

Tutorial: Making a Maze with the MDX-50

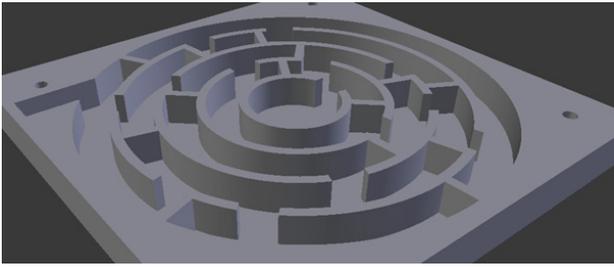
- Step 1: The 3D file _ 2
- Step 2: Preparing the CNC router _ 2
- Step 3: Setting the origin _ 2
- Step 4: SRP player _ 2
- Step 5: Finishing up _ 6



CENTRE for
INNOVATION and
ENTREPRENEURSHIP



This is a step by step tutorial to use the CNC router to create a 100x100mm maze. A ball bearing is placed inside the maze and an acrylic square is bolted to the top to make the finished game.



Step 1: The 3D file

- To make the maze you need a 3D file to tell the CNC router what to cut away. I have created this 3D file for to use you in a 3D modeling program called Blender. I exported the file as a .stl file which is one of the accepted file types for the CAM software SRP player that converts the 3D file into instructions that the CNC router can understand (G code).
- I have added tabs to the model so when you cut all the way through the material on the outside of the model it does not come loose and move. IF IT MOVES WHILE CUTTING. YOU WILL HAVE TO START AGAIN AND MAY DAMAGE THE MACHINE.
- I highly recommend learning CAD software such as Blender, Sketchup or solidworks. Knowing how to 3D model means you can digitalise anything you can think of then make it into a physical object in real life with the 3D printers or CNC router.
- **Instructions for how to get files:** Unleash USB stick? QR code to file hosted somewhere? Currently stored on the google drive: Equipment>CNC Router>Inspire.

Step 2: Preparing the CNC router

1. Select the material you wish to use to make your maze. I used MDF to create the example but high density foam will work great too. The material should be greater than or equal to the thickest part of your 3D model if you want to rout the entire model. The closer the thickness is to your model the less the router will have to carve away and the faster it will be. Don't use an 80mm thick block to rout a 10mm model. I used a 9mm thick sheet of MDF to make the maze which I designed to also be 9mm thick.
2. Make sure the router is free from swarf and

- dust. If not, brush swarf into swarf bin, vacuum any excess and wipe down the table (especially important or the material will not stick well.)
- A sacrificial sheet of material is needed because you will be cutting all the way through your material to the other side. I used 4.5mm MDF.
- 3. Take your sacrificial material and apply double sided tape to the underside. Don't overlap the tape or the material might not lay flat. Stick the sacrificial material to the table. Perfect alignment isn't crucial.
- 4. Follow the same procedure as the step above with your actual material.
- 5. Apply duct tape to the edges of the material, sacrificial sheet and table to properly secure everything. THIS IS TO GUARANTEE NOTHING MOVES WHILE CUTTING. YOU WILL HAVE TO START AGAIN OR MAY DAMAGE THE MACHINE.

Step 3: Setting the origin

- The CNC router needs to know where it should cut the model from your material. Do you want your model cut out of the center or in the corner to save material? What I do most of the time is set the origin at the front left of where the model should be placed in the material.
- To set the origin you need to tell the spindle to pick up the smallest router bit then move it through the X, Y and Z axis to 1mm above the surface of where you want the origin to be. You will then tell the spindle to start spinning and slowly lower it until it just touches the very top surface of the material.
- 1. To pick up a bit press the "menu" button twice to get to the bit selection screen. Look in the tool magazine to see what position the smallest bit is in. Select this bit in the menu by scrolling with the wheel and selecting with "enter".
- 2. To move the spindle in the X, Y and Z axis select an axis to move in by pressing either the X, Y or Z buttons (green) and rotating the wheel. Position the bit 1mm above where you want the front left corner of the model to be.
- Add steps here to make the spindle spin, lower the bit slowly and set the origin without using vpanel.

Step 4: SRP Player

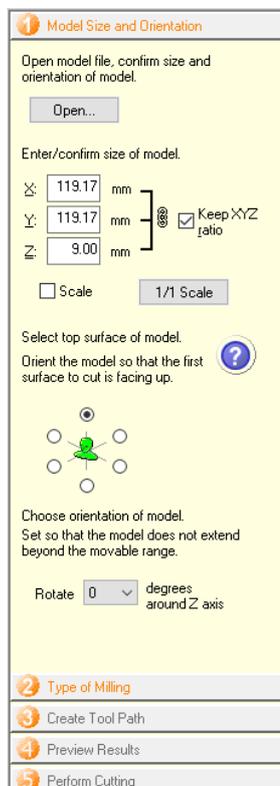
- SRP Player is the CAM software that converts the 3D file into G-code. G-code is a list of instructions that tells the CNC router things like what bits to use, where to cut and how fast to go.





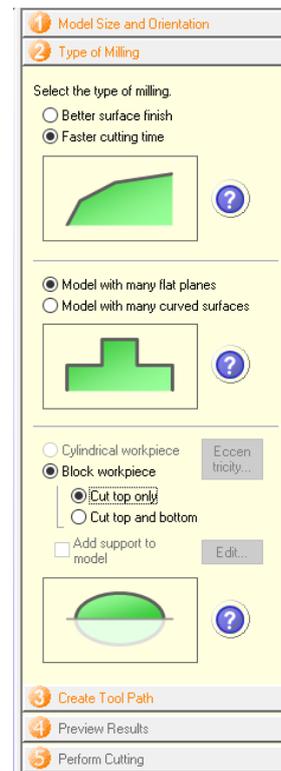
Importing the model, dimensions and orientation

1. On the right side of the screen you will see the “Model Size and Orientation menu.” Click the open button and import the .stl file for the maze.
2. As you can see the dimensions of the model are 119.17x119.17x9.00mm. The maze itself is 100x100mm. The extra size is caused by the tabs I added to the model. The size can be changed proportionally by editing any of the X, Y or Z values and unproportionally by unchecking “keep XYZ ratio.” You should keep the dimensions the same as scaling could affect how the ball bearing moves inside the maze.
3. The model should be oriented correctly with the detail facing up so no need to change the orientation.
 - As our model is a square rotation is not necessary so the drop down menu can be ignored.
4. To continue click “Type of Milling.”



Type of milling

1. Flat surfaces like in the maze look the same whether “Better surface finish” or “Faster cutting time” is selected so it’s a good idea to pick “Faster cutting time” in this case.
 - This model has no curves in the Z axis so it is a model with many flat planes.
2. You are only cutting from the top of the material and not flipping it so select “Cut top only.”
3. To continue select “Create tool path.”



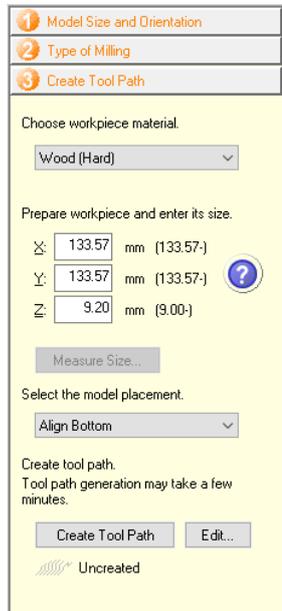
Material, sizes and alignment

1. Select the type of material you are using. If using MDF select “Wood (Hard)”. Although MDF isn’t really a hard wood it is always a good idea to select a slightly harder material in the settings. The speed can be sped up while cutting if it is too slow and is safe to do so.
2. The workpiece size (material you cut from) must be at least the size of the model plus enough for the router bit to move around the entire model. The minimum size it can be is stated next to the entry boxes. Since the model is placed in the center of the material size you give it is usually wasteful to input the actual full size of the block of material. For this project I just entered the minimum values into the entry boxes. I actually add 0.2mm to the Z size to trick the router into going a tiny bit deeper, cutting into the sacrificial



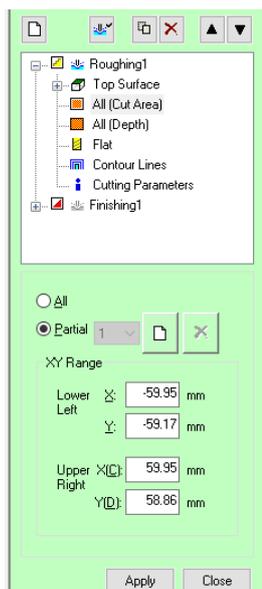
sheet. This is to ensure the model is properly cut out.

3. Model placement is where the model will be placed inside your block of material. Since I want to cut all the way through the material I selected “Align Bottom.”
4. I am going to edit the toolpath to fix something important and check details so click “Edit...”



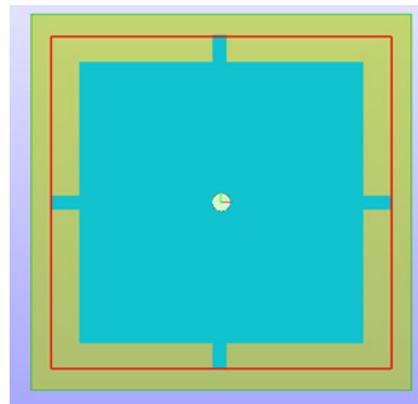
Removing the finishing pass

- You can see that there is a roughing pass and a finishing pass. Since the maze model has not curves in the Z axis finishing won't actually make it look any better but it will take a lot longer! I turned off finishing by selecting “Finishing1” then the “cut/no cut” button. You can also outright delete the finishing pass with the “X” button.



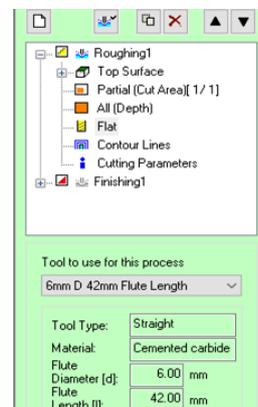
Fixing cutting area

1. Expand the roughing pass menu by clicking the “+.” You will see there are various options. Select “All (Cut area)” to see a top view of the area that is going to be cut out.
2. You will see that the cutting area is too big. The tabs aren't actually joined to the outside which means when the model is cut out it will move and possibly damage the machine. Select “Partial” in the bottom menu to be able to click and drag the red lines inwards so they are just touching the tabs. This will cause the tabs to be attached to the outside material. They will need to be cut away afterwards manually but at least they will stop the model moving! Apply the changes and click on “Flat” in the drop down for the roughing pass.



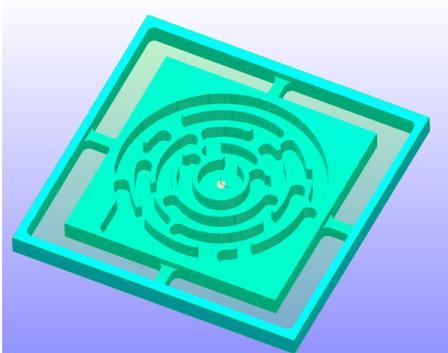
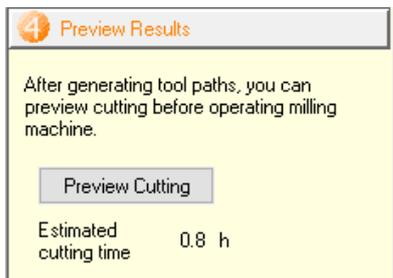
Checking router bit and generating G-code

1. In the bottom menu of “Flat” there is a drop down menu that allows you to select what bit to use for the roughing pass. The 6mm flat bit is already selected and is the one we want because all details in the maze are at least 7mm thick. If you had smaller details you need to use a smaller bit.
2. Click “Close” then “Create tool path”. The actual G-code will now be generated. The G-code is the list of instructions for the CNC router.
3. Once generated click on the “Preview Results” tab.



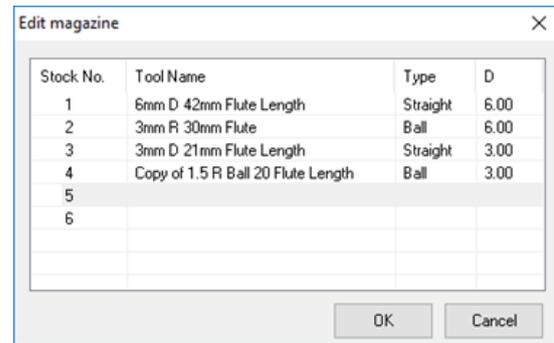
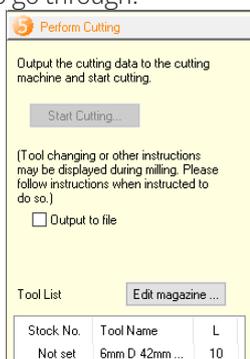
Preview

1. ALWAYS click “Preview Cutting.” This generates a 3D model of what your part will look like. I can see that the maze paths are showing up and the tabs are connected to the outside correctly. A good thing to look for in the preview is if all the detail in your model is showing up. Our model has some 3mm holes in the corners but we are cutting everything with a 6mm bit so the holes won’t actually be cut out. You can see that they do not show up in the preview. In this case it will be faster to just leave it and drill the holes in manually afterwards with a cordless drill. In the preview menu you can also see that the cutting will take 0.8 hours (that’s 48 minutes).

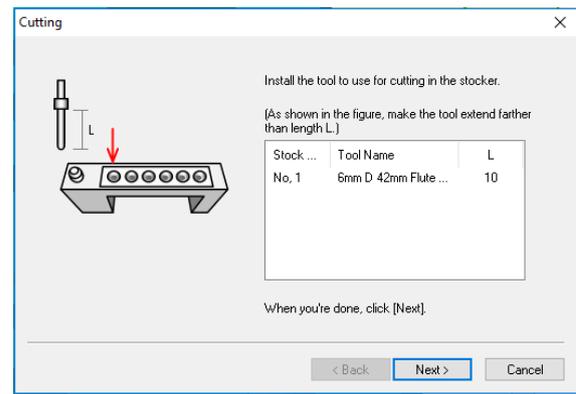


Perform cutting

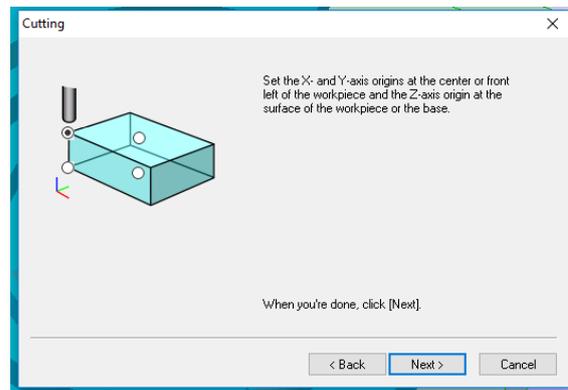
1. Before cutting you need to tell the router what tool is stored in what position in the tool magazine. Click “Edit magazine.” Select the tool for each position and click “OK.” Click “Start Cutting.” The router will not actually start cutting yet. Still a few screens to go through.



2. The tools the router will use are displayed. You can see that only the 6mm flat is going to be used. If multiple tools are used it will automatically switch between them when required. Click “Next.”



3. Since we positioned the origin in the front left corner of the workpiece, select that corner. If you leave the center selected your model could be cut in an undesirable location. Click “Next.”



4. Click “Next” one last time to actually begin the cutting. The computer will send the G-code to the router and it will start. The computer will display “Cutting is finished” because it’s job is done.



Step 5: Finishing up

1. Use the .svg file to laser cut a lid for the maze from 2mm acrylic. If you haven't done the training a CT will happily cut the piece for you or we may even have a supply of ready cut pieces.
2. Place the acrylic lid onto the maze and mark with a pencil where the 4 holes should go.
3. Use a center punch and hammer to mark the center for where each of the 4 holes will go. The little dents from the center punch make it easy to align the drill bit without it drifting when starting the hole.
4. Use a drill and 3mm bit to drill each of the 4 holes.
5. Place a 6mm ball bearing into the maze. Use multiple if you want!
6. Bolt the acrylic lid to the maze with 4 3mm bolts.

