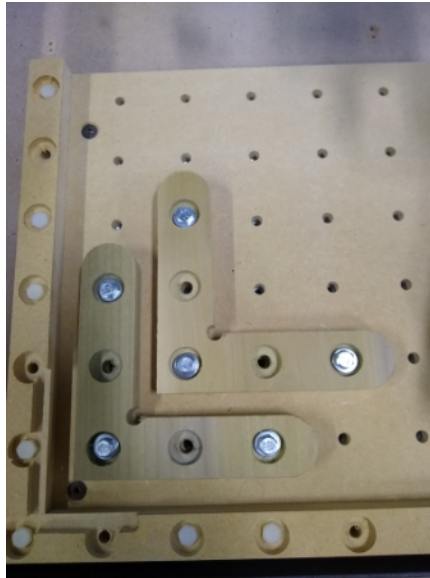


How to Create L Brackets in Carbide Create and Cut out the Project

This document is a how to for creating L Brackets in Carbide Create. Carbide Create 520 was used to create these brackets. Carbide Motion 536 was used to cut them out. Future versions may change.

The L Brackets for a 90 degree corner to secure projects on a threaded wasteboard.



The first consideration is how big your brackets should be. These are 6 inches by 6 inches with 5 holes and a corner relief. Set up a grid pattern that is a multiple of the width of your L brackets and check snap to grid. In this case I set up .25 inch grid pattern.

To start you need a piece of hardwood lumber that is a minimum of 9.75 inches wide by 7.5 inches tall. This gives you room to cut the pieces out without going over the edge and cutting your clamps or fences. You can use MDF but MDF is soft and subject to adsorbing moisture and is flexible. Poplar, Oak or Maple would be good choices. Poplar and Oak are available at big box stores or a local hardwood supplier.

The next consideration is the spacing of the bolt holes. For this example I have a 2 inch spacing threaded wasteboard with 1/4-20 Tee Nuts. You can calculate for your spacing need and use this for a general how to.

The L Brackets consist of 4 elements. First element is a through hole in the inside corner for a relief. The second element are the pockets for washers to give your bolts something to pivot on. The third element is the through hole for your bolts to hold down the L Bracket. The fourth element is the cutout of the L Bracket.

The first element is a relief hole for the corner. This allows you to place square material in the corner without interfering with the fit due to saw dust. This through hole is 3/8 inch round and centered on the

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inside corner. Create one circle with a radius of 0.1875 inches. It does not matter where you will place the circle for now you will move them to center over the inside corner later.

The second element are the pockets for the washers. To calculate the depth measure your material and subtract 0.5 inches. The reason for this my waste board is $\frac{3}{4}$ inches tall. Subtracting .5 inches from your depth of your material gives you a consistent measurement of 1.25 inches from the bottom of the pocket of the washer to the bottom of the wasteboard. You do not want to over penetrate with a longer bolt because this pushes up your wasteboard and can make the surface uneven and you get uneven cuts. The diameter of most $\frac{1}{4}$ inch washers is 0.625 inches. I made the pockets 0.80 inches wide, radius 0.40 inches, to give me room for manufacturing variances and you could use a $\frac{5}{16}$ inch washer. I use two washers in each pocket to make sure I do not bottom out the bolt and more washers can be added as you surface your wasteboard. The start depth of the pocket is the top of the material and the depth is (material thickness - .5 inches=pocket depth) .25 inches.

The third element are the through holes for the bolts. I made these $\frac{5}{16}$ inch wide. This gives you some wiggle room and also so I can use the #201 $\frac{1}{4}$ inch cutter to make the whole project. In my case I made the radius of these holes 0.15625 inches. The start depth of these holes start at the bottom of the washer pocket and Use Stock Bottom.

The fourth element is the cutout of the L Brackets. You need tabs to keep the parts from moving during cutting and when the final cut is made they would be loose and could be jammed against the cutter. These cuts are made from the top to the stock bottom.

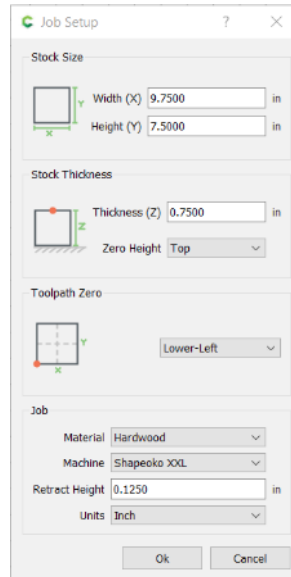
Please read through the entire document and understand it before attempting to make these L Brackets.

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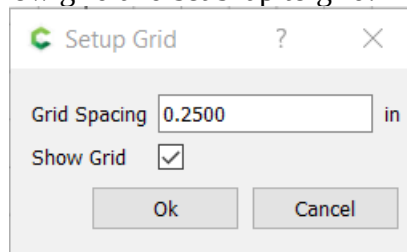
Step by Step Procedure to Design L Brackets

1. Open Carbide Create 520 and set up your material and grid.

Set thickness to your material.



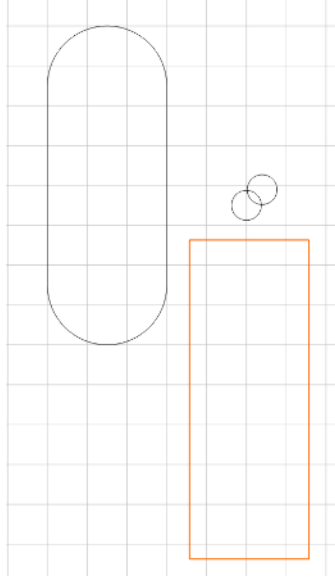
2. Next set up your grid spacing, show grid and set snap to grid.



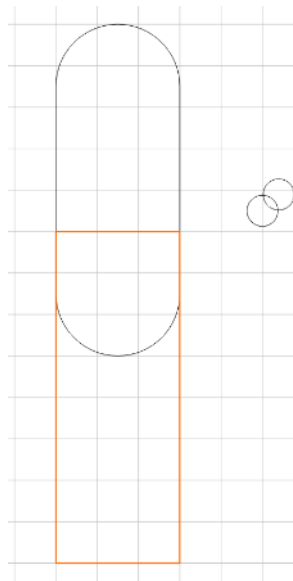
3. Save your project. I create my projects in a folder called “Project Templates”. I create a folder for each project and a sub folder called “gcode”. This is personal preference but it is a good practice to find your projects should you want to duplicate the project.
4. Create a circle for the relief hole in the inside corner. The hole is .375 inches and the radius is 0.1875 inches. (.375 divided by 2=0.1875) You can place it any where on the screen and you will place it later.

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5. Create a square that is 1.5 inches wide and 4 inches tall. Choose a fillet and make the radius .75 inches. This will round both ends of the box. Now create another square that is 1.5 inches by 4 inches.



a. Now select both objects and grab the lower corner node and move the two object together to make them 6 inches long. With snap to grid they will align.



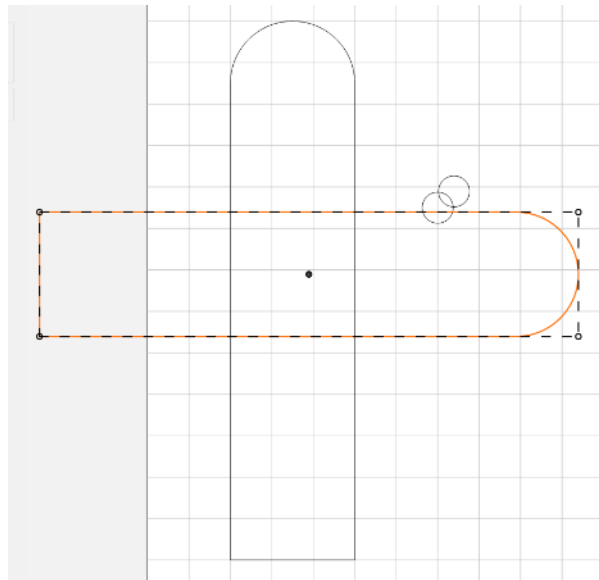
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b. Select both objects and with Boolean Union join them to form a single 6 inch tall and 1.5 inches wide object.

c. Next select the single 6 inch tall and 1.5 inches wide object and copy it, Control C.

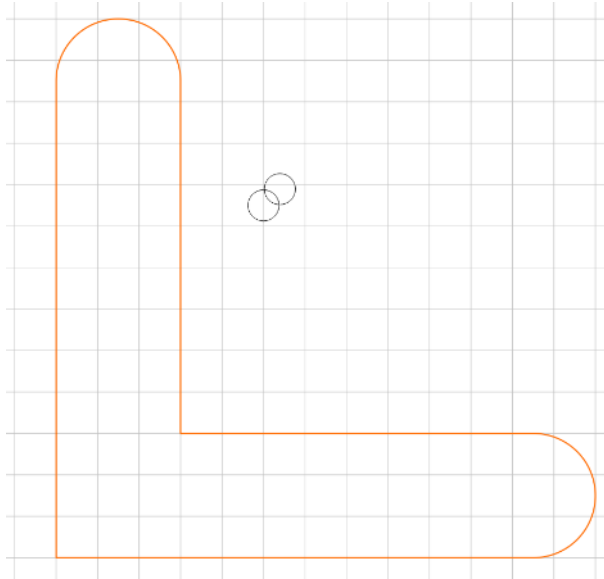


d. With the copy selected rotate the image -90 degrees and select the lower left corner node and drag it to align with lower left corner of the first object, this forms an L.

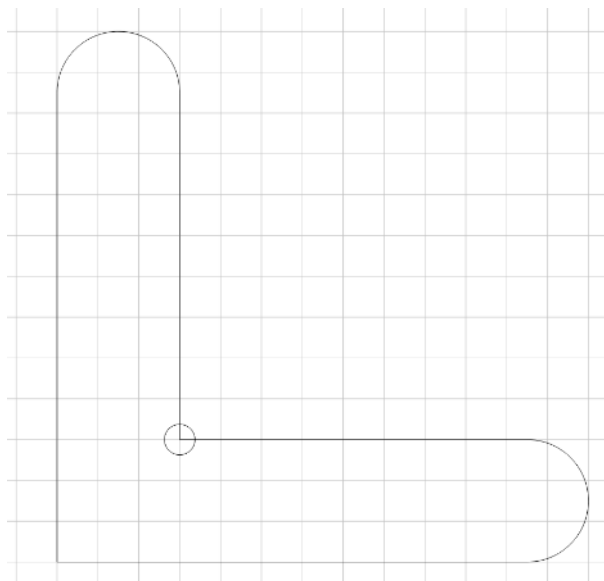


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- e. Now select both objects and do a Boolean Union to join them into a single L shaped object.

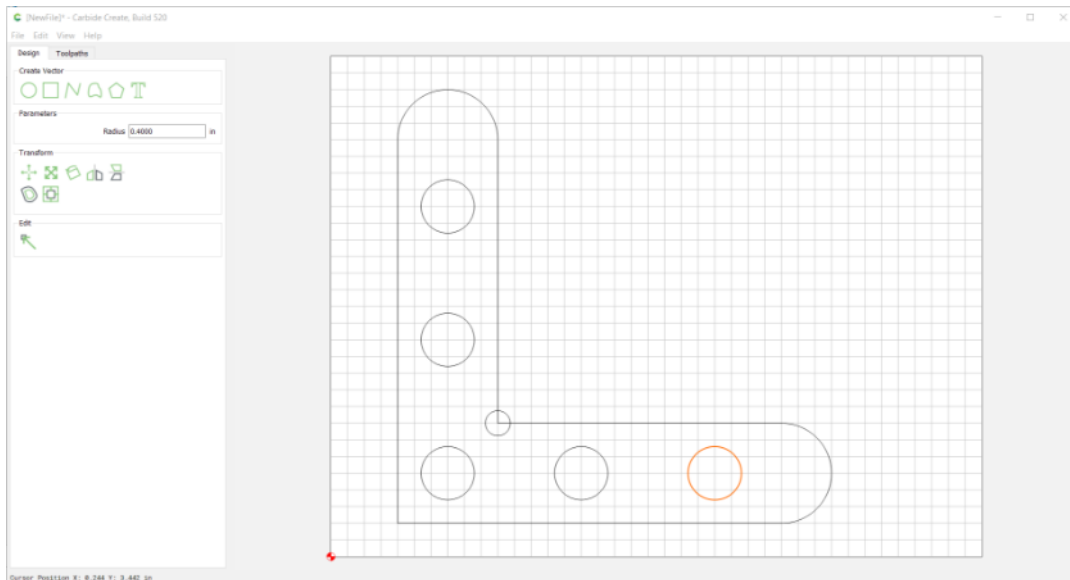


6. Now you can move the .375 inch relief hole over the inside corner. Select the circle and grab the center node and align it with the center of the inside corner.

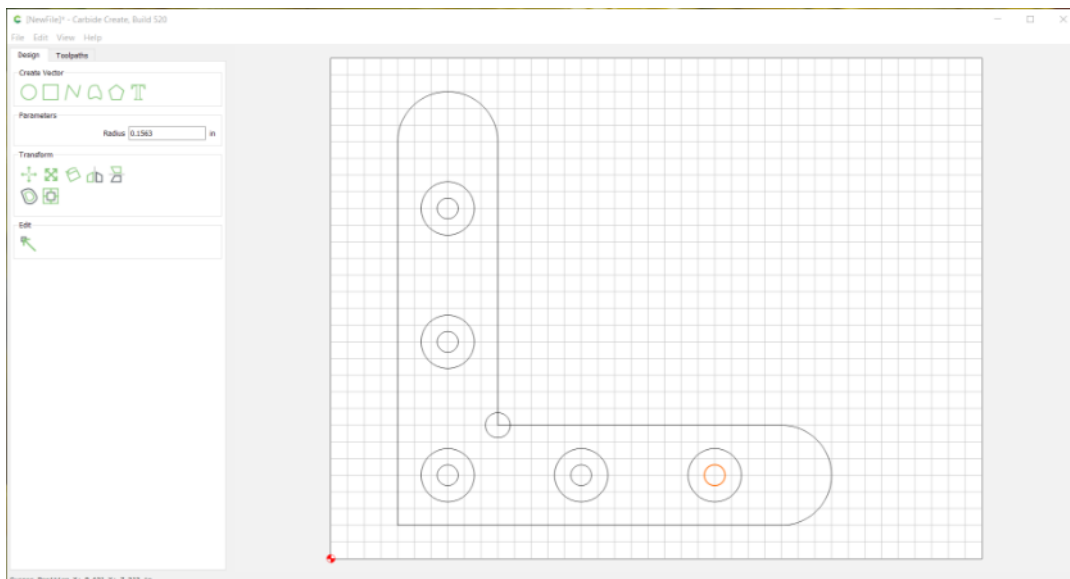


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7. Next you will create the washer pocket circles. Create the circle with a .80 inch diameter, .40 inch radius. Copy the washer pocket hole and duplicate it and move it to the first corner and then 2 inches apart centered on the width of the L bracket.

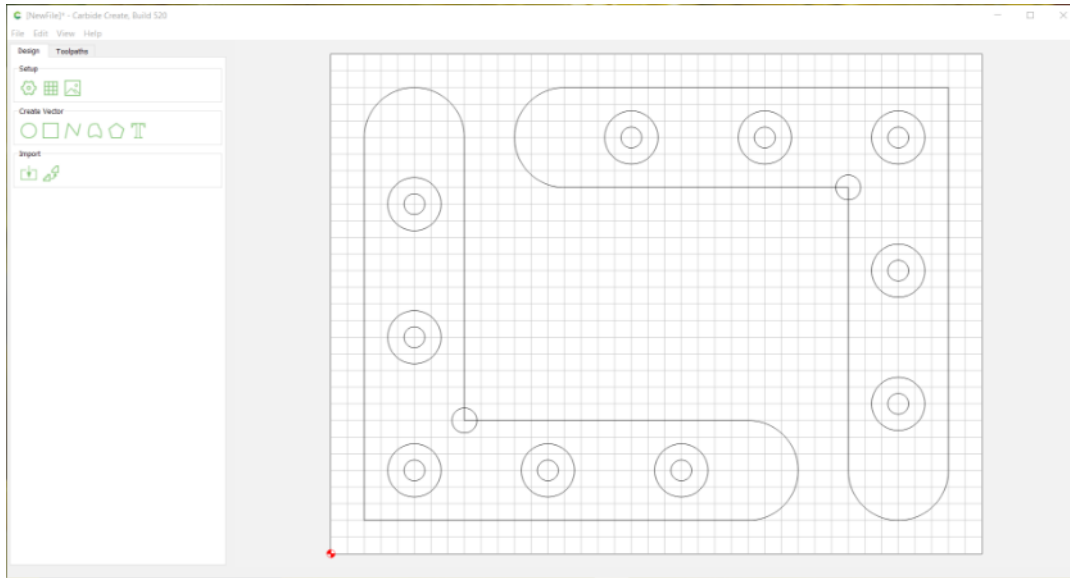


8. Next you will create the through circle for the bolts to anchor the L Bracket. Create a circle that is 5/16 inch round, radius 0.15625 inches. Copy the through hole and use the center node to place over the center of the larger washer pocket. Copy the through hole and use the center node to place over the center of the large washer circle. Duplicate the circle and place on all 5 washer circles.



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9. Next you will select all objects together. You can group them so they will not be moved separately by accident. When all objects are selected copy it, Control c. The copy should be grouped it so when moving it will not cause objects to be left behind. Select the copy and first mirror the object and then flip it horizontally. After you get two objects move the corner of each object to $\frac{1}{2}$ inch from the edge of the material. This allows you to cut the project out without cutting your fences and/or clamps.

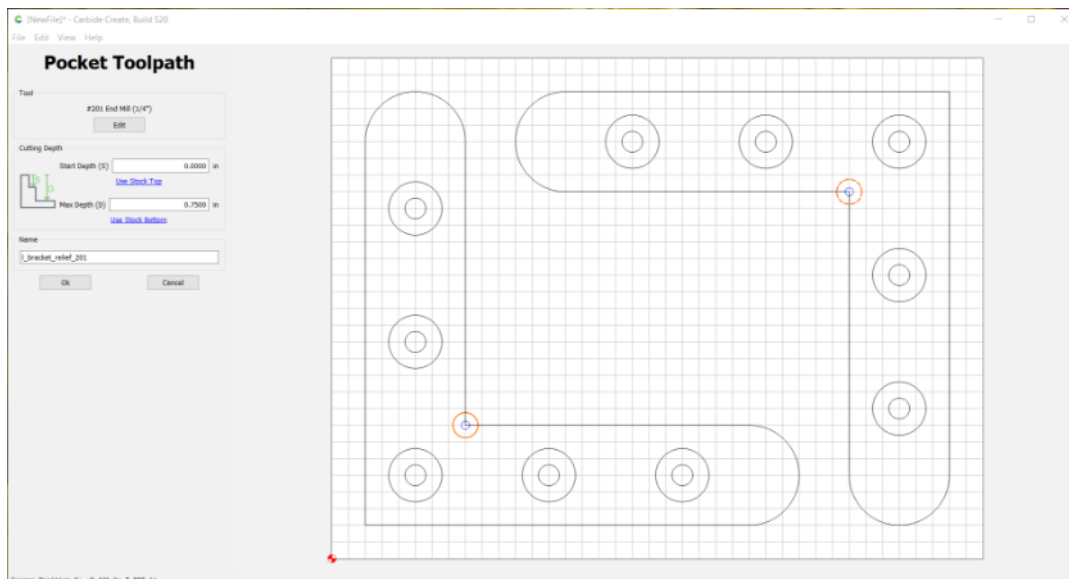


10. This concludes the design phase of the project. Next the tool paths will be created. Save your project to prevent any loss of work.

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Step by Step Procedure to make Tool Paths for L Brackets

1. The tool paths will be created in the order which the project should be cut out.
2. The first tool path is the .375 inch relief cut. You may need to ungroup the objects to select the objects for Tool Path creation. Select the two .375 inch circles and select Tool Path. Select the #201 ¼ inch upcut bit. You could select a down cut if preferred like #251. Either tool will work and will be used for all tool paths. With the two relief cuts select Pocket. Start the cut at the top of the material. Set the depth to Use Stock Bottom. This is a through cut.

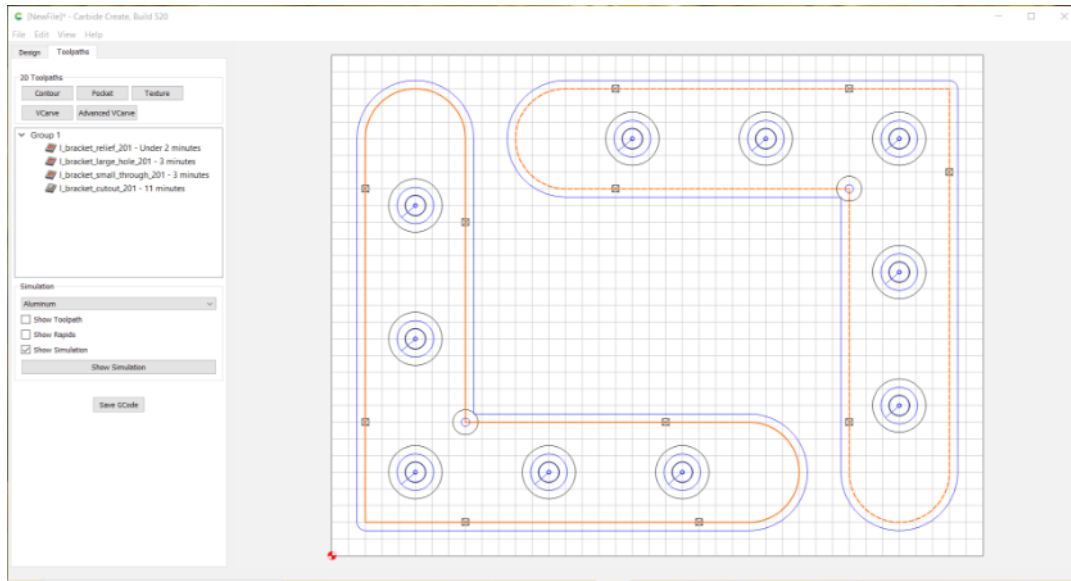


3. The next Tool Path will be the large washer pockets. Select all 10 of the .80 inch circles and create a Tool Path with the #201/#251 router bit. The start depth will be at the top and the depth will in this example be .25 inches. **Your depth may be different.** Use your stock thickness and subtract .5 inches. This will be your pocket depth.
4. The next Tool Path will be the smaller through holes. Select all 10 of the 5/16 inch circles. Create the Tool Path with the #201/251 router bit. The start depth in this example will be .25 inches. For your brackets use the pocket depth from the large washer pockets. The start depth is .25 inches and Use Stock Bottom for this through hole. **Your start depth may be different.**
5. The last Tool Path will be cutout of the brackets. Use tabs to keep the brackets from moving during cutting and coming loose when free. I made my tabs ¼ inch long and .125 inches tall. You can use what ever tab size you think is best for the material you are using. My tab placement was two tabs on

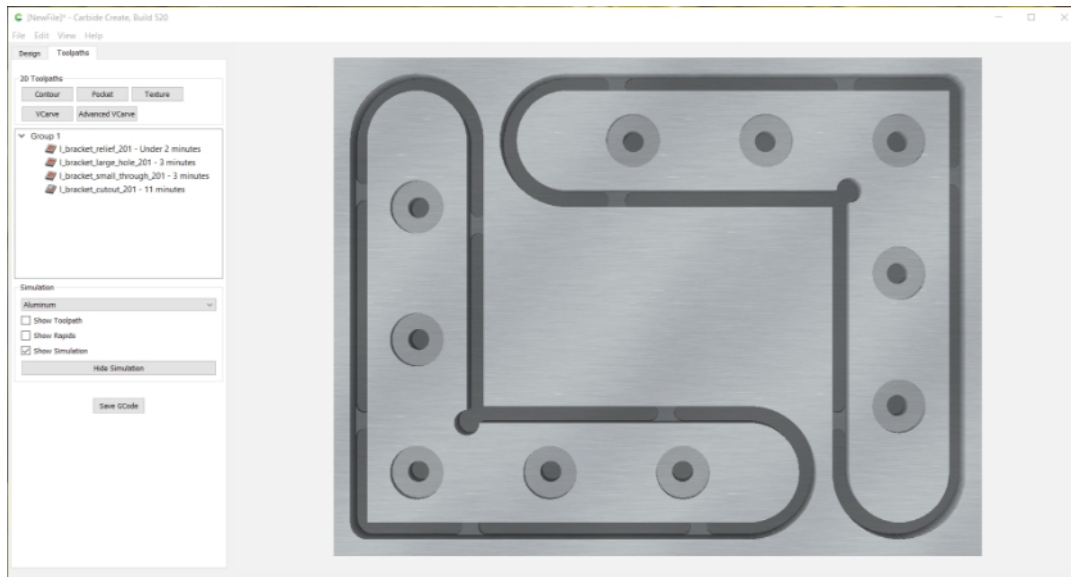
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the outside edges of each L Bracket and one tab on the inside edge of the L brackets. The reason for this is the removal of the tabs later. This makes it easier to remove the inside edge tabs.

6. Here are all 4 Tool Paths in the order in which they should be cut.



7. Here is the simulation of the L Brackets.



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8. You are now ready to cut the L Brackets. The origin was set to the lower left corner. The project is referenced from the top of the material. Be sure to zero your x y and z axis. I would recommend dust collection for all CNC Router projects. When you get your L Brackets cut you will need to remove the tabs. The large washer holes were designed to leave .5 inches from the bottom of the pocket to the bottom of the L Bracket. I use two ¼ inch washers and a 1.25 inch 1/4-20 bolt. The reason for the two washers is because I do not want the 1.25 inch bolt to bottom out on the machine base. As you surface your wasteboard you may need to add washers to the pocket to keep the bolts from bottoming out. Always after surfacing measure your wasteboard thickness and add .5 inches and that is the maximum bolt length you can use, use the two or more washers to keep the bolt from bottoming out.

9. Here is a picture of the finished L Brackets made of poplar. Also here is a picture of the Cam Clamps I use on my threaded wasteboard. I need to make some mirror images of both sizes of clamps. Sometimes it advantageous to have opposing forces on a project. All of the clamps were made to have .5 inches between the bottom of the washer pocket and the bottom of the material. I can use the same 1.25 inch 1/4-20 bolts. As you surface your wasteboard you may need to replace all your bolts with a shorter 1/4-20 bolt. After every resurfacing always measure to keep from having an uneven waste board after bolting down the clamps. When I use the clamps I hold the cam clamp tight against the material with one hand and tighten the bolt with the other using a socket wrench. When clamping against a fence I put one or two, depending on the size of the project, against the opposite side from the fence. This helps keep the project from moving tightening the side clamps. With the side clamping secure the first clamp slightly and then place the clamps on the opposite side. Tighten the second side securely and then go back and loosen the first clamp and secure the project and then tighten the bolt. After all clamps are secured double check that all are tight against the material and the bolt is tight. This prevents the material from moving during cutting. If you use the #201 Upcut Bit it tries to lift the project during cutting. There is tremendous side force on the project as well. So the material needs to be securely clamped down before cutting a project. Some people prefer the overhead type clamp. Use what ever makes you feel comfortable just know how your clamps work and always put more clamps on rather too few. Make your clamps in batches so if one gets cut up you can toss it out. Do not reuse damaged clamps. When you place the L Brackets on your wasteboard only snug them down. Then jog your router over with a straight bit inserted. Jog the router up to the inside edge of the bracket. Carefully jog your router to the other end of the bracket and see if it is aligned. There is 1/16 of an inch oversize in the through bolt holes and you want to make sure your L Bracket is square to your router. After you jog back and forth and the L Bracket is square tighten the bolts down and recheck for square. You will need to square every time you remove the L Bracket and put it back on the wasteboard.

If using my example files be sure to edit your material thickness. You will need to go to each tool path and edit and re-click the Use Stock Bottom to replace the example thickness with your material thickness. Save the tool paths. If you use the example file your through cuts may be too shallow or too deep depending on your stock thickness. If your stock is exactly .75 inches no changes need to be made. ***It is unlikely that your stock thickness will be the same as the example.***

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