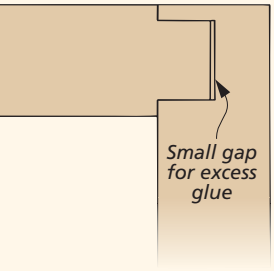
MORTISES & TENONS — SOLUTIONS & SHORTCUTS

Mortise and tenon joints are the "meat and potatoes" of woodworking. They're strong, easy to make, and versatile — and most issues of *Woodsmith* feature at least one project that uses some form of this common woodworking joint.

As you might imagine, with having cut, fit, and assembled so many mortises and tenons, we've run into more than our share of problems (as well as a few mistakes that needed fixing). Some of the solutions meant using tools we wouldn't normally use. Others meant salvaging a piece by doing a little extra clean up work. But most of the time, the best "solution" was one that let us avoid the problem the next time around.

So here are some of our favorite solutions and shortcuts. And whether you've created a few mortise and tenon joints or a few dozen, I'm sure you'll find something to use on your next project.

Rounded Mortises and Tenons



▲ *To allow for excess glue, I like to make the mortise slightly deeper than the length of the tenon.*

Unless you have a dedicated mortising machine (or drill press attachment), the mortises you cut will have round ends. When using a regular drill bit, I have to clean up the walls of the mortise anyway. So I usually square the ends too.

But this isn't the only option. Mortises can also be cut with an upcut spiral end mill bit. (See box at right.) This tool leaves the mortise walls smooth, and since I don't need to use my chisel, I leave the mortise ends round.

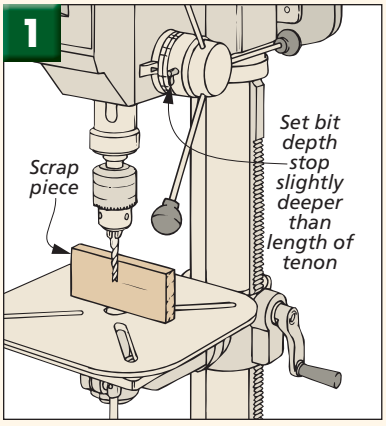
The nice thing is, you don't have to own a plunge router to be able to use a spiral end mill bit. It also works on a drill press, which is what I did when building the wrap-around benches on page 14.

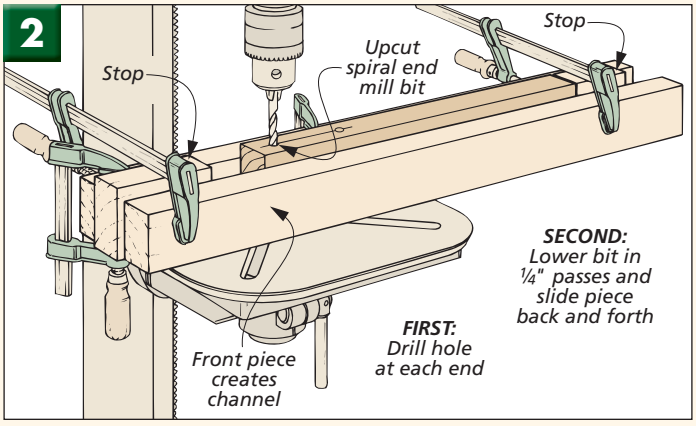
DRILL PRESS SETUP. To use a spiral end mill bit, the first thing you need to do is increase the speed of the drill press to its highest setting (3000-5000 RPM). Then set the depth of the bit so it will stop slightly *deeper* than the length of the tenon, as in Fig. 1. (This allows room for excess glue, as you can see in the left margin.)

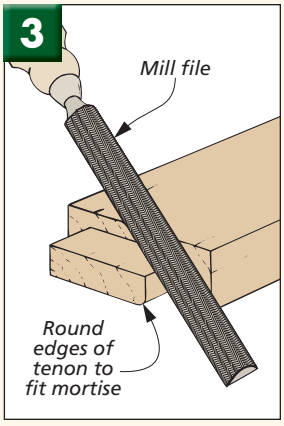
Next, I like to create a channel that will trap the workpieces so they can be slid back and forth easily without shifting in or out. I did this with a fence and three scrap pieces, as in Fig. 2. Two pieces act as stops and are clamped at each end of the drill press fence. The third scrap piece creates the channel. It's clamped to the front of the stops to hold the workpiece against the fence.

CUT MORTISE. To cut the mortises, I drill a hole with the bit at each end. Then you can lower the bit ¼" and slide the piece back and forth. (You have to hold the drill press handle with one hand and slide the piece with the other.) Remove the waste in ¼" passes until the mortise is roughed out.

Later, after cutting the tenon to fit the mortise, you can round over the edges quickly with a sanding block or a mill file, as shown in Fig. 3.







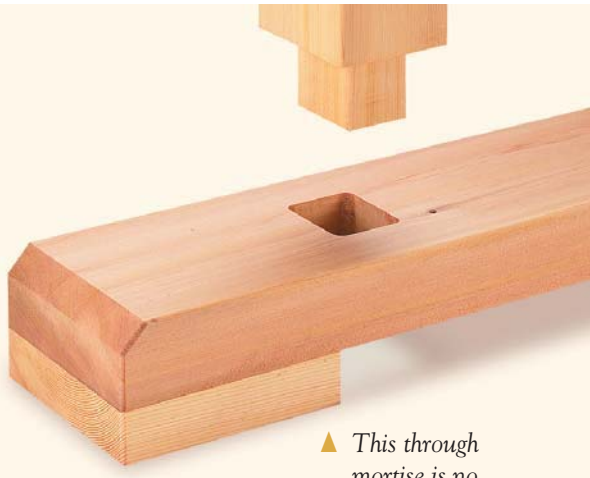
Large, Through Mortises

The base of the table on page 6 has through mortises, as shown in the margin photo. Here's a shortcut you can try the next time you have mortises like this to cut on a large workpiece.

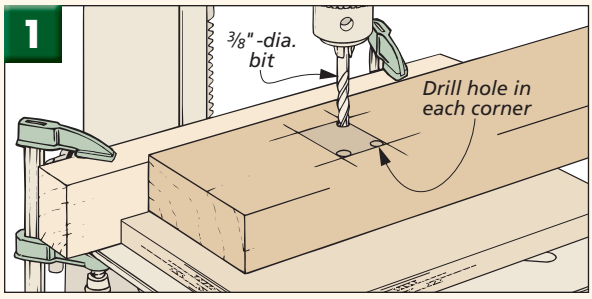
Like a typical mortise, this one starts out at the drill press. But rather than drilling overlapping holes, drill a hole in each corner, as shown in Fig. 1 below.

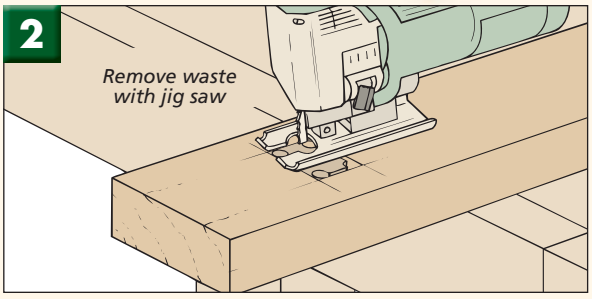
Now you can remove the waste quickly by simply getting out your jig saw and cutting along the layout lines, as in Fig. 2.

At this point, you can square up the corners of the mortise. Or you can leave them round (like I did here) and then later round over the edges of the tenons with a mill file or sanding block, as in Fig. 3 on page 22.



This through mortise is no trouble at all to cut. All you need is a drill press and a jig saw.



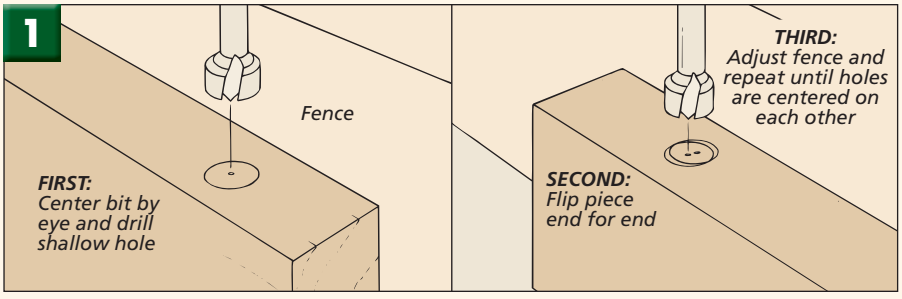


Centering the Mortise

Mortises are almost always centered on the thickness of the workpiece, and I try to be as accurate as I can when setting up the drill press. It's sure a lot easier to get the mating piece to fit correctly if you've taken the time to make sure the mortise is centered.

I start with a scrap piece that's the same thickness as the workpiece. Then I roughly center the bit on the piece and drill a shallow hole (Fig. 1). Now flip the piece around and drill a second hole over the first. (A Forstner bit will work best because it won't wander into the first hole.)

If you can see the edges of two holes here, the drill bit is *not* centered exactly, and you need to adjust the fence slightly. Then simply repeat this process until the two holes line up perfectly. Now you know the drill bit is centered.



BITS FOR MORTISING

Using the right tools is just as important as using the right technique. Here are the bits we use to make mortises in our shop.

DRILL BITS. For most mortises, I will use either a brad point bit (top photo at right) or a Forstner bit (middle photo). Both have center points that keep the bit from wandering, but the Forstner is easily the best choice. With a brad point bit, you have to leave a tiny gap between each of the holes you drill, as shown in the top board at right.

On the other hand, the Forstner bit can drill overlapping holes. As you can see in the middle board, this means nearly all of the waste can be removed with the drill bit. So there's less clean-up work with the chisel.

SPIRAL END MILL BITS. The other bit I like to use is an upcut spiral end mill bit (bottom photo). Though technically it's a router bit, I've used it to cut mortises with a hand-held plunge router and in the drill press, as shown in Fig. 2 on page 22.

The flutes on an upcut bit are designed to pull the chips out of the mortise. And because it's run at a higher speed (up to 5000 RPM), the cheeks end up smooth, so you don't need to do any clean-up work at all.

Multiple Mortises

The more mortises there are to cut, the more I want them to end up as identical as possible. If all the mortises are the same, then fitting the tenons later will be that much easier.

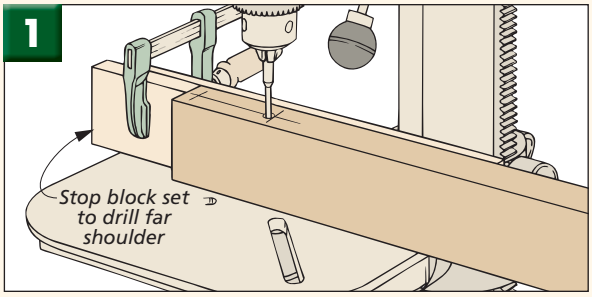
So when making multiple mortises, I make sure the shoulder cuts will be consistent by using a pair of small scrap blocks.

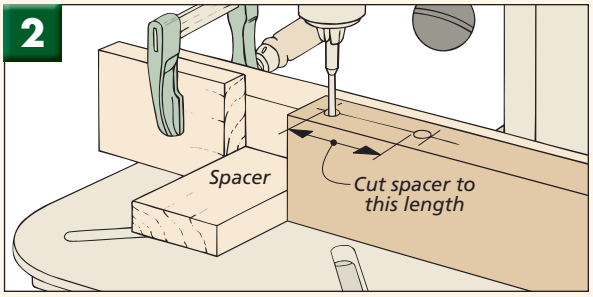
STOP BLOCK. The first block acts as a stop, as in Fig. 1. It's clamped to the fence to establish the shoulder that's *farthest* from the end of the board.

SPACER BLOCK. For the other shoulder of the mortise, I like to cut a spacer that slips between the stop and the end of the workpiece, as in Fig. 2.

Finding the length of this spacer is easy now that you have one of the holes drilled. Just measure from the *edge* of the hole to the *end* of the mortise and cut the spacer to this size. (This equals the mortise's length *minus* the diameter of the bit.)

After drilling the second shoulder, just remove the spacer and drill overlapping holes back to the first hole to remove as much waste as possible.



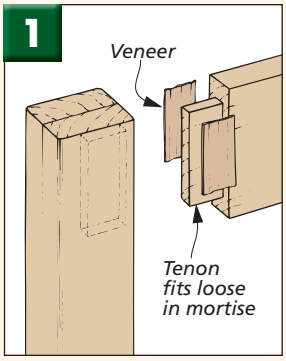


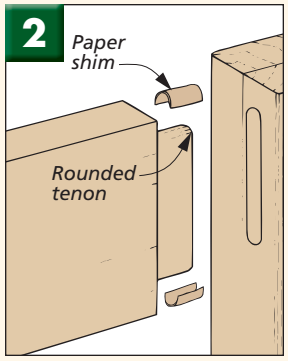
Loose Tenons

No matter how carefully you try to work, occasionally you're going to end up with a tenon that is too loose for the mortise.

VENEER. If you're working with a through tenon that will be visible (or the tenon is really loose), then you can enlarge it with thin pieces of veneer sliced from a piece of scrap, as you can see in Fig. 1. I glue the veneer to the tenon's cheeks and sand it to fit the mortise.

BROWN PAPER. For hidden tenons or rounded tenons, the same technique will work using brown paper cut from a grocery bag, as shown in Fig. 2.





Fine-Tuning the Tenon

When dry assembling a mortise and tenon joint, you want to check that the workpieces end up flush. If they're not (as shown in the photo below), you'll need to fine-tune the tenon with a sharp chisel.

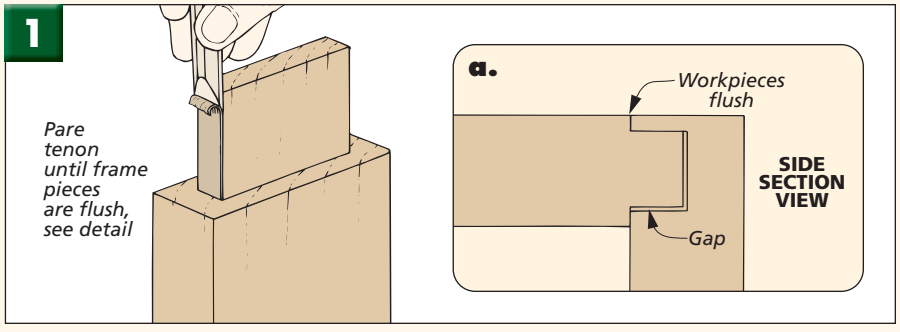
Technically, you could do this fine-tuning to either the mortise or the tenon. But I've found that paring away the long grain on a tenon is a whole lot easier than trying to chop through the end grain in a mortise.

What you want to do is remove enough of the top (or bottom) shoulder of the tenon to allow it to shift slightly up (or down) until it's flush with the mating piece, as in Fig. 1a. So before pulling the two pieces apart, I visually take note of the size of the shoulder. This is the amount of stock that has to be removed.

This is easy enough to do with a sharp chisel. Just clamp the piece in a vise and pare away small shavings, testing the fit often.

This fix will create a small gap in the mortise. But don't worry. The joint will still be plenty strong. But since there's a little "play" in the joint now, you'll need to take care that the two pieces end up flush during assembly.

If the rails and stiles of a frame don't flush out, it's easy to correct with a chisel. ►



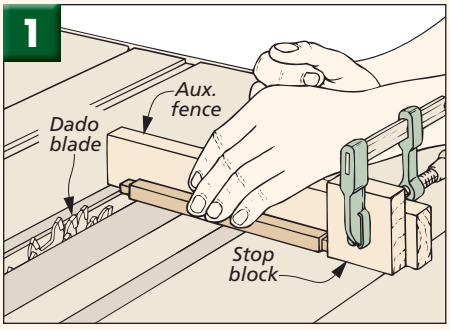
Using The Rip Fence as a Stop

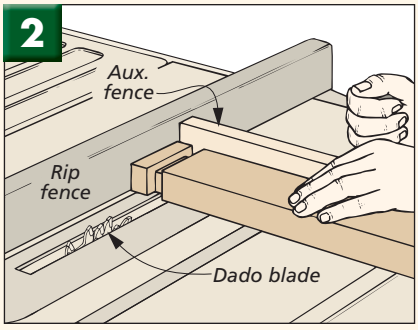
Most times, when cutting tenons on the ends of a workpiece, I like to clamp a stop block to an auxiliary miter gauge fence, as you can see in Fig. 1 below.

But this isn't always the best solution. Some workpieces are too long to use with an auxiliary fence. Plus, there are a lot of times when I need to cut identical tenons on pieces that are different lengths. And if I were to use a stop block, I'd have to reset it several times to end up with the same size tenon on each piece.

In both of these situations, I find it's a lot easier to use the rip fence as a stop, as in Fig. 2. Safety Note: With a typical crosscut, you should *not* use the rip fence and auxiliary fence together — the waste piece can kick back at you. But here, you're not cutting *through* the piece, so you don't have to worry about kickback.

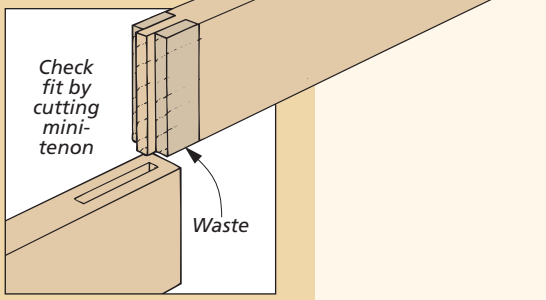
There are two things to keep in mind when using the rip fence as a stop. First, when positioning the fence, you'll need to measure to the far (left) side of the dado blade. And as you can see in Fig. 2, you still want the auxiliary fence to extend past the blade, so it will support the wood fibers at the back of the cut.





MINI-TENON

When making trial cuts for a tenon, I often cut a mini-tenon on the end of one of the pieces. This small tenon is long enough to let me check the fit. And if the mini-tenon ends up with a loose fit in the mortise, I can correct the setup and still use the workpiece — it's not going to affect the strength of the joint.



Stepped Shoulders

To cut tenons, I often lay the workpiece down on my table saw and make multiple passes over a dado blade, using the rip fence as a stop. This is a fast way to cut tenons, but you may find that the shoulders at the top and bottom of the tenon end up uneven, as in the photo at right.

The problem here isn't the procedure. Instead, it's usually a good indication that the rip fence isn't 90° to the table, as shown in Fig. 1 below. (Or, if you happen to be using a stop block on your auxiliary fence, then this stop isn't square to the table.)

The reason for this is that when cutting the long shoulders with the piece lying face down on the table, the piece contacts the fence near the bottom (Fig. 1). But as soon as the piece is set on edge, it contacts the rip fence higher up, as in Fig. 2. Here, the fence pushes the piece away from the blade creating a "stepped" shoulder.

SOLUTIONS. The best way to solve this is to adjust the rip fence so it's square to the table, and to do this, you'll want to check your owner's manual.

But there's a temporary solution for this problem. You can clamp or carpet tape a short strip to the fence, as in Fig. 3. (The strip should be just taller than the tenon shoulder.) Basically, this strip acts like a short fence, so the piece always contacts it at the same spot. (Or for yet another solution, check out the tip on page 4.) W

Stepped shoulders on a tenon indicate that it's time to give the rip fence a little tune-up.