Techniques to Master Dovetail Joints:

Beyond the Basics with a Router

Photo by Al Parrish

Sliding Dovetails

Two router bits with guides and a simple shop-made jig make three variations of this joint a snap.

One of the defining features of 17th- and 18th-century furniture is the dovetailed horizontal case divider. Case dividers are the rails that separate the drawers, or the door and drawer sections. Attaching these dividers to a case's sides using sliding dovetails is probably the strongest way possible to assemble a carcase.

However, reproducing this detail is daunting to many woodworkers. Not only is a sliding dovetail seen as complex joinery, but it can be made in different ways. The basic sliding dovetail, shouldered sliding dovetail and through sliding dovetail (shouldered or not) are just a few of the options.

by Glen Huey

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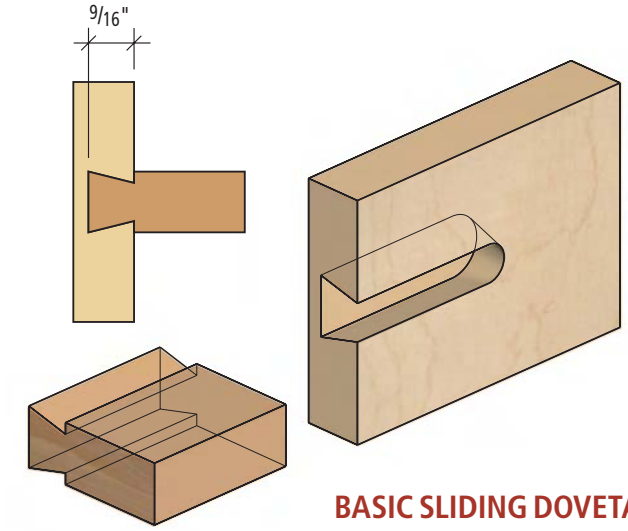
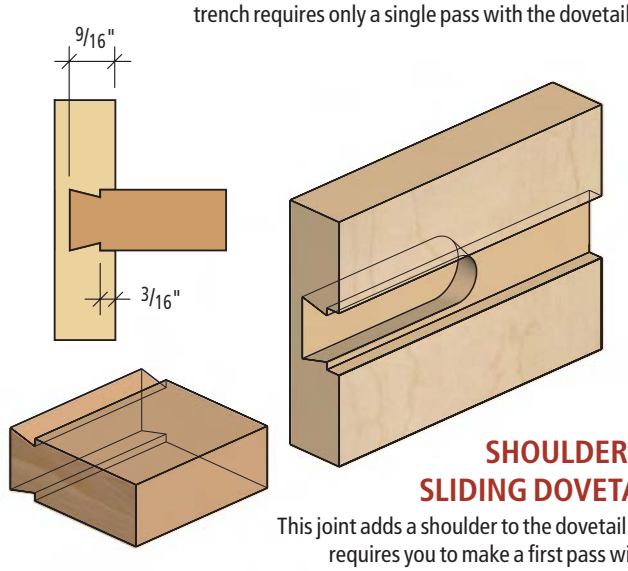


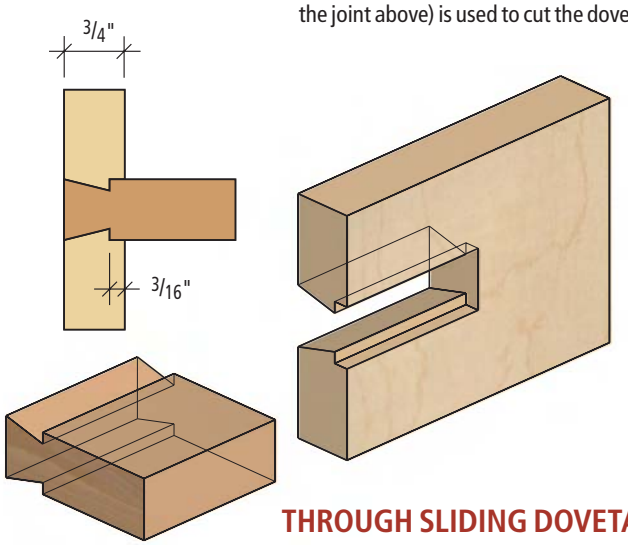
BASIC SLIDING DOVETAIL

The simplest option in sliding dovetails. The socket or trench requires only a single pass with the dovetail bit.



SHOULDERED SLIDING DOVETAIL

This joint adds a shoulder to the dovetail and requires you to make a first pass with a pattern-making straight bit. Then the dovetail bit (set at the same depth as on the joint above) is used to cut the dovetail.



THROUGH SLIDING DOVETAIL

A more complicated joint, this is made in three steps. First the straight bit forms the shoulder, then the dovetail bit shapes the divider pin. The final dovetail socket is hand cut to avoid tear-out.

Each type of sliding dovetail requires a different jig. I've used a variety of these jigs in my many years of building reproduction furniture. Some jigs capture the router base and are specific to a certain router bit. If you need to use more than one bit (to make a shouldered dovetail, for example) this can be a problem – unless you own two identical routers.

Other jigs are as large as the entire case side, making them hard to handle and store. But I've found a better way. Using a 3/4" top-bearing flush-trimming bit (often used for pattern routing), a 3/4" dovetail bit, a template guide with a 3/4" outside diameter and a shop-made straightedge, any of these joints can be made easily.

From Dado to Dovetail

To understand how this works, let's start with a simplified version of the joint: a dado. With a straightedge clamped across a cabinet side and a flush-trimming bit in your router, you can cut a dado for case dividers or web frames. Simply position the straightedge where you want your dado, set the depth of cut on your router and plow it out. The bearing on the bit follows your straightedge.

By using a dovetail bit with a template guide and this same setup, you can use the straightedge to make the basic sliding dovetail shown above left.

Use a template guide that has the same outside diameter as your dovetail bit to make measuring simple. Next, clamp your straightedge exactly where you want the sliding dovetail to go.

Set the proper depth for the bit, (9/16" in 3/4" material, for example) then rout the dovetail trench or socket in a little further than the width of the divider. The trench doesn't need to extend all the way across the side. But because the dovetail trench will have a rounded end, the trench must extend a little further so the square-shouldered tail on the divider will fit.

Two-step Shouldered Joints

A shouldered dovetail is ideal for casework that uses web frames, which support drawers. The straight shoulder, which supports the web frame, is cut just as you would cut a basic dado.

First align your straightedge as you did with the basic sliding dovetail. With a 3/4"-diameter flush-trimming bit in your router, plow out the dado to 3/16" deep. Next, take your router with a template guide and dovetail bit, set it to 9/16" deep (without moving the straightedge) and make the cut into the case side. The cut should be a bit longer than the width of your front divider.

Thanks to the template guide (and keeping the straightedge in one fixed location), the dovetail portion of this cut is centered in the dado automatically.

Through Sliding Dovetails

For an even fancier look, you can create through sliding dovetails. These joints allow the end of the case's divider to be seen on the outside of the case.

Start once again by plowing the dado as explained above. You could cut the socket portion of this joint with a router, but there's much less chance of tear-out if you cut the socket using a handsaw.

If you go with this hand-tool route, you should first cut the male portion of the joint (called the tail) on the end of your horizontal divider using the dovetail bit in your router table. The process is explained on the next page. Then use the tail to lay out the location of the socket on the case side.

Now you can saw out the socket. Orient the saw to match the two tail sides, then cut in from

the front edge the width of the divider. Finally, chisel out the waste between your saw cuts.

Don't Forget the Tails!

To make the mating joinery on the dividers (the tails), I use my router table. Use the same dovetail bit you used to cut the dovetail sockets to form the tails to ensure that the joint fits well. Set the fence to adjust the size of the tails, cutting on both sides of the divider. I like to sneak up on the final cut to ensure a snug fit.

Set the bit to cut at the appropriate height for each joint style. For the basic sliding dovetail, that height should be about two-thirds of the width of the case side. If you're making a shouldered dovetail, allow for the 3/16" shoulder depth in your layout.

The through dovetail is cut with the height of the tail equal to the thickness of the case side (if you are adding a shoulder, remember to allow for the shoulder).

Your through dovetail doesn't need to expose the whole width of the divider. For example, you can show only 3/4" on the sides if you like. After cutting the tails on both ends of the divider, use a saw to trim the end 3/4" back from the front of the divider on both sides. Then cut from the back of the divider right at the point where the tail begins from the divider to remove the unneeded tail section. Repeat this cut on both ends.

With the back portion of the tail removed, slide the divider into the dado in the case and mark, then cut, the matching socket.

Whatever Size You Need

While these techniques work great with the standard 3/4"-thick drawer dividers that are common today, they also work with other thicknesses of dividers by using different-sized template guides and bits. The guides are readily available in a wide variety of sizes, including 51/64" and 1" if you need thicker drawer dividers.

You should consider using sliding dovetails for any number of woodworking tasks. The possibilities are endless. **PW**

THE STEPS TO A SHOULDERED SLIDING DOVETAIL

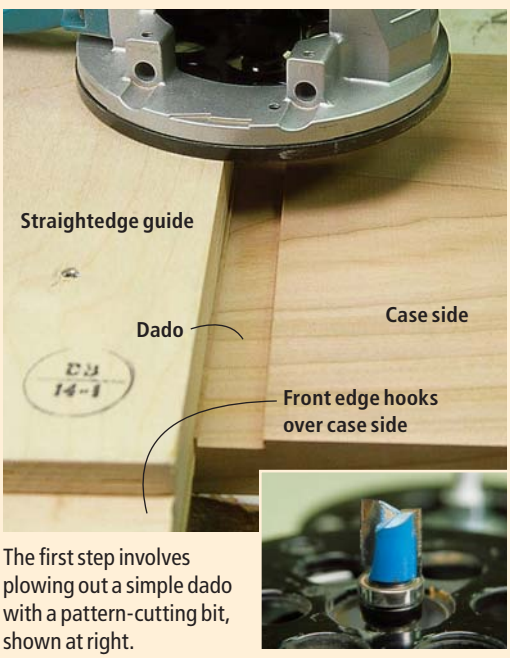
Making a shouldered sliding dovetail begins by cutting a dado in the case's side. This dado is easily made with a pattern-cutting bit and the right jig, which I call a straightedge guide.

The bed of my jig, shown below, is simply two pieces of plywood cut slightly longer than the width of the case side, then glued or screwed together face to face. (Depending on your router and bit, you might need only one thickness.) To complete the jig, screw a third block to the underside of the straightedge guide to hook it square against the front edge of the case side. The hook should be sized so you can clamp the jig in place without interfering with the base of the router. As you cut the dado, make sure you move the router in the correct direction (against the rotation of the bit) to keep it tight against the jig.

Next, install a template guide in your handheld router and the dovetail bit. I should mention one important detail: To use a template guide that is the same diameter as the pattern-cutting bit's bearing collar (in this case 3/4"), it will be necessary to attach the guide first, then insert the bit afterward. Because of the identical diameters, the router base can't be slipped over the bit with the template guide in place. The guide is the same diameter as the collar to allow the dovetail to run exactly down the center of the dado cut.

With the template guide in place and the depth set on the dovetail bit, you're ready to cut the dovetail socket, as shown below.

With the socket created, it's time to make the mating tail on the end of the drawer divider. Mount the dovetail bit in a router table and run both sides of your divider on end between the fence and bit. You will need to make a few test passes to get the perfect fit. Note that I'm using a push block behind the divider for safety and to stabilize the piece during the cut. *— GH*



The first step involves plowing out a simple dado with a pattern-cutting bit, shown at right.

Use a dovetail bit, shown at right, to make your shouldered dovetail socket.

You can easily rout the tail of the joint on your router table with the matching dovetail bit.

Variable-spaced DOVETAILS *by* JIG

Rig your jig. *If you don't want to hand cut dovetails you can come close to the look with these techniques and a fixed-finger jig.*

Two methods to move beyond the limitations of a fixed-space dovetail jig.

BY DON MEANS

Some of us just don't have the time, patience or skill to produce hand-cut dovetail joints and instead resort to one of the numerous dovetail jigs available on the market. However, at several hundred dollars apiece, not everyone can justify the expense of a variable-space jig, such as the Leigh D4R. Even if you do happen to own this fine jig, for certain applications I find it easier and more efficient to use a simpler jig. For example, when building cabinets or furniture for my workshop I usually don't want to spend the time setting up my Leigh D4 (yes, I do own one). However, I still want the dovetail joinery to have aesthetic appeal.

I've experimented with a number of dovetail router bit sizes and cutting angles and, using a basic fixed-finger dovetail jig, have refined two techniques that greatly improve the overall aesthetics of the resulting half-blind dovetail joint. In addition, with a bit of planning, and within certain limitations, it is even possible to create "variable-spaced" half-blind dovetails with this "fixed-finger" jig.

Dovetail Jig Geometry

In order to fully utilize these techniques, it is helpful to have an understanding of the geometry surrounding the dovetail joint produced by the fixed-finger jig. Although jigs of this type generally operate the same way (that is, the pins and tails are produced in a single

operation) not all of them have the same geometric characteristics. For example, the Porter-Cable and Hartville jigs are similar, while jigs by Rockler, Jet and Woodtek have slightly different characteristics. For this article, I worked with the Porter-Cable 4112 dovetail jig equipped with a 1/2" half-blind dovetailing template. However, it should be possible to apply this technique to just about any fixed-finger dovetail jig, once you understand the basic geometric relationships.

When using a fixed-finger jig, the dovetail bit diameter and center-to-center finger spacing are the critical dimensions that control the geometry of the dovetail joint. The key geometric relationship for the joint is the amount of overlap or interference between the tail and the pin.

This relationship is determined by (1) the center-to-center finger spacing, and (2) the diameter of the dovetail cutter. The slope or angle of the dovetail bit is secondary to this relationship. In fact, this is what we are going to "play with" in order to improve the appearance of the joint.

Adjusting the depth of cut determines the amount of interference between the tail and pin, and determines the fit of the joint. As the angle of the dovetail bit is reduced, it is necessary to increase the depth of cut in order to maintain the proper tail/pin interference. This reduced or slighter angle, as well as the increase in the depth, is the key to improving the appearance of the joint.

For these types of fixed-finger jigs, the relationship between center-to-center finger spacing, cutter angle, diameter and, ultimately, cutter depth is defined by the following formula:

Depth of Cut = {D-S/2} ÷ Tangent(a)

where:

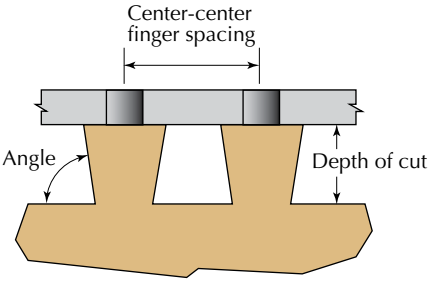
D = dovetail bit diameter

S = dovetail jig center-to-center finger spacing

a =cutter angle (in radians)

This formula provides the insight we are seeking. As you can see, for a given cutter diameter and finger spacing, the cutter angle is inversely proportional to the depth of cut. As the cutter angle is decreased the depth of cut must increase.

This formula might be the end of our minor math lesson if we were cutting dovetails in metal with a precision CNC mill. Unfortunately, we are cutting with tools that have a variety of associated built-in errors (router and bit run-out, bushing and template fit and



CRITICAL DOVETAIL DIMENSIONS

bushing/router eccentricity, to name a few). All these factors result in an effective increase in the diameter of the cutter.

A 1/2" cutter will tend to act like a slightly larger bit. With my equipment (the PC jig and a DeWalt 621 router) I found through trial and error that all of these imperfections added about .010" to the bit diameter. In other words, a 0.500"-diameter router bit acts like a 0.510"-diameter bit. This effective diameter should be used to calculate the estimated depth of cut provided in the preceding formula. (Note: Everyone's tools are slightly different so you will have to experiment to find the amount of variation in your setup.)

Planning the Width (Plus or Minus)

For the majority of applications, the most aesthetic arrangement for half-blind dovetails is to end with a half-pin at the upper and lower edge of the drawer side (or tail board). Unfortunately, when using a fixed-finger dovetail jig this requires the side of the drawer to be limited to certain widths. Some planning is necessary to ensure the joint ends on a half-pin. The Porter-Cable 4112 has a center-to-center finger spacing of 7/8" so in theory, drawer side widths have to be multiples of this dimension.

But it isn't necessary that the half-pins be exactly one-half the pin width. A typical 1/2"-dovetail cutter will produce a throat width that is approximately 3/8" (therefore the half-pin throat width would be about 3/16"). As long as you are close to this dimension (± 1/16" at most) the joint will look OK. Because there are two half-pins on each drawer side this allows a total variation of ± 1/8" over the drawer side. The chart below lists the possible sizes under this parameter.

Most moderately priced dovetail jigs include a basic 1/2" diameter, 14° dovetailing bit. Under normal operation these cutters produce a "stubby" dovetail joint, with tails approximately 5/16" long. In addition, the 14° angle of the tail is not very graceful.

Although there are a variety of dovetail cutters on the market, only a few have the proper cutting geometry that will allow them to work with the typical fixed-finger jig. See the chart below for cutters I have found that work with this technique.

A Simple Improvement

A basic improvement when using the fixed-finger jig is to simply substitute a 1/2"-diameter, 8° cutter (such as the #80 bit for the Leigh jig) for the standard cutter. Set up the jig as you normally would by following the manufacturer's instructions. The only change to the normal setup is the depth of cut – which should be

Drawer Side Width*

MULTIPLIER OR FINGERS	NOMINAL WIDTH (INCHES)	MINIMUM WIDTH (INCHES)	MAXIMUM WIDTH (INCHES)
3	2 5/8	2 1/2	2 3/4
4	3 1/2	3 3/8	3 5/8
5	4 3/8	4 1/4	4 1/2
6	5 1/4	5 1/8	5 3/8
7	6 1/8	6	6 1/4
8	7	6 7/8	7 1/8
9	7 7/8	7 3/4	8
10	8 3/4	8 5/8	8 7/8
11	9 3/8	9 1/2	9 3/4

* Note: This chart provides the typical drawer side widths that are possible when using the PC 4112 dovetail jig and similar jigs with equivalent finger spacing. When properly set up in the dovetail jig, these widths will result in a half-pin at each end of the drawer.

Commercially Available Dovetail Bits That Can be Used in Fixed-finger Jigs

	STANDARD	LEIGH (#101)	INCRA	LEIGH (#80)	CUSTOM*
Cutter diameter	1/2"	1/2"	17/32"	1/2"	17/32"
Effective diameter	0.510"	0.510"	0.542"	0.510"	0.542"
Angle or slope	14°	10°	14°	8°	1:6
Depth of cut	19/64"	26/64"	27/64"	33/64"	5/8"

Most manufacturers make bits in the sizes listed above. * Whiteside will custom-make this bit (or any other for that matter) for a price of around $200. It is only shown here to indicate what the characteristics of the "optimal" router bit for this technique would consist of – if you are prepared to pay for it!

LEAD PHOTO BY ALLEN SINGER AND THE AUTHOR; STEP PHOTOS BY THE AUTHOR; ILLUSTRATION BY MARY JANE FAVORITE

set to about 25/32". The actual length of the tail will be about 17/32". However, when measuring the cutter depth from the base of the router, it is necessary to take into account the thickness of the finger plate (1/4" in this case).

It will probably be necessary to fine-tune the depth of cut by experimenting with some scraps of wood. Simply follow the jig maker's instructions for making these adjustments.

Once you have fine-tuned the settings, you are ready to dovetail the final pieces. I like to back (or climb) cut the inside edge of the tails to create a clean inside edge for the pin sockets. Proceed to cut the pins and tails as you normally would, then assemble the joint. The longer tailed, slighter-angled dovetail produced with this bit is an improvement over the standard cutter.

'Variable'-spaced Joints

It is also possible to create a variable-spaced dovetail joint with the fixed-finger jig. Again, it takes a bit of planning to ensure that the drawer side ends on a half-pin. In addition, for certain drawer side widths it will only be possible to create asymmetrical dovetails. Another consideration is the number of tails that will show in the assembled joint. I find wider tails with an "odd" number of pins to be aesthetically pleasing.

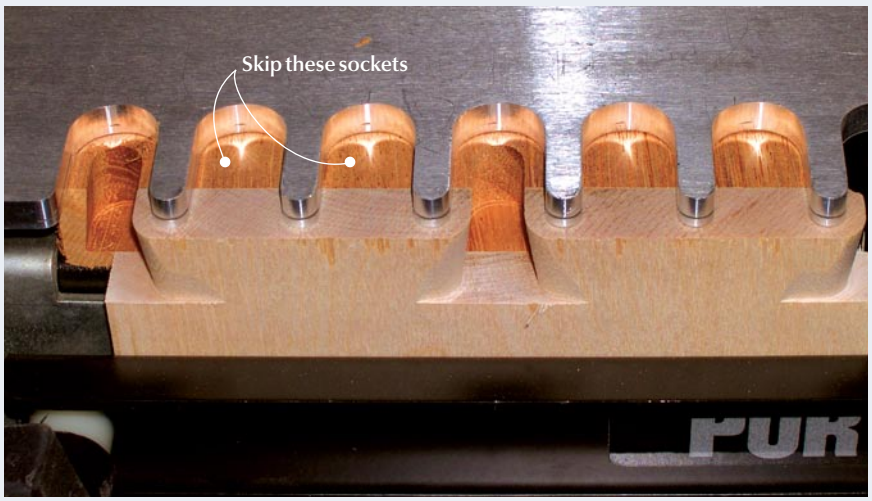
However, this imposes quite a limitation on the drawer widths that can be used. (If you limit yourself to this convention, it will only be possible to use the widths corresponding to the even-numbered multiplier in the "Drawer Side Width" chart on page 73 – assuming you wish to end up with symmetrical tails.)

The following procedure outlines how to produce a variable-spaced dovetail joint that has two half-pins at the top and bottom of a 5 1/4"-wide drawer side and with a single full-pin in the center.

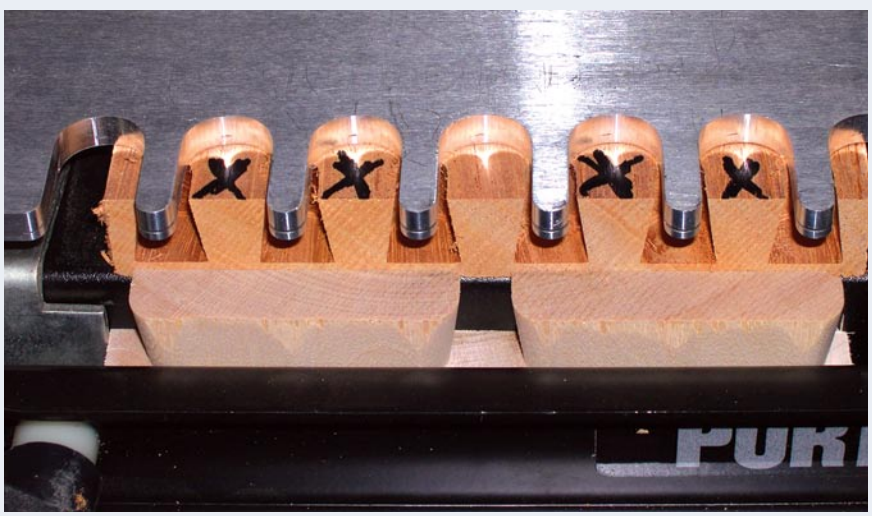
As before, I used the 1/2"-diameter, 8° cutter for this example. Again, set up the jig as you normally would by following the manufacturer's instructions – adjusting the depth of cut to about 25/32". (As before, it may be necessary to fine-tune the depth of cut.) The sequence of accompanying photographs illustrates the procedure.

Don Means is an amateur woodworker and spends much of his free time in his shop (or as his wife refers to it, the garage) in Danville, Calif. He has an engineering background and has been woodworking seriously for about 15 years – mainly constructing furniture and other woodcraft for family and friends. You can view some of Don's completed work at: home.earthlink.net/~mbwoodworks/.

Creating a Variable-spaced Dovetail Joint With a Fixed-finger Jig

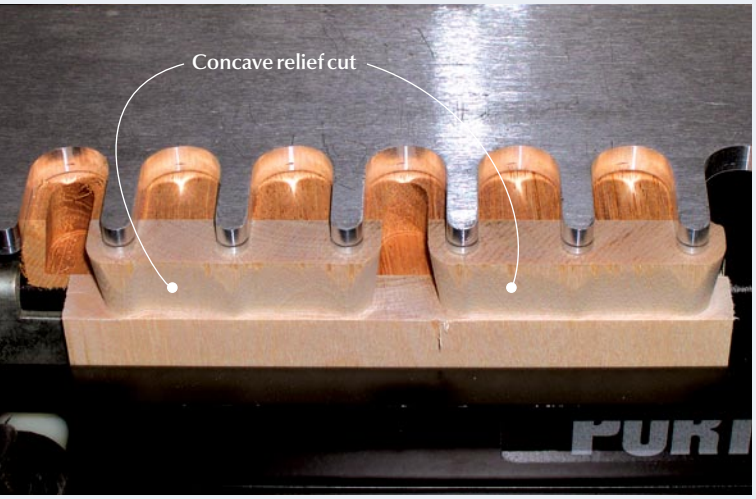


1 ***Rough cut the tails.*** *With the jig and depth of cut properly set, first take a back cut along the width of the drawer side. Then, as you normally would, start at the inboard end of the jig and rout out the first tail socket. However, do not rout the next slot in the jig template. Instead skip over the next two slots to the fourth slot. Rout out this tail socket, then again skip the next two slots and finish up on the last slot (which should be the outside edge of the drawer side). As you look at the drawer front there should only be two tail sockets routed in the drawer front (or pin board) and two "wide" tails that are roughly defined on the drawer side.*



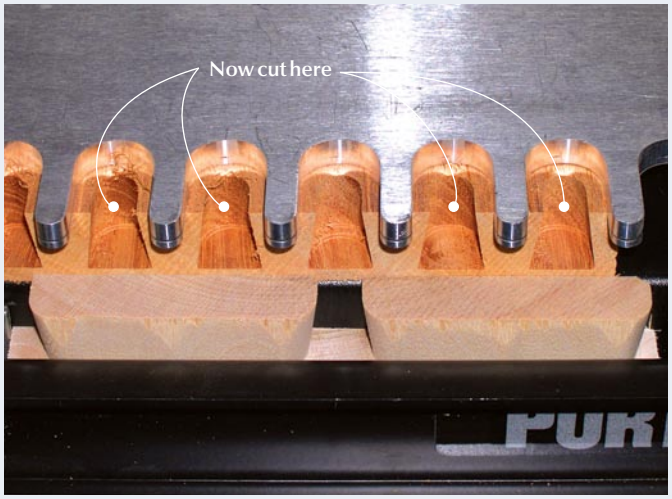
4 ***Finish the tail sockets.*** *The next several steps in the procedure require you pay close attention to your work. Basically, we are going to manipulate the drawer front in the jig to hog out the unneeded pins in order to create two wide sockets for the wide tails we just milled.*

First, unclamp the drawer front and slide it toward the outboard side of the jig (to the right as you are facing the jig) exactly half the finger spacing (do not unclamp the drawer side). At this stage the edges of the drawer front and sides should be aligned and it should become obvious which pins will be removed to create the wide sockets for the tails that were previously cut. Use the drawer side as a reference to square up the drawer front by pushing it up against the tails and re-clamp. At this point, there should be no tail sockets showing (in other words, all you should see are the individual pins). For this particular dovetail layout, unneeded pins will be removed using the second, third, fifth and sixth template "slots" (notice we skipped the fourth slot since this pin is aligned with the pin socket from the tail cutting operation). These steps in the procedure can get confusing if you are not careful. The safest strategy is to use a pen to mark the areas that are to be removed.

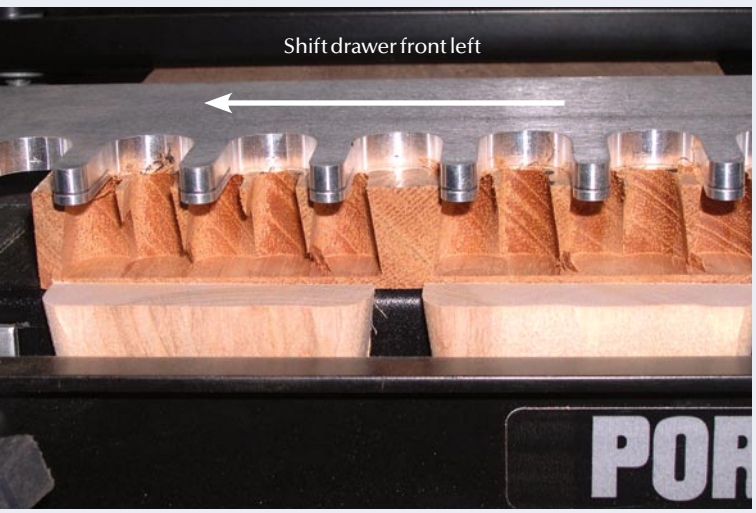


2 ***Finish the tails.*** *Next it is necessary to "finish" the tails by carefully removing the material on the back (or inside) of each of the tails. This is necessary to ensure the proper fit of the joint. Start at the left-hand side of the jig and carefully move the router from left to right between the template fingers, slightly "dipping" between the template fingers. (It is not necessary that this be a perfectly straight cut since it will be hidden in the assembled joint.)*

I usually make this cut slightly concave – just to ensure there will be no interference with the tail socket. Make sure you do not remove too much material as this will begin to affect the strength of the joint (obviously if you cut all the way through the tail you will have ruined the piece).



3 ***Rough cut the tail sockets.*** *Once the drawer side is complete we turn our attention to the drawer front (or pin board). First, unclamp the drawer side and lower it so the top of the tails are just below the tail sockets on the drawer front and then re-clamp (this is so the router bit will clear the top of the tails when cutting the tail sockets). Now rout out all of the tail sockets as you normally would.*



5 ***Rout between the fingers.*** *Once the drawer front is marked and secure in the jig, rout out the marked areas between the template fingers. After this is complete you should be left with very thin sections of the former pins. Now unclamp the drawer front and slide it toward the inboard end of the jig (to the left) until these thin sections are centered in the template finger slots. As before, use the drawer side as a reference to square up the drawer front.*

Clamp the drawer front and hog out the marked sections. At this point it should begin to become obvious how we are manipulating the jig to produce the wide tail sockets. Once this is done, unclamp the drawer front, slide the piece in the opposite direction (to the right) until the remaining thin sections are centered in the template slots (again use the secured drawer side as a reference to square the drawer front in the jig) and repeat the cutting procedure.

6 ***Ready to assemble.*** *If you performed these last several steps correctly when you remove the drawer front from the jig you will see two wide tail sockets that should perfectly match up to the wide tails previously cut. The joint is now complete and ready to be assembled.* **PW**

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