

Gimbal Jig

How to use a plunge router to scoop out a curved seat.

by Alan Turner



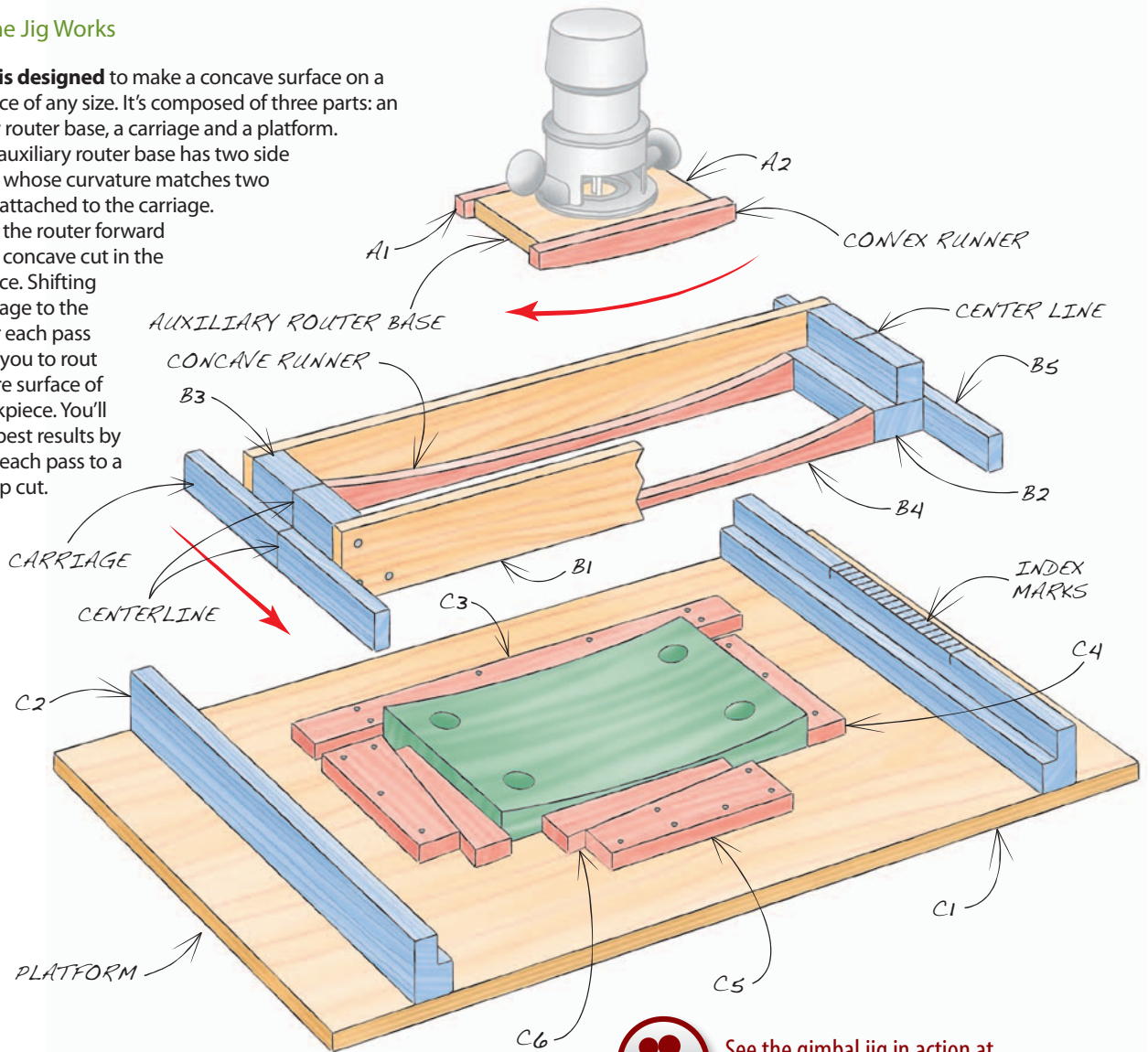
OK, HOW DO YOU MAKE A CONCAVE SEAT? I designed a stool quite a while ago that called for one, but I stalled out trying to decide what approach to take. I considered lots of options—such as using an adze (nope, too easy to screw up), a tablesaw (way too many cuts, and a lot of cleanup), or a bandsaw (again, too much cleanup). The best way, I've found, is to use a router.

Of course, you have to build a device to guide the router—something I call a gimbal jig (see *How The Jig Works*, Fig. A, page 62). It's not very complex, and it's easily adaptable to a seat of any size. All you need is a plunge router and a 1" dia. extra-long straight bit (see *Source*, p. 65). We've used this jig dozens of times at the school where I teach, Philadelphia Furniture Workshop, to build the stool I designed (left).

Fig. A
How The Jig Works

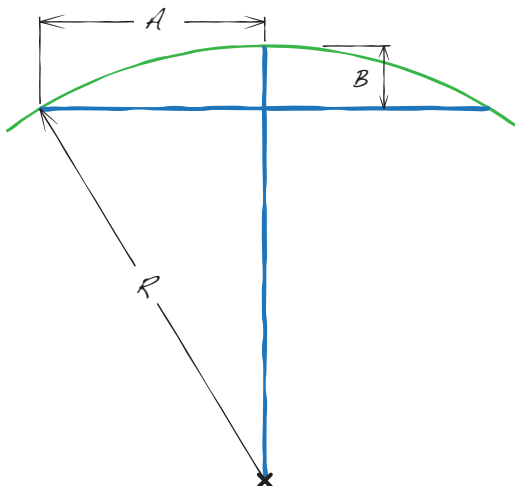
This jig is designed to make a concave surface on a workpiece of any size. It's composed of three parts: an auxiliary router base, a carriage and a platform.

The auxiliary router base has two side runners, whose curvature matches two runners attached to the carriage. Pushing the router forward makes a concave cut in the workpiece. Shifting the carriage to the left after each pass enables you to rout the entire surface of the workpiece. You'll get the best results by limiting each pass to a 1/8" deep cut.



See the gimbal jig in action at
AmericanWoodworker.com/WebExtras

Fig. B
How To Calculate the Radius of An Arc



Have you ever been stumped trying to figure out the radius of a large arc? It's actually fairly easy—with a calculator.

First, draw a line between the two points that the arc will connect—let's call this the run. Mark the midpoint of that line. Next, determine how high the arc will go—let's call that the rise.

Next, use your calculator to convert these numbers to decimals. Finally, use this formula:

$$R = \frac{A^2 + B^2}{2B}$$

R= the radius of the arc

A= 1/2 of the run

B= the rise

For example, for a curve that connects two points 17" apart and rises 1/2", the calculation goes like this:

$$\text{Radius} = \frac{8.5^2 + 0.5^2}{2 \times 0.5} = \frac{72.25 + 0.25}{1.0} = 72.5$$

Make the jig

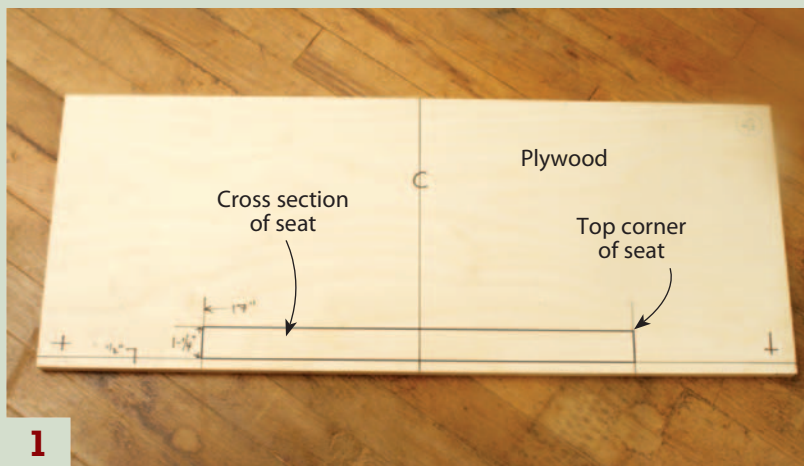
Begin building the jig by making the plywood runners (B4) for the jig's carriage. Baltic birch is the best material—it's strong, stable and doesn't have any voids. Cut a piece of Baltic birch about 6" wide and the final length of the runners—about 10" longer than the seat you'll be routing.

The runners will have exactly the same curvature as the seat. So, how do you accurately draw a curve that large? You'll need a simple formula (Fig. B), a calculator and a really big compass.

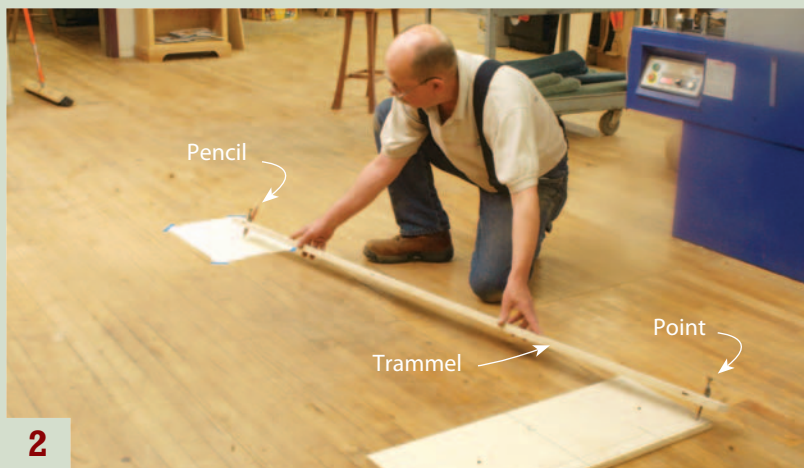
First, draw a cross-section of the seat on the plywood (**Photo 1**). Center the drawing, parallel to the long edge. My seat begins with a blank that is 17" long and 1-1/4" thick. The scoop is 1/2" deep in the middle. Using the formula, I find that the curve has a 72-1/2" radius—just over 6 feet! I'll need some elbow-room to draw a curve this big, so I move everything down to the floor. You'll have to anchor the piece of plywood so it can't move. In our teaching studio—an old industrial loft—I just screw the plywood to the floor.

Next, make a beam compass. I use a pair of trammel points that can be clamped anywhere on a narrow wooden stick. One of the points also holds a pencil; the other has a sharp tip. (While trammel points are convenient, because they're adjustable, you can make a beam compass by drilling a hole for a pencil in one end of a long stick and a hole for a nail in the other end, spaced the correct distance from the pencil.)

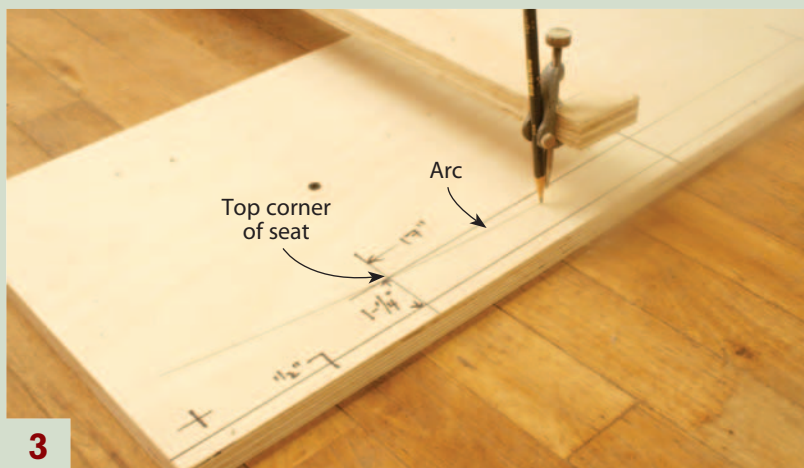
The next step is to find the center point of the seat's curve (**Photo 2**). Tape a heavy piece of paper to the floor (a manila folder works well). Position it about 6' away from the piece of plywood. Place the pointed end of the trammel on the upper right corner of the drawing and draw an arc on the paper. Next, place the trammel's point on the upper left corner of the drawing. Draw a second arc. The intersection of the two arcs is the center point of the curve.



1 **Begin making the jig** by drawing a full-size cross section of the seat on a piece of 3/4" plywood. Tape or fasten the plywood to your floor.



Tip ▶ To find the center of a large curve, make a trammel that's the radius of the arc. Place one end on each point you want to connect (here, the top corners of the seat). From each point, draw a short curve on a piece of paper taped to the floor. The intersection of these curves is the center point of the arc.



3 **Draw the arc.** Turn the trammel around, so the pencil end is on the plywood. Place the trammel's point on the center point of the arc. Draw a curve through the two top corners of the seat. Continue the curve all the way across the board.



4

Saw the arc, staying close to the line. Make another piece just like this one. They will become the jig's runners—the curved parts that guide the router.



5

Fair each runner's curve to eliminate lumps and flat spots. Use an oscillating spindle sander or a drum sander mounted in your drill press.



6

Assemble the carriage that holds the runners.

Turn the trammel around, place its point on the center point, and draw the curve all the way across the piece of plywood (**Photo 3**). You'll need two runners for the jig; repeat the process, using the other half of the plywood for the second runner.

Saw the runners (**Photo 4**). Save the offcuts—you'll need them later. Sand exactly to the line (**Photo 5**). When you're done, make sure both runners are identical.

Mill the other parts for the carriage (B1, B2, B3 and B5) and assemble them on a flat surface (Fig. C). Be sure that the sliders (B5) are parallel to each other. Add the runners (**Photo 6**). Draw a centerline on the outer faces and across the top edges of both sliders.

Build the platform to hold the workpiece (C1 through C6, Fig. D). The base (C1) must be flat, without bend or twist. Position the rails (C2) so the carriage will slide easily. Position the side stop (C4) so the seat will be centered between the rails. After the platform is complete, draw index marks on the right-hand rail. Begin by placing the carriage on the rails. Align the carriage's centerline with the inner edge of the rear stop (C3). Draw one index mark opposite the centerline, then continue the series of marks at 1/2" intervals (half the diameter of the router bit)

down the rail.

Using the offcuts from the runners, build an auxiliary base for your router (Fig. B). Apply a coat of finish to this base's runners, the runners and sliders on the carriage, and the rails on the platform—wherever two pieces slide on each other. Add a coat of paste wax after the finish dries.

Use the jig

Mill the seat blank and secure it to the platform (**Photo 7**). (My seat has holes drilled in it for through tenons—it's best to make these holes before the seat is routed.) Place the carriage on the platform, align the carriage centerline with the first index mark, and clamp the carriage to the platform (**Photo 8**).

Fasten the auxiliary base to your router (**Photo 9**), then place the base and router in the center of the carriage. Adjust the router's depth stop so the bit will cut a maximum depth of 1/2" into the blank. Rotate the router's depth-stop turret so the first pass cuts only 1/8" deep. Pull the router back to its starting position, nearest you (**Photo 10**).

Before you begin, stop to think about three safety issues:

- *Cut only on the push stroke.* If you cut on the pull stroke, you'll be climb-cutting, which can be unsafe.

- *Move the carriage from right to left for successive passes.* You'll be climb-cutting if you move the carriage the opposite way.

- *Use only the left half of the bit.* If your cut is wider than half of the bit's diameter, the router will probably be hard to control. The jig's index marks will limit the width of each cut by the correct amount.

Start the first cut. Push the router down the carriage (**Photo 11**), then pull it back. Turn off the router, re-clamp the carriage at the next index mark and make another pass. Repeat the process until you've routed all the way across the seat.

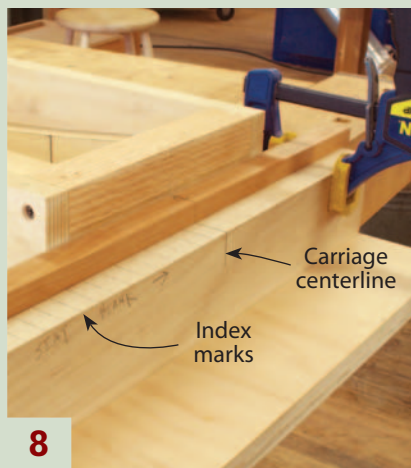
Return the carriage to the first index mark. Adjust the router to cut an additional 1/8" deep and rout the entire seat again. Repeat this once more; you've now gone a total of 3/8" deep. Make two final passes using 1/16" deep cuts.

When you're done, the seat should be fairly smooth (**Photo 12**). I glue the entire stool next, running the legs through the seat. After the glue is dry, I spokeshave the ends of the legs so they're flush with the seat, then lightly sand the seat and the end grain of the legs. 🛠️



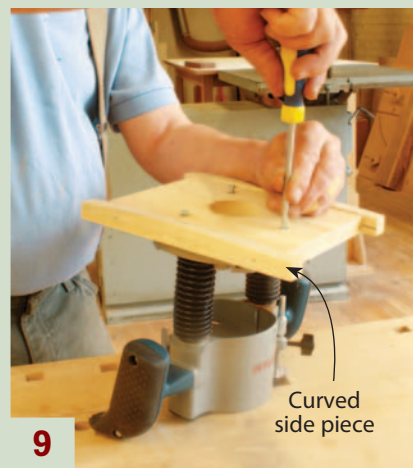
7

Set up the jig for routing. Begin by securing the seat blank to the jig's platform, using opposing wedges.



8

Clamp the carriage to the far right side of the platform. Line up the carriage's centerline with the first index mark on the platform.



9

Fasten a shop-made curved base to your plunge router. The side pieces on the base match the curvature of the runners on the carriage.



10

Place the router in the carriage. Adjust the router to make a 1/8" deep cut in the center of the seat, then pull the router back to the starting position, nearest you.



11

Push the router along the carriage to make each cut. Pull the router straight back to the starting position, then move the carriage to the next index mark and repeat. Make the same cut all the way across the seat.



12

The finished seat. The full scoop requires five passes of the router across the seat, taking 1/8" at a time. For the last passes, set the bit to remove only 1/16", and go slowly.

Cutting List

Section	Part	Name	Qty.	Th x W x L
Auxiliary Router Base	A1	Base	1	3/4" x 5-5/8" x 8" (a)
	A2	Runner	2	3/4" x 13/16" x 9-1/2" (b)
Carriage	B1	Side	2	3/4" x 2-5/8" x 30 (a)
	B2	End block	2	1-3/8" x 3" x 7-1/8"
	B3	End block stop	2	1-1/4" x 1-1/4" x 7-1/8"
	B4	Runner	2	3/4" x 1-3/8" x 27-1/2" (a)
	B5	Slider	2	3/4" x 1-1/2" x 16" (c)
Platform	C1	Base	1	3/4" x 24" x 39-1/4" (d)
	C2	Rail	2	1-3/4" x 2-1/2" x 24 (c)
	C3	Rear stop	1	3/4" x 2" x 24"
	C4	Side stop	1	3/4" x 2" x 7-1/2"
	C5	Fixed wedge	2	3/4" x 4" x 10"
	C6	Loose wedge	2	3/4" x 4" x 7"

Notes: a) Baltic Birch plywood
b) Use offcuts from B4
c) Use offcuts from B4
d) Shop-grade birch plywood



GARTH HERRICK

Alan Turner

is the founder of Philadelphia Furniture Workshop (www.philadelphia-furnitureworkshop.com), a woodworking school dedicated

to traditional furniture built with hand and power tools. Alan teaches a class on building the stool featured in this article.

SOURCE

Whiteside Machine Co., www.whitesiderouterbits.com, (800) 225-3982, (see website for a list of distributors), Double Flute Straight Bit, 1/2" shank, 3-3/4" overall length, #1095, \$30.