



SHOP-TESTED TECHNIQUE



4 Straightforward Ways to Make Super-Strong Mortise & Tenon Joints

No matter your tools, you can successfully cut and fit this time-tested joint. Simply select one of these proven methods, from using inexpensive tools you probably have on hand, to dedicated machinery.

Start here: Ground rules for mortise-and-tenon joints

Regardless of how you cut your mortises and tenons, these tips will help guide you toward perfect-fitting, stronger joints for all your projects:

- Great mortise-and-tenon joints always begin with accurate layout. Use a reliable steel rule and square, and a sharp pencil, marking gauge, or marking knife to make the layout marks.

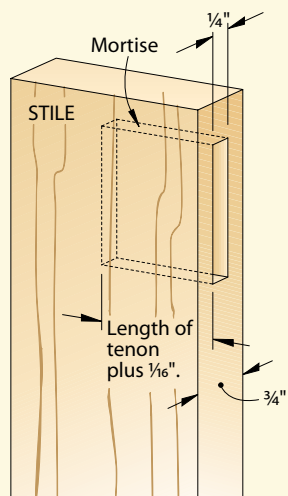
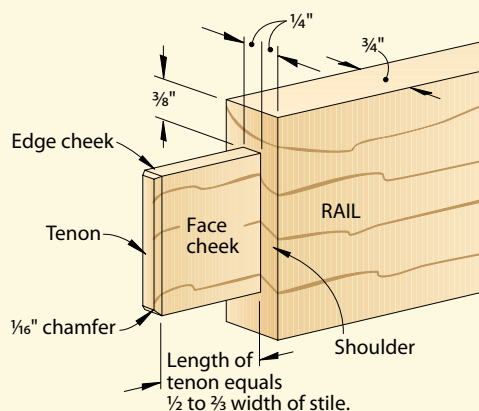
- The rule of thumb for laying out a mortise in end or edge grain is to divide the mortised workpiece into thirds. The two outer thirds will be the mortise walls, and the middle third will be cut away. So for a $\frac{3}{4}$ "-thick board, as shown *below*, cut a $\frac{1}{4}$ "-wide mortise centered on the $\frac{3}{4}$ " edge. For stock thicker than $\frac{3}{4}$ ", you can make the mortise wider than one-third the thickness of the stock; just leave the mortise walls at least $\frac{1}{4}$ " thick for strength.

- Cut your mortises first and then make your tenons to match. It's easier to fine-tune a tenon's size than a mortise's.

- You'll get the best glue bond from joints with smooth surfaces.

- A proper-size tenon should be tight enough—in a dry fit—to remain in a mortise when turned upside down yet require only slight hand pressure to insert or remove it.

- Drilled-out or routed mortises will have rounded ends. You can square them with a chisel to fit a rectangular tenon. Or save time and effort by simply making rounded tenons to match, as shown on *page 5*.



Make the Mortises First

Method #1: Low-tech and simple doweling jig

The first two mortising methods involve drilling a series of overlapping holes and then removing the waste between them. Those holes must be perpendicular to the board's edge—the perfect job for a doweling jig. That's especially true when mortising $\frac{3}{4}$ "-thick stock, where the $\frac{1}{4}$ " drill bushing common to most jigs sizes the mortise just right. (Most doweling jigs come with $\frac{1}{4}$ ", $\frac{5}{16}$ ", and $\frac{3}{8}$ " guides; some include one for $\frac{1}{2}$ " bores.) If your doweling jig didn't come with a drill bushing, get a brad-point bit because it cuts cleanly without surface tear-out.

To make a mortise, clamp the jig to drill a hole at one end of the marked mortise, with the hole just kissing the end and side layout lines. Drill to your preset depth. Repeat for the other end of the mortise, as shown *below left*. Then reposition the jig and drill out holes between them without overlapping. Now go back and center the jig on the areas between the holes and drill again.

After you've drilled out most of the waste, clean up and flatten the side walls with a chisel, the widest that will fit, as shown *below*. If you prefer square-end mortises, clean the ends with a chisel as wide as your mortise.

MAKE MORTISES WITH THESE COMMON TOOLS



Install a stop collar on the drill bit to limit the hole depth. If you don't have a stop collar, use a masking-tape flag.



Hold the chisel 90° to the board edge and make light cuts down the mortise walls. A sharp chisel won't need a mallet.

Method #2: Same concept, bigger drilling machine

If you own a drill press, use it instead of a doweling jig and portable drill for greater speed and accuracy. You'll need a fence—it can be as simple as a straight board clamped to your drill-press table—to locate the mortise and keep it parallel with the workpiece edges. Use a square to make sure the table sits perpendicular to the bit's shank. Install a brad-point bit or a Forstner bit because their center spurs prevent them from drifting off target. Set the drill-press depth stop to fix the mortise depth.

As with the doweling jig, start the mortise by boring a hole at each end. Then leave about $\frac{1}{8}$ " space between holes as you bore out the middle, as shown at *right*. When finished drilling, flatten the sides and ends with chisels.

CONNECT THE DOTS



The space left between holes provides a firm starting point for the drill bit as you bore out the remaining waste.

Method #3: Take the plunge—with a router

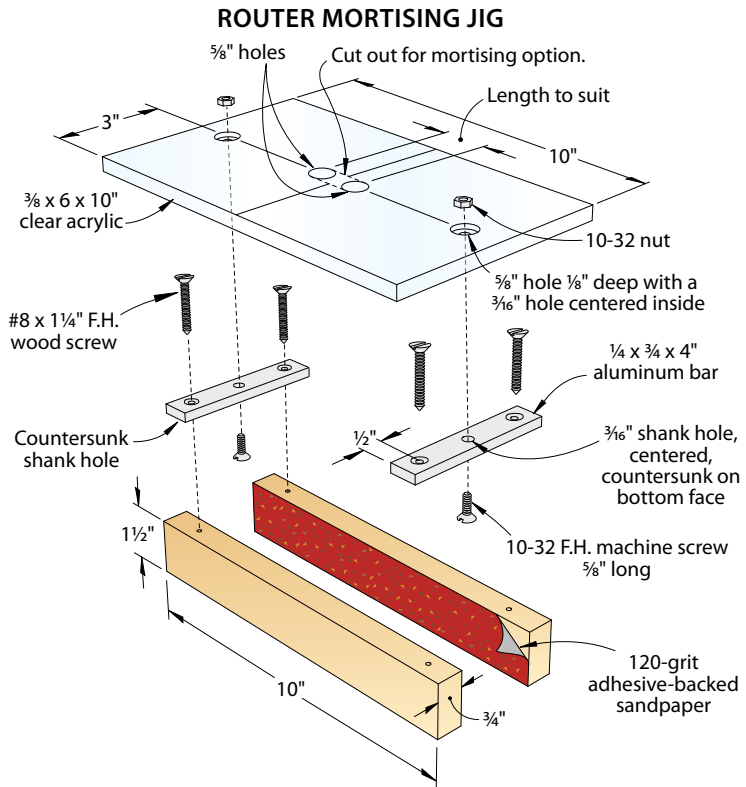
This technique calls for routing a slot in 1/4"-deep increments. In addition to a plunge router, you'll need a sharp bit—we recommend upcut spiral bits—and either an edge guide or jig to keep the router bit within the layout lines. You can eyeball the start and end points of the mortise, or clamp on stopblocks to limit side-to-side travel.

Whether shop-made or store-bought, a router-mortising jig, like the one at *right*, proves a versatile addition to any shop. You can easily align the clear acrylic top's scribed centering lines to workpieces. When making a jig, cut the mortising slot slightly longer and wider than the actual mortise to allow for the offset between the bit and the guide bushing that rides in the jig slot.

The added expense of a store-bought jig buys you fast setup and flexible mortise sizing. We recommend the Mortise Pal and the Leigh Super FMT. The self-clamping Mortise Pal, \$170 (619-459-7951, mortisepal.com), comes with six templates for different mortise widths and lengths, with additional templates available for more options. With the benchtop Leigh Super FMT (\$450,

800-663-8932, leighjigs.com), you route both the mortise and tenon with the same setup. This jig comes with guides

and bits to make five sizes of mortises and tenons, but you can buy optional guides for more variety.



ROUTING MORTISES IN EDGE AND END GRAIN



EDGE GRAIN: For narrow workpieces, such as this stile, clamp an auxiliary support piece to it to prevent the router from tipping.



END GRAIN: A mortising jig provides a large, stable surface for the router when routing mortises into the ends of workpieces.

Method #4: Drilling square holes has never been easier

Okay, technically you aren't really *drilling* square holes with a mortising machine. You're actually *chiseling* a square mortise around a round hole as you drill it, using a special auger bit inside a hollow chisel, like the one shown *near right*. Although this technique cuts mortises quickly, it also can be the costliest. Benchtop mortisers should handle nearly all your mortising needs and sell for about \$225 to \$500; floor-standing mortisers start at \$900. (Be aware that some dedicated mortisers do not include chisels and bits; these cost \$10–\$30 apiece, with four-piece sets starting at \$40.)

Here's how a mortising machine works. First, install a drill bit/chisel into the mortiser. Set the mortiser's depth stop to establish the mortise depth. Position the fence parallel to the chisel so the chisel cuts precisely between the layout lines. Begin by cutting the two ends. Then cut out the middle in overlapping bites.

If you like this concept but simply can't commit to a dedicated mortising machine, consider a mortising attachment for your drill press. One of these costs from \$65 to about \$125. It mounts to the quill, as shown at *right*; then it works exactly like a mortising machine. The drawback: You won't be able to use your drill press for other drilling chores without removing the attachment.

ONE-MINUTE MORTISES



Once you set up your mortiser, you can chisel out mortises like this in a minute or less.

DEDICATED MORTISING MACHINE MAKES REPEATABLE, ACCURATE CUTS



The steep flutes on the drill bit evacuate chips quickly so the surrounding square chisel can slice the walls cleanly.



The long handle on a mortising machine provides added leverage to drive the chisel into the wood.

FROM DRILL PRESS TO MORTISER



In about 20 minutes, you can convert your drill press into a mortiser by adding an accessory mortising attachment to the quill.

Now Make Tenons to Fit the Mortises

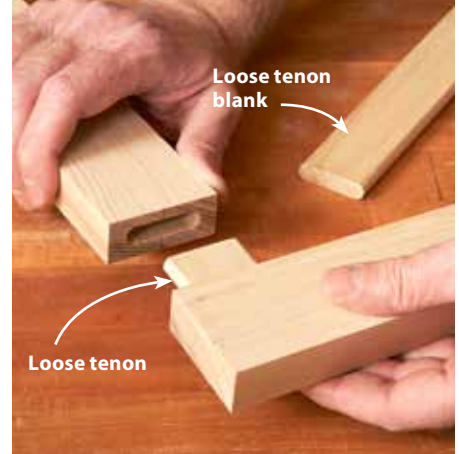
Depending on the mortise method you used and the available tools in your shop, you have a choice between integral tenons—a narrowed end of a workpiece that fits into a mortise—or loose tenons, a separated tenon that joins two mortised workpieces.

With loose tenons you make mortises in mating workpieces, and then insert a tenon cut to fit inside both, as shown at *far right*. Rather than buying premade loose-tenon stock, make your own from scrap hardwood, preferably at least 12" long for safer handling. Simply plane the stock to a thickness that fits snugly in the mortises. If your mortises have rounded ends, rout matching roundovers onto your tenon stock. Then, cut tenons to length to fit the mortises.

THINK OUTSIDE THE SQUARE-TENON BOX



Fitting an integral tenon to a rounded mortise is easier than squaring the mortise. Use a utility knife or rasp to round corners.



Loose tenons prove a good option for routed mortises. Cut loose tenons to length from a longer blank you've machined to size.

Method #1: Dado set helps you tackle tenons quickly

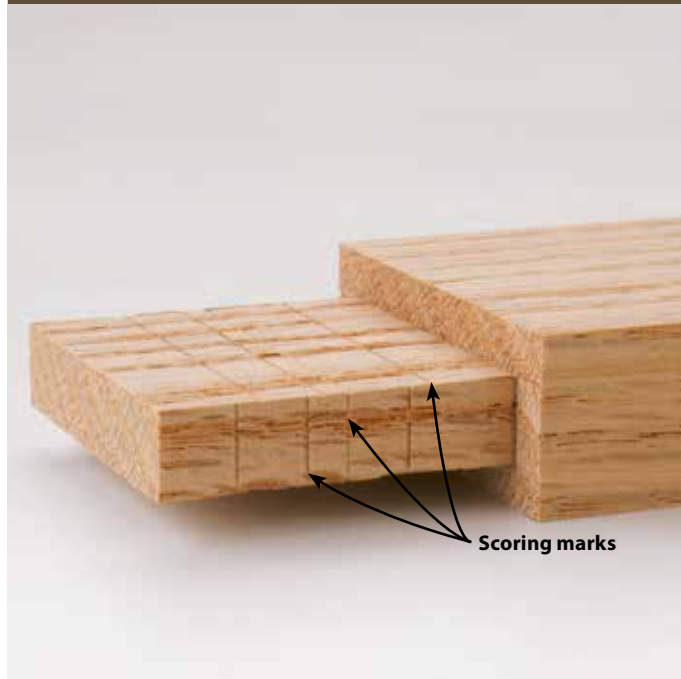
A stacked dado set allows you to make precise-fitting tenons in no time. You don't need to set the stack to a precise width because repeated passes remove the waste. To cut tenons this way, install the two outer blades with three 1/8" chipers between. Add a plywood or MDF extension to your miter gauge to prevent grain tear-out where the blades exit the workpiece.

With your dado stack installed, set the blade height to cut just shy of your tenon layout mark. Cut a pass on each face in scrap stock the same thickness as your tenon stock; then, check the fit in the mortise. Adjust the blade up or down and make more test cuts until you've got a snug fit.

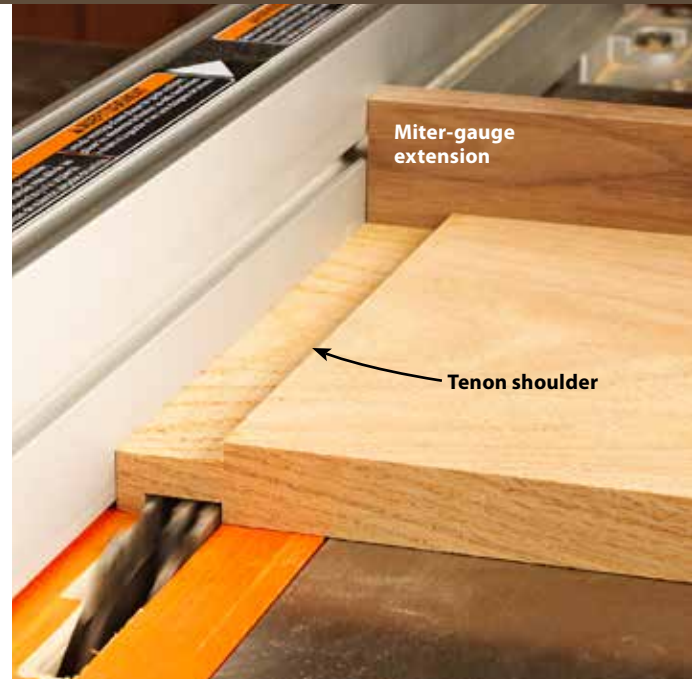
Next, set your rip fence to be the stop-block that defines the length of the tenon. Measure from the fence to the teeth of the outer blade farthest from

the fence to define the tenon shoulders. As long as you've aligned the fence parallel to the blade and miter slots, your workpiece shouldn't bind or kick back during the cut. Cut both face cheeks with this setup for all pieces. Then, without moving the rip fence, repeat the procedure for the edge cheeks, adjusting the blade height as needed to get the correct tenon width. When finished, remove scoring marks with a shoulder plane or sanding block.

DADO SETS CUT SHOULDERS AND CHEEKS AT THE SAME TIME



Stacked dado sets prove quick and easy to use, but often leave scoring marks that require post-machining cleanup.



Cut face cheeks with a dado set before edge cheeks. A tall miter-gauge extension supports the workpiece on edge-cheek cuts.

Method #2: Tenoning jig makes smoothest tenons

For about the same cost as a good dado set (\$100–\$150), a tenoning jig, such as the one shown at *far right*, delivers smoother tenon cheeks. Set the blade height to the shoulder width. Then, using your miter gauge to guide the workpiece, cut all four tenon shoulders, as shown at *near right*, changing blade height, if needed, for the edges. This ensures clean, crisp shoulders.

To make the cheek cuts, simply clamp your workpiece standing on end into the jig, adjust the jig to align the layout lines with the blade, set the blade height, and make the cut. Flip the board and cut the opposite cheek for a perfectly centered tenon. (You'll need to make separate setups for offset tenons.) You also can cut angled tenons with one of these jigs by tilting the rear fence.

Here again, you can save money by building your own tenoning jig. Choose from several plans, some for free, at woodmagazine.com/tenonjigplans.

TWO STEPS TO SUPERSMOOTH TENON CHEEKS



Make the tenon-shoulder cuts first, holding the workpiece square with your miter gauge and using the fence as a stopblock.



Set your tenoning jig so the tenon-cheek offcut falls away from the blade, not trapped between the blade and jig.

Method #3: Your bandsaw makes quick work of tenons

You can set up to cut tenons on a bandsaw as easily as setting up a common rip cut. But before doing this, cut the shoulders on your tablesaw as described in Method #2. Then, align your bandsaw fence so the tenon will be about $\frac{1}{32}$ " thicker than needed, and make the cut, as shown *below*.

When ripping away the tenon cheeks, feed the board slowly to minimize any blade deflection, which can create curved tenons. Take care to stop feeding the workpiece into the blade when the cutoff falls away; you don't want to accidentally cut into the shoulders. Bandsawn cheeks will be slightly rough, so smooth them with a sanding block or shoulder plane for best glue adhesion.

BANDSAWN TENON SETUP IS A BREEZE



Feed stock slowly and use a 3-teeth-per-inch $\frac{1}{2}$ " blade when cutting tenon cheeks on a bandsaw to get the best cut quality.

Method #4: Who needs a tablesaw when you have a router table?

You can make smooth, accurate tenons on your router table with a single bit, miter gauge, and fence. First, install the largest diameter straight bit or mortising bit you have, and set the height to the tenon layout lines. Position your table's fence to serve as a stopblock set for the precise tenon length. Align the fence parallel to the miter slot to ensure tenon shoulders square to the workpiece edges.

Once set up, begin by routing a pass along the end of the tenon. Make successive passes until the end of the workpiece rides against the fence. (Routing the shoulder first could create a trapped cut on successive passes that might jerk the board from your grip.) 🌱

Written by **Bob Hunter** with **Kevin Boyle** and **Jeff Mertz**

TABLE TENONS MADE EASY



Leave a slight opening between your router-table fence panels so your shop vacuum can suck away the chips.