Woodsmith PLANS

BETTER TENONS

tips & techniques for

Better Tenons

Mortise and tenon joinery is a hallmark of solid, long-lasting construction. To improve your skills, it's helpful to take some time to zero in on one part of the process. Here, let's take a look at how to raise your tenon-making game.

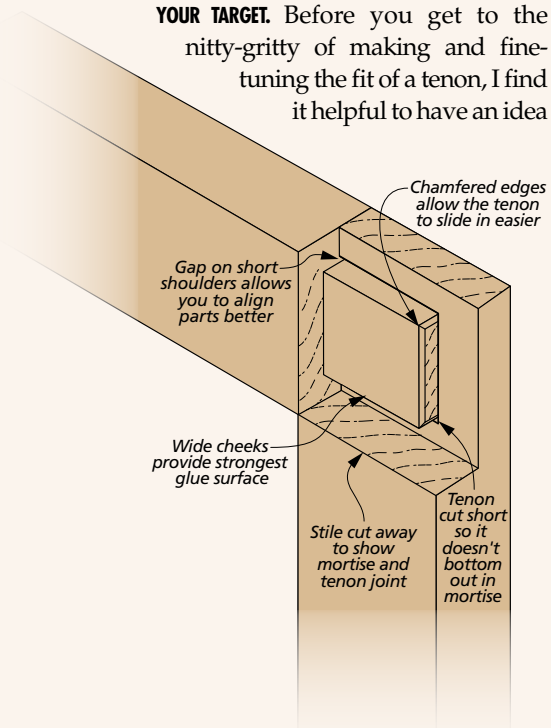
YOUR TARGET. Before you get to the nitty-gritty of making and fine-tuning the fit of a tenon, I find it helpful to have an idea of the key details. The drawing and photos below highlight what you're after.

For me, there are two main points of attention: First, the connection between the wide cheeks of the tenon and the long-grain walls of the mortise. This gives the joint its strength. The other surfaces have at least one end-grain component and contribute very little to the overall strength of the joint.

The other detail that I key in on is a tight, even seam around the shoulders. This looks good, but it also resists the forces that try to lever the pieces apart.

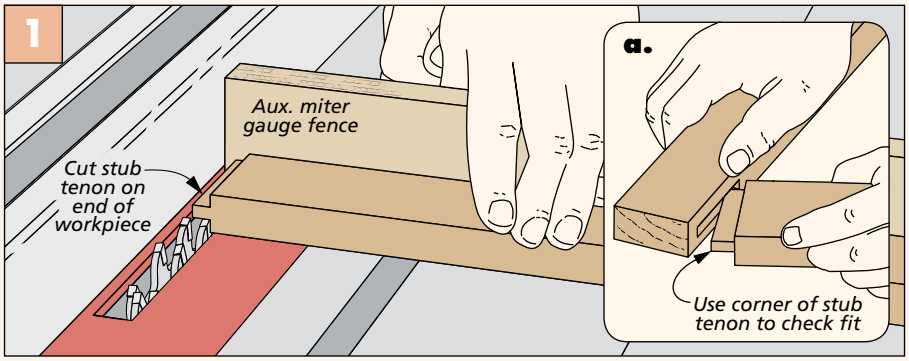
As for the fit of the tenon at the ends of the mortise, I'm not concerned about that. In fact, a little gap here gives you some wiggle room to align parts at assembly.

Another aspect you don't need to worry about is making the length of the

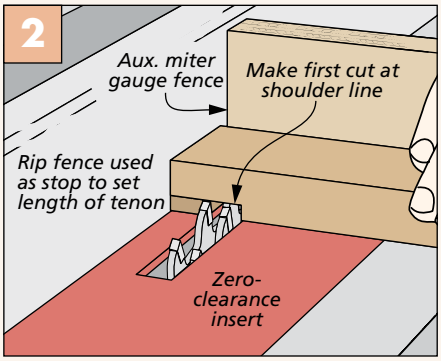


▲ A properly sized tenon should fit into the mating mortise with moderate hand pressure or light mallet taps.

▲ Another test for a tenon is to dry fit the joint and raise the mortised piece. The workpiece should stay in place.



Adjust the Blade Height. *Dial in on the correct blade height with test cuts across the tip of one test piece. The result is a stub tenon that will allow you to check the fit to the mortise. You're aiming for a fairly snug fit.*



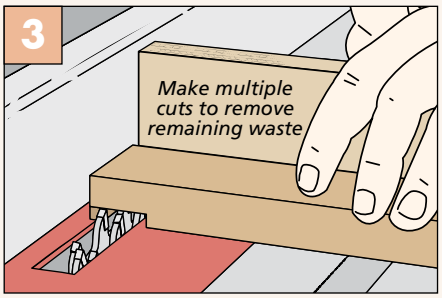
First Cut. *Start with a cheek cut along the shoulder line, keeping the workpiece flat on the table and tight to the fence.*

tenon match the depth of the mortise perfectly. I prefer the tenon to be a little short, so I don't have to worry about cleaning up the bottom of the mortise.

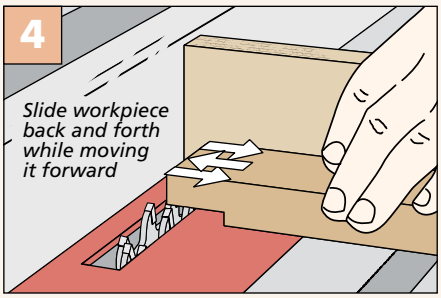
There are several good ways to make tenons. No matter which method you choose, your aim should be to get a good-fitting joint right from the tool. The less time and effort you spend in fine-tuning tenons means more time you have for other details. To get an idea of what I mean, I'll provide an overview of one popular and simple tenon technique.

DADO BLADE METHOD. There's a reason that many woodworkers turn to a dado blade to cut tenons. The setup is simple, the process is straightforward, and with a little practice, the results are hard to beat. Long story short, you use a miter gauge to guide the workpiece across a wide dado blade to create each face of the tenon. Of course, there's more going on here than meets the eye.

Prior to cutting the actual workpiece, I like to make a couple extra parts so they can be used as test pieces for setting up cuts. This takes away the pressure of trying to get things right on the first try.



Nibble Waste. *Once the shoulder cut is made, start to nibble away the waste toward the end of the tenon.*



Back & Forth. *Remove ridges left by the dado blade to create a smoother tenon cheek and a better glue surface.*

The drawings on this page run down the overall process. In Figure 1, you can see how to use a test piece to sneak up on the correct blade height. I start with the dado blade set low and make a pass along each wide face. At this point, the stub should be too thick to fit the mortise.

SNUG FIT. Raise the dado blade a tad and make another pair of passes. Remember, you're removing material from each face, so don't raise the blade too much . You've reached your goal when you can just barely fit the tenon in.

From here, you can set the rip fence to cut the full length of the tenon. Grab your project parts and cut the wide tenon cheeks (Figures 2 and 3). Most tenons are longer than the width of your average dado blade. So you'll need to make multiple passes across the blade.

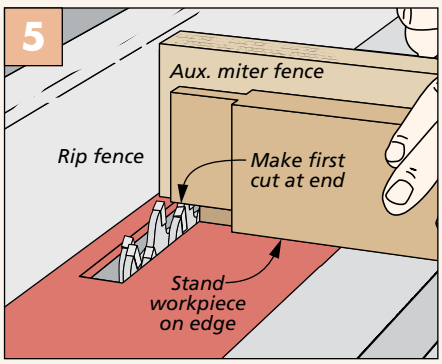
These overlapping cuts can leave ridges that affect the fit of the tenon. To smooth them out, I slide the workpiece back and forth across the blade, as in Figure 4.

SHORT CHEEKS. The remaining step is cutting the end cheeks of the tenon. Here the workpiece is held on edge. Remember, this isn't a critical glue surface, so you don't need to worry about getting an air tight fit.

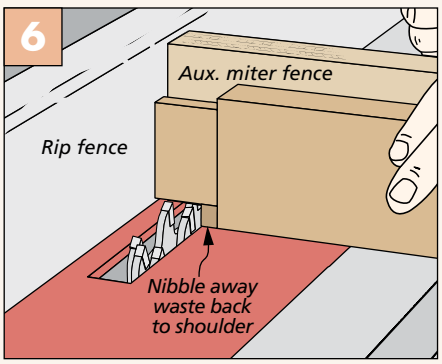
The margin photo shows what the results will look like. The cheeks of the tenon may still show light scoring marks. But overall, the cheeks are smooth, not ragged. If everything went well, then each tenon should slide home easily.

▲ Here's the result of cutting a tenon with a dado blade.

The reality is a joint or two may show small gaps or may not close at all. On the next pages, I talk about the process for tracking down and fixing any problems.



Edge Shoulders. *You may need to adjust the blade height to cut the edge cheeks and shoulders of the tenon.*



Edge Shoulders Last. *Complete the tenon edge by making a careful cut along the short shoulders.*

Troubleshooting Tenons

Taking the time and care to set up your table saw and cut accurate tenons pays off when it's time to fit the joints together. However, it isn't uncommon to end up with a couple of joints where you still need to do some additional work.

You may wonder why you have a problem at all if you've followed the steps I've already discussed. The answers cover a wide range: Individual workpieces may vary slightly in thickness or width. A part may have a subtle bow or curve. Depending on your technique, the mortise size may not be perfectly consistent. Whatever the reason, when the fit isn't right, you need to do a little detective work to diagnose the problem and fix it.

ONE STEP AT A TIME. On these pages are several common issues you're likely to run across. In some situations, you may have more than one problem going on. I find it's easier to take things one at a time. Focusing your attention on a single issue makes it easier to get a better-fitting joint in the end.

TOO THICK. I start with looking at the fit of the tenon cheeks to the sides of the mortise. After following the process on the previous pages, the most common problem occurs when the tenon is just a hair too big. It may fit only with a lot of clamping pressure, or firm mallet strokes.

The danger here is that you run the risk of splitting the workpiece as you drive the tenon into the mortise. In addition, once the glue goes on, the joint may swell slightly. So you may be unable to even assemble the joint at that point.

▲ Trim tenon cheeks with a shoulder or rabbet plane, or a hardwood sanding block (inset). Take care to keep the tenon straight and parallel to the face of the workpiece.

The temptation is to take it back to the table saw and trim it. The problem is it's all too easy to take too much off. Instead, skip the table saw and reach for some hand tools to get the final fit. The photos above show two tools that accurately make the tenon thinner.

Considering its name, it's no surprise that many woodworkers think a shoulder plane is just for trimming shoulders of tenons and rabbets. But actually, I find that this specialized tool is ideally suited for paring tenon cheeks.

A shoulder plane is narrow, so you need to trim a tenon in several passes. It's possible to create a tapered tenon, if you aren't careful. So check your progress often as you work.

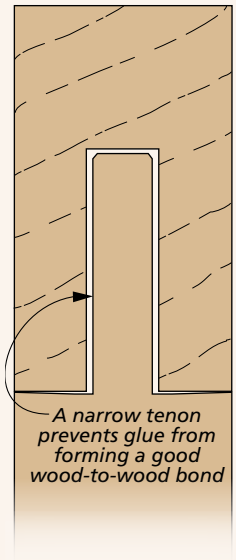
The other tool is simpler by far — a sanding block. To keep the tenon flat, I use a hardwood block rather than a cork block. I apply adhesive-backed sandpaper to the block, leaving at least one edge without sandpaper. This "safe edge" prevents me from altering the shoulder of the joint unintentionally. I size the block so that I can sand the entire tenon cheek.

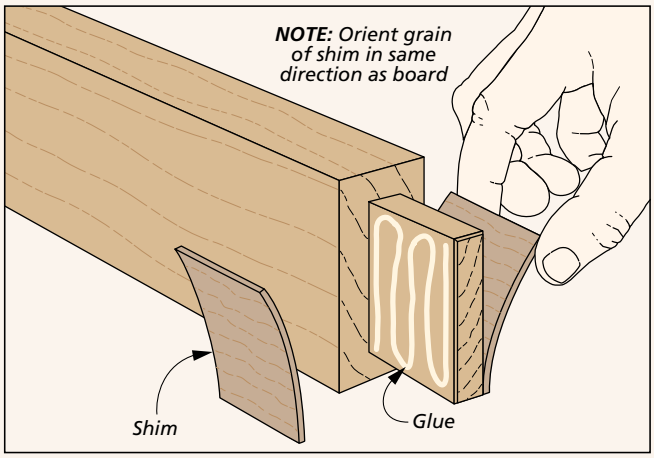
No matter which tool you use, the key is taking the same amount of material off each face. This keeps the tenon centered for a consistent fit of the overall assembly.

TOO THIN. The opposite problem is a tenon that drops into the mortise without any resistance. Don't worry, your workpiece isn't doomed to the scrap bin. To rescue it, you first need to make the tenon bigger. You do that by gluing a thin shim to each cheek. Clamp it firmly so that you have a gap-free connection between the shim and cheek.

When the glue is dry, refit the joint. I like to use relatively thick shims so I can recut the tenon at the table saw. If you use thin shims, you need to fit the joint with a shoulder plane or a sanding block.

THE SHOULDERS. Taking care of the wide cheeks allows you to concentrate on





Shim a Small Tenon. *If a tenon is too small, glue shims on each cheek. After the glue dries, you can recut the tenon at the table saw or trim it to size, as shown in the upper photos.*

other aspects of a strong and good-looking mortise and tenon joint. The next area of attention is the fit between the tenon shoulders and the mating piece that has the mortise.

Slide the joint together and examine the joint line along the two faces and both edges. If there's a gap all around the joint, the culprit could be that the tenon is bottoming out in the mortise. Check to make sure the mortise is clear of any chips. Then trim back the tenon slightly (if necessary), and reassemble the joint.

On a side note, I like to cut a small chamfer on the end of the tenon, as shown in the upper left photo on this page. This makes inserting the tenon easier and provides some glue relief.

EVEN SHOULDERS. Another problem is a step between the face and end shoulders. My tool of choice here is a chisel to remove the step (upper right photo).

When you're sure the shoulders are even and the joint still doesn't close tightly, there may be a small ridge of waste where the tenon cheeks meet the rim of the mortise. The remedy is to pare the waste away with a chisel. Take care not to cut into the tenon (near right photo).

Some woodworkers undercut the shoulders of a tenon to ensure a tight joint line. The idea here is that you hold the chisel at an angle to create a beveled shoulder where it meets the tenon (far right photo). If you do this, be sure to leave at least a 1/16" flat around the outer edges.

If the flat is too narrow, the undercut shoulder may show up as a gap if you have to do a lot of sanding after assembly.

▲ A slight chamfer around the end of the tenon allows it to slide into the mortise easier, and it provides some glue relief.

▲ Cure stepped shoulders by taking small bites with a chisel. Register the chisel on the low side of the shoulder.

▲ A small ridge of waste where the tenon meets the shoulder can prevent a joint from seating. Trim it with a chisel.

▲ Undercutting the shoulder all around the tenon is another method for eliminating gaps. Leave a narrow flat on the rim.

Now I said earlier that I don't tweak the mortise, but I sometimes make an exception. With the chisels out, it's easy to cut a slight chamfer around the edge of the mortise. This creates a small recess to accept minor inconsistencies in the shoulder. And it also provides glue relief during assembly to reduce squeezeout.

ASSEMBLY. The final stage of the process is assembly. But beware, there are still hazards to avoid. The first is applying too much glue — and in the wrong places.

Instead, put the glue only where it matters most, the cheeks and sides of the mortise. This is shown in the photos at left. Brush a thin coat of glue on the wide cheeks of the tenon. Then use a paddle to put a coat on the mortise walls. Putting glue on both surfaces prevents starving the joint and creating a weak bond.

Now don't dawdle. Get the joints together quickly. Moisture in the glue can cause a tenon to swell and make it difficult to insert. It's easy to go from a just-right fit to too tight.

As you make the last turns on your clamps, the joint will close tightly. After applying these tips and techniques, it will be the last time you need to think about this joint. And peace of mind is a good destination if you ask me.

▲ Apply a thin, even coat of glue to the wide cheeks of the tenon. Too much glue here can lead to messy squeezeout.

▲ For the strongest joint, brush glue onto the side walls of the mortise. No other glue is neccesary for solid assembly.