

Milling Protocol Instructions

Materials Required:

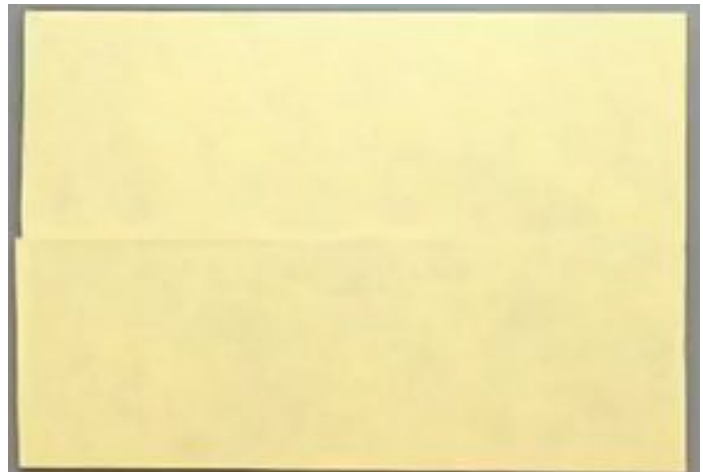
- 2 Pieces of Polycarbonate
- Electronic caliper (Min accuracy of 3 decimal points)
- Double sided tape
- Endmills of the required sizes
- Rubbing alcohol
- Soft toothbrush
- Handheld vacuum
- Hand-held roller
- Sturdy metal spatula
- Exacto knife
- Magnifying lens
- Epoxy
- Plastic weighing tray
- Stirring tool
- Screw - in ports
- PEEK tubing

Instructions:

Before beginning, input the correct feeds and speeds into the othermill - this can be found on the MARS Wiki page under “Feeds and Speeds”

Preparing the Polycarbonate:

1. Remove the protective plastic from both your polycarbonate pieces
2. Cut two pieces of double sided tape as long as the widest part of your polycarbonate
3. Paste the tape onto one side of the polycarbonate, ensuring there is no overlap.
4. Smooth out as many air bubbles as possible using the hand-held roller



5. Peel the plastic off the double sided tape
6. Turn your electronic caliper on and zero it to ensure an accurate reading
7. Measure the thickness, width and height of the polycarbonate piece with the tape attached
 - a. Keep a note of these measurements, as these will be entered into Otherplan
8. Ensure the spoilboard in the Othermill is clear of any debris and stick the polycarbonate down. Press firmly to ensure a strong attachment to the spoilboard.

Setting up Otherplan:

Setting up the Polycarbonate dimensions

1. Open Otherplan on your computer
2. On the right hand side menu, select the “Size” drop down under Materials
3. Enter the width, thickness and height of your polycarbonate into the size menu

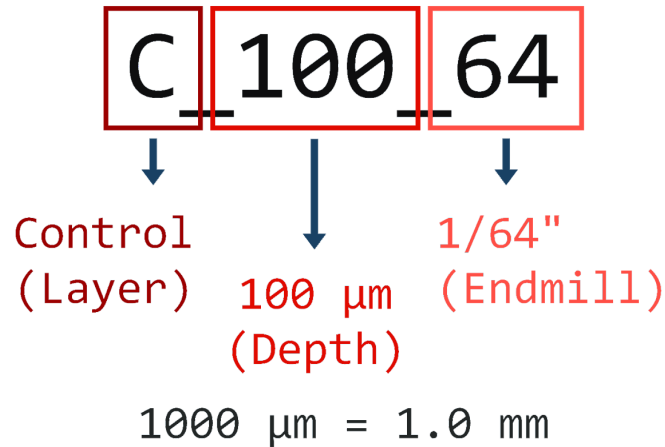


Setting up your SVGs

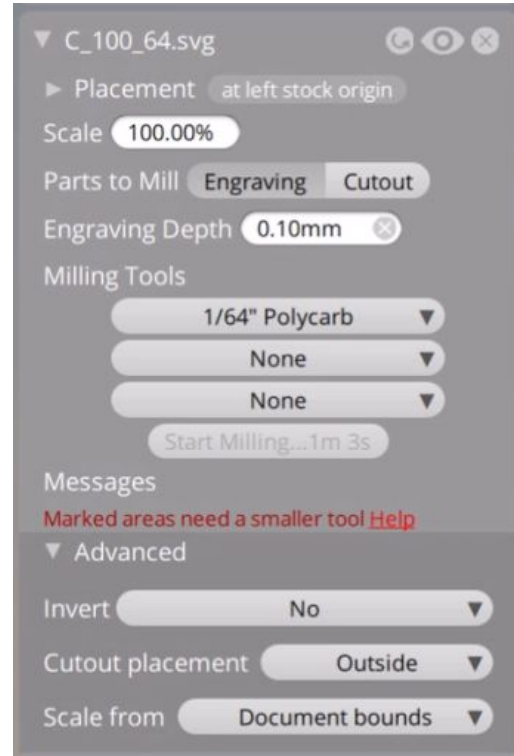
1. On the right hand side menu, select “Open Files”
2. Select and open all the SVG files corresponding to the layer you are milling. If you are unsure what SVGs to mill, check the milling guidelines for your chip
3. First, set up your “Border File”
 - a. Deselect “Engraving” for this file, as it will be a cutout, it should look like the image below.



- b. Under "Milling Tools" deselect the default tools and select the 1/8" Polycarbonate tool in the dropdown menu. All border files are milled using the 1/8" polycarbonate tool.
4. Next, set up all your non-border layers
- a. For all non-border SVGs, the engraving depth and endmill you will be using are included in the file name.
 - b. The first letter in an SVG file name, C or F, stands for Control or Flow respectively.
 - c. The first number in the filename is the engraving depth.
 - d. The second number refers to the endmill required for the file.

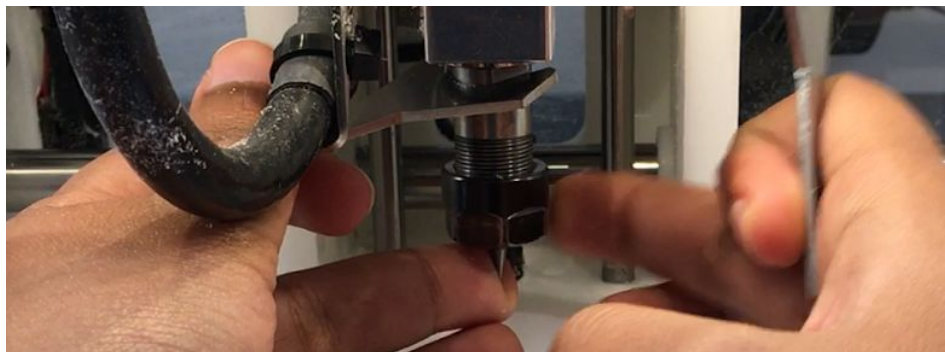


- e. Enter correct milling tool for each SVG ensuring you deselect all other tools
 - f. Enter the desired depth for each SVG. Remember to convert your depth from microns to mm (1000 microns = 1.0 mm).
 - g. For layers that list the depth as “PORTS,” set your engraving depth equal to the polycarbonate’s thickness.
 - h. Under the “Advanced” option for each SVG, select “Document bounds” position them correctly on Otherplan’
5. Each chip should come with milling guidelines telling you the order to mill your SVGs in. Select the SVG you will mill first by deselecting all other layers

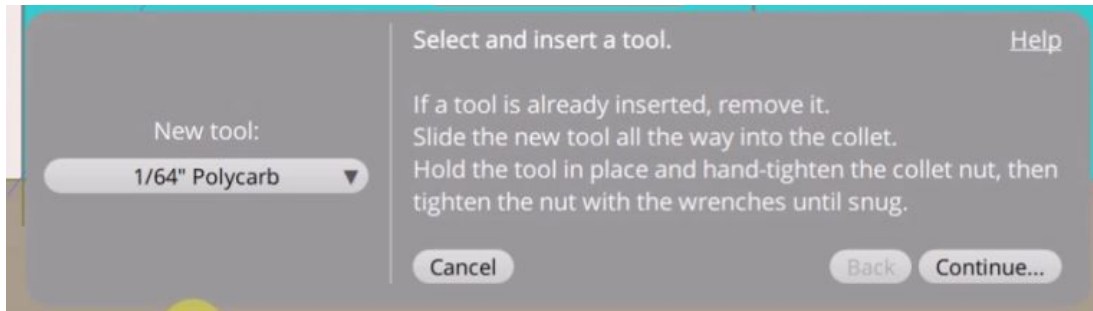


Milling Setup

1. In the upper right hand side of Otherplan, select the “change” option next to tool.
2. The Othermill will move the spindle to the center of the mill in order to make it easier for to insert the endmill
3. Select the desired endmill, place it inside the spindle and tighten completely using the wrenches provided with the Othermill
 - a. Ensure you are holding the endmill in place with one finger when removing or inserting it. If an endmill falls the tip may break off or become damaged.



4. When the endmill is secure, select its size in the dropdown menu at the bottom of the screen. Ensure you have inserted and selected the correct tool, then select continue



5. The menu will then ask you to verify the tool's position.
6. Move the spindle in the x and y direction using the options on the menu until it is over a piece of the spoilboard that is not covered by your polycarbonate. You can track the movement of the spindle on Otherplan by following the red cross on the display.

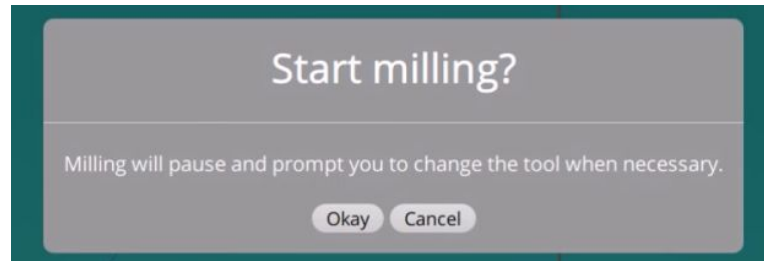


- a. Make sure this section of spoilboard is clean. If the spoilboard has been milled into, or if there is a large amount of polycarbonate dust, the tool could locate incorrectly, leading to issues while milling
7. Now, select locate tool. The spindle will begin to drop down towards the spoilboard, if something goes wrong hit the escape key on your laptop or the big red button on the right side of the Othermill to halt the milling.
8. Once the tool position has been successfully located, you are ready to begin milling.

Begin milling

1. Before beginning your milling, spray a little rubbing alcohol on the polycarbonate where the milling will take place. This will prevent the endmill heating up too much.
 - a. Be careful not to spray too much alcohol onto the polycarbonate as this can lead to the glue dissolving

2. Press the “Mill All Visible” Button on the right hand side of the screen. This should begin your milling.
 - a. A popup will alert you when to insert a tool may appear. Click okay.



- b. If a popup telling you that the milling may collide with the spoilboard appears **DO NOT CLICK IGNORE**. Your depth has been improperly input into otherplan. Stop the milling, and check all your values are correct.
3. The spindle will begin spinning and descend to mill on the polycarbonate. If anything looks wrong while milling, press the big red button on the right side of the othermill to halt the milling
4. If necessary, you can spray more rubbing alcohol on the polycarbonate during a milling
 - a. When the spindle lifts off the polycarbonate to move to another position, select the “pause” button. After spraying the polycarbonate, you can restart the milling by selecting “play”
 - b. Only pause the milling when the endmill has lifted off the polycarbonate. Pausing while the tool is milling can break the tool
5. In between millings, use a hand held vacuum to clean the polycarbonate dust from the chip

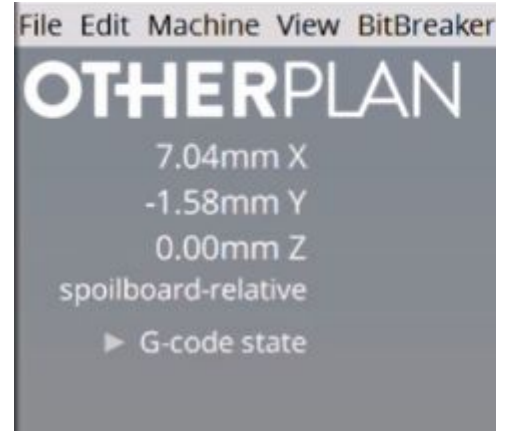
Milling a New Layer

1. Deselect the SVG file you have just finished milling
2. Select the next SVG file to be milled
3. Select the “Change Tool” option on Otherplan, the spindle should move to the center of the mill to allow you easy access to the endmill
4. Use the two wrenches to loosen the endmill, ensure you are holding the endmill in place with a finger to prevent it falling during the change
5. Once the endmill is free of the spindle, gently pull it out
6. Insert the next endmill desired following the instructions previously outlined

7. Mill the new SVG based on the previous instructions

Milling your Border

1. The border of any chip should only be milled at the end of a milling (when all other SVG files have been milled)
2. When milling your border, only use the 1/8 " tool
3. There is no need to spray rubbing alcohol onto the chip during a border milling
4. If necessary, pause the milling in order to remove excess polycarbonate from the endmill with a pair of tweezers. You do not need to wait for the endmill to lift from the polycarbonate
5. As soon as the Othermill display reads a depth of 0.00mm, halt the milling as this prevents the endmill drilling into the spoilboard



Removing the chip:

1. Wedge your spatula under the edge of the polycarbonate
2. Gently move it up and down to remove the chip from the spoilboard
3. If needed, spray rubbing alcohol between the spoilboard and the chip to dissolve the glue on the double sided tape.

Cleaning the Othermill:

1. Once you are finished milling, ensure you have removed the chip from the spoilboard and that the endmill has been removed
2. Next, use a handheld vacuum to clean the polycarbonate dust left behind from the milling.
3. You can use the "move" panel on Otherplan to change the orientation of the spoilboard to clean all around the base of the Othermill
4. Also clean the top, sides and front panel of the mill
5. Use the spatula and a little rubbing alcohol if needed to clean the spoil board and ensure all double sided tape has been removed from it

6. If the endmills used have a layer of polycarbonate on them, soak them in a little rubbing alcohol and then peel it off
7. Refer to the Othermill website for more instructions on mill maintenance such as regular oiling and deep cleaning