Next Wave Automation

Project Tutorial

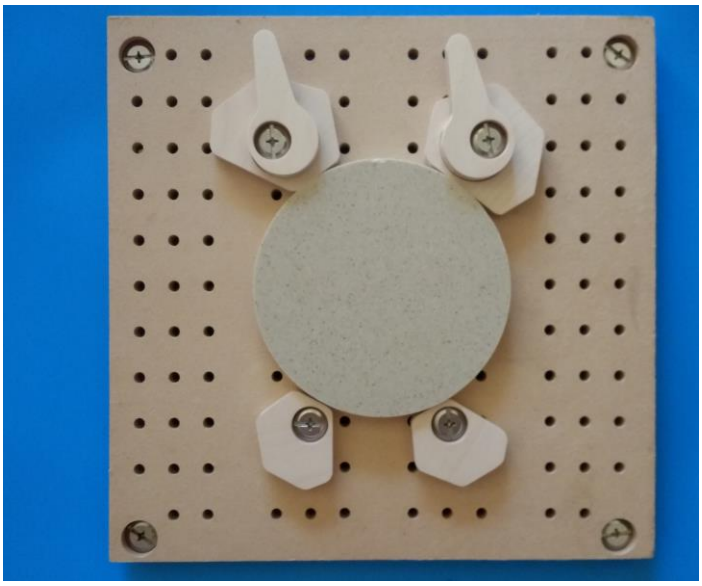
Compatible with the Current Version of VCarve PRO & DESKTOP

Project: Euro Style Universal Clamping Jig

By David White

The first issue right out of the box for a new CNC machine is creating a spoil board and clamping system for work pieces. This is generally when most operators have the least experience with their new machine and software.

This is a good early project because it's easy, it is in-expensive, and exceedingly useful with those with those of any experience level.



This type of jig offers:

- Fast repeated parts
- Can hold just about any shape
- Massive lateral clamping force
- Very hard for a tool to hit
- Can be used directly on T-Track
- Doesn't cover the surface of the part so you can "surface plane" in place

My inspiration for this was many projects using irregular stock and spending too much time thinking about how and where to clamp a project work piece. Since we are using MDF as a spoil board one doesn't want to impart any force other than compression in the soft material if doing precision machining.

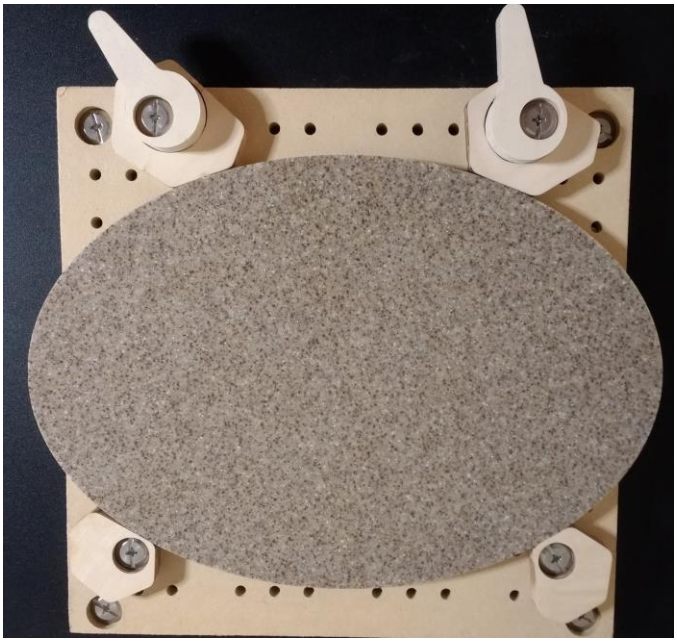
By using oval nuts and hurricane bolts, we can use the metal t-track that has great rigidity. By using the hurricane bolts, we also don't have any protrusions above the height of the cams as in using toggle bolts and knobs. Hurricane bolts are also designed not to come lose with vibration. If you don't want metal anywhere close you can use nylon bolts.

Using the cam levers on the on the deep part of the table reduces the likelihood of crashing the tool if you home to the front. The stationary cam plates only rise .365 inches above the spoil board. You can also use this system right on the bed itself if a spoil board is not needed.

Brass inserts, oval nuts, oval head bolts, and hurricane bolts. Digging out thread inserts out of old spoil boards is no fun.

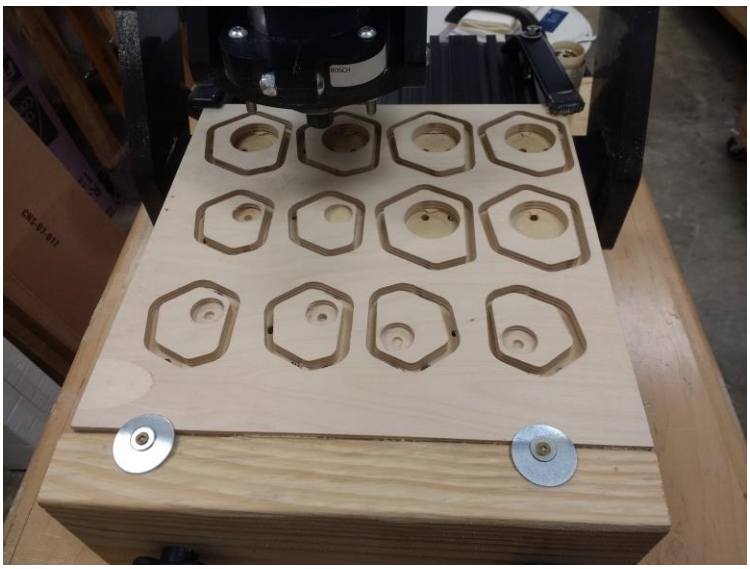
Some like to use threaded inserts in MDF. That can be very expensive and time consuming as they are hard to reuse. Also, since mounted in the weak MDF, it can induce error in critical tolerances when tightened.

Make several spoil boards in your down time and the only thing that becomes a waste item is the spoil board itself. One can also have a spoil board set up to a specific project to drop right back on the table. Hence the title, universal clamping jig.

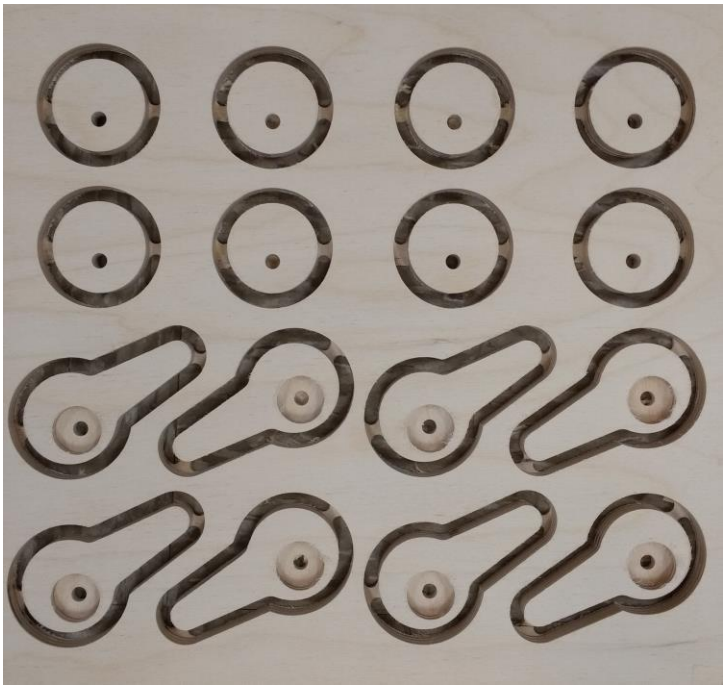


Design Goals:

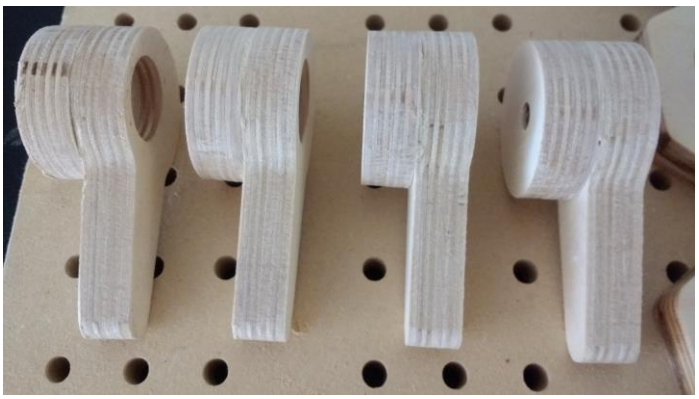
- Very low vertical profile so thinner stock and attachments like the laser can still be used
- Should scale to different size tables
- Reasonable cost
- Easily adaptable for production use
- Little tooling is needed, just a ¼” upcut bit and a 1” spoil board cutter
- Use off the shelve cut 12” x 12” x 3/8” plywood stock for levers and cam plates



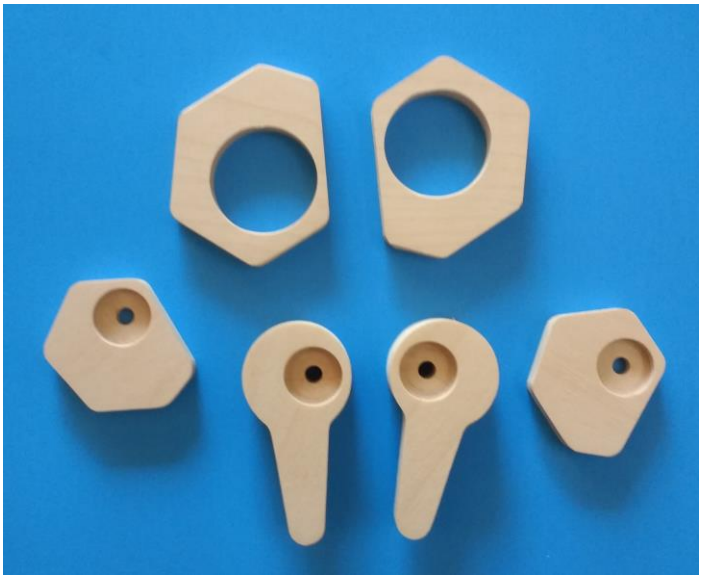
Cutting the original prototype plates using the maximum cutting area of the Piranha.



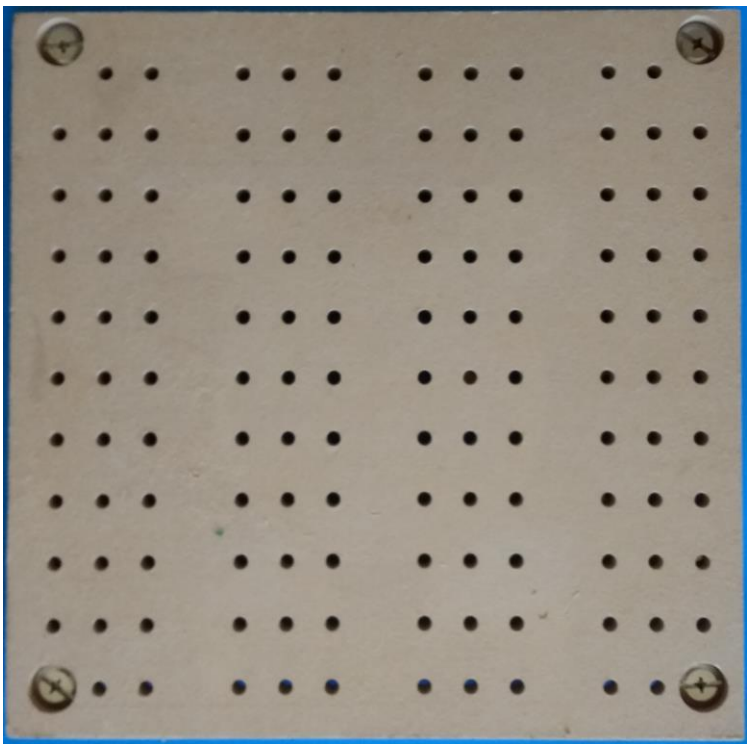
The original prototype levers and plates. Notice that they are not mirrored with right and left pivot points. In these production CAM files they are and will add more versatility.



Cam levers are two pieces glued together. I used the bolts and oval nuts to clamp while drying. The levers keep the cam plates firmly to the spoil board.



Completed parts.



Spoil board prototype. This final project has the thru holes on ¾” spacing to match the t-track spacing. This one had 1” on the Y. Tighter spacing is better.

Parts List:

- Hurricane bolts 1/4x20 (~20) assorted lengths in ¼” increments
- Oval nuts 1/4x20 (20)
- 3/8” Baltic birch 12” x12” plywood (2)
- 12” x 12” 3/8” MDF or working bed size.

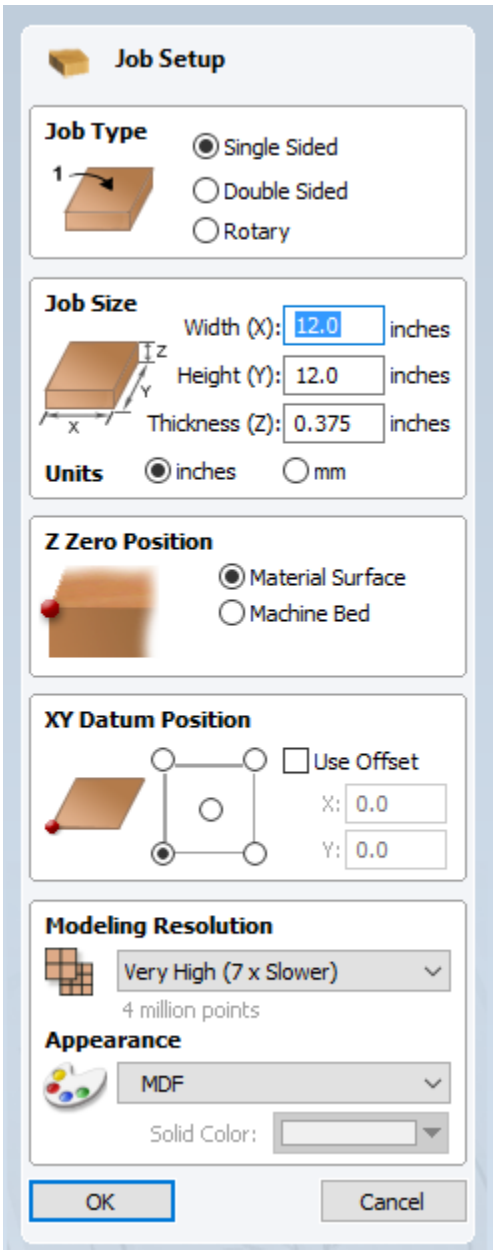
Step by Step In V-Carve 9.5

This tutorial highlights the process we took in creating the CAD and G-Code files for this project. Different sized tables can be easily adapted using the same techniques.

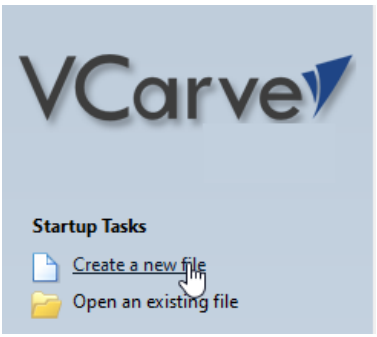
This project really includes three separate projects. The spoil board, cam levers, and cam plates and the fixed plates.

Remember to set your speeds, feeds, and cutting depth for your specific router, CNC machine, and material thickness.

Also, if you are reading this as a PDF, remember that holding the control key down as you move the mouse scroll wheel will let you zoom in for more detail.



Spoil Board Project



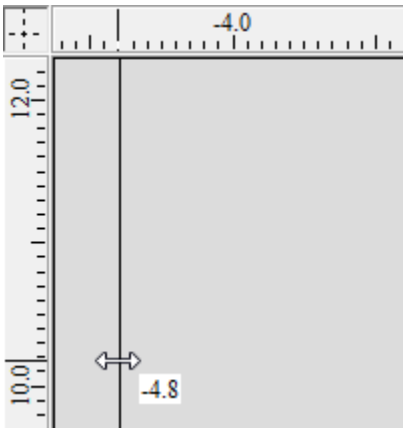
Of course, the first thing to do is create a new file.

Then set up the size. This one is for a Piranha and is 12” x 12”.

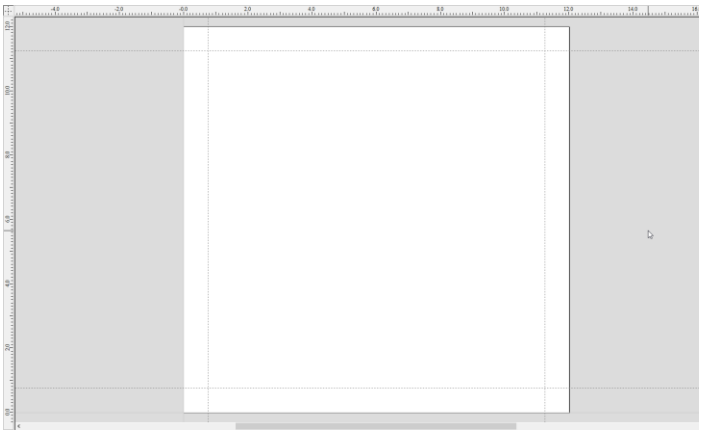
On the Piranha, the T-Track is spaced .75” for three tracks and then a 1.5” gap before the pattern continues.

Remember to change the project to match your T-Track spacing. This shows the new HD5 spacing which is 10mm.

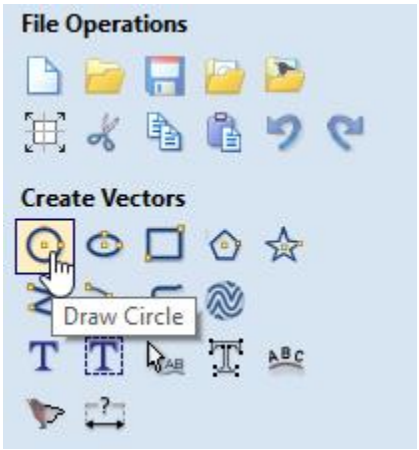
Pull guides to ¾” on both sides of the working piece and then top and bottom or matching the T-Track spacing.



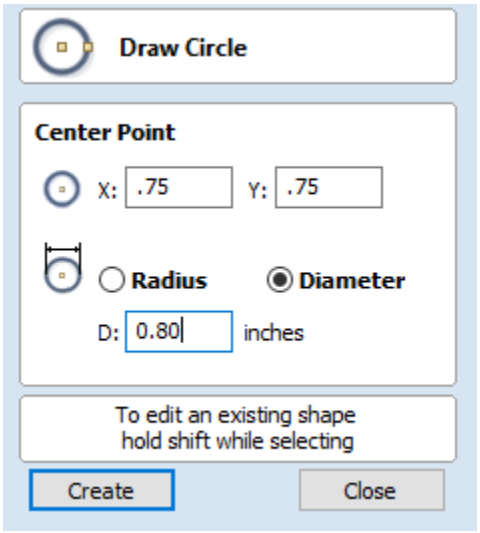
Until there are four guides.



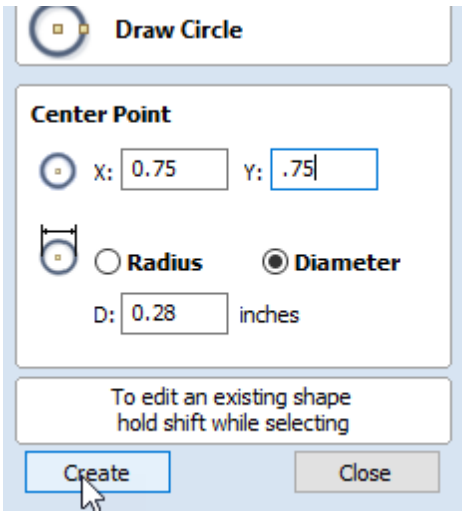
Select the Draw Circle vector tool.



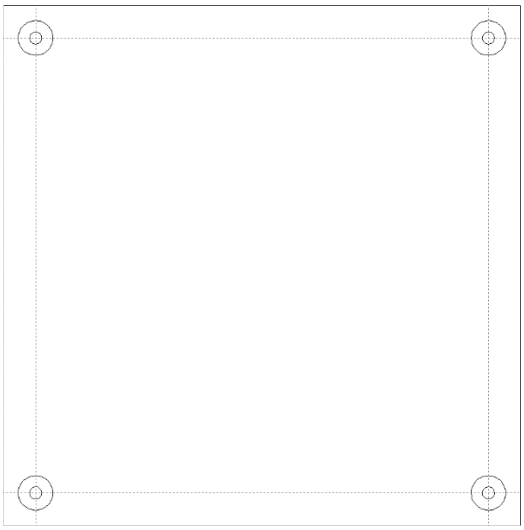
Create the four bolt head pocket circles ¾” in from each corner.



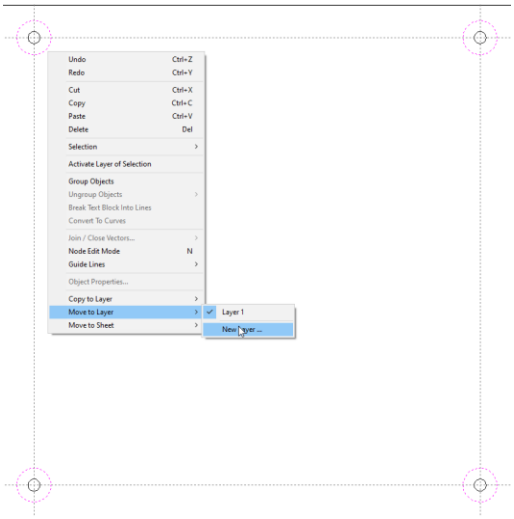
Then create the thru holes for the bolt shaft.



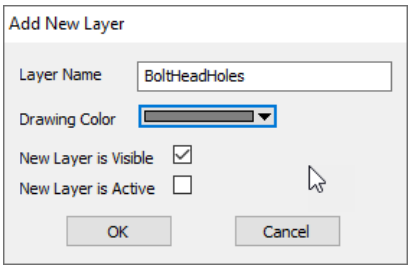
It should look like this.



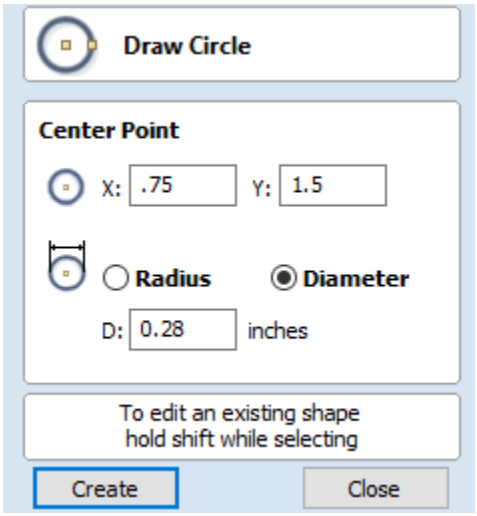
Select the bolt head circles and move them to a new layer.

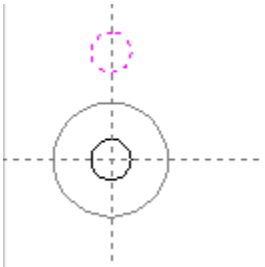


Call it BoltHeadHoles.

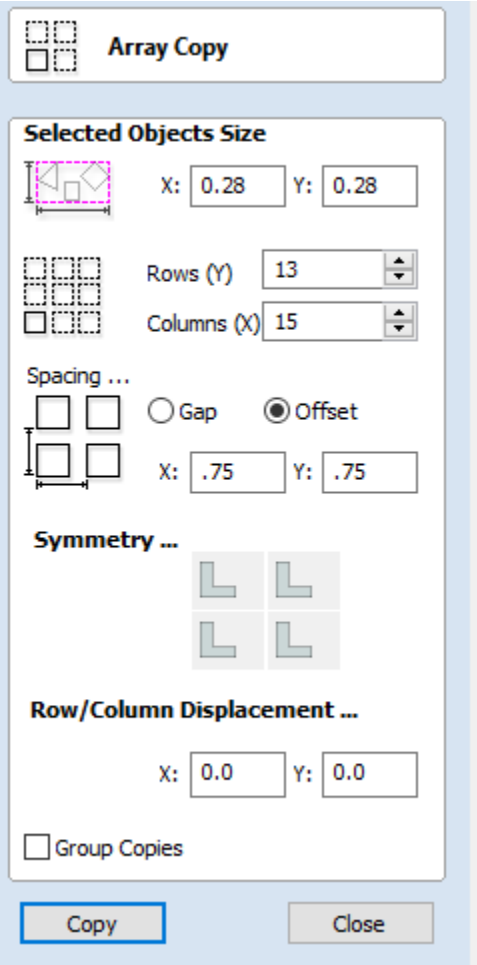


Create a new circle for the through holes in the spoil board. Place it ¾" from the edge and above the lower left bolt head pocket.

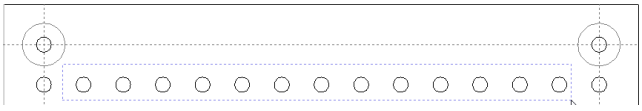




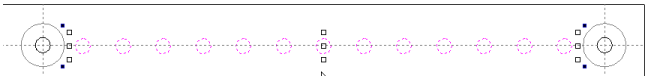
With it selected, click on the array copy tool.

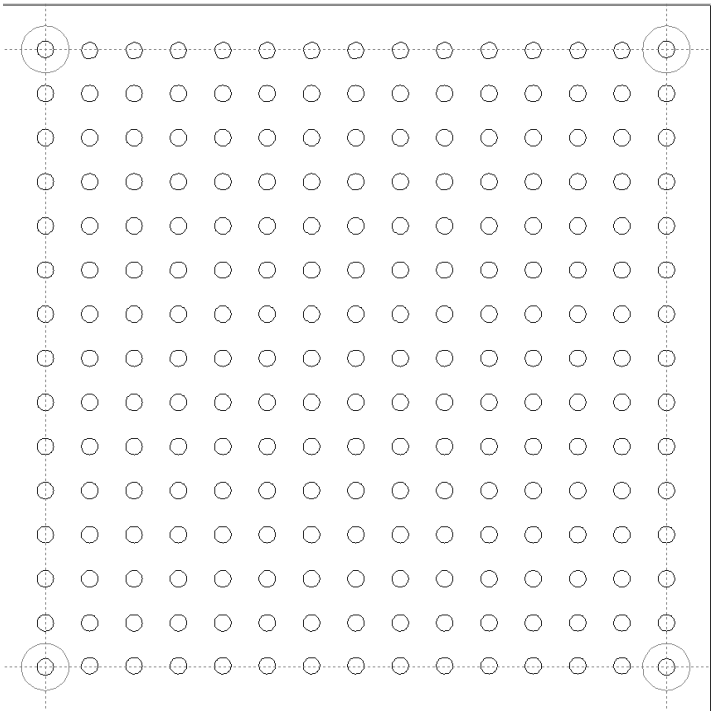


Copy and paste a part of a row between the corner bolt head holes.

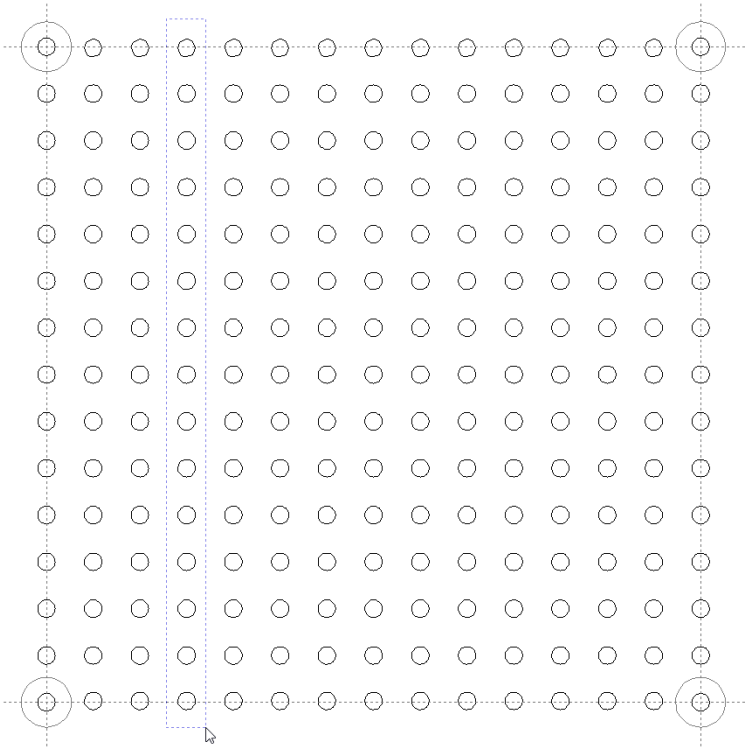


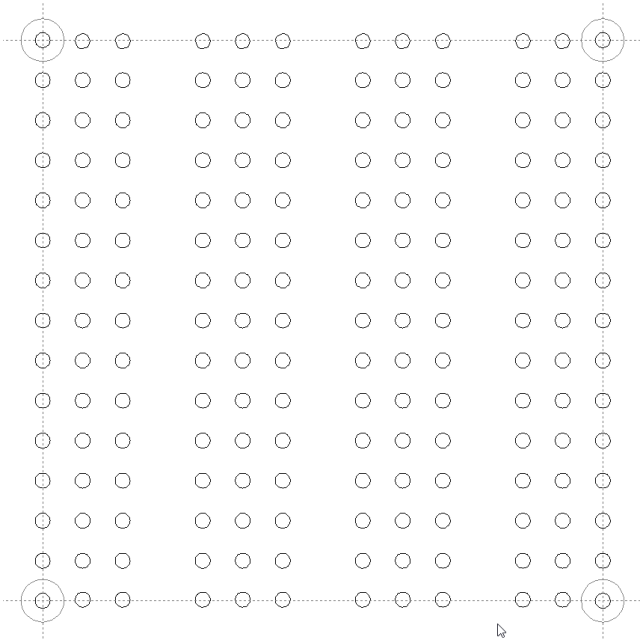
Copy and paste.

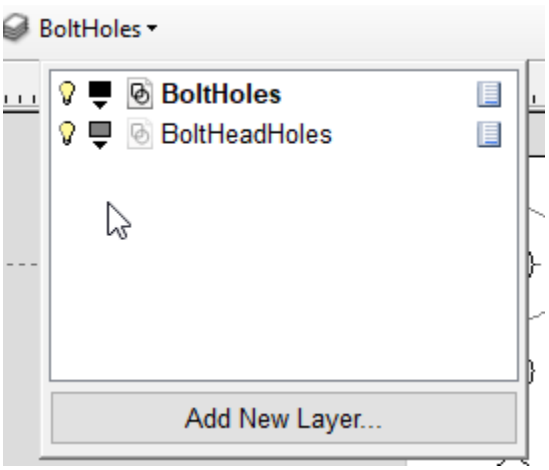




Select every third row and delete those holes with no T-Track slot beneath them.

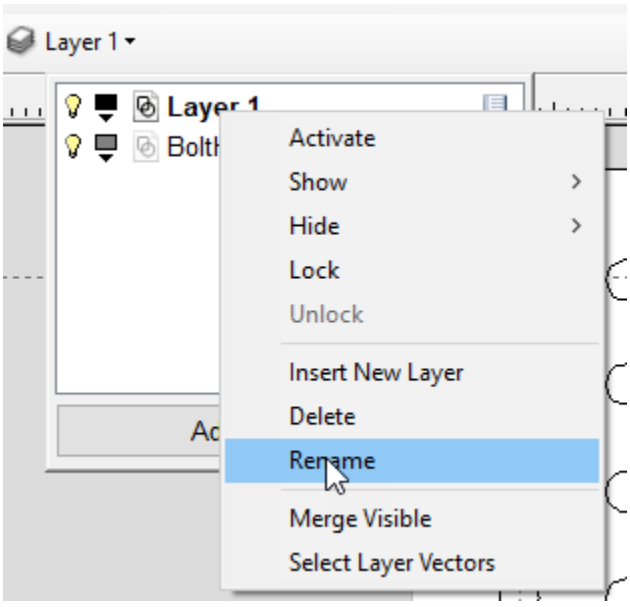


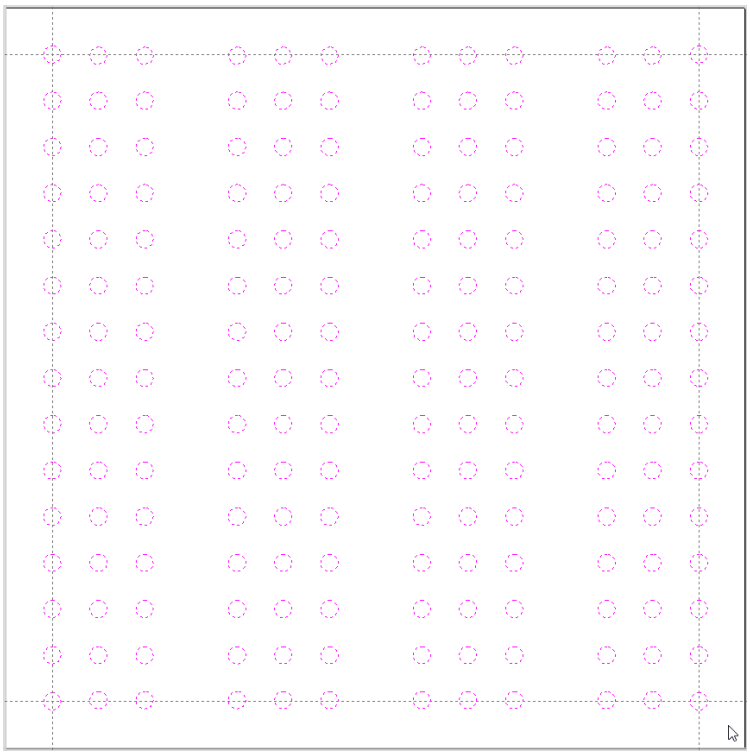




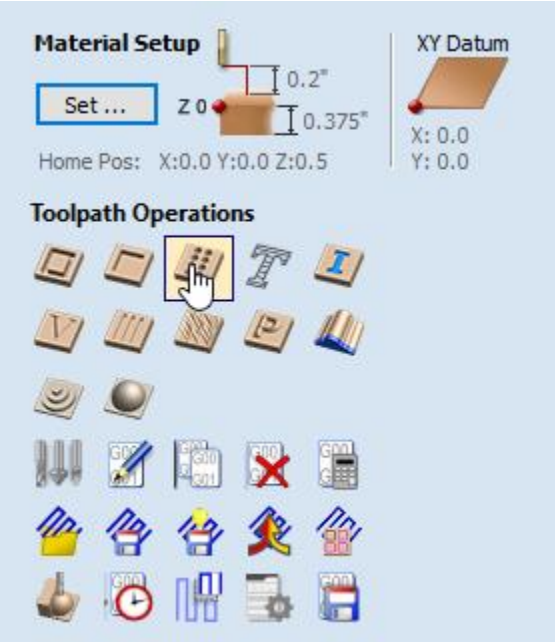
Click the light bulb next to the BoltHeadHoles to show just the thru holes that we will be drilling.

Select all the thru holes and move them to a layer of their own by renaming the default layer or by moving to a new layer.

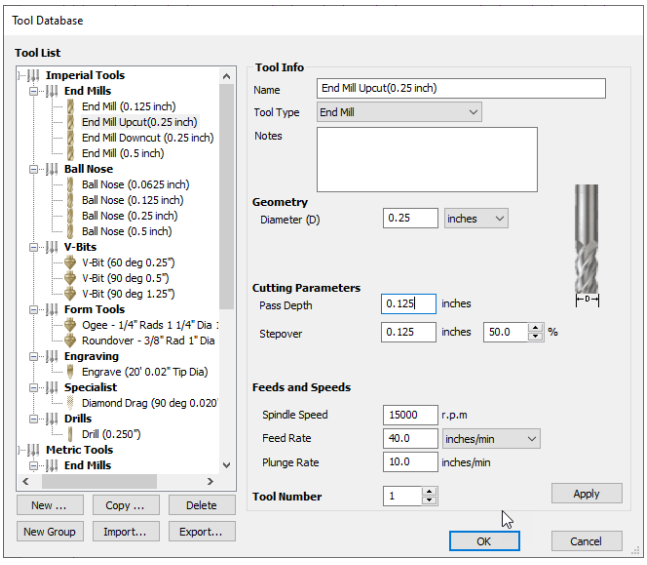


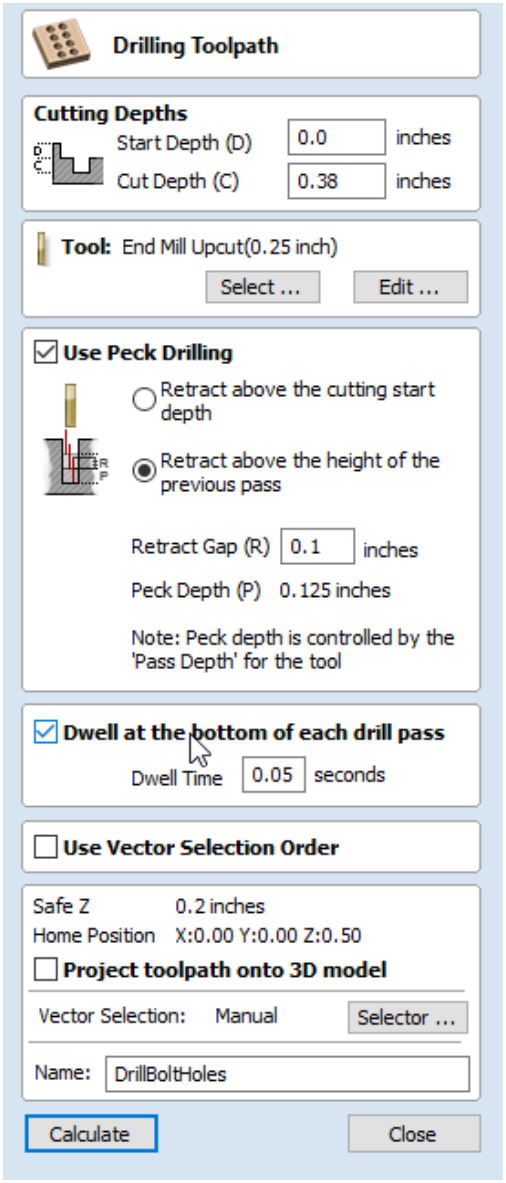


With all the thru holes selected, open the toolpaths tab and select the drill toolpath.



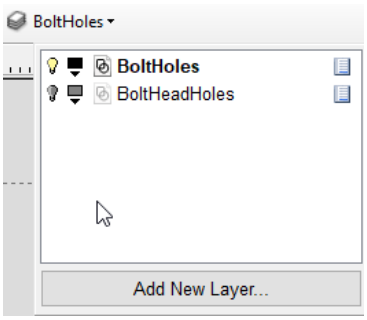
In that dialog select the Tool to use and set according.



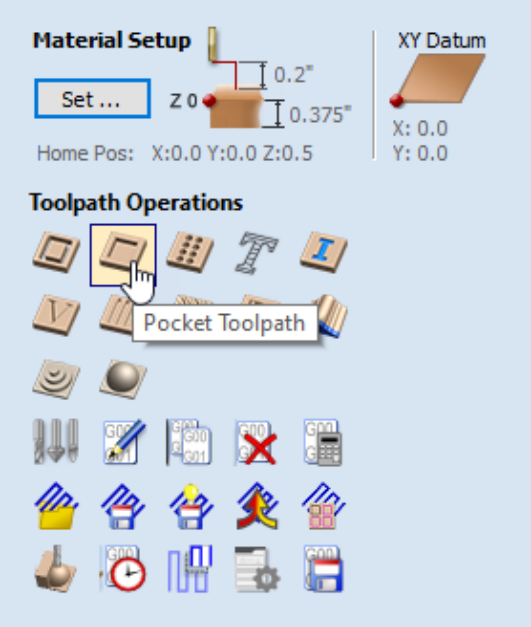


Click the Calculate button.

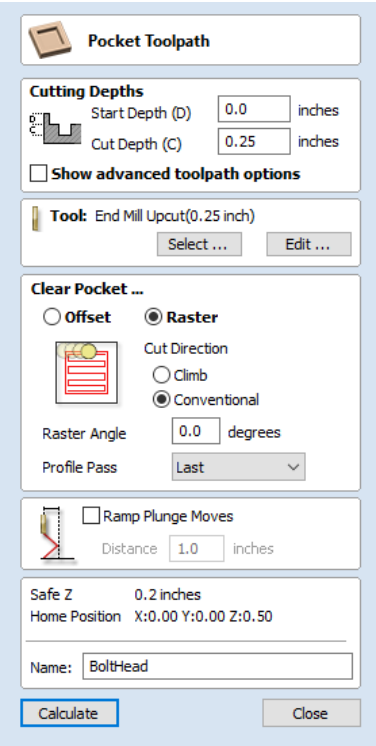
In the Layers section, click the light bulbs so just the “BoltHeadHoles” are now visible.



With all the bolt head pockets selected, open the toolpaths tab and select the pocket toolpath.



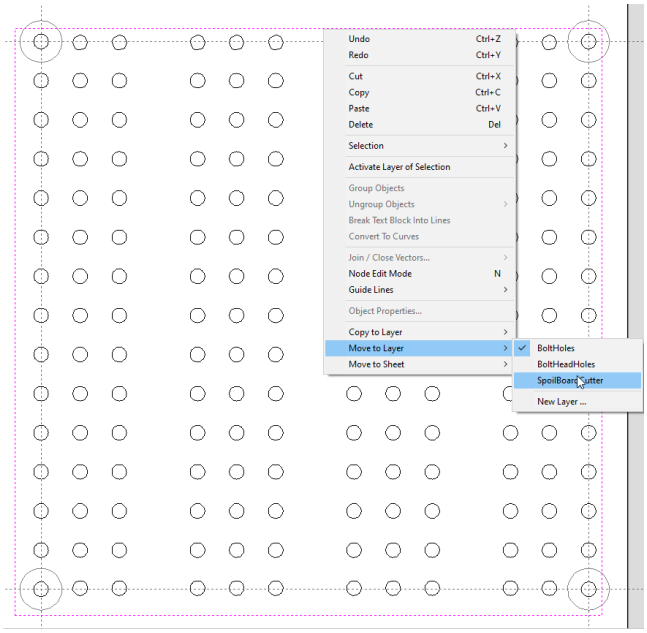
Set the tool to the same as the one in the drilling toolpath.

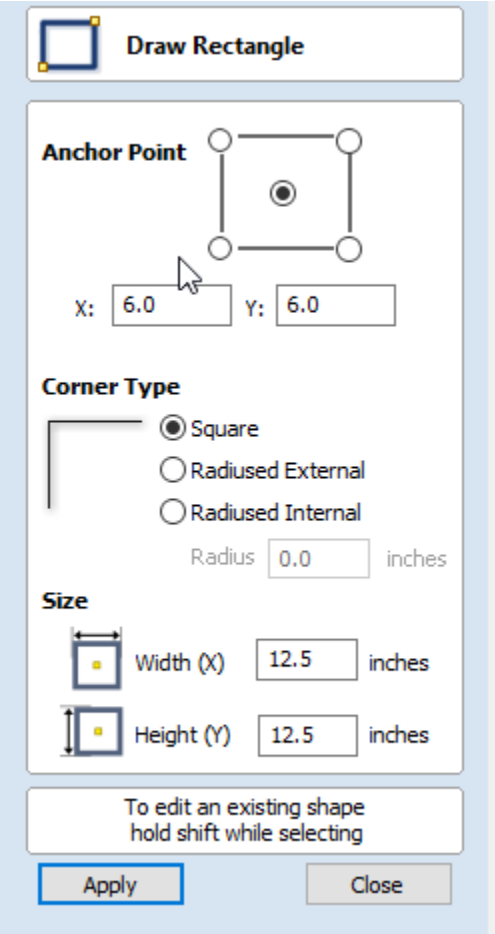


Click the Calculate button.

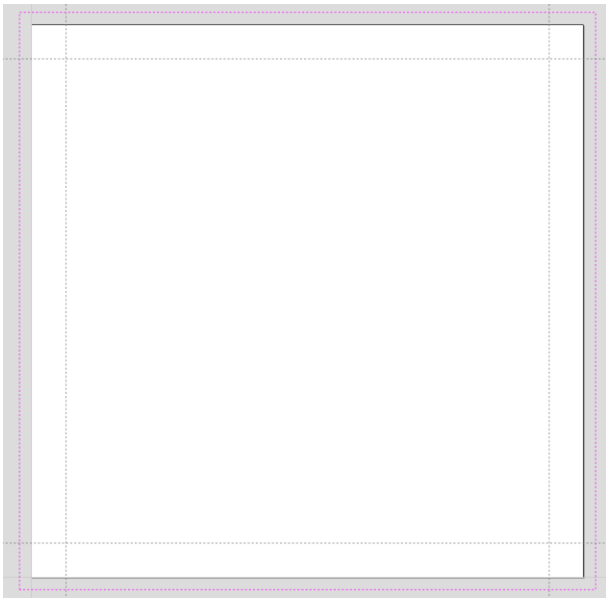
We need to now add a rectangle slightly larger than the spoil board. This is necessary to get the spoil board corners cut to the same level as the rest of the board. The software will not cut outside the bounds of the materials size without us making a larger target.

Make a rectangle slightly smaller than the project size. Move the rectangle to a new layer and turn off the visibility of all other objects. Select the rectangle and size it to fit half an inch over all the sides of the work piece.

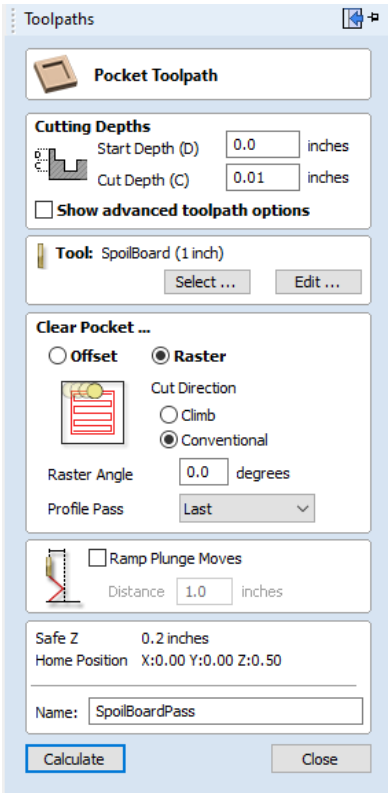




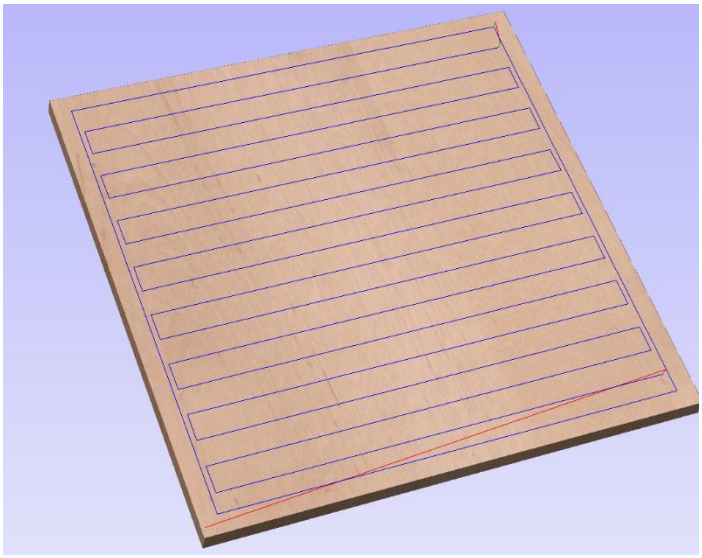
We are ready to make a new toolpath for the spoil board cut. This will depend on what cutter you purchase. I am using the [WhiteSide 6210] which is available around the mid $35 level or better.



With the rectangle around the project piece selected we are going to create a new pocket toolpath.

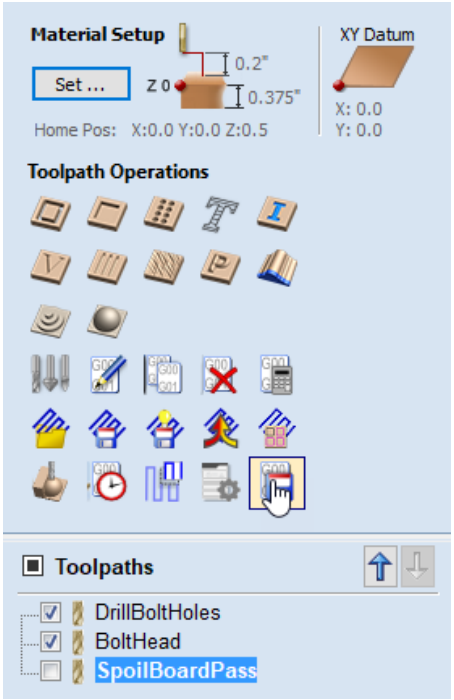


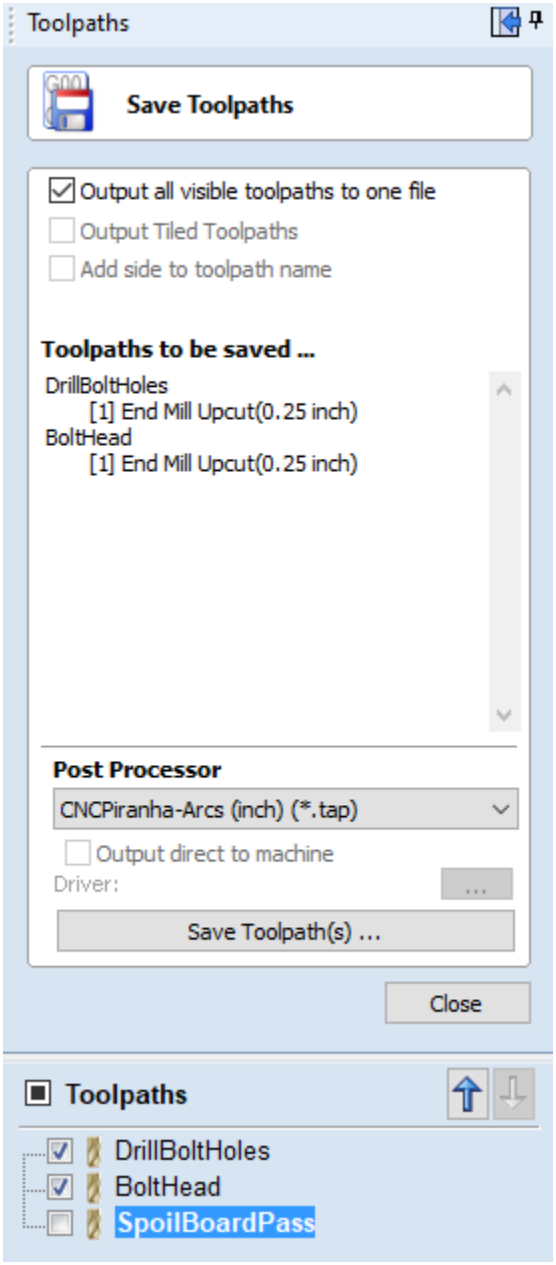
I call it the mowing the grass toolpath. Adjust the cut depth as necessary. Running this file multiple times is preferable to taking big swings to level the spoillboard.



Now its time to create the G-Code for the three different toolpaths. Since two of them use the same tool, they can be combined.

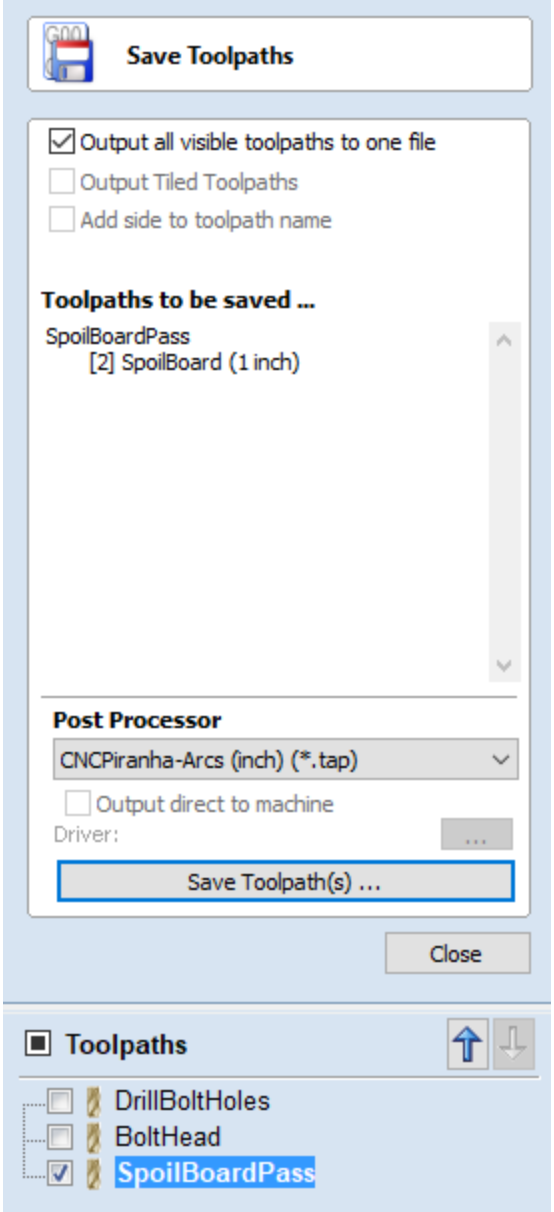
Select the two toolpaths, DrillBoltHoles and BoltHead and get ready to export the G-Code files.





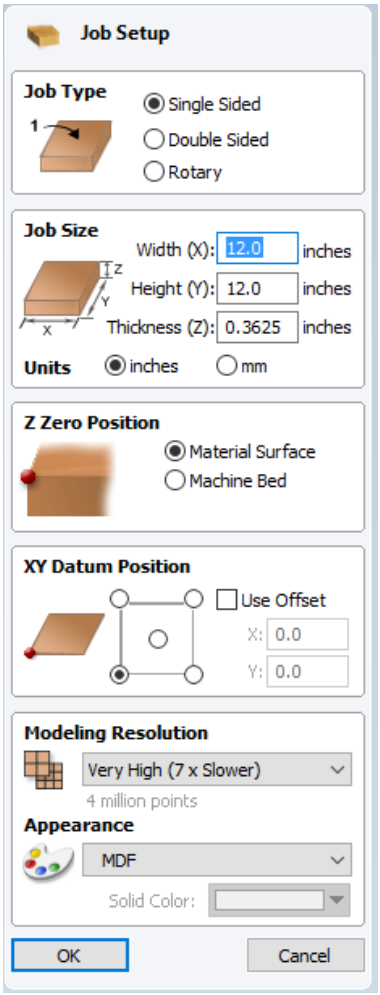
Remember to select the Post Processor for your machine.

Deselect the “DrillBoltHoles” and “BoltHead” toolpaths and export the G-Code file for spoil board pass.

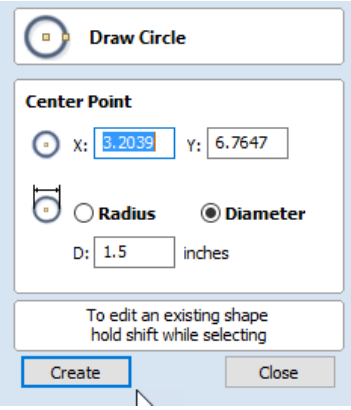


Cam Levers Project

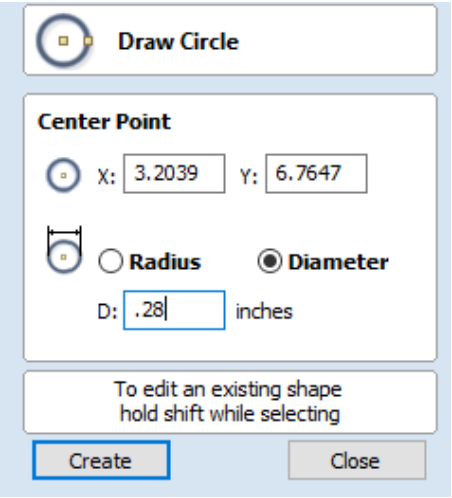
Create a new project with the thickness of your plywood. Its good to take an average of the board on all sides and use that as the thickness.

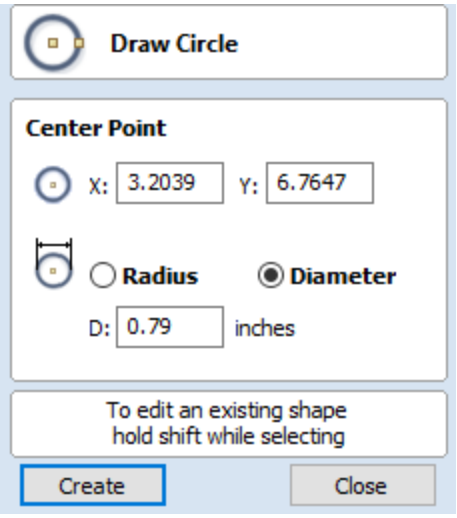


The first step is to create circles of the size 1.5” diameter.

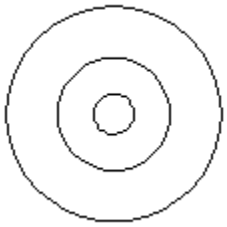


Then we need to more circles on the same center point of .28 (a little larger than the bolt shaft) and one a little larger .78 than the bolt head.

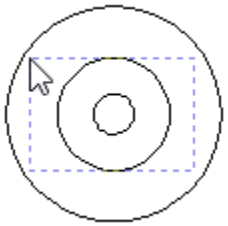




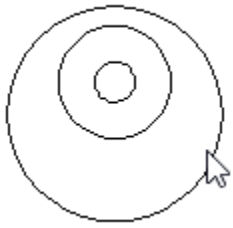
To where we have something that starts to resemble a bullseye.



Select the inner two circles. This will be the bolt head pocket and the bolt shaft thru hole.

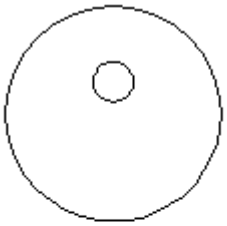


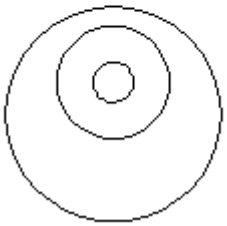
Using the keyboard arrow keys move it halfway to the edge.

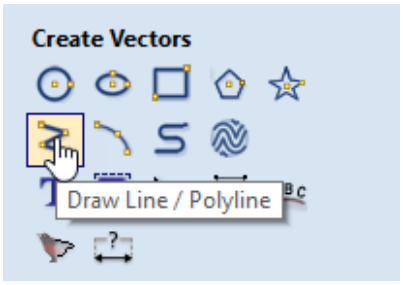


That will give us the eccentricity for the cam and give approximately half and inch of travel.

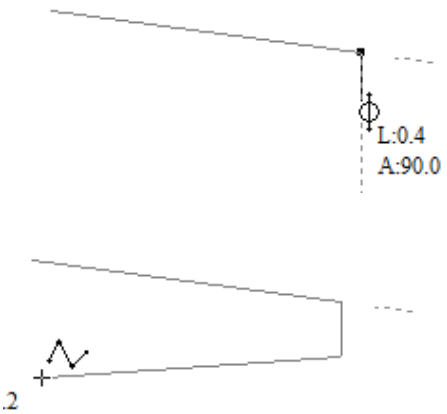
We need to have the bolt thru hole the same on the top and bottom of the cam head, so we want to copy and paste this now. Delete the bolt head circle from one.

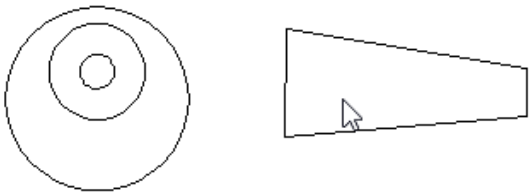






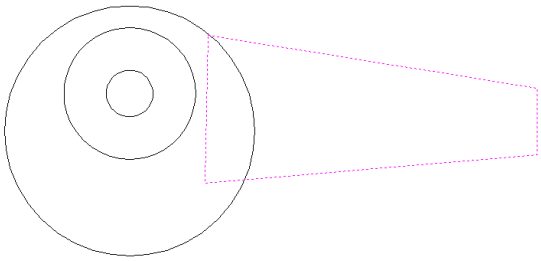
Time to draw the cam handle and it starts with the [polyline](#) tool.



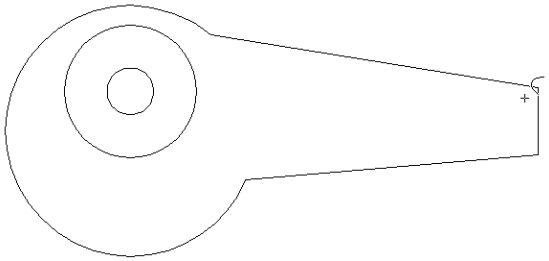


Zoom in to the handle and make sure all vectors are closed.

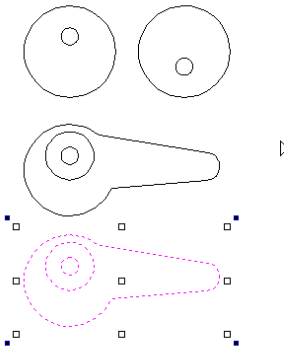
Select the handle and move over the cam about three quarters to one side.



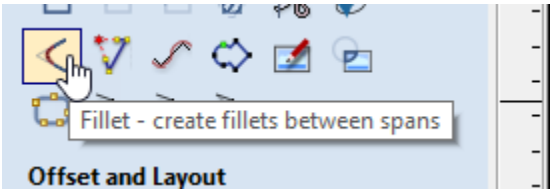
Select the Trim tool.

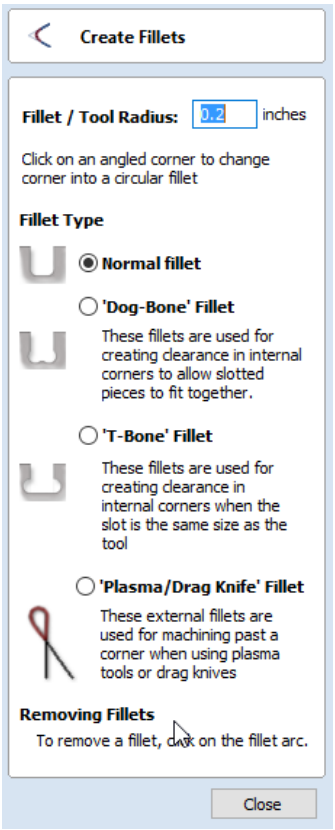


Cut the over lapping lines away. Verify there are no open vectors.



Select the filet tool.



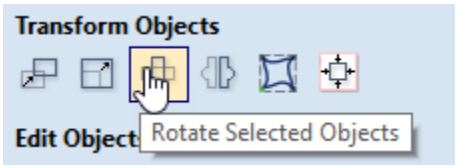


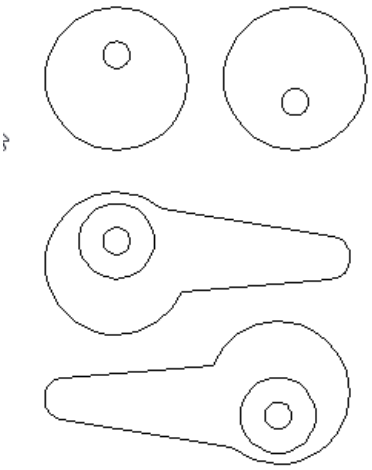
Set the radius to half the length of the end of the handle.

Click on the inside of any of the corners you want to smooth out.

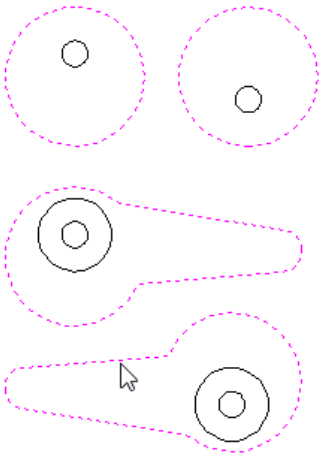
Select the cam handle and all internal circles to cut/paste them as a copy. Using the keyboard arrows move it away from the original one. Same with the lower half of the cam handle.

Using the Rotate Selected Objects transform, flip them so they appear as so.

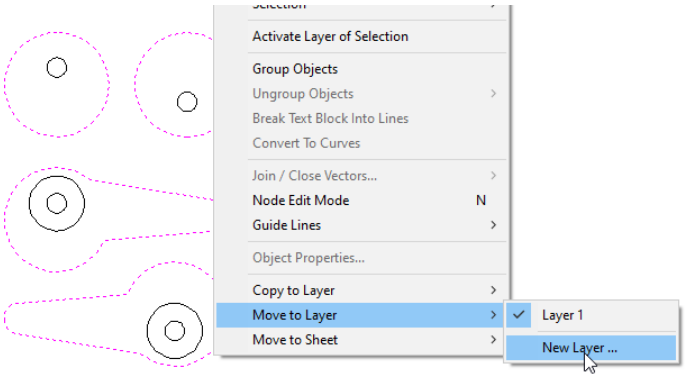




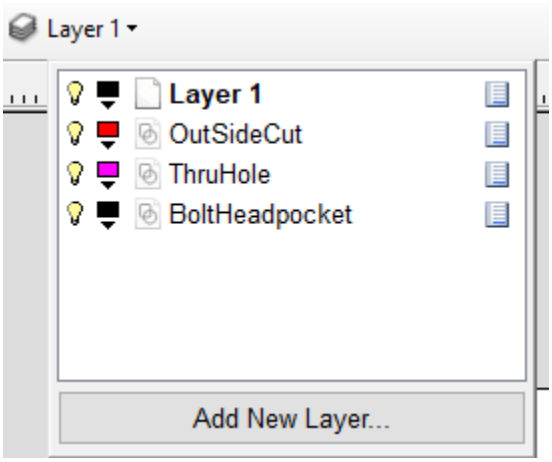
Select the outside edges.



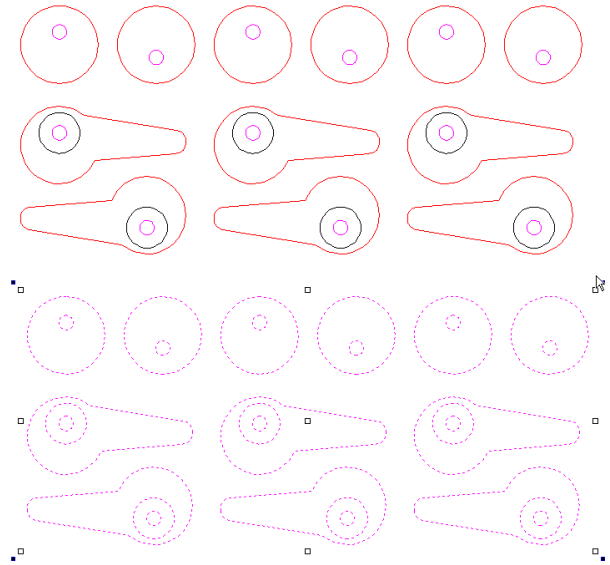
Move them to a new layer.



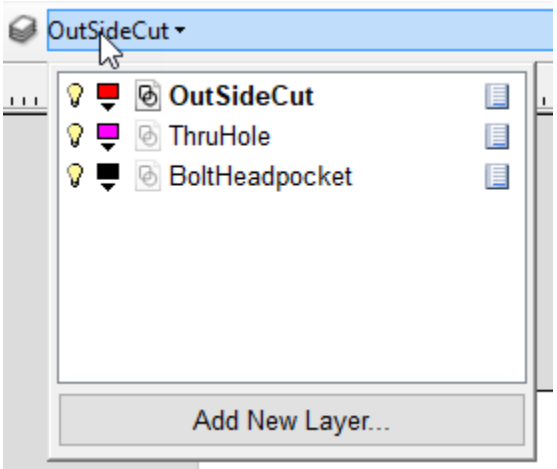
When we are done, each part will have its own layer to make it easy to select the objects for a toolpath. There will be three for this project.

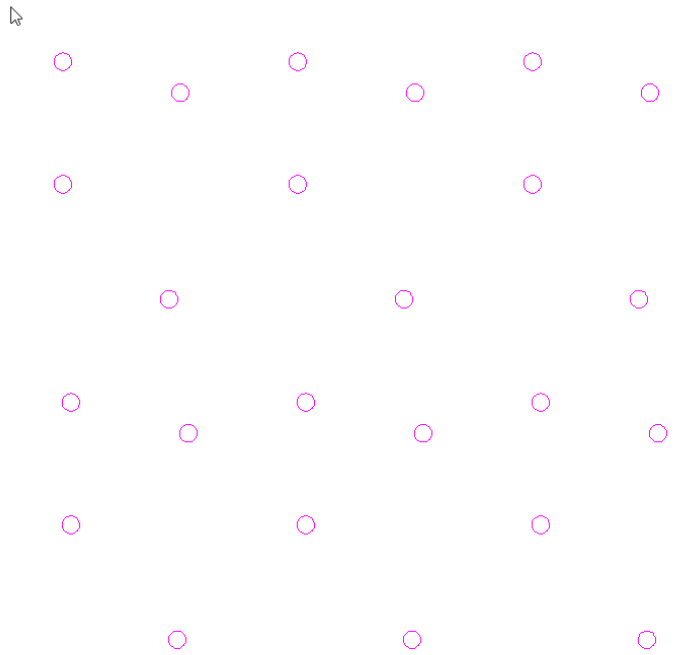


Select all the items and paste them repeatedly until we fill the work piece. Once you have three at the top, you can select them and paste them on the lower half of the job.

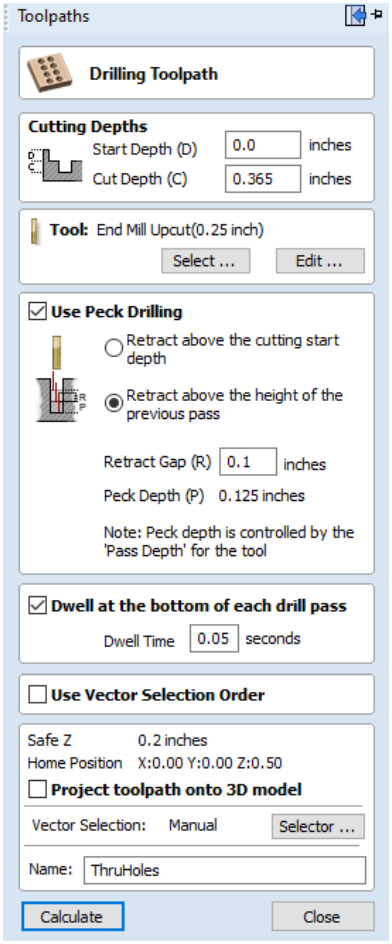


Using the lightbulb control in the layer's menu, show just the Thru Holes.



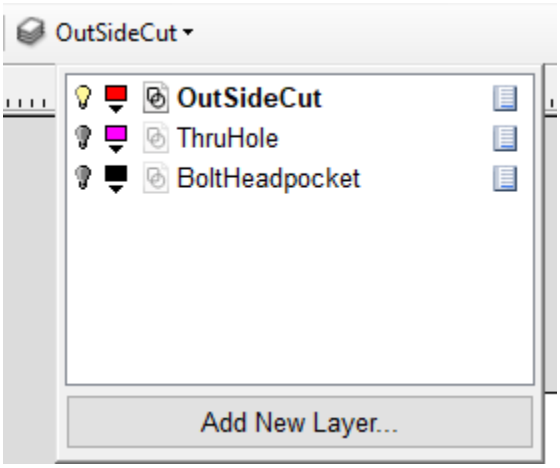


Select them all and add a Drilling Toolpath from the Toolpath menu.

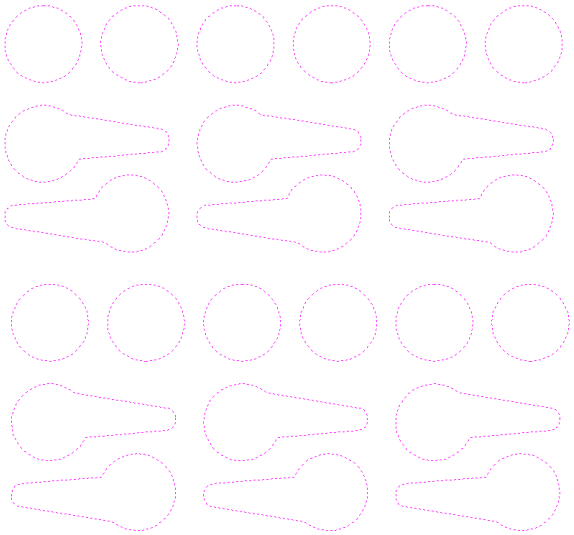


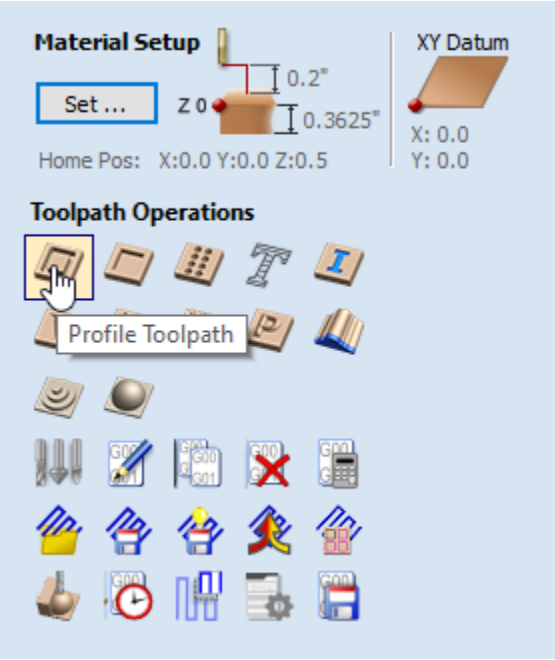
Click the Calculate button.

Select the “OutSideCut” layer and de-select the others.

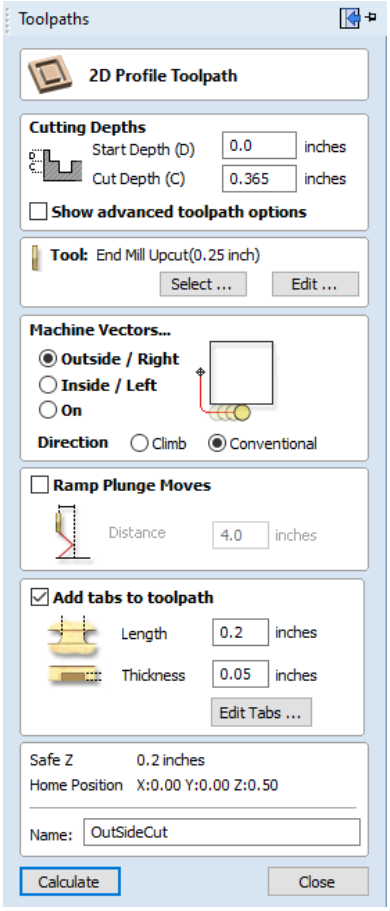


Selecting the outside of the objects we want to cut out in the project we create a Profile Toolpath.

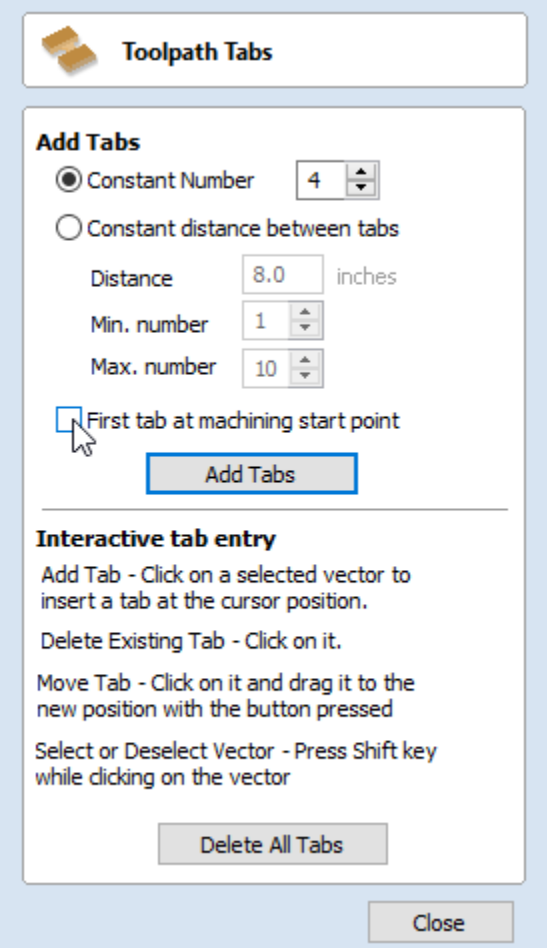


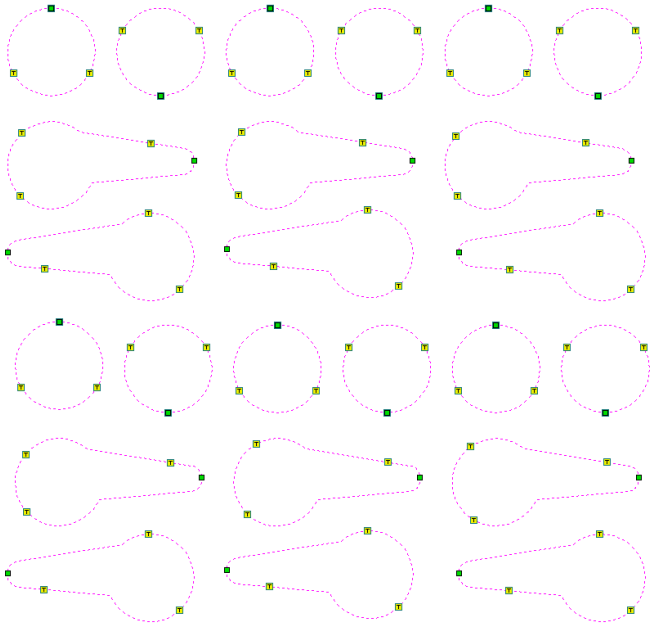


Set the tool you want to use to cut out the cams and cam spacers.

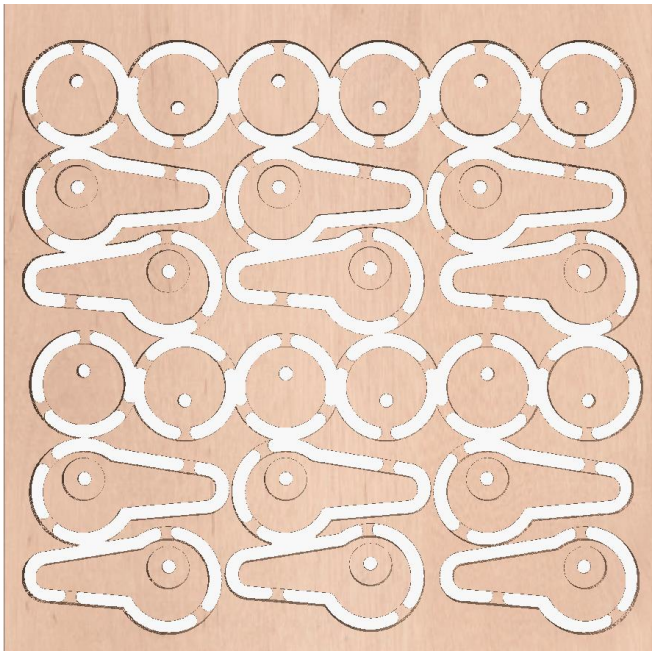


Then set the tabs.



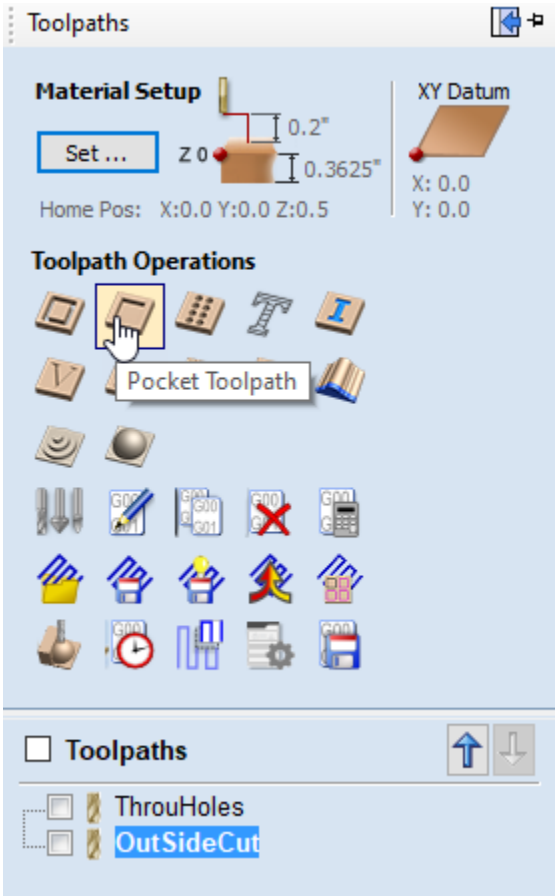


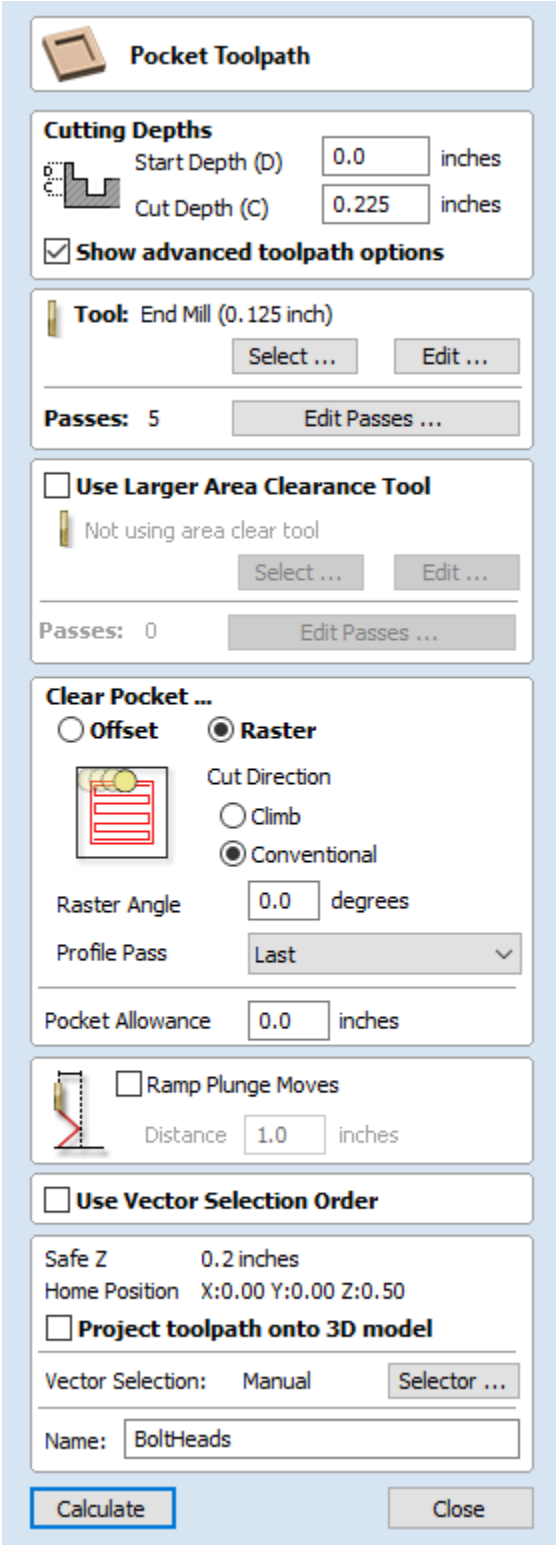
Adjust the tabs and run a preview to make sure you have enough meat to hold them through cutting.



The last Toolpath to create is the bolt head pockets.

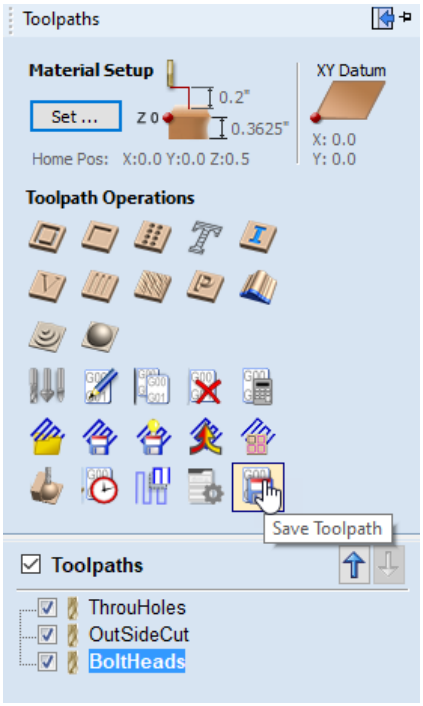
Select the layer only for the bolt hole heads and select them all. Then create a Pocket Toolpath.

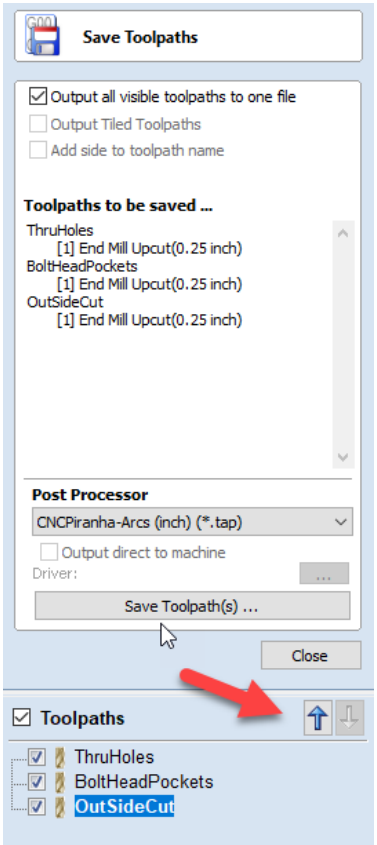




Set the options and then click the Calculate button.

Time to save the Toolpaths and export the G-Code to a file.

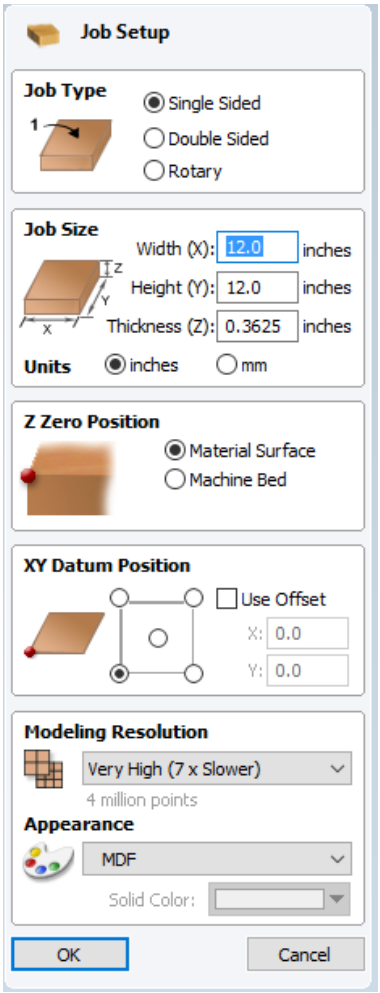




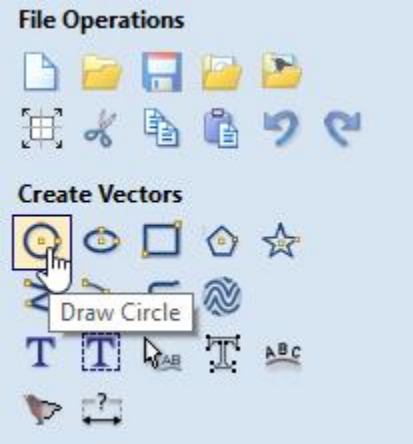
Since all the toolpaths use the same tool, we can run the G-Code in one file. The order is important and it's a good habit to get the stuff inside done before the cuts with the tabs. You can edit the order with the arrow tool pointed at by the big red arrow.

Cam Plates Project

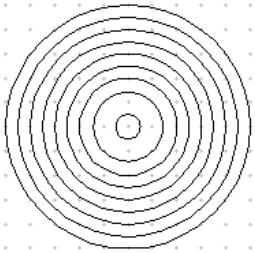
Create a new project with the thickness of your plywood. It's good to take an average of the board on all sides and use that as the thickness.



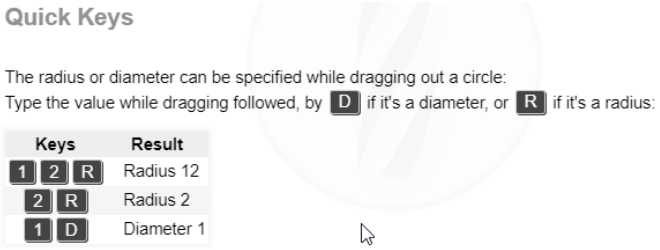
We are going to be making a template for the both cam plates, the fixed and those that fit the cam lever and spacer.



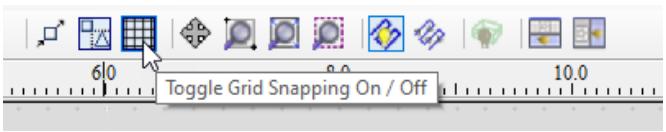
It will look like a bullseye when completed.

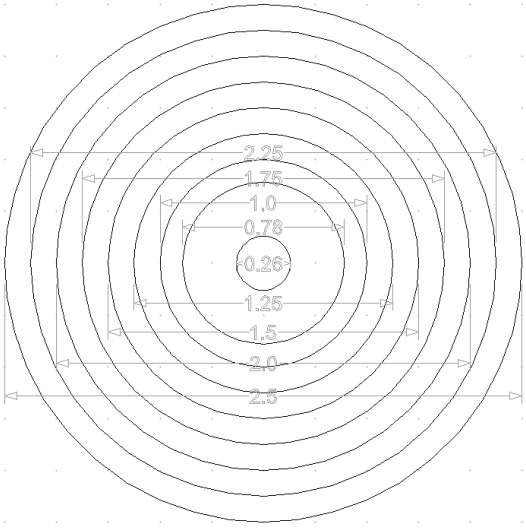


Why you are constructing these you might want to take advantage of the hot keys for setting the size.



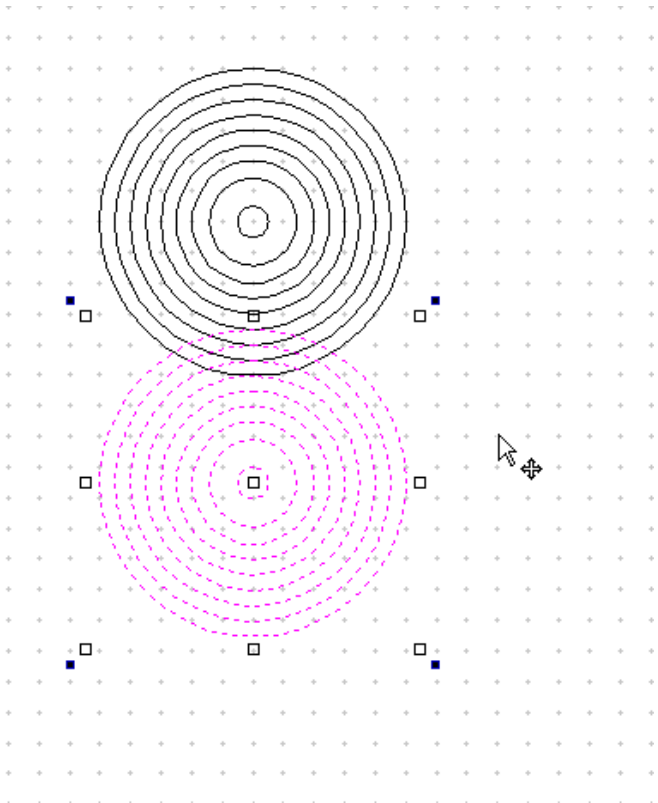
Also turning on Grid Snapping can make this much easier.



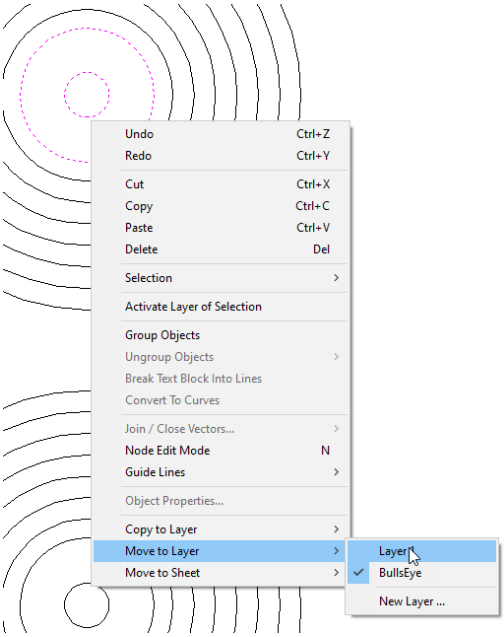


These are the sizes I used. Remember you can use the mouse wheel to zoom in and out to see more detail.

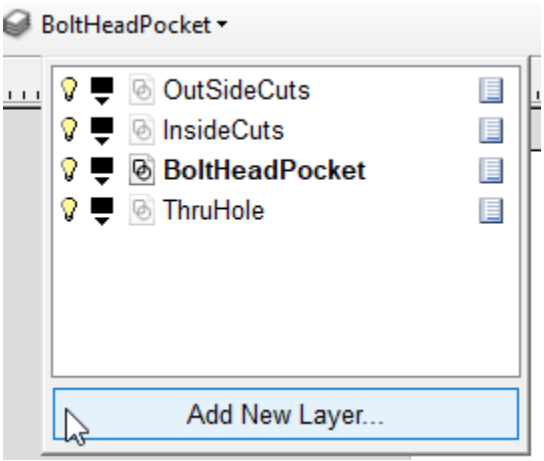
Copy and past a copy of the “bullseye” and place it well away of the original. Using the arrows keys to do this is something I like to do.



The inner two circles are for the bolt shaft and the bolt head. The others are the template so we can see just what the offset of the plates is in design. Move them to a new layer.

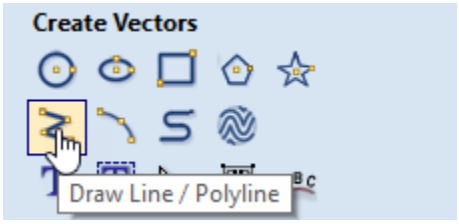


Let's move the inner two circles to a new layer of their own to assist in selection later.

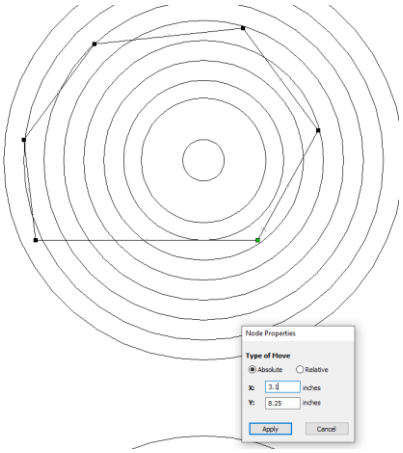


I will have four layers when done. The outside profile cut, the bolt head pocket, the thru hole, and the inside cut for the plate that is used with the cam layer.

Using the polyline tool, we will create the outside dimensions of the plates.

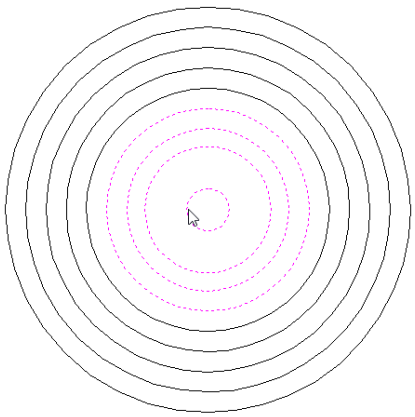


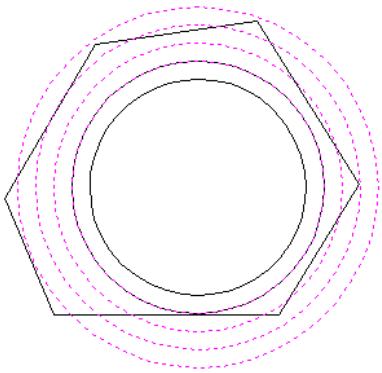
Draw the ruff shape of the static plate, then use the node edit mode to fine tune the positions. You should have ¼" incremental sides.



We can now delete the unused circles outside of the bolt head circle on the first bullseye.

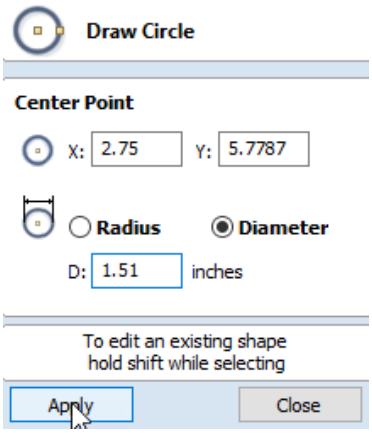
On the second, we can select the inner circles out to the 1.5" diameter and delete them.





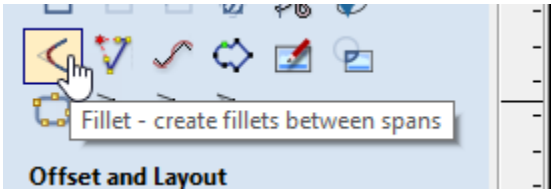
Use the polyline tool as before and then the node edit mode to fine tune the shape.

Edit the 1.5” circle to something slightly larger to allow it to fit over the cam spacer. 1.51” for me. We can sand a bit if its too tight.

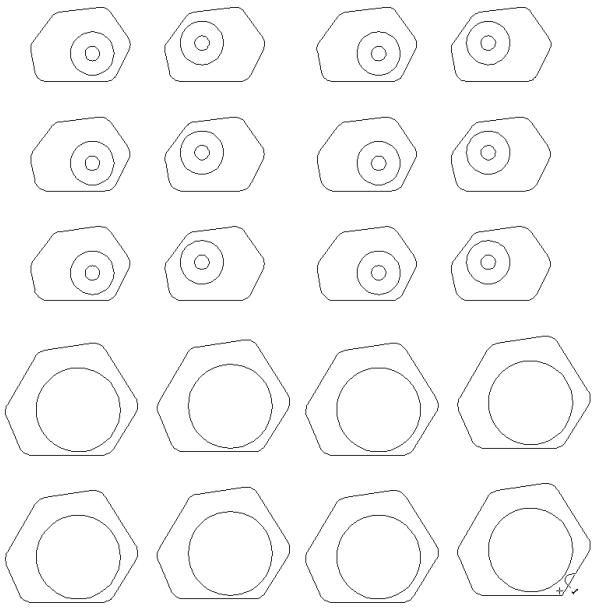


Delete all the unused circles outside the 1.51” hole.

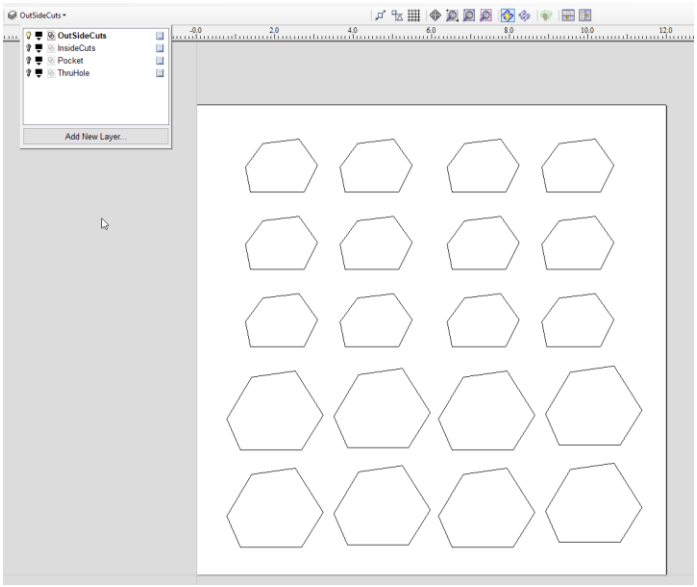
Use the fillet tool to ease all the outside edges. I used .25”.



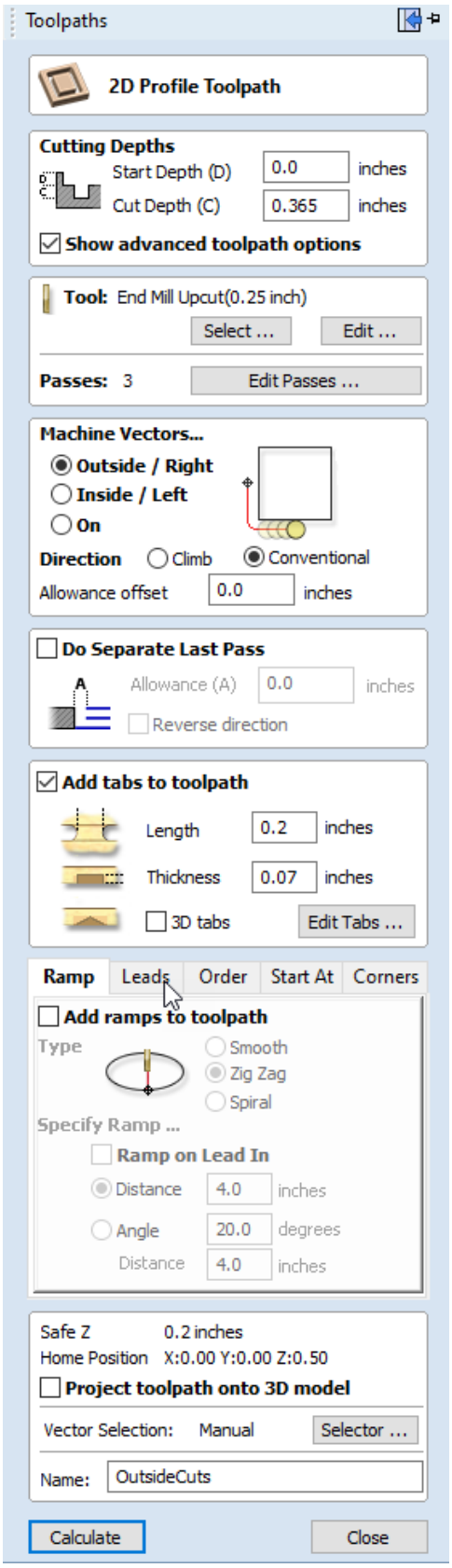
Cut and paste the objects until you fill the work piece. I flipped the static cam plates and move the bolt head and bolt shaft holes to the opposite side before I copied to give more variety in spacing. The Cam plates can be always flipped so no reason to mess with those.



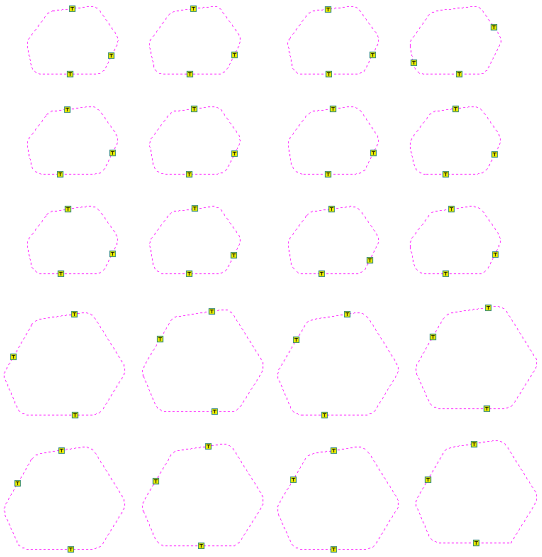
Select just the “OutSideCuts” layer.



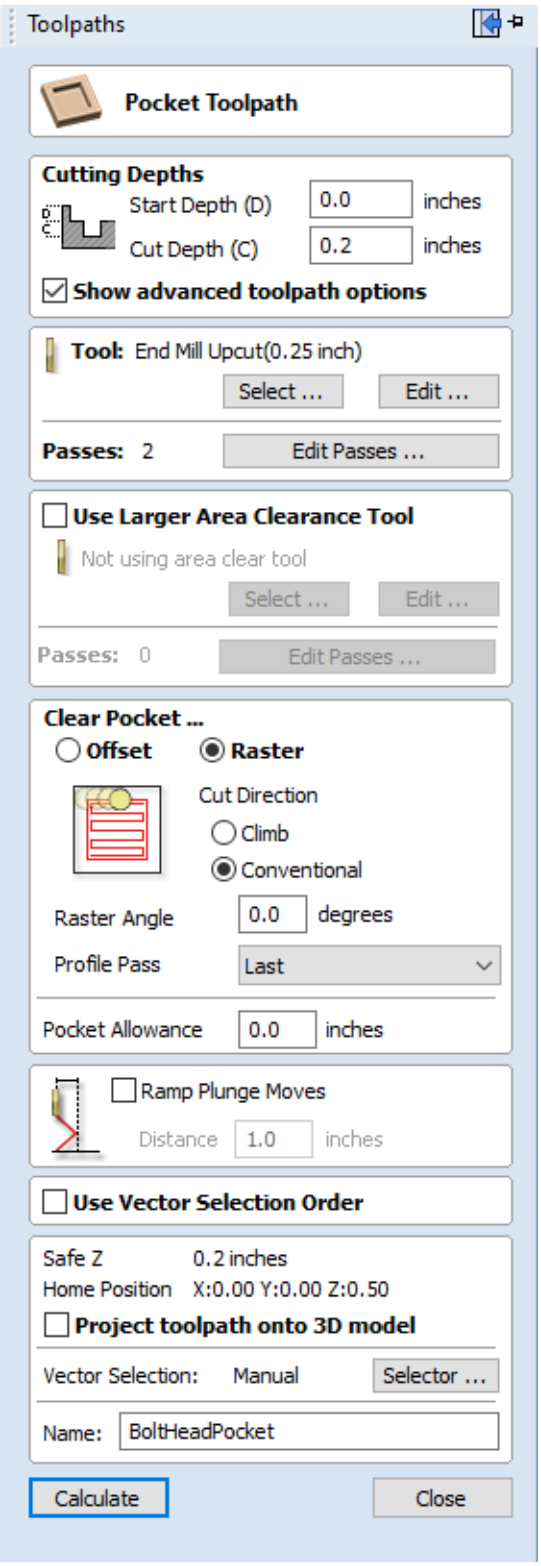
Select the Profile Toolpath operation form the Tool Path tab and set the desired settings for the outside cuts.



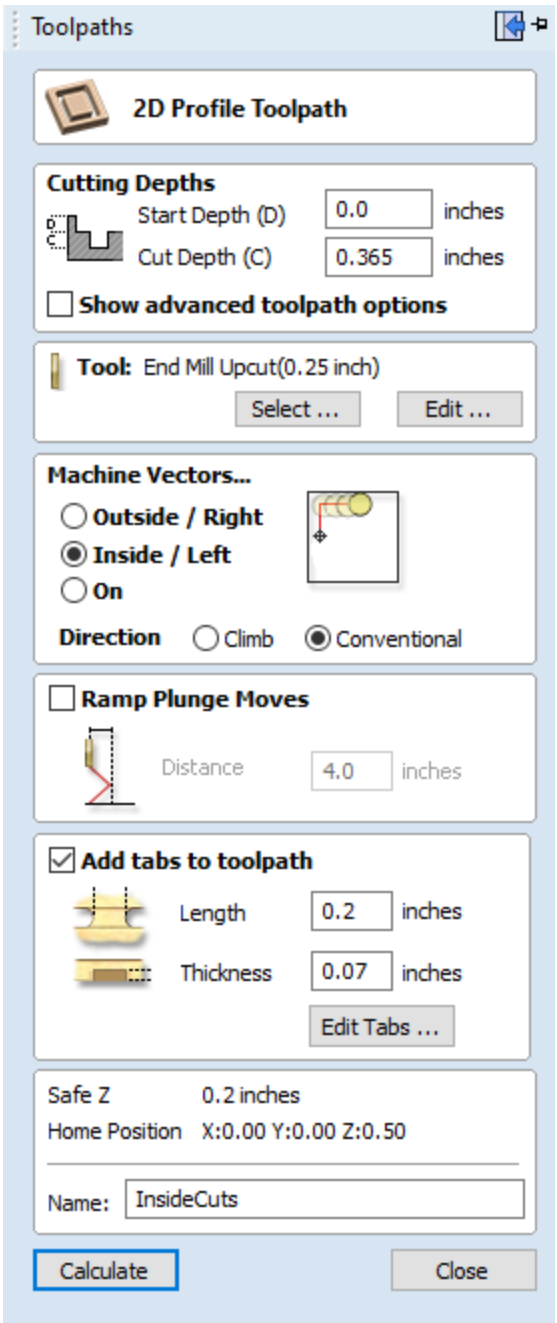
Click the Edit Tabs button and add and move the tabs so they make sense and for safety.



Select just the bolt head layer, select the bolt head circles and create a pocket toolpath for those.

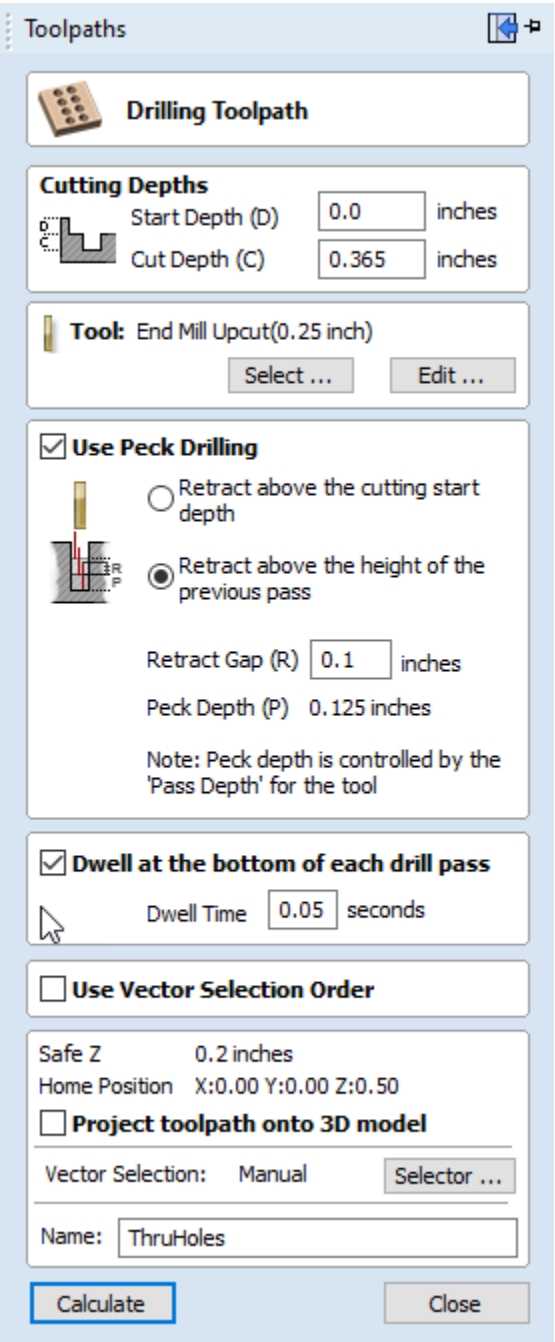


Select just the inside cuts layer and create a profile tool path for the cam plates.

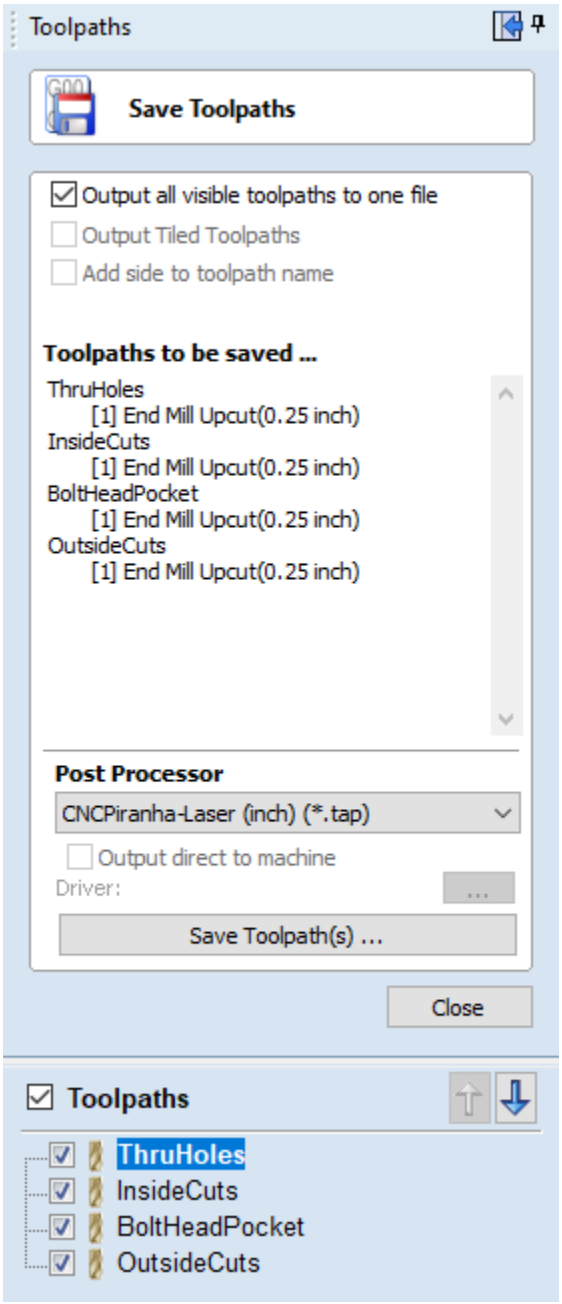


The last toolpath we need is the for the bolt shaft. Select hold the bolt shaft layer and select those circles.

Create a Drilling Toolpath for them.



Now its time to export the G-Code to the .tab files for your machine.



As always select the correct post processor and select the toolpath order as all these toolpaths can be cut at the same time. I like to go from inside to outside when using tabs.

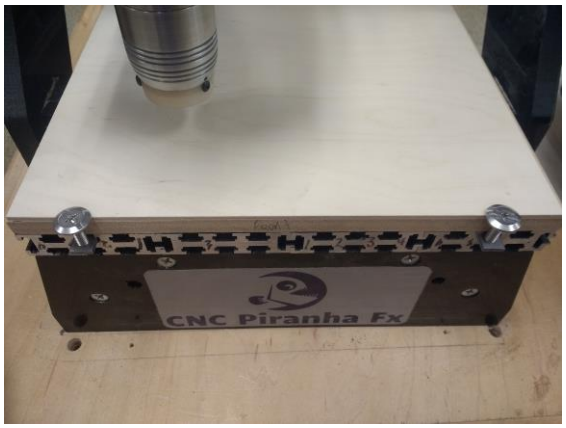
About the Contributor:

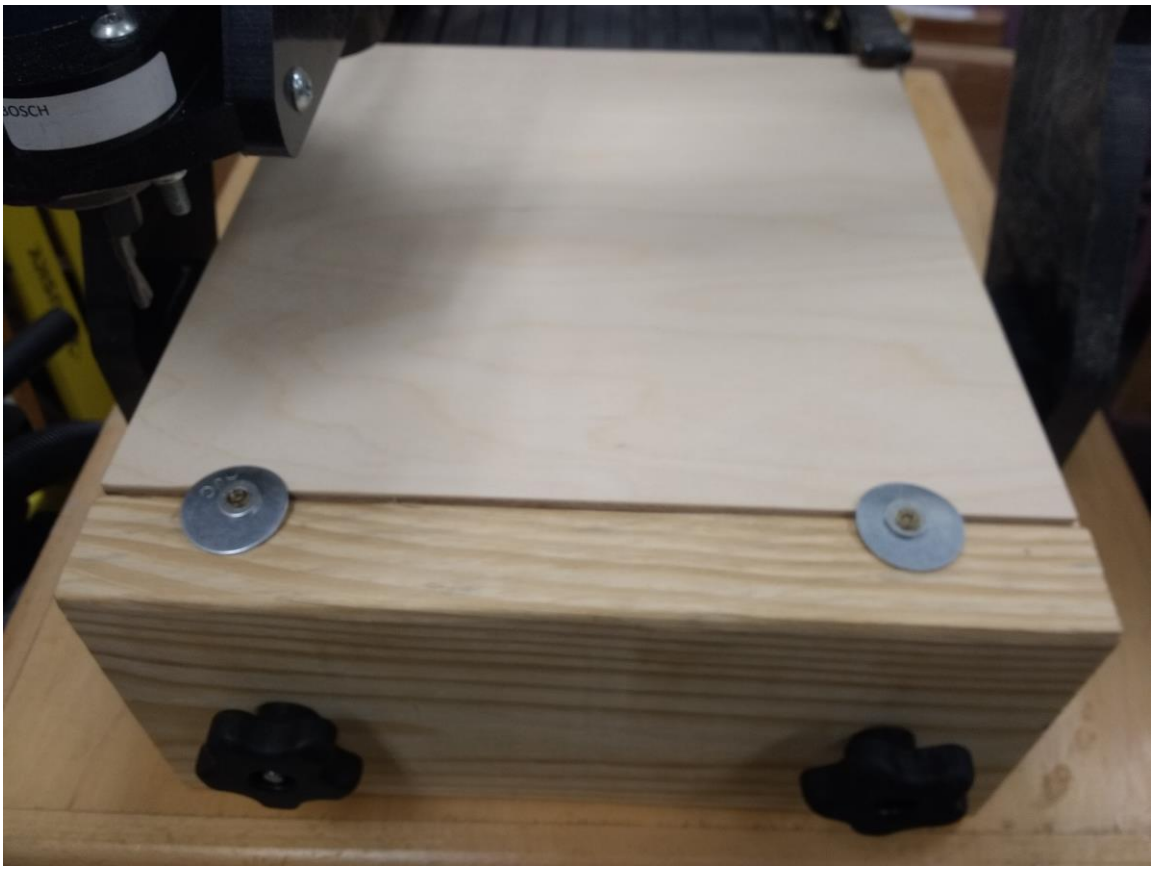
David White is a weekend CNC and a computer programmer/financial technology analysist during the week. You can find him hanging out around the Woodcraft store in Clearwater Florida occasionally. The best way to contact him is through his email at:

superdavewhite@outlook.com.

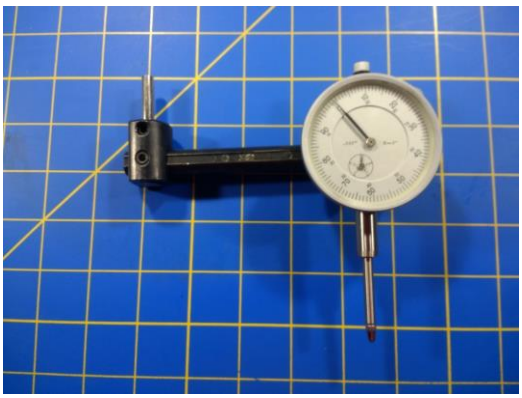
Hurricane bolts are a low-profile clamp when getting started.

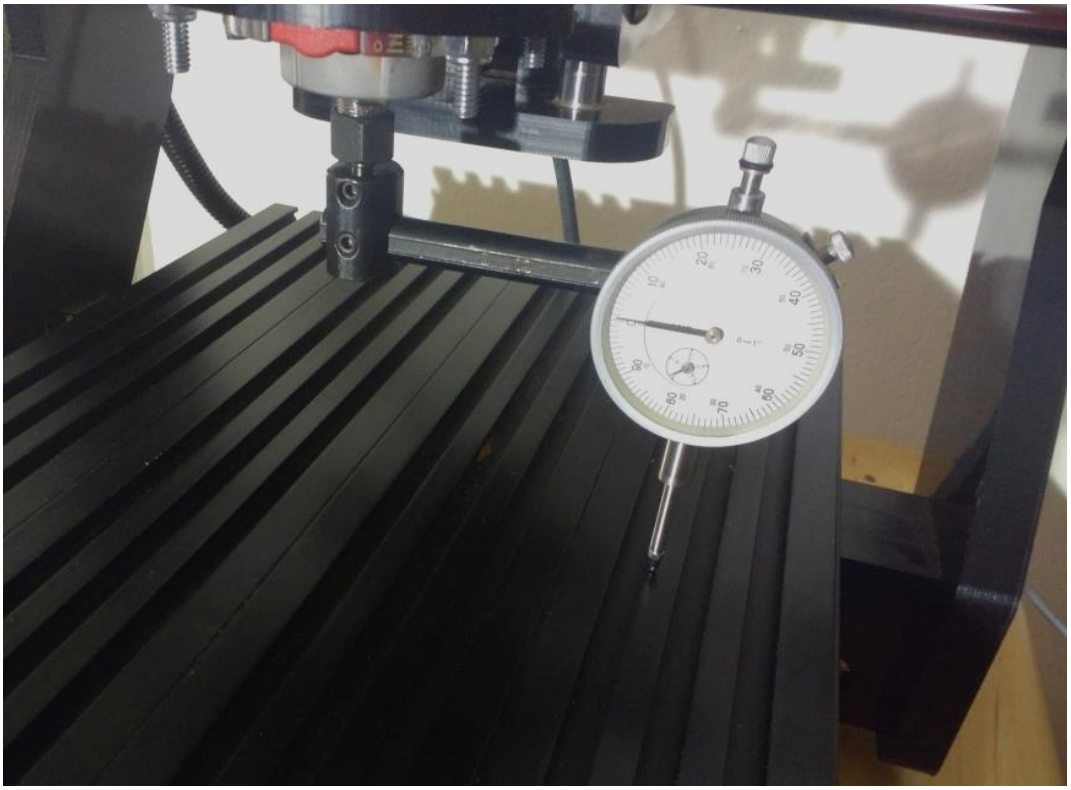
A piece of flat bar also can become a handy clamp on the Piranha to cut to the front of the bed.



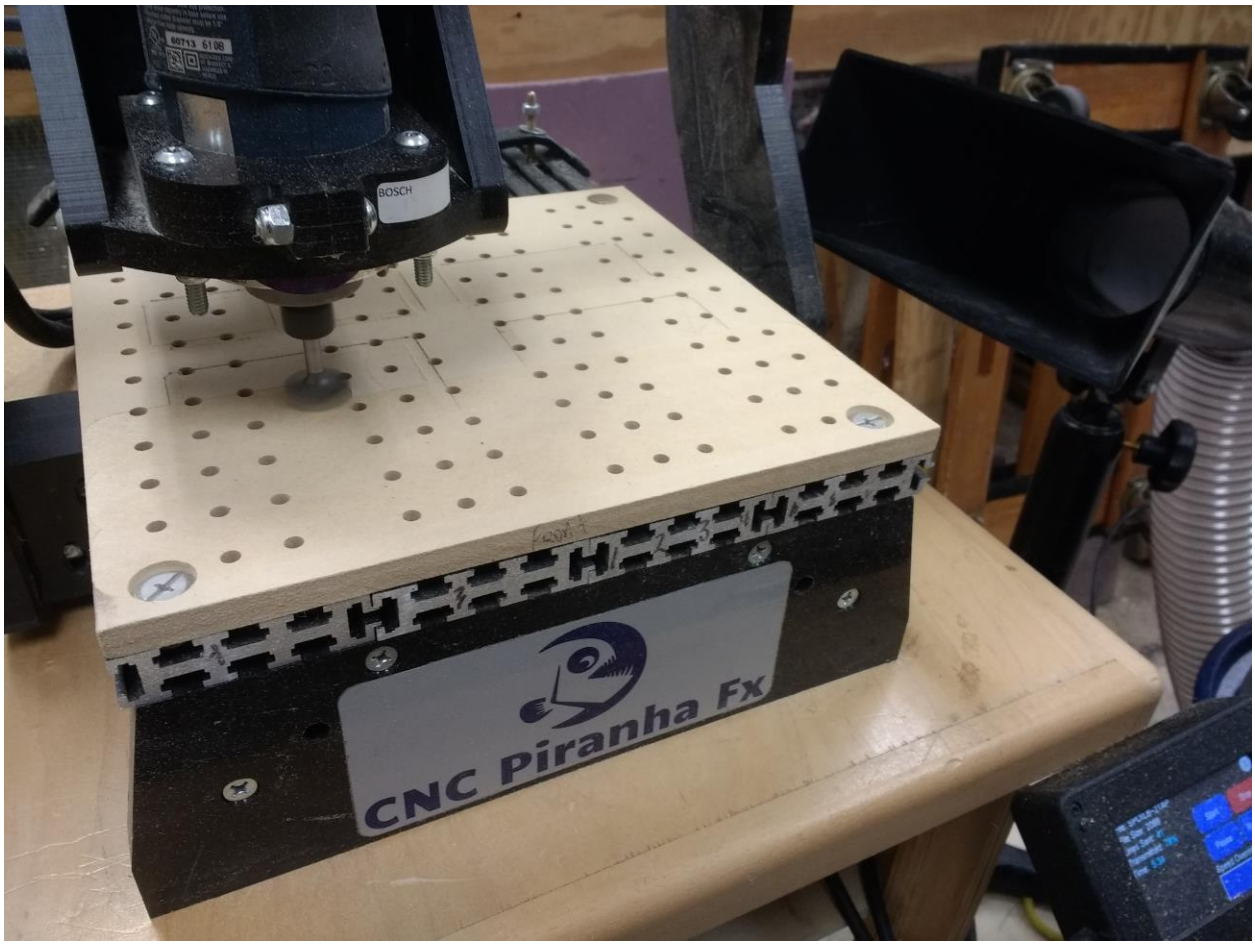


Another quick way for a low-profile hold down while cutting a spoil board to the front of the T-Track.





A fly cutter with an inexpensive dial gauge makes a good way to tram your router for perfect cuts. When you surface the spoil board, if you have a scallop pattern, you might want to get some shim material and tune the routers mounting.



Time to clean up one I had been using with the spoil board cutter and get it flat as West Texas.

Using the cams on the far side or the deep side of the beds is better, so tools don’t hit the cam levers. Oh, you live and learn.