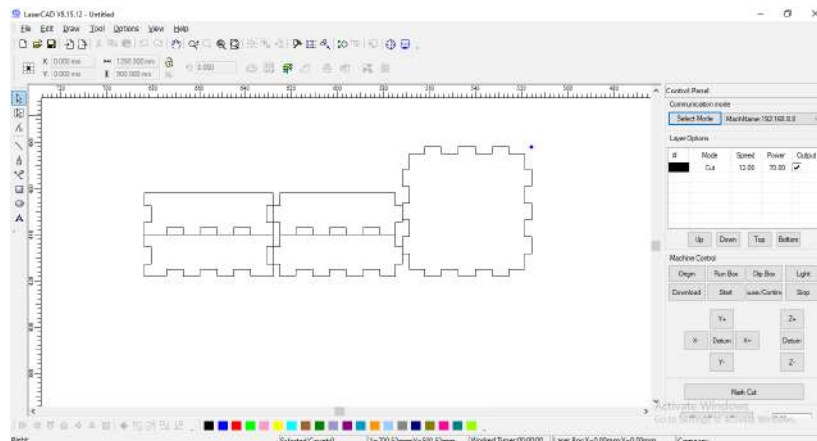


Figure 20: Importing box DXF file to the LaserCAD software

- Now lets engrave the name SPACER on all the sides except bottom.
- Select 'Draw text' icon and write the text SPACER and change the color to green as shown in the below figure 21.

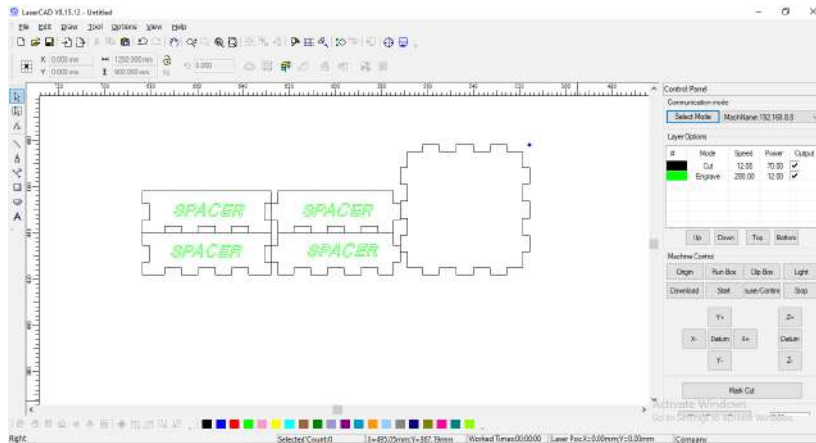


Figure 21: Adding text to the case

- Now download the U file.
- We are done with both the designs of SPACER and its casing.
- In the following section we will see how to upload the U file on machine and get it work. We will only see how to get spacer design, same steps can be applied to design case.

2.2 Operating the Machine

1. Switch on the machine



Figure 22: Main Switch

2. Push the knob to turn on the machine



Figure 23: Push Button

3. Pressing the knob will turn on all the switches and machine gets started



Figure 24: All switches

4. Turn on the chiller and set the temperature of machine between 20°C to 25°C



Figure 25: Chiller

5. Turn on the exhaust fan and air compressor from behind the machine



Figure 26: Exhaust



Figure 27: Air Compressor

6. Insert Pen-drive for uploading your design



Figure 28: Place for pen-drive

7. When machine turns on, the following screen will be visible



Figure 29: On screen

8. **Uploading the file:** Press the double arrow to view menu



Figure 30: Double arrow

9. Press 'Menu'



Figure 31: Menu

10. Press 'UDisk Files'



Figure 32: UDisk Files

11. Press 'Work Files'



Figure 33: Work'Files

12. Select your file which is saved in pen-drive (here SPACER.UD5)



Figure 34: Select file

13. Press 'Copy to System'



Figure 35: Copy to system

14. Press 'Back'



Figure 36: Back

15. Main screen will be visible with the new file which is uploaded for laser cutting



Figure 37: Main Screen

16. **Setting the origin:** Press 'Origin', this will set the origin for machine so that cutting of object is proper and we don't fall short of material.



Figure 38: Origin

17. Press 'Box' for encircling the required area. After pressing machine will rotate and cover the area which is required on that material, if machine go out of the material then we have to reset the material and do the process of setting origin again.

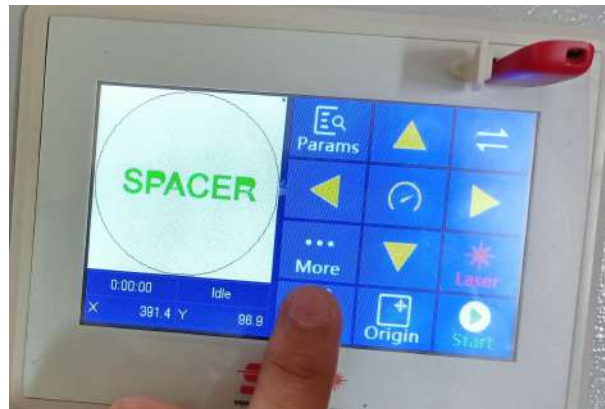


Figure 39: Box

18. **Setting distance between nozzle tip and material:** This will set the distance between nozzle tip of machine and material. Take another material of thickness 6mm and keep it between nozzle tip and desired material. Now set the tip so that it lies just above that another material. Press More



Figure 40: More

19. Press 'Move'



Figure 41: Move

20. Press these arrow buttons to move the bottom base up and down so that another material lies properly under nasal tip, it should be easily able to move but nasal tip should not be far away from that.



Figure 42: Arrow buttons

21. Press 'up arrow' to reduce the space and 'down arrow' if you want to increase the space.



Figure 43: Up arrow

22. Nozzle tip and material final setting

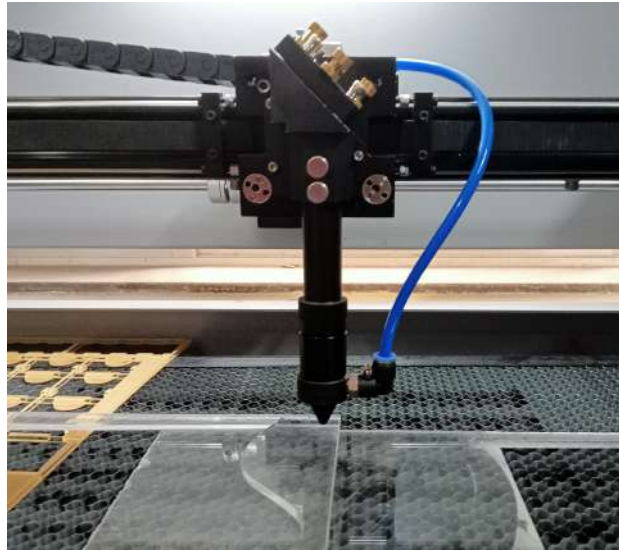


Figure 44: Nozzle tip

23. **Setting parameters:** If we want to change some parameters like speed and power or want to set these parameters of cutting and engraving then that can be done on machine too. Press 'Params'



Figure 45: Params

24. Speed and power1 is visible on screen. You can change and set any one of them. Press any one and it will navigate to next screen.



Figure 46: Speed or Power

25. Layer1 with green color is for engraving and Layer2 with black color is for cutting. Selecting Layer1 will allow us to change speed and power for engraving.



Figure 47: Layer1

26. Selecting Layer2 will allow us to change speed and power for cutting.



Figure 48: Layer2

27. Press on any one of the parameters and set the value from keypad.



Figure 49: Param Value

28. Press 'Start', this will start the process of cutting and engraving.



Figure 50: Start

29. While cutting or engraving, please close lid of the machine.
30. When cutting and engraving is over, carefully open the lid and first move the required material on its own place before picking it out. As if the cutting is not done properly then we have to set the origin again and repeat the process of cutting.
31. Good practice is to do cutting first then engraving. Because if cutting is not done properly then we have to take a pause and restart cutting process.
32. Each material has some specific chemical for its cleaning when process is completed. Like acrylic should be cleaned by alcohol and cleaning it with acetone can make it look matt instead of glossy.

2.3 Speed and power values

Figure. 51 shows different values of speed and power for different materials based on the mode of operation. This figure must be referred while mentioning speed and power parameters in LaserCAD software

First Start Chiller before start mechine, Chiller Water Change after 15days

<u>Acrylic Cutting</u>			
Size	Speed	Power	Mode
2mm	22-24	45-50	Cut
3mm	18-20	50-55	Cut
4mm	15-16	60-65	Cut
6mm	12-13	65-70	Cut
8mm	8-10	70-75	Cut
10mm	6-8	75-80	Cut
12mm	3-4	80-85	Cut
15mm	2	85-90	Cut
18mm	1-2	90-95	Cut
<u>Acrylic Engraving</u>			
	280-300	12-20	Scan
<u>Paper Cutting</u>			
	100-110	25-30	Cut
<u>Glass Engraving</u>			
	200-250	25-30	Scan 0.1
<u>Thermocol Cutting</u>			
	70-80	25-30	Cut
<u>Lather Engraving</u>			
	40-50	25-30	Scan
<u>MDF Cutting</u>			
2mm	15	55-60	Cut
3mm	13	60-65	Cut
4mm	10	70	Cut
<u>Marbal Engraving</u>			
	250-300	25-30	Scan 0.110.05
<u>Card Board Cutting</u>			
	25	30	Cut


 If you want to cut the wood scale Increase Power and Decrease Speed below 25

Figure 51: Speed and power values

3 Some Maintenance Tips

1. **Cleaning of Lens:** Lens should be cleaned once a week. Make sure that, the machine is turned off. Lens is cleaned used denatured alcohol and/or acetone. Use Q-tip to apply the cleaner. Do not rub, as rubbing can cause scratches on the lens coating.
2. **Cleaning of Mirrors:** Engraving machine has three mirrors. They must be cleaned very often, on monthly basis. Follow the same procedure that is adopted while cleaning lens.
3. **Cleaning the guide way:** This must be done once in every two weeks. Firstly , make sure that the machine is turned off. Move the laser head to far right or left, and clean the slide by a little oil. Push the laser head several times slowly along the guide so that the lubricant can be easily distributed.
4. **Cleaning the water Tank:** Turn the machine and its accessories off, disconnect water inlet pipe, let the water inside the laser tube flow into water tank automatically. Clean water tank and replacement of water once a week is recommended.
5. **Cleaning of exhaust Fan:** After a long time use, the inner exhaust will accumulate much solid dust, so fan will make great noise. When the exhaust becomes poor, we have to clean the fan and smoke pipe.

4 Some Do's and Don't

1. This machine uses class IV CO₂ Laser, which is harmful in direct contact with the body or from mirror reflection to body. Therefore, it is advised to close the lid when the machine is in action.
2. Kindly check the chiller temperature regularly. The chiller temperature should not exceed 35°C and the minimum temperature to be maintained is 25 °C.
3. Do not run the machine unattended. Your processing material can catch fire.
4. In case of emergency press the stop button.
5. Turn off the machine before taking the engraved or cut material.
6. Don't run the machine without exhaust. Provide adequate exhaust duct to remove fume from the area where machine is kept.
7. Machine has optical parts, which may tend to go bad due to dust, fumes and moisture. So, it is advised to keep the machine in dust free and less humid environment.
8. Since the machine is running at high voltage, it is mandatory to have proper earthing for the machine. Voltage between neutral and earth should be less than 2V. Make sure that you insulate yourself while using the machine.

9. Separate UPS should be provided to machine so that immediate shutdown of the machine can be avoided.
10. Don't look at the laser for a long duration, as it can damage your eyesight.
11. Don't run this machine without air in nozzle, as it might spoil the lens.