

# ShopBot Desktop

## Tabletop CNC Machine



ShopBot Desktop Training Guide - Entrepreneurship Garage

# Requirements

## Be Certified - Training Required

You must complete ShopBot Certification Training before using the machine. By using the Entrepreneurship Garage ShopBot you certify that you have been trained by Garage Staff and agree to abide by all rules set forth by the Entrepreneurship Garage.

**UNAUTHORIZED USE WILL RESULT IN RESTRICTED ACCESS TO THE GARAGE.**

## Be Present During Operation

You must always be present when using the ShopBot CNC, to monitor for potential hazards! **Do Not Walk Away** from the machine while it is operating.

## Verify your CAM Toolpath

Before using the ShopBot CNC in the Garage you must ensure that you've properly setup your CAM toolpaths. Paying close attention to start locations, spindle speed, feed rates, chip loads, plunge depths. Also be cautious of hold down methods and path obstructions as this can lead to dangerous scenarios.

## Guidelines

The ShopBot Desktop is a desktop style CNC router than can accommodate materials up to 18" x 24" in size. The ShopBot Desktop Max can be used to carve, cut, machine and mill materials such as wood, MDF, plastics, foams, and non-ferrous metals (like aluminum).

### Material Processing Area:

(X x Y x Z) 24 x 18 x 3.5 in

## Materials

### Approved Materials

#### Hardwoods, Softwoods, Plywoods, Foams, Plastics

In theory the ShopBot Desktop is capable of machining Aluminum. However, in practice, its properties and capabilities require extensive planning and design to mitigate associated risks. For this reason we do not machine Aluminum on the Garage ShopBot CNC.

# Safety

## **SAFETY GEAR - EYE AND EAR PROTECTION**

**\*SAFETY GLASSES AND EAR PROTECTION ARE REQUIRED WHEN OPERATING THE SHOPBOT. Roll-up Sleeves, Wear Closed Toed Shoes, Tie Hair Back and Remove all Loose Jewelry.**

## **NEVER OPERATE THE SHOPBOT WITHOUT CONSTANT SUPERVISION.**

You must remain at the ShopBot while it's operating. Never leave the ShopBot while it's operating.

## **HIGH SPEED SPINDLE!**

ANY OBJECT IN THE PATH OF THE ROTATING SPINDLE/BIT WILL BE CUT/EJECTED. THE MACHINE WILL NOT STOP UNLESS YOU STOP IT. NEVER PLACE YOURSELF OR OTHER UNWANTED OBJECTS IN THE PATH OF THE SPINDLE.

## **EMERGENCY STOP!**

In case of Emergency use the 'spacebar' to stop the spindle. You can also press the 'Power Kill' button on the wall near the woodshop entrance, to kill power to all equipment in an emergency situation.

## **TURN OFF MACHINE WHEN LOADING AND POSITIONING**

Always ensure that the machine is off when loading or positioning your workpiece.

## **ENSURE ALL GUARDS ARE IN PLACE AND PROPERLY SECURED BEFORE STARTING YOUR JOB.**

High speed flying debris, parts and bits pose a safety risk. Make sure that all guards are secure and in place.

## **ENSURE THE DUST SKIRT IS IN PLACE AND THE JET DUST COLLECTION SYSTEM IS ON AND OPERATING PROPERLY.**

Turn on the JET Dust collection system before use and make sure duct gates are open.

# Fusion 360 CAD File Tutorial

1. Open Fusion 360
2. Hit File tab in the upper left hand corner and select "New Design" Hit Save icon in the upper right hand corner. Name the file and choose an appropriate location
3. Hit the gray arrow beside the "Document Settings" tab in the left hand side of the workspace, and be sure that the file's units are in Inches. This should be the default
4. To create a sketch, hit "Create Sketch" icon just to the right of the design dropdown tab
5. Select one of the three orange planes that appear on the workspace
6. Now we are in "sketch mode".
7. Hit the "CREATE" dropdown and hover over "Circle". Select "Center Diameter Circle"
8. Draw a circle with a center at the origin and a radius of 2 Inches.
9. To exit sketch mode, hit "FINISH SKETCH" on the far right side
10. To edit a sketch, hit the gray arrow beside the "Sketches" tab in the left hand side of the workspace
11. Double-click "Sketch1". Now we are back in sketch mode
12. Now add a square that is 3"x3" centered at the origin
13. Under the "MODIFY" dropdown at the top, select "Fillet" and apply to the four corners of the square we just sketched.
14. Finish sketch
15. To Extrude a sketch, select the face inside the square, but outside the circle (it should highlight blue)
16. Hit the "CREATE" dropdown and hit "Extrude"
17. Drag the blue arrow until the part is 0.25 in tall. You may also type the proper height in the box. Hit enter
18. This will result in a 3D part, but the sketch will turn invisible.
19. To make the sketch visible, hit the eye icon beside the sketch you want to see (in this case, Sketch1)
20. Now select the circle we sketched earlier and extrude to 0.2 in
21. To edit and extrusion, look for an extrusion icon on the bottom left timeline and select the proper icon.
22. Change the circle extrusion to 0.15 in
23. Now our part is complete. Hide the sketches and save the file.

# Fusion 360 CAD File Tutorial

1. Open Fusion 360
2. Hit File tab in the upper left hand corner and select "New Design" Hit Save icon in the upper right hand corner. Name the file and choose an appropriate location
3. Hit the gray arrow beside the "Document Settings" tab in the left hand side of the workspace, and be sure that the file's units are in Inches. This should be the default
4. To create a sketch, hit "Create Sketch" icon just to the right of the design dropdown tab
5. Select one of the three orange planes that appear on the workspace
6. Now we are in "sketch mode".
7. Hit the "CREATE" dropdown and hover over "Circle". Select "Center Diameter Circle"
8. Draw a circle with a center at the origin and a radius of 2 Inches.
9. To exit sketch mode, hit "FINISH SKETCH" on the far right side
10. To edit a sketch, hit the gray arrow beside the "Sketches" tab in the left hand side of the workspace
11. Double-click "Sketch1". Now we are back in sketch mode
12. Now add a square that is 3"x3" centered at the origin
13. Under the "MODIFY" dropdown at the top, select "Fillet" and apply to the four corners of the square we just sketched.
14. Finish sketch
15. To Extrude a sketch, select the face inside the square, but outside the circle (it should highlight blue)
16. Hit the "CREATE" dropdown and hit "Extrude"
17. Drag the blue arrow until the part is 0.25 in tall. You may also type the proper height in the box. Hit enter
18. This will result in a 3D part, but the sketch will turn invisible.
19. To make the sketch visible, hit the eye icon beside the sketch you want to see (in this case, Sketch1)
20. Now select the circle we sketched earlier and extrude to 0.2 in
21. To edit and extrusion, look for an extrusion icon on the bottom left timeline and select the proper icon.
22. Change the circle extrusion to 0.15 in
23. Now our part is complete. Hide the sketches and save the file.

# ShopBot Operating Instructions

1. Lift the red shield on the main power switch, and switch the machine on
  - a. Using the key, make sure that the Variable Frequency Drive unit (gray box on the side of the machine) powers on (it has a delay)
2. Load the "ShopBot 3" software on the PC and wait for it to connect with the machine
3. This will bring up the red position box
  - a. Within this box, select the yellow "keypad" icon "K Command"
4. Be sure nothing is between the yellow and black tape and the ShopBot
5. With the keypad active, you may use the on screen buttons to move the gantry, car, and spindle. You can also use the arrow keys on the keyboard, as well as the page up/down keys.
  - a. Raise the Z axis so you have access to the collet, and collet nut
6. Turn the machine OFF at the red flip kill switch
7. You will see two wrenches on the spoilboard. One is a blue park tool wrench (20mm), which is used to hold the spindle stationary. The other is the splined collet wrench. Using these two together, please loosen the collet nut and remove the nut and collet. You may be able to do this by hand without the wrenches.
8. Our machine has  $\frac{1}{4}$ " and  $\frac{3}{8}$ " collets, which means we can only use those sized bits
9. Ensure that the collet is installed properly into the collet nut. It should seat with a very pronounced "click"
10. Slide the appropriate bit fully into the collet until the top is flush with the collet.
  - a. Ensure that none of the cutting points, flutes, etc. are pushed into the collet... that's bad
  - b. Ensure that no more than  $\frac{3}{8}$ " sticks up out of the top of the collet
  - c. We want to be CERTAIN that at least  $\frac{3}{4}$  of the bit shaft is inserted into the collet. This will prevent the bit from spinning within the collet, or the bit breaking (GOGGLES!)
11. Back at the machine, ensure the threads are free of debris and clean, and hand thread the collet nut onto the spindle
12. Using the two wrenches, tighten the collet nut so it is hand tight, plus an additional  $\frac{1}{8}$  turn. The official spec is 59ft-lbs.
13. Now is a good time to position our materials on the spoilboard
  - a. Check your T-Clamp clearance!
  - b. Take a moment to decide where you'll be producing your piece. Now is a great time to measure!
14. Once the bit is secured, power the main power switch back on so we can begin the zero axis procedure

## ShopBot Desktop CNC Training Guide - Entrepreneurship Garage

15. Zeroing the Z (every time, with every bit, with every material adjustment)
  - a. With the gantry and the car positioned roughly near your cut, and your bit installed, place the Z zero plate (located in a sleeve on the left front of the machine) flat on the table under the bit.
  - b. Take the grounding clamp, and attach it to the 20mm spindle shaft just above the collet nut. This will allow an electrical current to flow through once the bit touches the plate, and the zero will be set.
  - c. Back at the PC, close the yellow control box, and on the RED control box, you'll see a "Z zero height" icon. Select this. The machine will load a script, and ask if you're ready to zero. With the plate flat under the bit, and the grounding clamp connected to the spindle shaft, hit enter, and the machine will go down and touch the plate. You should see the number 1 input icon light up when it makes contact. If this does not happen, contact the garage manager.
  - d. The machine should now retract the Z to .500 inches above the zero surface.
  - e. Remove the plate, and clamp, and store them ensuring they do not touch, which would cause the #1 icon to light up.
  - f. If for any reason this was unsuccessful, consider the machine INOP, and contact the garage manager.
16. Zeroing the X and Y axis
  - a. Select the "X & Y Zero" Icon on the red control panel
  - b. The machine will use the limit switches to calibrate.
  - c. Select OK afterwards
17. Raise your Z and attach the dust foot.
18. Next we need to warm the bearings in the spindle up to operating temperature.
  - a. Adjust the VFD to approximately "100" which equals roughly 6000 RPM. This should run for approximately ten minutes to properly warm the bearings up to operating temperature. So please note the time.
  - b. Install the front plexi shield
  - c. Open the yellow control box, and select the "#1 Output" blue icon. This WILL activate the spindle.
19. While the bearings are spinning up to operating temperature, let's work on our design!  
See the Fusion 360 CAD and CAM tutorial on pages 3 and 4
20. After ten minutes, adjust the VFD slowly to read approximately "300" which will be 18000 RPM. You should hear the speed audibly change as you increase the RPM
  - a. Select the "#1 Output" icon again to turn off the spindle

## ShopBot Desktop CNC Training Guide - Entrepreneurship Garage

21. With the bearings fully up to operating temperature, it's time to run a Part File!
  - a. First we should run our Part File in "Preview" mode
    - i. Exit out of the yellow control box
    - ii. Select "Preview Part" button on red position box
    - iii. Choose file from file explorer
    - iv. To change any cutting parameters or settings, select "Set File Parameters" button in red position box
    - v. Hit "Start" button in red position box
      1. This is the path that you have programmed into the tool.
      2. Red lines indicate travel moves
      3. Blue lines indicate cutting moves
    - vi. Observe this file in 3D, and expand the "Material" tab on the left to find any errors
      1. Check material thickness, and orientation for Z
22. Select the "Toolpaths" tab on the left
  - a. Ensure that the "Table", "Material", and "Origin" boxes are checked, and CONFIRM that these make sense. Click them on and off to be sure.
  - b. Select "Preview Cut" to ensure your finished (digital) model matches what you'd like to have in real life
23. Now that the sample looks good, we can switch to "move/cut mode" by selecting the "Cut Part" button in the red position box
24. From here, we should run an "air cut" to be certain the machine does what we want before actually cutting the material.
  - a. Air-cutting allows us to run our actual toolpaths with the machine zeroed a distance ABOVE our material. This is an excellent way to ensure that the machine has interpreted your toolpaths correctly.
  - b. To do this, we should run a "K Command" and raise our Z to a specific (appropriate) height
  - c. We can now set this as our zero position by typing a letter "O" command and a "Z" command and hit enter
  - d. ESC out of the yellow control box
25. Press "Cut Part" button and load the same file as done before
  - a. Ensure our safety shielding is in place
  - b. Safety glasses and ear protection are mandatory
  - c. The machine will ask if the correct tool is in the spindle
  - d. The machine will ask if the Z axis is zeroed
  - e. This will ask you to select "OK" to run your PartFile. THIS WILL START MOVING THE MACHINE
  - f. When the PartFile is done running, the machine will ask you to hit "OK" to acknowledge completion of the cut

## ShopBot Desktop CNC Training Guide - Entrepreneurship Garage

26. Now to make our actual cut, re-zero the Z axis using the touch plate as described in Step 15
27. Press "Cut Part" button and load the same file with the newly corrected Z axis
28. The machine will ask you if it's ok to start the spindle and run the PartFile
29. THIS WILL BEGIN YOUR ACTUAL CUT!!!!
  - a. Ensure all safety measures are in place
  - b. Ensure that our two primary environmental controls are active. Check that the JET Air filtration vent behind the ShopBot is fully open (Both Grizzly Dust Extractor, and JET Air Filtration)
  - c. Select "OK"
30. Select "OK" to acknowledge the completion of the cut
31. We should inspect our work before we remove the stock to ensure we don't need to make any adjustments
32. Once we're sure our work is satisfactory, we can position the gantry and car in a position that will allow us to easily remove the bit, and our work
33. Power the machine off at the VFD and the main red kill-switch
  - a. Remove the bit, and reinstall the collet, and collet nut
  - b. Once the bit is safely stored, remove your materials, tidy up and log your time