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Winter 2007

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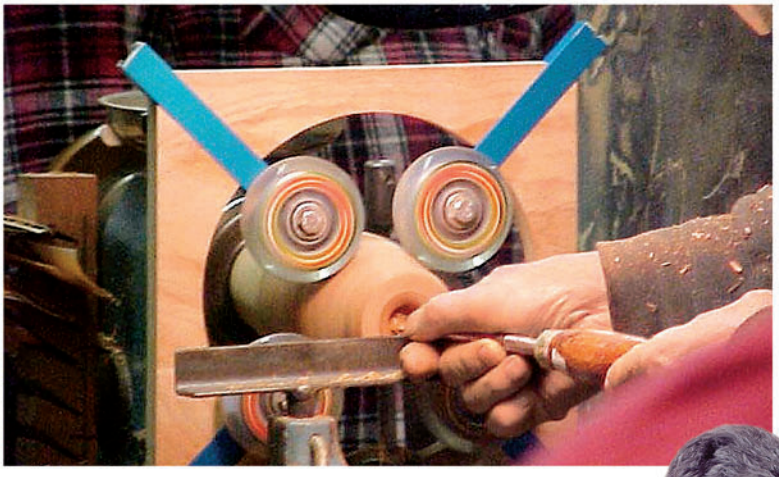

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Editor's Note

Accessories Make the Tool

It couldn't have been more than an hour after I put my first table saw together that it happened: I needed an accessory to go with it. I had bought the saw with the grand plan of building a few cabinets for my budding garage shop, then charging into the other projects on my list.

Well, next to that stack of plywood, my shiny new saw looked woefully small. In fact, it was downright puny. Despite my excitement to get those cabinets underway and turn that stack of plywood into a pile of parts, my cautious nature in the shop was applying the brakes. Could I possibly cut those sheets up safely on my own without a helper to catch the offcuts? No way. I needed an outfeed table. So much for the cabinets. Task One was to cobble together my first of many, many jigs and fixtures for that saw. In the years since then, I can't even count the number of accessories I've built for my tools.

No doubt, you've come to the same revelation I did that day. Out of the box, our woodworking tools can work wonders for us, but sooner or later — probably sooner — you'll be making a few jigs or fixtures to go with them. Think about it: a router becomes more useful with a straightedge guide, a handful of templates and, of course, a router table. Clamp a shop-made table with a hole in it to your drill press and it transforms into a drum sander. You can slice up your own wood veneer on a band saw, but you'll fall short on uniform thickness unless you make a point fence to steer those tricky long rip cuts.

Shop accessories make tools safer to use. They expand a tool's range of functions, improve convenience and sometimes even make up for a shortcoming here or there in a tool's design. Adding the right jig or fixture to your mortiser, miter saw or lathe will help you "trick it out" to be the tool that fits you best.

This special issue of *Woodworker's Journal* is dedicated to workshop projects. Special Projects Editor Chris Marshall and I have selected some of the best shop accessory stories from past issues to help fortify your collection of jigs and fixtures. (We're even including a table saw outfeed table plan!) We've also added a handful of smart technique articles so you can bone up on veneering, steam bending and gluing up large panels. If you're just getting started with your tool collection, I think you'll enjoy Chris's lead-off article on the top five shop tools, starting on page 8.

Can you work wood without shop accessories? Sometimes. But the right jig or fixture can fit your tools like a hand in a glove. You'll work faster, safer and in most cases, more accurately too.

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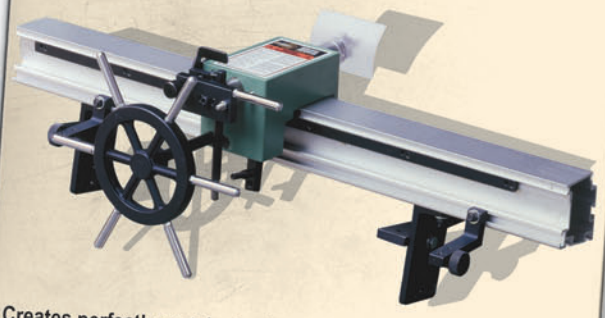

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Top Five Tools for Tooling Up

By Chris Marshall

Ready for serious woodworking? These five tools should top your "gotta get" wish list.

Filling your workshop with tools is part of the joy of woodworking, but it helps to know what to buy, in an order that makes sense.

So you say you're finally ready to get serious about building a "real" woodworking shop. Time to step up from that circular saw, portable router and a couple sawhorses ... Great! You've even got some money stashed away to cover those first major woodworking tools. Perfect! Now, the perplexing problem: What should you buy and in what order? Ask ten woodworkers and you'll probably get ten different answers, but they'll all agree that some tools are flat out essential. Put these five at the top of your shopping list and you'll have a rock-solid foundation to build on.

For handtool work, layout or assembly, a sturdy workbench is an invaluable shop tool.

Buy This First: A Workbench

Surprised? Bet you thought the first "must have" tool is a table saw. It nearly tops the list, but I think workbenches are terribly underrated in our machine-frenzied hobby. Benches are often seen as workshop furniture instead of important tools in their own right. Fact is, a sturdy, flat work surface will serve you well throughout the building process. With a full-sized bench you'll have room to lay things out for measuring and marking. A bench gives you a dead-flat reference surface you can count on when you're inspecting stock prior to surfacing, checking the accuracy of joinery or clamping up assemblies or panels. A good bench should be heavy enough to stay put. The heavier the better. You'll know why when you use it for hand sawing, planing or pounding and chiseling.

Usually, benches have at least one vise with rows of bench dog holes in the top. These are super-handy features for general clamping. A storage shelf, tool tray or set of drawers just makes a good bench even better.

Building your own bench is a woodworking tradition. (We're including a stunning bench plan from renowned woodworker Frank Klausz in this special issue; see page 14.) Or, you can buy a quality workbench instead. Most benches are made of dense, stable hardwoods such as beech or maple, but even a worktable with a heavy, thick top made of MDF will work as fine as a modest bench. Just make sure it's absolutely flat with overhangs that allow for installing clamps.

continues on page 10 ...

If You Haven't Tried Biscuit Joining with Lamello, Then You Haven't Tried Biscuit Joining

Ask any expert you find, and they'll tell you that done properly, there is no better joining technique than Biscuit Joining. Yet many woodworkers have had disappointing results and have "sworn off" Biscuit Joining as a viable technique. The fact is that unless you've tried it with a Lamello Biscuit Joiner and Lamello Biscuits, you haven't done it as well as you could have. There's no question that Biscuit Joining works, and offers several advantages over other joining techniques. The problem is not Biscuit Joining, the problem is inferior machines and biscuits being sold by big name competitors and used by many woodworkers. Deciding it doesn't work without ever using the best available tools doesn't make sense. Try it with a Lamello and you'll change your mind pretty darn fast. In fact we're so confident, we offer a 100% satisfaction guarantee on all of our power tools. With Lamello, you've got nothing to lose and everything to gain: speed, precision, strength, and versatility.

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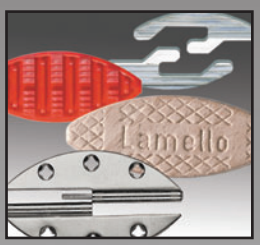

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A top quality table saw is worth its weight in gold. You'll use it for making the usual straight cuts as well as milling a slew of other joinery. Rabbets, dadoes, grooves, box joints, laps and tenons are all within its capability.

Buy This Second: A Table Saw

Your next investment? Buy a table saw with a quality rip fence. It will give you arrow-straight rip cuts every time, plus it does a fine job of crosscutting and angle-cutting. You can even cut rabbets, tenons and other joinery with a single blade, or speed things up with a dado blade. Odds are, a table saw will become your wonder tool for most straight-cutting tasks.

You don't have to spend a month's salary to get a good saw these days. If you're cramped for space, buy a benchtop saw. For the longer haul, splurge on a heavy-duty contractor's or hybrid table saw in the 1½ to 2 hp range with an induction motor. You'll never regret spending the extra cash.

Buy This Third: A Jointer and Planer

Okay, I'm exercising a little editorial license here. A jointer and planer are obviously two machines, but they really perform in unison as the "Dynamic Duo" of stock preparation. Don't let anyone fool you into believing you can have one without the other. It just isn't true. A jointer is crucial for flattening edges and faces, whereas a planer reduces stock thickness and keeps faces parallel. Each machine performs a set of independent functions. Once you have both, you're no longer a slave to the premium prices and iffy quality of pre-surfaced home center lumber. Now you can buy more economical roughsawn stock in any species you like, then surface it perfectly flat, square and smooth.

If you can swing it, buy both machines at the same time. Get a 12"- to 13" planer and a jointer with the longest bed you can afford. A 6" jointer will certainly do the job, but an 8" machine is even better. (Then ask your special someone to buy you a dust collector in the 650 cfm range for your next big holiday gift; jointing and planing make truckloads of chips.)

Buy This Fourth: A Router Table

Want to squeeze every dime from your portable router? Here's how: Mount it to a router table, and you'll double its value as a "poor man's" shaper. The virtues of a router table are many. First, a router table

continues on page 12 ...

You can surface lumber like a pro, but it will require adding two more machines to your inventory: a thickness planer and a jointer. The jointer creates flat reference edges and faces; the planer keeps faces parallel and reduces stock thickness. Neither does double duty for the other.

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allows you to take your hands off the router and feed the wood instead of the machine. That way, routing doesn't have to be a balancing act, especially when profiling or template-routing those small parts. A router table's fence is a perfect support surface for milling dadoes and grooves or to set up long runs of molding. The fence also delivers greater precision when cutting joinery. You can even modify it to turn your router into a jointer (see page 68).

A router table allows you to use large panel-raising or joinery bits that would be unsafe to run in a handheld machine. It's your ticket to building cabinet doors or milling your own custom crown molding. Be sure to use a 2½ to 3 hp router for heavy shaping work.

Router tables that enclose the router will help cut down on noise, and a fence with dust collection will help control the debris. Make sure the tabletop is flat and sturdy and the fence is easy to adjust. (See page 26 for a Custom Router Table plan you can build.)

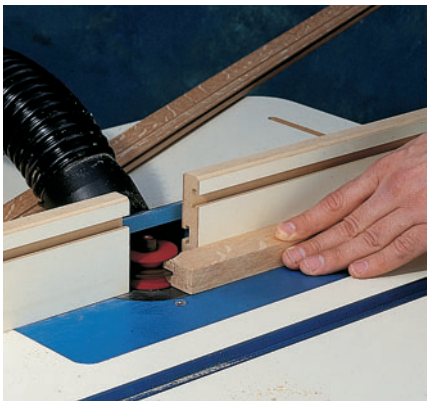
Buy This Fifth: A Band Saw

Some woodworkers will insist that a band saw is more useful than a table saw. It will make rip cuts, crosscuts and angle cuts like a table saw but without the possibility of dangerous kickback. Fair enough. Personally, I think a table saw cuts more cleanly, makes a wider variety of joints and provides better tabletop support. Your experience will show you which camp you're in.

Band saws can make straight cuts more safely than table saws, but they really shine for cutting curves and resawing. You'll also appreciate their quiet, cleaner manners.

From the standpoint of functionality, there's no disputing that a band saw really shines as a curve-cutting and resawing tool. Sooner or later, your projects may include cabriole legs, curvy rails, circles and blanks for turning. A jigsaw might work, but a band saw ensures greater accuracy, control and cutting smoothness. It's the right tool for these jobs.

Resawing isn't essential for most projects, but the ability to split a board through its thickness can transform a pair of ordinary doors or panels into mirror-image dazzlers. A table saw just can't compare in the resawing department.



Want to turn your full-sized router into a door-making superstar? Just hang it from a router table. Now any router bit, large or small, is safely within your range of options.

Worth Every Penny

So there you have it: Five machines you'll use again and again for as long as you're a woodworker. One last piece of advice you've probably heard a hundred times before: Buy the best equipment you can afford. If you start with professional quality machines, their capability will rarely disappoint. You'll be as proud of your tools as you are of your projects.

A Traditional European Workbench

If you'd like to build a bench to top all other benches, ours was designed by master woodworker Frank Klausz. You will use it for a lifetime, and so will your children's children.

Building a bench like this is an enjoyable process made up of many simple steps. A craftsman worthy of such a bench will be able to make it with ordinary hand and power tools. The benchtop is very heavy once it is glued up, so you'll want to have a helper on hand when you need to maneuver it around your shop.

Building the Base

The base of this bench consists of two leg trestles connected by two heavy rails that support a storage shelf. (For details, see the *Exploded View Drawings* on page 16.)

The first thing you must do is determine how high you want your bench to be and size the legs accordingly. For hand planing, the ideal height is generally considered to be the height of your palms from the floor when your arms are at your sides. This height allows you to make the best use of your body weight to push a hand plane down. For chiseling and other bench work, you can put blocks under the feet to raise the height a couple of inches. To determine the overall length of the legs, subtract 6½" from the overall bench height.

The legs are connected to the top rails with through-wedged mortise and tenon joints and to the foot rails with fox-wedged mortise and tenon joints. (See the *Drawings* on page 16 and the photo on page 17.) The shorter tenons may be cut on the table saw, using a tenoning jig for the vertical cuts; but the longer ones are best cut on the band saw, as demonstrated in the bottom photo at right.

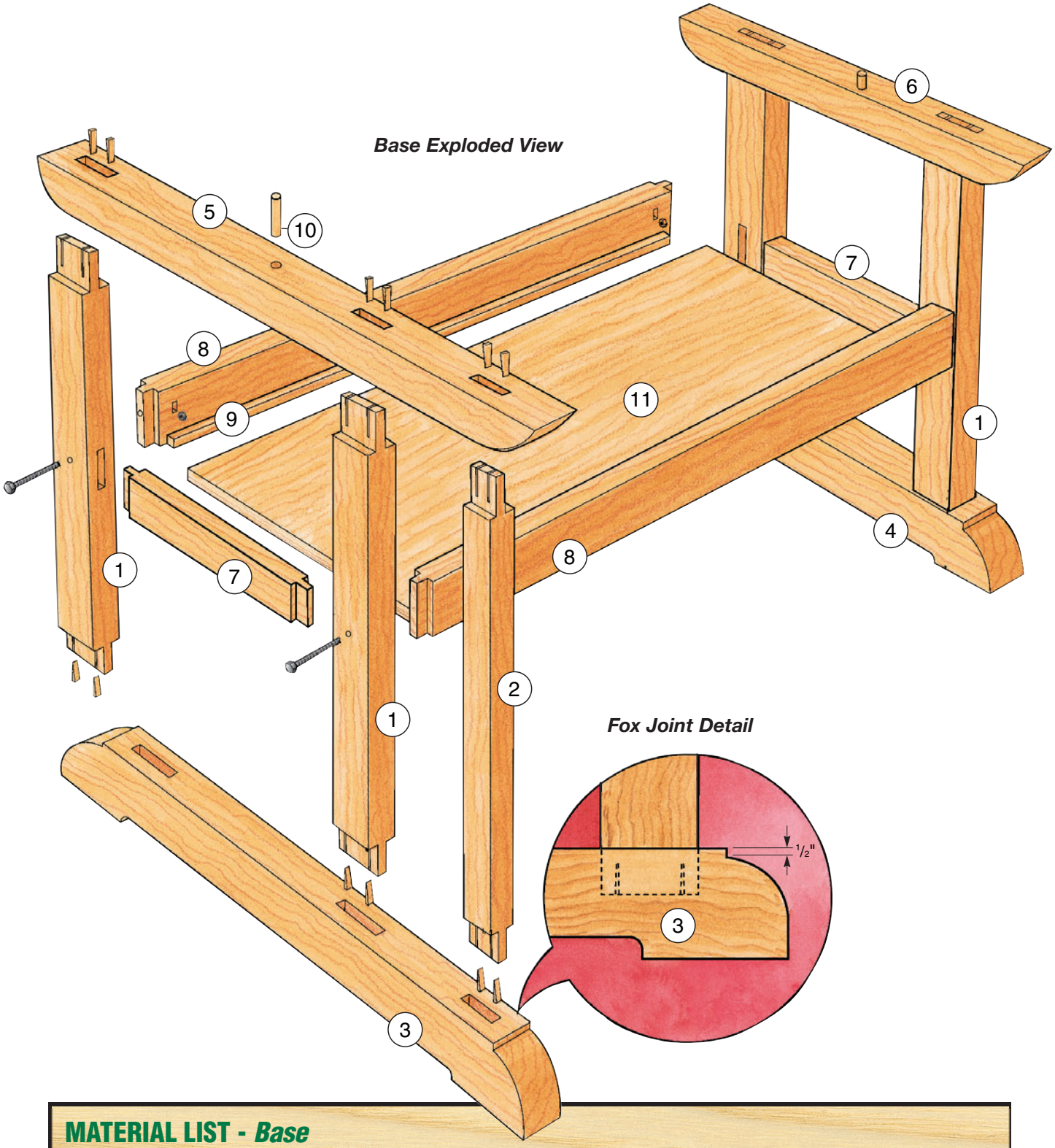
Use a cardboard template to lay out the curves on the feet and the top rails. Cut the curves on a band saw and smooth them out with a light pass on the disk sander, but don't cut out the recesses on the bottom of the feet until you have made all the mortises.

Cut the mortises for this bench with a mortising attachment on a drill press (see top photo, right), but you could drill them out with a brad-point or Forstner bit and clean them up with chisels if you don't have a mortiser.

Before you glue up the trestles, mortise the legs for the stub tenons of the stretcher rails that connect the trestles. Drill a 1/2" hole through the center of each mortise for the hex bolts that will join the rails to the legs. Dry-assemble the rails to the legs and drill the long holes into the ends of the rails. Rout or mortise a pocket about 3⅛" from the shoulder of each rail for a hex nut. Frank usually makes this pocket oversize, in order to get fingers or pliers in there to hold the nut in place. Finally, glue up the trestles (see the photo on page 17) and set them aside until the top of the bench is completed.

Mortise the feet before cutting out the recesses on the undersides. Here the author uses a mortising attachment on a drill press.

Cut the shorter bottom tenons of the legs and the stub tenons of the rails with a tenoning jig on the table saw. Use the band saw for shaping the through tenons, as shown here.



MATERIAL LIST - *Base*

		T x W x L
1	Legs* (4)	2⅜" x 3½" x Varies
2	Narrow Leg* (1)	2" x 2⅜" x Varies
3	Foot (1)	3¾" x 2¾" x 33"
4	Short Foot (1)	3¾" x 2¾" x 24"
5	Top Rail (1)	2⅜" x 2¾" x 33"
6	Short Top Rail (1)	2⅜" x 2¾" x 24"

		T x W x L
7	End Stretchers (2)	1½" x 2½" x 13½"
8	Long Rails (2)	1½" x 5" x 45"
9	Shelf Support Strips (2)	3/8" x 3/4" x 43"
10	Bullets (2)	3/4" Dia. x 3"
11	Shelf (1)	1/2" x 13" x 43"

**The legs are cut to length according to your height (see text).*

The legs are attached to the feet with fox-wedged tenons.

Assemble each trestle section with white glue and clamps. Here the author uses a mallet to drive the fox-wedged tenons home (into the bottom of the legs).

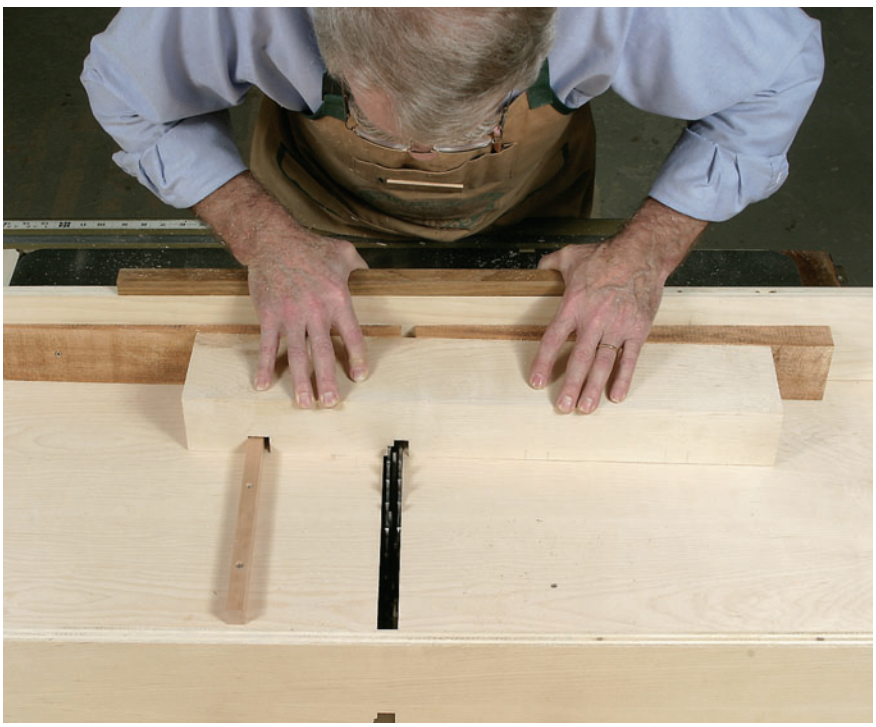
Selecting Lumber for the Workbench Top

Next, make the main part of the benchtop. The top of the bench consists of a long section, usually made of two hefty 7"-wide boards, and a short front section that becomes the fixed jaw of the tail vise. (See the *Drawings* on pages 18 and 19.) The front piece of this shorter section is 4" high and contains a series of bench dog holes that align with opposing holes in the tail vise.

Begin by letting your lumber acclimate in your shop for a week or so before you start milling it. Then rip, joint and surface all the pieces. It does not matter if there are some rough mill marks or defects on the underside of the top, because these will not affect the utility of the bench. Frank recommends using the band saw to rip lumber that is more than 2" thick, because a band saw blade cuts through thick lumber much more efficiently than a table saw blade.

Making the Bench Dog Holes

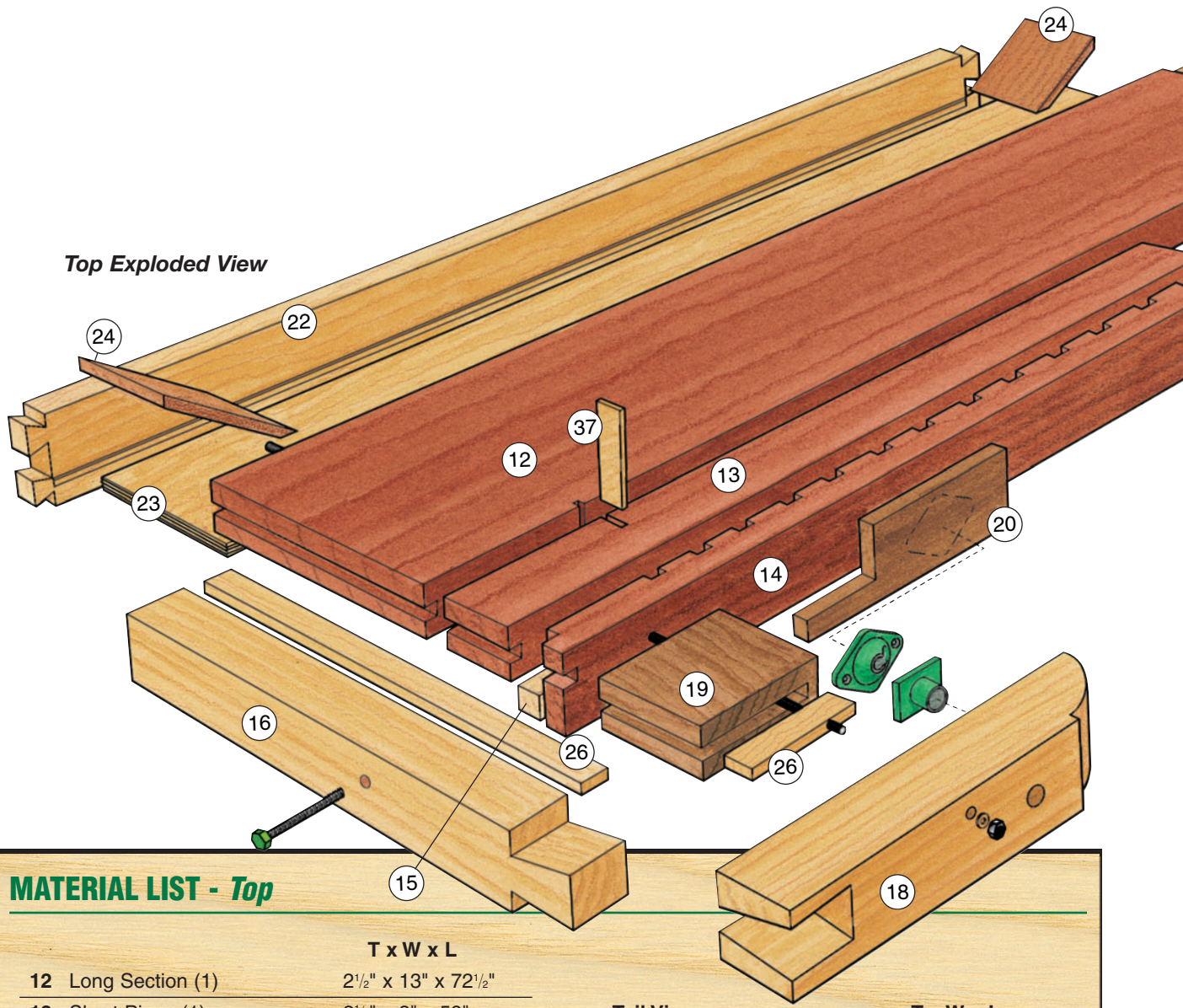
To make the bench dog holes, cut slots in the front lip of the bench before gluing it to the other short section of the top (see the *Pinup Shop Drawings*). You want the dogs to tilt 2° toward the opposing bench dogs, so the slots must be at an 88° angle to the bench surface.



Use a table saw sled with a 2° auxiliary fence to cut the bench dog slots in the tail vise face. Reverse the fence for the opposing slots in the front lip of the bench. A guide strip tacked to the sled ensures equal slot spacing.

To cut the slots in both the front strip and the tail vise, Frank used a table saw sled that works like a box-joint jig, with a 3/4" dado blade and a tapered auxiliary fence that skews the workpiece 2° from perpendicular (see photo, left). Reverse the tapered fence for cutting the tail vise slots, because they need to slope 2° in the other direction.

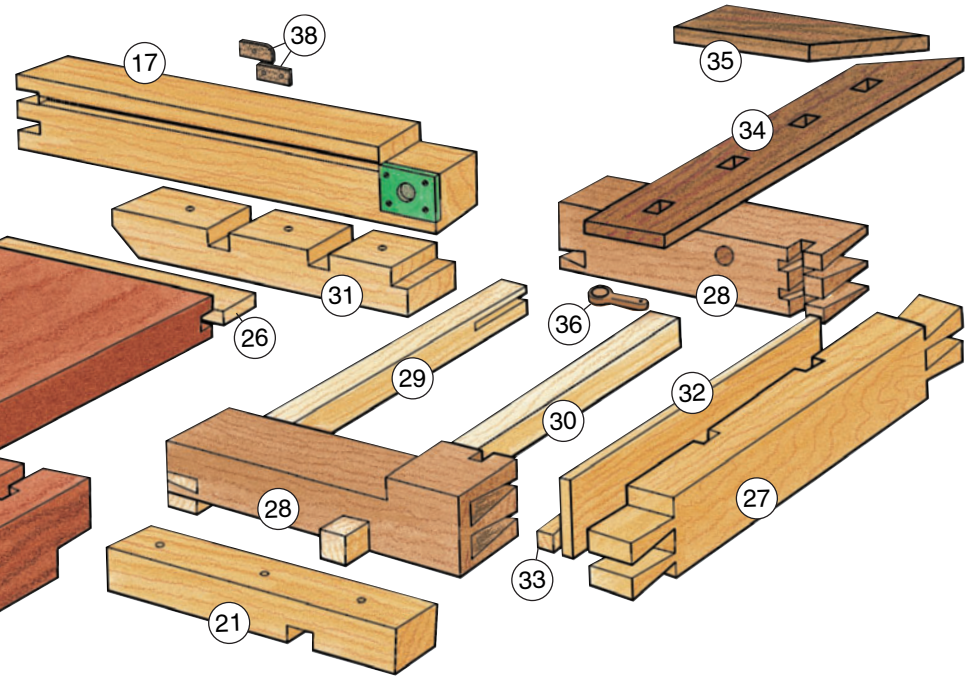
After you make the first cut, tack a strip of wood the same thickness as your dado blade to the base of the sled at the appropriate hole spacing — in this case 5¾". After cutting the first slot, you can cut each successive slot by indexing the previous slot on the wood strip. Note: the last slot, at the end of the strip, has a different spacing. See the *Pinup Shop Drawings* for more details about this slot.



MATERIAL LIST - *Top*

		T x W x L
12	Long Section (1)	2½" x 13" x 72½"
13	Short Piece (1)	2½" x 3" x 58"
14	Front Lip (1)	2½" x 4" x 58"
15	Backer Strip (1)	1½" x 1½" x 58"
16	Long End Cap (1)	4" x 3¼" x 37½"
17	Short End Cap (1)	4" x 3¼" x 24¼"
18	Shoulder Vise Arm (1)	4" x 3¼" x 23"
19	Shoulder Block (1)	2½" x 8⅝" x 7½"
20	Shoulder Vise Jaw (1)	1" x 4" x 17½"
21	Inside Guide Block (1)	3" x 2¾" x 17¼"
22	Backboard (1)	1" x 4" x 76¼"
23	Tool Tray (1)	1/2" x 8⅜" x 7½"
24	Tool Tray Ramps (2)	1/2" x 7½" x 6½"
25	Spacer Blocks (2)	1½" x 3¼" x 22"
26	Plywood Spline Material	1/2" x 1½" x 60"

	Tail Vise	T x W x L
27	Front Face (1)	2½" x 4¼" x 22½"
28	Jaws (Ends) (2)	3½" x 4¼" x 13½"
29	Back Rail (1)	1½" x 1⅜" x 23"
30	Center Rail (1)	1½" x 1⅜" x 17¼"
31	Outside Guide Block (1)	3¼" x 2¼" x 20"
32	Plywood Liner (1)	1/4" x 4¼" x 16"
33	Front Runner (1)	3/4" x 7/8" x 16"
34	Long Vise Cap (1)	7/8" x 5½" x 23"
35	Short Vise Cap (1)	7/8" x 4" x 13½"
	Miscellaneous	**T x W x L**
36	Carved Oil Cup (1)	1/2" x 2" x 6"
37	Wooden Stop (1)	1/4" x 1¾" x 7"
38	Crosscut Stops (2)	1/4" x 1" x 3"



Use a router with an edge guide to cut the spline grooves in the ends of the glued-up benchtop. These grooves will match the spline grooves you'll form later in the end caps.

Assembling the Top

Assembling the top involves several steps. Before you can glue the various parts together, you need to drill the hole for the threaded reinforcing rod that goes through the full width of the top at the shoulder vise.

To do this, clamp the two planks of the long section together and drill a 9/16" hole through the first into the second. Then clamp this section to the next section and repeat the process, drilling the hole progressively through all the parts, including the block and the arm of the shoulder vise. Use a spade bit with an extension attachment to do this.

Once you have drilled through all the pieces, rip grooves for the splines with a dado blade on your table saw. Glue up the 13"-wide section and the short front section separately. Use 1/2" x 1½" plywood splines and glue to join all the parts of the top, including the end caps and shoulder vise block.

Square off the short section and glue it to the long section, making sure that all the holes line up and that the splines don't interfere with them. Finally, trim the ends square and rout the grooves for the end cap splines (see photo, above).

Attaching the End Caps

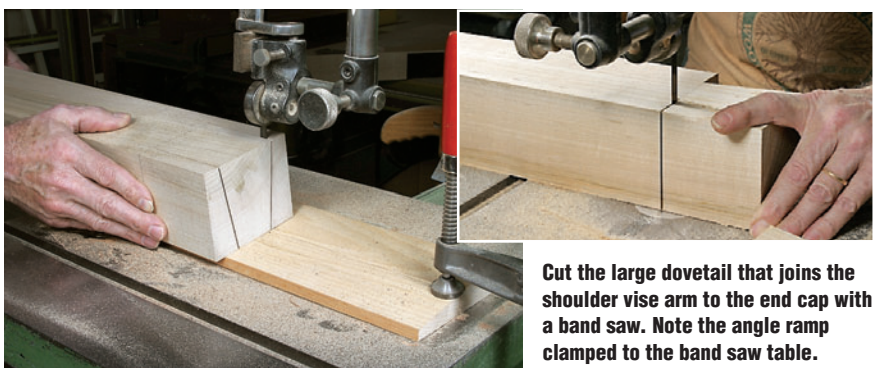
Before you can attach the end caps, you'll need to first join the long end cap to the arm of the shoulder vise. This is a simple through-dovetail joint that you can cut on the band saw and clean up with chisels and rasps (see photos, below, and on page 20). Make an angled ramp, clamped to the band saw table, to tilt the shoulder vise arm when cutting the dovetail socket.

Dry-fit this dovetail, then disassemble the parts and rout or rip the spline grooves in both parts, stopping the grooves so they won't show when the parts are assembled. Cut the groove in the short end cap also. All the spline grooves should be centered on the thickness of the top.

Notch and drill the short end cap for the benchscrew nut at this time. You will need to drill a hole in the inside face with a Forstner bit for the cast-iron nut, then a smaller hole the rest of the way through for the screw itself. Then trace the benchscrew flange around the larger hole and rout the end cap to the depth of the flange. (A typical installation is shown in the bottom photo on page 20.) Repeat this procedure for the shoulder vise benchscrew nut, and install both nuts with the appropriate sized screws before glue-up.

Next, drill the 1/2" holes through the end caps for the hex-head machine bolts that will reinforce their connection to the top (see *Drawings*). Start the holes from the inside of the end caps, centered on the spline groove. Then dry-assemble the caps to the top and drill the long holes into the endgrain of the top. Remove the caps and continue the holes to their full depth. Drill or rout pockets in the underside of the top for the hex nuts, as you did with the rail joints in the base of the bench.

If necessary, trim the shoulder block for a perfect fit between the



Cut the large dovetail that joins the shoulder vise arm to the end cap with a band saw. Note the angle ramp clamped to the band saw table.

Clean and finish the joint with a paring chisel. Test-fit the joint before you try to glue it up and join it permanently. It should fit snugly but not too tight.

Bar clamps and hex-head bolts with captive nuts connect the end caps to the benchtop. Note the installation of the benchscrew nut in the short end cap.

top and the end cap assembly. Rout spline grooves on three sides of the block and dry-assemble it. Then, mark the finished length of both end caps at 8½" past the back edge of the top, and cut them to length on a miter or radial arm saw.

The final step before gluing on the end caps is to rout the dovetail sockets in the ends for the backboard. Frank used a simple router jig similar to the one for the tail-vise dovetails (see photos, next page). The jig uses a 1/2"-diameter straight bit and a 5/8" template guide bushing.

Glue-up isn't difficult, but it is somewhat complicated, so it's good to have a helper, if possible. Start by turning the top over, with a couple of beams underneath it to raise it off your assembly table. Do a dry run first, to make sure you have everything you need, including all the clamps, bolts and splines.

Frank used a brush to spread glue in the grooves and a small disposable paint roller to roll it onto the various surfaces quickly. White glue is a good choice for this application, as it allows more open time than yellow glue.

Get all the parts assembled before clamping them, because they must be tightened in all directions at once. At the shoulder vise end, clamp the big dovetail first with one long clamp lengthwise and another squeezing the joint itself. Then use another clamp to pull the vise arm and the shoulder block tight against the top and two more to clamp it to the end cap. Now, clamp both end caps at the same time with two 8-foot bar or pipe clamps, and tighten the bolts to pull both caps into tight contact with the ends of the top.

The final step of this main glue-up is to install and tighten the threaded rod with washers and hex nuts at each end (see photo, page 22). When the glue dries, plane or belt-sand all the joints flush.

Next, mill and install a solid strip of hardwood behind the row of dog holes. This encloses the holes and provides a larger clamping surface under the front lip of the bench, where you are always clamping workpieces. The backboard and tool tray are next on the list.

Frank likes to use a special piece of wood for the backboard, since it is so prominent on the customer side of the bench. Cut the backboard to the correct width and length to span the end caps. Then, clamp it temporarily to the ends so you can lay out the dovetails. Cut the dovetails with a band saw and clean them up with a chisel.

Now, plow a 1/4"-deep groove in the backboard for the tool tray, at a height equal to the thickness of your benchtop. Rip your plywood for the tray to a width that will underhang the benchtop by about an inch when fully seated in the groove in the backboard.

Glue the tray into the backboard, then install the assembled parts to the bench, gluing and screwing the tool tray to the underside of the bench (see bottom photo, page 23).

To complete the top, install spacer blocks with screws and glue to the underside, where the top rails of the base will meet the top as shown in the top photo on page 23.

Making the Tail Vise

Many woodworkers are nervous about making a tail vise, because it appears so complicated. In fact, it is only parts and pieces, like anything else you make.

Begin by building the tail vise frame, which consists of two jaws dovetailed to a face piece, and a back runner connecting the front and rear jaws (see the *Exploded View* on page 18). Frank's design uses through dovetails at the rear jaw but half-blind dovetails at the front jaw, to provide an unbroken face-grain surface where it meets the other jaw. Here again, he uses a simple router jig to hog out the dovetail sockets, then cleans them up with a chisel. The tails themselves are band-sawn carefully and then pared to final fit with chisels. While the front vise jaw is still free, joint about 1/8" off the rearward part so you'll be able to resurface the clamping surface of the jaw a couple of times in the future, as necessary.

The dovetail joints that join the back rail to the jaws are also easily cut with a band saw. The top of this runner should be even with the bottom of the end cap when the vise is assembled to the bench. To make sure this happens, drill the clearance hole for the benchscrew in the rear jaw so that it is the same height up from the runner as the benchscrew nut is from the bottom of the end cap. Drill this hole slightly oversize so you have some room for adjustment when assembling the tail vise to the bench. (Refer to the *Drawings* for details.)

To complete the tail vise subassembly, glue a thin piece of plywood to the inside of the face piece to close off the bench dog slots and install the hardwood runner to support the front of the vise.

Through and half-blind dovetails join the face of the tail vise to the front and rear jaws. A simple router jig guides a template bushing and straight bit to remove most of the material, and a sharp chisel finishes the job.

Installing the Tail Vise

In order to attach the tail vise, you'll need to make two guide blocks and one more runner. The outside guide block bolts to the underside of the end cap, and the inside block is bolted and glued to the underside of the top, where it forms the lower part of the vise jaw. (Again, look at the *Elevation Drawings* for these construction details.) The runner is bolted into a notch in the inner block and slides in the notch in the main jaw of the vise as shown in the inset photo on the next page.

For smooth operation of the tail vise, it is critical to make all the parts accurately and to be sure the runners are parallel to each other and to the benchtop. Before you install the benchscrew, move the tail vise through the full range of its motion by hand to check for binding and interference. Any misalignment or eventual sagging can be fixed by shimming the runners and rails as needed.

After clamping all the parts together and bolting the end caps, the final step in the glue-up is to install and tighten the threaded rod that reinforces the shoulder vise.

To assemble the tail vise, bolt the center guide rail to the fixed tail vise jaw and then bolt the outside guide block to the end cap. Finish up by installing the bench screw.

Once you have everything running smoothly, with as little slop as possible, you can install the benchscrew. Run it all the way in, center it in the clearance hole, and screw the flange to the rear jaw of the tail vise.

Making the Vise Caps

Next, make the vise caps. The two parts of the cap should be thicker and wider than necessary; you will trim them after installation. Miter the ends where they meet, then set the larger part of the cap onto the completed tail vise, with the inside of the miter aligned with the inside corner of the frame. Mark the bench dog hole locations from the underside, then drill and chop the corresponding holes in the top cap.

Finally, glue the two parts of the cap together at the miter, and assemble them to the frame with glue and clamps. Then plane them flush with the benchtop and tail vise surfaces.

Finishing Touches

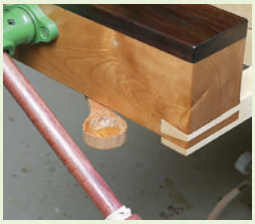
At this point, the bench is nearly finished. There are just a few more important details left to do.

First, mount the top on the base. Frank uses rock maple "bullets" to register the top to the base. Turn the bullets to 3/4" diameter as shown in the *Drawings*. Glue one into each of the two bearing strips on the underside of the benchtop. Drill mating holes in the top rails of the base so the bullets will register the top in the exact location each time you assemble the bench. After you install the bullets, drill through the top rails of the base for the 1/2" lag screws that secure the top.

Next, modify the benchscrew for the shoulder vise. The shoulder vise on this bench is designed to open to about 5½". When the vise is closed, you want the handle to come to rest about 1/2" from the arm of the shoulder vise. The stock benchscrew that Frank used for the shoulder vise was 2" too long, so he had to shorten it.

First, he punched out the roll pin that holds the screw into the handle casting. Then he used a reciprocating saw to cut off 2" from the end of the screw and ground the end of the screw to fit back in the handle casting. He made a simple V-block jig to hold the screw at the proper height for grinding. Frank screwed the jig to his grinding bench with a single screw at the rear corner in order to pivot the jig toward the grinding wheel. When he reached the right diameter, he reinstalled the screw in the handle. This procedure worked well.

Details Make the Difference



Carved Oil Cup

Leather Vise Liners

Ebony Crosscut Stop

Small but important details elevate Frank's bench to the highest level of craftsmanship. The carved oil cup mounted to the underside of the tail vise, for instance, is a handy place to keep a little vegetable oil to lubricate anything that needs it, such as saws and plane soles.

Leather vise liners are another delightful finishing touch featured on Frank's bench. The leather protects the jaws and the work. When it wears out or gets damaged, you can soak it off and replace it.

And, of course, the fold-down crosscut stop at the end of Frank's bench is another detail that truly enhances the performance of his classic design.

Building the Wooden Vise Jaw

Once you have bolted the top to the base and cut the benchscrew to length, you're ready to make the wooden vise jaw for your shoulder vise. Frank used a 1"-thick piece of rosewood for his, but any seasoned hardwood is okay for this detail. Make it a little wider than necessary so you can plane it flush with your bench after you install it.

The wooden vise jaw has an extension on the left end that fits between the shoulder block and the top rail of the base. It is connected to the benchscrew by a cast-iron foot that allows the jaw to pivot left or right to accommodate tapered or odd-shaped workpieces.

To locate the pivoting foot accurately, hold the wooden jaw in place and tighten the benchscrew against it (with the swiveling foot attached), making sure the open side of the foot faces to the right. Trace the outline of the foot onto your vise pad, then remove the pad and rout a 3/8"-deep recess in it to receive the foot. This allows the jaw to open a bit wider, and it looks better, too.

Constructing a Wooden Stop

The wooden stop is another useful feature of this bench. It is simply a strip of tough hardwood — Frank used holly — that fits tightly into a rectangular mortise through the top (see the *Drawings*). A tap of a hammer or mallet from below raises it to working height for planing thin pieces of wood.

To make the mortise, drill a series of 1/4" holes with a brad-point bit, and then remove the waste between them with a paring chisel. The mortise should slope about 2° from vertical, toward the right end of the bench. It's a good idea to make the mortise first, then make the stop to fit the mortise.

Frank likes to finish his benches with Waterlox® wiping varnish. A few coats at the beginning and a little more from time to time keep the bench looking beautiful. Make sure to seal up the entire bench with the finish, including under the benchtop. This will equalize moisture that moves into and out of the wood as the seasons change.

If you build Frank's bench, you will have a trusty shop friend forever. You may even ask yourself how you worked without this bench up until now. Many years from now, your children will thank you, too.

Attach spacer blocks to the underside of the benchtop where it meets the trestles. Then glue one maple "bullet" into each spacer block and drill mating holes in the tops of the trestles to locate the top perfectly each time you assemble the bench.

After gluing the backboard to the ends of the end caps, glue the plywood tool tray into the groove in the backboard and screw and glue it to the underside of the benchtop.

Custom Router Table

There's no better fixture you can build or buy for your router than a router table. Our design provides maximum versatility, convenience and storage space — all on wheels.

After reviewing numerous router table designs, we took the best features from each to create our customized version. Key concerns were accuracy, easy access and tool and bit storage.

Next to a table saw, we consider a quality router table to be the next most important piece of shop equipment a woodworker can own. Aside from its joint-making and profiling capabilities, a router table can serve as a jointer if you don't have one. It also makes a handheld router safer to use for milling small, narrow or odd-shaped workpieces.

Designing a router table involves two challenging requirements, and our group of woodworking experts has come up with very good solutions. The first challenge is making the router easily accessible for exchanging bits or adjusting their height. On our cabinet the router can be removed through the tabletop for major alterations or adjusted from the front for raising and lowering the bits. The second hurdle is designing a fence that works for every possible routing operation. Our system begins with a conventional fence that adjusts quickly for general routing. With the addition of an Incra jig attachment, the fence system offers precise, incremental adjustments for routing perfect dovetail joints, finger joints or flutes.

Several other minor considerations must also be met. In our shop, tools need to be mobile, so we put wheels on the router cabinet to get it out of the way when it's not needed. The drawers provide storage space for router bits and accessories, and the lower cupboard shelters power tools from all the dust in the shop. The addition of an electrical strip on the right side of the cabinet is a handy feature that provides easy access to the On/Off switch.

We built this router cabinet from white oak, using a half sheet of 3/4" plywood, 11 board feet of 1⅛"-thick solid stock and 4 board feet of 3/4"-thick material. Making the top requires a half sheet of 1/2"-thick Baltic birch plywood and another half sheet of 3/4" Baltic birch plywood. In addition to the lumber and plywood, we used a piece of plastic laminate to cover the router table surface for improved durability and a roll of oak iron-on edgebanding to cover the exposed plywood edges.

Building the Cabinet

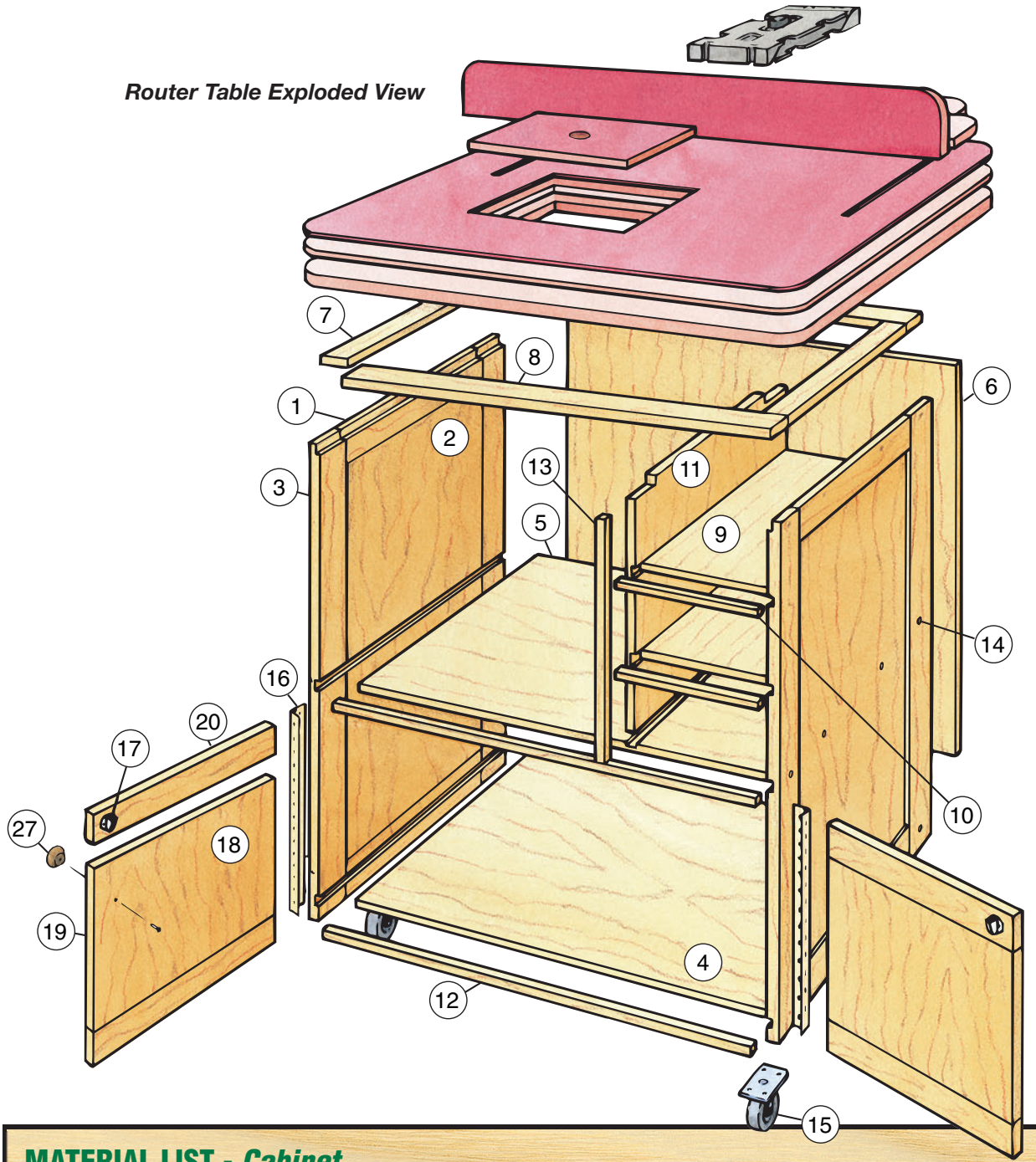
Begin constructing the router table by making the frame and panel sides. You'll want to continually refer to the *Pinup Shop Drawings* while building the router cabinet, as they detail all the parts and joint locations. The two side walls are made of 3/4" plywood surrounded by 1⅛"-thick solid-oak frames. Cut the frame rails (pieces 1) and plywood panels (pieces 2) to size and rout one edge of the rails with a 1/4" roundover bit. Join the rails to the plywood with biscuits as shown in *Figure 4*, page 30. Now cut the stiles (pieces 3) to match the overall length of the panels. Hold the stiles up to the panels and mark the points where the frame pieces intersect, then rout the length of the edge between the marks with the roundover bit. Join the stiles to the panels with biscuits.

After the two side walls are constructed, lay them on their faces and mark the dado and rabbet locations shown on page 30. The dadoes and rabbets are all 3/4" wide and 1/4" deep. In the left side wall, rout two dadoes — one for the bottom shelf (piece 4) joint and one for the center shelf (piece 5) joint — and rout a rabbet along the top inside edge for securing the web frame (pieces 7 and 8). The right side wall requires dadoes for the bottom shelf joint, the center shelf joint and the two drawer dividers (pieces 9) as well as the top rabbet. Use a straightedge jig such as the one shown in *Figure 1* to guide the router while cutting the dadoes and rabbets. Also, while the panels are still laying face down, rout a 3/8"-deep by 1/4"-wide rabbet along the back edge of each side wall for installing the back (piece 6) later.

The web frame, which secures the router table to the cabinet, is made of four pieces. Rip and crosscut the two rails (pieces 7) and the two stiles (pieces 8) to size, then join the frame together using the biscuit joiner and your smallest size biscuits.

Rip 3/4"-thick plywood for the bottom shelf, the center shelf and the upper section divider (piece 11) all at the same time, then crosscut the pieces to length. Glue on the solid-wood banding (pieces 12 and 13). Now cut the two drawer dividers (pieces 9) to size and band their front edges with solid wood (pieces 10).

Router Table Exploded View



MATERIAL LIST - *Cabinet*

		T x W x L
1	Side Wall Rails (4)	1⅛" x 3" x 14"
2	Side Wall Panels (2)*	3/4" x 14" x 2¾"
3	Side Wall Stiles (4)	1⅛" x 3" x 29¾"
4	Bottom Shelf (1)*	3/4" x 19" x 25¾"
5	Center Shelf (1)*	3/4" x 19" x 25¾"
6	Back Panel (1)*	1/4" x 25¾" x 29"
7	Web Frame Rails (2)	3/4" x 2½" x 14¾"
8	Web Frame Stiles (2)	3/4" x 2½" x 25¾"
9	Drawer Dividers (2)*	3/4" x 7½" x 19"

		T x W x L
10	Drawer Divider Banding (2)	3/4" x 3/4" x 7½"
11	Upper Section Divider (1)*	3/4" x 19" x 15⅝"
12	Shelf Banding (2)	3/4" x 3/4" x 25¾"
13	Upper Divider Banding (1)	3/4" x 3/4" x 15¾"
14	Walnut Plugs (24)	3/8" Dia.
15	Casters (4)	2 Swiveling, 2 Fixed
16	Piano Hinges (2)	1¼" x 12"
17	Door Catches (2)	White Plastic

** Plywood*

Next, rout the 3/4"-wide by 1/4"-deep dado in the center shelf for securing the upper section divider. The same size dadoes must also be routed into the upper section divider for the drawer dividers, as shown in *Figure 4*. Finish up on this piece by cutting notches out of the upper corners so that it fits around the web frame stiles.

All the shelf dado joints in the side walls are reinforced with screws. To accurately drill the pilot holes for these #8-2" wood screws, first dry-assemble the cabinet, then draw the three lines on the outside face of each side wall to indicate the center of each dado or rabbet. One hole is centered on each stile and two more are spaced on the panel. Drill 3/8"-diameter by 5/16"-deep counterbores for the plugs and follow the counterbores with a 5/32"-diameter bit for drilling the 2"-deep pilot holes.

One operation that you definitely should perform now rather than after the cabinet is assembled is drilling the pilot holes for the Blum drawer slides (pieces 28). Set the Blum slides 13/16" back from the front edge of the right side wall and the upper section divider to allow for the inset drawer fronts, and position the slides directly above each drawer divider dado. Use an awl to mark the screw locations and then drill the pilot holes with a 1/8"-diameter bit.

Disassemble the cabinet and spread glue in the side wall dadoes for the bottom shelf and the center shelf. Pull these four pieces together once again and drive the 16 screws into place. Now spread more glue in the center shelf dado, the two dadoes in the upper section divider and in the two remaining dadoes in the right side wall. Slip the upper section divider into the center shelf dado, then set the lower drawer divider in place, followed by the upper drawer divider, and slowly pull the assembly together.

Wrap up the carcass assembly by applying glue to the rabbets on the side walls and drop in the web frame, slipping it over the upper section divider. Fasten the walls to the web frame with #8-2" screws, and drill countersunk 5/32" pilot holes through the web frame into the upper section divider. Secure the joints with #8-2" screws. Lastly, glue walnut plugs (pieces 14) into the counterbored holes in the side walls, and sand them flush when the glue dries.

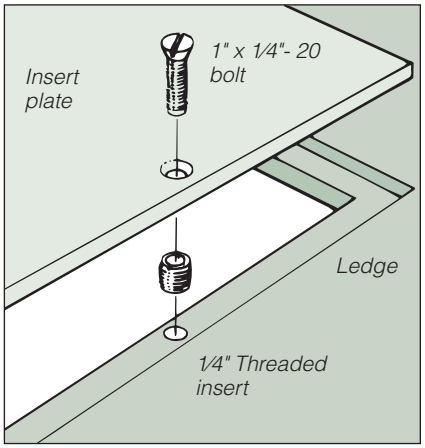


Figure 2: *Use 1/4"-20 threaded inserts and 1"-long bolts to hold the interchangeable insert plates in place.*

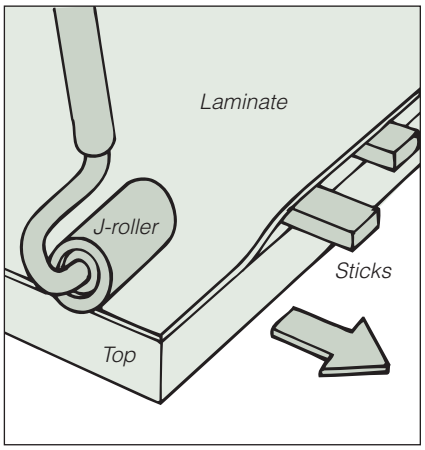


Figure 3: *Position the laminate, then remove the sticks one at a time, rolling the laminate down as you go.*

Figure 1: To make this straightedge jig, fasten a straight, narrow board to an oversized piece of hardboard, then rout the edge of the jig with the router and bit you intend to use for the dado. Next, align and clamp the edge of the jig with the layout line and rout the dado.

Making Drawers and Doors

The cabinet doors are made from 3/4" plywood (pieces 18) banded on their vertical edges with 3/4" by 1/2" banding (pieces 19) and trimmed on the top and bottom edges with rails (pieces 20). Regularly refer to the *Exploded Views* of the doors and drawers throughout this section of the project. Cut the plywood pieces to size, then glue on the banding strips. Now cut the rails and join them to the plywood with biscuits.

The drawers are made with a simple, durable joint. Cut the 1/2"-thick plywood drawer sides (pieces 21), fronts (pieces 22) and backs (pieces 23) to the sizes shown in the *Material List*. Next, install a dado blade in the table saw and set it to cut 1/4"-wide by 1/4"-deep

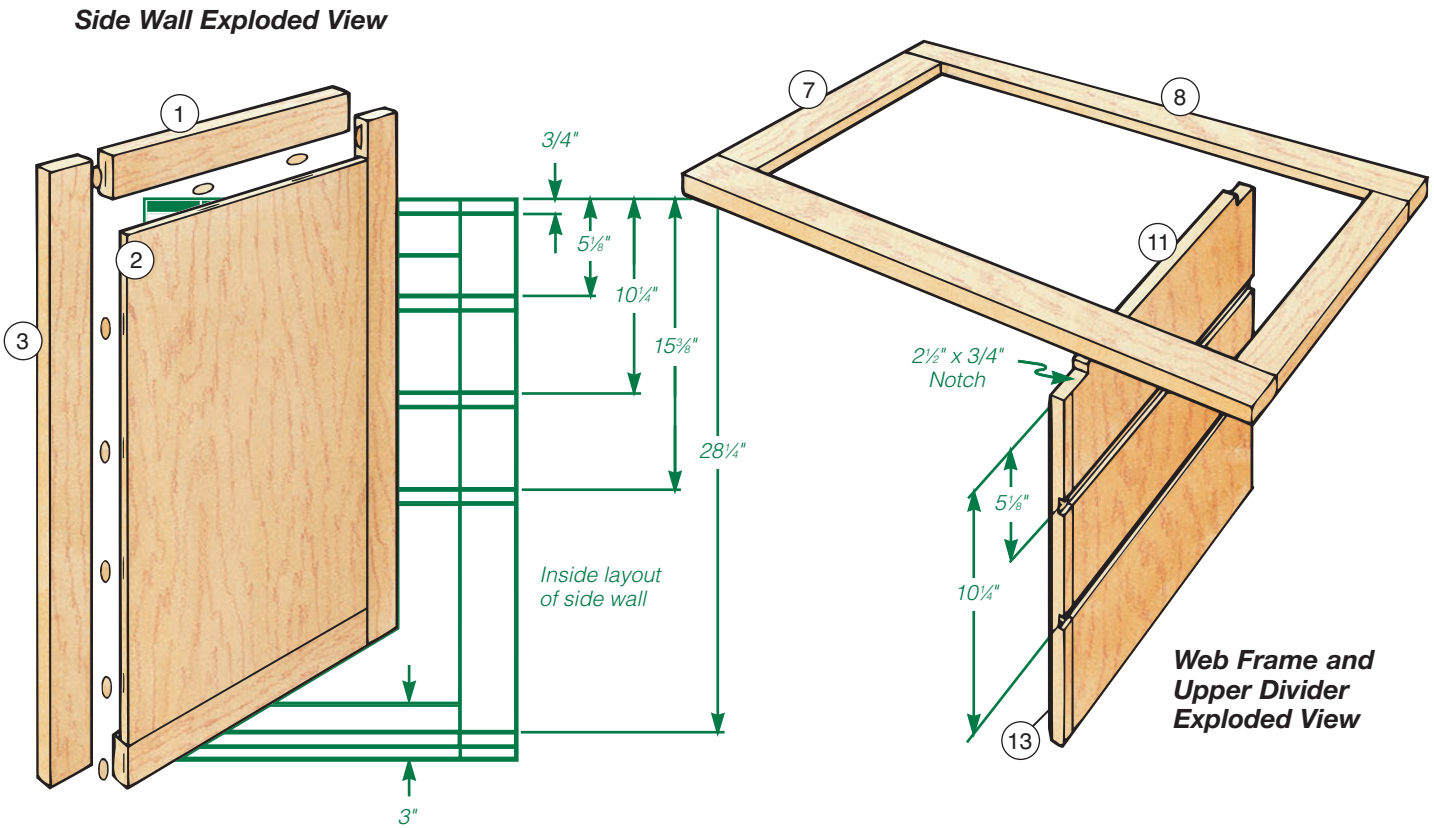
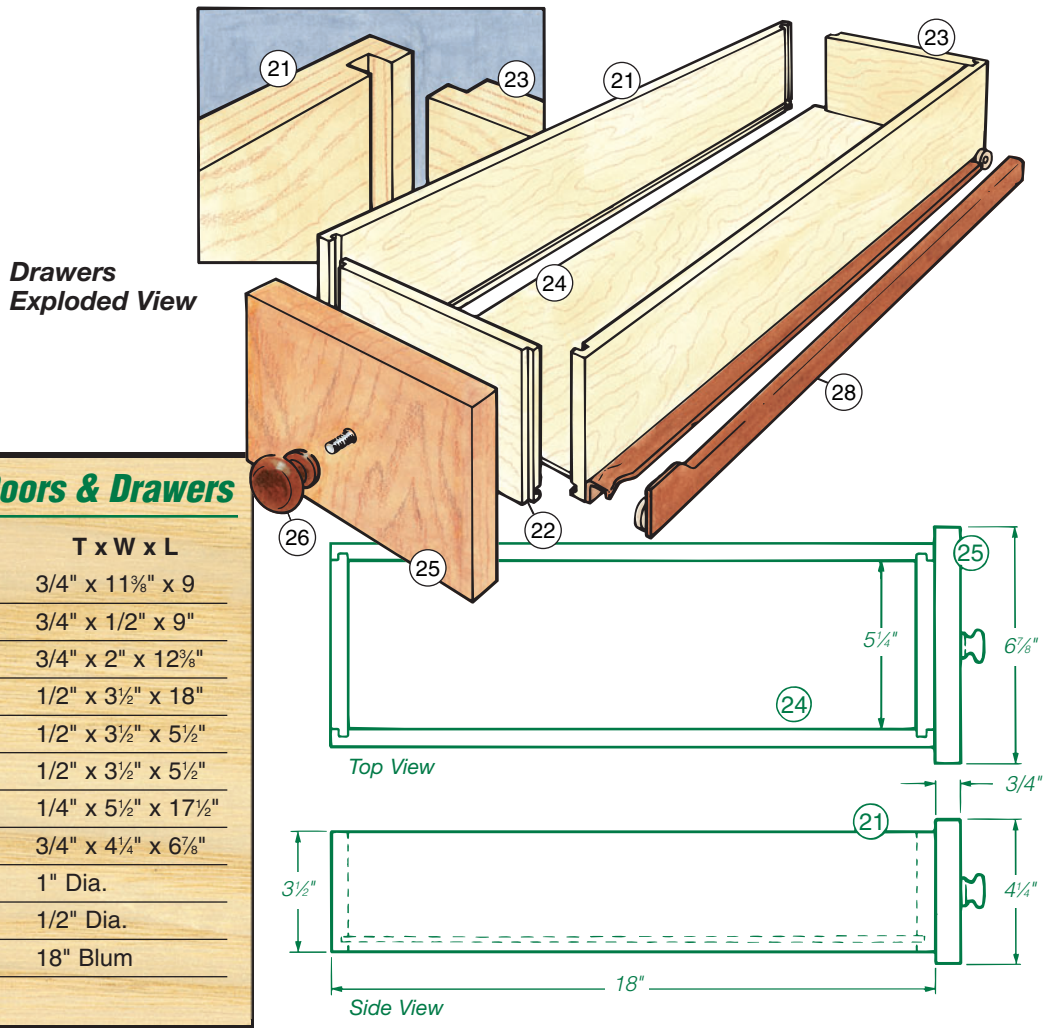


Figure 4: *Side Subassembly (drawer side), top web frame and upper section divider.*



MATERIAL LIST - *Doors & Drawers*

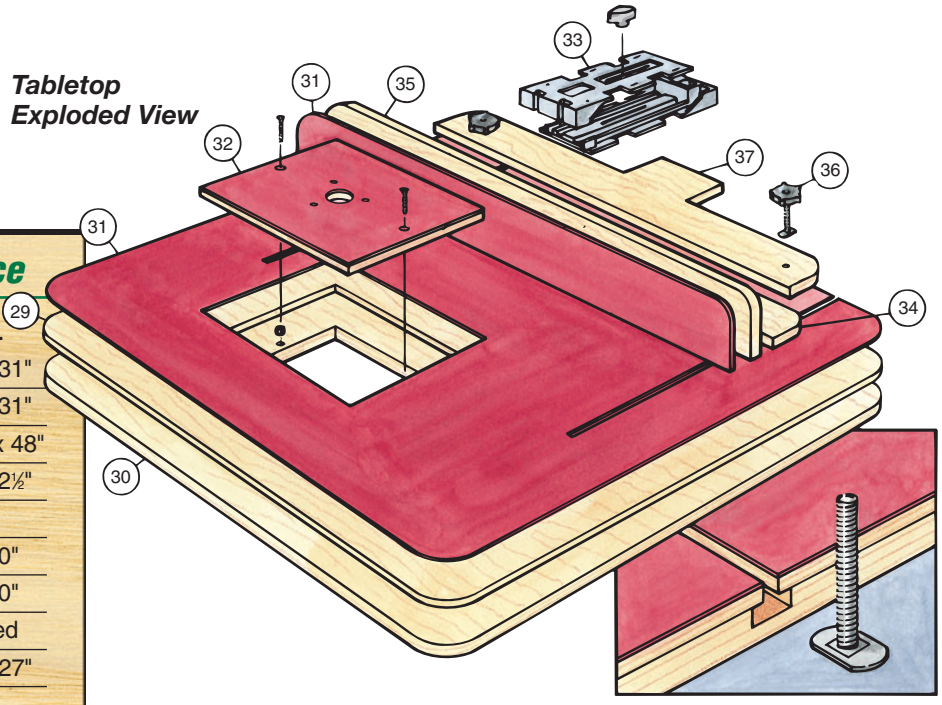
		T x W x L
18	Door Panels (2)*	3/4" x 11⅜" x 9
19	Door Banding (4)	3/4" x 1/2" x 9"
20	Door Rails (4)	3/4" x 2" x 12⅜"
21	Drawer Sides (6)*	1/2" x 3½" x 18"
22	Drawer Fronts (3)*	1/2" x 3½" x 5½"
23	Drawer Backs (3)*	1/2" x 3½" x 5½"
24	Drawer Bottoms (3)*	1/4" x 5½" x 17½"
25	Drawer Faces (3)	3/4" x 4¼" x 6⅞"
26	Drawer Knobs (3)	1" Dia.
27	Door Knobs (3)	1/2" Dia.
28	Drawer Slides (3)	18" Blum

*Plywood

MATERIAL LIST - *Top & Fence*

		T x W x L
29	Top (1)*	1/2" x 30" x 31"
30	Sub-Top (1)*	3/4" x 30" x 31"
31	Plastic Laminate (1)	1/16" x 48" x 48"
32	Insert Plates (3)*	1/2" x 8" x 12½"
33	Incra Jig (1)	
34	Fence Base (1)*	3/4" x 3" x 30"
35	Fence Front (1)*	3/4" x 4" x 30"
36	Clamping Knobs (2)	3/8" Threaded
37	Incra Jig Platform (1)*	3/4" x 8½" x 27"

*Plywood



grooves. Clamp a spacer block onto the table saw's rip fence and, using a miter gauge, pass the drawer sides over the blade to cut dadoes 1/4" from the each end.

Move the rip fence to align the edge of the spacer block with the dado blade and make the 1/4"-wide by 1/4"-thick tongues at the ends of the front and back pieces to fit into the dadoes in the drawer sides. Readjust the blade to cut a 7/32" dado and move the rip fence 1/4" away from the blade (remove the spacer block). Cut a dado on the inside face of all the drawer pieces for holding the bottoms in place. Cut the drawer bottoms (pieces 24) to size and dry-assemble the three units. Once the fit is satisfactory, disassemble and sand the drawer parts, then glue them together.

The drawer faces (pieces 25) are made from solid oak and are cut to fit the drawer openings with a 1/16" gap all around. Cut this stock and attach it to the drawer fronts from the inside with a couple of #8-1" screws. With the drawers and the doors completed, drill the holes for attaching the knobs (pieces 26 and 27). You'll need to counterbore the drawer fronts to allow the knob screws to bridge the combined thickness of the front and face. Mount the doors to the cabinet with surface-mounted piano hinges (piece 16) and screw the door's roller catches (pieces 17) in place. As usual, the back panel (piece 6) is the last piece to make for the cabinet. Cut this out of 1/4" plywood, but don't nail it onto the cabinet until after the top is attached.

Building the Tableop

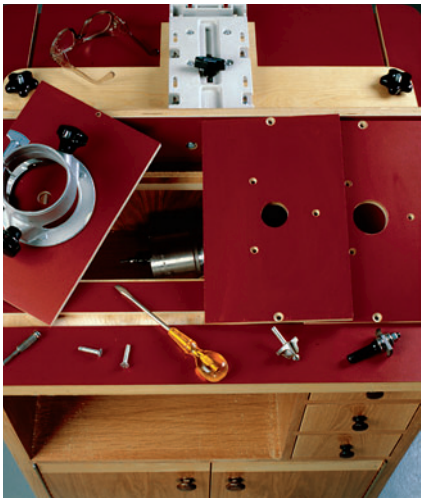
The tabletop is made with two layers of plywood, which accommodate the two tracks for the fence system and give the table as much vibration resistance and stiffness as possible. The top of the table is covered in plastic laminate, providing a slick surface to slide the stock over and making it easy to clear off wood chips and dust. While building the tabletop, continually refer to the *Exploded View Drawing*, above, as it lays out the details for constructing the top and the fence.

The first step in constructing the table is to cut a piece for the top (piece 29) to the shape shown in the *Pinup Shop Drawings* from 1/2"-thick Baltic birch plywood, and make another piece in the same shape from 3/4" Baltic birch plywood for the sub-top (piece 30). Clamp the two pieces together and sand all the edges smooth. Use a jigsaw to cut 1½" corner radiuses, and sand the four corners smooth.

Take the clamps off the plywood and set the top aside for the moment. Chuck a 3/4" mortising bit in the router and attach an edge guide. Now, rout 7/16"-deep fence adjustment tracks in the sub-top, following the positions shown in the *Drawing*. Once the grooves are routed, lay out the rectangular insert area as shown in the *Drawing* and drill a 1/2"-diameter hole at the inside of each corner. Use a jigsaw to cut out the insert area, then sand the edge of the hole smooth. Drill the pilot holes for the 1/4" threaded inserts at both ends of the opening as shown in *Figure 2*.

Before gluing the two top pieces together, cut the rectangular insert area out of the top piece of Baltic birch plywood. You'll notice that the hole in the top is larger than the hole in the sub-top. The difference in the two holes creates a sturdy ledge to support the insert plates and the router.

Liberally spread glue over the sub-top, keeping it at least 1/2" back from the fence adjustment track dadoes, and lay the top onto the sub-top. Clamp the two pieces



Our router table is full of convenient features that make it a more efficient shop tool. Ample storage space in the drawers and cupboard provides room for routers, bits and other accessories; the interchangeable insert plates accommodate a wide range of router bit sizes; and the fence system adjusts mechanically or the old-fashioned way—with a quick tap of the hand at one end.

together, making sure the edges line up perfectly, and let the glue dry overnight. The next day, clean up any glue squeeze-out and apply iron-on veneer edging to the table's edges.

Cover the surface of the top with plastic laminate, which is easy material to work with if you take your time and position it carefully. Cut a piece of laminate (piece 31) about one inch larger than the top all the way around and lay it upside down on your workbench. Clean the plywood and the bottom of the laminate thoroughly, removing sawdust or particles of any kind. Apply an even coat of non-flammable contact cement to both surfaces and let it dry, which usually takes about 20 minutes. After the first coat is dry, apply a second coat and let it dry. Now lay about eight narrow sticks across the tabletop and set the laminate on top of the sticks (see *Figure 3*). The sticks enable you to situate the laminate on the table before the two pieces meet and permanently bond.

Begin removing the stickers at one end of the top and press the laminate against the surface of the plywood. Use a J-roller to press the laminate down once the surfaces are making contact, but avoid rolling the unsupported insert plate area to prevent cracking the laminate. Once you've applied pressure to all points on the table's surface, trim any laminate overhanging the top with your router and a piloted flush-cutting bit. Also, drill a 1/2" starter hole through the laminate near one inside corner of the insert plate area, then run the router around the rectangular opening to uncover the hole.

The insert plates are laminated on both sides, making them thicker than the top by 1/16". As a result, the insert area's ledge must be lowered for the top surface to be even. Chuck a piloted straight bit in your router and, following the upper edge of the insert area, lower the ledge on the sub-top by 1/16". Square up each corner of the insert area where the router bit couldn't reach and ease all the laminate edges on the top with a mill file. Install the threaded inserts in the pilot holes at both ends of the insert plate area.

Now put a 3/8" straight bit in your router and rout the fence adjustment tracks into the top (see *Pinup Shop Drawings*). Install an edge guide attachment on your router base to follow the top's side edges, routing the slot through the entire 1/2"-thick plywood, centered on the 3/4" adjustment track in the sub-top.

Rout the miter gauge slot, using a straightedge guide as you did for the dadoes on the side walls.

Before moving on to construct the fence, laminate both sides of some extra 1/2" plywood to make three insert plates (pieces 32). Cut the laminated plywood to fit the insert hole snugly, then mark the center of each insert, at which point you should drill a one-inch hole in the first insert, a 1½" hole in the second, and a 2" hole in the third. Be sure to ease all laminate edges with a mill file. When operating the router table, choose the most appropriate insert for the bit you intend to use, and make more inserts with different hole sizes if you need them. Drill 1/4" pilot holes at either end of the inserts for securing the plates to the table. Countersink the holes so the head of the bolt sits below the laminate surface and screw one of the plates into place with 1"-long, 1/4"-20 bolts.

Building the Fence

The heart of the fence system is an Incra jig (piece 33), which excels at making incremental adjustments for repetitive cuts. This is a great device, but it isn't always needed for general router work, so we made it easy to remove. When the jig is disconnected the fence can move freely over greater distances.

Begin constructing the fence by making the main L-bracket from 3/4" plywood, first cutting the base (piece 34) and then the fence front (piece 35). Cut the back corners of the base to a 3" diameter as shown in the *Pinup Shop Drawings*. Laminate the fence front and drill a series of countersunk holes for screwing the front to the base.

There's no need to laminate the back side of the fence front as it is restrained from warping by the base connection. Also, drill the counterbored bolt holes to secure the Incra jig to the front. Screw the front to the base and drill a hole at each end of the base to install the clamping knobs (pieces 36) and T-bolts.

We made the two adjustment track T-bolts from standard hardware store stock. Take two 3/8" inside diameter fender washers and file the hole to fit around the square nut area of a 3/8"-diameter by 2½"-long carriage bolt. Use epoxy to glue the washers onto the bolt. Now use a hacksaw to cut two sides of the washers flush with the head of the carriage bolt and file or grind these edges smooth. Insert the T-bolts into the fence adjustment tracks, set the fence assembly onto the bolts and thread the clamping knobs into place.

The Incra jig platform (piece 37) is made from 3/4" plywood and has two 3/8"-diameter holes for securing the platform to the router table tracks. The other four holes shown in the *Drawing* hold the jig to the platform and need to be countersunk. Drill the 1/4"-diameter holes and countersink each one on the underside of the platform. Insert 1/4"-diameter flathead bolts through the platform, and set the Incra jig onto the bolts. Secure the assembly with four hex nuts.

To mount the Incra jig, first undo the clamping knobs from the T-bolts and remove the fence. Now set the Incra jig platform onto the T-bolts and thread on the clamping knobs. Butt the fence into the front of the Incra jig and insert two 1/4"-diameter by 1½"-long flathead bolts through the fence front's holes and into the Incra jigs' mounting slots. Thread the hex nuts on firmly. Move the fence into position and tighten the clamping knobs. Release the Incra jig knob to maneuver the fence into position.

Completing the Final Details

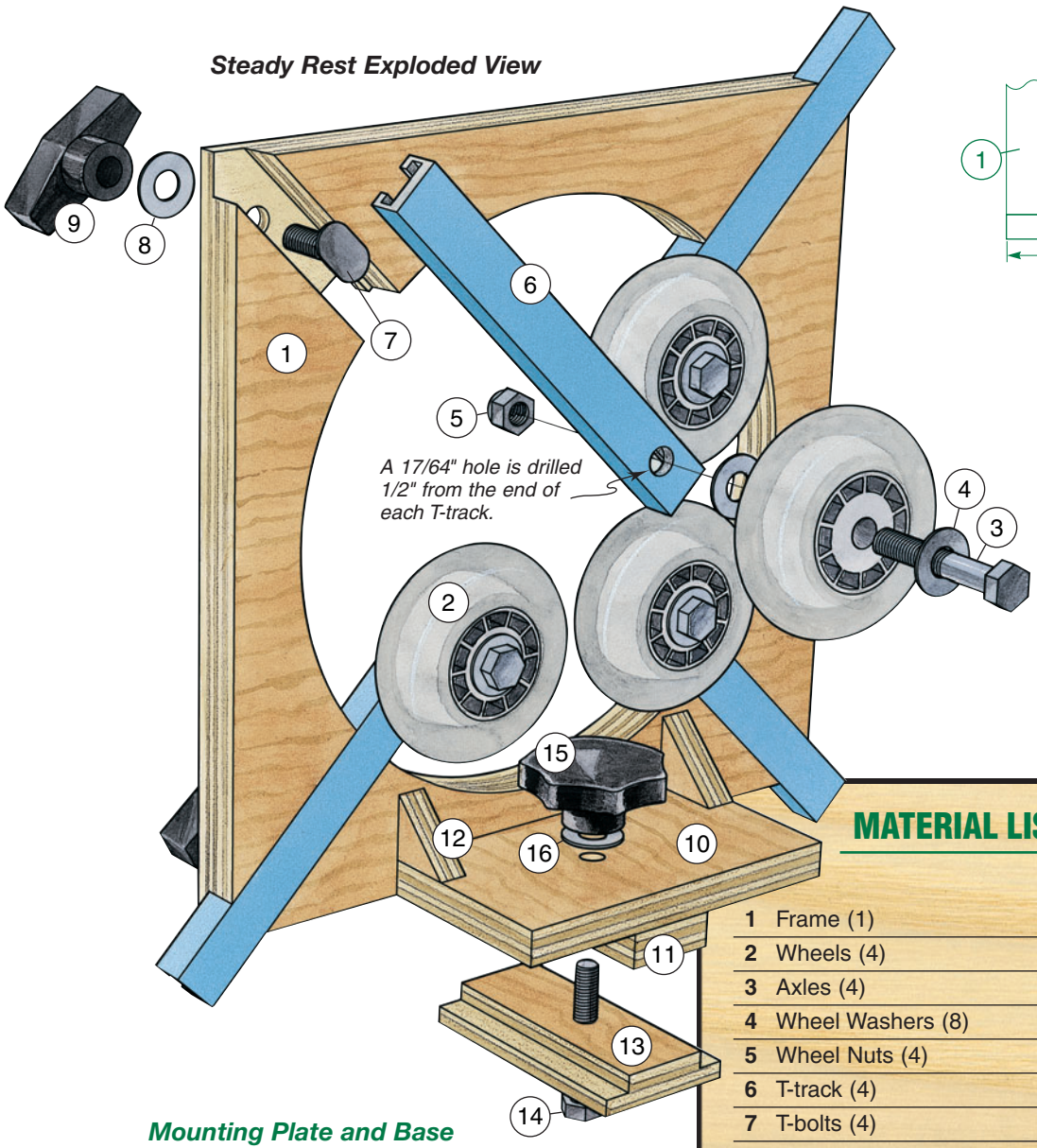
Set the router tabletop on the cabinet and square the two pieces to each other. Drill a number of 5/32" holes up through the web frame into the top for #8-1½" screws, making sure to stay clear of the tracks. Countersink these pilot holes and secure the cabinet to the top.

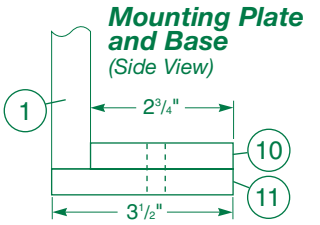
Disassemble all the parts of the router cabinet and the table and apply a durable finish to all the wood surfaces. Once the finish is dry, drill four 1/4" holes in each corner of the bottom shelf for the carriage bolts that mount the casters (pieces 15) under the cabinet. Install the swiveling casters near the back edge of the cabinet and the stationary casters along the front edge. We mounted an electrical outlet strip to the outside right wall and drilled a 1" access hole in the back panel for the router's cord. Put all the doors and drawers into the cabinet and nail on the back panel. Mount your router housing to an insert plate, then install the router motor in the housing. Now set the assembly into the insert hole in the table and secure the plate.

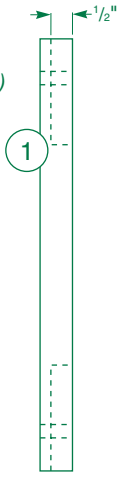
Constructing the router table takes about 30 hours and costs about $450 in materials, depending on the wood you choose. There really isn't a particularly difficult technique involved in building this project, but pay close attention to the layout measurements. Following the small details will make your router table more accurate and result in greater returns for your time and investment.

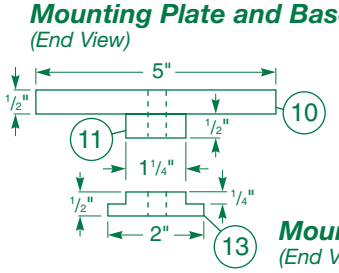
Lathe Steady Rest

Give those dusty, discarded inline skates a second shot at useful life — in the shop!



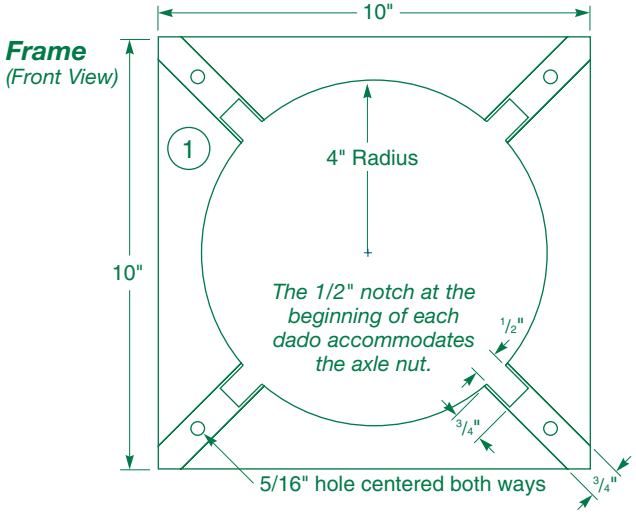






MATERIAL LIST - *Steady Rest*

		T x W x L
1	Frame (1)	3/4" x 10" x 10"
2	Wheels (4)	2¾" Dia.
3	Axles (4)	1/4" x 2½" Hex bolt
4	Wheel Washers (8)	3/4" O.D.
5	Wheel Nuts (4)	1/4" Locking
6	T-track (4)	1/2" x 3/4" x 6"
7	T-bolts (4)	1"
8	T-bolt Washers (4)	3/8" I.D.
9	T-knobs (4)	1/4" x 20
10	Mounting Plate (1)	1/2" x 5" x 2¾"
11	Mounting Plate Base (1)	1/2" x 1¼" x 3½"
12	Mounting Plate Gussets (2)	1/2" x 1" x 1"
13	Mounting Plate Runner (1)	1/2" x 2" x 3½"
14	Mounting Plate Bolt (1)	1/4" x 2" Hex
15	Base Star Knob (1)	1/4" x 20"
16	Base Washer (1)	3/8" I.D.



The steady rest allows a vase to be chucked and comfortably supported while the inside of the neck is being shaped.

If you've ever tried to hollow out the inside of a vase or other narrow form, you know that at some point you'll have to remove the tailstock. This steady rest resolves the dilemma of working without the tailstock by securing the turning between four in-line skate wheels. Better still, the T-tracks make the rest easy to adjust for turning different diameters.

Constructing the Rest

Begin by cutting a piece of plywood to size for the frame (piece 1). Mill two diagonal dadoes in one face, then lay out the circle on the frame and cut it out with your jigsaw. Sand the edges with a drum sander chucked in the drill press, and form the small notch for each wheel nut to slide into, as shown in the *Drawing* on the facing page.

Slide the wheels (pieces 2) onto their axles (pieces 3) with a washer (piece 4) located between each wheel and bolt head. Slide a second washer onto the axles so a pair of washers sandwich each wheel. Keep them in place temporarily with the wheel nuts (pieces 5).

Cut the T-track (pieces 6) to length and file or sand each end to remove any burrs. Drill a 17/64" hole located 1/2" from one end of the T-track sections. Remove the nuts and slide the axles into these holes. Secure them with a washer and locking nut so the nut is on the open side of the T-track.

Installing the T-tracks

The diagonal dadoes in the jig are milled to accept standard T-track. To install it, begin by drilling a 5/16" hole in each dado, centering it both side-to-side and along the length of the dado. Slip a T-bolt (piece 7) into each hole so the large head of the T-bolt sits in the dado. On the other side of the base plate, slide a T-bolt washer (piece 8) onto the protruding threads of each bolt, then screw the knob in place with a couple of turns. Push the knob in to raise the T-bolt's head in the dado, and slide the track into the dado, catching the bolt head as you do.

Mounting the Jig on Your Lathe

No two lathes are alike, so the mount for your jig may have to be customized. A good starting place is to create a mounting plate (pieces 10 and 11) at a right angle to the face of the jig. These pieces are cut to size, glued together and glued in place. Glue a couple of triangular gussets (pieces 12) to the frame and plate, then move on to creating the rest of your base (pieces 13 through 16), which will vary with the type of lathe you own.

To locate the jig correctly, chuck a piece of straight dowel or steel pipe between the centers, slipping it through the jig as you do. Then you can adjust the wheels so they are centered and locked on the dowel. The jig is now located properly, and you can measure for your custom mounting device.

Safety Tip

After you've mounted a workpiece in the jig and the wheels have been drawn up to ride freely and lock in place, install a chuck on the tailstock. Use a Forstner bit in the chuck to core out the neck, rather than hogging out the inner waste with a gouge. It's a safer and smoother method.

Here's an example of an inside-out turning made by Ron Mostel, designer of this steady rest. Ron has experimented with various materials using his steady rest, including Corian®.

Downdraft Sanding Box

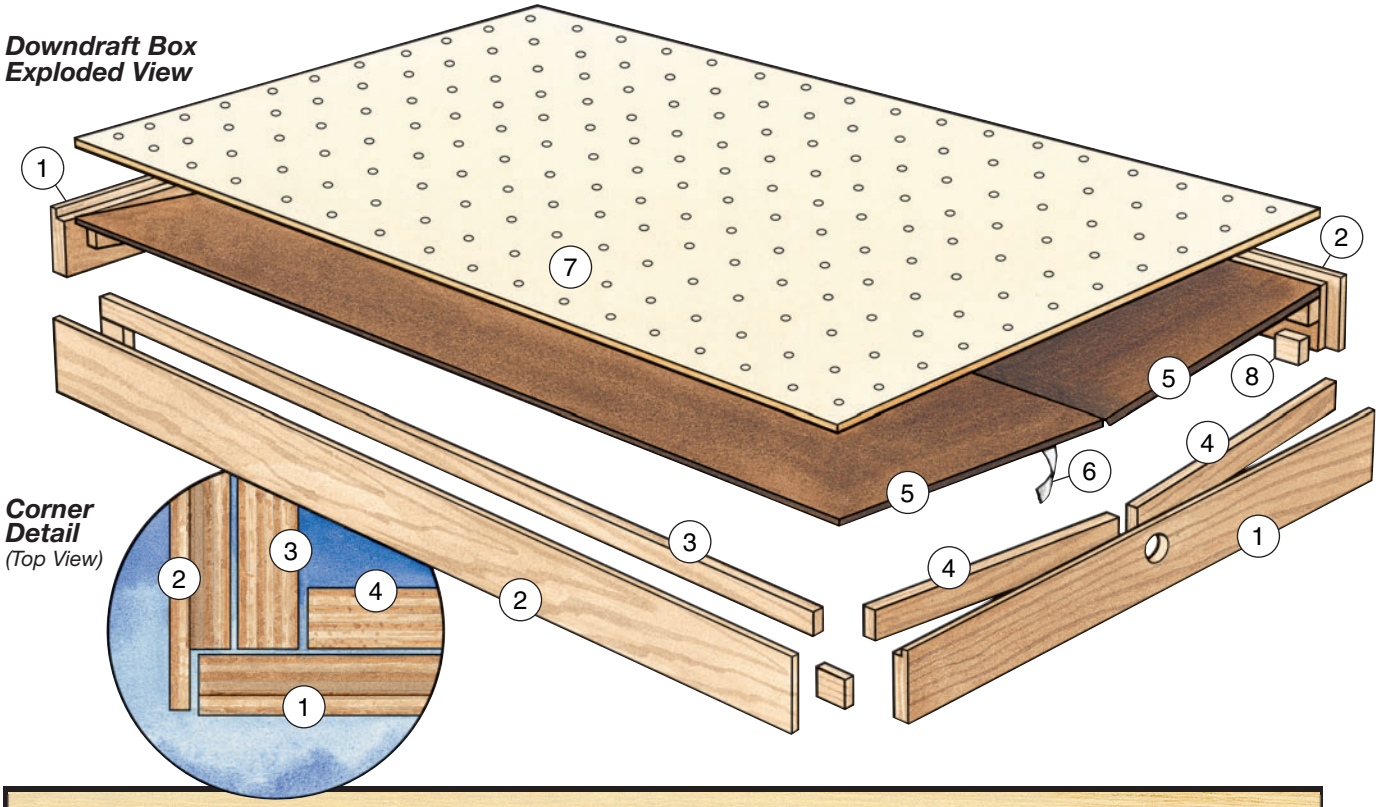
A downdraft sanding device doesn't have to be an involved, time-consuming project. This little beauty comes together in one afternoon and will handle moderate sanding jobs with ease.

Here's a helpful accessory for anyone who wants to breathe a little easier during sanding, especially with those wood species like cedar, walnut or cocobolo that can cause allergic reactions. And, given the recent research that suggests wood dust might be a carcinogen, anything we "lifer" woodworkers can do to manage dust is a good idea. Even with this downdraft box, continue to use your sander's dust bag or canister for added protection.

Basically, this project is an air box. Its thin profile keeps the volume of air to a minimum. This increases the airflow rate, which improves efficiency. Storing it is easy. The case is only the thickness of a 2 x 4, so it hangs neatly out of the way on the shop wall. (You can make the sidewalls higher if you need to accommodate a larger dust hose.) When it's on the workbench, that thin profile also means the top of the box is low enough to work on without raising your arms too high, which would eventually lead to fatigue.

It's a good idea to cover the empty portion of the sanding top with paper or hardboard during use, to boost suction in the section of the box you are using.

This tabletop downdraft box is a handy to use, easy to store addition to anyone's shop.



MATERIAL LIST - *Downdraft Sanding Box*

		T x W x L			T x W x L
1	Ends (2)	3/4" x 3½" x 23"	**5**	Bottom Halves (2)	1/4" x 11" x 34½"
2	Sides (2)	3/4" x 3½" x 36"	**6**	Bottom Tape (1)	Duct Tape
3	Long Cleats (2)	3/4" x 1½" x 34½"	**7**	Top (1)	1/4" x 23" x 35¼"
4	Short Cleats (4)	3/4" x 1½" x 20½"	**8**	Glue Blocks (4)	3/4" x 1" x 1⅜"

Start construction by cutting the ends, sides and cleats (pieces 1 through 4) to size, then secure the corners with glued and nailed butt joints. Cut the bottoms (pieces 5) next, and install them in two halves to form a slight V-shape, as shown in the *Exploded View* above.

The V-shape creates a valley that catches dust and funnels it more efficiently toward the vacuum. To begin, glue and nail (or screw) all four cleats in place, at the locations shown on the *Corner Detail* drawing above. Cut the bottom to size and temporarily install the two halves.

Clamp a few scraps to the sides, just to hold the bottom in place for a minute. Then turn the assembly upside down and apply duct tape (piece 6) along the joint. Turn it back upright and secure the bottom to the cleats with small nails or brads, squaring the box as you fasten the joints.

The top (piece 7) is nothing more than a piece of 1/4" pegboard. We used a brand with a finished face to help prevent scratching. You can cut it to rest on the top and secure it with duct tape or trim it to fit just inside the box and let it rest on the bottom. Either method allows for easy replacement when it gets a worn. If the top flexes too much, add a couple of band-sawn triangular cleats to the carcass ends.

We use a shop vacuum with a special switch designed to be used with dust-creating power tools. When you plug your sander into the vacuum, each time you start the tool the vacuum turns on as well. When you turn your tool off, the vacuum continues for a short time to catch the last bit of dust.

Hooking It Up

Attaching a vacuum or dust collector hose is generally just a matter of drilling the right size hole for the hose end. Or, you can buy a flange that screws to the box to connect your dust collector or vacuum hose. Bring your hose to a home center and spend a little time in the plumbing aisle to find the right connector; there's bound to be one that fits. Virtually any size dust collector will work with this project, but it goes without saying that bigger is better — just be sure to wear ear plugs.

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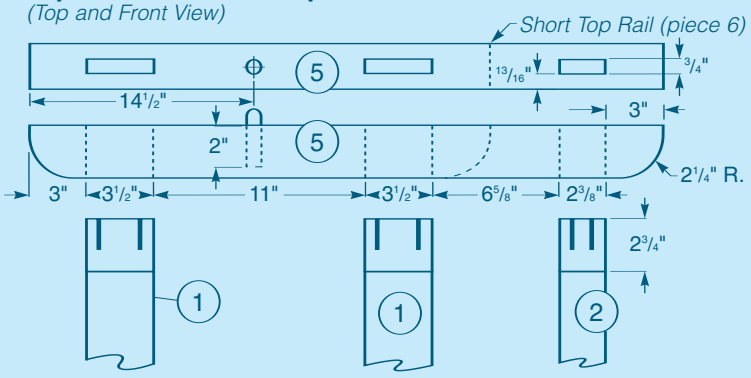
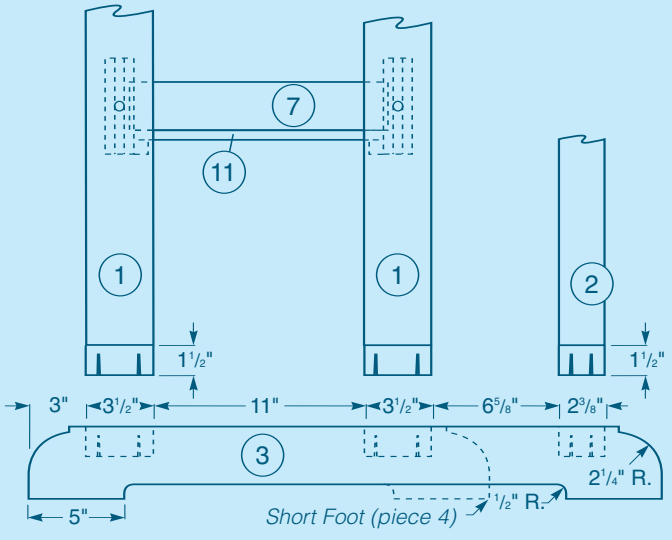
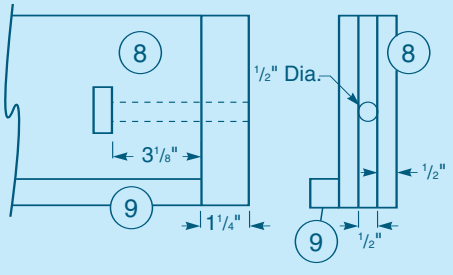
Top Rail and Short Top Rail
(Top and Front View)



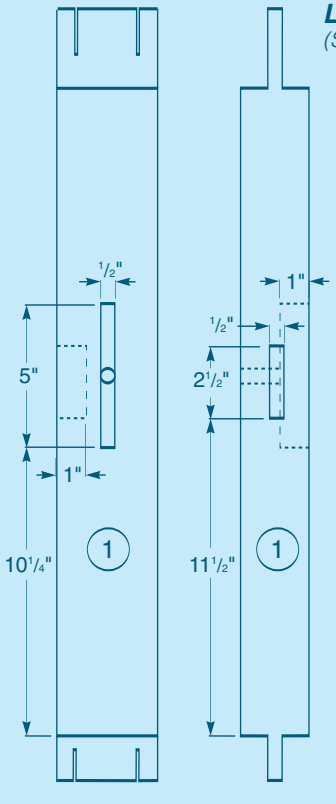
Bench End Subassembly
(Front View)



Long Rail and Shelf Support
(Inside and End Views)



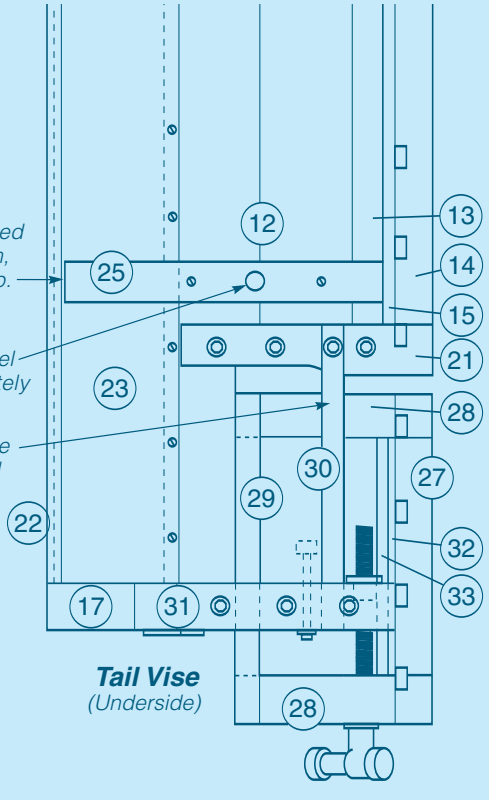
Leg
(Stretcher and Rail Locations)



The two spacer blocks are notched to accommodate the tray bottom, providing a level base for the top.

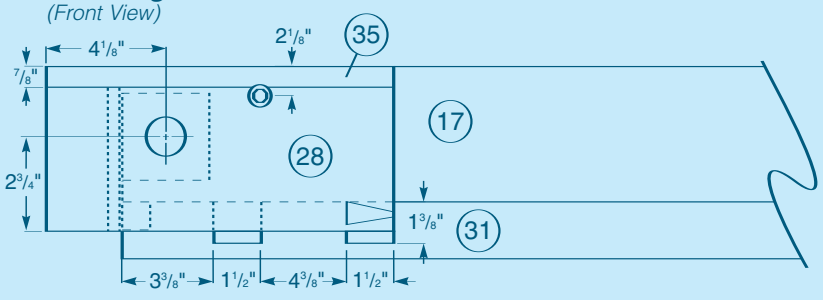
Drill a 3/4" hole for a "bullet" dowel so the top can be placed accurately on the base.

The center rail is screwed into the inside guide block and short end cap. It supports and guides the vise movement.

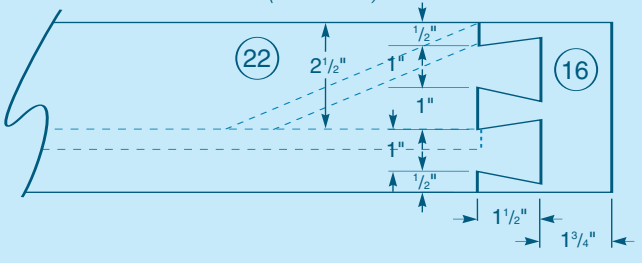


Tail Vise
(Underside)

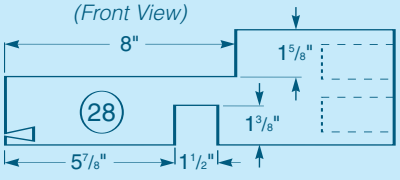
Shoulder Vise Screw Mounting Detail
(Front View)



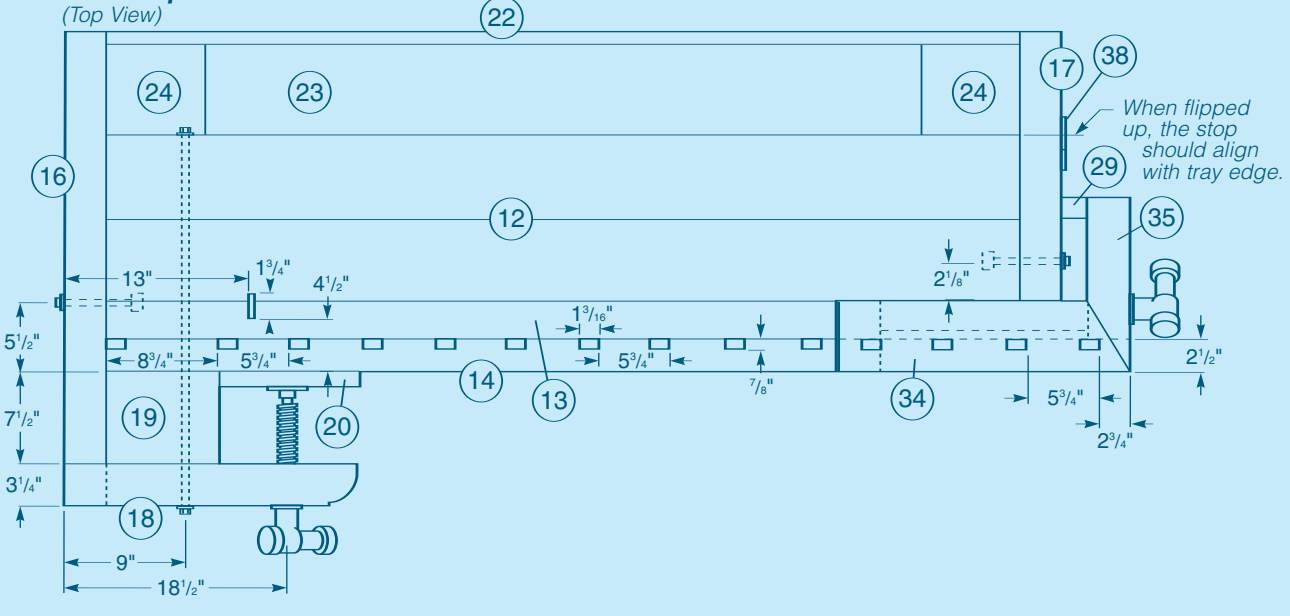
Backboard/long End Cap Dovetail Detail
(Rear View)



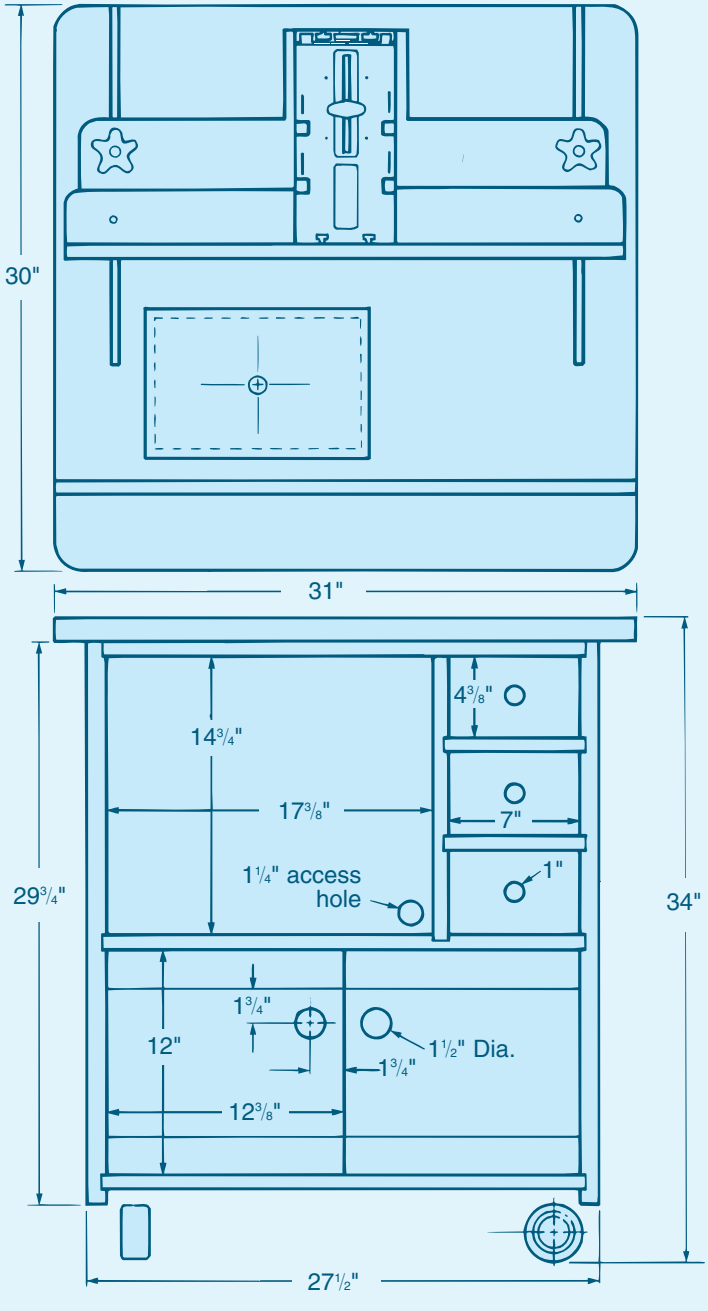
Inner Jaw Detail
(Front View)



Benchtop
(Top View)



Router Table
(Top, Front and Side Views)

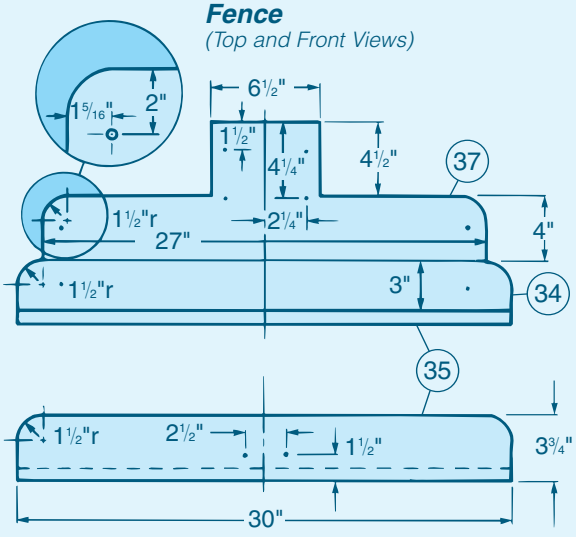


Pinup Shop Drawings

Custom Router Table

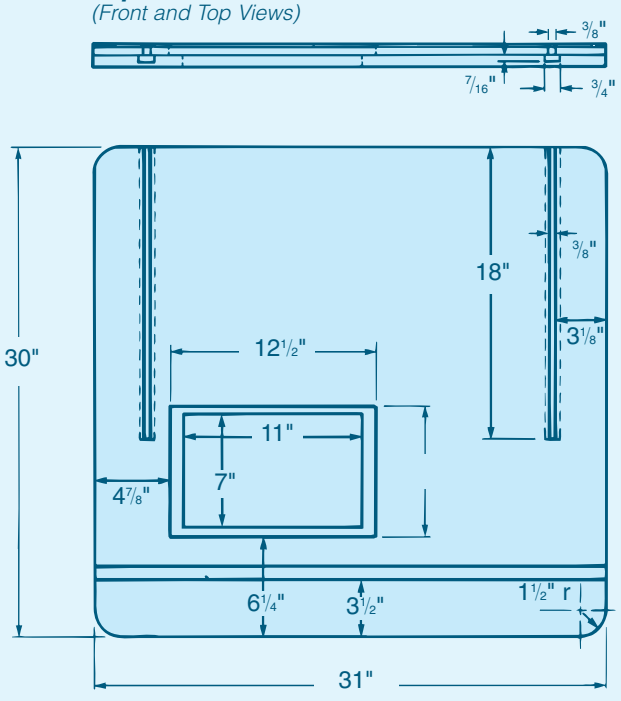
Fence

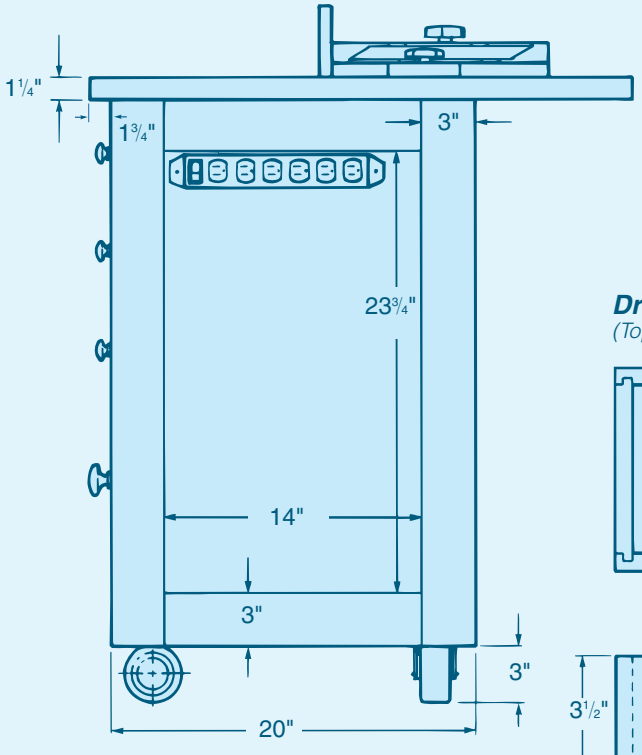
(Top and Front Views)



Top

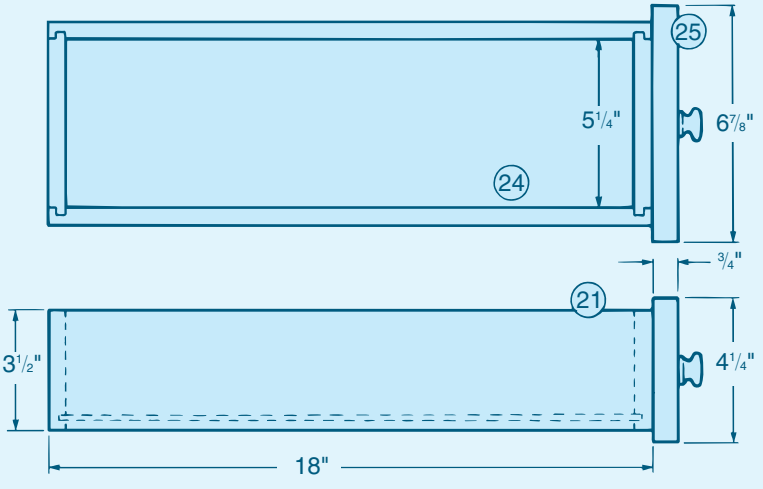
(Front and Top Views)





Drawer Assembly

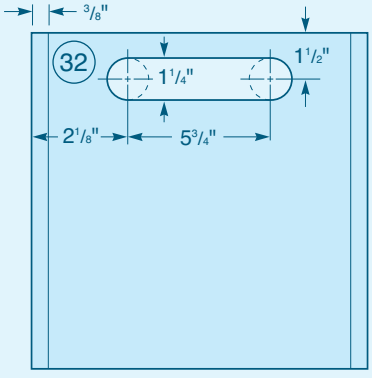
(Top and Side Views)



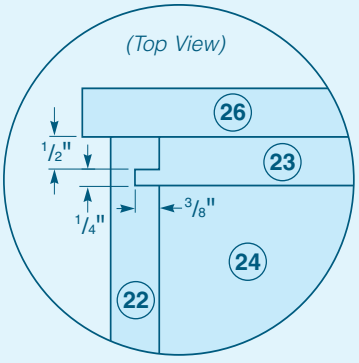
Pinup Shop Drawings

Outfeed/Assembly Table

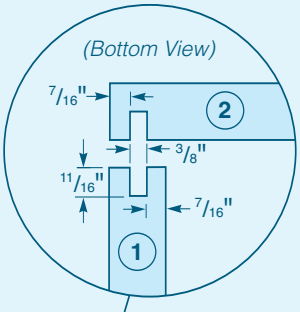
Cady Handle



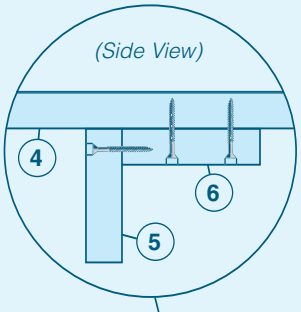
Drawer Assembly



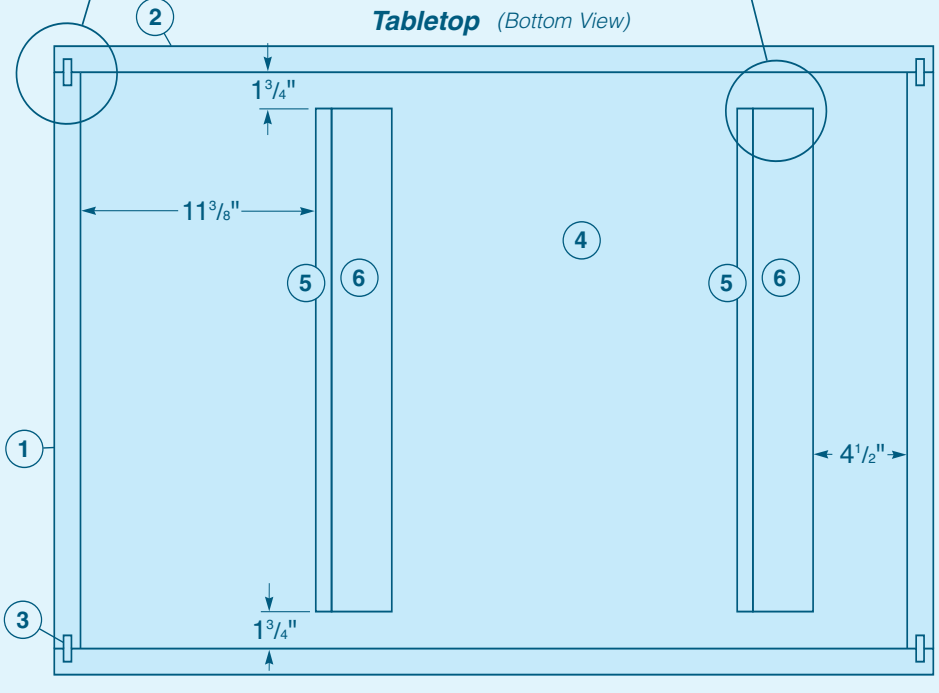
Apron Spline Dado Locations

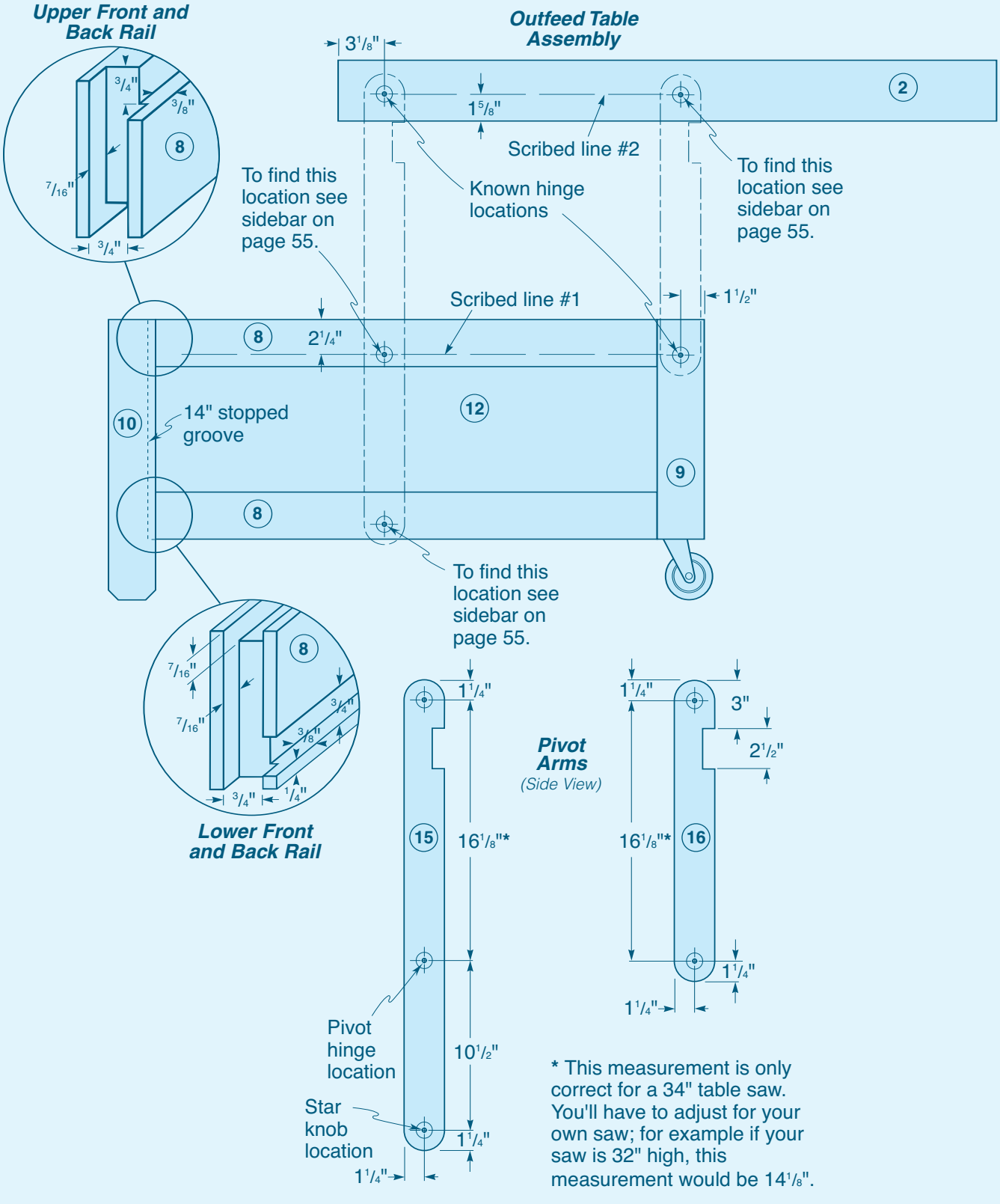


Tabletop Support



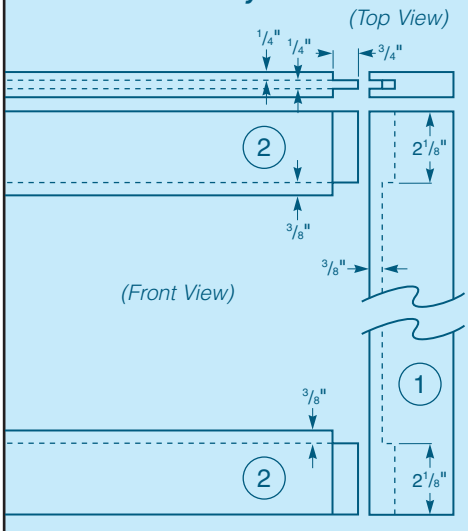
Tabletop (Bottom View)





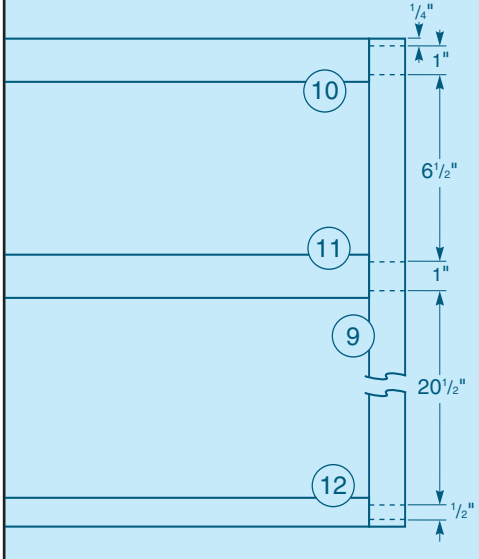
* This measurement is only correct for a 34" table saw. You'll have to adjust for your own saw; for example if your saw is 32" high, this measurement would be 14 1/8".

Side Joinery



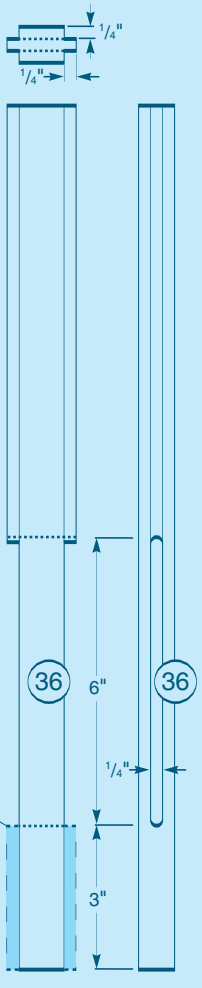
Face Frame

(Front View)



Leg

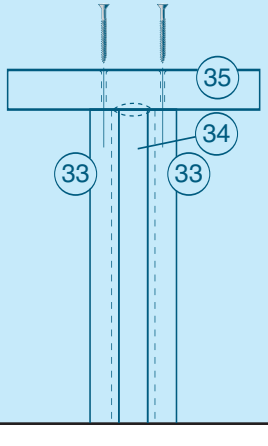
(Top, Front and Side Views)



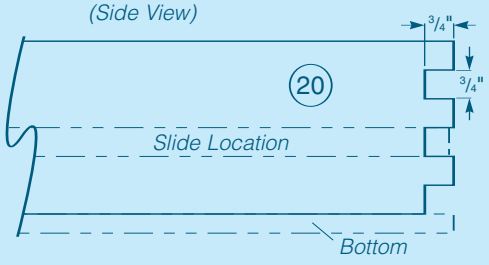
Note: *Use a 1/4" up-spiral bit to form the slot at right. During the first few passes the tongue is removed, except for the 3" on the bottom, which rides the fence. After the slot is formed, the waste at the bottom can be removed.*

Leg Hinge Assembly

(Front View)

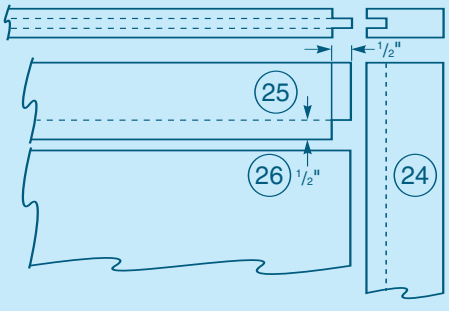


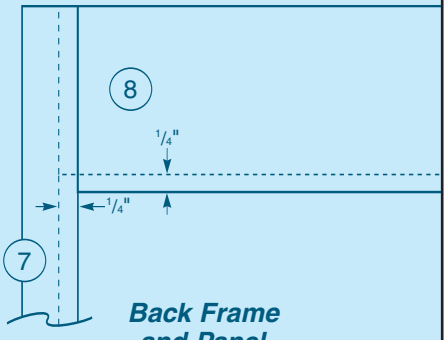
Drawer Side and Bottom
(Side View)



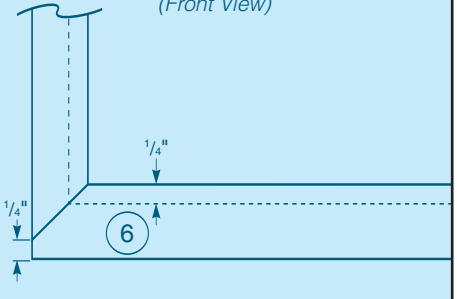
Note: *The author builds his shop fixtures to withstand a nuclear attack. The drawer bottoms can easily be removed and replaced.*

Drawer Face Assembly
(Top and Front Views)

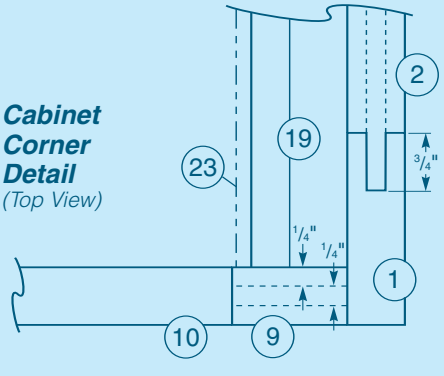




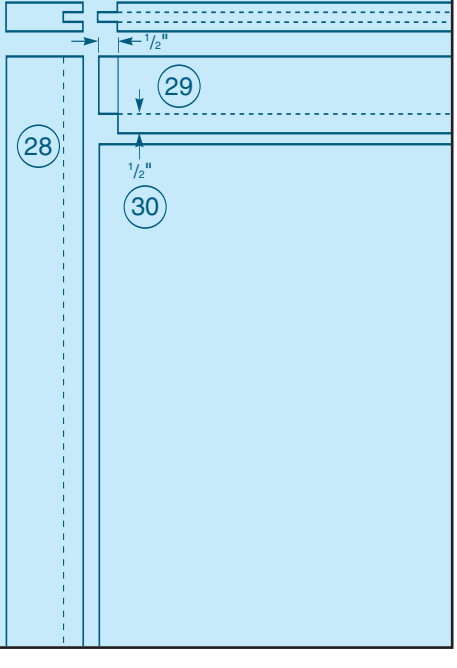
Back Frame and Panel Detail
(Front View)



Cabinet Corner Detail
(Top View)



Door Frame and Panel Assembly
(Top and Front Views)



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Outfeed/Assembly Table

If you've got a space-cramped shop, here's a saw outfeed table that transforms into a low-height assembly table. It also provides plenty of storage for blades and other saw accessories.

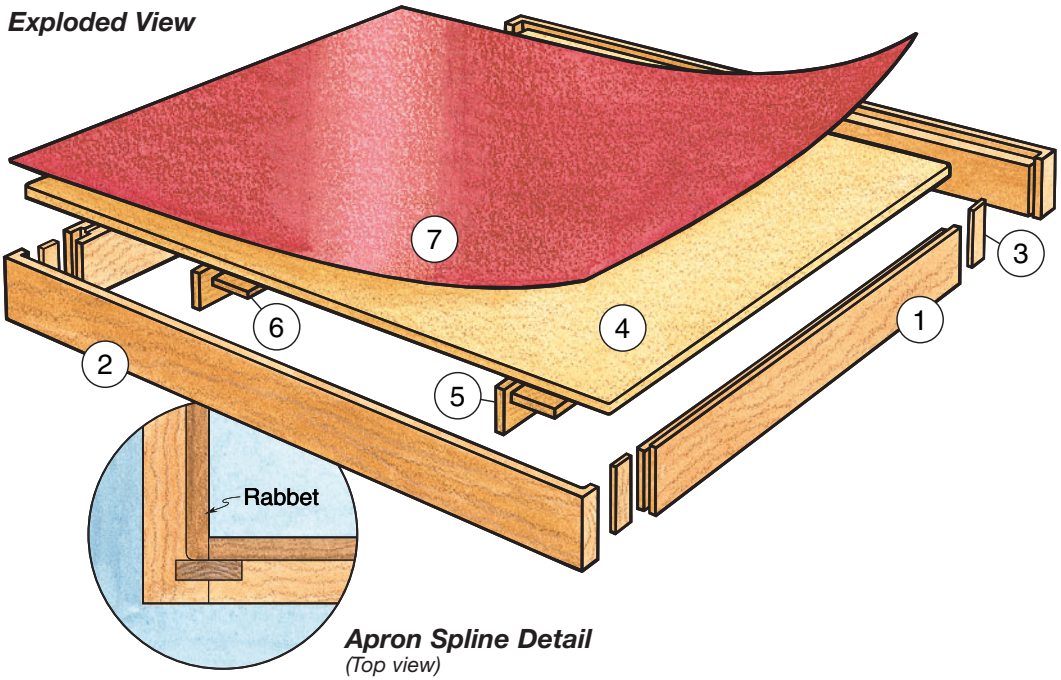
Working in a one-man shop can have its drawbacks. We all know what handling large sheets of plywood or MDF alone on a table saw is like: It's not only awkward, it can be dangerous. An outfeed table is essential, but it takes up a lot of room, especially in a small shop situation.

Most of us don't have a comfortable place to assemble large projects, either. Your workbench may be too high, while the floor is too low. This outfeed table unit solves both problems: it does double-duty as outfeed support for your table saw while also being a low assembly bench. Dual functionality makes it perfect for a small shop.

The outfeed/assembly table has a pair of extra-deep drawers for storing saw accessories such as push sticks, earplugs and table inserts. But our favorite feature is the blade storage caddy that includes a special space for a dado set. This portable caddy is a safe and convenient device for carrying blades to the sharpener's shop.

As an outfeed table, this dual-purpose project keeps large panels or long boards from tipping off the saw. Dropped down into an assembly station, it brings larger projects within easier reach and saves a lot of backache.

Tabletop Exploded View



Apron Spline Detail
(Top view)

MATERIAL LIST - *Tabletop*

		T x W x L			T x W x L
1	Side Aprons (2)	1¼" x 3⅞" x 27½"	**5**	Tabletop Supports (2)	3/4" x 2⅞" x 24"
2	Front and Back Aprons (2)	1¼" x 3⅞" x 42"	**6**	Support Cleats (2)	3/4" x 2⅞" x 24"
3	Apron Splines (4)	3/8" x 1¼" x 3⅞"	**7**	Tabletop Laminate (1)	1/16" x 31" x 43"
4	Tabletop (1)	3/4" x 28⅜" x 40⅜"			

Making the Tabletop

We used white oak with walnut accents to build this piece, but any stable hardwood will do. To make the tabletop, cut all the parts to size according to the dimensions given in the *Material List* above, then install a 3/8" dado blade in your table saw. Using a 12" high auxiliary fence, create spline slots on the ends of the side aprons (pieces 1). Now use your miter gauge to make matching dadoes in the faces of the front and back aprons (pieces 2) at the locations indicated on the *Pinup Shop Drawings*. Glue your apron splines (pieces 3) in place and check the subassembly for squareness by measuring diagonally. When both of the measurements are the same, tighten your clamps.

The next step is to create the rabbet for the particleboard tabletop (piece 4) with your router. Run a 3/4"-deep by 7/16"-wide rabbet all the way around the inside edge of the frame. Round the corners of the tabletop to match, then glue the top into place.

Next, install the tabletop supports (pieces 5) and their cleats (pieces 6). Screw and glue the cleats to the supports and position them on the underside of the tabletop as shown in the *Drawings*. Screw the cleats to the underside of the top using 1¼" wallboard screws. Countersink the heads, but don't go too deep or the screws will interfere with installing the laminate. You'll also want to make sure that the screws don't fall where the miter slot extension grooves will be cut in later.

Applying the Plastic Laminate

If you haven't worked with laminate before, the process may sound more difficult than it really is. The first thing you need to do is check that the joint between the aprons and the tabletop is flat, and sand it if necessary.

You can use a brush to apply your contact cement, but we've had much better luck using a serrated trowel. Spread a coat of cement on the

tabletop and your laminate (piece 7), and let it dry to the touch. Place dowels or thin sticks about every eight inches along the tabletop as shown in the tint box below, and gently lay the laminate in position, centering it over the top. If you followed the *Material List*, you'll notice that the laminate is 1" longer and wider than the tabletop to allow for trimming. Remember that the adhesive bonds on contact, so there is no room for mistakes: You must have everything lined up right the first time.

Working from the center out, remove the dowels and press the laminate down firmly. When the last dowels are removed, roll the entire surface with a 3"-wide hand roller, applying heavy pressure from the center out to the edges. Or, use a piece of 2 x 4 wrapped in a towel to press the laminate flat. The goal here is to provide full contact and force out any air bubbles between the laminate and the substrate.

Before trimming, it's important to use a scraper to remove any adhesive that may have run down the sides of the tabletop: The laminate-trimming bit in your router must have a clean surface to run against. Keep in mind that a minimum amount of the bit's cutting edge should be exposed to reduce the possibility of damage in case the router tips.

Making the Base Frames

The front and back of the base are frames with floating panels. Their stiles and rails receive 3/4"-wide grooves (see *Pinup Shop Drawings*) that house both the panels and splines. Forming those 7/16"-deep grooves is the first milling process and it is done with a dado blade in the table saw.

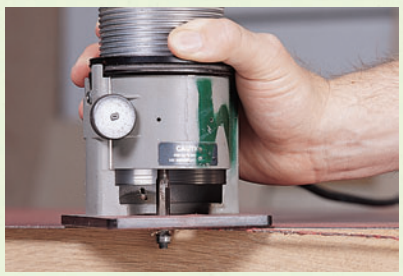
The front and back rails (pieces 8) are milled along their full length, as are the short stiles (pieces 9). However, the cuts on the long stiles (pieces 10) are stopped at the 14" mark. This is because these two stiles extend beyond the bottom rails and become the assembly table's legs. After the grooves are made, square their ends with a sharp chisel. Now chamfer the bottoms of the long stiles, and you're ready for assembly.

Assemble the frames and panels using the base splines (pieces 11) and glue, but don't glue the panels

Working with Plastic Laminate

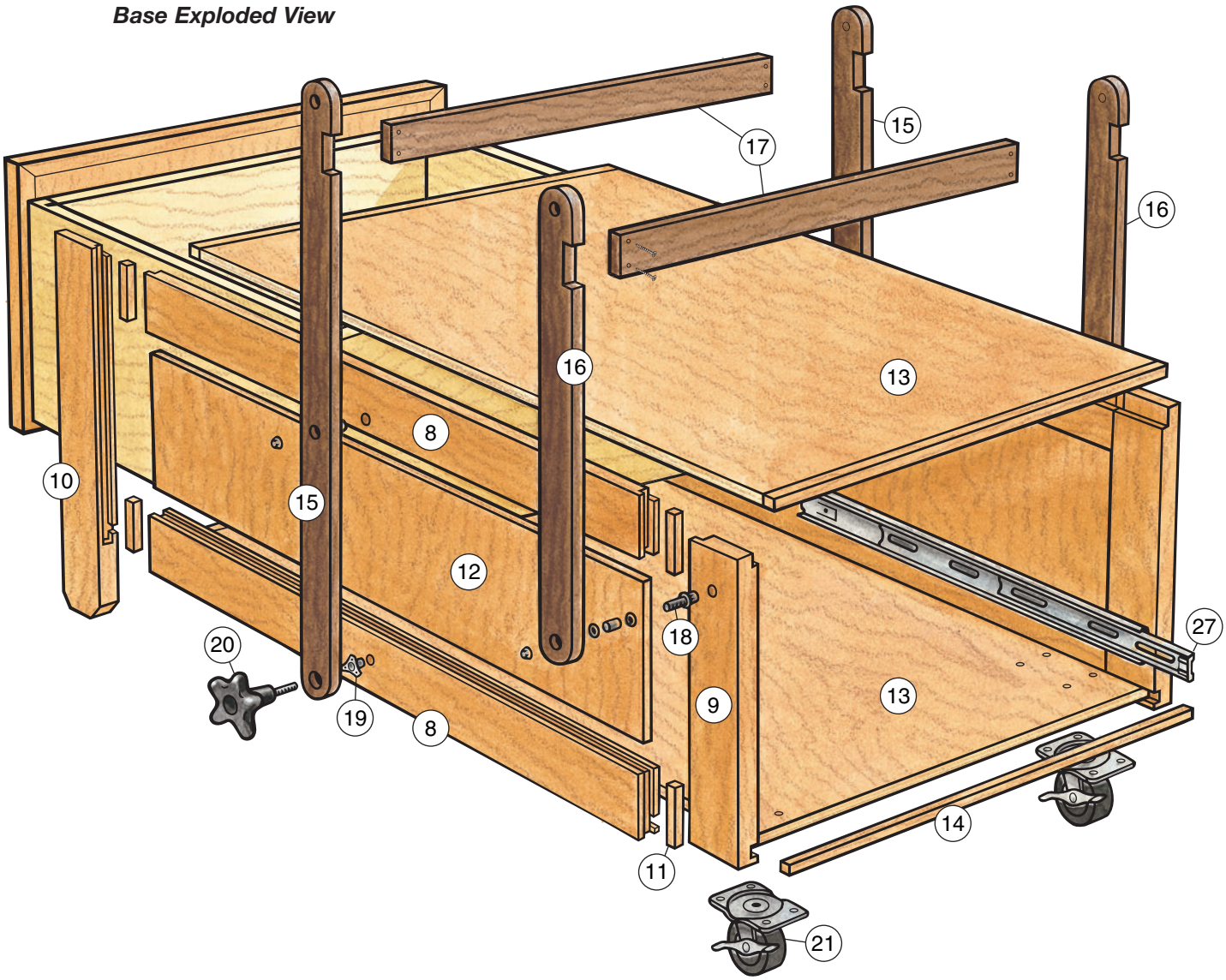
Applying plastic laminate is not too complicated, but you should keep in mind that the adhesive is very unforgiving. The plastic must be positioned correctly the first time: Once contact is made, it can't be repositioned.

Use dowels or thin sticks to separate the two cemented surfaces while positioning laminate on the substrate. Remove them one at a time, starting in the center.



Use a piloted laminate-trimming bit to trim off the overhanging laminate. Feed the router counterclockwise and at a constant speed to avoid burning or chatter marks.

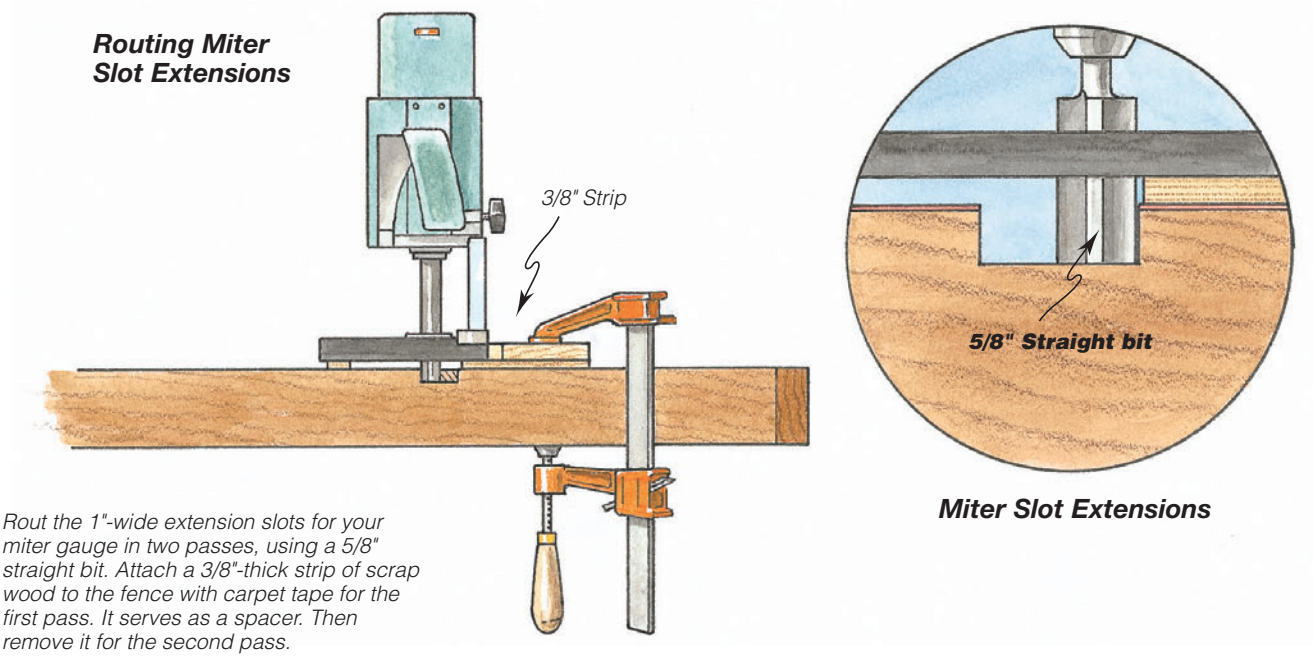
Base Exploded View



MATERIAL LIST - *Base*

	T x W x L		T x W x L
8 Front and Back Rails (4)	1¼" x 3" x 32"	**18** Pivot Hinges (4 pairs)	Rust-resistant
9 Short Stiles (2)	1¼" x 3" x 14"	**19** Threaded Inserts (2)	Screw-on T-nuts
10 Long Stiles (2)	1¼" x 3" x 17¾"	**20** Star Knobs (2)	5/16" x 1" Stud
11 Base Splines (8)	3/4" x 3/4" x 2⁹⁄₁₆"	**21** Heavy-duty Locking Casters (2)	3" Dia.
12 Front and Back Panels (2)	3/4" x 32¾" x 8¾"	**22** Drawer Sides (4)	3/4" x 10½" x 17¾"
13 Base Top and Bottom (2)	3/4" x 23⅝" x 36½"	**23** Drawer Fronts and Backs (4)	3/4" x 10½" x 21⅛"
14 Top and Bottom Edging (1)	3/4" x 3/4" x 96"	**24** Drawer Bottoms (2)	1/4" x 21⅛" x 16⁵⁄₁₆"
15 Long Pivot Arms* (2)	3/4" x 2½" x 29⅛"	**25** Drawer Faces (2)	3/4" x 21¼" x 10¾"
16 Short Pivot Arms* (2)	3/4" x 2½" x 18⅝"	**26** Drawer Face Edging (1)	3/4" x 3/4" x 144"
17 Stretchers (2)	3/4" x 2½" x 27¼"	**27** Drawer Slides (2 pairs)	18" Full-Extension

***** *Lengths shown are for a 34"-high table saw. Adjust this dimension to fit your saw.*



Rout the 1"-wide extension slots for your miter gauge in two passes, using a 5/8" straight bit. Attach a 3/8"-thick strip of scrap wood to the fence with carpet tape for the first pass. It serves as a spacer. Then remove it for the second pass.

(pieces 12) in place — they float freely to allow for expansion and contraction. Be sure to check for squareness as you tighten the clamps.

Once these two subassemblies are dry, go back to the dado blade and mill the rabbets for the base top (piece 13) and the grooves for the base bottom (also piece 13) as shown in the *Drawings*. To prevent chip-out, be sure to back up these cuts with some scrap.

Attach edging (piece 14) to the base top and bottom with glue and finish nails, drilling pilot holes through the oak for the nails. Set the nail heads, fill the holes and sand the edging flush. Complete the base carcass by gluing and clamping the top and bottom to the front and back, checking for squareness as you go.

Building the Drawers

We used aspen to make the drawer sides (pieces 22) and the fronts and backs (pieces 23), but you could use other woods or even plywood to produce sturdy drawer boxes. Cut the drawer box parts to size and mill the 1/4"-wide by 3/8"-deep grooves that hold the bottoms (pieces 24). Stop the grooves on the fronts and backs 3/8" from each end so they won't show when the boxes are assembled.

Now create a 1/4"-thick by 3/8" tongue on each end of the drawer fronts and backs. These tongues fit into the dadoes on the drawer sides (see *Drawing,* page 54, for locations). Cut these dadoes on your table saw, and you are ready to assemble the drawers with glue and clamps. Remember to measure diagonally for squareness, and don't glue the drawer bottoms. It's critical that the drawers are square so they engage the drawer slides properly.

The drawer faces are plywood panels (pieces 25) that are edged with mitered solid oak (piece 26). Make the faces now, but don't attach them until the drawers have been installed; that way you can align them perfectly. Installing the drawers is a matter of following the instructions that come with the drawer slides (pieces 27). However, before you can install them, you'll need to attach the casters (pieces 21), so you're working on a level surface.

Once the drawers are in, align the faces and secure them from the back with screws. Install the knobs (pieces 28) next and you're ready to make the removable blade caddy.

Constructing the Blade Caddy

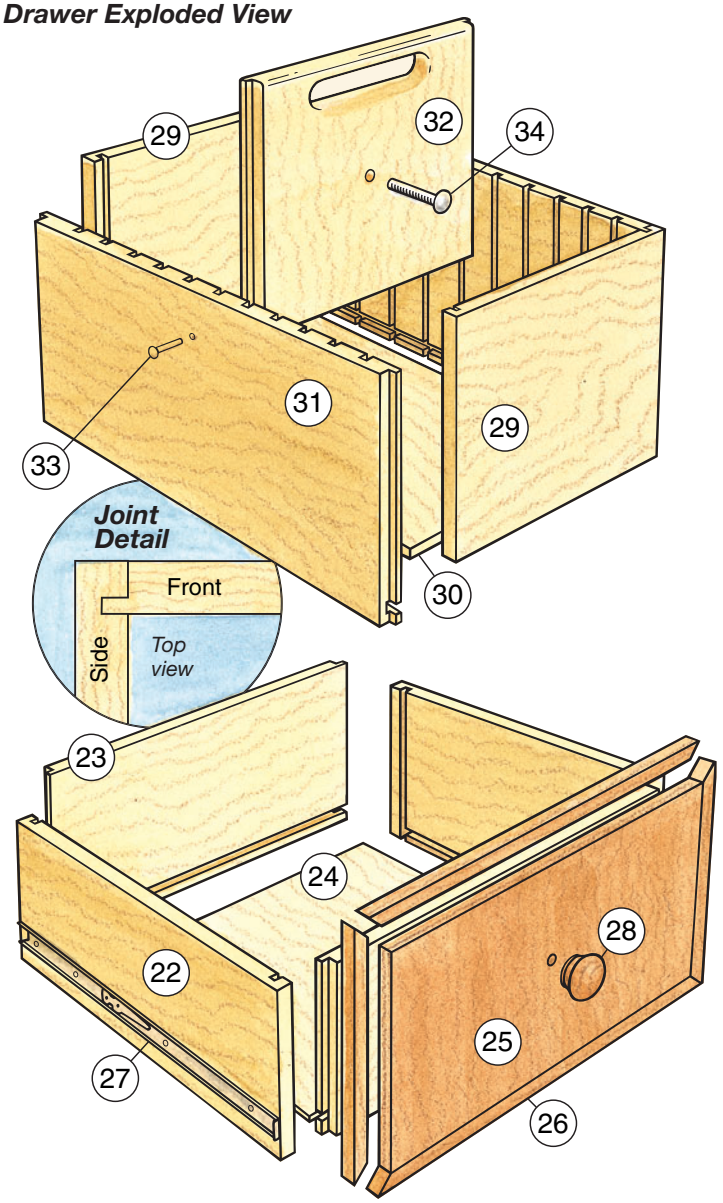
Making the caddy is fairly easy because it uses the same dado setup several times. It is sized for ten 10" blades and an 8" dado blade, but you can change that to suit your own saw or collection of blades.

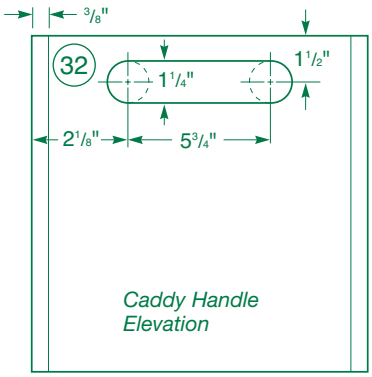
With the parts cut to size, plow two vertical dadoes on the inside face of the sides (pieces 29), using a 1/4"-wide dado blade set for a 3/8"-deep cut (see *Joint Detail* on the next page). Next, cut the dadoes for the blades and handle. The first two cuts run down the inside center of the front and back (pieces 31), then additional cuts are made to the left and right, each 1½" on center from its neighbor.

The last operation to perform with this setup is making the grooves on the bottom of the front and back to hold the caddy bottom (piece 30). Because you're using a 1/4" dado, you'll have to take two passes. The corresponding grooves in the sides are best done on a router table, as these are stopped at each end.

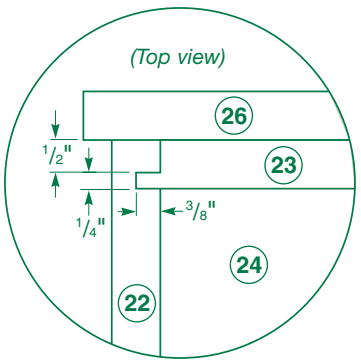
Now it's time to make the tongues on the ends of the front and back. Raise the blade height to 1/2" and set the fence for a 3/8" cut, making two passes with the miter gauge.

Drawer Exploded View





Drawer Assembly



MATERIAL LIST - *Drawer/Caddy*

		T x W x L
28	Drawer Knobs (2)	2" Dia.
29	Caddy Sides (2)	3/4" x 11" x 10¾"
30	Caddy Bottom (1)	1/2" x 9 15/16" x 19"
31	Caddy Front and Back (2)	3/4" x 11" x 19⅛"
32	Caddy Handle (1)	3/4" x 9 15/16" x 10"
33	Handle Locking Pins (2)	2⅜" x 1/4" Tie Pegs
34	Dado Blade Holder (1)	1/2" x 2" Carriage Bolt and Nut

With the same setup, create the rabbets on both ends of the caddy handle (piece 32). Now use the *Elevation Drawing* at the top of this page to create the cutout for the handle. It's simply an elongated slot formed by drilling a pair of 1¼"-diameter holes and connecting them with a pair of jigsaw cuts. This handle slips into the center groove and is held in place with two wooden locking pins (pieces 33). Removing the locking pins allows you to take the caddy out of the drawer (perhaps for a trip to the sharpener). Your dado blade mounts on the handle with a carriage bolt and nut (pieces 34).

Making the Pivot Arms

Making the pivot arms (pieces 15 and 16) the correct length is not really as complicated as it seems. The dimensions given in the *Material List* are for a saw that is 34" high, so adjust that measurement to suit your saw.

Connecting the Table to the Base

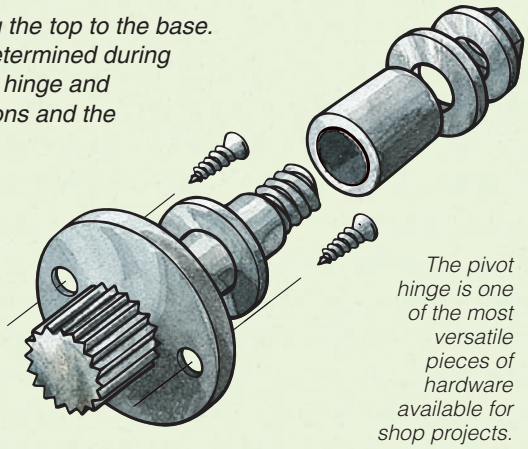
With all the parts made, there's still one step left — connecting the top to the base. Since saw heights vary, some of the hinge locations have to be determined during assembly. But first, check the Pinup Shop Drawings *for the known hinge and scribed line locations. Transfer these to the inside of the table aprons and the upper base rails, drill the holes and install the pivot hinges (see illustration, right) and arms.*

To find the location for the lower hinge on the long arm, center the table on the base and move the arm in an arc until the hole for the hinge intersects the scribed line on the base rail. Mark this location, repeat the procedure on the other side, drill the holes in the rails and install the hinges, as shown in Step 1.

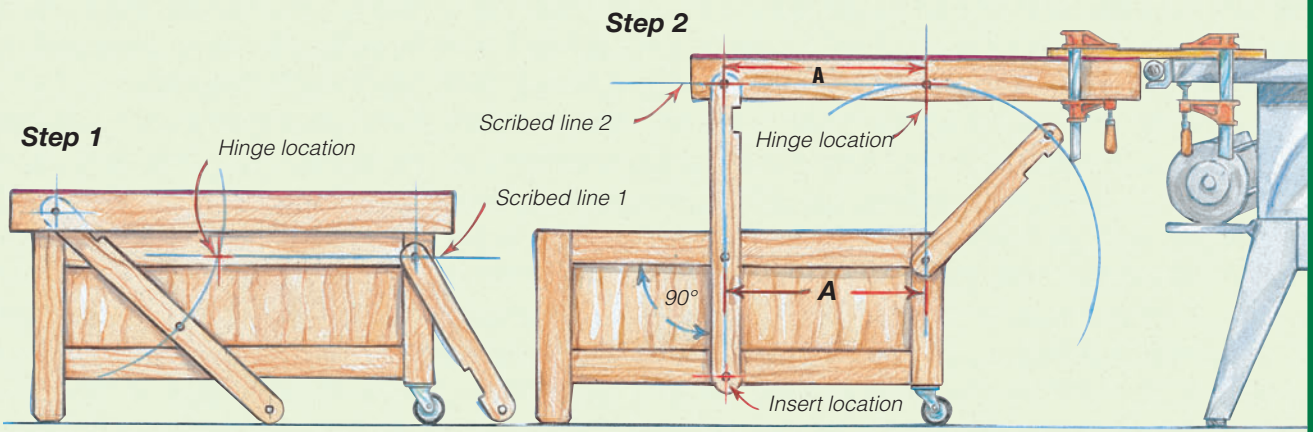
To establish the threaded insert location, begin by elevating the top to its full outfeed height, as shown in Step 2. Keeping the top level, use an awl to mark the insert location on the bottom rail. Use a framing square to keep the arm perpendicular during this operation. Drill the holes, install the inserts and lock both arms in the "up" position with the star knobs.

To find your final pivot hinge location on the inside of the table apron, simply measure the distance between the two hinges on the base rail (shown as "A" below) and transfer this measurement to the scribed line on the inside of the apron. With that point established, you can drill for the final hinges.

The last step is to glue and screw the two stretchers (pieces 17) in place to add extra stability to the assembly.



The pivot hinge is one of the most versatile pieces of hardware available for shop projects.



For example, if your saw is 36" high, add 2" to each arm. With that length determined, cut the arms to size. Use your band saw to round both ends of each arm, then sand away any kerf marks. You can now use the *Pivot Arms Detail* on the *Pinup Shop Drawings* to mark the drilling locations for your hardware. While you're at it, lay out the cuts for the two stretchers (pieces 17).

Follow the instructions that come with the pivot hinges (pieces 18) and drill the arms at the locations you just marked. Remember that the top hinges are installed on the outsides of the arms, while the bottom ones are located on the insides. Then, using your band saw, make the cuts that house the stretchers.

Refer to the tint box, above, for your final assembly instructions. Once the table is all together, lay out and cut the miter slot extensions, as shown in the illustrations on page 53. Using a router and straight bit, a pair of cuts will complete both miter saw tracks. Locate the tracks carefully so they line up accurately with the slots on your saw table.

Finishing Up

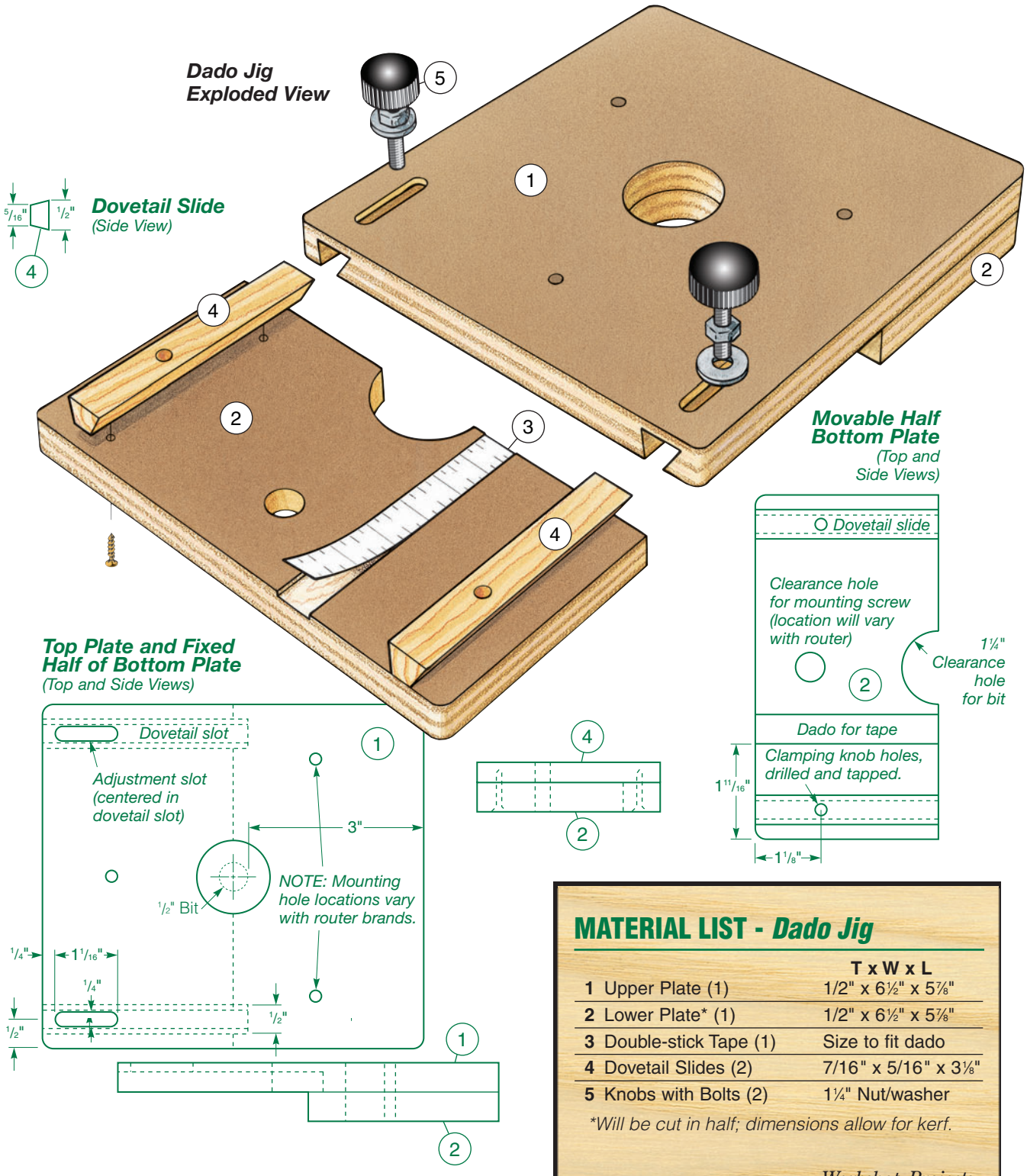
With that done, wrap up your outfeed/assembly table with three coats of a durable finish. We used a waterbased varnish that dries quickly and spares you from the strong fumes. Mask off the laminate surfaces first to keep them clean.

Once the finish dries, you can go to work on all those large projects you thought your small shop couldn't handle. Now you've got support to spare and a convenient new benchtop for putting things together.

HARDWOOD SHOWCASE

Adjustable Dado Jig

This adjustable auxiliary router base gives you total control of dado dimensions. It's perfect for today's undersized plywoods.



MATERIAL LIST - *Dado Jig*

		T x W x L
1	Upper Plate (1)	1/2" x 6½" x 5⅞"
2	Lower Plate* (1)	1/2" x 6½" x 5⅞"
3	Double-stick Tape (1)	Size to fit dado
4	Dovetail Slides (2)	7/16" x 5/16" x 3⅛"
5	Knobs with Bolts (2)	1¼" Nut/washer

**Will be cut in half; dimensions allow for kerf.*

Every woodworker knows that 3/4" is not really 3/4 of an inch, and virtually no two boards are exactly the same thickness. This makes milling snug-fitting dadoes difficult indeed, and it was the impetus for this adjustable dado jig.

While there are a number of tried-and-true methods for cutting perfectly sized dadoes, we wanted to be able to set a single straightedge and mill most any size dado needed — in just two passes. Our solution involves running two of the auxiliary base's edges along the straightedge. One edge is a fixed distance from the cutting edge of the bit, and the second can easily move in and out to adjust the final dado width.

Milling the Base Pieces

Begin by cutting 1/2" material to form the two plates (pieces 1 and 2) of the auxiliary base. It is important that the next step is exactly matched top to bottom, so stick the two parts together with double-sided tape. Lay out the mounting hole locations for your router on the face of the top plate so the cutting edge of your 1/2" straight bit will be exactly 3" from the fixed edge of the jig (see *Elevation Drawings* at left). Drill the mounting holes and the clearance hole for the bit through both layers. Separate the two parts and turn the top plate over to countersink the mounting holes and mill the dovetail slots, as shown at left. Next, mill the 1/4" adjustment slots through the top plate, along the centerlines of the dovetail slots.

Next, cut the lower plate in half, and bore the mounting holes out to 1/2" to provide clearance for the mounting screws. Glue the front half to the top plate to create the fixed edge of the jig. Then mill a shallow 1/2"-wide dado in the movable base for a stick-on ruler (piece 3).

For safety, mill the hardwood dovetail slides (pieces 4) along one edge of a wider 1/2" board to fit the slots. Once they slide smoothly in the slots, trim them off on the table saw. To attach them, slip them into the slots, clamp the second half of the bottom plate to the rest, and screw (no glue) the half plate to the slides. Finally, with the movable base set flush, drill and tap the holes for the clamping knobs (pieces 5).

Using the Jig

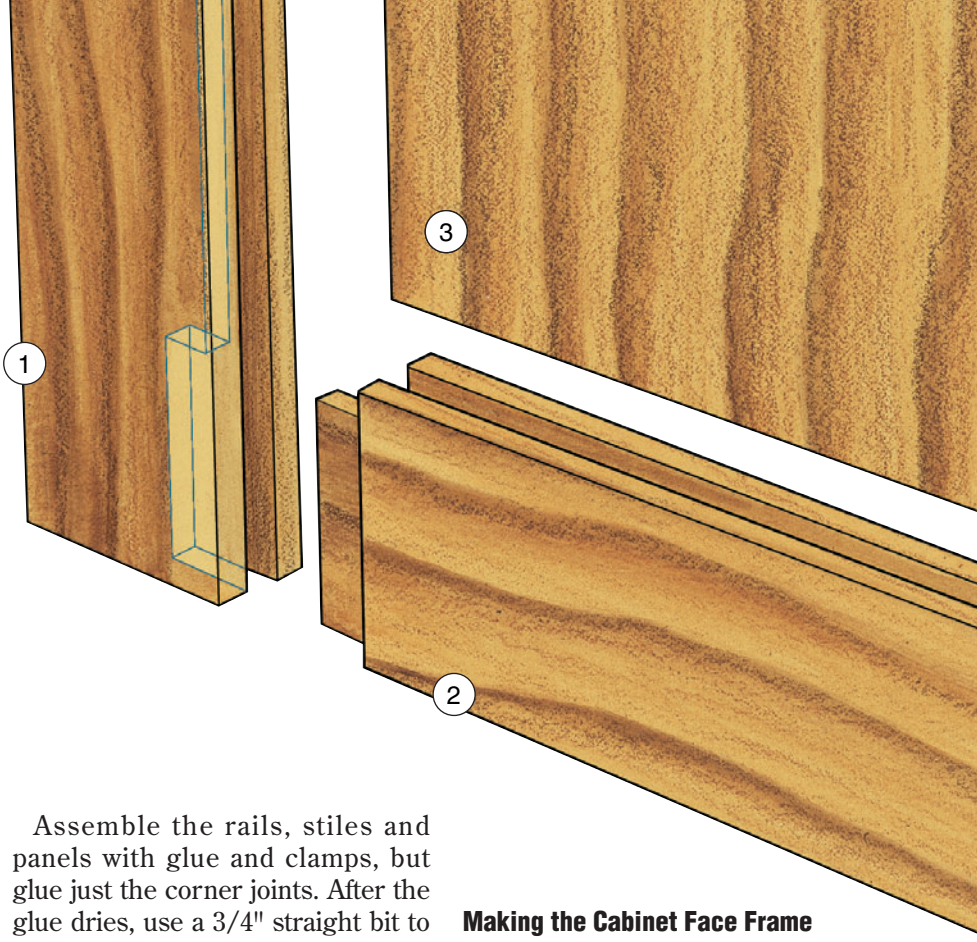
Let's say you need a tight-fitting 19/32" dado, and you've got a 1/2" bit chucked in your router. To use the jig, first clamp your straightedge 3" from the desired edge of the dado. Use the tape measure to set the movable edge to 3/32" (the difference between the bit and the desired width of the dado). Tighten your knobs and make the first pass with the movable edge riding along the straightedge. Spin the router around so the fixed edge is along the straightedge, and form the other wall of your dado — exactly 19/32" wide! Perfect dadoes every time.

The second pass with this jig widens the dado for a perfectly snug fit.

Miter Saw Station

Miter saws deserve a full-time workstation. If you don't have the six or eight feet of wall space they require, this rolling cabinet with tip-up extension wings may be the perfect compromise.

The author's miter saw stand features fold-down wings, casters and integral dust collection.



Side Panel Joint Exploded View

Space is at a premium in every shop we've ever been in, and yours is probably no exception. If you own a miter saw, it really should have a solid working surface with supports on either side. But, it's hard to justify devoting so much space to one benchtop tool when others, such as mortising machines or benchtop drill presses, also compete for space.

The inspiration for this miter saw station actually came from a previous routing system built by contributing editor Rick White. Like this saw station, Rick's router table featured fold-down wing extensions and rolled out of the way easily. This unit also incorporates built-in dust collection and a drawer to store the rollers that are integral to the design.

The saw station is essentially a cabinet on wheels, and each side is made up of two stiles, two rails and a panel (pieces 1 through 3). Check the *Material List* on page 62 for dimensions, and begin construction by cutting these parts to size.

The rails are attached to the stiles with tongue and groove joinery, as shown in the illustration on this page and in the *Side Joinery Detail Drawing* in the *Pinup Shop Drawings*. Form tongues on the ends of the rails using either a dado blade in the table saw or a router table. Make several passes of increasing depth until you reach the final required depth.

Plow a through groove in one face of each stile. This must be done on the router because it is a stepped groove: the groove is 3/8" deep to hold the panel and increases to 3/4" deep where the rail tongues join the stiles. This almost doubles the glue areas and the strength of the joints.

Assemble the rails, stiles and panels with glue and clamps, but glue just the corner joints. After the glue dries, use a 3/4" straight bit to plow a 1/4"-deep stopped rabbet in each side for the cabinet bottom (piece 4). Glue and clamp the bottom in place, and make sure it is square to the sides.

Continuing the Carcass

The back of the cabinet (piece 5) is held in place with three U-shaped mitered moldings (pieces 6 and 7). Rip these to size, then plow a groove in one edge of each, using a dado blade in the table saw. Miter the moldings to fit and use glue and clamps to attach one piece to the top face of the cabinet bottom, flush against the back edge. Secure two more lengths of molding to the sides (only their bottom ends are mitered) and, after the glue dries, slide the back in place.

The top edge of the back is housed in a rail (piece 8), which has a tongue milled on each end and a groove plowed along its bottom edge (see *Pinup Shop Drawings*). Attach the rail with glue and clamps, making sure everything is square. Leave the clamp in place while you make the face frame for the front of the cabinet.

Making the Cabinet Face Frame

The face frame accommodates both the drawer and door openings. Begin by ripping the stiles (pieces 9) to size, then chop the three through mortises in each of them (see *Pinup Shop Drawings*).

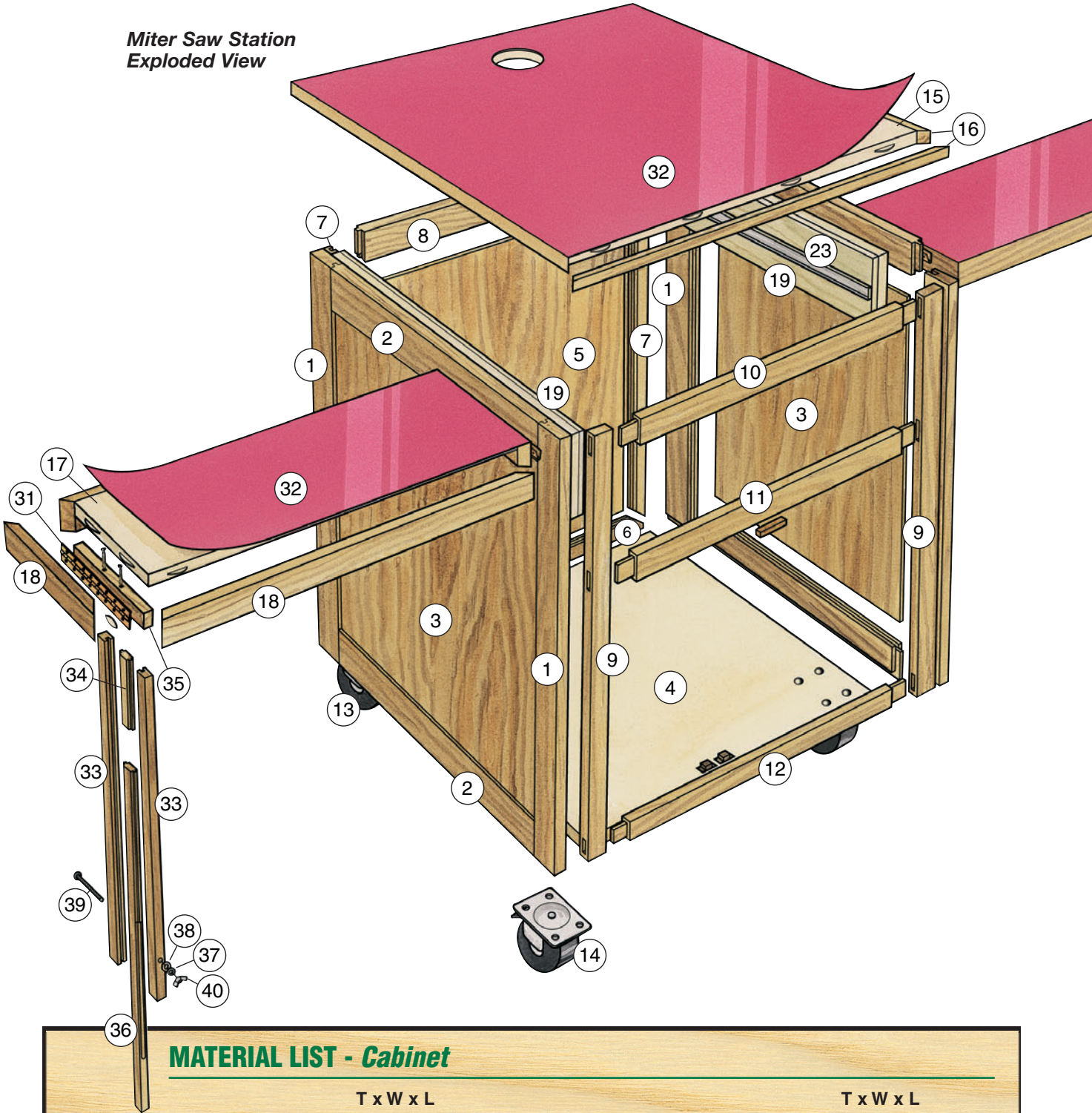
The three face frame rails (pieces 10, 11 and 12) need to have tenons milled on their ends. Use a tenoning jig on the table saw or your miter gauge and a dado blade. Glue and clamp the face frame together and, after the glue is dry, remove the clamps. Dry-fit the frame in the front of the cabinet and trim it to fit. Glue and clamp the face frame in position and leave the clamps in place until the top of the cabinet is attached.

Now you can turn the station upside-down and attach the four casters (pieces 13 and 14).

Building the Cabinet Top

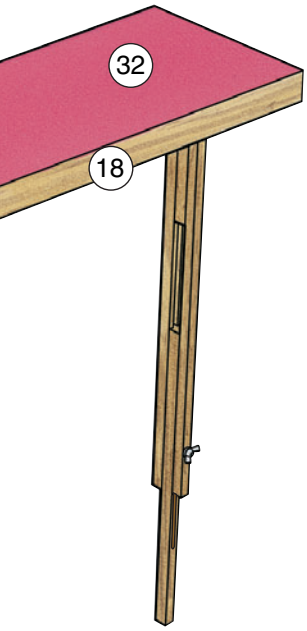
Cut the MDF top for the cabinet (piece 15) to the dimensions shown in the *Material List* on page 62, then create a hardwood molding (piece 16) to wrap its edges. This is simply ripped and jointed to size, then mitered to length.

Miter Saw Station
Exploded View



MATERIAL LIST - *Cabinet*

		T x W x L
1	Side Stiles (4)	3/4" x 2 1/2" x 30"
2	Side Rails (4)	3/4" x 2 1/2" x 26 1/2"
3	Side Panels (2)	3/4" x 25 3/4" x 25 3/4"
4	Bottom (1)	3/4" x 29" x 29 1/4"
5	Back (1)	1/4" x 27 1/2" x 28 1/2"
6	Back Lower Molding (1)	3/4" x 1" x 27"
7	Back Side Moldings (2)	3/4" x 3/4" x 29"
8	Back Upper Molding (1)	3/4" x 2 1/2" x 27 1/2"
9	Face Frame Stiles (2)	3/4" x 1 1/4" x 30"
10	Face Frame Top Rail (1)	3/4" x 1 1/2" x 28 1/2"
11	Face Frame Middle Rail (1)	3/4" x 1 1/2" x 28 1/2"
12	Face Frame Bottom Rail (1)	3/4" x 1" x 28 1/2"
13	Free Casters (2)	2 1/4" Dia.
14	Locking Casters (2)	2 1/4" Dia.
15	Top (1)	3/4" x 30 1/4" x 30 1/4"
16	Top Molding (1)	3/4" x 1" x 130"
17	Wing Panels (2)	3/4" x 9" x 26"
18	Wing Edge Molding (1)	3/4" x 1 7/8" x 160"
19	Drawer Slide Spacers (2)	1 1/4" x 6" x 28 1/2"



Attach the molding with biscuits, glue and clamps and, after the glue has dried, sand the top edges absolutely flat. Dry-fit the top to the cabinet (but don't attach it yet): the top assembly should overhang the cabinet by 1⅛" all around.

The two outfeed supports (wings) add about three feet of stock support on either side of the saw. As each folds out, a hidden adjustable leg drops down to support it. Movable rollers, clamped to the wings, support stock in a range of lengths and widths.

Each support is made up of a panel of MDF (pieces 17), trimmed with a hardwood molding (piece 18). Rip and joint the molding to size, then miter it to length and attach it to the panel with glue, biscuits and clamps. When everything is dry, sand each wing and mill a very slight chamfer on the bottom edge with a bearing-guided chamfering bit.

Building the Drawer Box

It's a lot easier to build and install the drawer before you attach the cabinet top permanently. The first step is to face-glue a piece of 1/2" plywood to some of your 3/4" MDF, to create a couple of spacers (pieces 19). These build out the edges of the drawer cavity so it's flush with the inside edge of the face frame. Secure the spacers with glue, clamps and predrilled, countersunk screws to hold them in place while the glue dries.

We used poplar for the drawer sides, front and back (pieces 20 and 21). Use a 3/4" dado blade in the table saw to create the fingers, then glue and clamp the box together.

It never hurts to overbuild your shop fixtures. Drive a 2" screw through each of the drawer box fingers into countersunk, predrilled holes (see *Figure 3*).

The bottom of the drawer (piece 22) is a piece of 1/2" Baltic birch plywood, attached to the sides with 2" countersunk screws and no glue, so it can be replaced when necessary.

Install the drawer box with a pair of heavy-duty 24" full-extension drawer slides (pieces 23). Align the box's front face flush with the face frame's back edge to allow for the drawer face, and screw the slides to the spacers.

Making the Drawer Face

The drawer face has two stiles, two rails and a panel (pieces 24 through 26). Plow a through groove in the inside face of each stile, the bottom edge of the top rail and the top edge of the bottom rail, (see *Drawing*, page 64). Mill matching tongues on the ends of the rails, cut the panel to size and, when everything fits, glue and clamp the drawer face together. Attach it to the drawer box with screws driven from inside the box. Complete it with walnut-stained hardwood knobs (pieces 27).

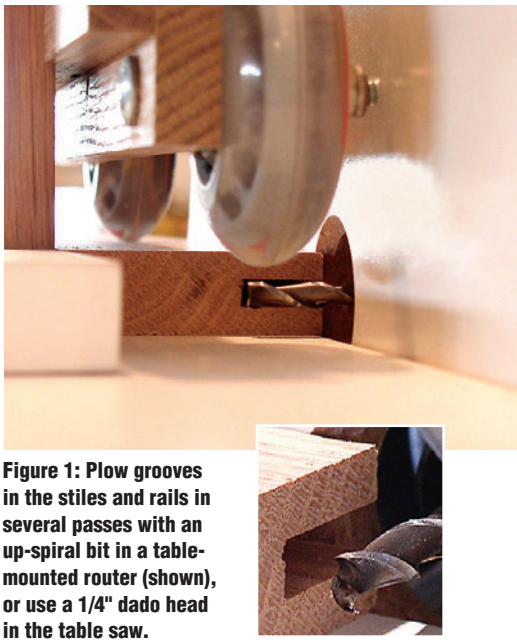


Figure 1: Plow grooves in the stiles and rails in several passes with an up-spiral bit in a table-mounted router (shown), or use a 1/4" dado head in the table saw.

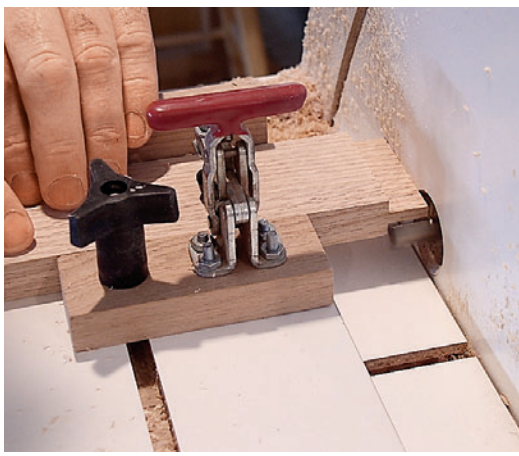


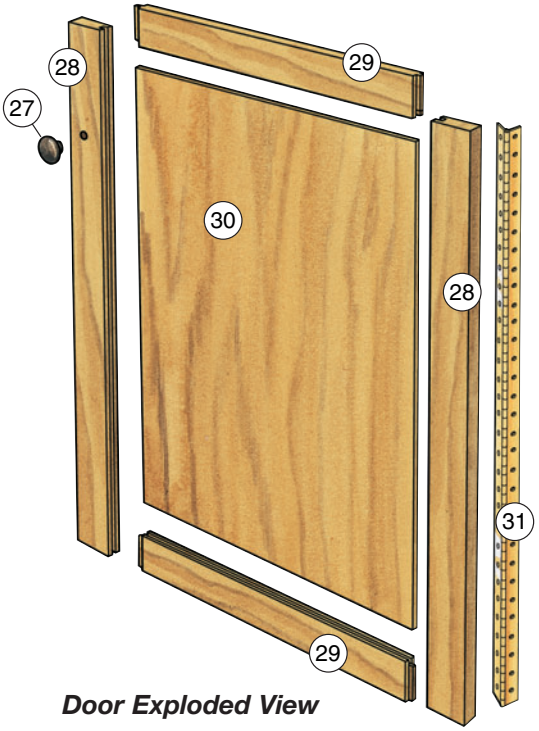
Figure 2: Adjust the height of your spiral bit to form matching tongues on the ends of the rails. Again, make numerous passes to prevent stressing the workpiece or the tool.

Each door calls for two stiles, two rails and a panel (pieces 28 through 30). Plow a through groove in the inside face of each stile, the bottom edge of the top rail and the top edge of the bottom rail. Then mill matching tongues on the ends of the rails, cut the panel to size and assemble the doors without glue. Check their fit in the openings.

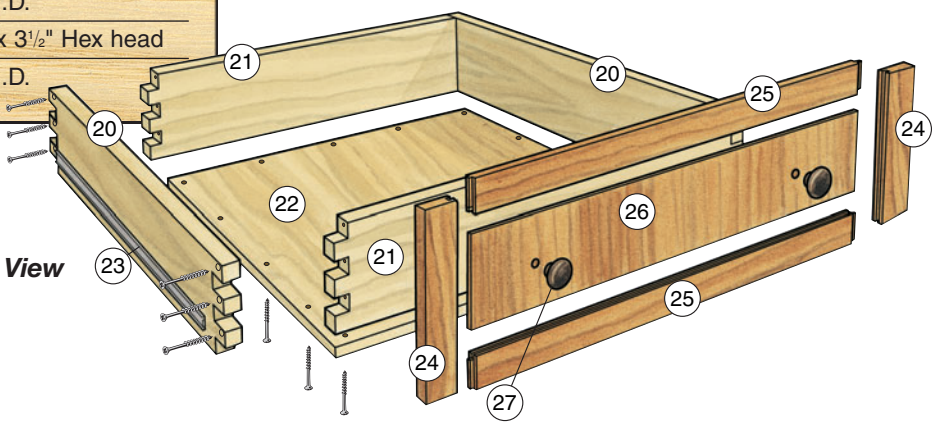
When everything fits perfectly, glue and clamp each door together. After sanding, attach the doors to the cabinet with brass piano hinges (pieces 31).

MATERIAL LIST - *Doors/Drawers/Legs*

		T x W x L
20	Drawer Sides (2)	3/4" x 4½" x 24"
21	Drawer Front & Back (2)	3/4" x 4½" x 25"
22	Drawer Bottom (1)	1/2" x 24" x 25"
23	Drawer Slides (1 Pair)	24" Full-extension HD
24	Drawer Face Stiles (2)	3/4" x 2" x 6"
25	Drawer Face Rails (2)	3/4" x 2" x 23"
26	Drawer Face Panel (1)	1/4" x 23" x 3"
27	Drawer & Door Knobs (4)	1½" Dia.
28	Door Stiles (4)	3/4" x 2" x 20"
29	Door Rails (4)	3/4" x 2" x 10"
30	Door Panels (2)	1/4" x 10" x 17"
31	Continuous Piano Hinges (2)	1½" x 36", Brass
32	Plastic Laminate (1)	36" x 60"
33	Leg Housings (4)	3/4" x 1" x 23⅝"
34	Leg Spacers (2)	3/4" x 1½" x 5½"
35	Leg Hinge Bases (2)	3/4" x 1⅜" x 8¾"
36	Legs (2)	3/4" x 1⁷⁄₁₆" x 18"
37	Leg Lock Washers (4)	1/4" I.D.
38	Leg Flat Washers (4)	1/4" I.D.
39	Leg Bolts (2)	1/4" x 3½" Hex head
40	Leg Wing Nuts (2)	1/4" I.D.



Door Exploded View



Drawer Exploded View

Figure 3: The drawer is built for shop use with heavy-duty, full-extension slides and screws through each of the 3/4" glued finger joints.

Installing the Top

With the doors and drawer in place, you're ready to attach the top permanently. But first, turn it over and mill a 1/4" chamfer along the bottom outside edge with a bearing-guided chamfering bit chucked in a portable router. This eliminates the sharp edge and some painful slivers.

Apply glue to the top edge of the cabinet, put the top in place and drive 2" countersunk screws down through it into predrilled pilot holes in the cabinet members. Fill the holes with a wood filler that hardens completely.

After the filler dries, sand it flush. Then apply a second coat of filler and sand that flush, too, after it dries.

Applying Plastic Laminate

If you don't work with a lot of plastic laminate, you may not know that there are waterbased contact adhesives for applying laminate that give off none of the volatile fumes. We advise using this formulation, especially if you are building this project during the winter in an enclosed shop.

Apply an equally thick coat to the top of each wing, the saw station top, and the bottom of each piece (cut 2" oversized for easy trimming) of plastic laminate (piece 32). Let the adhesive dry until it doesn't feel sticky, then place sticks or dowels on the wings and top. Line up the laminate (you only get one chance

to get it right), remove the sticks one at a time and press the laminate in place. Use a roller to ensure complete contact, then trim the edges with a bearing-guided chamfering bit chucked in a portable router (see *Figure 4*). Stick some masking tape to the laminate so you can write on it, and locate the saw on the station's top.

Mark the locations of the bolt holes, remove the drawer so you don't hit it with an errant drill bit, and bore holes for appropriately sized bolts. Secure the saw to the station with bolts, washers and nuts.

Making the Legs

Before attaching the two outfeed wings to the saw, you need to install their adjustable legs. Begin by ripping and jointing the housings (pieces 33) to size, then plow a 1/4" square groove in the inside face of each. The spacers (pieces 34) are just cut to length, then a 1/4" square tongue is milled on each of the long edges. Glue and clamp a pair of housings to each spacer and, when the glue is dry, attach a hinge base (piece 35) to each of these subassemblies. This is done with a biscuit, glue and a pair of pre-bored, countersunk 2" screws.

The legs (piece 36) begin life as a simple molding that is just a piece of stock ripped and jointed to size, with 1/4" removed from each long edge (see *Figure 5*). Crosscut them to length, then sand each so it slides freely in its housing.

To make the legs adjustable, each is slotted (see the *Exploded View Drawing*, page 62). Cut these slots on the router table with a 1/4" up-spiral bit, in several deepening passes.

On the drill press, bore a 1/4" hole through each housing about 3" up from the bottom. Slide each leg into its housing, put a lock washer and a flat washer on a bolt (piece 37 through 39), and slide the bolt through the hole in the housing subassembly. Thread it through the slot in the leg and out the other side, then slide on a flat washer, a lock washer and a wing nut (piece 40).

Wrapping Up with Dust Collection

If you have a mid-sized shop vacuum, it should fit nicely in this cabinet. Drill a 3" clearance hole in the saw station top for the vacuum hose.

Attach the wings to the cabinet with brass piano hinges. Then apply the finish of your choice. For the shop, we used a natural Danish oil finish that can easily be renewed as needed.

With that done, you're ready to start looking for a new project, preferably one that requires a whole lot of miter cuts!

Figure 4: After applying the laminate, trim it with a bearing-guided chamfer bit. Creating this 1/8" chamfer will eliminate sharp edges.

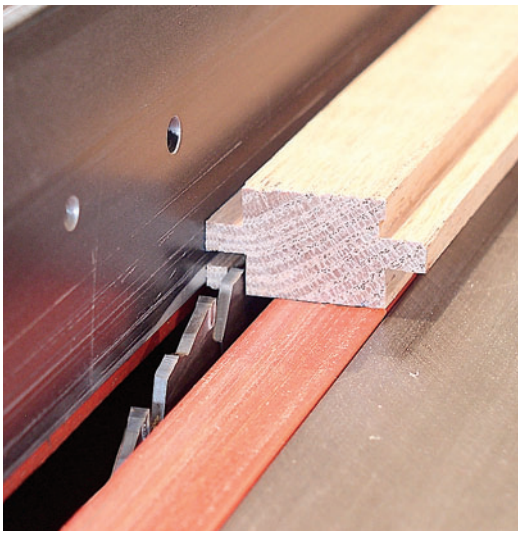
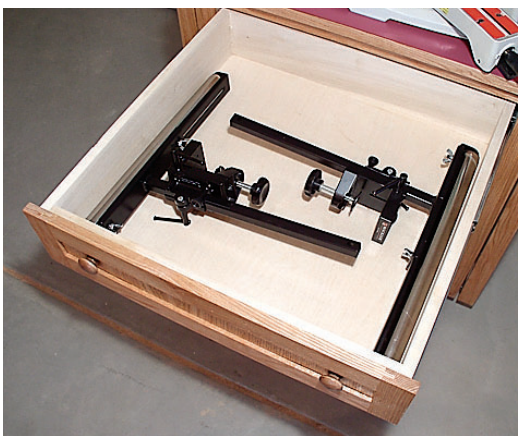


Figure 5: The two drop-down legs that support the outfeed tables are made from a simple molding milled on the table saw.



The portable rollers can be attached anywhere along the length of the wings and store in the drawer when you're done.

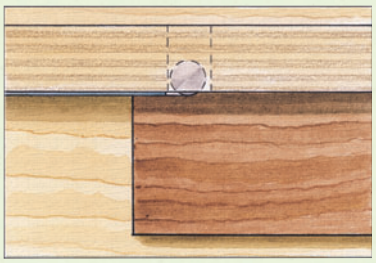
Jointing with a Router

Carol Reed creates a simple router jig that makes squaring up an edge a snap. When you're done, it stores quickly and easily on a wall.

Offset with Laminate

When you use a traditional jointer, the two beds of the tool offset to accommodate the depth of the cut you are making. On this jig, it is the fence that has the offset built into its design.

Create that offset using the thickness of the plastic laminate on the outfeed side of the fence. This same thickness determines the depth of cut.



Want a jointer in your shop? Most of us do, but not all of us have enough floor space or a big enough wallet. However, if you have a router of almost any size, you can make a jointing jig that in our opinion does some tasks better than a "real" jointer.

The secret is a spiral-flute router bit that, unlike the knives of most conventional jointers, produces tearout-free jointing on squirrely grained or bird's-eye figured wood (see page 71). Even if you do have a jointer but often work in these lovely but difficult-to-machine woods — especially in smaller dimensions — a router-jointer jig will consistently create a smoother surface. The router-jointer jig also allows you to joint clean plywood edges and other composite or even plastic materials, a task that can quickly dull the knives of a regular jointer, especially if the plys are bonded with a hard glue.

A conventional jointer will perform two operations: edge jointing and face jointing. Many of us only edge-joint because we buy our wood already surfaced (face jointed). This router jointer jig will yield smooth, accurate edges — safely, comfortably, and consistently — for the price of a long spiral bit and a few square feet of plywood. Obviously, this jig can't perform face jointing.

The setup has four components: a router, a spiral-flute bit, the table and the fence. Ideally, the router should have a 1/2" collet because larger-diameter bits run smoother and make cleaner cuts than smaller diameter bits, assuming that speed of bit rotation and feed rate are the same. However, since the amount of stock removed is so small, a junior version could be made using a router with a 1/4" collet. This limits the thickness of the wood to be jointed to stock less than 3/4", but if you are a box maker working in thinner woods, this may be just the ticket.

The bit of choice has spiral flutes. Because the cutting edge of the bit's flutes are in continuous contact with the wood and presented to the wood at an angle, it always produces a chatter-free, smooth edge. Just as in hand planing, presenting an angled cutting edge to wood fibers produces a cleaner edge. An additional benefit is that the bit runs cooler, thereby staying sharp longer.

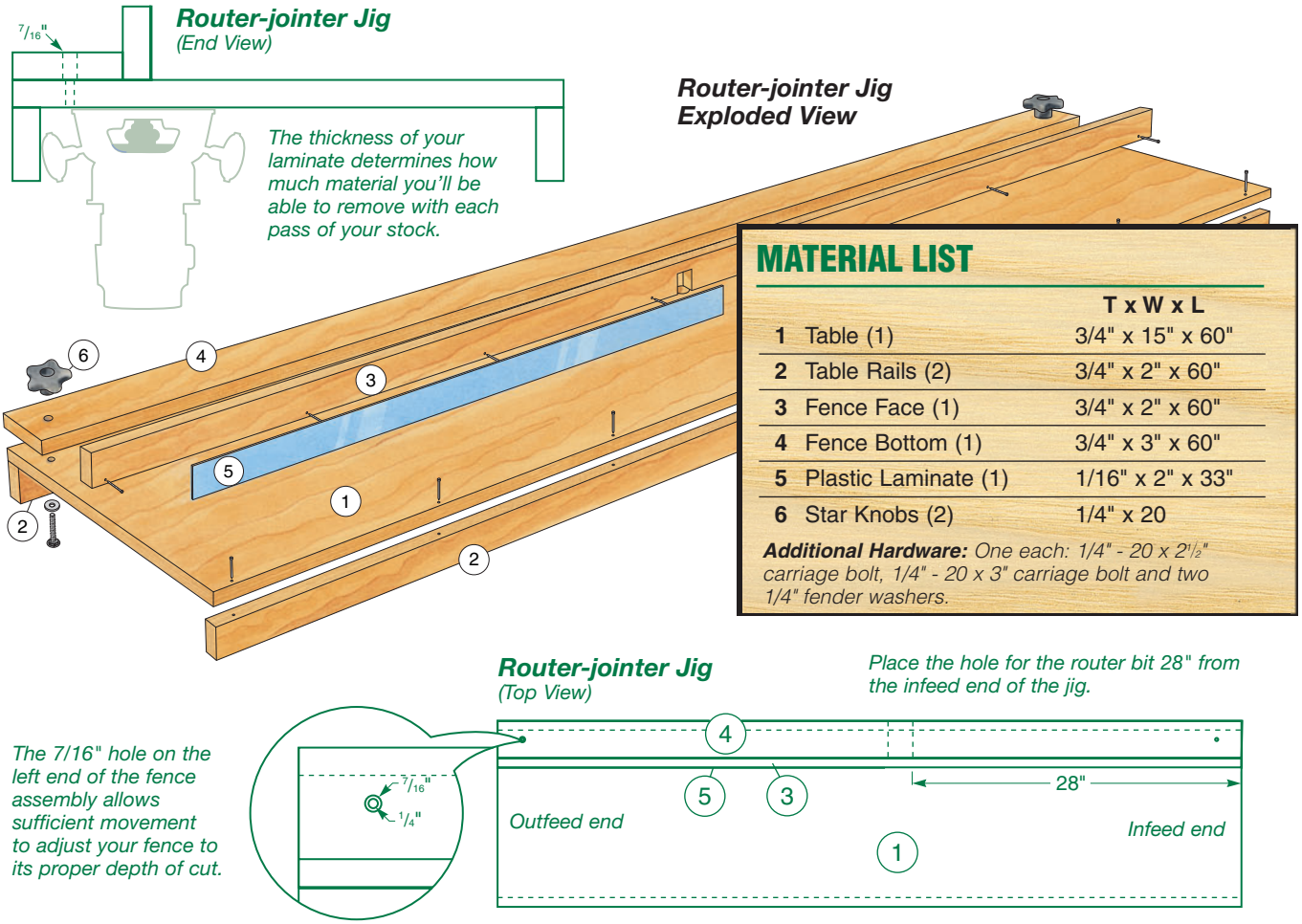
Spiral-flute router bits, now widely used in woodworking, were inspired by end mills, long used by machinists for metal-working. The router bits come in three configurations: upcut, downcut and compression. They are available from many woodworking supply stores and web sites. Carol opts for an end mill because she uses the same bit for mortising operations, but an upcut router bit would work just fine. Either way, a 3½"-long, 1/2" diameter, two-flute bit is more than adequate for most edge jointing.

Mark the router base mounting holes by clamping the sub-base in the desired location and tapping the properly sized transfer punch with a small hammer. This impresses a small dimple in the exact center of the hole. Countersink the hole in the top table surface.

The jig's table and fence are made so they may be stored by hanging on the wall or shelved when not in use.

An examination of a dedicated jointer's construction shows two flat surfaces — a split table and a fence — perpendicular to one another. It's true that a jointer's fence can be tilted, but since it is most commonly used with the fence at 90°, our router-jointing jig will be constructed to produce only 90° edges. The dedicated jointer has an infeed table and an outfeed table, separated by a cutterhead that rotates in a horizontal plane. The knives are set so they are exactly level with the outfeed table at the top of the cutting circle. The depth of cut is variable and is determined by adjusting the infeed table up or down.

The router-jointer may be seen as a modified jointer stood on its side. Its fence serves as the infeed and outfeed surfaces, and the bit rotates in a vertical plane. In the case of our jig, the depth of cut is fixed. The beauty of this configuration is that wood to be edge jointed is moved past the cutter with its wide side face down on the table. This



presentation is much more comfortable and controlled than standing the wood on its edge and moving it past the cutter supported only on its edge.

To create infeed and outfeed surfaces on the one-piece continuous fence, glue a piece of high-pressure plastic laminate to the outfeed side. You can find it at any home center. The thickness of the laminate determines the depth of cut. Typical countertop laminate is around 1/32" to 1/16" thick. This shallow cut removes just a small amount of stock, which is perfect for twisted or wild-grained woods.

The router is mounted on the horizontal surface, or the table, presenting the bit vertically. The upcut spiral bit or end mill exerts downward force, and actually helps to "hold" the work firmly on the table. This may sound contrary to common sense, but with the router mounted under the table, it is essentially upside-down, so an up-spiral bit or right-hand twist end mill is the proper cutter. Do not use a downcut spiral bit. It would work against you and might lift the wood off the surface of the table.

The typical length of a small conventional jointer is 48", with the knives in the middle of the table. That presents about 24" on either side of the cutterhead. Longer infeed and outfeed surfaces are better, because they provide more workpiece support. Depending on the material used to construct this jig, you can make the infeed and outfeed surfaces as long as you wish.

We opted for a 5'-long jig with the router positioned 28" from the infeed end. For the fence material, 3/4" Baltic birch plywood (which comes in 5'-square sheets) is an ideal jig-making material. It's a high-quality lay-up, with more plys per unit of thickness than standard plywood, and it has no voids. It's also much lighter than MDF or melamine. Since this jig is intended to be stored when not in use, weight is an important consideration.

Making the Jig

Downward force on the table and sideways force on the fence is exerted when jointing, so the jig must be firmly secured while in use, to effectively oppose those forces. If the most stable item in your shop is the bench, simply clamp one end to the bench and the other end to a shop stand. For purposes of photography, we used a pair of sawhorses instead of a bench and a stand. This works well, but it may be a little low for your back. Choose the place to use your router-jointer based on a flat, sturdy surface that allows the router-jointer to be securely clamped and at a height that is comfortable for you. Remember that the router hangs down from the bottom of the table, so the jig cannot simply rest on your bench or support surface.

There are two parts to make: the table and the fence. The width of the table is determined by the amount of desired work surface, plus the diameter of the router base and the

overhang for the clamping system. Eight inches of work space is adequate. Add this to the diameter of your router base to come up with an overall width for the table (Carol's setup came to 15").

Rip the table to width and then measure 28" from the right end and in from back edge the same measurement as the radius of your router base to locate the router bit hole. Mark and drill the holes to mount the router base at the location of the router bit hole. Mount it so the router's motor tightening system on the base is facing the front. Drill a 1/2" hole for the router bit, and chamfer both sides of the hole to keep workpieces from splintering the plywood around the bit hole.

Now rip the two rails to exactly 2". Make the cuts dead straight or the router-jointer jig will be twisted when you clamp it down, and you won't be able to edge-joint at 90°.

Attach the rails to the bottom of the table with glue and brads. Be sure to countersink the brads so they can't mar the wood being jointed. Use a block plane to slightly chamfer all the edges to make the jig "splinter-free."

The author checks out a tight, clean joint machined on her router-jointer jig. No muss, no fuss.

Rip the fence bottom and fence face. Mark the router bit recess at 28" from the right end and 1⅛" up from the bottom edge. Drill a 5/8" hole. Mark two lines tangent to the hole and perpendicular to the bottom edge. Carefully saw along the lines creating the U-shaped bit recess. Sand the sharp edges smooth.

Drill a 1/4" hole 2" in from the right end of the fence bottom and a 7/16" hole 2" in from the left end (for making fence adjustments). See the *Drawing* on the left page for more details.

Applying Laminate

Glue the fence face to the fence bottom. Use brads to hold the two pieces while the glue dries. Again, be sure to countersink the brads. Glue a piece of high-pressure laminate to the outfeed surface, extending from the bit recess to the end. Contact cement is a good choice for adhesive here. Flush-trim the laminate so no edges extend beyond the fence edges. Freshly cut laminate can slice your fingers, so file the edges smooth to ease any sharp corners. Place the fence on the table in its proper position and use a pencil to mark the spots where you'll drill 1/4" holes for installing the carriage bolts.

Using the Jig

Fasten the router base to the bottom of the table. Install the cutter in the router. Raise the cutter to extend above the thickness of the wood you'll be jointing. Flip the table over and clamp it down. Now turn the bit until a flute is presented to the widest cutter arc. Tighten the fence's right knob, then rotate the fence forward so the bit is fully contained inside the recess. Place a straightedge firmly against the outfeed surface and carefully rotate the fence until the emerging bit just touches the straightedge. Tighten the left knob to lock the fence into final position. Because this setup guarantees that the cut equals the thickness of the laminate, the edge of the workpiece will be fully supported by the fence during the entire cut as it passes from the infeed surface to the outfeed surface, and the edge will be straight.

With the router on (use eye and ear protection), place the wood face-down on the table and move the wood from the right to the left against the fence. At the start of the cut, hold the wood firmly against the infeed surface, gradually shifting pressure to the outfeed surface as the cut progresses. Repeat the operation until the edge is completely jointed. Try a test cut for straightness, and check for square as well. Squareness is not usually a problem because it depends on the router base and its relationship to the bit. If it is a problem, check that the base is firmly attached to the table bottom. One other point: if the face of your stock is not flat or is out of winding, your edge will be out of square … it is always best to check, just to be sure.

Spiral-Flute Bits

Spiral-flute carbide router bits produce superior cuts in a wide range of materials because their cutting edges are in continuous contact with the workpiece, slicing through the wood fibers at a shearing angle. In contrast, the cutting edge of a straight-flute bit contacts the workpiece intermittently and cuts into the entire width of the workpiece at a right angle. If the depth of cut and feed rate remain the same, more flutes will produce a better cut. That's why many woodworkers use end mills, a type of spiral-flute bit popular with machinists. They are commonly available with four flutes and longer flute lengths.

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Veneering Wide Panels

Veneering wide panels is easy with a simple shop-made press. All you need are some scraps of oak, a few sheets of kraft paper and ordinary particleboard.

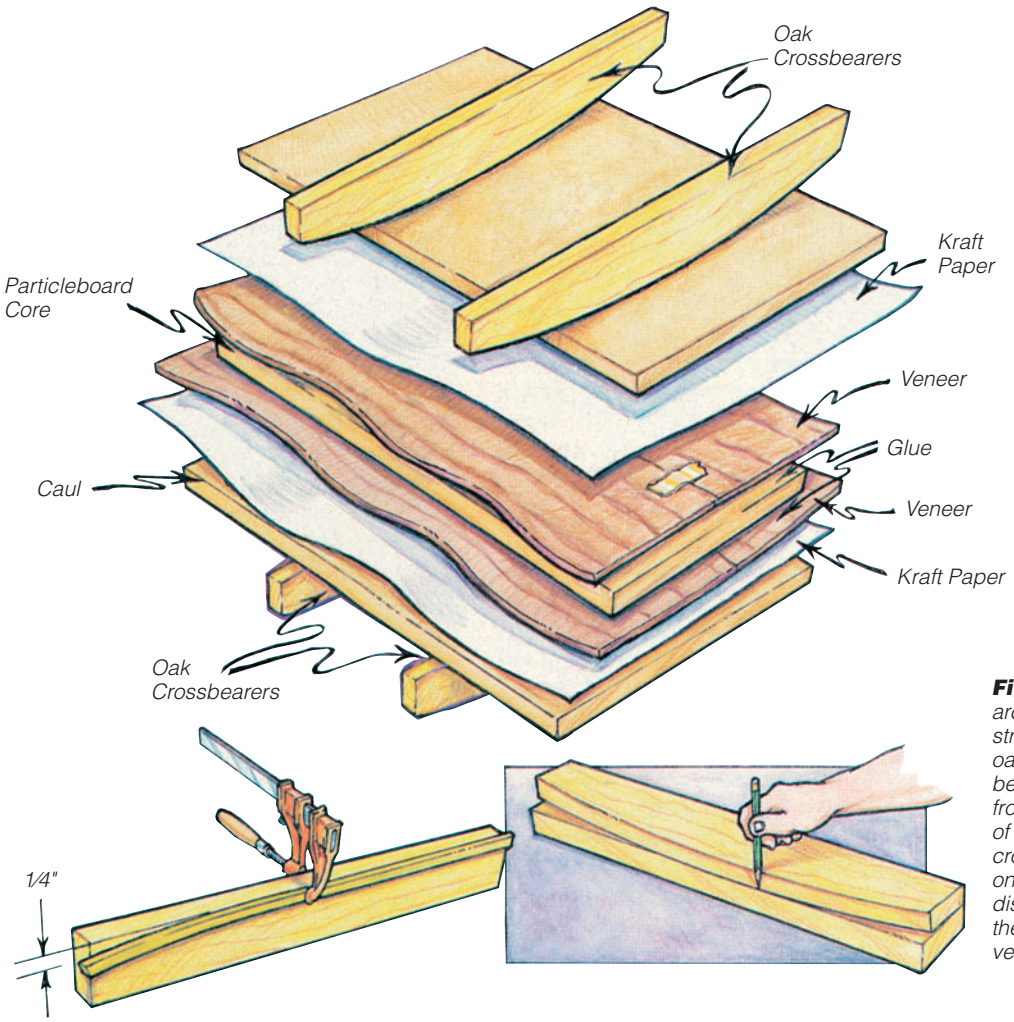


Figure 1: *To form the arc, clamp a thin wood strip to the center of an oak crossbearer and bend the strip so it is 1/4" from the edge at the ends of the board. When the crossbearers are clamped onto the cauls they distribute pressure over the entire width of the veneer evenly.*

Most woodworkers who start experimenting with veneer quickly face a dilemma. They need to cover a surface wider than the capacities of their clamps but they don't want to purchase a costly veneer press. Don't fret; try caul veneering. It's cheap, easy, effective and adaptable to most of the situations you'll come across.

Caul veneering is a simple idea consisting of two easy-to-make wood devices known as cauls and crossbearers. Cauls are pieces of 3/4" particleboard cut slightly larger than the core that's being veneered. Crossbearers are long pieces of hardwood with a slight arc cut on one side. When used together these devices transfer clamping pressure to the center of the core, across the veneer, and then out to the edges (see *Figure 1*). This technique eliminates the chance of trapping glue pockets between the veneer and its core.

Preparing the Veneer and Core

The first step in veneering is to splice and join your veneer sheets together and cut the particleboard core to its finished dimensions.

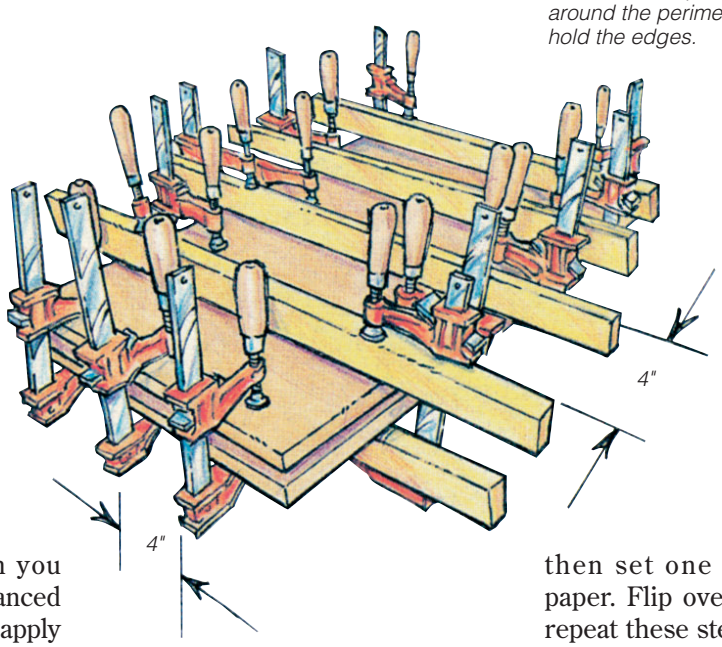


Figure 2: *Clamp the crossbearers at 4" intervals and space additional clamps around the perimeter of the assembly to hold the edges.*

Always remember that when you veneer you need to create balanced panels. This means you must apply veneer to both sides of the core, keeping the grain running in the same direction so the finished panel won't warp.

Forming Cauls and Crossbearers

After much experimentation, we've come to the conclusion that oak makes the best crossbearers. Cut your crossbearers 1½" thick, 2½" wide and 36" long (or longer if you anticipate the need to clamp wider veneer). The number of crossbearers needed depends on the length of your veneer. You'll need a set of two crossbearers at each clamping position and enough to space the sets at 4" intervals along the length of the veneer.

Cutting uniform arcs on the crossbearers is critical so they distribute pressure across the width of the veneer evenly. Draw the large radius of the arc by tracing along a thin flexible strip of wood clamped at the center of the crossbearer and held back 1/4" from the edge at both ends, as shown in *Figure 1*. Cut away the waste and sand the sawn edge smooth. Use this finished crossbearer as a template for cutting out one more crossbearer. Clamp these two crossbearers together at the ends with their arched edges facing each other. Look at the joint between the crossbearers to see that there are no gaps and that pressure is being applied over their entire length. Make any necessary adjustments, then use these first two pieces as templates for laying out the arcs on the rest of your crossbearers. Cut out the remaining crossbearers and sand them to match in pairs.

The two cauls are cut from 3/4"-thick particleboard and are made 1" wider and 1" longer than the core being veneered.

Gluing the Veneer to its Core

When faced with clamping large sheets of veneer, use a slow-setting glue such as white glue to give you more assembly time. On smaller areas you can also use yellow glue for its fast-drying qualities. Have everything ready before you begin, including tools, glue, newspaper, clamps, cauls and crossbearers. An extra set of hands also helps for larger veneering tasks.

Pour glue onto one side of the core and on one sheet of veneer, and use a 3" or wider paint roller to spread the glue evenly. Position the glued veneer on the core so there is an equal amount overhanging all the edges. Place a piece of kraft paper on the face of the veneer, then set one caul on top of the paper. Flip over this assembly and repeat these steps to glue veneer to the other side of the core. Remember to match the grain direction on both sides of the panel.

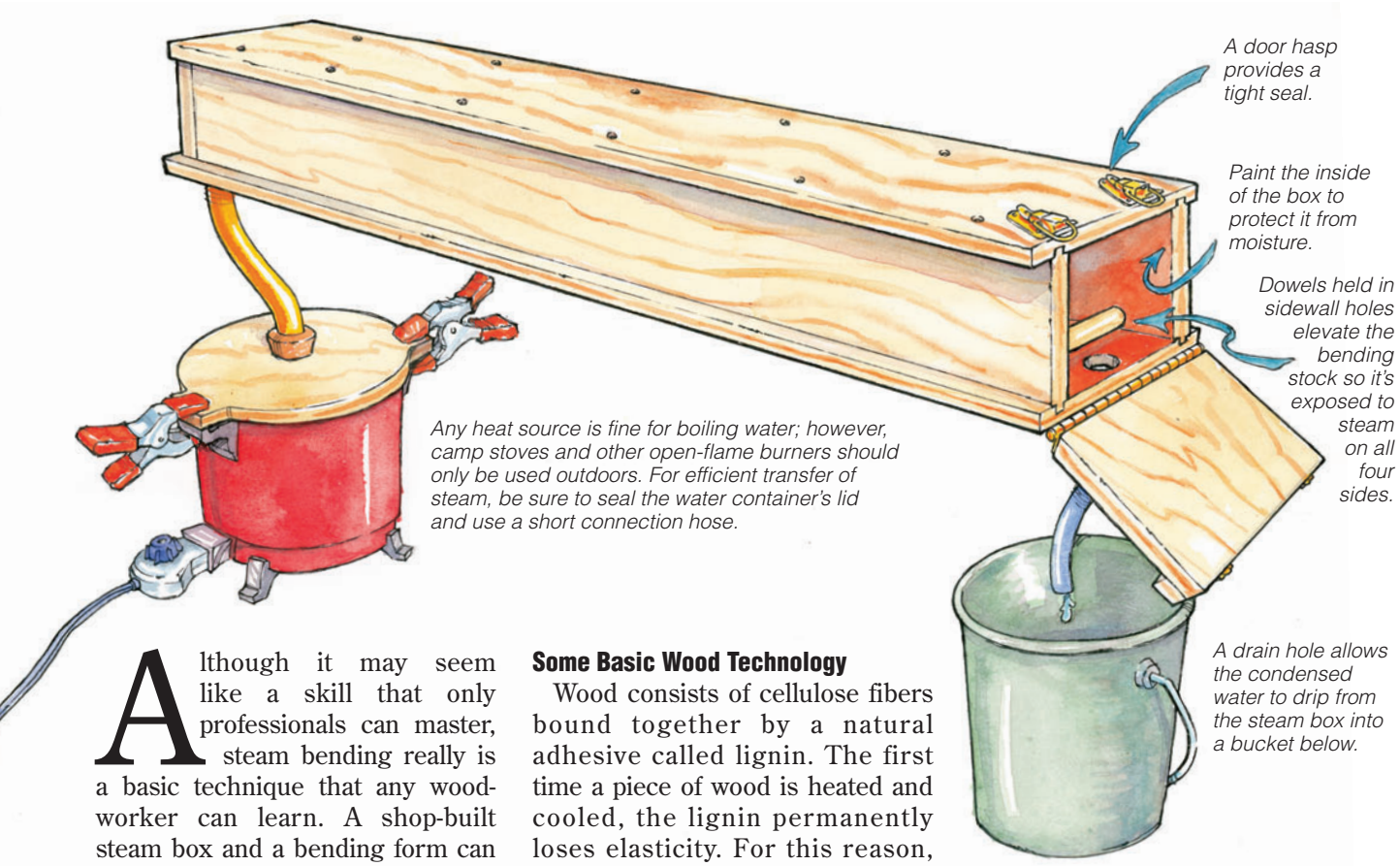
Clamp a set of crossbearers across the middle of the cauls and apply clamping pressure until the crossbearer ends touch the cauls on both sides. Check to see that the veneer sheets haven't slipped out of position. Working toward the ends of the veneer, clamp on the remaining crossbearers at 4" intervals. Place additional clamps between the sets of crossbearers near the edges of the cauls and use more clamps across the ends of the cauls at 4" intervals (see *Figure 2*).

Look at the joint between the veneer and the core to see if glue is oozing out its entire length. If there are dry spots, that probably means there's not enough clamping pressure, so add a few more clamps and turn the cranks a little further to bear down on the crossbearers.

After allowing the glue to cure overnight, remove the clamps, crossbearers and cauls. Next, peel away the kraft paper, trim off the overhanging veneer edges and sand the faces of the veneer smooth. Now you're ready to use your veneered panel for whatever project you've planned.

Steam Bending Basics

With a steam box, a bending form and the right technique, you'll be on your way to creating curved shapes. Here's how.



Although it may seem like a skill that only professionals can master, steam bending really is a basic technique that any woodworker can learn. A shop-built steam box and a bending form can be made from common materials.

Steam-bent wood is generally strong since its grain follows the length of the curve. By comparison, curved components cut from solid planks tend to contain weak sections of short grain (see *Figure 1,* below). Avoid lumber with severe grain runout, however, as it will usually crack.

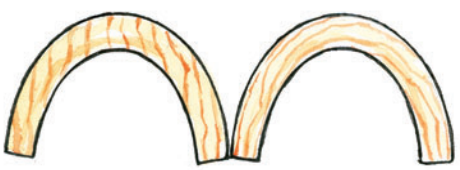


Figure 1: *A curve bandsawn from solid wood (left) usually has significant grain runout, which weakens the piece. The grain lines on a steam-bent piece (right), on the other hand, are continuous, making it the stronger alternative.*

Some Basic Wood Technology

Wood consists of cellulose fibers bound together by a natural adhesive called lignin. The first time a piece of wood is heated and cooled, the lignin permanently loses elasticity. For this reason, kiln-dried wood, which has already lost much of its pliability in the kiln, is not your best choice for steam bending. Air-dried wood is the ticket: when it's steamed and bent, the lignin helps lock the new curve in place.

Wood subjected to steam in an enclosed container heats up and absorbs moisture, dramatically increasing the flexibility of its fibers. When it reaches sufficient pliability, the wood should be rapidly bent onto a sturdy form. After cooling and drying the wood will retain its new shape, although varying degrees of springback can occur, depending on the character of the wood, the amount of steaming and the rapidity with which the hot wood was bent to the form.

Some species of wood lend themselves to bending more readily than others. For example, white oak, red oak and hackberry are particularly good, while mahogany and hard maple are unsuitable. Select straight-grained pieces to reduce the likelihood of fracturing.

Building a Steam Box

Making your own steam box is easy, as shown in the illustration above. For most bending needs, an exterior dimension of about 7" x 7" x 60" will do nicely. Follow these additional guidelines:

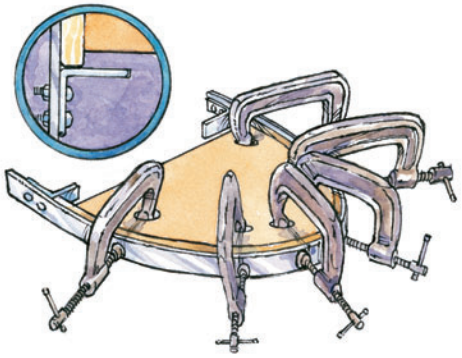


Figure 2: *Make a banding strap using metal between 1/16" and 3/32" thick, and bolt angle irons to its ends so the steamed wood fits tightly between them.*

- Use exterior-grade plywood for the box since its waterproof glue won't degrade from the steam.
- Paint the box's interior to protect it.
- Space a line of dowels across the box's width to elevate the wood above the condensation runoff and to promote the flow of steam.
- Seal one end of the box, and hinge the other end for easy access.
- Drill a small hole through the bottom at one end to drain condensed steam.
- Drill a second hole, at the other end, for the steam hose entrance.

The heat source for your steamer can be an electric burner, a wood fire, a camp stove or whatever you have that will boil water. For safety's sake, remember to use your equipment outside if it generates a flame or has exposed hot coils.

The water container should hold several gallons and have an access hole small enough to be plugged with a large cork or rubber stopper. If the container is made of iron, make sure it's galvanized or enameled, otherwise the steam will probably stain your wood. By drilling a hole through the stopper you can hold the connecting hose in place. The hose should be made of rubber, plastic or copper of at least 1/2" in interior diameter. Thin-walled plastic tubing is not recommended as it collapses when the steam runs through. In use, be sure to set the steam box at a slight incline so condensation flows out the drip hole.

Steaming Your Wood

The first step in steaming your wood is to fire up the burner and boil the water. Once steam begins filling the chamber, put the wood in the box and close the lid. Steam the wood until it's pliable, then, wearing gloves for protection, remove the hot wood and rapidly bend it to the form.

How long should wood be steamed? There is no precise answer, so it's a good idea to include a couple of test pieces in the box for experimentation. Species, moisture content, and the intensity of the steam environment are all factors. Here are three rules of thumb for steaming air-dried lumber:

- Keep wood with a moisture content below 20% in the steam box for about an hour and a quarter per inch of thickness.
- Steam wood with 20-30% moisture content for 45 minutes per inch of thickness.
- Wood with a moisture content in excess of 30% needs only about 1/2 hour of steaming per inch of thickness.

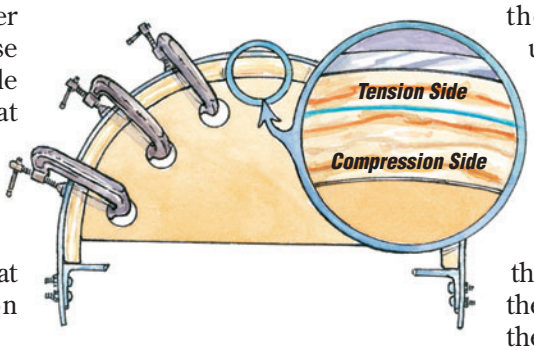


Figure 3: *A banding strap is often used to force the entire piece of wood into compression, decreasing the possibility of a split on the tension side of the bend.*

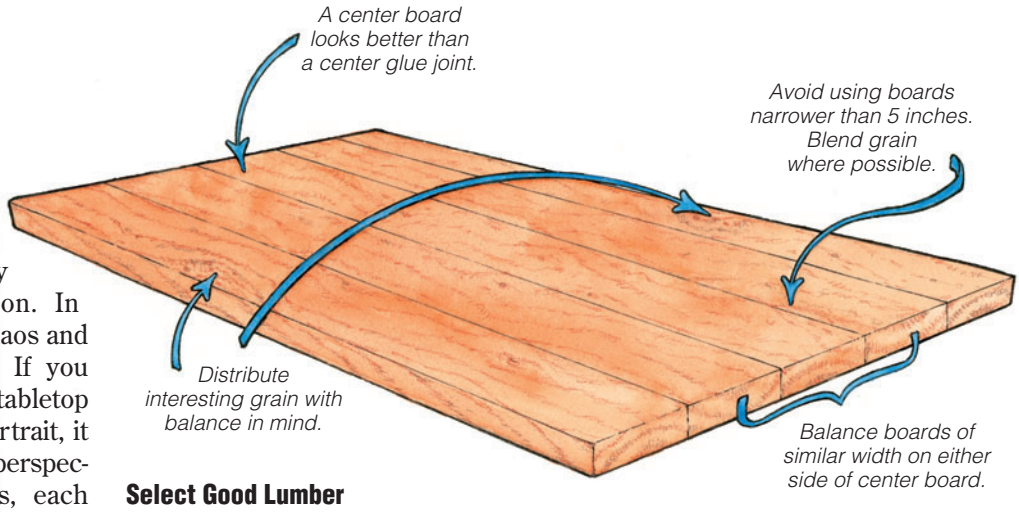
When pulling hot wood from the box, work rapidly to place it in the bending form. The wood begins to cool instantly, and it's amazing how quickly flexibility diminishes. If possible, leave the wood clamped in the form for several days.

There are a variety of designs for bending forms. The most common is a one piece form, usually built with layers of plywood, to which the steamed wood is clamped (see *Figure 2*). Another type of form consists of two mating parts between which the work is sandwiched. Since steamed wood almost always has some springback, cut the form to a slightly more severe bend than you want to end up with. However, springback is unpredictable, so until actual test bends are made, the exact amount of over-bend required is anyone's guess.

When you bend a piece of wood, an imaginary line up the center stays constant in length (see *Figure 3*), while the outside of the curve gets longer (tension) and the inside becomes shorter (compression). Wood is fairly good at compressing, but splits apart readily under tension. It's the tension factor that limits the degree of curvature in a simple bend. Many woodworkers reduce the chance of splitting on the tension side of the wood by using a bending strap — a flexible steel strap about 1/16" thick and as wide as the bending stock, with end stops spaced to enclose the exact length of the workpiece. As soon as the wood is pulled from the steam box, the strap is fitted to the tension side of the stock. With the outside curve unable to expand, the entire piece of wood is forced into compression, minimizing the chance of splitting.

Guidelines for Making a Tabletop

Avoid the pitfalls that can happen with large panel glue-ups by following these tried-and-true tips.



Putting together a tabletop is a lot like taking a family picture at a reunion. In both cases you start with chaos and end up with an heirloom. If you think of the boards in your tabletop as individuals in a family portrait, it might help put the task in perspective. Like family members, each board has a unique personality. Your job is to organize them to look their best. Then, just like clicking the camera shutter, you freeze the boards for eternity in a glue-up — you don't want to live with a hasty arrangement.

A successful tabletop has two qualities: it must be pleasing to look at and it must remain stable. Accomplishing this requires an artistic eye and good craftsmanship. Here are some guidelines for selecting and arranging boards in a tabletop. These rules aren't written in stone, but at the very least you'll become familiar with all the aspects of the challenge.

It's also important to mention that not all boards belong in a tabletop. In a stack of lumber, each board has characteristics that make it suitable for different uses in a project. Woodworkers must learn to be harsh board critics for successful tabletop work.

Select Good Lumber

This is the one rule you shouldn't bend. Choose boards that are likely to remain flat and straight. Look at the ring pattern at the end of a board. The more the grain lines curve, the greater the likelihood the board will cup. Wide boards are often tempting to use, but be careful: rip them in half or thirds if they come from too near the center of the tree, and separate them in the panel arrangement. Predicting wood movement is fundamental to making a successful tabletop.

Use Boards with Interesting Grain

Perfectly symmetrical or straight grain can be monotonous. Small knots, color streaks, squirrely grain and other defects can be pleasing to look at if distributed evenly throughout a top. The top should not look like bookmatched plywood. Avoid using widely spreading grain patterns at the end of a board. Don't cut or join boards too near a knot or crotch.

Plan Ahead

Unless you're working on a pretty small table, don't use boards narrower than 5". These tend to make a top look like it's been chopped into little pieces.

Plane Carefully

Plane each surface of a board the same amount. Stop planing when your boards are 1/8" too thick, then stack the boards with stickers so all sides are equally exposed to the air. After three days, see if they remain true.

Rip for Effect

Choose boards with similar widths, keeping the differences under two inches. A top is less interesting when all the boards are exactly the same size, but widely varying board sizes are distracting. Balance similarly wide boards on either side of the center board to build up a symmetrical pattern.

Odd is Better than Even

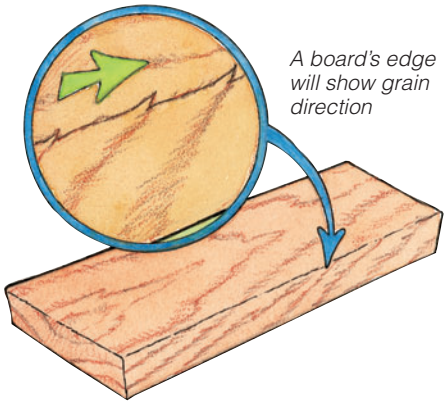
Always use an odd number of boards. The eye is usually drawn to the center of a panel, and a center board looks better than seeing a glue joint here instead.

Create a Composition

Arrange interesting areas in a balanced, random pattern. Don't cluster knots or swirly grain at one end of the tabletop or in the middle. Consider disguising transitions from board to board by placing similar grain patterns together.

Arrange for Effect

Frame a top with straight-grained boards along both outside edges. Run-out grain at an edge carries the eye with it.



Color can be a Surprise

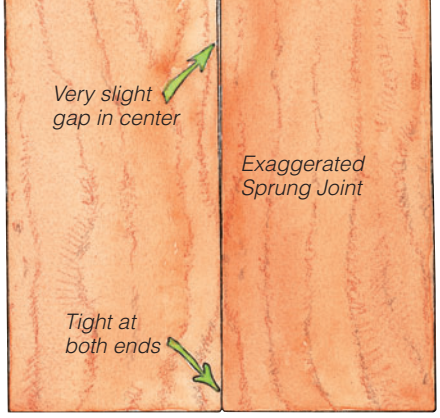
Check for color differences. Neighboring boards shouldn't be dramatically different in color. Wet boards with water, alcohol or mineral spirits to get an idea of their finished appearance. Think twice before using sapwood or other distinctly different features.

Make Planing Easier

Try to line up all the boards so the edge grain runs the same way. If you're successful, you'll avoid tearing out the wood when planing the top by hand.

Give it a Rest

This is important. Walk away from your best arrangement for a day or two, then come back later to have a fresh look. See if it's still pleasing to the eye.



Keep Joints Simple

For a tabletop, butt joints are fine. Biscuits, dowels or splines will help align a top, but they will not make a well-fitted joint much stronger.

Joint with a Purpose

Long joints should be sprung. This means that the edge will be planed or jointed in a slightly hollow manner. Two sprung boards will touch at their ends but have a minute gap in the middle. Since boards lose moisture from their ends faster than out their sides, unsprung joints can separate at the ends over time. Check for tight joints before you glue.

Know Your Limits

Don't try to glue up too much at once. Thick, unsightly glue lines result when there is too much open time. Consider gluing the top in halves. Be sure to apply glue completely to all edges about to be joined.

The Last Rule

Draw a zigzag line down the length of each joint, then plane the panel by hand. When all the lines are removed the joints should be flush. Holding a light at a low angle will reveal any defects.

End Grain Debate

Like so many other things in life, woodworking is not always cut and dried. One controversy that divides many woodworkers has to do with orienting the end grain patterns in a panel made up of several boards, such as in a tabletop.

All of us know that wood moves with changes in seasonal moisture. Along with the expansion and contraction of the wood often comes some warping, which usually shows as a slight cupping of a board. The challenge for woodworkers is planning for this tendency of the wood to cup so a panel will remain as flat as possible.

The adherents to the first school of thought might be called the "ripplers." These woodworkers alternate the end grain pattern of every board so half the boards have their bark side facing up and half have their pith side facing up. Typically, a board cups toward its bark side. In this panel configuration, as every board warps slightly, each one in the opposite direction from the one next to it, the panel looks like a series of ripples and the overall effect is minimal. Holding the panel with tabletop fasteners or breadboard ends will limit the distortion, but not eliminate it.

The "big wave" proponents orient all their boards with the end grain repeating in the same direction. As the boards cup in this panel, the whole piece will distort into a uniform bowl shape, which can be controlled with just a few fasteners. The panel then feels smooth even if it's not perfectly flat.

Both theories are right, but neither is foolproof. It's probably a sign that no matter how hard we try, we can't control everything.

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