Instructions for machining components using the AXYZ CNC milling machine

Room cnc router - g17b at Grand Parade FABLAB BRIGHTON 2018

1. Setup material and clamp

Make sure machine is off!

Clamp material, ensuring that sacrificial material is underneath your material, and make sure your material is square and lined up with the sacrificial front edge.





2. Setup machine

Twist Emergency Stop to check it's out and not activated.

Press the green button to turn on the machine. Seek X/Y origin - YES - press enter to start.



Start spindle (may take time to warm up).

Timer counts down 10 mins whilst warming up spindle.

If you want to the stop the 10 min warmup, press the RED button on the keypad which has the spinning disc on it (NOT the emergency stop!).



Use ruler to measure the distance the clamp protrudes e.g. 20mm within the edges. Subtract this from the job size measurements (the clamps at the back don't matter).

Press 'F' and 3 and enter to set XY, then move the gantry manually using the 2 (towards back), 4 (left), 6 (right), 8 (towards front), 1,3,7,9 (diagonally).

Note that +- will speed up or slow down the movement of the gantry.

After you position XY to where you want 0 to be correctly, then Press 'F' + 3 and enter again to set the XY as zero. Check that the zero for X and Y is where it should be.

Note that 'F' and 13 will take the gantry back to XY 0.

CHANGING TOOL/Ensuring it is in correctly section?????

Press 'F' and 84 and enter.

Set Surface: move the gantry down (use an appropriate speed! Using +-). Spin the spindle by hand as you move the gantry down using increments (very small!) until the cutting tool just starts to press into the surface. A phone torch light from behind the tool can be useful here. Then press enter.

Lift bottom: move the gantry up and over away from the edge, then down to your lower z limit to about half way through the sacrificial material. This will restrict the machine to that depth. Note that when you're there, z should be lower than our maximum cut depth -18.5mm we set earlier. Then press Enter to accept that value. Note that when prompted for the lift bottom, you can press 'F' and then enter the z-bottom limit manually (this might be needed if you can't actually move the gantry down because the workpiece is in the way).



Lift top: set the top limit well above the work surface (about 20mm) which is clearly above the 6mm safe z. Press Enter when done.

Press 'F' 13 and the machine will move to 0,0 some distance above the workpiece.

Then bring the guard down by turning the switch dial to the left to bring it down. The machine will hiss at you like it is tsking at your bad jokes.

3. VCarve Pro software (to generate tool path).

Start - Programs - V-Carve Pro.

File - Open (find .dxf file).

Job setup:

Measurements should be the size of your board or cutting area not the full machine dimensions

Width: X 1000 (if there is nothing blocking X)

Height: Y 980 (needs to be clear of the clamps at the front which are in the way)

Material (Z): 18mm (from our own measurements). Make sure that you zero the TOP option (the top radio button).

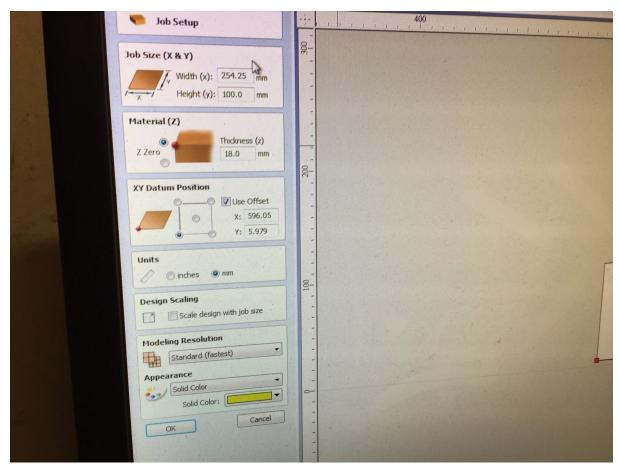
XY Datum Position: UNCHECK Use Offset (it will go to 0,0), and make sure you select the BOTTOM LEFT option.

Units: mm

Design Scaling: keep the option unchecked.

Modelling resolution: Set to STANDARD, and Appearance: SOLID COLOUR.

Click OK.



2D view control

Switch to toolpaths tab (it's the last icon on the right).

Toolpath Operations

First option/icon is Profile Toolpath.

Cutting depth

Start depth: 0mm

Cut depth: add 0.5mm to the depth of your material e.g. 18.5mm for material thickness of 18mm. This allows the cut to go beyond the material so it will go into the sacrificial material below

Make sure the 'Show advanced toolpath options' option is selected.

Tool

Select - Metric - End Mills - 6mm

Keep the default settings but could play around with cutting parameters and slower speeds. Click OK

Machine Vectors

Direction: Outside/right, Conventional

ALLOWANCE OFFSET: 0

Vector startpoint: leave unchecked

Layers

Need to consider outside vs inside cuts - for profile cuts and pocketing - TBC

Last pass

Don't tick separate last pass - would improve quality but requires changing tool.

Tabs

Constant number, start with about 6.

Tick add tabs to tool path

Length 6mm (length should vary dependant on part size)

Thickness 2mm (thickness should vary dependant on board thickness)

Select the drawing on your drawing view, then go to Edit Tabs, press Add Tabs and then move the tabs on the drawing to where you want them

SafeZ - is the same as Zjog in fabmodules - 6mm.

Type name of file

Click Calculate

Warning pop up - incase you don't have sacrificial layer warns it would cut into machine. Click OK

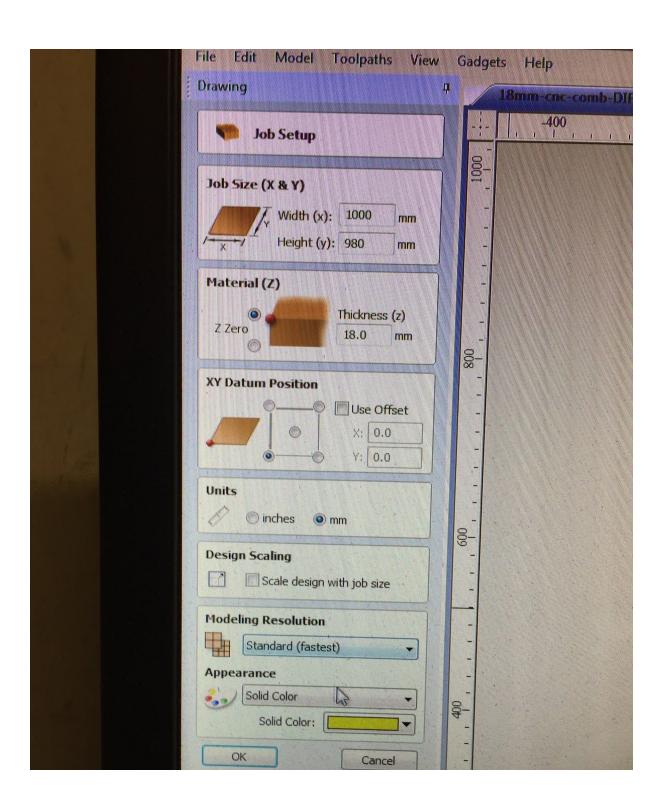
Then press Preview All Toolpaths and it gives you a rendered view and animation of the piece and you can see the toolpath.

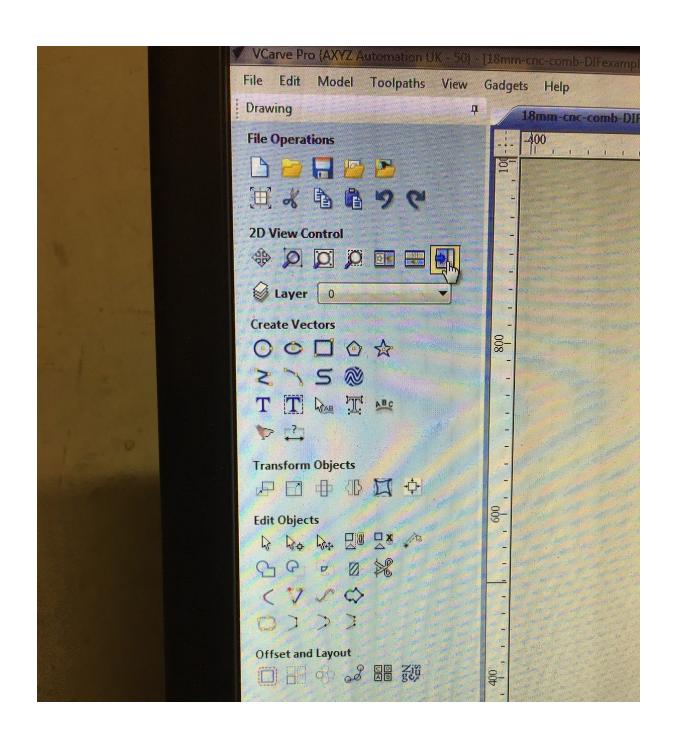
Press close.

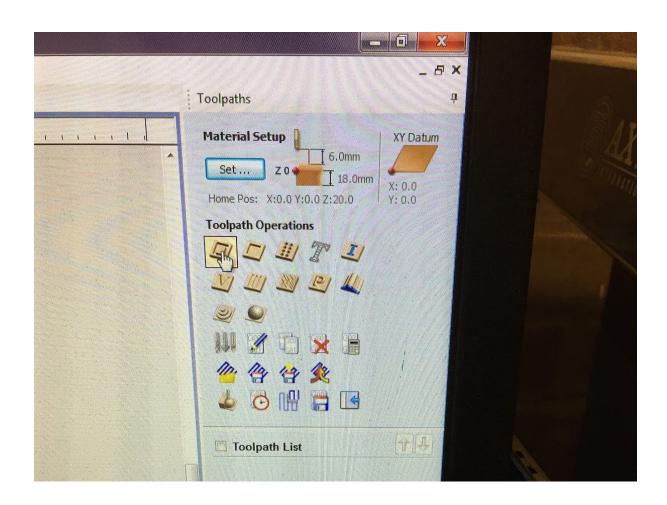
Select the profile (we called ours Profile 1).

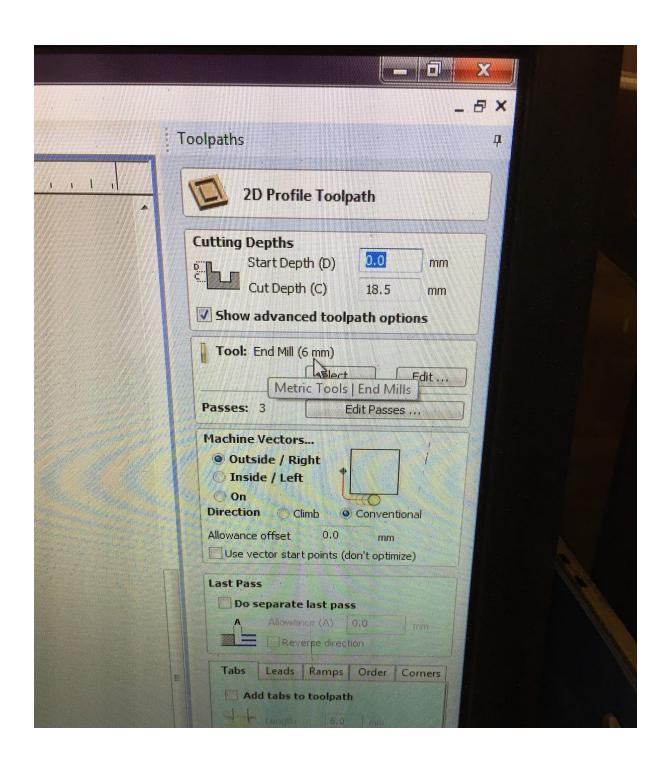
Click on Save Toolpath which is the 2nd from the bottom right.

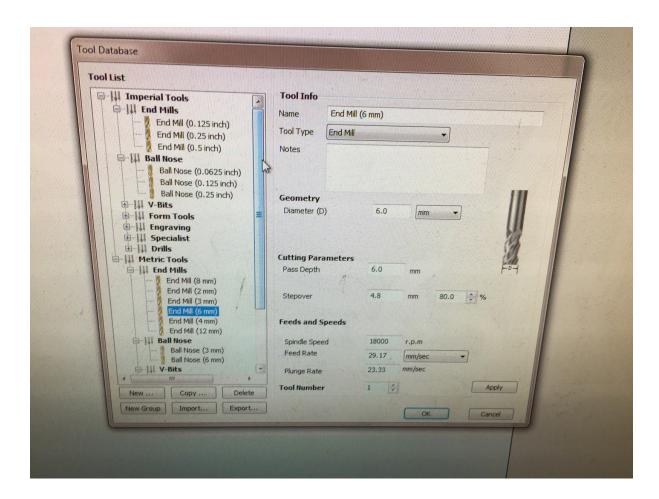
Keep the options unchecked (relating to output), then for the post processor chose the AXYZ Arcs (mm) (*.nc) and select Save Toolpath/s.

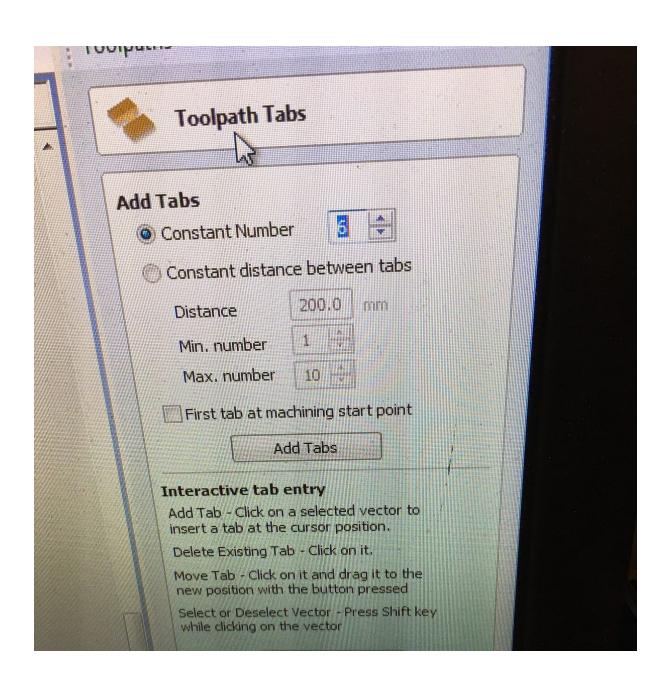


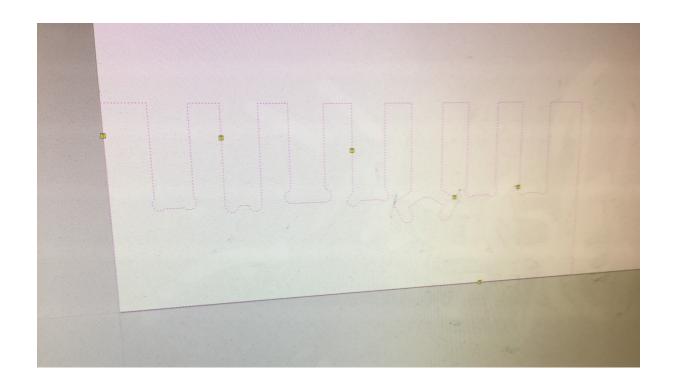


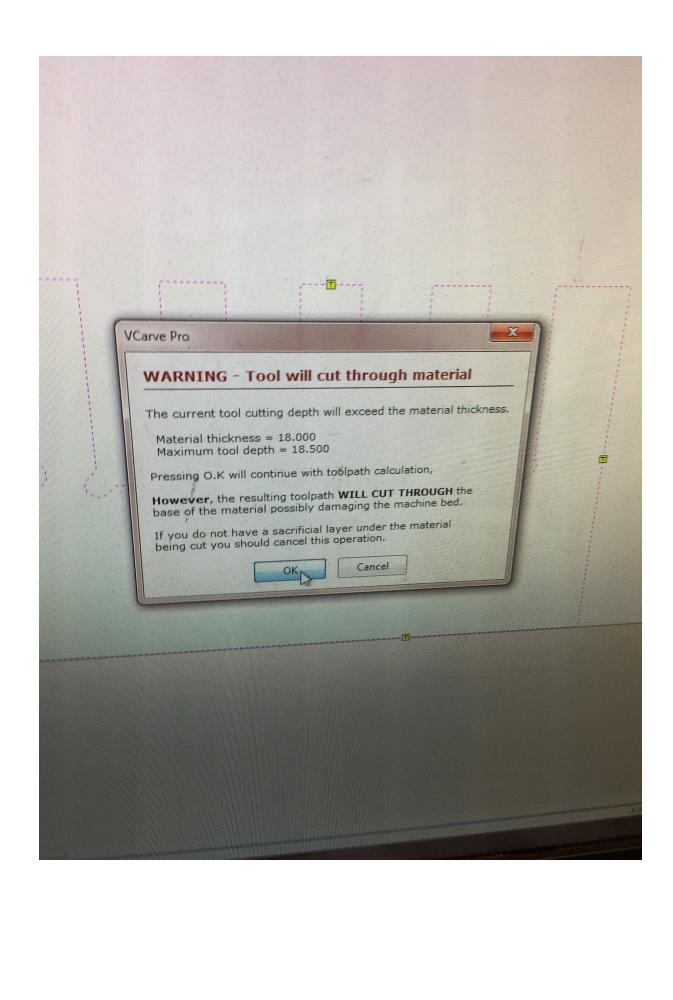


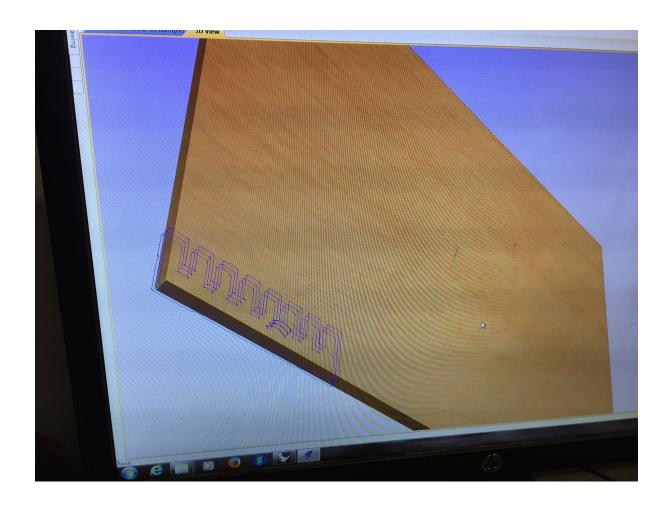


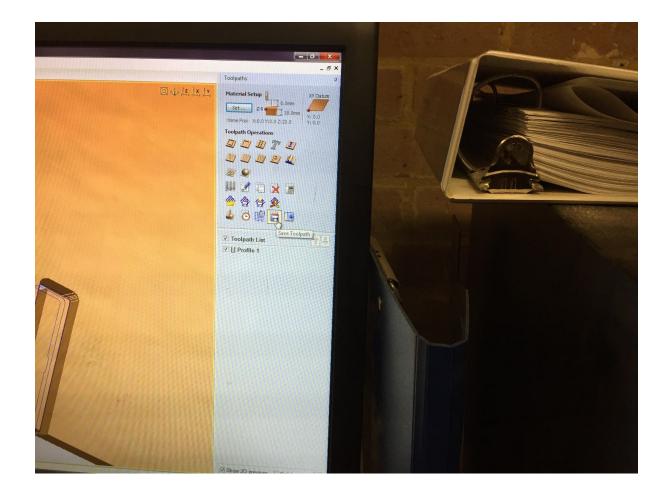












4. AXYZ DNC software - sending toolpath to machine

Click on AMC File Mode and Select File (find your .nc file saved from step 3). Click Send File.

5. Cut

Go to the CNC machine and press the yellow folder button (top left) which will cycle through the files to be machined, and find your .nc file (but don't do anything yet).

Turn on the muck sucker extraction.

Then goto the CNC again and hit the Green IO button on the keypad (NOT the main green ON button). It will move to the 'Lift Top Height' if you are then happy with the setup press the

Green button again to start the job. It will start! Then make sure you close the gates, put on your PPE and stand behind the gates.

If need to pause the job at any point press Red keypad button (not Emergency Stop) Press Green keypad button to start again. To cancel a job once paused press F9.

If there is an emergency hit big red Emergency Stop button.

6. Aftermath

Once the cutting has finished, turn the machine off, gnaw at the part like a beaver with your two front teeth until you're able to take a full bite at the part like an apple, or you can cut it out with a chisel and hammer if that's easier.



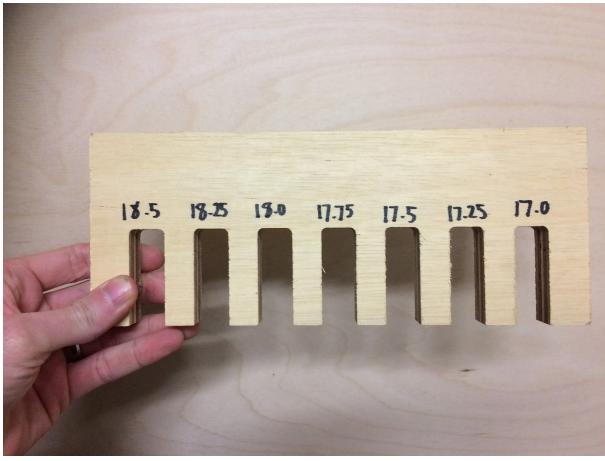
From our comb, here's a table of fits we achieved with the 18mm ply:

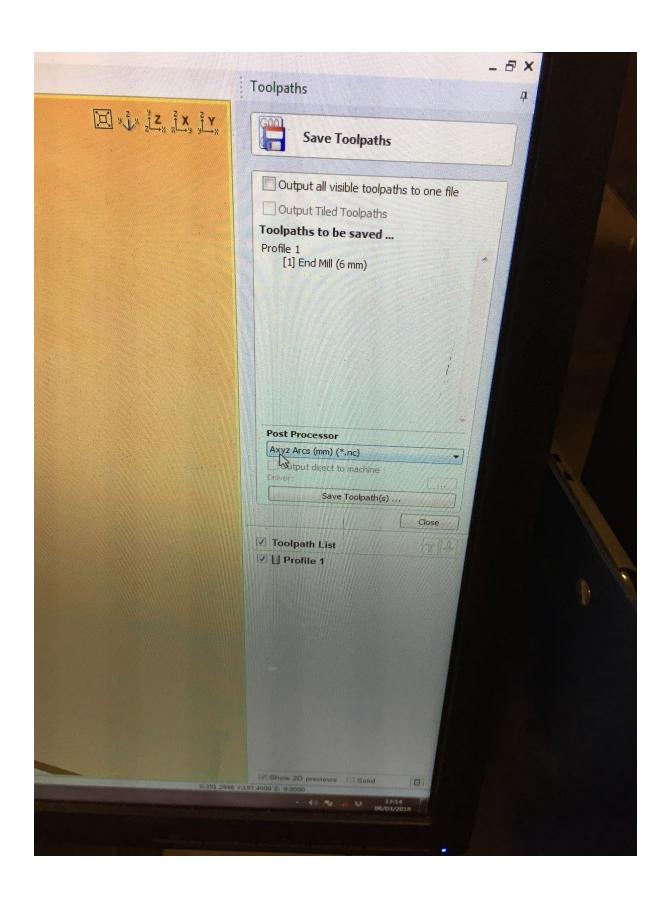
Comb slot width	Comb slot width, n=6	Fit type	Notes
(as drawn mm)	(as measured mm)		

17.00	17.12±0.05	Forced fit	High interference shrink fit requiring considerable force to assemble with a mallet
17.25	17.38±0.04	Driving fit	Medium interference requiring light tapping to assemble with a mallet
17.50	17.69±0.07	Press fit	Light interference assembling can be done by pressing by hand
17.75	17.92±0.07	Location fit	Very close clearances for precise accuracy requirements, which can be assembled without force
18.00	18.11±0.04	Sliding	Minimal clearances for high accuracy requirements, which can be easily assembled and slide together freely
18.25	18.36±0.05	Easy running	Moderate clearances with a bit of play. Use when you have minimal requirements for accuracy
18.50	18.64±0.09	Loose running	Larger clearance which rattles, for use where accuracy is not essential

And here's an image showing how the fit for one of the comb slots was tested with another piece of 18mm ply.



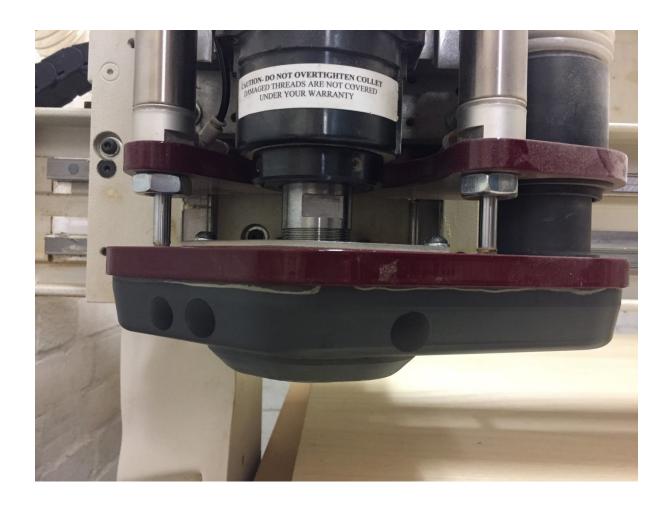




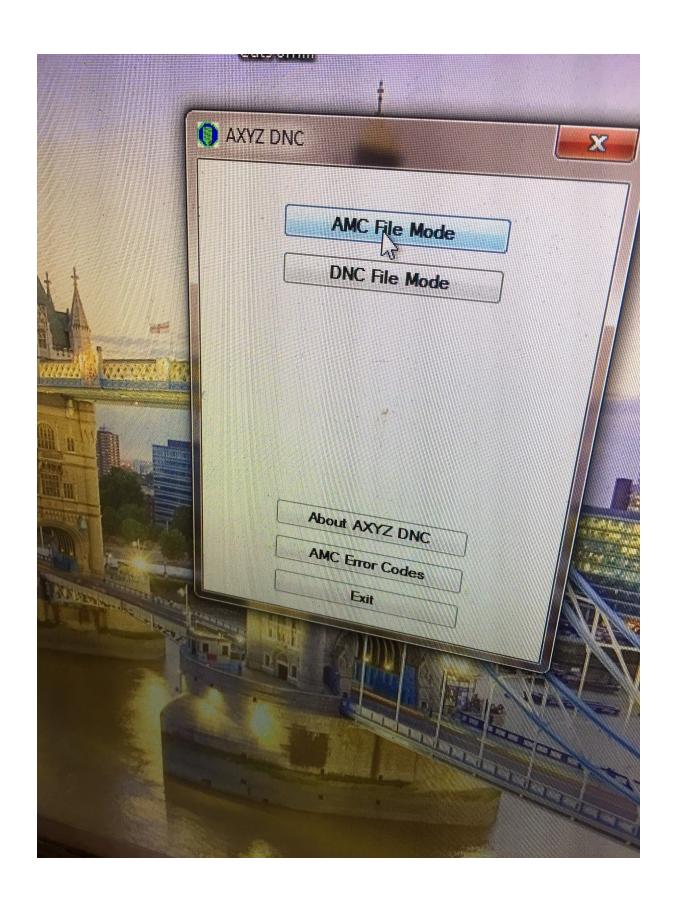


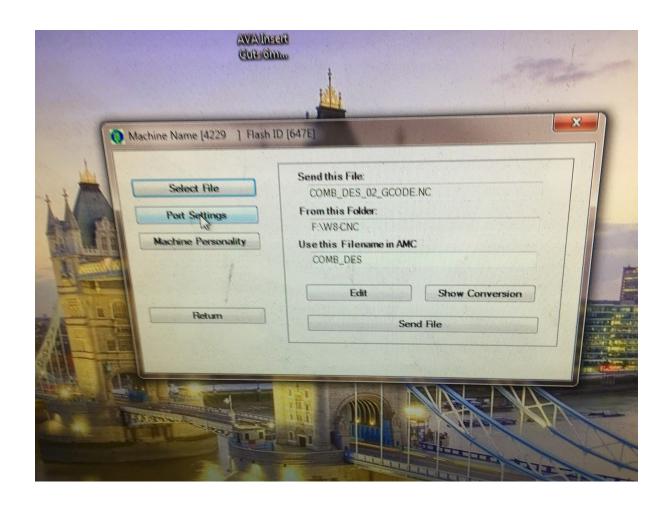












On machine:

Centre X/Y: Function 3

Rate: +/- button

2,4,6,8 to move (1,3,7,9 move diagonally)

Function 3 set

Set Z: Function 84 0 and 5 up and down Function 84 set

Open toolpath software??

Drawing:
Import DXF file
Export as R12 Lines and Arcs
Make sure your drawing avoids the clamps.

Switch to toolpath tab:

Start cut: 0

Cut depth: 18.5mm (material thickness + half mm)

Metric: 6mm end mill

References and useful links

- 1. CNC design guide https://www.engineeringclicks.com/design-guide-cnc-milling/
- 2. Online design feedback for CNC parts https://www.plethora.com/how-it-works



AXYZ Millennium Router Table Hand Console Operation





Press to cycle through the list of jobs making the displayed job active.



START KEY

Press to start the active job. See below. RUNNING A JOB.



Press to stop machine movement and pause the running job. Press START to resume job.



FUNCTION KEY

Access all of the machines functions. To access Function 13, press F,"1", "3" ENTER.



ENTER KEY

Pressing completes functions, or numeric value input, in job mode, holding ENTER displays job size. During the start sequence, press ENTER to select the starting shape.



TOGGLE KEY

In jog mode, toggles between FAST, MEDIUM and SLOW. Use it also to enter negative numbers and decimal





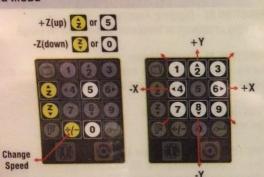








JOG MODE



The console is in JOG mode whenever it is not running a job or executing a function. All the numeric keys are also jog keys as shown. The key toggle between FAST, MEDIUM, SLOW and INCREMENT jog.

SETTING TOOL TIPS AND JOB PARAMETERS

Setting Tool Tips

To set the tool tip for the tool at position 8

(i.e. tool 8 in the tool changer):

- Press F 25 18 ENTER
-When prompted, jog the head down so that the tool tip touches a common point such as the table surface

-Press ENTER to store the settings

Repeat the process for every tool bit that will be used.

Set Surface & Lift Bottom/Top (Function84)

Quick setup for 1" material, 1/16" waste cut, 1/4" lift top (Replace numbers in red with you actual measurements).

-Press F 84 ENTER. Lower the tool to the material surface. -Press ENTER - F +/- 1 +/- 063 (-1.063)

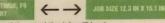
-Press ENTER F 0 +/- 25 (0.25" lift top above material)

-Press ENTER to finish.

RUNNING A JOB

Starting a job

- Select the job File: Press FILE until the required job file appears on the hand conole display.
- -The job is ready to go! Position the spindle at the lower left corner of the material using the jog keys.
- Press START. The head will lower to the "lift top" position, the spindle will start, and the display will flash:



- Press START a second time and the job will begin - Press F 9 ENTER to abort the start sequence

-Similar to starting a 2D job (above), except after pressing START the first time, the display will show:

-Use the UP and DOWN keys to touch the surface of the material with the tip of the bit. If the material surface was set by Function 8 or Function 84, then simply press START to begin the job. Material surface has already been set.

Pausing and Aborting

Press STOP to pause a running job. All machine movement will stop.

Restart the job by pressing START. To abort the job, press F 9 ENTER. The head will return to the start (origin) position.

- When the job is paused, all jog keys can be used to move teh head of the machine. Also, all functions marked with STOP key on the reverse can be used while the job is paused.

Restarting a job after replacing a bit

- -Pause and abort the job as described above. Note the shape number after
- -Replace the bit, the jog keys can be used to positio the head accordingly.
- -Reset the tool tip using Function 25
- -Function 13 will return to the last job's origin.
- -Press START to begin the start sequence. The head will lower.
- -Press ENTER to input shape number when prompted. This will start the job at the shape where it was previously paused.
- For instance, press 1 2 ENTER to go to shape 12. Press +/- to step through the job one shape at a time.
- -Press START and the job will begin at the selected shape.

AXYZ Millennium Quick Function Reference

FUNCTION 1 - Set feed rate

Set speed in in/min or mm/sec. Positive numbers 0.1 to max. speed.

FUNCTION 2 - Spindle control

Select:

Spindle AUTO Spindle OFF

Spindle ON When set to AUTO spindle will come on automatically when running a job. FUNC 6, or FUNC 17. It will always default to AUTO after these operations.

FUNCTION 3 - Seek Z AXIS control

Move Z axis up to seek the sensor, X and Y positions are set to 0.0.

FUNCTION 5 - Auxiliary Control

This function controls the vacuum hold-down & chip extraction system automatically.

Control settings are: AUTO, OFF, ON

FUNCTION 6 - Measured Move

- Step 1: Enter X axis move distance ENTER
- Step 2: Enter Y axis move distance ENTER
- Step 3: Select HEAD UP or HEAD DOWN*
- Step 4: ENTER machine will move specified distance and direction.
- * Ensure spindle is turned ON!

FUNCTION 7 - Adjust Depth

Adjust Lift Bottom by the specified measurement. Use inches or mm.



Negative

FUNCTION 9 - Delete/Abort Job

See Reverse.

FUNCTION 12 - Seek X and Y Sensors

Head will seek first the X axis sensor then the Y axis sensor. Origin will be set at the sensors. Soft stops will be enable.

FUNCTION 13 - Seek Origin

Head will return to origin. The origin will either be the start position of the last job run or origin set by FUNC 12 above.

FUNCTION 15 - Plungle Speed

Sets speed of vertical plunge into the material. Positive number 0.1 to max. Plunge speed. Use in/min or mm/sec.

FUNCTION 17- Cut Rectangle

Enter X and Y dimensions of a rectangle. As soon as the Y dimensions is entered the rectangle will be cut. Bit compensation must be set using FUNC 2.

FUNCTION 21 - Repeat Job

Set the number of job repetitions.

Step 1: Select job and press START

Step 2: Select FUNC 21

Step 3: Enter the number of job repetitions

Step 4: Press START to begin jobs.

FUNCTION 22 - Digitizing Feature

Digitizing of patterns or templates. See manual on usage.

FUNCTION 24 - Disable Motors

Disable and resets all motors and motor drives. All servo drive systems have this feature. Most steppers systems do not.

FUNCTION 25 - Set Tool Tips

See reverse.

FUNCTION 35 - Store machine settings

Stores following settings: F4, F8, F1, F15. This gives the flexibility to save different settings for different material thicknesses and other material properties. 16 F35 settings available. Ex. F35.1, F35.2.....F35.16

FUNCTION 36 - Retrieve machine settings

This function retrieves stored settings. 16 F36 settings available. F36.1, F36.2....F36.16

FUNCTION 84 - Quick Setup

See Reverse.

FUNCTION 92 - Clear job memory

All jobs files will be erased from memory.

NOTE: indicates that the function can be adjusted any time during the job. Simply press the Stop buttom, and carry out the function.

"Functions shown in red represents Primary table functions"



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