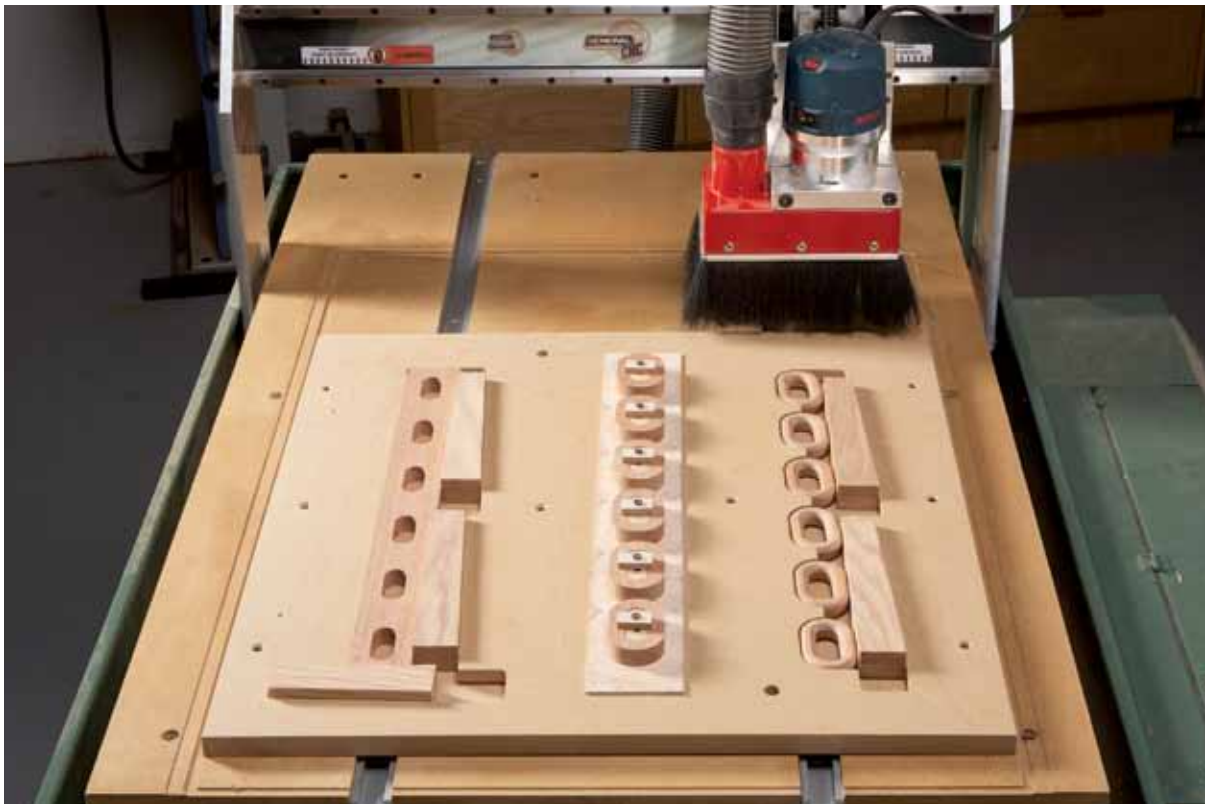
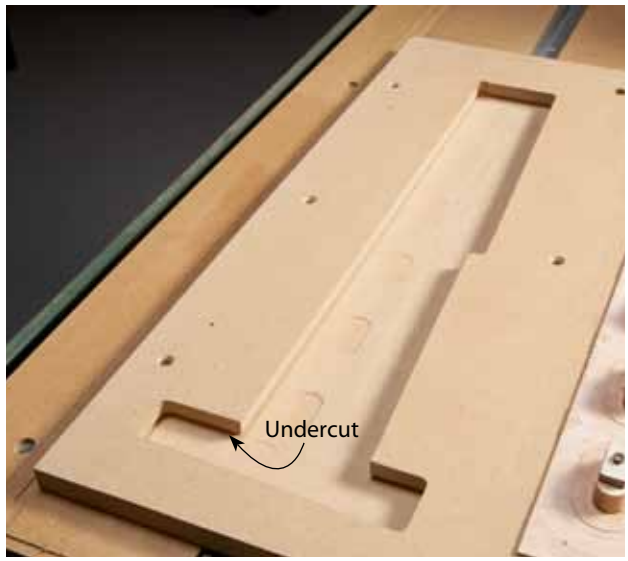
By Randy Johnson

CNC Wooden Chain

Lessons in small parts jigging.

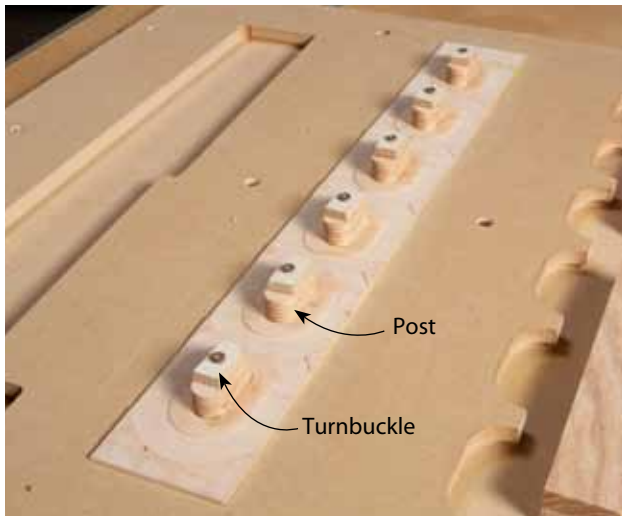
MY INSPIRATION for this project came from a wooden chain I made years ago using a handheld plunge router and plans from Patrick Spielman's *New Router Handbook* (1993). Since making the chain involved routing a bunch of the same parts, it seemed like a good project for a CNC. Patrick used a one-link-at-a-time routing jig setup that partly relied on the router's base to hold the links steady during routing—something not possible with a CNC. So making the links on the CNC became a good exercise in designing CNC small parts jigging. I had three goals in mind while developing the jigs. I wanted them to be simple to make, easy to use, and sufficiently durable. After trying various methods involving clamps and hold-downs, I settled on a combination of recessed cutouts, wedges and small turnbuckles. But the real secret to these jigs came from the CNC's ability to easily and precisely create matching parts that fit snugly together like puzzle pieces.





Jig 1: Routing Inside the Links

Rather than make this jig out of separate pieces of wood, I found it easier to rout it as a recess in a piece of MDF. I used three wedges to hold the workpiece in place while routing. The bottom wedge forced the workpiece tight against the upper end of the jig, while the two side wedges pushed the workpiece to the left. The wedges were also created with the CNC, so matching the tapers in the recess to the angle of the wedges was a breeze. The wedges have a 1 in 20 taper, which made them easy to secure and remove with a couple stiff mallet taps. The wedges proved very secure, as they never once vibrated loose during routing. I also routed an undercut around the bottom of the recess with a T-slot router bit. The undercut insured that the workpiece didn't hang up on any stray wood chips at the bottom of the jig.



Jig 2: Routing Outside the Links

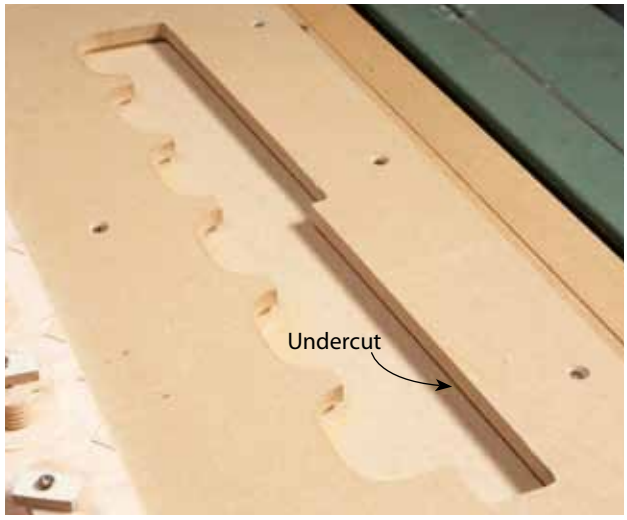
Creating the second jig required the most experimenting. I initially created it as a recess similar to jig 1, but the MDF proved too weak and the center posts easily broke off. A piece of Baltic birch plywood glued to the top of the MDF created a much stronger jig. I made the center posts .05" shorter than the thickness of the work piece. This made it easy to apply pressure with the turnbuckles. The center posts were also .05" smaller in diameter than the inside of the links. This slight gap was needed so the workpiece could slide onto the posts without binding, but was still snug enough to prevent the workpiece from shifting during routing. A couple workpieces were slightly warped, which made them hard to slip on to the center posts. A few taps from a mallet solved that problem. Once the links were routed into separate parts, they were easily removed.

Rounding Over the Outside

Jig 2 served a dual purpose. Once all the links were routed into separate parts, I switched to an ovolo bit and rounded over the outside corners. The links were flipped over to do the other side. The snug fit on the center posts and the turnbuckles helped to hold the link securely in place for this step.

Only Three Bits are Required

The 1/2" dia. straight bit did the heavy work of removing stock from both the jigs and the chain links. The slotting bit created the undercut at the bottom of jigs 1 and 2 to prevent stray wood chips from getting in the way. The 1/4" radius ovolo bit gave the links their round shape.



Jig 3: Rounding Over the Inside

Similar to the first jig, the third jig used wedges in a recess to hold the parts in place. This jig really took advantage of the CNC's ability to cut parts that fit together like a glove. The recessed pockets for the links were cut the same size as the link, without any clearance gap. This created a very snug fit and required a couple extra mallet taps on the wedges to make sure the links were fully seated. This snug fit insured that the links didn't move or vibrate while I rounded over the inside corners. After the first side was done, I flipped the links over to rout the other side.

Note: Although CNC's are capable of precise machining, you should always test your setups and adjust the dimensions of your jigs, parts and tool paths to accommodate slight variations in materials and bit diameters.

A Quick Sanding

Sanding each link took a minute or two per link, but removing the machine marks at this stage was easier than doing it after assembly. Next time I'll use a flap sander or inflatable drum sander and save my finger tips.

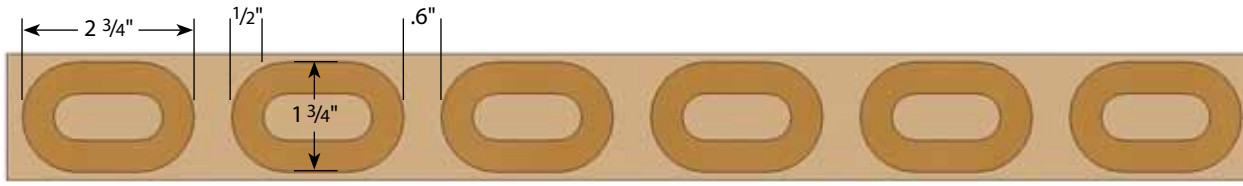
Break Every Other Link

A quick hit with a mallet was all it took to crack the links in half. I used quartersawn boards for this project because when broken, they tend to create flatter joints than plainsawn wood. The flat joints made reassembly easier.

Okay, it's kind of cheating—but it works.

Glue and Clamp Back Together

I assembled the chain by adding two unbroken links to each broken link. Then I assembled these three link sections with more broken links until the chain was complete. Because the links were broken on the grain, the glue joints were nearly or completely invisible. Using a light application of glue and removing the squeeze out while it was still soft made cleanup sanding easy. After it was done, I dipped the chain in an oil finish a couple of times and rubbed it dry with a cloth.



The Dimensions

The six links started out as a board measuring 5/8" x 2" x 20". The .6" spacing between the links provided the necessary clearance for the 1/2" dia. straight bit and the bottom end of the ovolo bit. The six links produced 11-1/2" of finished chain. Drawings for the three jigs can be downloaded at AmericanWoodworker.com/CNC.