How to make a Torsion Box for a Shapeoko XXL

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This document is to discuss the construction of a torsion box to set a Shapeoko XXL CNC Router on. This torsion box will be 47.75” x 48” x 5”. I will discuss how and why I made my torsion box.

This document is for entertainment purposes only. User assumes all responsibility for their own personal safety. Read the instructions and understand the use of all tools before use.

How does a torsion box work?

A torsion box consists of two layers of material (skins) on either side of a lightweight grid, usually a grid of beams. It is designed to resist torsion under an applied load. A hollow core door is probably the most common example of a torsion box (stressed skin) structure. However a torsion box used to hold up a machine is different from a torsion box hollow core door. The skins are important in that they can take the weight and/or abuse for the surface for the purpose of the intended use. The height of the ribs/grid inside are what make the skins resistant to compression and tension. So a very thin top and bottom with a narrow rib/grid would not be very resistant to compression and tension. So you must balance the need of your torsion box for the purpose it is built. A hollow core door does not have much stress on it other than its own weight and the occasional slamming. A torsion box to hold up a Shapeoko XXL that weighs 150 pounds/68KG is different. I have searched for a scientific formula to build a torsion box to purpose but I have not found a formula. From experience I designed my torsion box to hold my Shapeoko XXL without being crushed and provide a solid base for it to sit on. The strength of a torsion box is the skins being held in position by the ribs/grid. The torsion box works like an I beam or many I beams that are cross linked and secured together.

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I choose Maple Plywood over MDF because the Maple Plywood is lighter and has more strength than MDF. I feel the Maple Plywood is easier to work with and holds screws better. However MDF would work fine with the same dimensions because of the nature of a torsion box. Thinner plywood could be used but the cost is almost the same and with the ¾ inch (18MM) plywood I know my torsion box will hold up for its intended purpose. I would avoid oak plywood due to oak's open grain. Also I would avoid pine plywood because of pine's softness.

This torsion box consists of two skins that are 48"x47.75"(approximately), two 48"x3.5" side pieces, two 46.25"(approximately)x 3.5" side pieces, 3 internal ribs that are 46.5"(approximately)x3.5" and 3 internal ribs that are 46.25"(approximately)x3.5" ribs. The six internal ribs are half lapped to join them together in a strong interlocking grid. The sides and internal grid pieces are screwed and glued to the base and each other with Kreg Pocket Hole Screws. The top skin is secured with glue and 4 screws or nails and/or pins. I finished the outside of my torsion box with Dewaxed Shellac and MinWax Polyurethane Oil Based Finish. The finishing is optional but I wanted to seal out moisture and make my torsion box look presentable.

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Materials Needed:

2 Sheets Maple Plywood (MDF or other Plywood is also acceptable)
100 1.25” Kreg Course Pocket Hole Screws
1 Eight Fluid Ounce Bottle of TiteBond III Glue (This is water proof and gives you longer open time)
4 1.25” #6 Flat Head Screws and/or 1.25” nails/pins
1 Quart Zinzer Universal Sanding Sealer (Dewaxed Shellac) (Can be used with oil or water based finishes)
1 Quart MinWax Polyurethane Fast Drying Oil Based Finish

Use of water based finish is ok but raises the grain so pre raise the grain and sand down the raised grain.

I prefer oil based because it penetrates the wood and gives a slight amber color to the white maple plywood.

Tools Needed:

Table Saw (Track Saw would work)
Circular Saw with Kreg Rip Cut or similar (Track Saw would work or Shooting Board)
Drill with Clutch
#2 Roberts Square Drive Bit
Kreg Pocket Hole Jig with Step Drill
Router with bottom bearing router trim bit
Minimum of 12 Six Inch Clamps
Random Orbit Sander with 150, 400 and 600 Grip Sandpaper or Sanding Block
Dado Set
Shooting Board for Circular Saw with 4’x8’x3/4” Rigid Foam
Various other tools as needed or required

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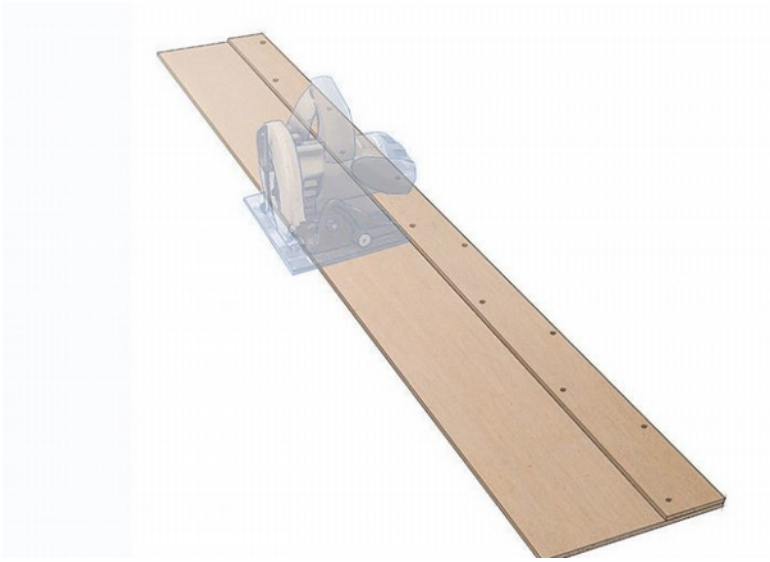
Construction Steps

1. Rip a 4’x8’ piece of Maple plywood in half making two 4’x4’ pieces. My piece of plywood was exactly 96” x 48” which meant that I would get two pieces of plywood 48” x 47.875” approximately. I then trimmed the pieces down to 48”x47.75” with a router and a bottom bearing router bit.

a. I used a shooting board to cut the plywood down to size sitting on a 4’x8’x.75 inch rigid foam sitting on a concrete slab to minimize tear out and support the plywood while cutting so it does not fall like when cutting on a saw horse. The plywood could be cut on a table saw but I find that cutting large sheets of material on a table saw is dangerous and hard to control. If you use the foam on a hard surface be sure to set your blade height so you cut through the material and about a quarter of an inch into the foam. You do not want to cut through the material and foam into the hard surface below. Alternately you could set up two saw horses and lay several 2x4s across the saw horses and place the foam on top of the 2x4s and then the plywood. This would support your plywood and keep it from falling from the saw horses. I do not recommend only putting the plywood on the saw horses and cutting due to the unstable nature of only two saw horses and the weight of the plywood and your ability to keep control of the plywood after cutting.



b. See youtube.com for videos about making a shooting board for a circular saw. Here is one example from This Old House TV Show: https://www.youtube.com/watch?v=qIeIZdrbz-Y. I use my shooting board and foam to break down large sheets of plywood safely and securely. I can cut manageable sizes to finish trimming on my table saw for other projects with the shooting board. If you make a shooting board you can find many uses for it.

2. After ripping the plywood in half use one of the factory edges on the bottom and flip the other half of the plywood over so the cut edge is lined up with the factory edge at the 48” length. Even up the piece so a small amount of the cut edge is just over the edge of the factory edge and use the trim router to cut plywood edge even with the factory edge. Then flip the two half pieces over and repeat on the

other edge of the plywood trimming the edges on the short side of the plywood pieces to match each other. The finished plywood pieces will be 48” x 47.75” approximately. The exact size of the shorter side of plywood is not important because later we will measure and custom cut the ribs/grid to match the individual pieces. However both pieces must identical in size.

3. Set these two pieces aside and protect them from damage.

4. With the second piece of plywood use the Kreg Rip Cut Jig and a Circular saw (shooting board or similar) to cut 4 inch pieces of plywood. Cut 12 pieces 4” x 48”. You will need 10 pieces to make the sides and grid of the torsion box and the extra pieces are spares and can be used later to test dado sizes for making half lap joints for the grid.

5. Trim one side of the 48” x 4” pieces to 3.75” on a table saw. Stack the pieces so the fresh cut sides are all on the same side. After all 12 pieces are cut to 3.75” run the pieces through the table saw again on the opposite edge and make the pieces 3.5” exactly. Try to cut these pieces on the same setting to get them as consistent as possible. The 3.5” size is not as important as that all 12 pieces are exactly the same size. It is critical that the pieces are identical in height to make the internal grid uniform and work perfectly. You may find the ½ inch wasteful but if you cut the pieces much narrower you get a lot of sawdust thrown in your face on the table saw.

6. Now take two of the 48” x 3.5” pieces and cut 10 pocket holes using the approximate pattern below. The two pieces will become two of the outside pieces of the internal grid of the torsion box on the 48” sides of the plywood base. Starting at one end place the pocket holes at 2”, 4”, 8”, 16”, 20”, 28”, 32”,

40”, 44” and 46”. Avoid any holes near 12”, 24” and 36” locations because later these areas will have the ribs/grid placed there. Exact placement of the pocket holes is not necessary, just close enough is alright.

7. Place one of your panels on a flat surface to start the assembly process of the torsion box. There are many videos on youtube.com about making a dead flat temporary surface to assemble your torsion box. It is important that you assemble the torsion box on a flat surface. A good video on making a temporary assembly for your torsion box can be found at https://www.youtube.com/watch?v=1-Hbsou6cWo. However there are many other videos available for making a flat temporary assembly area. Just remember if your surface used for assembly is not flat your torsion box may not be flat and that defeats the purpose of making the torsion box in the first place.

8. After getting your bottom panel on your flat surface and drilling the pocket holes in the first two sides apply glue to the bottom of the two side pieces and spread with a glue brush. Place one side at a time with glue and clamp the piece in place perfectly lining up the ends and the edge of the base on the 48” side of the base. Screw down the side piece with Kreg pocket hole 1.25” course screws. Make sure everything is lined up and stays lined up while screwing down the side. If you do not clamp the pieces in place the pocket screws have a tendency to make the wood skate and move out of place. After gluing and screwing the piece in place you will have some glue squeeze out. I prefer to clean up the glue when it is wet using a wet sponge. Some people like to wait a few minutes and scrape the skinned over glue. Which ever method you use removal of the glue squeeze out is important for later assembly. After getting the first piece placed install the second piece the same as the first piece, cleaning up the glue squeeze out. Now you have two sides installed across from each other on the 48” side of the plywood base.

9. Now that the first two outside pieces of the grid are installed measure each end and cut two pieces the exact measurements needed, each piece should be exact for its position not exactly the same as each other. If you have cut everything square they will be exactly the same but if they are a little bit off it will be alright. It is important that these pieces fit exactly with a friction fit that does not require hammering it in place. Equally important is that the pieces just fit and are not too short. You want a Goldilocks fit, not too tight, not too loose, just right with a smooth friction fit. After you get these two pieces cut and fitted you need to drill three pocket holes on each end. These will secure the two pieces to the other two previously mounted sides. Also drill 8 pocket holes spaced approximately at 4”, 8”, 16”, 20”, 28”, 32”, 40”, 44”. These pocket holes will secure the sides to the base skin. After the pieces are drilled spread glue on the bottom of each piece and screw in place one at a time. It is important to clamp these pieces down before securing with the pocket screws. Without the clamps the pieces tend to move out of place. It is important that these pieces line up perfectly with the outside edge of the base and with the outside edges of the two existing sides. Recommend you screw the sides on both ends to the base before screwing the ends to the sides of the existing pieces. Again clean up any glue squeeze out with what ever method you prefer but clean it up.

10. With the 4 outside edges in place you can select three of the rib/grid pieces and at approximately 12”, 24” and 36” locations on the outside edges trim these pieces individually to fit between the two 48”x3.5” side pieces. The pieces will be approximately 48”-1.5”=46.5”. After fitting the pieces in

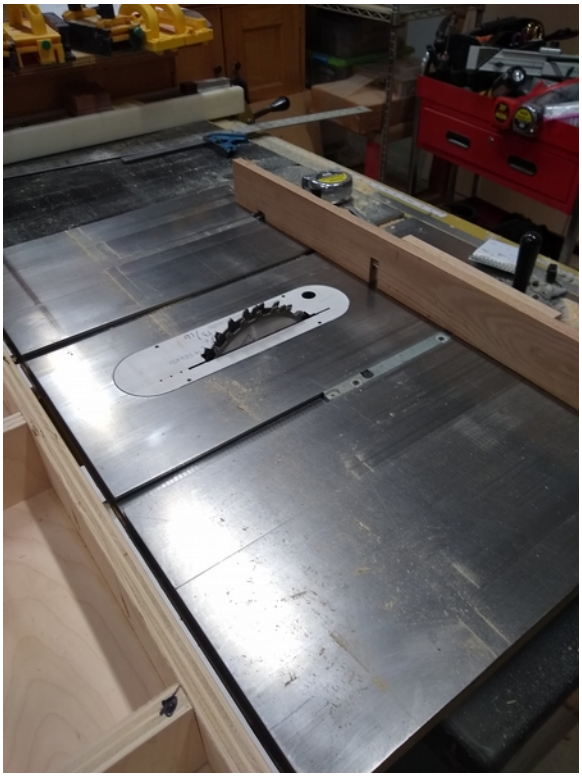
place drill three pocket holes in each end and 8 pocket holes in the bottom edge using the approximate spacing of 4”, 8” 16”, 20”, 28”, 32”, 40” and 44”. After all 3 pieces are cut and drilled place them in their approximate places at 12”, 24” and 36” but do not secure them at this time. Also mark on the side pieces and the 3 ribs numbers 1, 2 and 3 on one end only and on the top surface to keep them separated and for use later on. The marks will make sure if the ribs are slightly different in length they will be placed in the correct spot later on. The numbers will also be used to index the pieces when cutting the half laps.

11. Now remove the 3 ribs marked 1,2 and 3. Now pick 3 more ribs and at the 12”, 24” and 36” positions fit ribs for a friction fit like the first three. These three ribs will be perpendicular to the ribs 1, 2 and 3. Mark these ribs 4, 5 and 6 like you marked the first three. Place the mark on the top side and on only one end. These marks will be used later to place these back in their places and as a reference when cutting the half laps. Now cut 3 pocket holes in the ends of all 3 ribs and also cut 8 pocket holes at the approximate spacing of 4”, 8”, 16”, 20”, 28”, 32”, 40” and 44”. Avoid any pocket holes near the 12”, 24” and 36” spacing. These holes do not need to be perfectly placed the approximate location is acceptable. Do not secure these ribs in place at this time. The ribs will be secured later when all the half laps have been cut and the grid is assembled.

12. Now you can cut the half laps in pieces 1, 2 and 3. The placement of these half laps are approximate but all 3 pieces must have their half laps in the exact same spot. I used a Rockler Cross Lap Jig but you can make a simple jig (see Optional Finger Joint Jig) to make the half laps in a consistent location of all pieces.

a. Using the Rockler Half Lap Jig. Follow the setup instructions for the Rockler Cross Lap Jig. Start by measuring your plywood and set up a dado blade exactly the width needed. You do not want these dado groves too loose or too tight. The Goldilocks fit is what is needed. The ribs are 3.5” high so you want to set the dado height to 1.75” + 0.005”. The half laps need to be just a little deeper than half the width of the 3.5” ribs. It is not necessary that the half laps fit in the middle perfectly in fact a little space is desired where the half laps meet. During assembly we want to avoid the two intersecting ribs from not seating all the way. With the dado tested so the plywood rib pieces fit together with a friction fit use one of the dado to set the fingers on the Rockler Cross Lap jig. After the fingers are set to the width of the dado move your fence away from the right side of the blade to 11.5 inches from the right side of the blade to the left side of the finger on the Rockler Cross Lap Jig. Lock down your fence and you will use this setting for all the half lap

b. To make the dado on the ribs 1, 2 and 3 set the #1 rib with the number marking its position down on the table saw top with the number on the right and with the pocket holes facing up. Place the right hand edge of the board on the left side of the left side finger. At this time the board will fit over the fingers. Run the board through the dado stack and this will cut the first dado and also make a zero clearance cutout in the fence. Now flip the board 180 degrees so that the #1 mark is on the left side end and against the table saw top. Now cut the second dado in the opposite end of the rib. After the second dado is cut flip the board around 180 degrees placing the first dado over the Rockler Cross Lap Jig Fingers and cut the third dado. The important thing is that all three ribs 1, 2 and 3 are cut the same way in the same place so all three of the dado line up perfectly. Now cut the #2 and #3 ribs the same way.



This is a custom fence made from the Rockler Cross Lap instructions.

c. Now you can cut ribs 4, 5 and 6 exactly the same way you cut ribs 1, 2 and 3 except you will cut ribs 4, 5 and 6 with their number facing up and their pocket holes facing down. This will make ribs 1, 2 and 3 fit together with ribs 4, 5 and 6.

d. Now place ribs 1, 2 and 3 on the base skin. Then place ribs 4, 5 and 6 on the first three ribs. If cut properly the ribs should line up just fine. The grid pattern will not be perfect but it is not required to be perfect to work. If you want to have a perfectly symmetrical grid you can spend the time to figure out exactly the spacing on the Rockler Cross Lap Jig or your homemade Finger Jig. Take a pencil and mark out the outline of the entire grid on the base skin. After you get the pencil lines drawn remove the whole grid as one piece if possible. If it falls apart reassemble the grid outside of the torsion box. Now use your glue bottle to apply glue to the inside of the pencil marks made previously. Place the assembled grid in the torsion box and secure all the pocket screws to the bottom skin. Secure ribs 1, 2 and 3 first and then ribs 4,5 and 6. When all the ribs are secured to the base then secure the pocket hole screws to the sides of the torsion box. Follow the directions for the glue and allow it to dry.

e. After the glue is dry use a random orbit sander or sanding block to make sure each intersection of the grid is flat. You do not want one rib higher than another. Sand flat if necessary. If you cut everything consistently and the dado just a little deeper than center everything should fit without much adjustment. Clean up the torsion box with a vacuum to get any dust removed. You could also use a tack rag on the surfaces of the ribs and sides.

13. You are now ready to attach the top to the bottom, sides and ribs. I recommend you attach 3 blocks to three sides of the torsion box. This will aid in aligning the top when you place it on. The combination of glue and the heavy top will make it slide around and you want the top to be in perfect alignment with the sides and base. When you get the top in alignment use a screw in each corner or a nail/pin to keep the top from sliding around. You can remove the 3 blocks to keep them from being glued to the torsion box because of glue squeeze out. Use the six inch clamps to clamp down the perimeter of the torsion box. Place a heavy object in the middle of the torsion box to help hold down the middle. If you have long reach clamps you can use them but most people do not have clamps that will reach further than 8-12 inches. You can use cauls and clamps on the top but for this one project I would not make special cauls. Clean up the glue squeeze out with your prefered method. Let the glue dry completely.

14. The torsion box is now ready for finishing if you want to finish it. Sand the whole box to 150 grit paper with a random orbit sander. Vacuum the torsion box off or use a tack rag. Put the top of the torsion box down and apply Dewaxed Shellac to the bottom and the 4 sides and let it dry. Sand the torsion box bottom and 4 sides with 400 grit sand paper. Vacuum or use a tack cloth to remove any dust from the torsion box. Apply MinWax Polyurethane Oil Based topcoat on the bottom and the 4 sides. Let the finish dry and flip over the torsion box so the top is now up. Sand to 150 grip if you have not previously sanded the top. Vacuum or tack off the surface and the 4 sides. Apply Dewaxed Shellac to the top and let dry. After drying sand to 400 grit and vacuum or tack off the dust. Apply a

coat of MinWax Polyurethane Oil based finish. You can coat the sides again but make sure you get any drips from the top off the sides and do not let them dry with the drips in place. When the first coat on the top and the second coat on the sides are dry sand to 600 grit sand paper. Vacuum or tack off the dust. Apply a second coat of poly on the top and the 4 sides and let dry.

15. The bottom can be coated again with polyurethane but it is not necessary. Evaluate the top and sides and apply a 3rd coat if you think it is necessary. I only applied the Shellac and Polyurethane with two coats. The Shapeoko will set on top of the torsion box and only the front edge will get any wear. For me the 3 coats of finish, shellac and 2 coats of poly, are enough but you can apply as many coats as you think are necessary for your shop environment.

16. With an assistant or two move your Shapeoko weighing 150 pounds from its existing location and install your torsion box securing it to a stand. Be sure the torsion box is secure because it will be holding a 150+ pound moving mass. Then place your Shapeoko on top of the torsion box with the help of an assistant or two. You will want to check your Shapeoko bed is level in all directions. It would be a good idea to level your spoil board with a fly bit now that you have a secure level base for the Shapeoko to sit on. I would be a good idea to check out Winston Moy's youtube video about squaring and leveling your Shapeoko. https://www.youtube.com/watch?v=P4VverLXpCI. There are many more videos on youtube and other websites about this subject.

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Optional Steps

1. You may want to place some blocks around your leveling feet to keep the Shapeoko from being accidentally moved. After you get your machine square and level you do not want it moving around. Eight small blocks placed on the perimeter will help keep your Shapeoko from moving around. You can screw or nail these little blocks in place. You will need to move your Shapeoko to put these blocks on so do not level your machine until after this optional step is done. On some Shapeoko's the middle will sag from its own weight. You may need to measure how high your Shapeoko is off the surface of the torsion box and put a block of material under the center of the Shapeoko to keep it from sagging.

2. Another option would be to remove your leveling feet from the Shapeoko and place a sheet of 3/4" rigid foam on the torsion box and set your Shapeoko on top of that foam. If you do this check your level and you may need to level your spoil board after placing the Shapeoko on the foam.

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Optional Finger Joint Jig

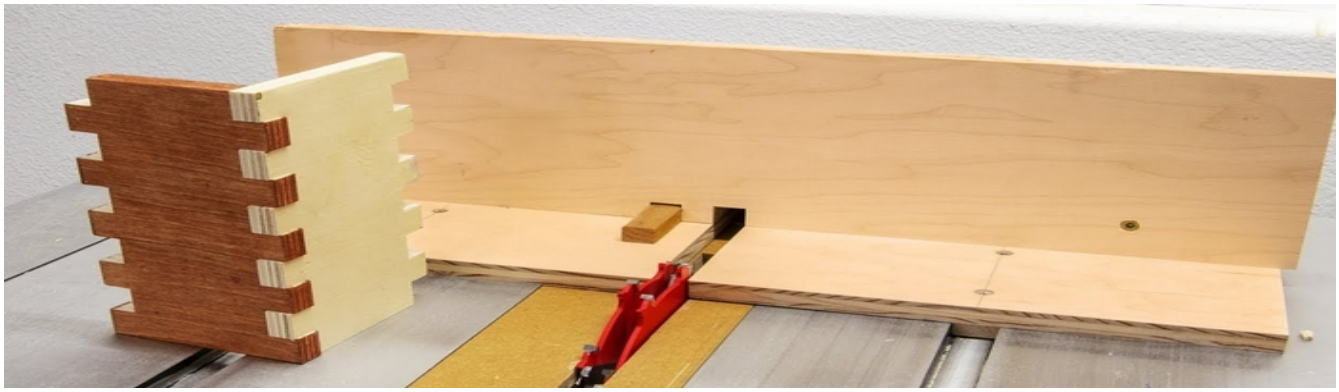
If you do not have a Rockler Cross Lap Jig you can easily make a jig to cut your dado joints for this project.

a. Cut a piece of solid wood or plywood that is 24 inches long by 3.5 inches and is ¾ inches thick to make a custom fence for cutting your dado.

b. Set up your dado stack to cut the dado and after it is confirmed the correct size place your fence on a suitable miter gauge and about three inches from the right side of the of the fence cut a dado in the fence. Remove the fence and glue in a piece of the torsion box plywood to form a finger which you will use to index your dado cuts. The plywood piece should be long enough to stick out about half an inch on the back side of the fence and stick out ¾ of an inch in the front making the finger approximately 2” long. The exact length is not important but the width is very important because it indexes the dado for the middle dado on each rib. Clean up any glue squeeze out, this is very important that you do not have any glue obstructing around the finger.

c. Place your fence on your miter gauge and secure it so that the right edge of the dado stack is 11.5 inches from the left side of the plywood finger you glued up in the previous step. Now follow the steps for using the Rockler Cross Lap Jig from step 12 above.

This image is similar to what I am suggesting you make. The key will be further away from the blade and there is no need for the base. This is the closest example I could find for a home made jig.



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Leveling your Spoil Board Considerations

After getting your Shapeoko XXL set up on the new torsion box you need to level your spoil board. There are several considerations to make concerning the parameters of the cutting area of your Shapeoko and the size of your spoil board. The factory specifications for an XXL say that the cutting area is 32"(X) x 33"(Y) x 3"(Z) . The X and Y areas are true but misleading. The actual cutting area of your Shapeoko XXL on a spoil board that is on top of your machine base is more like 32” (X) x 29.5” (Y). This discrepancy is not false advertising by Carbide3d but part of the Y cutting area extends off the front of the Shapeoko. You can get 33” of cutting area but your spoil board is usually contained withing the confines of the frame of the Shapeoko. Plus you want to level your spoil board past the edges of the spoil board. You do not want to leave a lip around the very outside of your spoil board.

My spoil board on top of my base measures 29.25” (X) x 32” (Y). I have about half in inch between the spoil board and the front steel base plate. My Shapeoko is capable of cutting the Carbide3d specifications but only if I cut off the front of the machine.

It is important that you find the limits of your Shapeoko so you do not try to cut outside the real boundaries of your Shapeoko. To figure the real range of your Shapeoko you need to jog your machine from the extremes of X and Y and measure these distances. Jog your machine to the front left corner and set the X zero. Then jog the machine to the right until it stops. The Carbide Motion screen shows the exact measure you were able to move in the X direction. Now set the Y Zero and jog your machine to the rear until it stops. This is the maximum distance you can move your machine in the Y direction. The Carbide Motion Jog screen shows the exact measurement. Write these measurements down. You can check what your machine is set at by going into the MIDI interface and typing “$$” and Enter. Then look at these parameters in the log:

$130=845.000 X Max travel, mm

$131=850.000 Y Max travel, mm

$130, $131, $132 – [X,Y,Z] Max travel, mm

This sets the maximum travel from end to end for each axis in mm referenced from the home position. So you want your spoil board to fit inside these measurements and be slightly smaller so you can level the entire spoil board.

These settings represent the maximum travel from the homing position that the controller will allow the X and Y axis to travel. You can change these settings and possibly get a little bit more room but these are the safe settings for the design of the machine. The X travel for an HDZ can be increased if you do not have the Suckit dust collection system. The Suckit dust collection reduces the X travel for an HDZ to prevent crashing into the Y Axis rails because the Suckit dust collection is wider than the Z carriage. Previous versions of Carbide Motion had default HDZ settings for with and without Suckit dust collection. In version 5.35 it appears they simply put the default in for the Suckit dust collection system by default. You could increase the X travel and find your absolute maximum travel but be careful you do not crash your Shapeoko. You will not gain much but it is customizable I just made

sure my spoil board fit inside the maximum default travel measurements. Another brand of dust collection may also stick out beyond the confines of the Z carriage. So consider that when setting the maximum X travel.

Leveling your Supplemental Spoil Board for a Shapeoko XXL

To start the leveling process make sure if you have anything attached to the spoil board you remove it. If you have fences remove them as well. Next you want to put pencil marks all over the spoil board. The pencil marks help you identify when you have the whole spoil board level. Without the pencil marks it is hard to tell if your spoil board has been completely surfaced.

For me I like to make my origin in the center of the spoil board for leveling. This makes sure I cut all the way around my spoil board. If you start from the lower left you could leave material on the back and right side of the spoil board. This is personal preference. Use a straight edge to mark from corner to corner and find the center of your spoil board. Measure your spoil board exactly and when you create your Carbide Create file make the material just about a quarter of an inch larger than your actual spoil board. My actual dimensions of the spoil board were X=32” and Y=29.25” so in Carbide Create I made my material 32.25 Wide and 29.50 Tall. This gives me a little overlap for my Whiteside 6210 1” Fly Cutter.

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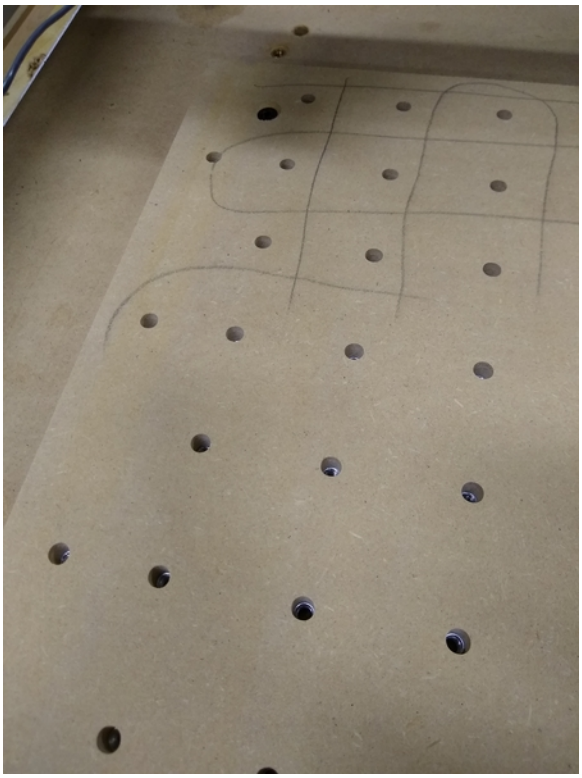
Draw a box that matches your material size and use the alignment tool and align the box to the stock centered in both directions.

Choose a tool path to pocket the box you drew. I have a custom tool created that removed 0.010” per pass and has a 50% stepover for a 1” fly cutter. I set the depth of the pocket 0.010” from the top so I get a single cutting pass. Save your gcode and your Carbide Create File.

Upon opening your Carbide Motion connect to your machine **but do not initialize**. Instead go to the settings and disable the BitSetter if you have one, be sure to send the configuration. The position of the BitSetter could cause it to be hit by the fly cutter. The large 1” bit will not properly hit the BitSetter button anyway so just disable it in software and send the configuration. Mark the location of your BitSetter and remove it from the Shapeoko base. After the configuration is sent you will be prompted to initialize. Initialize and get set up to set your zeros.

Insert a 90 degree Vee bit. It is much easier to set the origin at the center with the vee bit. Jog your machine over the mark you created earlier and set your X and Y zero only. You will set the Z zero after you replace the 90 degree Vee bit. After setting the X and Y zero replace the Vee bit with your fly cutter. Jog to the center and set your Zero using the paper method. You are now ready to surface your spoil board.

Start your gcode and let the surfacing complete. Upon completion inspect the spoil board for any residual pencil marks. If there are any pencil marks jog to the areas with the pencil marks and set your Z zero in that area. Start the gcode again and resurface the spoil board. The first surfacing you referenced the center of the spoil board for Z zero. If required a second time set the zero where the pencil marks are still remaining. This saves time in surfacing and not wasting time zeroing on high spots and leaving low spots uncut if your spoil board is very uneven.



Hopefully two times will be enough but if required repeat until the whole spoil board is smooth with no pencil marks remaining.

Your spoil board should be smooth and ready to machine on. If you have ridges left in either the X or Y direction you may need to level your router mount. There are many videos on youtube to do this. If you need to level your router then repeat the spoil board surfacing until it is smooth and level. If you had fences then reattach them at this time.

If you have a BitSetter go into the configuration and check the BitSetter and send the configuration. Confirm the BitSetter is reattached in the same place and if necessary calibrate its position from the BitSetter installation instructions. If you marked the location precisely you not need to calibrate the position but be sure to check it.

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Specifications and GBRL settings for Shapeoko XXL

Will Adams recently posted these specs for the default paramaters of different machines and configurations on the Carbide3d Community Forum.

Shapeoko Default Sizes for GBRL Configuration

To allow folks to confirm their Grbl configurations, here are the settings for:

Setting	Belt Drive Z-axis	Z-Plus (inc. Pro)	HDZ
$100	40	40	40
$101	40	40	40
$102	40	200	320

The Travel Dimensions for the various machine sizes and options are:

Machine size and Z-axis type	X	Y	Z
Shapeoko 3 Standard Belt Drive	420	430	100
Shapeoko 3 Standard Z-Plus	420	430	95
Shapeoko 3 Standard HDZ	420	430	140
Shapeoko XL Belt Drive	830	430	100
Shapeoko XL Z-Plus	830	430	95
Shapeoko XL HDZ	830	430	140
Shapeoko XXL Belt Drive	830	850	100
Shapeoko XXL Z-Plus	830	850	95
Shapeoko XXL HDZ	830	850	140
Shapeoko Pro XL	870	440	95
Shapeoko Pro XXL	870	850	95

Note that it is possible to increase X-axis travel if using an HDZ w/o a dust collection system which limits X-axis travel.

Shapeoko XXL GBRL Configuration Carbide Motion 5.35

$$

$0=10	Step pulse, microseconds
$1=255	Step idle delay, milliseconds
$2=0	Step port invert, mask
$3=2	Direction port invert, mask
$4=0	Step enable invert, boolean
$5=0	Limit pins invert, boolean
$6=0	Probe pin invert, boolean
$10=255	Status report, mask
$11=0.020	Junction deviation, mm
$12=0.010	Arc tolerance, mm
$13=0	Report inches, boolean
$20=0	Soft limits, boolean
$21=0	Hard limits, boolean
$22=1	Homing cycle, boolean
$23=0	Homing dir invert, mask
$24=100.000	Homing feed, mm/min
$25=2000.000	Homing seek, mm/min
$26=25	Homing debounce, milliseconds
$27=3.000	Homing pull-off, mm
$30=1000	Max spindle speed, RPM
$31=0	Min spindle speed, RPM
$32=0	Laser mode, boolean
$100=40.000	X steps/mm
$101=40.000	Y steps/mm
$102=320.000	Z steps/mm (HDZ)
$110=10000.000	X Max rate, mm/min
$111=10000.000	Y Max rate, mm/min

$112=1300.000	Z Max rate, mm/min
$120=500.000	X Acceleration, mm/sec^2
$121=500.000	Y Acceleration, mm/sec^2
$122=100.000	Z Acceleration, mm/sec^2
$130=845.000	X Max travel, mm
$131=850.000	Y Max travel, mm
$132=150.000	Z Max travel, mm (HDZ)

$130, $131, $132 – [X,Y,Z] Max travel, mm

This sets the maximum travel from end to end for each axis in mm. Carbide Motion enforces these settings and not the GBRL settings.