

**SECRETS FOR  
Router Table Success**

**WEEKEND WORKSHOP  
Handy Shop Stool**



# ShopNotes®

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Vol. 22 Issue 131

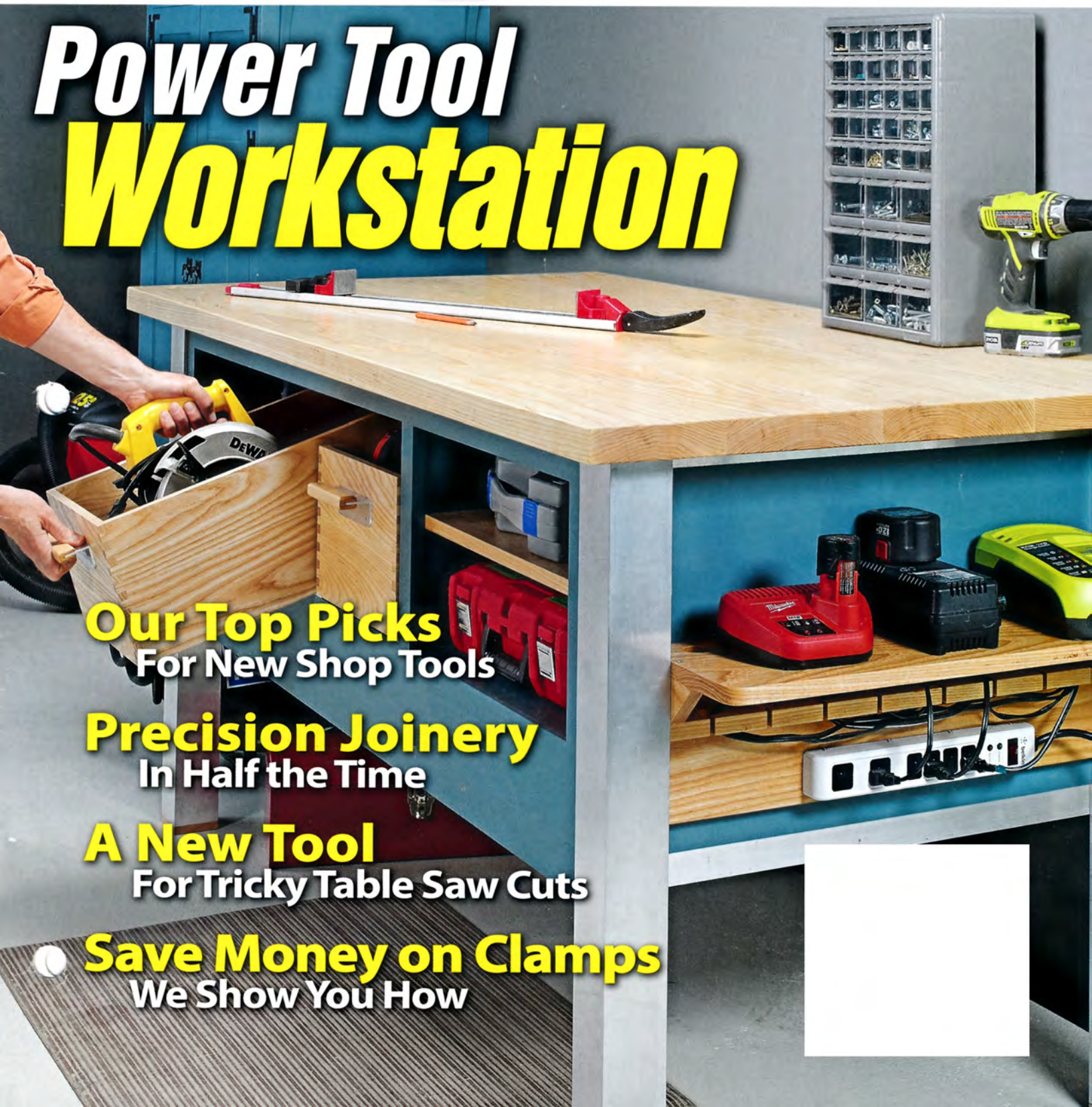
## ***Power Tool Workstation***

**Our Top Picks**  
For New Shop Tools

**Precision Joinery**  
In Half the Time

**A New Tool**  
For Tricky Table Saw Cuts

● **Save Money on Clamps**  
We Show You How



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One of the main reasons I enjoy woodworking is because it gives me the opportunity to escape from it all — in a manner of speaking. I can head to the shop and leave the high-tech world behind.

Don't get me wrong, I love my computer, smartphone, and other bits of technology as much as the next guy. And honestly, one reason today's tools are so good is because of improved technology. I don't know too many woodworkers who would want to give up their computer-designed and manufactured saw blades and router bits. These days, it's getting easier to bring high-tech manufacturing equipment into the shop. And by that I mean CNC woodworking.

CNC, or Computer Numerically Controlled, woodworking uses a computer and a router to create parts in a wide range of materials. It's amazingly accurate and it's just another way to add to your woodworking skills. To learn all about the essentials of CNC and how to put it to use in your shop, check out the article that starts on page 38. Let me know what you think about CNC woodworking in general and if you'd like us to include more articles on this topic in future issues.

This issue includes a lot of good, basic woodworking, as well. The shop stool (page 20) and power tool workbench (page 28) are great projects for any shop. I'm kind of partial to the cutoff bin on page 34. It's time for me to knock out one of my own to get my pile of scraps organized.

*Bryan*

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from our  
Readers

# Tips for Your Shop

## Rotary Tool Base

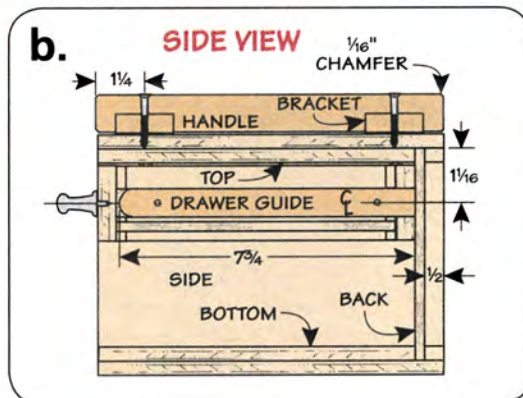
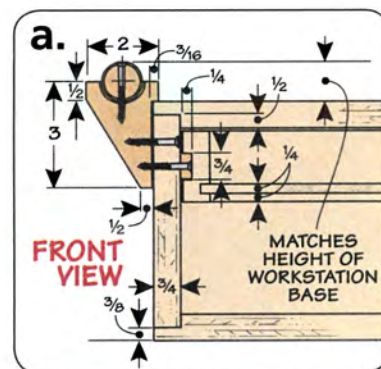
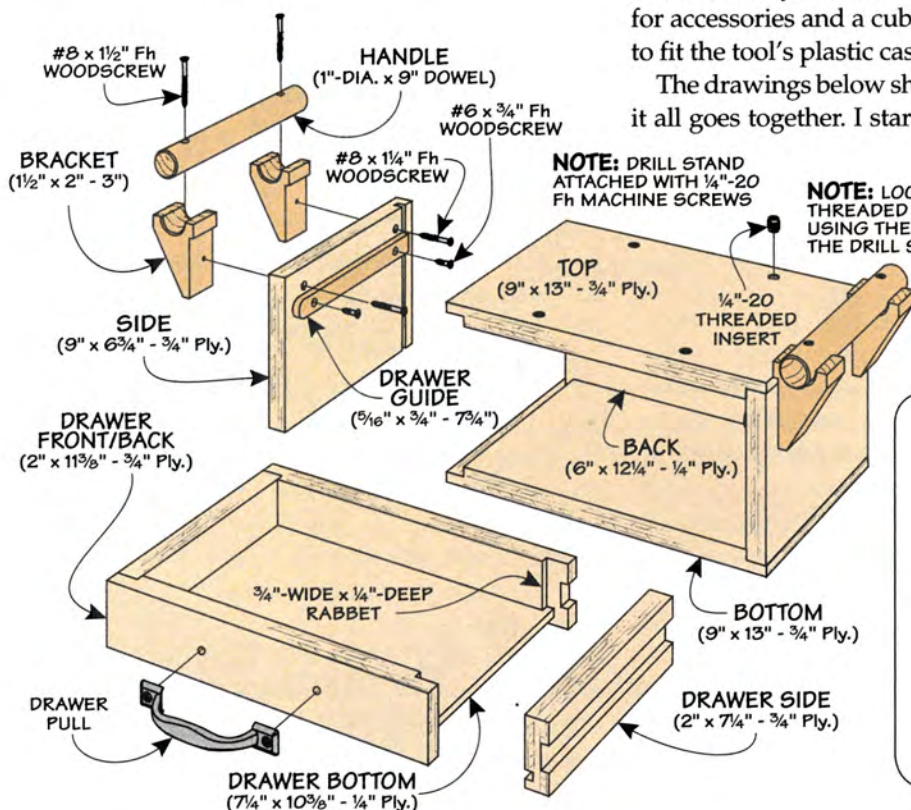
I purchased a drill stand accessory that converts my rotary tool to a drill press. It's a great system, but there are two problems — the base is rather small plus it lacks storage for all of the tool's accessories.

I designed the small cabinet above to address these issues. The top has two "outriggers" that support long workpieces and also act as handles for moving the cabinet to the benchtop. Underneath, you'll find a drawer for accessories and a cubby sized to fit the tool's plastic case.

The drawings below show how it all goes together. I started with

the basic box for the case. Then I added the drawer guides, drawer, and handles before attaching the drill stand to the top.

*Stephen Carroll  
Covington, Washington*



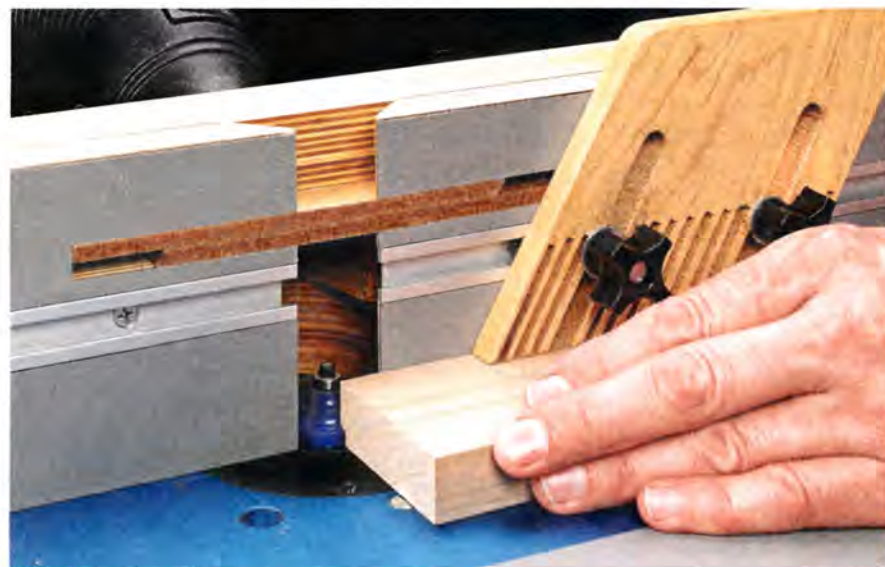
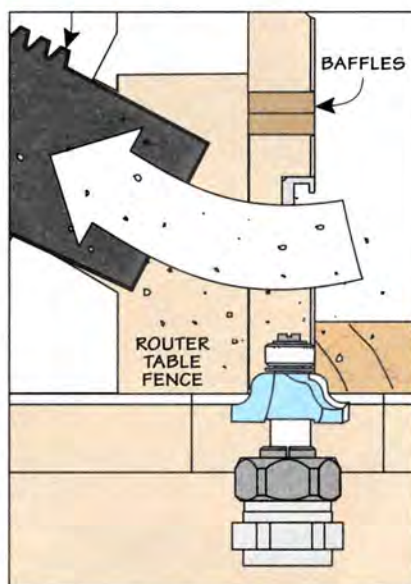
## Maximize Dust Collection

My router table has a split face on its fence. This makes it easy to adjust the opening to accommodate router bits of varying diameters. The problem is, dust collection is less effective due to the opening in the fence.

To get around this, I installed hardboard baffles. They overlap and slide past one another while reducing the opening in the router fence.

The process is simple. Cut a narrow slot in each half of the fence face. The width is sized for two thicknesses of hardboard. A bevel on one end of each strip helps realign the baffles if the two fence faces are ever pulled far apart.

*Donald Porter  
Merritt Island, Florida*



## Submit Your Tips Online!

If you have an original shop tip, we would like to consider publishing it. Go to

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**SUBMIT A TIP**

There, you'll be able to describe your tip in detail and upload photos or drawings. Or you can mail your tip to the editorial address shown in the right margin. We will pay up to \$200 if we publish your tip. And if your tip is selected as the top tip, you'll also receive the *Porter-Cable* compact router kit shown on the right.



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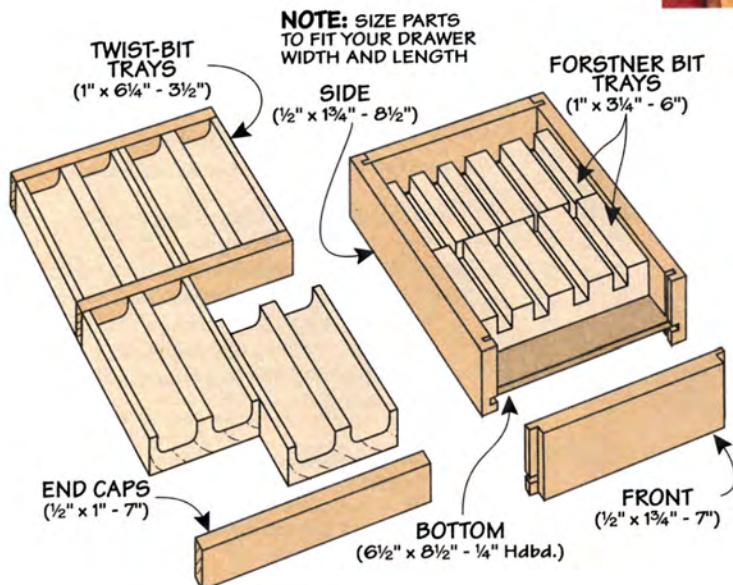
## Drill Bit Trays

After years of fumbling through a drawer looking for the right drill bit, I decided to devise a better solution. The result was the drawer inserts you see here.

The bits are organized neatly in trays with shallow slots to hold them in place. The two-level, sliding trays allow me to quickly access any bit I need.

The slots for the twist bits were made using a bowl bit at the router table. I used a dado blade to cut slots for the Forstner bits. Now my bits are always at the ready.

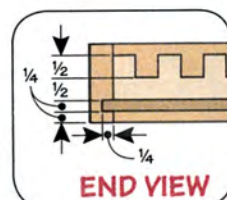
*Joe Murphy  
Springfield, Massachusetts*



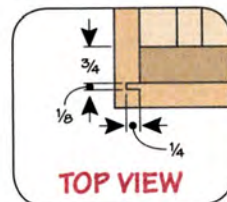
**NOTE:** SIZE PARTS TO FIT YOUR DRAWER WIDTH AND LENGTH

**FORSTNER BIT TRAYS**  
(1" x 3 1/4" - 6")

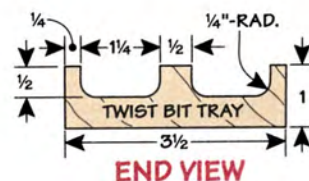
**NOTE:** ALL PARTS HARDWOOD EXCEPT BOTTOM



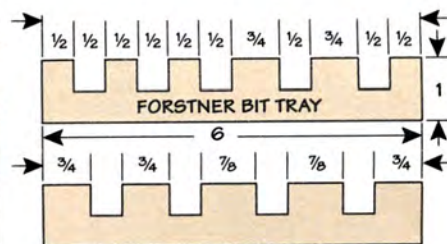
**END VIEW**



**TOP VIEW**



**END VIEW**



**END VIEW**

## Quick Tips



▲ **Roger Rayburn** of Colorado Springs, CO, found that dental picks are great for adding glue into a crack or split in wood. The picks are thinner than standard toothpicks and the small "feathers" on the pick hold more glue.



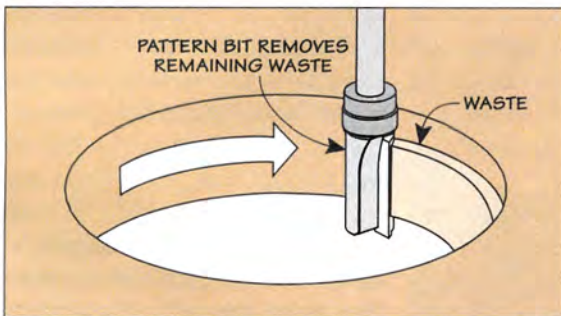
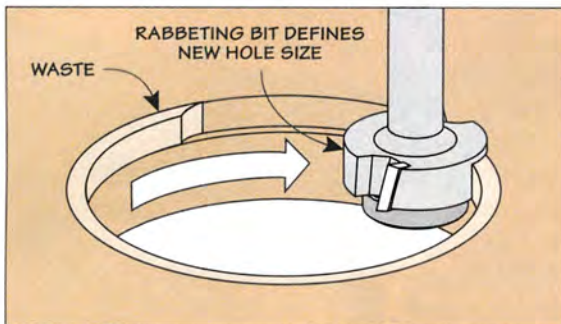
▲ When planing thin stock, **Cory Hoehn** of Jeffersonville, IN, uses a magazine as a shim. With just the right number of pages he can raise the top face of his workpiece so it clears the fence on his bench hook.

## Dado Blade Inserts

A zero-clearance insert is the key to a chip-free cut. This is simple enough when using a standard saw blade. But when it comes to a dado blade, it can be challenging. The various widths of different cutter and chipper combinations, plus the addition of shims, means you have to create multiple inserts.

Making the inserts isn't difficult, but trying to remember which insert to use can lead to mistakes. That's why I write the combination of cutters, chippers, and shims on each insert so I never have to guess again. It's a simple solution that works.

Jake Lee  
Amery, Wisconsin



## Enlarge a Hole

Like most woodworkers, I make the occasional mistake when working on a project. Some are easy enough to fix, while others are more difficult to address.

One of the challenges I encountered recently was to increase the size of a hole that was cut  $\frac{1}{4}$ " too small. The location of the hole had to be exact and I knew it would be difficult to accurately center the workpiece directly under a larger bit. To solve the problem I turned to my hand-held router and a pair of router bits.

I started with a rabbeting bit set to cut  $\frac{1}{8}$ " deep. The bottom edge of the hole was used to guide the bearing of the bit as I routed around the entire circumference of the hole.

Then I switched to a pattern bit. With the bearing of the bit held firmly against the newly cut rabbet, I was able to remove the rest of the waste from the hole (right drawings). The end result was a perfectly centered hole that's just the right size.

Tony Gallo  
Brampton, Ontario



▲ **Joe Kleban** of Baltimore, MD, keeps his open caulk tubes from drying out by using the protective tips designed to cover the cut ends of wire shelving.



▲ Mixing paint is an easy task says **Delbert Rogge** of Dalton Gardens, ID. Just chuck an eye bolt into a hand-held drill to create a power stir stick.

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## design secrets for **Top-Notch Router Tables**

■ Building a router table is a great way to upgrade your shop and get just the features you need. The result is a custom solution that typically costs less than a commercial router table. At its essence, a router table is nothing

more than a router attached to the underside of a rigid tabletop.

While it's easy to get carried away with the extras, it pays to think about that first detail — attaching the router to the table. Of course, the connection needs to be secure. But there are some other things to consider.

We've built a number of router tables over the years and used several different methods for attaching the router. Here's a rundown of the options and a short description of the benefits.



▲ **Direct Approach.** Long screws thread through the table into the router base. A hinged top makes access easier (right).



▲ **Toggle Clamps.** Release the clamps to switch to use the router hand-held routing tasks.

### DIRECT ATTACHMENT

The simplest way to attach a router is to mount the router base directly to the table. I used this setup on my first router table, and it works quite well. Besides being straightforward, you have a solid connection that limits vibration.

This setup is ideal if you have a router that includes a fixed base as well as a plunge base. You can attach the fixed base to the table and then use the plunge base for hand-held tasks. To switch operations, simply swap the motor from one base to the other.

All you need to do is transfer the locations of the holes in the router base to the table and drill shank holes. You may need to buy longer screws to pass through the top and thread into the base. (Take the base with you to make sure you get the right screws.)

There are a few drawbacks to this method that are worth

bringing up. First, a thick top reduces the effective range for using longer bits. In addition, you're typically limited to a single size clearance hole for the bit.

If you have only one router, installing and removing the base from the router table can be a hassle. Changing bits and adjusting the bit height may require a lot of bending and looking under the table (depending on your router). The inset photo on the bottom of the previous page shows a good solution for this problem.

### INSERT PLATE

The second method I want to talk about — using an insert plate — is similar to the first. The difference is the router base is secured to a thinner plate that's easy to pop out of the table for bit changes or other adjustments. Most commercial insert plates allow you to change the size of the bit opening to better match the size of the router bit, as well.

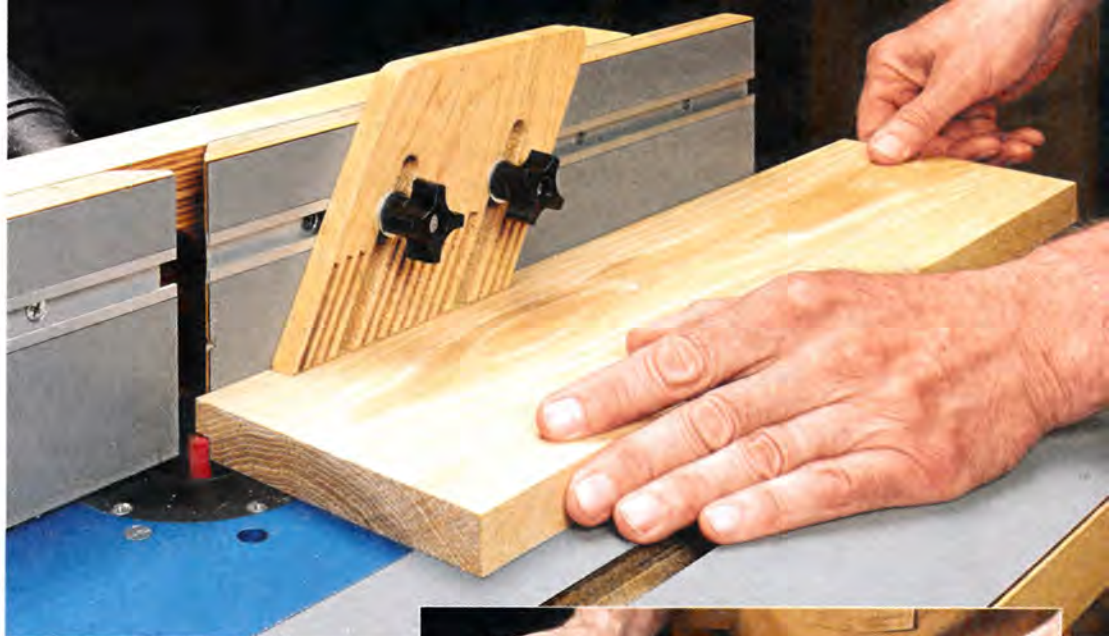
The insert plate can also be used as an oversized baseplate for hand-held routing. The plate increases stability and gives you the ability to span wide openings.

Insert plates aren't without challenges, however. You need to size the opening in the router table for a snug fit. If it's too loose, the plate can vibrate loudly during use. A plate that can shift will also lead to inaccurate cuts. Making such a large opening in a tabletop can create a weak spot, so you need to design the top with the opening in mind.

It's also important that the insert is perfectly level with the tabletop. Otherwise, the workpiece can catch on the edges. But it's a problem that can be fixed with shims or set screws.

### TOGGLE CLAMPS

There's another option that you may want to consider, and that's to use toggle clamps. You can see how it works in the inset photo on top of the facing page. A shallow pocket in the



▲ **Insert Plate.** Bolting the router to an insert plate provides ready access (right).

tabletop captures the router base. Three toggle clamps pin it in place. This arrangement is a big plus if you have just one router. You can quickly go from hand-held to table routing functions in seconds. I've used this setup for several years and it's really handy.

Like the direct attachment method, you are limited to a single clearance hole size. Another downside is that you need to



stoop down to fine-tune the height of the bit.

One of these methods is sure to work for you. And the right attachment system will make your router even more versatile. ▲

## table upgrade Router Lift

One router table accessory you may want to consider is an insert plate with an integrated router lift. The key benefit is the mechanized lift. This means you can adjust the bit height from above the table and even raise the motor high enough to change bits.

There are a few considerations before you take this route. First, it's not as convenient to switch from table to hand-held routing. Second, a lift adds weight, so your table design will need to take this into account.

Router lifts can be expensive. But the added precision and convenience may make it a worthy investment for your shop.



# JessEm Pocket Mortise Mill

Fast and accurate mortises are easier than you think with this easy-to-use shop accessory.

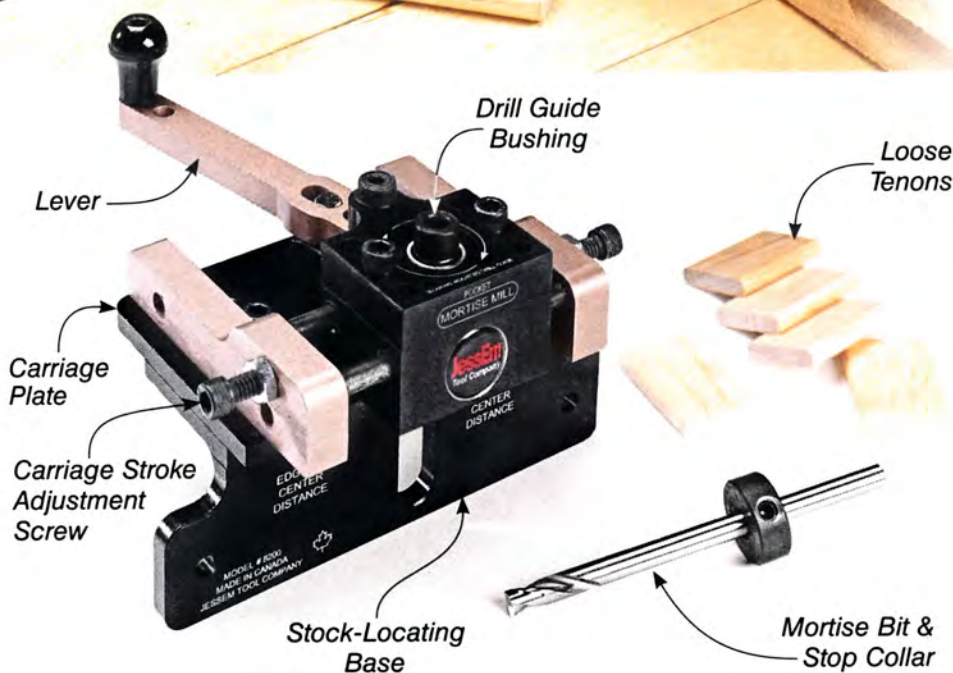


It's tough to beat the strength of a mortise and tenon joint. Furniture built using this type of joinery stands the test of time. But creating the mortises, and the tenons to fit, can be a tedious process. I recently discovered a jig that takes the hassle out of drilling the mortises: the *Pocket Mortise Mill* from JessEm (\$99.95).

If you look at the main photo at left, you'll notice that joints created by the *Mortise Mill* differ from traditional mortise and tenon joinery. Instead of cutting individual tenons for each mortise, you'll use loose tenons to hold the workpieces together. These tenons fit in mortises cut by the jig on mating workpieces.

To use the *Mortise Mill*, you simply clamp the jig to your workpiece and utilize a handheld drill to cut the mortise, as in the photo above left. And to lay out the mortise locations, all you need to do is mark the centerpoint for the mortises on the mating workpieces. It's important to note that the jig will only cut  $\frac{1}{4}$ "-wide mortises.

**Setup.** Setting up the jig is straightforward. You start by adjusting the





▲ **Drill Full-Depth Holes.** Start each mortise with multiple, full-depth holes to remove most of the waste.



▲ **Lever Action.** Remove the remaining waste in multiple passes. Use the lever to move the drill bit from side to side.



▲ **Final Pass at Full Depth.** Make a few full-depth passes to create a mortise with clean sides and crisp edges.

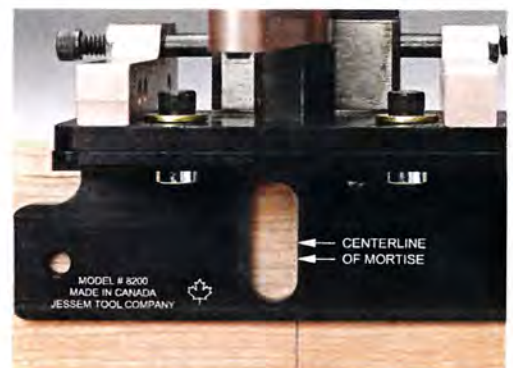
stock-locating base to determine the location of the mortise from the edge of your workpiece. This can be done two different ways. To specify the distance from the edge of your workpiece to the center of the mortise, use the scale engraved on the bottom face of the carriage plate. You can see this in the near photo at right.

Another method is to use the front edge of the carriage plate. This edge marks the centerline of the mortise bit. Just mark a line on the workpiece and adjust the base so the edge of the carriage plate lines up with the mark (main photo, opposite page).

**Locate Mortise.** As mentioned earlier, you want to mark the location for the two mortises you'll cut on opposing workpieces. So align the workpieces in their final location and strike a line for the center of the mortise across the face of both pieces. Then use the right edge of the slot in the base to position the jig (right photo above).



▲ **Edge-to-Center Scale.** It's simple to position the center of the mortise a set distance from the edge of the workpiece.



▲ **Centerline of Mortise.** Use the right edge of the slot in the base to center the mortise on your workpiece.

Once you clamp the jig in place, adjust the stop collar on the bit to set the mortise depth. This is best done with the bit inserted in the guide bushing.

**Cut Mortise.** Cutting a mortise starts with drilling a series of holes to full depth. This helps clean out most of the waste. Then, while running the drill, slowly move the bit from side to side, increasing the depth of cut between passes (photos, top of page). Test fit a

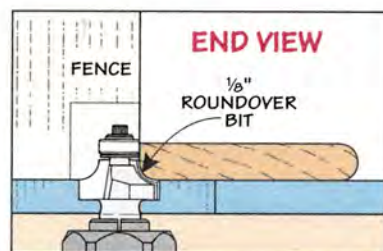
tenon in the mortise and adjust the width of the mortise using the adjustment screws on the sides of the carriage if necessary. I like to leave the mortises  $\frac{1}{8}$ " wider than the tenons to help with aligning the workpieces during assembly (photo below).

You'll appreciate how easy making perfectly sized and accurately placed mortises can be using the jig. For buying information, see Sources on page 51. 🛠️

## make your own Tenons

Making your own loose tenons is a snap. All it takes is a roundover bit at the router table.

The process starts with planing some stock to the same thickness as your mortise and ripping the material to the mortise length. Set the height of the roundover bit to cut halfway through the thickness of your blank as shown in the drawing at right. Then rout a roundover along one edge.



Flip the blank end for end and rout along the opposite face. Do this on the opposite edge of the blank, as well. The individual tenons can then be cut to length.

▼ **Mortise & Loose Tenon Joinery.** Cut mortises on butt or miter joints for a strong assembly that's easy to align.



## all about Nails & Brads

Find out why you'll want to keep these age-old fasteners on hand.

■ It's a common belief that nails have no place in high-quality woodworking. But I'm happy to admit that I keep a selection of nails on hand and use them often in my projects. From reinforcing joints to acting as a quick clamp, there's no shame in putting this humble fastener back in your woodworking arsenal.

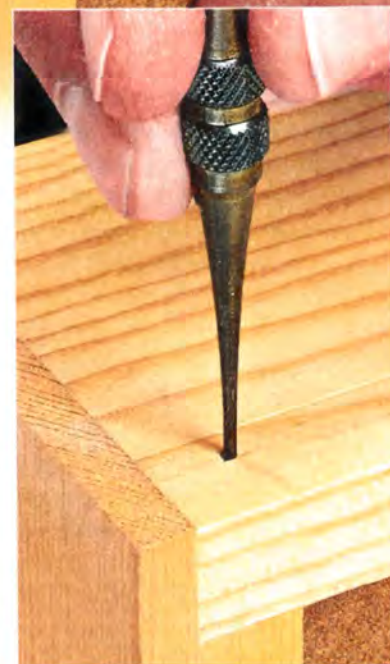
### A LONG HISTORY

I won't bore you with the detailed history of nails, but they've been around for thousands of years. In America around the 1700s, nails were forged by blacksmiths

called "naylor." Then, in the 1800s, machines took over to produce square nails cut from sheets of steel. Cut nails are still manufactured today. (Read more about them in the box at the top of the opposite page.) Finally, in the 1900s came our modern wire nails that are cut and formed from large coils of steel wire.

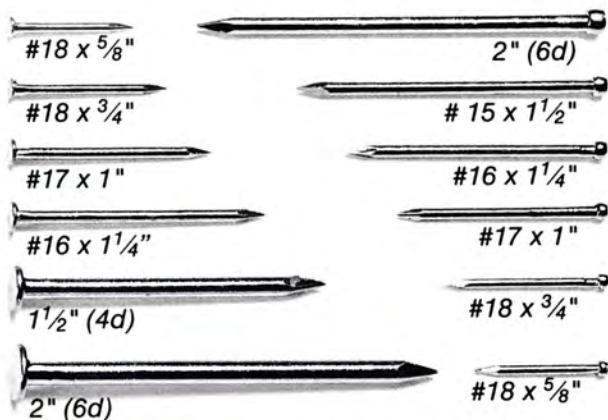
**What's a "Penny"?** Often, you'll see nails labeled "4d" (4-penny), "6d" (6-penny), and so on. We have the British to thank for this centuries-old "penny" designation. There are conflicting stories about the origin of the term, but in this context, it denotes both the diameter and length of the nail.

The common nails we're all familiar with range from 1"-long (2d) up through large, 6"-long (60d) spikes. Finish nails range from 1½" long (4d) through 3½" long (16d). You can already see how the "penny" designation can be a little confusing.



▲ **Nail Set.** Make brads and finish nails less visible by using a nail set to countersink them.

Wire brads are much smaller and are listed by their wire gauge size (diameter) and length. They're available from ½"-long, 20-gauge up through 1½", 16-gauge. But when shopping for brads, you're mostly concerned about what length is best suited for the task at hand.



▲ **Practical Fasteners.** A supply of small brads, wire nails, and finish nails (shown full size) are handy for many fastening tasks around the shop.

Today, most manufacturers and retailers simply list the type and length of the nail, and sometimes the wire gauge of the diameter. For the furniture and smaller projects I build in my shop, I keep a supply of brads and finish nails from 1/2" to 2" long.

## USES FOR NAILS

While there are dozens of types of nails — many for special applications — I stick with an assortment of nails you see in the lower left photo on the opposite page.

**Wire Nails.** For building jigs and fixtures, wire nails make assembly go quickly. When gluing joints, the large head on the nail can act as a clamp to keep the joint tight while the glue dries.

**Finish Nails & Brads.** When appearance is a concern and I don't want the large head of a nail to be conspicuous, I'll turn to finish nails and brads. Their smaller heads make them less visible and easier to hide. In spite of their small size, I find a lot of uses for finish nails and brads.

**Reinforcing Joinery.** If you take a look at the main photo on the opposite page, you'll see how I use finish nails to reinforce a drawer joint. I've seen drawers in antique furniture built this way and they're as solid as the day they were built. Adding a few nails makes assembly go quick

## traditional Cut Nails

Cut nails are most often used by woodworkers who want a traditional, "old-school" look on their projects. But I also use them for another reason. Their holding power is much greater than a round nail. Their wedged shape and increased surface area really "grab" the wood fibers and help resist pullout.

A typical use that capitalizes on this benefit is for installing cabinet backs (upper right photo). It's best to predrill a pilot hole before driving the nail. Some examples of cut nails used in cabinet work are shown at right.



and makes the joint less likely to fail. You can use a nail set to countersink the nail head, as shown in the inset photo.

**Door Panels.** Another use for small brads is securing a solid-wood panel in a door frame. You can see what I mean in the left photo below. A single nail installed at the center top and bottom of the frame keeps the panel from rattling, yet allows it to expand and contract with seasonal changes in humidity.

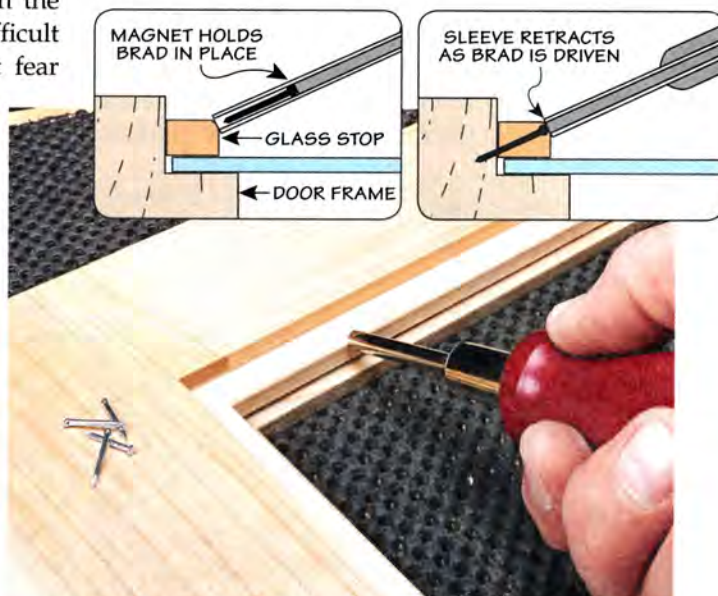
**Glass Stop.** Another common use for small brads is installing glass stop, as shown in the right photo below. It's difficult to use a hammer without fear

of striking the glass — or your fingers. Instead, a brad driver makes it easy to push or tap the brad in position.

**Handy.** You can find small brads and nails at any hardware store. For cut nails, refer to Sources on page 51. My suggestion is to go spend a few bucks on nails. They're handy to have around and you never know when you might need them. 🛠️



▲ **Securing a Panel.** To keep a solid-wood panel from rattling in a door frame, tack it at the centerpoint with a small brad at the top and bottom of the frame.



▲ **Installing Glass Stop.** A brad driver takes the risk of using a hammer out of the equation. Insert the brad into the driver and push it into the glass stop until it's seated.

# weekend workshop

## 5 shop-made Clamps

Save money and solve unique clamping challenges by building your own clamps.



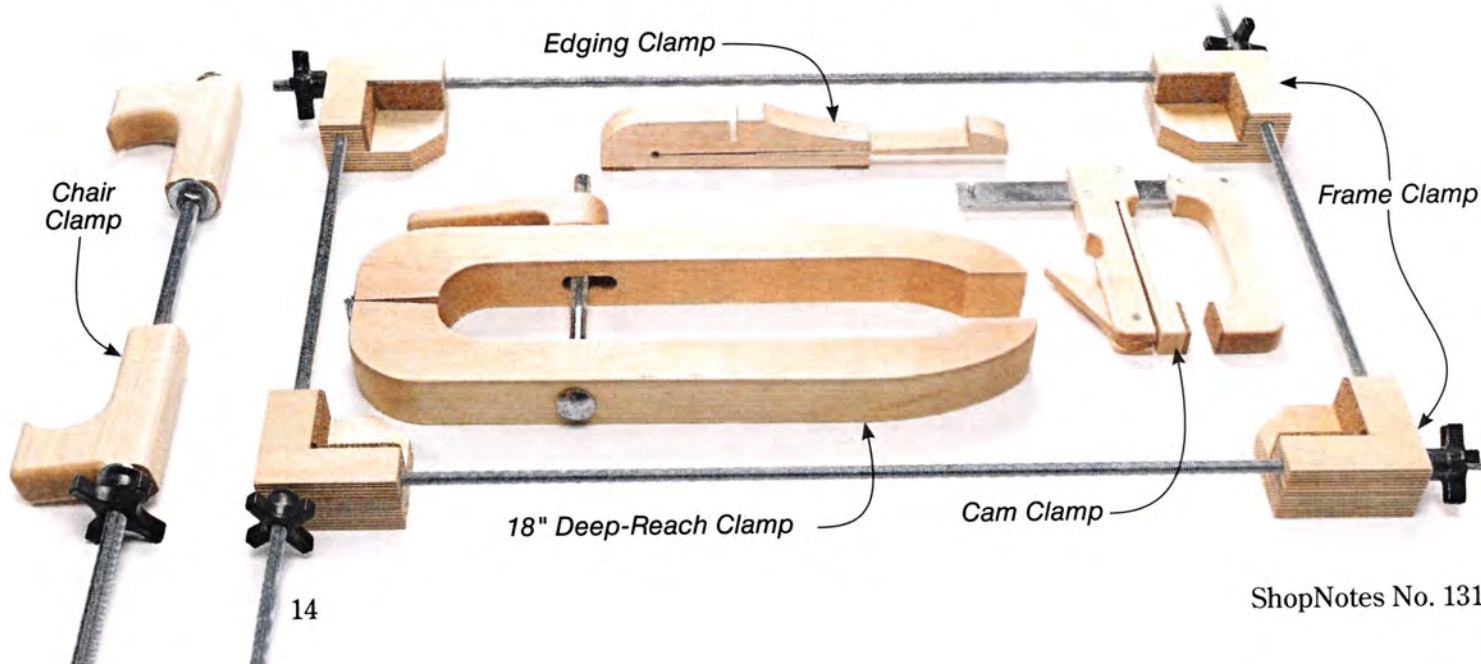
■ A good selection of bar clamps is an essential part of your tool kit for assembling projects. You'll inevitably find situations, however, where ordinary bar clamps just can't get the job done.

Woodworking catalogs feature a variety of specialty clamps to tackle these uncommon needs. Given their prices, it's hard for

me justify purchasing the clamps for occasional use.

On the other hand, with just a few, small pieces of wood and some inexpensive hardware you can make your own special-purpose clamps. We've included plans for five styles: cam clamp, edging clamp, frame clamp, deep-reach clamp, and chair clamp.

Any one of these designs can be built in an easy evening in the shop. And they're inexpensive enough that you can make a whole set of clamps without breaking the bank. What's certain is that you're sure to find one or two of these clamps that you can put to use right away in an upcoming project.



# Cam Clamp

The cam clamp you see here isn't new. In fact, I've admired the simple design for years. The big advantages of this design is that it's lightweight and doesn't apply a lot of pressure. That sounds like the exact opposite of the qualities of a good clamp, I know. However, for some tasks, like assembling small boxes, too much pressure (and a heavy clamp) can distort the project parts.

The clamp consists of two jaws and an aluminum bar, as shown in Figure 1. One jaw is fixed to the end of the bar, and the other slides along the bar to match the size of the workpiece. A cam lever in the adjustable jaw pivots against a flexible tongue to apply the clamping pressure.

The sliding jaw captures the aluminum bar between a pair of pins. To move it, you cock the jaw slightly to release it and slide it along the bar. The jaw wedges itself in place when clamping pressure is applied.

**Fixed Jaw.** Both jaws are fairly small. So it's a good idea to work with oversize blanks for the initial steps. I started by making the much simpler fixed jaw. You can use the patterns at right to guide you through the steps.

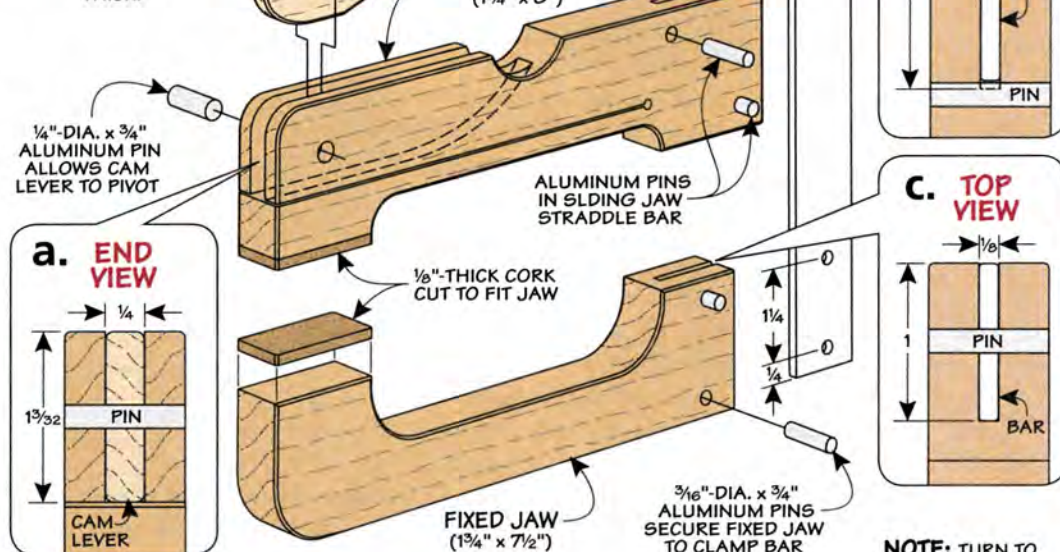
The first thing to do is cut a slot across the back edge (Figure 1c). The width of the slot is sized to accept the aluminum bar.

From there, you can create the notch on the inside edge, as shown in the pattern. Use a Forstner bit in the drill press to make the curved corners then remove the waste at the band saw.

**Sliding Jaw.** The sliding jaw has a few other details that deserve some mention. The first of these is a stopped slot that creates a pocket for the cam lever. I made this cut at the table saw

**1** FIGURE

**NOTE:**  
JAWS ARE  
MADE FROM  
3/4"-THICK  
STOCK. CAM  
LEVER IS 1/4"  
THICK.



with a dado blade. Turn to page 27 to see the setup I used.

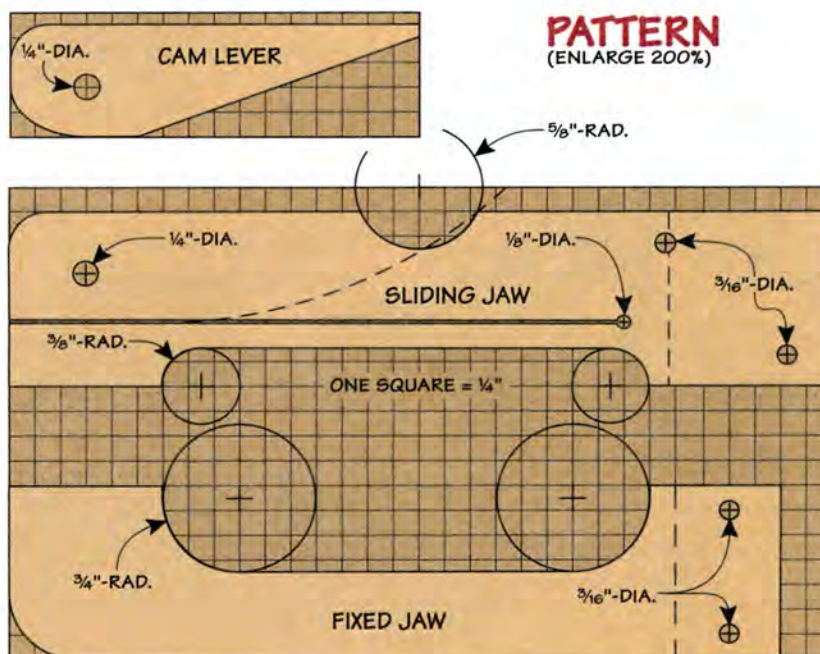
Another detail to note is the slot for the clamp bar along the back of the jaw. It's deeper than the slot in the fixed jaw to account for aluminum pins that trap the bar. The space between them matches the width of the bar.

The final unique detail is the narrow kerf that allows the clamp pad to flex as pressure from the lever is applied. I drilled

a stop hole at the end of the slot. The narrow kerf can be cut over at the band saw.

The final piece to make is the cam lever. I cut it to match the width of the stopped slot, then cut it to shape at the band saw.

**Making Multiples.** Chances are you'll want several of these clamps in your shop. So I've come up with some simple tips for making multiples. Shop Short Cuts on page 27 has the details.



**ShopNotes**

**GO ONLINE EXTRAS**

Full-size patterns, for the cam, deep-reach, chair, and edging clamps are at:

[ShopNotes.com](http://ShopNotes.com)

# Deep-Reach Clamp

The reach of most bar clamps is limited to just a few inches. So when a clamping task comes along that's beyond this, you're usually left scratching your head. The solution is to have a set of these deep-reach clamps hanging on your clamp rack.

Think of it as a cross between a C-clamp and an old-fashioned handscrew. Long, stout, jaws apply clamping force nearly a foot away from the edge. I chose straight-grained hard maple for the jaws for the most strength.

**Hardware.** The mechanism consists of hardware-store items: a carriage bolt, washer, and coupling nut. I used  $\frac{1}{2}$ " hardware to stand up to heavy use.

**Jaws.** The jaws are linked at the back end by a surface-mounted



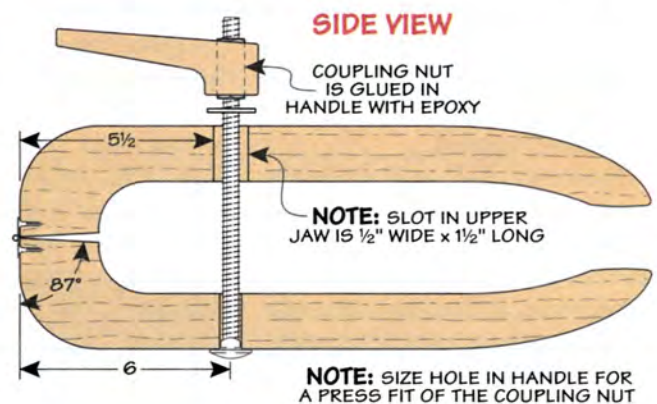
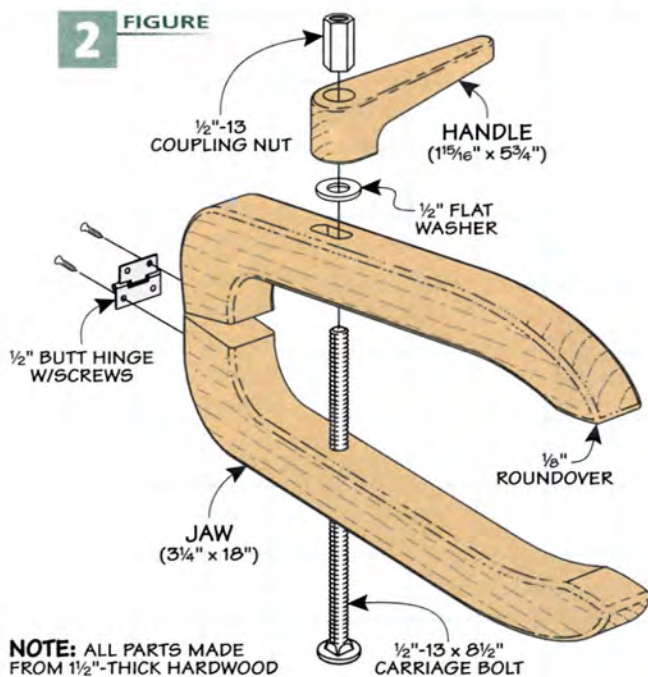
▲ **Long-Distance Clamping.** Long, thick jaws and a shop-made handle apply pressure well away from the edge of an assembly. This works great for projects like this veneered panel.

hinge. In use, the back end of the jaws are pressed together, so there isn't much stress placed on the hinge or its screws.

The two jaws of the clamp are nearly identical. The only difference is the upper jaw has a slot (rather than a hole) to accept the

carriage bolt. Drill the hole and create the slot before cutting the jaws to final shape.

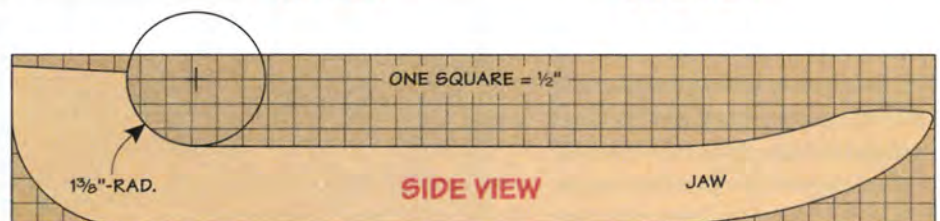
**Handle.** I opted for a maple handle and coupling nut to keep the cost down and match the jaws. The pattern below makes shaping the handle pretty simple.



## PATTERN (ENLARGE 400%)



## PATTERN (ENLARGE 400%)



# Chair Clamp

If you're like me, you often get called on to repair chairs with loose joints. If that's the case, this is the clamp you're looking for.

The secret is the hooked shape of the jaws that lets them get a good grip on angled surfaces. Ordinary threaded rod serves as the bar. A knob and washer apply the clamping pressure. But this isn't your typical star knob. It's called a "tip nut" and has a quick-release feature built in that ends the tedium of winding the knob along the threaded rod.

**Glue Up Jaws.** The thick jaws are glued up from thinner stock (Figure 3). Before gluing the blanks together, cut a groove in each piece. This creates a channel for the rod to pass through.

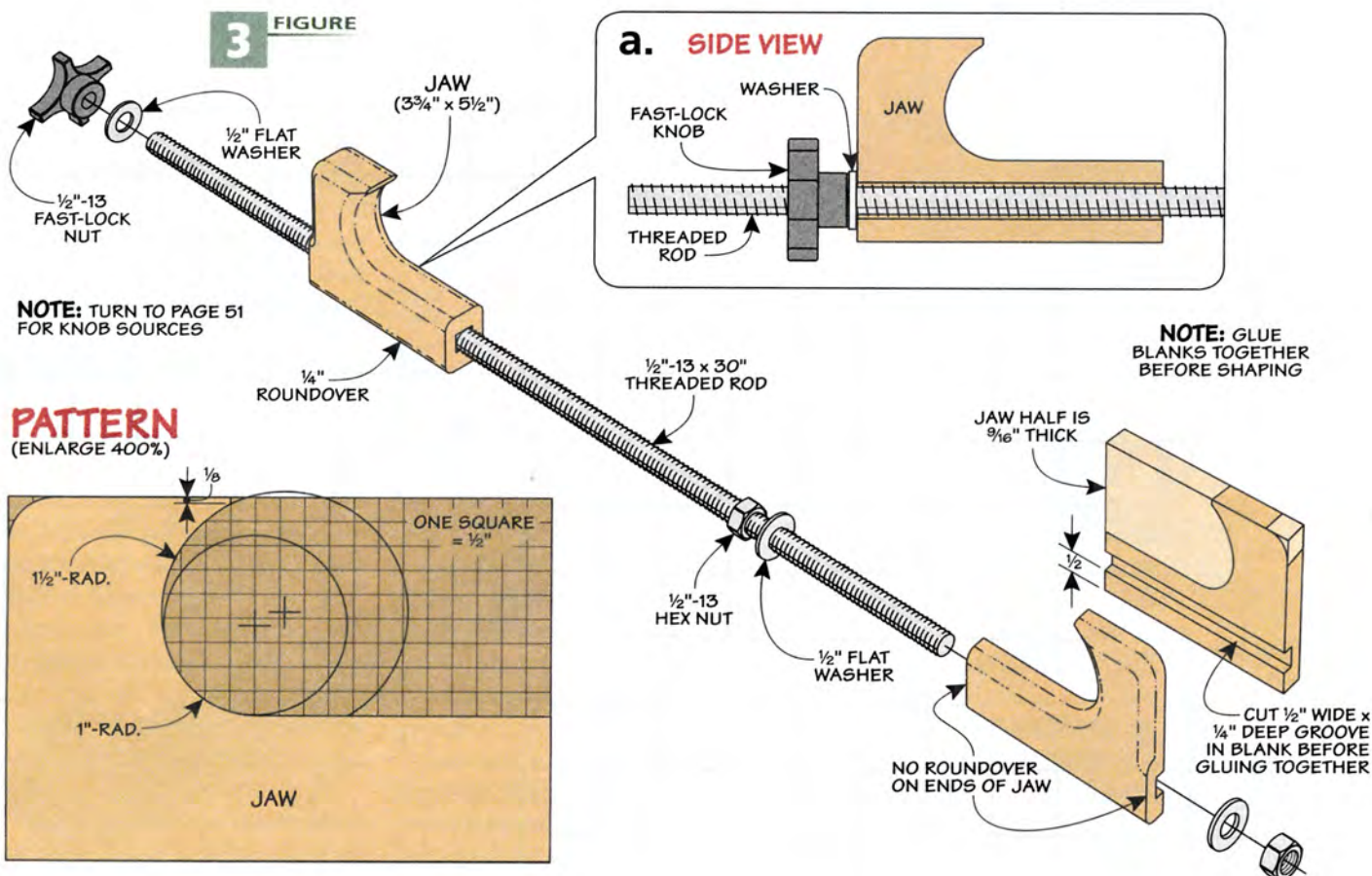
The blanks can be cut to shape at the band saw using the



▲ **Dual Purpose.** The hooked jaws of this clamp can grip round and angled edges for gluing up chairs (above). Flip the jaws around to spread joints apart (right photo).



pattern below. After sanding them smooth, head over to the router table to ease the edges to prevent the jaws from leaving dents on the workpiece.



# Edging Clamp

Attaching hardwood edging to a plywood panel isn't a difficult task. The trouble is spreading out the clamping pressure on such long joint lines without using every clamp in the shop.

The solution is the bar clamp accessory shown in the photo at right. It doubles the number of clamping points.

The shaped hardwood block and wedge works on the same principle as the cam clamp. The thin wedge replaces the cam lever to apply the pressure. When tapped into the slot, the wedge forces the two cork-faced pads against the edging.

A notch cut on the back edge of the block accepts the bar of the clamp and serves as a fulcrum to distribute the clamping pressure between both cork pads evenly — like a seesaw.



**Edging Clamp.**  
Tap a wedge into the slot of this unique clamp to attach hardwood edging to a plywood panel.

**The Block.** Building the edging clamp is about as straightforward as it looks, as shown in Figure 4. I cut the notch along the back edge at the table saw using a dado blade. It's a good idea to do this before shaping the block. This way the block remains stable during the cut.

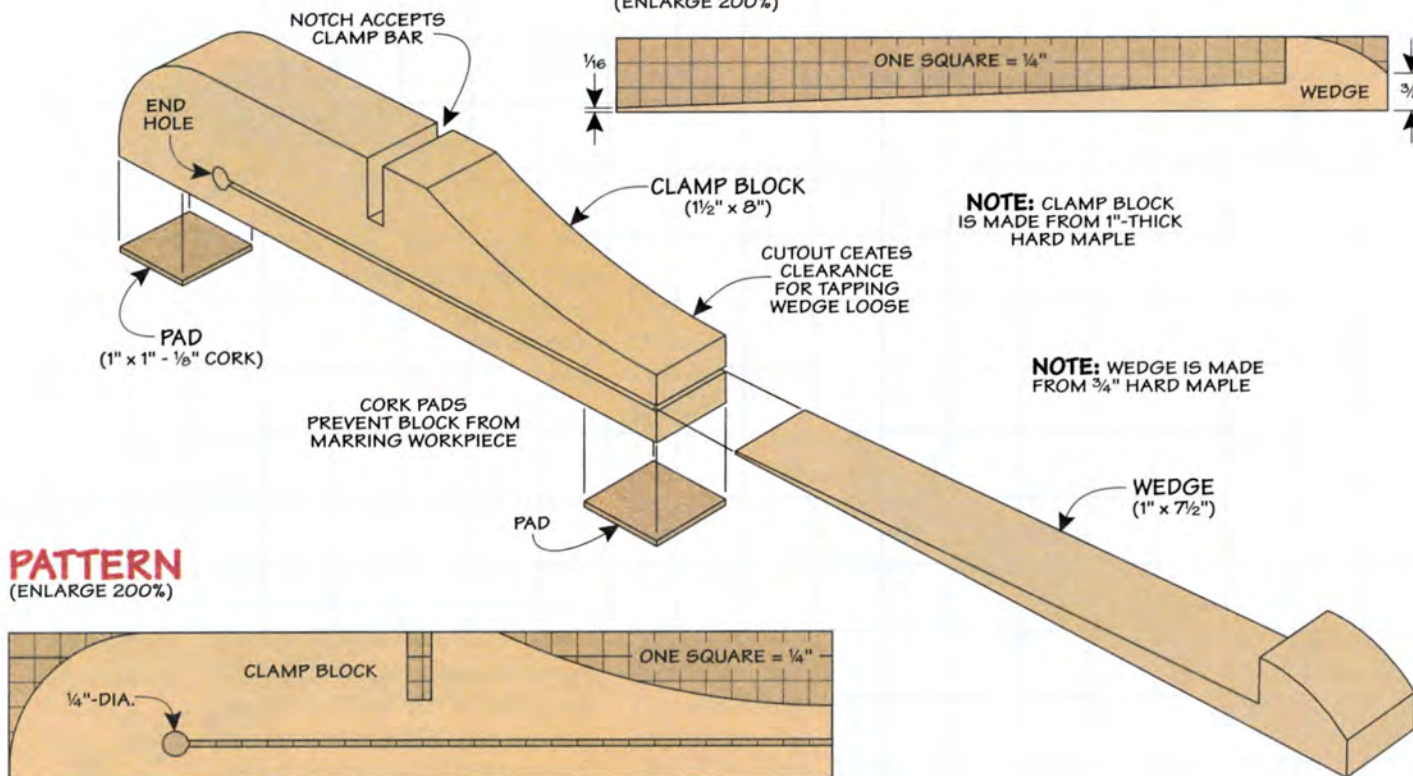
There's nothing critical about the shape, so feel free to modify it to something that suits you.

The next step is to cut the kerf. Drill the end hole then cut the kerf at the band saw. I used a rip fence to keep the cut straight. Now glue a pair of clamp pads on the flat edge of the block to prevent the clamp from marring workpieces.

**The Wedge.** The band saw is the tool of choice for making the wedge, too. Photocopy the pattern below and attach it to the blank to guide your cuts.

**4** FIGURE

**PATTERN**  
(ENLARGE 200%)



# Frame Clamp

Mitered frames have a clean look and a timeless appeal. But as a woodworker, they can sometimes be a pain in the neck. The biggest hassle? Gluing the corners together. The miter joint faces slide out of position if you try to use ordinary clamps.

The answer to my frustrations came in the form of the frame clamp you see here. Plywood corner blocks capture and draw all the joints together at once.

The blocks are joined with lengths of threaded rod you can get at the hardware store. Here again, I used tip nuts to speed up the process of adjusting the knobs and blocks.

**Making the Blocks.** Figure 5 shows the makeup of the blocks. Each one consists of three layers of plywood. The lower layer serves as a platform for holding



**Easy Frame Assembly.** Simple plywood corner blocks, threaded rod, and tip nuts combine to create a great way to glue up mitered frames.

the corner of the mitered frame. I clipped the inside corner of the platform to ease the edge.

The top is glued up from two layers of plywood and cut into an L-shape. It accepts a pair of threaded rods. The key is making sure the inside corner is 90°.

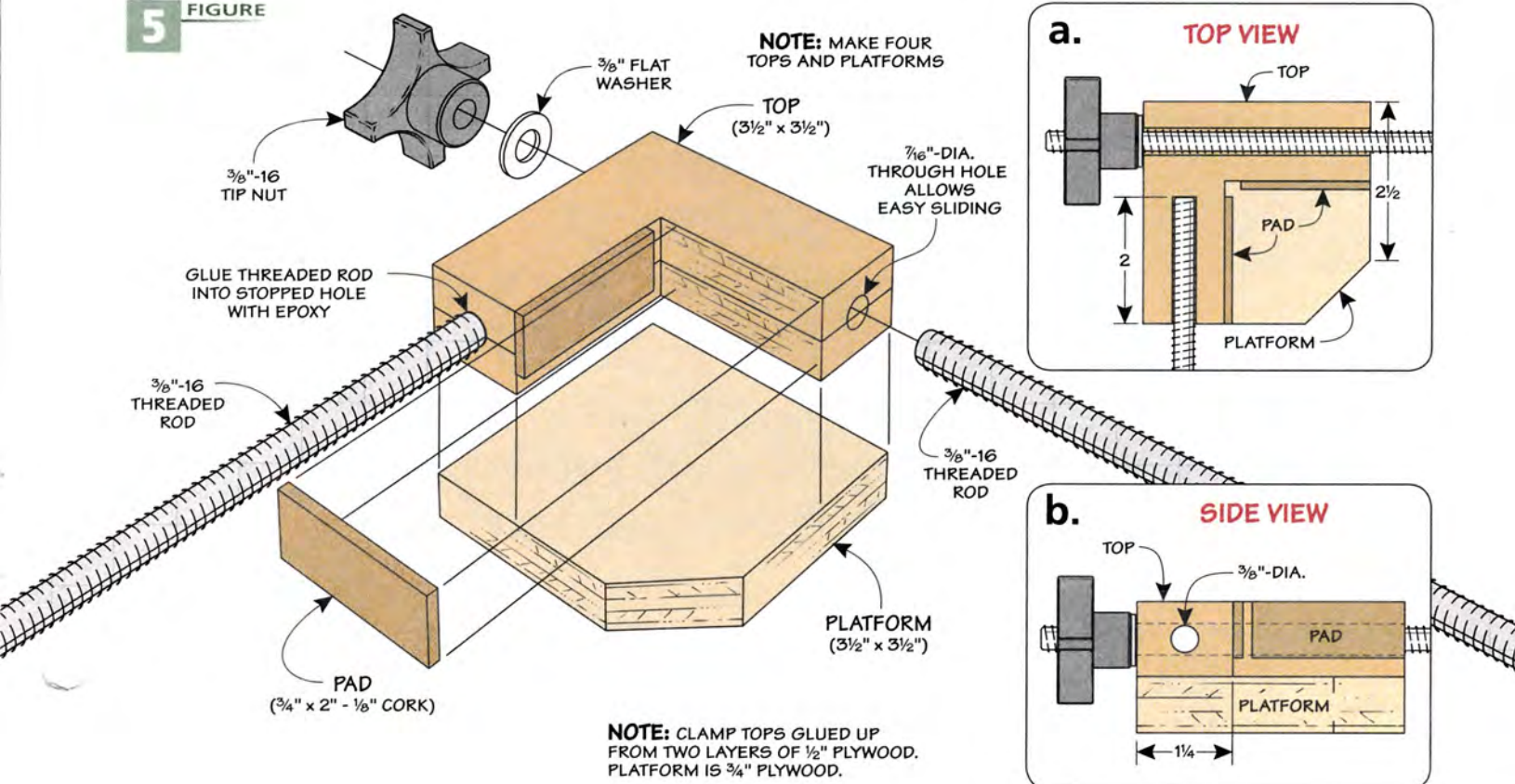
The holes in the top aren't identical, as you can see in Figure 5a. One is stopped, and the other is a through hole. When drilling

these holes, be consistent. The blind hole in one block should align with the through hole in the adjoining block.

After gluing the layers together, you can apply cork pads to the inside face. This keeps the clamp from marring the frame and provides a relief in the corner.

Finally, be sure to wax the platform before use so the frame isn't glued to the clamp blocks. 

**5** FIGURE



weekend project



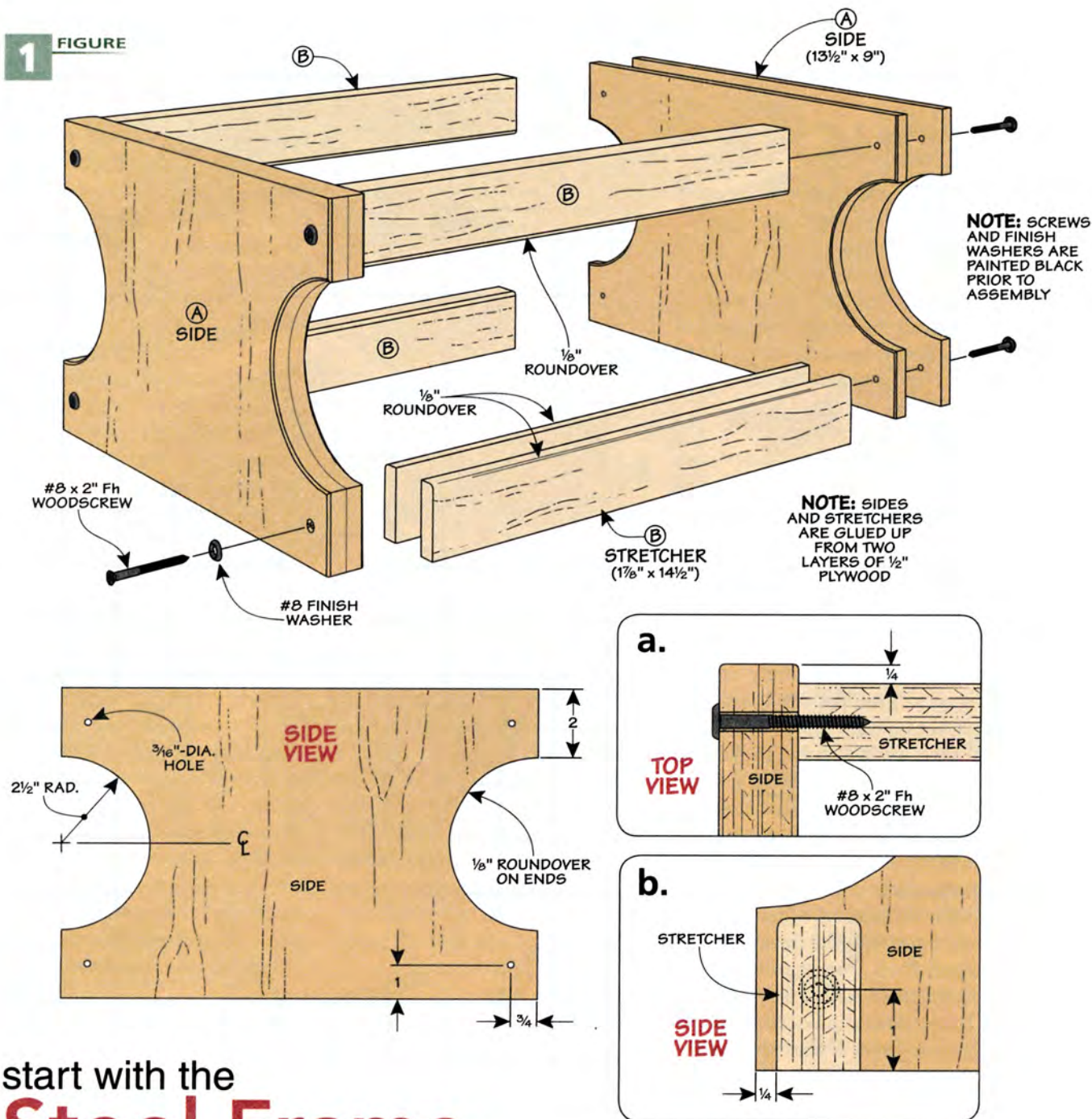
## roll-around Shop Stool

Your back and knees will thank you every time you use this low-profile shop stool.

■ I've got a couple of stools in my shop. They're great for working at my bench or just taking a load off my feet when I get tired of standing. But for many tasks, they're really too tall. That's where the compact shop stool shown above comes in. It's the perfect height for jobs that would otherwise require you to crouch or kneel down on the floor.

Whether you're installing drawers in a cabinet, applying finish to a large project, or just doing some routine tool maintenance, this shop stool really comes in handy. The fact that it has onboard storage and rides on casters makes it even more practical. You can simply scoot from place to place without having to get up and take your tools with you.

**1** FIGURE



## start with the Stool Frame

There are only eight parts to this stool — two sides, four stretchers, a seat, and a base. All the parts are made out of 1/2" Baltic birch plywood. I started with the sides. To make them, you'll need to glue up a pair of blanks out of two layers of plywood.

Since the sides attach to the stretchers with screws, after trimming the blanks to size, you can lay out and drill the 3/16"-dia. shank holes for the screws.

With the screw holes drilled, the next step is to lay out the arcs

on the edges. Rough them out at the band saw or with a jig saw and then sand the edges smooth.

**Stretchers.** The four stretchers are all identical. They're also

made out of two layers of plywood and simply cut to size. Then you can clamp all the parts together and add the screws and finish washers.

## Materials & Hardware

- |   |                |                         |
|---|----------------|-------------------------|
| A | Sides (2)      | 13 1/2 x 9 - 1 Ply.     |
| B | Stretchers (4) | 1 7/8 x 14 1/2 - 1 Ply. |
| C | Seat/Base (2)  | 14 x 17 - 1/2 Ply.      |

- (8) #8 x 2" Fh Woodscrews
- (8) #8 Finish Washers

- (24) #8 x 1 1/4" Fh Woodscrews
- (4) 3"-dia. Swivel Casters
- (16) #12 x 1/2" Ph Woodscrews
- (2) 3 3/8" Pulls w/ Screws
- (1) Rubber Shelf Liner

# finishing Touches

With the main body of the stool assembled, the next step is to add a seat and base (Figure 2). These two panels are identical. I cut them to size from  $\frac{1}{2}$ " plywood, eased all the edges with a small roundover, and screwed them in place to the rest of the stool.

## ADD THE HARDWARE

At this point, you may want to apply paint or a finish to the stool. (I chose paint.) It's a lot easier to finish the stool before adding the pulls and casters.

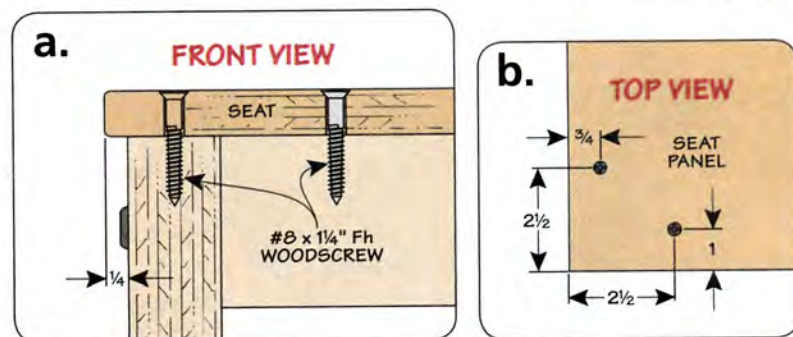
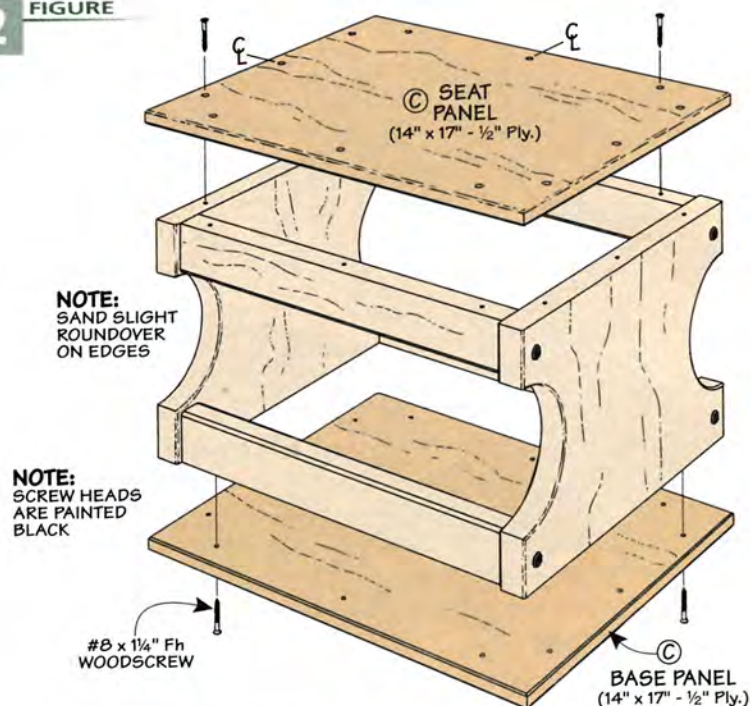
As you can see in Figure 3, I added a pull to each end of the stool. These are partly for looks, but they're also handy if you want to grab the stool with one hand to carry it somewhere.

Four swivel casters give you complete mobility in any direction when using the stool. In order to give the stool as much stability as possible, I mounted the casters on the outside corners of the bottom, as in Figure 3a.

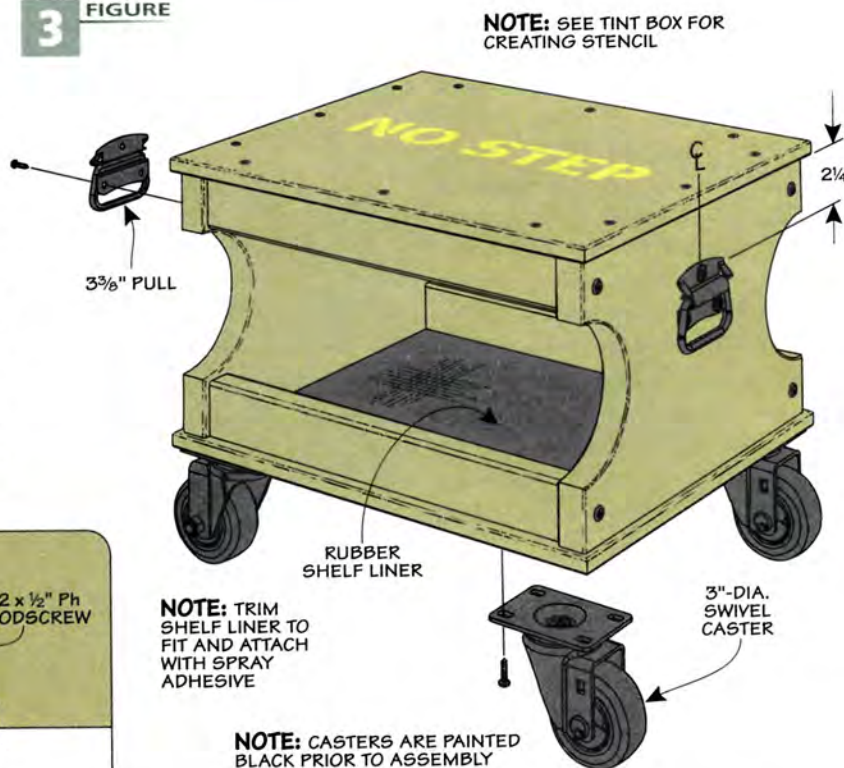
To prevent the inside of the stool from getting dinged up from tools, I added a rubber mat. This can simply be cut to fit and laid in place. If the mat doesn't want to lie flat, a little spray adhesive will persuade it.

Finally, once the stool was completed, several of us gave it a test run in the shop. The one concern we had was that someone might try to use it as a step stool by standing on it. With the casters, that would be very unsafe. So we came up with a reminder — see the box on the opposite page. 🚫

2 FIGURE



3 FIGURE



# Creating Stenciled Lettering

As you can see in the main photo on page 20, adding stenciled lettering or a stenciled design is a great way to dress up the shop stool — or any other project. And it's really not that difficult to do.

You can use the stencil pattern we've provided at the right or create your own unique design on your home computer.



**▲ Scuff.** Using a non-woven abrasive pad, lightly scuff the surface of the finish where you'll be applying the stencil.



**▲ Add Stencil.** Apply the stencil to the stool and then use a hobby knife to cut out the letters and peel them away.



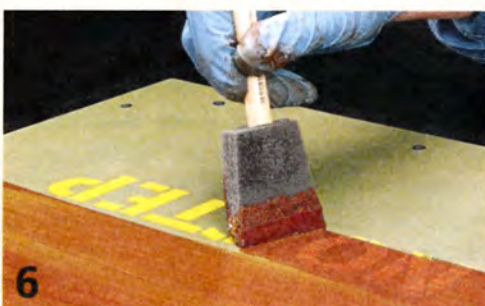
**▲ Spray Letters.** After masking off the surrounding area, spray the stenciled letters using several light coats of paint.



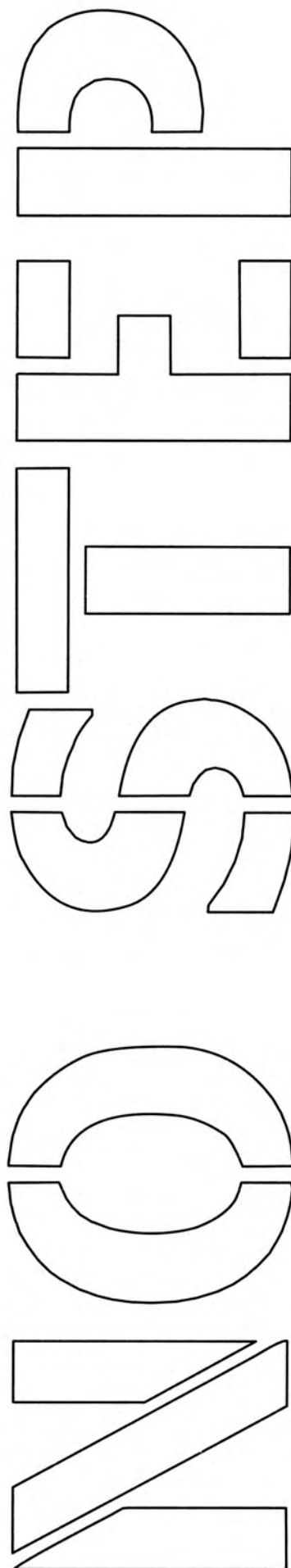
**▲ Peel Off Stencil.** Once the lettering is dry, carefully peel away the stencil. Go slowly so you don't accidentally lift the paint.



**▲ Clear Coat.** To help protect the lettering, apply a clear coat over the scuffed area and let it dry thoroughly.



**▲ Glaze.** To give the stool an aged look, brush on a gel stain and then lightly blot it off, leaving some stain remaining.





no-muss, no-fuss

# Finishing Tips

Learn the secrets to applying a water-based finish that goes on smoothly, dries quickly, and looks great.

■ Water-based finishes offer a lot of advantages for small-shop woodworkers: They dry fast, leave a durable surface, won't stink up your shop, and have an easy soap-and-water cleanup. However, getting

► **Avoid Brushes.**  
*Inexpensive paint pads lay down smooth coats of finish without brush marks.*

the best results requires learning a few tricks and understanding that these finishes don't work like oil-based finishes.

**Add Some Color.** One knock against water-based finishes is that they leave darker-toned woods like cherry and walnut looking dull and lifeless compared to the amber tone imparted by oil finishes. But the solution is pretty simple. Just apply a thin

coat of fast-drying, oil-based finish to add warmth. Be sure it's completely dry (wait a day or two) before applying the water-based finish. Otherwise the clear topcoat may not bond well.

**Skip the Brush.** When it comes to applying a water-based finish, I've tried everything from brushes designed for latex paints, to foam brushes — even rags and paper towels. The results were always the same — streaky, uneven finishes that took extra time and effort to sand smooth and level. (One exception is a set of high-end brushes that are made for water-based finishes. You can read more about them in the box on the facing page.)



Then I picked up a few inexpensive paint pads (left margin photo, opposite). They consist of a foam sponge with thousands of short, fine bristles. The sponge absorbs a lot of finish, so you don't need to go back to the tray as often. And the short bristles eliminate bubbles and lay down a smooth coat.

Larger pads make quick work of applying finish to wide, flat surfaces. A small detail pad is perfect for getting into corners and applying finish to moldings and narrow edges.

**Raise the Grain?** You may have heard you need to raise the grain before applying the first coat of water-based finish. This involves wiping the surface with water to swell the wood fibers and then sanding it smooth after the surface dries. I've found this is unnecessary. The first coat encapsulates any raised grain and "hardens" the surface, making it easier to sand smooth.

**The First Coat.** The right applicator gets you ready, but a smooth first coat is the most-important foundation for the final look of your finish. But it isn't something to worry about.



▲ **More Sanding.** Smooth out the first coat with 320- or 400-grit sandpaper. After that, use 600-grit between coats.



▲ **Grab a Grocery Bag.** Brown kraft paper provides just enough abrasive to burnish the final coat for a satiny feel.

The secret is to apply finish to the ends and edges, first. This prevents a run from the face from leaving a hard-to-remove mark that looks like a wet spot. Apply a wet film to the face, working quickly across the workpiece (main photo, opposite).

As the first coat of finish dries, you may notice that the surface looks bare. But as you build up the finish with subsequent coats, the look will improve dramatically.

**Between Coats.** There's a little more involved than just layering

on coats of finish. In a couple hours, the first coat will be completely dry. At this point, use some 320- or 400-grit sandpaper wrapped around a cork block to sand it smooth (upper left photo).

Use a light touch and sand the finish until the surface is uniformly dull. Like I said before, it will almost look as if the finish has been sanded away. It's a good idea to wipe, vacuum, or blow off the powdery dust and sanding grit before applying the next coat.

In most cases, three coats will give you an ideal amount of protection. For high-wear surfaces, like a dining table, you may want to apply four coats. Between coats, I lightly sand with 600-grit paper to knock back dust nibs.

**Finish the Finish.** After the last coat goes on, I wait overnight for the finish to cure. But when it comes to smoothing this final coat, it's time for the sandpaper to hit the showers. Instead, I use a piece of grocery bag (kraft) paper, as in the upper right photo.

I know it sounds like a gimmick. But the paper is just abrasive enough to create a consistent sheen. The paper wears quickly so switch to a fresh piece often.

The result is a rock-hard finish that will stand up to all kinds of abuse but has the look and feel of a classic, hand-rubbed finish. Better yet, you are able to complete the process in half the time. 🛠️

## high-quality Finishing Brushes



▲ **Worth the Cost.** Gramercy brushes have soft, ultra-fine synthetic bristles that are designed for water-based finish rather than latex paint (refer to Sources on page 51). Each is packed with more bristles than other brushes to hold a lot of finish.

# Shop Short Cuts



Tote Handles

■ The tote handles for the workbench on page 28 are made from a section of aluminum angle with a hardwood cap. The drawings below step you through the process of making the handles.

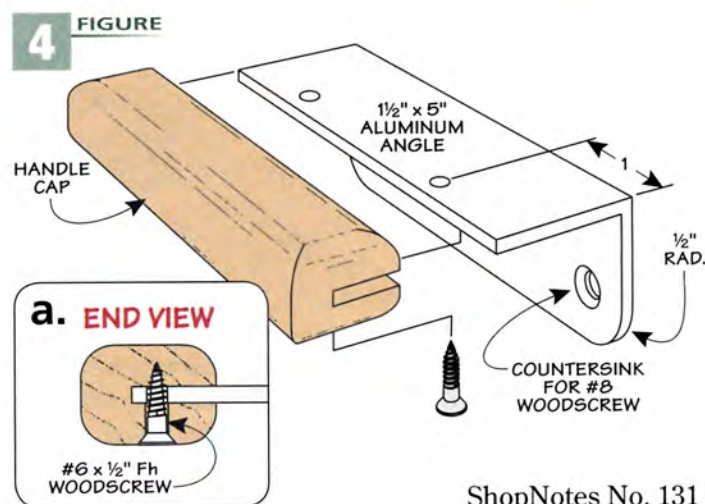
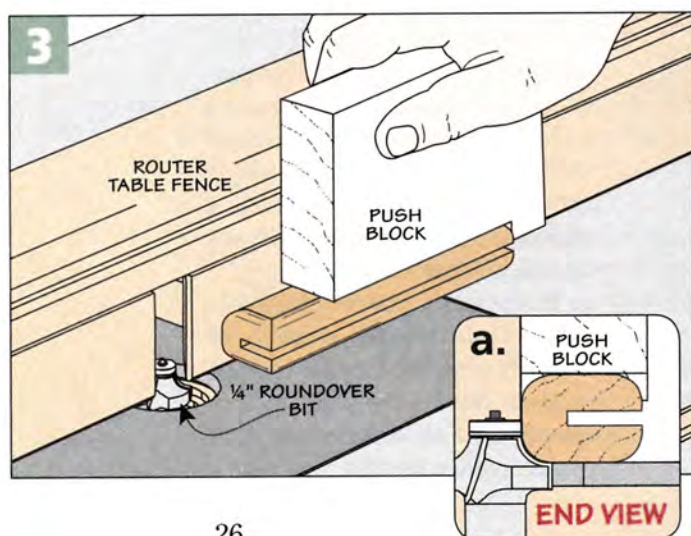
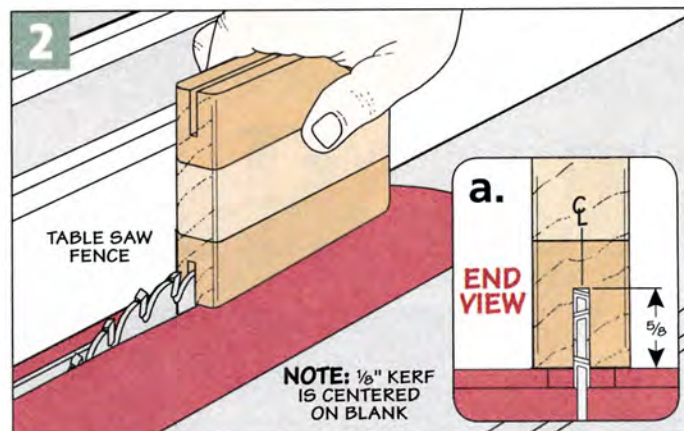
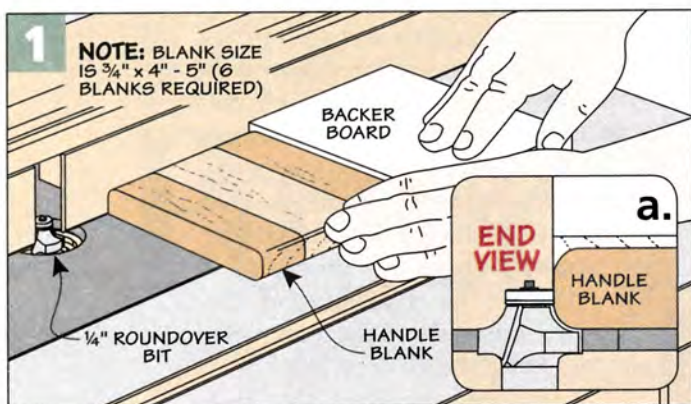
To make the handle caps, start with extra-wide blanks (Figure 1). After routing a roundover on both ends, I stepped over to the table saw to cut the slots that fit over the aluminum angle.

Figure 2 shows how I used an  $\frac{1}{8}$ "-kerf saw blade to cut a slot centered on each long-grain edge of the blank. The next step in making the caps is to rip them from the blanks and then round over the remaining edges, as illustrated in Figure 3.

Now for a little metal work. I cut the aluminum angle to length and rounded off two of the corners of one leg with a file, as you

can see in Figure 4. At the drill press, I drilled a pair of countersunk screw holes to fasten the handle assembly to the tote.

The cap is fastened to the other leg of the angle. To do this, I slipped it onto the angle and then drilled a couple of countersunk pilot holes on the underside of the cap. Take care not to drill all the way through. Then fasten the handle to the end of the tote.



The article on page 15 offers a good rundown on the steps to make a cam clamp. But you're sure to find this clamp so handy you'll want a whole set. I've come up with a few tips to streamline the process so that you can make two clamps or ten without investing a lot of extra time.

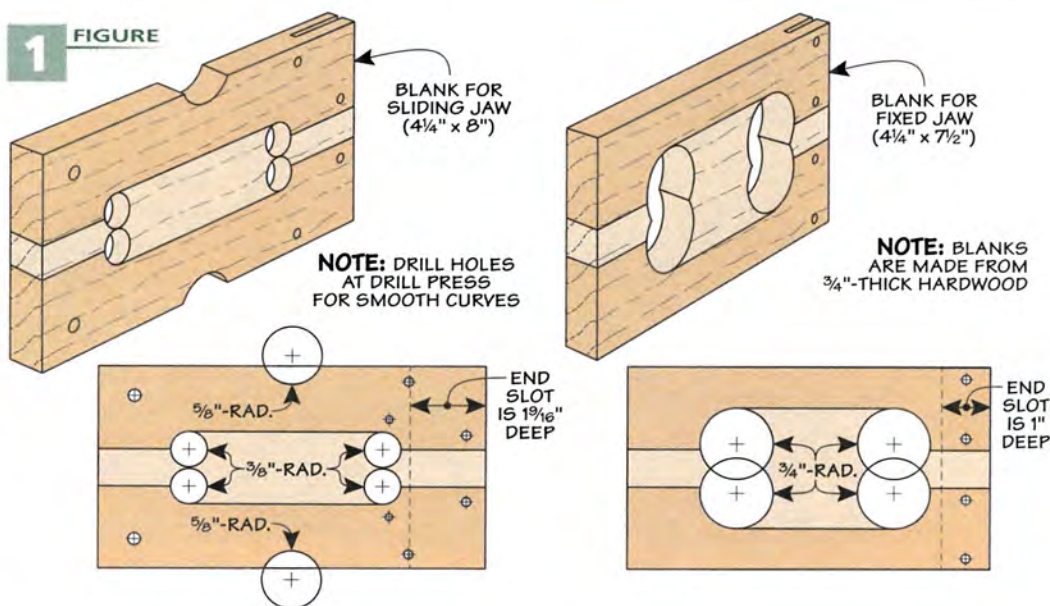
The key is using oversize blanks to get two identical parts from the same blank. This way, you can set up a tool for a specific step and perform multiple operations in short order.

**The Blank.** It all starts with the blank. I sized blanks to create pairs of each jaw — fixed and sliding, as illustrated in Figure 1. Size the blanks extra wide but match the length and thickness of the jaw components.

The key is the amount of waste between each part. You want to leave enough material here to keep the bit from wandering or grabbing the workpiece as you drill to create the radii on the inside edge of each jaw.

Before drilling, cut the slot for the clamp bar in each set of blanks. Be sure to note that the depth is different for each size.

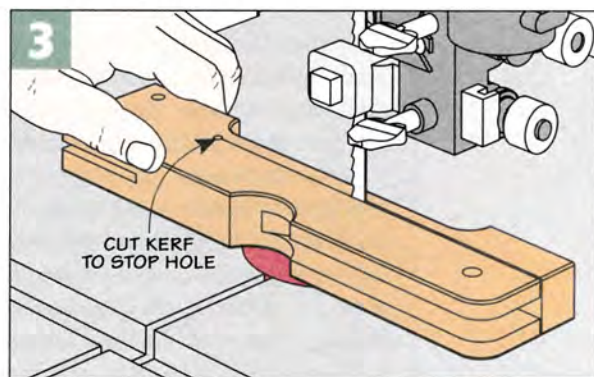
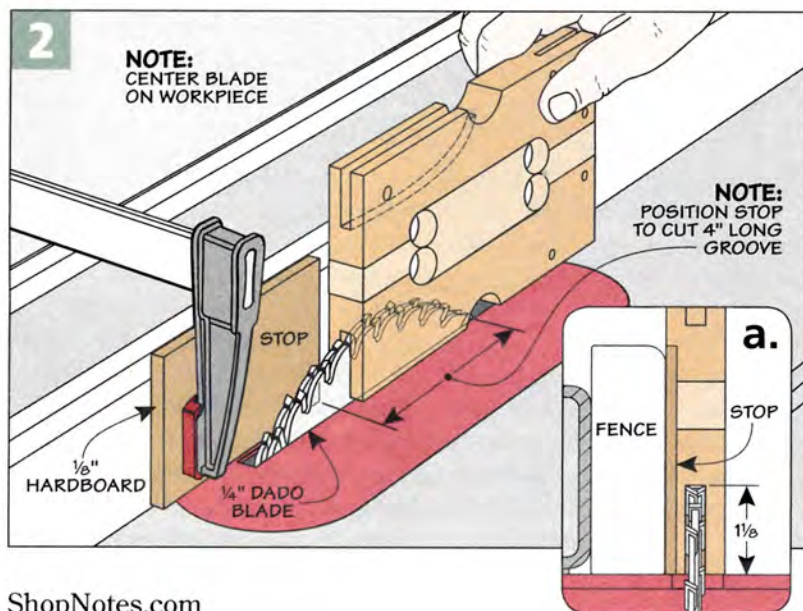
**Stopped Groove.** Once the drilling is complete, the next step is cutting the stopped groove in the sliding jaw. You can see the setup I used for this cut in Figure 2. Start by installing a  $\frac{1}{4}$ " dado blade. Then make some test cuts to center the blade on the



thickness of the blank. Clamp a hardboard stop to the rip fence at the location shown in Figure 2. This guarantees that each slot is the same length.

To make the cut, simply push the blank until it contacts the stop. Then turn off the saw and wait for the blade to stop before removing the workpiece.

Next I ripped the jaw blanks to final width and cut the profile at the band saw. You can also cut the kerf at the band saw, as illustrated in Figure 3.





# modern Power Tool Bench

With a large worksurface and plenty of storage, this bench is sure to be the center of attention.

■ I've yet to see a shop that has enough workspaces. Power tool storage is always at a premium, as well. This workbench addresses both of these needs and even throws in a convenient charging center for cordless tools. It's the perfect addition to any shop.

Let's start with the large worksurface. It's big enough to handle a project of just about any size. Look down below and you'll find plenty of storage for your power tools. Three removable totes are ideal for storing tools like saws, drills, and sanders. A deep cubby off to the side offers storage space with a shelf to hold all your accessories.

For all your battery chargers, a special shelf and power strip on the end of the bench keeps them all in one easy-to-reach spot. Built-in cord management keeps the chargers neat and tidy.

As I'm sure you've already noticed, this bench features some unique construction materials. Lightweight aluminum legs and end rails create a modern look without sacrificing stability and strength. This is one bench that will stand up to a lot of use.

The woodworking is pretty straightforward, and the metal work is nothing you can't handle. It's a combination that results in a rock-solid workbench.

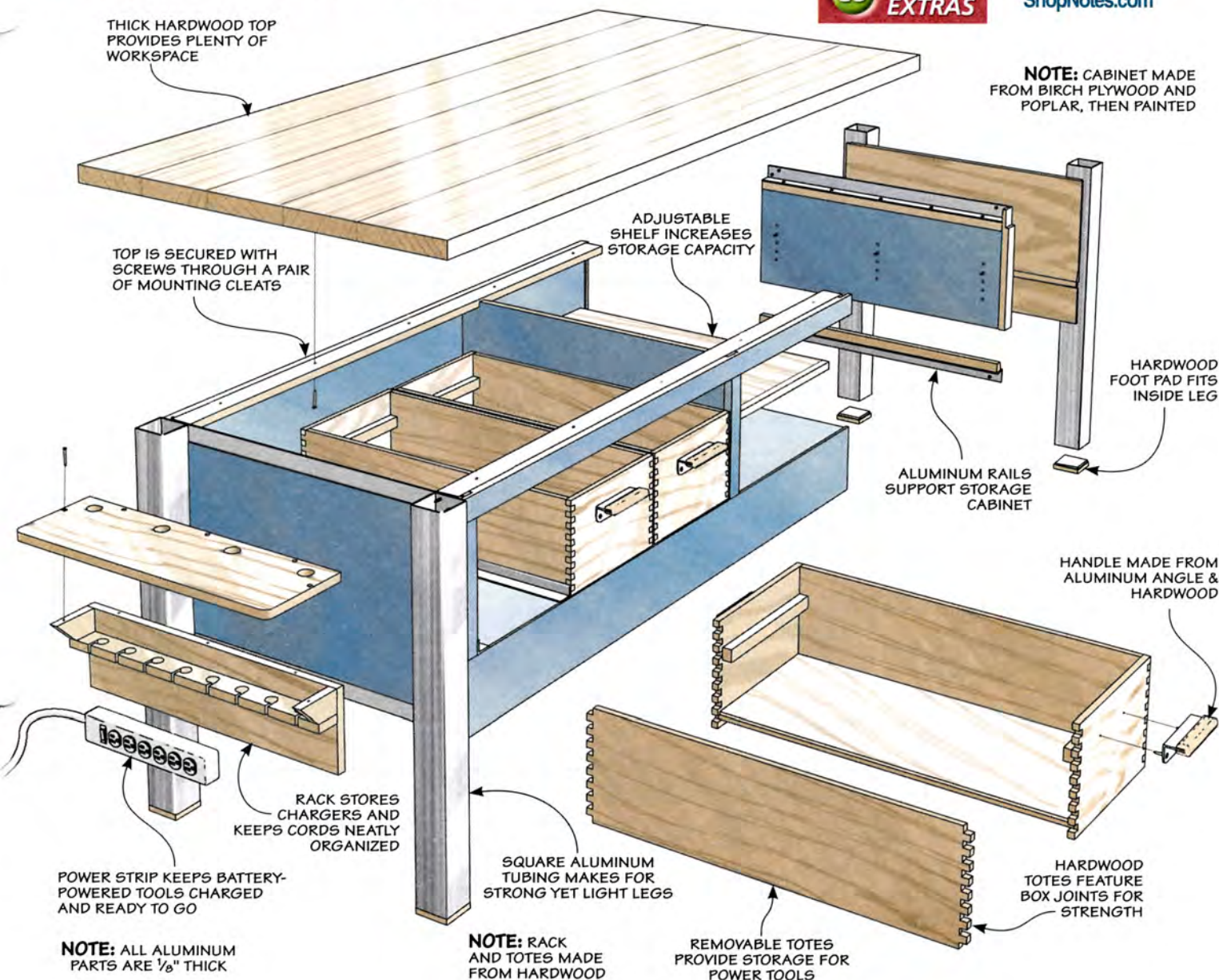
# Exploded View Details

OVERALL DIMENSIONS: 36"D x 72"W x 36"H

ShopNotes

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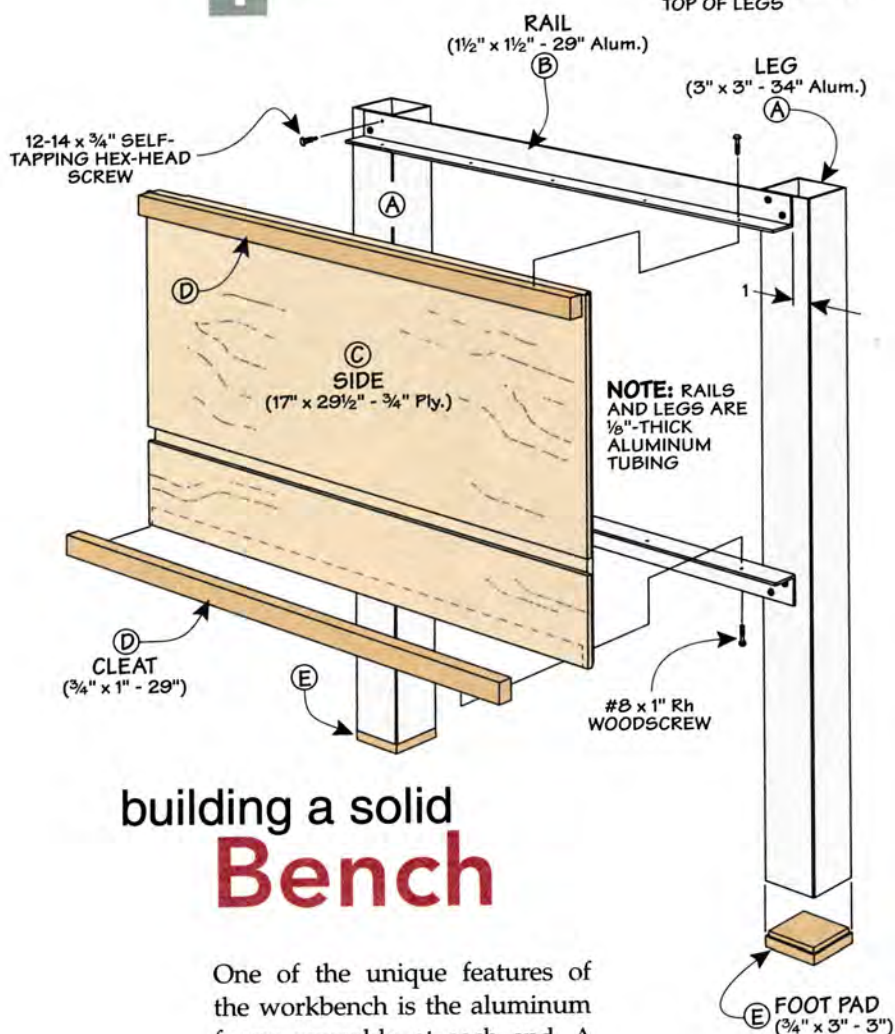


## Materials & Hardware

|                       |                                |                    |                               |                  |              |
|-----------------------|--------------------------------|--------------------|-------------------------------|------------------|--------------|
| A Legs (4)            | 3 x 3 - 34 Square Alum. Tube   | N Shelf (1)        | 18 3/4 x 28 1/4 - 3/4 Ply.    | AA Braces (2)    | 3/4 x 2 - 4  |
| B Rails (4)           | 1 1/2 x 1 1/2 - 29 Alum. Angle | O Shelf Edging (1) | 3/4 x 3/4 - 18 3/4            | BB Cord Rail (1) | 3/4 x 2 - 25 |
| C Sides (2)           | 17 x 29 1/4 - 3/4 Ply.         | P Stop (1)         | 3/4 x 1 3/4 - 38 1/2          |                  |              |
| D Cleats (4)          | 3/4 x 1 - 29                   | Q Guides (6)       | 3/4 x 3/4 - 28 Alum. Angle    |                  |              |
| E Foot Pads (4)       | 3/4 x 3 - 3                    | R Tote Sides (6)   | 1/2 x 8 1/2 - 28              |                  |              |
| F Back (1)            | 20 x 60 - 3/4 Ply.             | S Tote Ends (6)    | 1/2 x 8 1/2 - 12              |                  |              |
| G Bottom (1)          | 30 x 59 1/4 - 3/4 Ply.         | T Tote Bottoms (3) | 11 1/2 x 27 1/2 - 3/4 Ply.    |                  |              |
| H Lower Rail (1)      | 6 1/2 x 60 - 3/4 Ply.          | U Tote Cleats (6)  | 3/4 x 1 - 11                  |                  |              |
| I Inner Side (1)      | 29 x 11 - 3/4 Ply.             | V Handle Bases (6) | 1 1/2 x 1 1/2 - 5 Alum. Angle |                  |              |
| J Divider (1)         | 29 x 13 1/4 - 3/4 Ply.         | W Handle Caps (6)  | 3/4 x 1 - 5                   |                  |              |
| K Stiles (3)          | 3/4 x 1 1/2 - 13 1/2           | X Top (1)          | 1 1/2 x 36 - 72               |                  |              |
| L Upper Rail (1)      | 3/4 x 2 - 60                   | Y Rack Shelf (1)   | 3/4 x 8 - 25                  |                  |              |
| M Mounting Cleats (2) | 3/4 x 2 - 59 1/4               | Z Rack Back (1)    | 3/4 x 7 - 25                  |                  |              |

**1** FIGURE

**NOTE:** RAILS ARE MOUNTED FLUSH TO TOP OF LEGS



## building a solid Bench

One of the unique features of the workbench is the aluminum frame assembly at each end. A pair of 3" x 3" square aluminum tubes are joined with two rails made from aluminum angle. These two frames form the foundation for the rest of the bench.

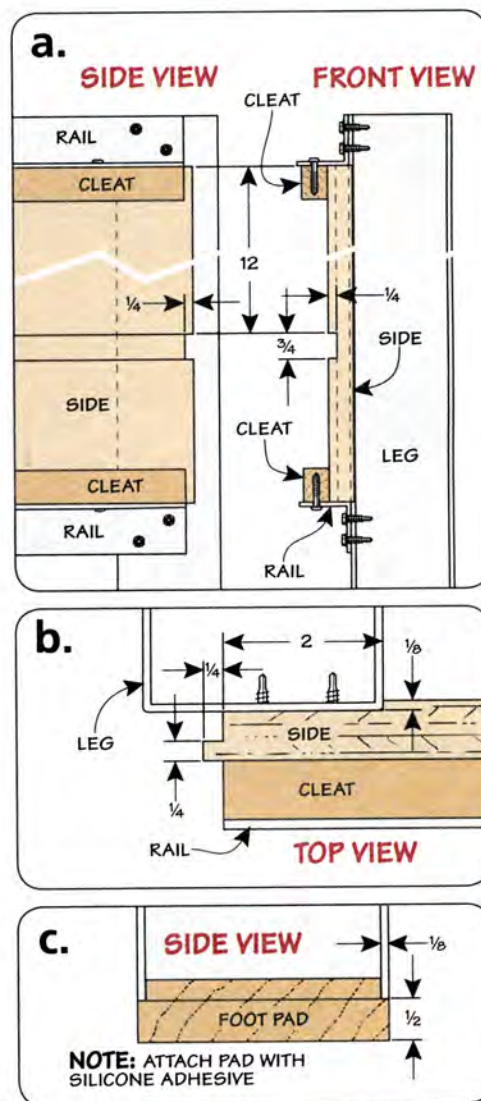
**Metal Work.** You'll start by cutting the aluminum legs to length. You can cut aluminum with your miter saw or table saw, but you'll want to use the right

saw blade. Use one designed specifically for cutting non-ferrous metals or one with a triple-chip grind and a negative hook angle. A slow, easy cut is best.

The same cutting technique applies to the angle rails. Once they're cut to length, you can set them aside for now.

The hardwood foot pads start out as square blanks. They're rabbeted on all four sides to fit snugly inside the legs, as you can see in Figure 1c. I used a few dabs of silicone adhesive to attach them to the bottom of the legs.

**Bench Sides.** The plywood sides of the bench need a little work after they're cut to size. Start by cutting a groove that will be used for securing the bottom panel (Figure 1). Next, cut rabbets to form tongues on the front and back edges (Figure 1b).

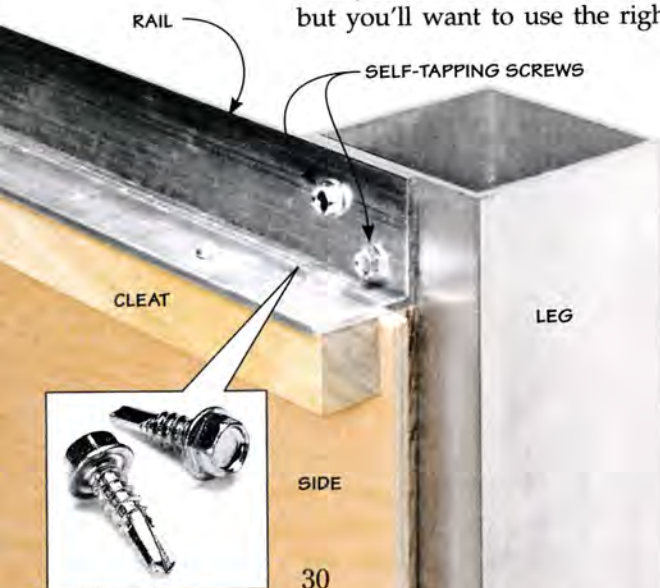


These tongues join with dadoes in the cabinet back and front.

The last thing to do on the sides is cut a pair of wide rabbets (Figure 1b). These wrap around the inside corners of the legs.

The sides are fastened to the aluminum rails with cleats, as shown in Figure 1. After gluing the cleats to the sides, you can fasten the sides to the rails through predrilled holes, as illustrated in Figure 1a and the photo at left. Then you can fasten the side assembly to the legs. I clamped the rails in place and drilled starter holes for the screws before driving them in.

**Cabinet Shell.** The next order of business is the cabinet that connects the two leg assemblies. Figure 2 shows how a bottom, back, and lower front rail tie the leg assemblies together. I started



with the large back panel. A dado near each end fits over the tongue on the cabinet sides. A long groove aligns with the grooves in the sides.

The bottom panel comes next. As you can see in Figure 2, you'll need to cut a dado to accommodate a divider. I drilled a series of countersunk holes from the bottom centered on the dado to fasten the divider later.

To trap the bottom panel in place, I added a lower front rail. Like the back, the ends of the rail need dados. Then form a rabbet along the top edge to fit over the bottom.

To glue up the bottom, back, and lower rail between the leg assemblies, you'll need some long clamps to secure the bottom to the sides. The tongue and dado joinery helps keep everything aligned when applying clamps.

**Cubby.** A divider and inner side panel form a cubby for an adjustable shelf (Figure 3). Cut them to size and drill holes for shelf pins before installing them.

**Face Frame.** To dress up the front of the cabinet, I added a face frame. The three stiles shown in

2 FIGURE

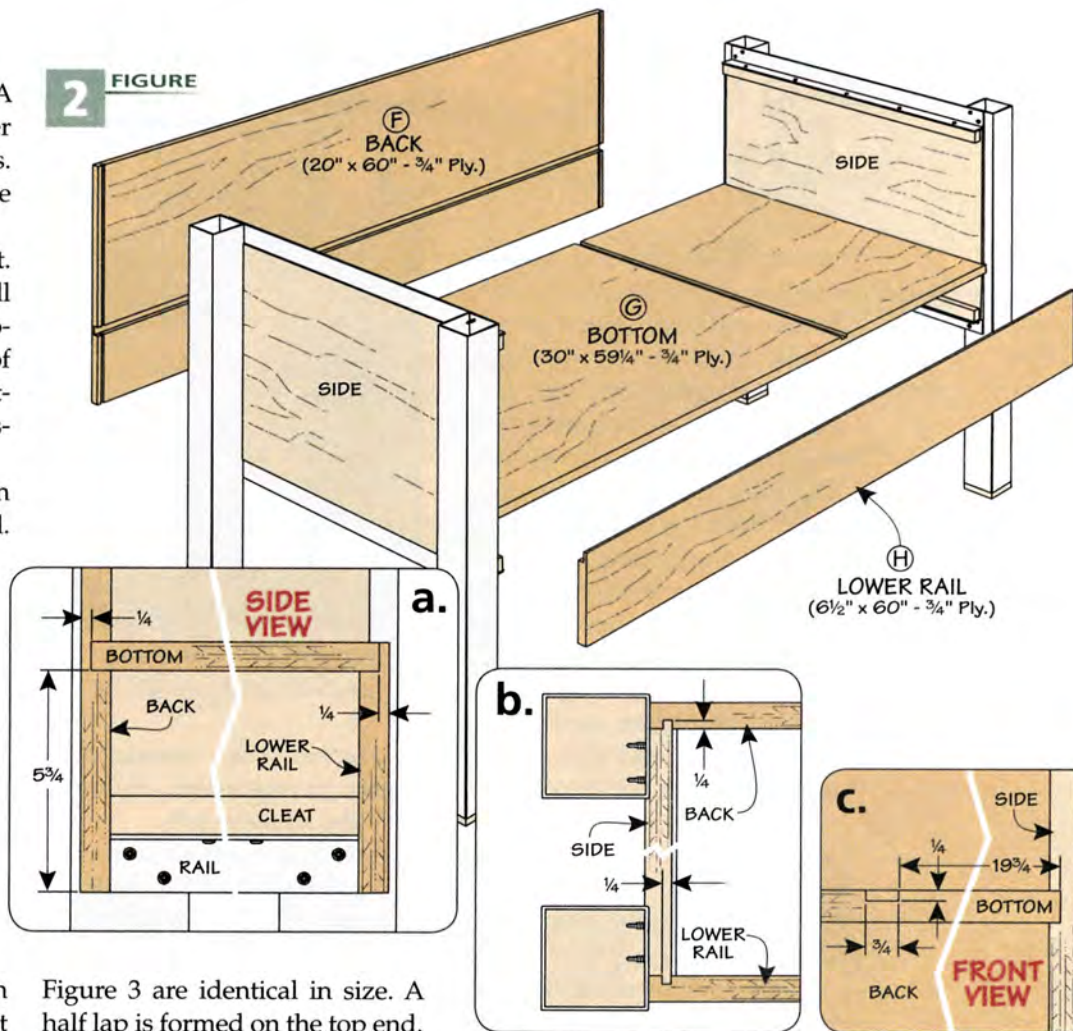


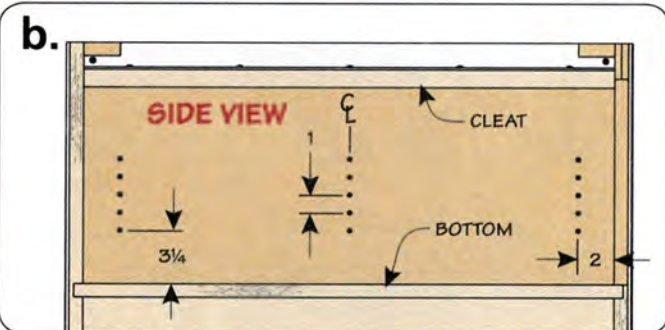
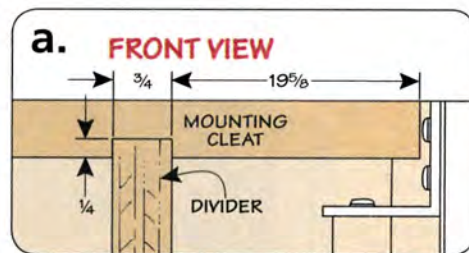
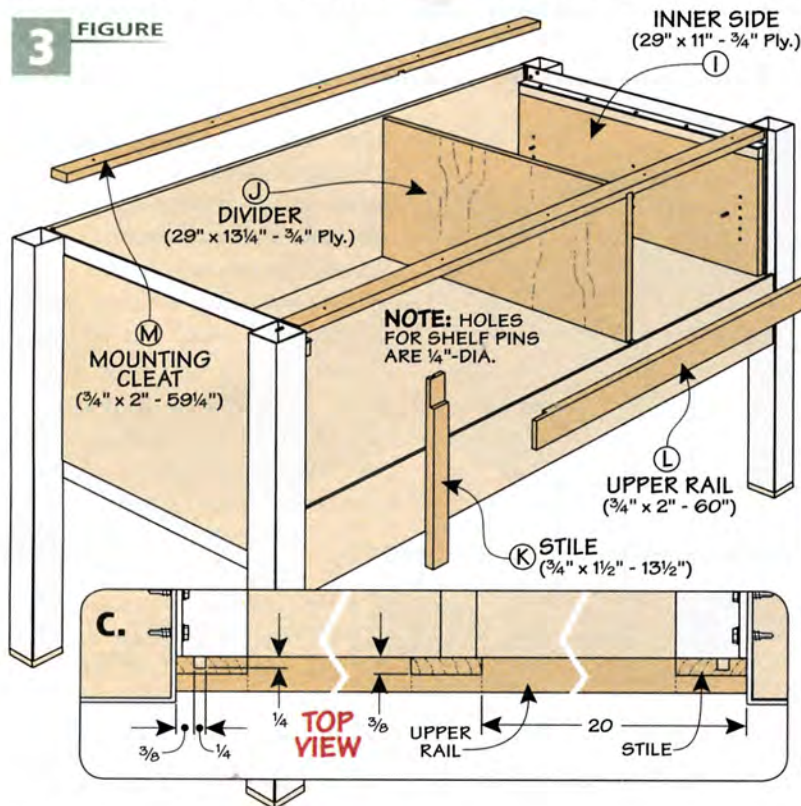
Figure 3 are identical in size. A half lap is formed on the top end. A groove in the two end stiles fit over the tongue on the side panels, as in Figure 3c.

Cut the top rail to size and create the half laps to mate with

each of the stiles. A dado near each end fits over the tongue you made earlier in the sides.

**Cleats.** I made two long cleats to fasten the benchtop. Simply predrill the screw holes before cutting dados to fit over the divider. The cleats can then be glued in place.

3 FIGURE



# adding the final Details

You can turn your attention now to adding storage, a top, and a battery charging station to your bench. Three roomy removable totes fit inside the bench to hold a variety of power tools. An adjustable shelf is ideal for accessories. The thick hardwood top makes for a lot of working space. Finally, the charging station keeps chargers and batteries organized and easy to access whenever needed.

**Paint.** Before getting started though, remove the leg and rail assemblies to paint the cabinet. I primed it first and then sprayed on a couple coats of paint.

**Shelf.** There's not a lot to do when it comes to the adjustable shelf. It's cut to size, and edging is applied to the front, as you can see in Figure 4.

**Guides.** After re-attaching the leg assemblies, install the drawer stop and guides (Figure 4). Spacers help keep them square and parallel as you fasten them.

**Strong & Sturdy Totes.** The trio of totes is designed from the ground up to hold a lot of tools (photo above). The  $\frac{3}{4}$ " plywood bottom combined with



▲ **Convenient Storage.** Sturdy totes hold a lot of tools and accessories and can be removed and carried anywhere.

box-jointed sides results in a sturdy combination. Figure 5 provides all the details.

Making the sides, front, and back of the totes is pretty straightforward. They're cut to length but left a little wide. After cutting the box joints, trim them to final width to create full pins.

Before moving on, there's something a little unique about the tote bottom I need to mention. I wanted to hide the grooves for the bottom so they wouldn't show up in the assembled box joint. The grooves in adjacent pieces are offset from each other

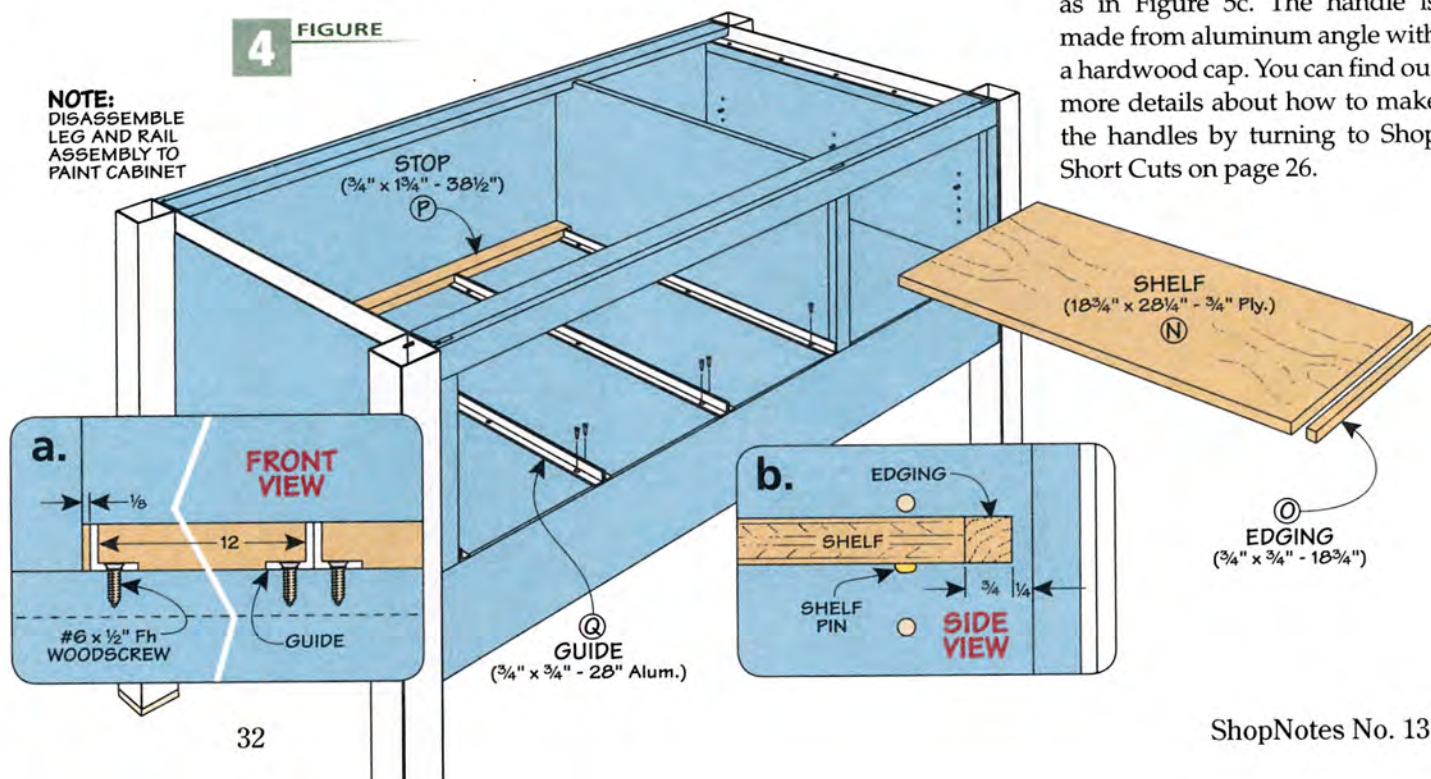
and aligned with the notch of the box joint on their respective pieces, as you can see illustrated in Figures 5a and 5d.

These offset grooves mean that you need to form matching offset tongues on the tote bottom. Figures 5b and 5d show you what I mean. A  $\frac{1}{4}$ " tongue along the sides of the bottom mates with the grooves in the tote sides. Likewise, a  $\frac{1}{2}$ " tongue on the ends of the bottom engages the grooves on the front and back of the tote.

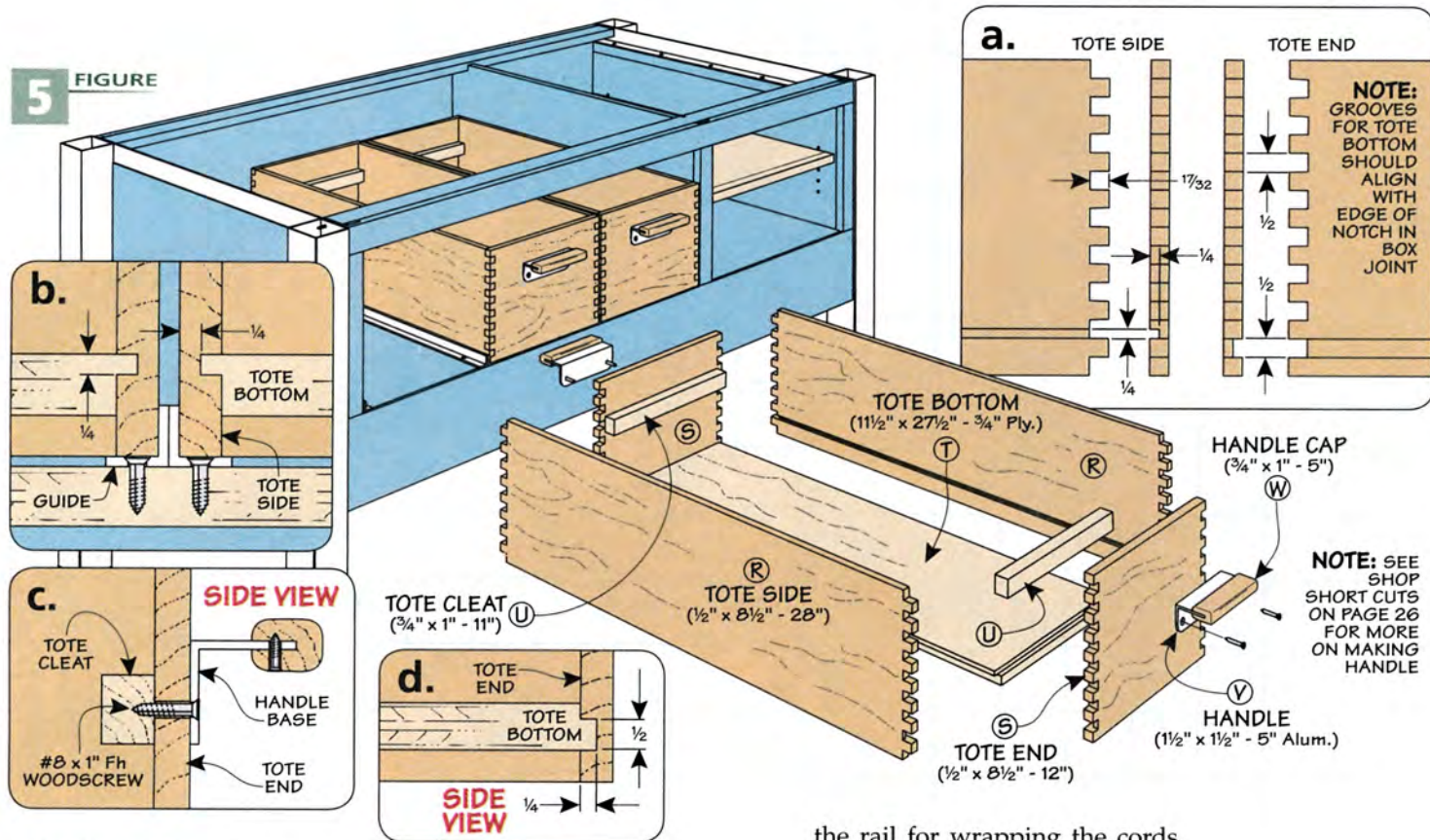
**Pairs of Handles.** After assembling the tote, you can add a cleat and two-part handle at each end, as in Figure 5c. The handle is made from aluminum angle with a hardwood cap. You can find out more details about how to make the handles by turning to Shop Short Cuts on page 26.

4 FIGURE

NOTE:  
DISASSEMBLE  
LEG AND RAIL  
ASSEMBLY TO  
PAINT CABINET



5 FIGURE



**Hardwood Top.** The next item on the to-do list is gluing up 1 1/2"-thick stock for the top (Figure 6). After trimming it to final size, install it with screws through the pair of mounting cleats.

**Charger Rack.** The last thing to do is build a rack that incorporates a shelf, power strip, and a

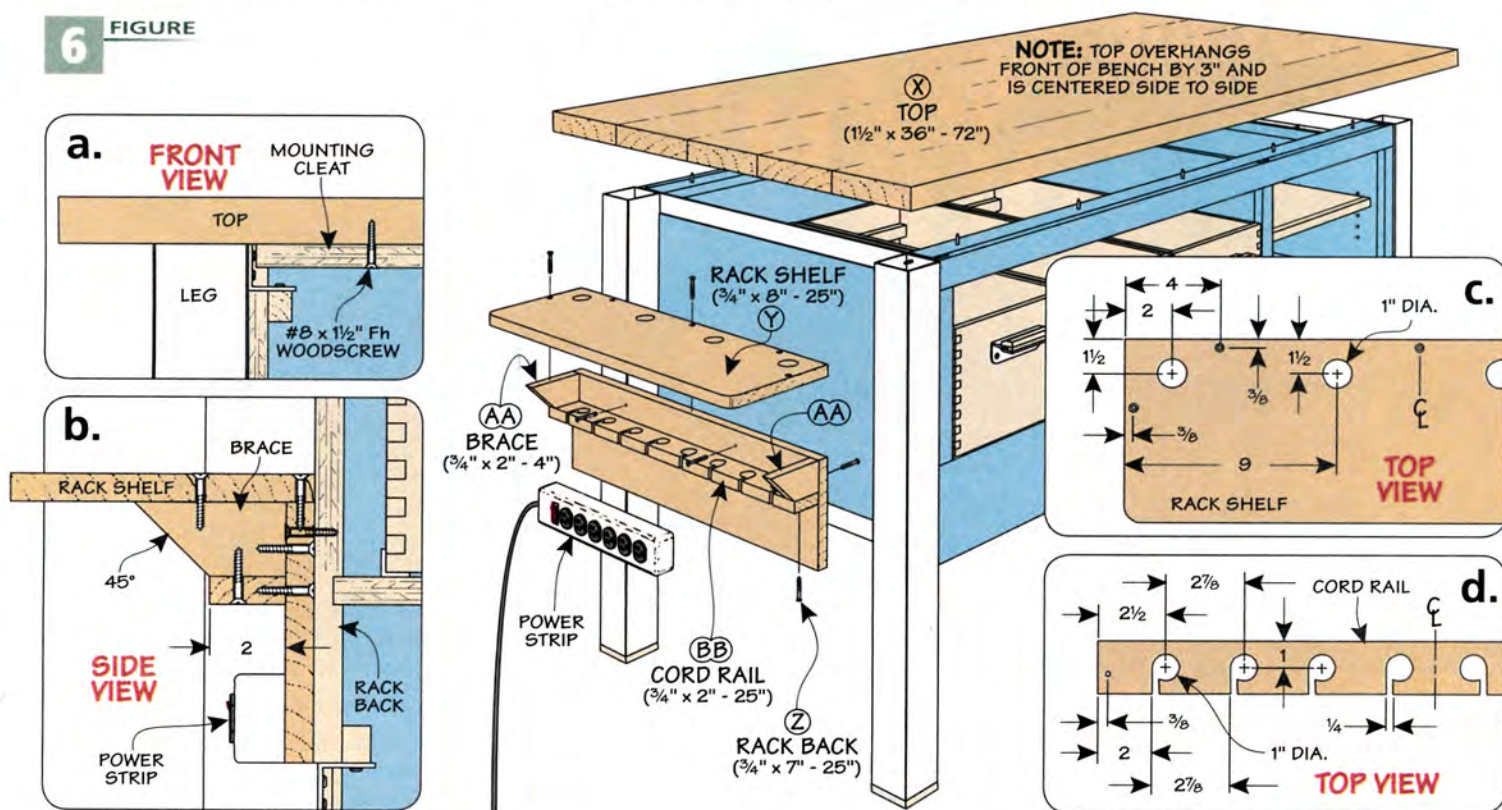
cord rail to keep the cords neatly organized. You can see in Figure 6 how it goes together.

After cutting all the parts to size, I drilled the holes in the shelf for the charger power cords. I also drilled the series of holes in the cord rail then cut the slots in

the rail for wrapping the cords. Now, assemble the rack and attach the power strip. For your convenience, you can mount the rack on either end of the bench.

**Finishing.** I wiped on a few coats of varnish for the totes, rack, and benchtop. Then you're ready to load the bench with tools and get to work. 🛠️

6 FIGURE



A person wearing a blue long-sleeved shirt, a green apron, and jeans is standing next to a mobile cutoff bin. They are placing a piece of wood into the bin. The bin is made of plywood and has several compartments. It is filled with various pieces of wood, including planks and boards. The bin is on wheels and has a handle on the side. The background is a workshop with a wooden wall.

storage  
solutions

# mobile Cutoff Bin

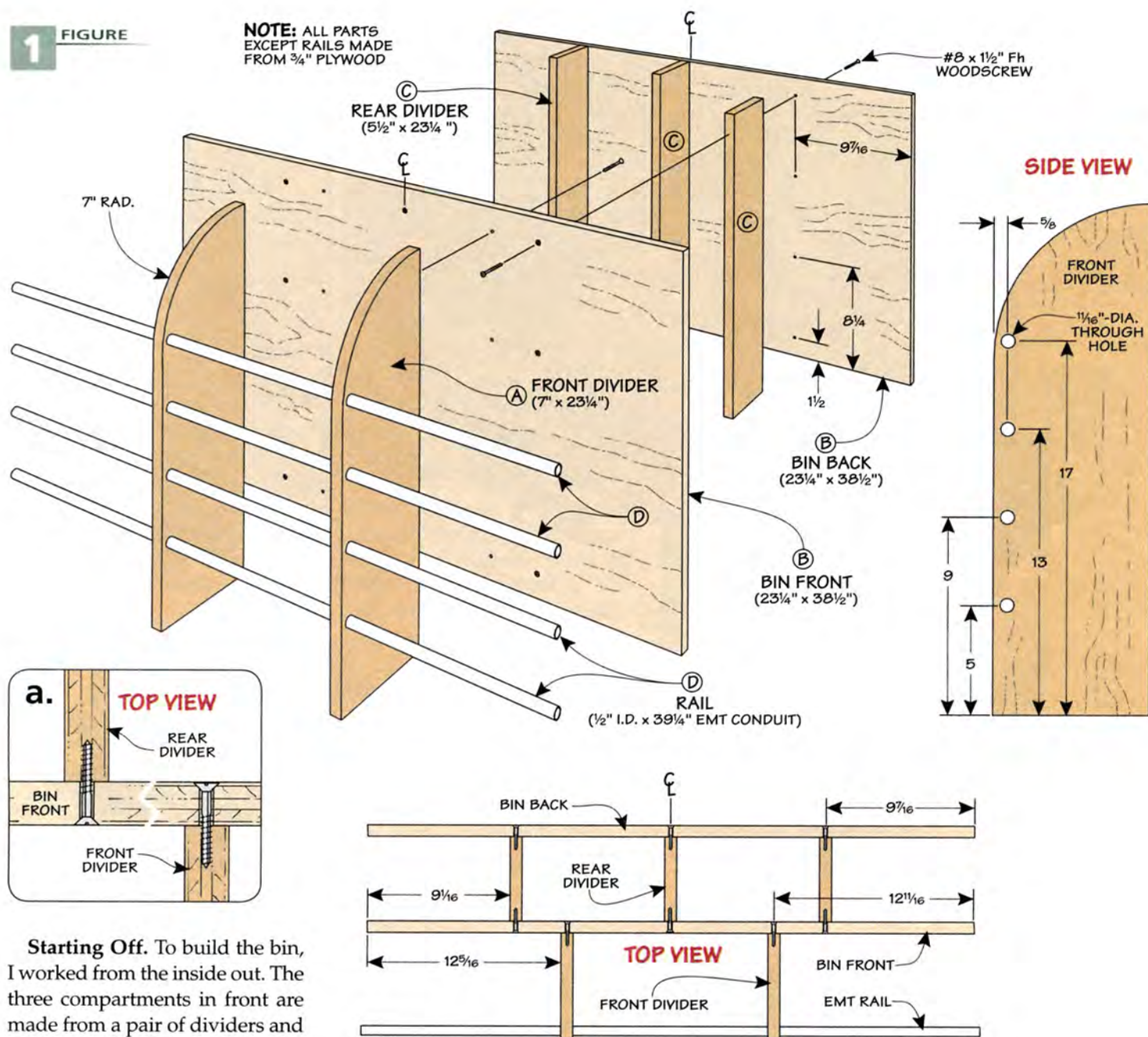
This handy cart provides a home for all those cutoffs that are too good to throw away.

■ When I'm in the middle of a project and using the table saw heavily, having a place to toss the cutoffs is pretty important. The mobile bin you see above is the perfect solution. It's home is usually right next to my table saw. But it can be rolled wherever I need a handy place to save useable cutoffs.

The construction couldn't be easier — it's made from plywood with butt joints reinforced with screws. And the front rails are made from  $\frac{1}{2}$ " EMT conduit you'll find at a home center or hardware store. It's a quick build that's sure to go a long way toward keeping your shop neat and clutter-free.

**1** FIGURE

**NOTE:** ALL PARTS EXCEPT RAILS MADE FROM  $\frac{3}{4}$ " PLYWOOD



**Starting Off.** To build the bin, I worked from the inside out. The three compartments in front are made from a pair of dividers and metal conduit. Two large panels form the front and back of the four compartments in the middle of the bin. The drawings above show the details.

**Curved Dividers.** Begin by cutting the two front dividers to size. Lay out the curves, and then use a band saw or jig saw to cut them to shape, sanding them smooth afterward.

To make the conduit easier to install, it's important to keep the holes in the front dividers aligned. To do this, I stacked the parts together before drilling the holes at the drill press.

**Front & Back.** Set the dividers aside for now to cut the front and

back of the compartments to size. You'll need to drill several countersunk screw holes that will be used when installing the dividers. The Top View drawing above will help in laying out the spacing and location of the screws.

**Rear Dividers.** The rear dividers are the last things to cut to finish up the inside compartments. They're simply cut to size before you start the assembly process.

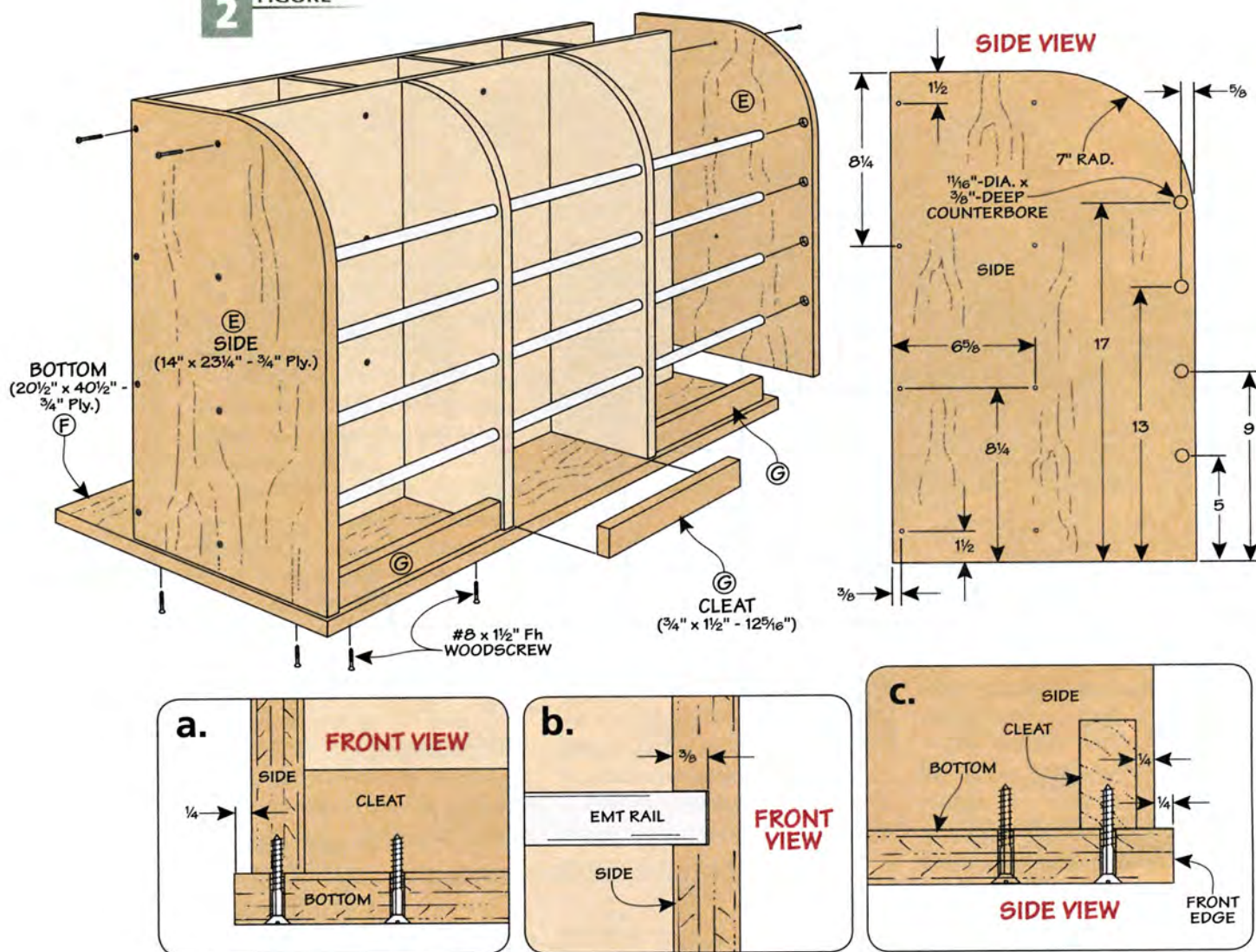
**Assembly.** Putting all the parts together involves clamping the parts in place, drilling pilot holes, and then driving in the screws.

There are a lot of screws, but I still glued all of the joints.

To help align and position the parts evenly while clamping them, I used scrap pieces of plywood as spacers. A spacer at the top and bottom of the dividers will help keep them square and parallel to each other until the screws are installed.

**Conduit Rails.** The four conduit rails are easy to cut with a hack saw. I took some time to file the rough edges smooth to make it easier to slide the rails through the holes in the front dividers.

2 FIGURE



## final Details

Finishing up the cutoff bin involves adding the sides plus a shelf and back that form a pocket for storing plywood cutoffs. You'll also add a bottom and casters to make the bin mobile.

**Sides.** The pair of sides start out as rectangular blanks. Figure 2 shows how they're curved to match the curve you cut on the two front dividers.

The holes in the sides that accept the conduit rails aren't through holes, so I couldn't stack the sides together to drill the counterbored holes. Here, some careful layout and temporarily

placing the sides on the bin assembly will help ensure these holes are in the correct location. Then drill the countersunk screw holes and attach the sides.

**Base.** Making the plywood bottom follows along the same lines as the front and back you made earlier. It's cut to size and then predrilled for screws used to attach it to the cart assembly.

I turned the assembly upside down on the shop floor to attach the bottom. I centered the bottom left-to-right and left a  $\frac{1}{4}$ " overhang on the front. Drive the screws to fasten it down before flipping the assembly over to add the cleats along the front.

**Cleats.** The three cleats you see above keep cutoffs from slipping out of the bins. They're pieces

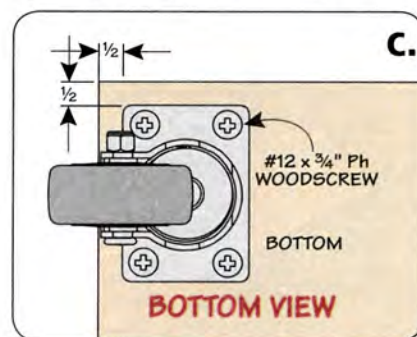
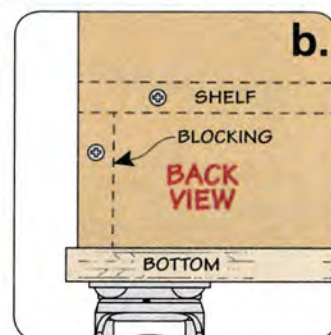
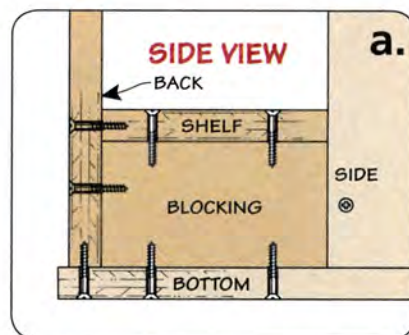
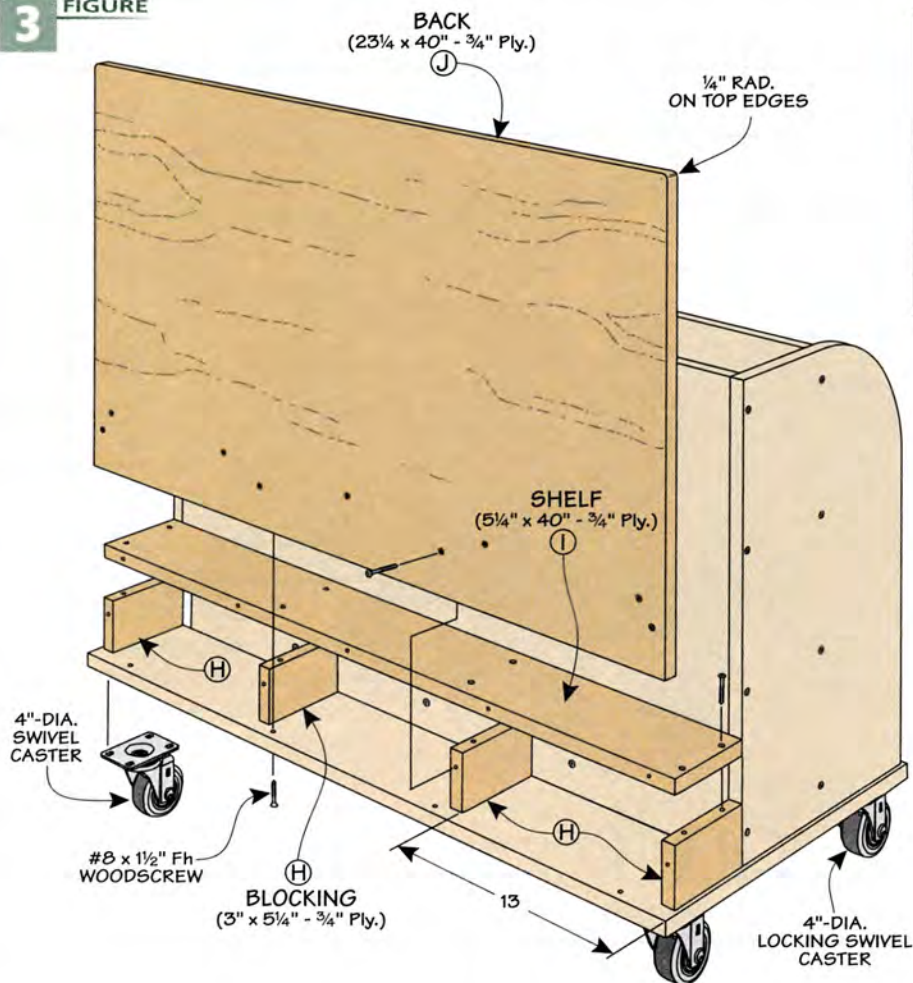
of hardwood cut to size and installed with a pair of screws through the bottom.

**Rear Storage.** You'll turn your attention now to the rear of the cart. Blocking creates an elevated shelf for holding plywood cutoffs and strengthens the back to keep the cutoffs contained.

You can start by cutting  $\frac{3}{4}$ " plywood to size to make the blocking shown in Figure 3. These pieces provide a secure connection for the back and serve to elevate the shelf. I installed the blocking with a few screws through the bottom.

Adding the shelf is just a matter of cutting it to size and installing it with screws on top of the blocking. Then the back panel can be cut to size.

### 3 FIGURE



**Installing the Back.** The back panel rests on the bottom and is screwed to the blocking and shelf. To help ensure that I installed the screws into the blocking, I extended pencil lines from the edges of the blocking out to the edge of the bottom panel.

Now you can put the back panel in place, aligning the outside edges flush with the outside blocking. Adding a few clamps to hold it in position frees up your hands to drill the screw holes and drive in the screws.

**Casters.** Once again, you'll need to flip the cart over to install the four swivel casters. Two of the casters are locking and I installed them at the front. Figure 3c shows how the caster plates are inset from the edges of the bottom. Drill pilot holes before installing the pan-head screws.

**Applying a Finish.** Because it's a shop project that will see quite a bit of use, I like to apply a couple coats of wipe-on varnish. (You can also use a spray finish if you prefer.) The finish helps keep

dirt and grime off the plywood. And since the cart will collect a lot of dust near my table saw, a finish makes it easier to vacuum away the sawdust when it comes time to tidy up the workshop.

The last thing to do is find a convenient spot to place the cutoff bin. You'll want to keep it within reach near your table saw or miter saw. It's a handy place to keep cutoffs that are too big to throw away. Who knows when you just might need those pieces for a special project? 

## Materials & Hardware

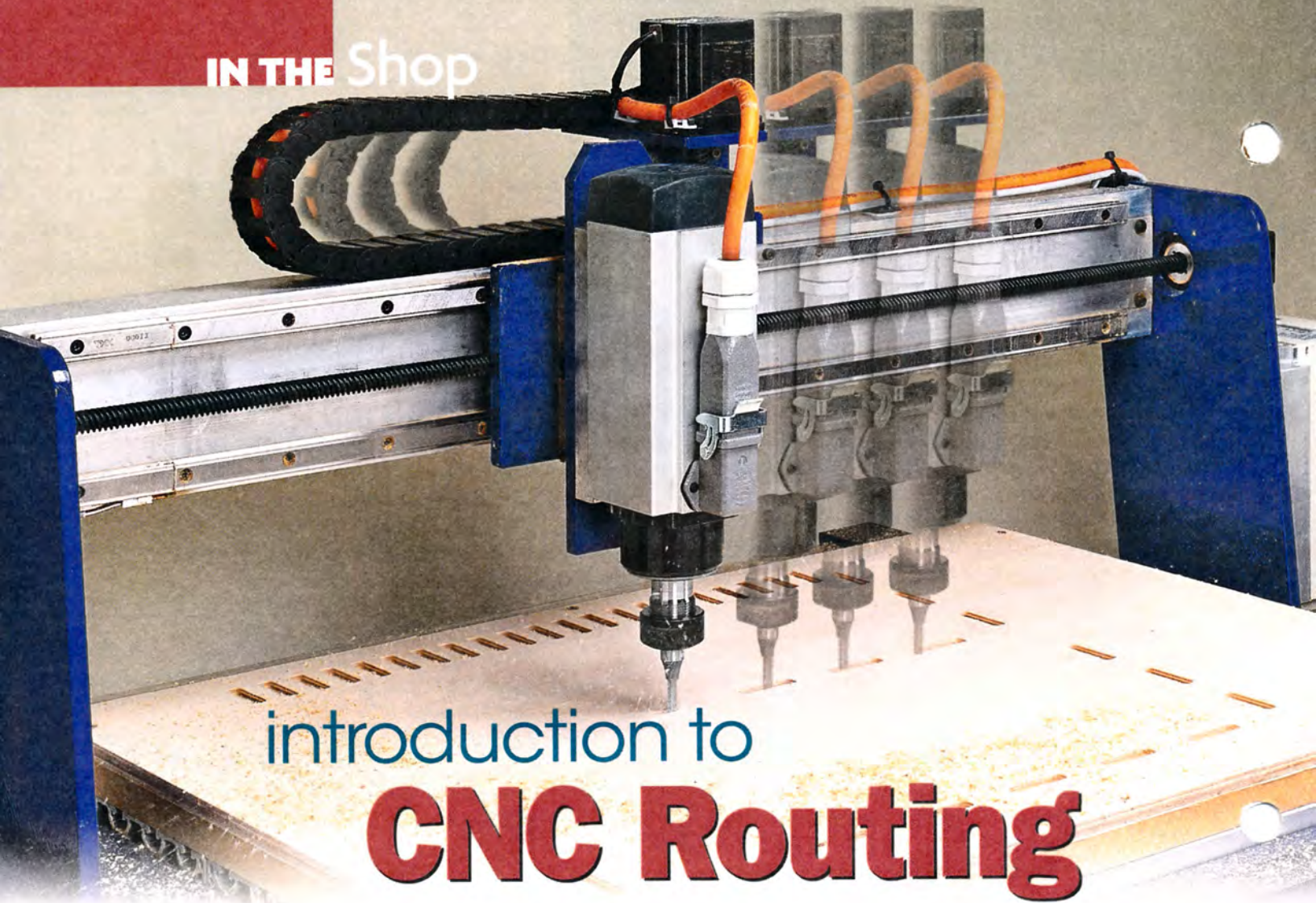
|   |                    |                               |
|---|--------------------|-------------------------------|
| A | Front Dividers (2) | 7 x 23 1/4 - 3/4 Ply.         |
| B | Bin Front/Back (2) | 23 1/4 x 38 1/2 - 3/4 Ply.    |
| C | Rear Dividers (3)  | 5 1/2 x 23 1/4 - 3/4 Ply.     |
| D | Rails (4)          | 1/2-dia. x 39 1/4 EMT Conduit |
| E | Sides (2)          | 14 x 23 1/4 - 3/4 Ply.        |
| F | Bottom (1)         | 20 1/2 x 40 1/2 - 3/4 Ply.    |
| G | Cleats (3)         | 3/4 x 1 1/2 - 12 5/16         |
| H | Blocking (4)       | 3 x 5 1/4 - 3/4 Ply.          |

|   |           |                        |
|---|-----------|------------------------|
| I | Shelf (1) | 5 1/4 x 40 - 3/4 Ply.  |
| J | Back (1)  | 23 1/4 x 40 - 3/4 Ply. |

- (69) #8 x 1 1/2" Fh Woodscrews
- (2) 4"-dia. Locking Swivel Casters
- (2) 4"-dia. Swivel Casters
- (16) #12 x 3/4" Ph Woodscrews



To download a free cutting diagram, go to:  
[ShopNotes.com](http://ShopNotes.com)



## introduction to CNC Routing

Learn the basics of this powerful tool and see if a CNC machine has a place in your shop.

▼ **CNC Toolbox.**  
The plywood parts  
for this toolbox  
were cut on the  
CNC machine.



■ If you've been sitting on the sidelines wondering what all the fuss is about CNC routers in the shop, go ahead and pull up a chair. You'll be interested to find out how a CNC router might be in your workshop's future.

**The Benefits.** A CNC router excels at routing any type of part repeatedly with incredible precision. Whether it's carving a model, recess for a complex inlay, accurately carving a detail on a period reproduction project, or just making signs, a CNC router can get the job done quickly and with repeatable accuracy.

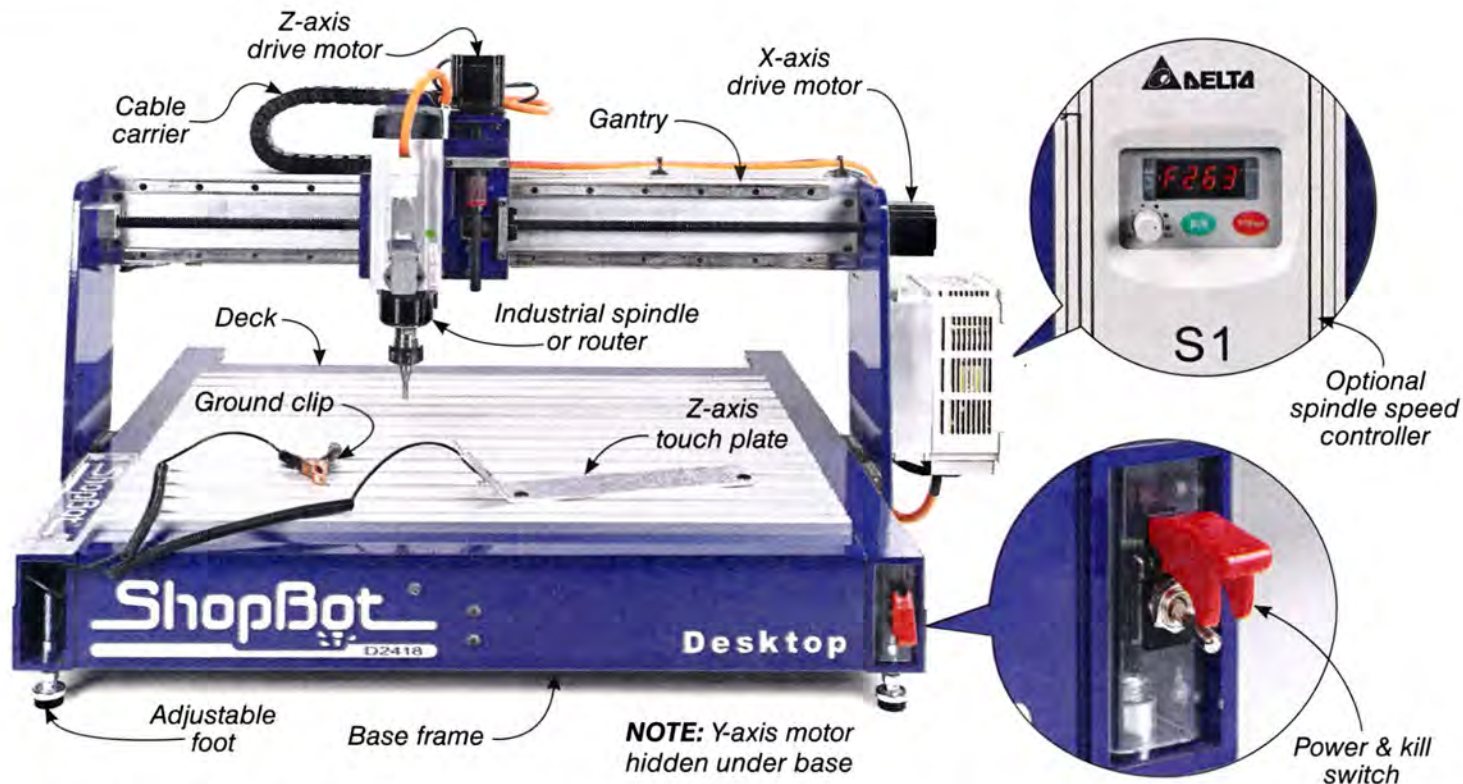
**A Brief CNC History.** Computer Numerically Controlled (CNC) machines have been around for decades. They were originally designed to make producing parts in factories faster and more accurate. These machines typically cost hundreds of thousands of dollars.

As with all things that take advantage of technology, the

price and size of these machines have come down to a point that fits the budget and shop space of a lot of home woodworkers. Now you can buy a small CNC router for as little as \$2,000.

**An Overview.** In an industrial setting, a "CNC machine" can mean any machine that uses a computer to control cutting, milling, drilling, grinding, or any combination of these steps. For home woodworking shops, a CNC machine usually means a computer-controlled router.

It's a good idea to become familiar with the parts of a CNC router, so I'll demonstrate with the ShopBot system shown at the top of the opposite page. Most CNC routers operate in the same



way and have similar components. The most important part is the spindle, or router.

**The Business End.** As you might guess, it's the spindle motor that drives the router bit. On some machines, the spindle is built in. On others, you supply a router motor. In either case, the spindle rides on an assembly that moves and is controlled by three separate motors.

**3-Axis Routing.** Each of these three motors drive the spindle in a different direction. You can see what I mean in the lower right photo. These step (sometimes called "stepper") motors spin in very small increments, or "steps" under computer control.

To perform any routing task, the spindle needs to move in three axes: X, Y, and Z. (You can see the X- and Z-axis drive motors above.) Basically, one step motor moves the spindle left and right. Another motor drives the front-to-back movement. And a third motor takes care of the depth of cut by moving the spindle up and down. They all work in unison under guidance from your own personal computer.

**Software Brains.** None of these mechanical parts are any

good without computer software. As a matter of fact, most machines need to be connected to a computer. It's the computer that translates your designs into instructions the CNC router can interpret. When CNC machines were first developed, you had to become a programmer to operate one. You had to know how to speak the machine's "language."

Not anymore. Most CNC routers include software to make them easier to use. The basic process starts with your design. You'll need to create your design on the computer first. Once that's done, you'll need to export the design file to the software that creates the set of instructions for the CNC router. What's nice is that a lot of CNC systems can import files from popular illustration and computer-aided drafting (CAD) software.

After you import your design into the CNC software, you can set up toolpaths and basically tell the router how to create your design. (You'll learn more about this on page 40.) Once that's done, you use another piece of software that controls the router. It follows the instructions you set up to create your project.

**What to Consider.** How do you shop for a CNC router? The first step is to do a lot of research. You'll find a list of resources online at ShopNotes.com to get you started. Some other items to consider are your budget, space, software support, dust collection, and how comfortable you are with computers and learning new software. Online forums are a great resource to learn more about a particular machine that you may be interested in.

**Making a Toolbox.** On the next few pages, I'll show you a few of the steps used to make the toolbox shown in the left margin.

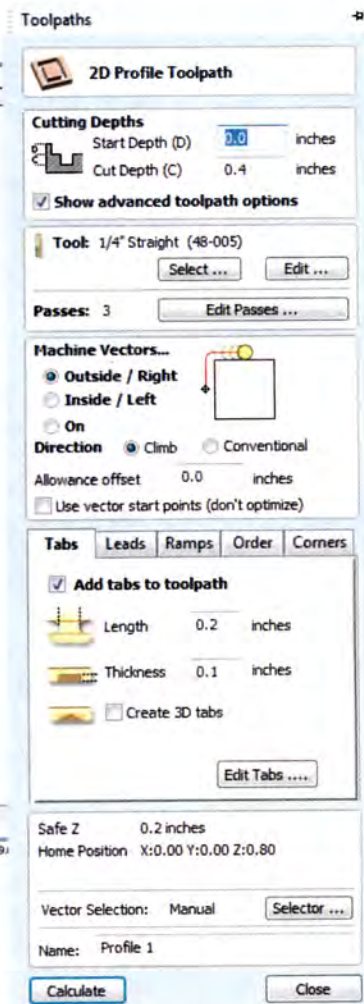
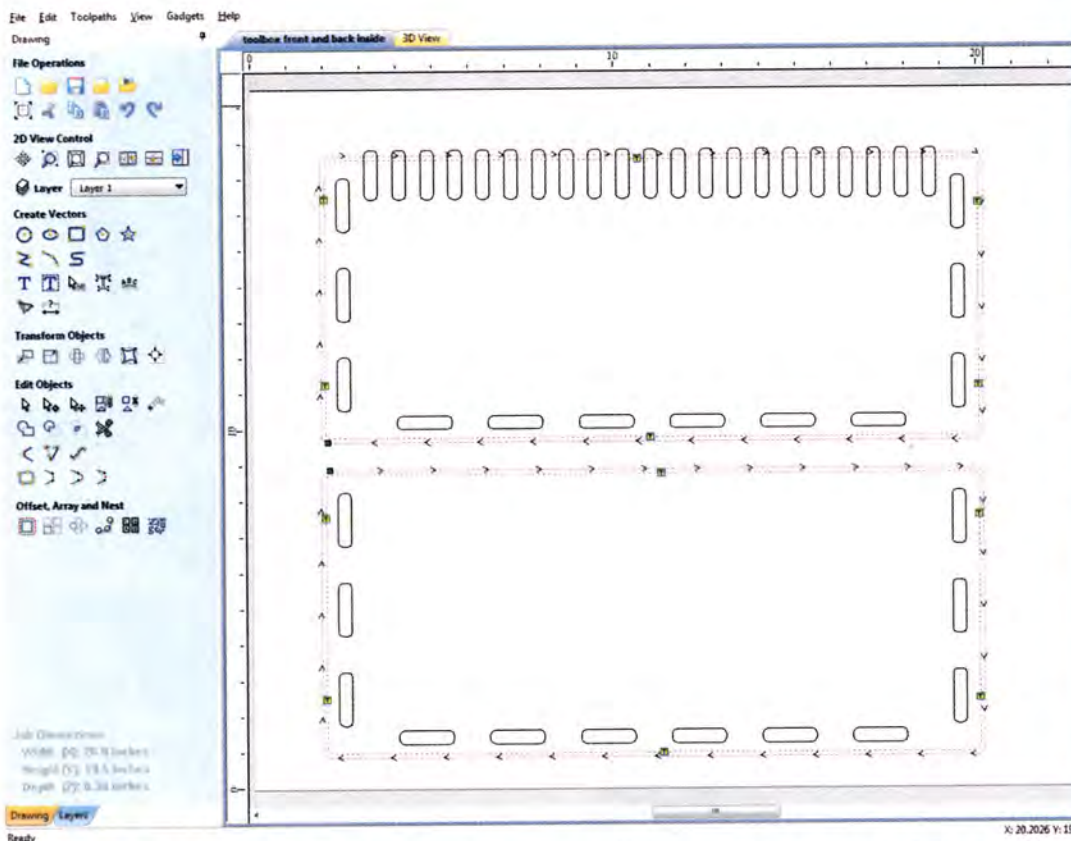
**NOTE:** For contact information for ShopBot Tools, refer to page 51.



For a list of online CNC resources, go to:  
[ShopNotes.com](http://ShopNotes.com)

▼ **3-Axis Milling.** The router spindle can move in three directions.





▲ **Design & Assign.** After importing or creating your design, you need to assign toolpaths (right) for each operation to be completed by the CNC router.

## setting up the CNC Router

**ShopNotes**

**GO ONLINE EXTRAS**

To download CNC and design files for the toolbox, go to: [ShopNotes.com](http://ShopNotes.com)

I want to take you through the basic process of making the toolbox shown in the photo below. I can't explain every step in detail, but I'll give you the highlights. (You can download the files I used and a brief description of the assembly process online at [ShopNotes.com](http://ShopNotes.com).) By the time we're done, you'll have a better understanding of just a small fraction of the CNC machine's capabilities and features.

**Design.** The first thing I had to do was design the toolbox on the computer. I used the software that came with the ShopBot, but you can use any drawing software you're already familiar with. You just have to be able to export the file from your design software into a format the CNC software can import and use.

The ShopBot software (VCarve Pro) is supplied by Vectric Ltd. and is included with the purchase of the CNC router. You can see part of the toolbox design in the upper left. This is the layout for the inside faces of the front and back of the toolbox.

▲ **Toolpaths.** Here, you specify which tool to use and all of the parameters for the operation.

**Assign Toolpaths.** Once your parts are designed, the next step is to start providing instructions for the CNC router. First, you'll need to specify the material thickness of the parts to be cut.

The next step is to provide specific instructions for cutting the parts. This is done through the Toolpaths menu you see above. You first select the vectors (lines) you want to be routed with the bit. These are the dashed red lines in the above photo.

Through the Toolpaths menu, you specify the tool (router bit) to use for this particular cut. You can pick from a standard library of CNC router bits or assign parameters to bits that may not already be in the list. From there, you specify all of the parameters as instructions for the CNC machine. You can see just a few of the many parameters above.

► **Assembly.** Precise parts means easier assembly. A little glue is all that's required.





▲ **Zero the Z-Axis.** After installing a bit in the spindle (left), use the touch plate (above) to tell the machine where the zero point of the Z-axis is located.



▲ **Status.** This window tells you the status and location of the end of the router bit.

For the vectors selected, I'm instructing the router to cut all the way through the plywood in three passes to make the parts. A different toolpath is set up to make the pocket cuts for the hinge knuckles shown in the bottom right of the page. A third toolpath takes care of routing the blind mortises (slots) for assembling the toolbox.

The software allows you to preview the toolpaths in 2D or 3D to make sure the router will do what you expect. Once you're satisfied, you generate a "post-processor" file (part file) that contains all of the instructions for the machine to do the work.

**Machine Work.** With the design done, you can get the machine ready to cut parts. First, you need to mount a sacrificial, auxiliary table to the bed of the machine. This is called a spoilboard and helps protect the bed.

Now you can launch the software used to send instructions to the machine. After loading the part file you generated earlier, you're almost ready to go.

But there's one critical step you need to complete first. And that's to tell the machine where the zero point of each of the three axes is located. The machine has switches to tell it where the origin of the X- and Y-axes are located.

To zero the Z-axis, install the router bit in the spindle (left

photo above). The ShopBot uses an aluminum plate under the bit to figure out where "zero" is (center photo above). In this case, zero will be the top of the spoilboard. The photo above right shows the status of the machine.

**Ready to Cut.** After mounting the Baltic birch plywood to the spoilboard with screws, you're ready to let the router get busy. The big green button shown in the photo at right gets the spindle spinning and start cutting. (Note: We've removed the dust shroud for clarity.) For this part file, the router uses the same bit for all three toolpaths I defined earlier.

Once the outline of the parts is complete, it will start routing the

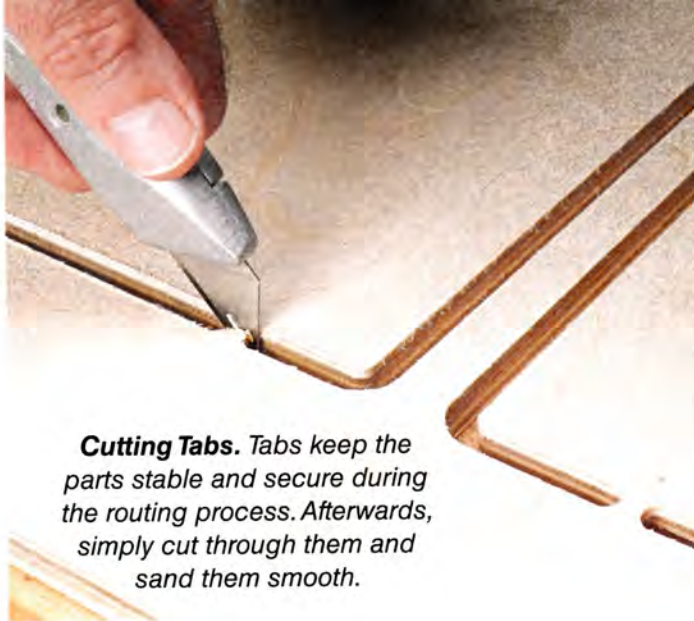
slots used for assembly, followed by the recesses for the hinge knuckles, as you can see in the photos below.

**Multiple Tools.** Just like building a project at your router table, you'll want to use different bits for different tasks. For example, I could use a 1/2" straight bit for cutting a dado and use an 1/8" straight bit for cutting out the parts. The control software recognizes when a tool change is necessary and stops the router when a different tool is required. Simply install the appropriate bit when prompted and re-zero the Z-axis. Then you can restart the machine to continue the job.



▲ **Routing Hinge Recesses.** A CNC router is perfect for tedious tasks like routing all of the recesses for the hinge knuckles to attach the lid, as shown in the inset photo.





**Cutting Tabs.** Tabs keep the parts stable and secure during the routing process. Afterwards, simply cut through them and sand them smooth.



▲ **Attaching a Workpiece.** One of the keys to success is making sure the workpieces are secure. Here, Z-clip fasteners do the trick.

## completing the Toolbox

Making all of the remaining parts of the toolbox follows along the same lines as before. First, you need to assign toolpaths to all of the linework in your design. Then generate a part file for the CNC machine. After fastening the material to the spoilboard and zeroing the Z-axis, you're ready to cut the parts.

**Creating Tabs.** If you're familiar with routing with a hand-held router, you know how important it is that the workpiece remain secure and stable during the cut. The same rule applies with a CNC router. This is particularly true when you're cutting out a part from the material. As the router is making the final pass and cutting through the material, the bit can "grab" the loose part.

There's a feature in the CNC software that takes care of this problem. You can let the software leave small "tabs" of material, as shown in the upper left photo.

These tabs keep the part stationary and secure.

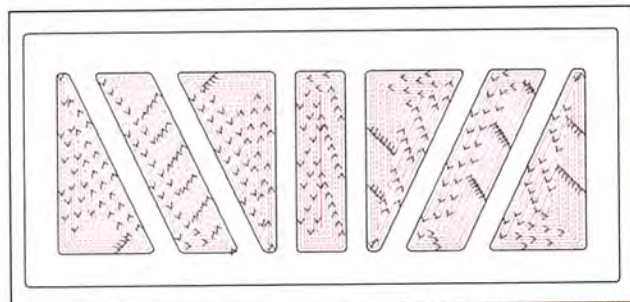
To cut the parts free, I use a utility knife to cut through the thin tabs. Then it just takes a minimal amount of sanding to remove the "nibs" and smooth out the edges.

**Two-Sided Routing.** Earlier, I routed the inside faces of the front and back of the toolbox and cut out the overall profile. I wanted to add some decorative pocket cuts to the outside faces, as you can see below. But the problem is how to register the workpiece so the router knows where to cut on the second side.

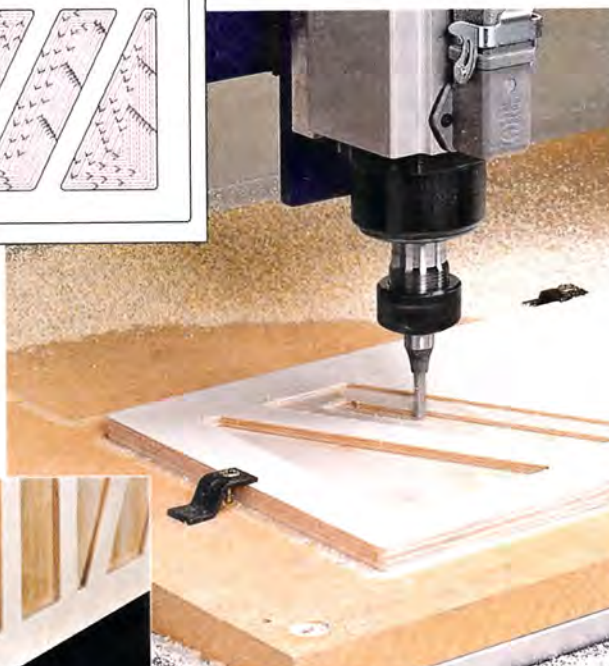
Fortunately, the depth of cut when routing out the profile left a shallow outline of the part in the spoilboard. So all I needed to do was flip the part over and register it against these lines as a guide. The right photo above shows how this works as I fastened the toolbox front to the spoilboard using Z-clip tabletop fasteners. These fasteners keep the workpiece from shifting.

**Lettering & Graphics.** To add a little more pizzazz to the toolbox, I thought it might be interesting to engrave our *ShopNotes* logo on top of the lid. You can see how it was carved and then painted in the upper photos, opposite page.

CNC machines have been used in the sign-making business for years, and for good reason. They excel at the intricate, precise carving requirements of signwork.



▲ **Toolpath.** The preview of the toolpath for the pocket cuts show the direction of routing.



▲ **Pocket Cuts.** The decorative pocket cuts in the toolbox (left) are cut in two shallow passes (above).

To add the logo to the lid of the toolbox, I imported the graphic file into the design software. Then I assigned a toolpath to each of the outlines (vectors). For this job, a  $\frac{1}{32}$ " ball nose bit is perfect for the job. It can get into the tight corners of the lettering and gives them an engraved appearance. It also can make the small details of the logo crisp. I painted the lettering and logo to really make them stand out.

**Panic.** There's one thing I haven't talked about. And that is, what if something goes wrong, like a bit breaking or a part flying loose? As with any machine, you need to remain nearby while it's running. If something does happen, you can stop the machine in one of three ways: Hit the "kill switch," press the spacebar on the keyboard, or use the mouse to press the "Stop" button on the software screen.

After addressing the problem, you can usually restart the job and the router picks up right where it left off. It "remembers" the point where it stopped so it can continue cutting.

**Final Details.** As I mentioned earlier, I've provided an overview of the toolbox construction online at ShopNotes.com. You'll need access to a CNC machine. (It took about four hours to cut

# ShopNotes



▲ **Lettering.** A CNC router is the perfect tool for carving letters and graphic elements. A little paint really makes them pop.

out all the parts.) But what if you don't yet own a CNC router?

There's an easy solution. A lot of people have invested in small CNC machines for their home workshop and are happy to cut the parts for a small fee. You can find CNC owners online in various forums and discussion groups. ShopBot is one of the leaders in connecting CNC owners with customers that may only need a few parts cut on occasion.

The box below talks about how you can buy CNC plans online. They can be downloaded and include the files you need to cut the parts on your CNC machine.

**Your Wishlist.** By now I hope you can see some of the benefits a CNC router can bring to your shop. I've only touched on just a few of the many capabilities of a CNC machine. Do a quick search online and you'll find all sorts of creative ways a CNC machine can be used — from cutting leather and vinyl, to carving 3D shapes, to etching glass, plastic, aluminum, and brass. You'll also find a great user community that can answer all your questions to help you make an informed decision. The possibilities are limited only by your imagination. 🐉

## CNC resources Models & Patterns

I love to spend time in the shop, especially trying new things on the CNC machine. But when it comes to creativity for designing new projects, I'm a little lacking in that department. Fortunately, the Internet provides access to a lot of talented designers.

You can see at right a few of the projects we downloaded online from *MakeCNC.com*. They offer dozens of plans for projects you can cut (or have someone else cut) on a CNC machine. The download

includes the CNC files and a PDF file that explains the assembly process with easy-to-understand, step-by-step graphics.

There are a number of websites that offer ready-to-cut plans for your CNC machine. If you can dream it up, chances are someone has a plan ready to go that will give you a good starting point. All you need to do is load it up and start cutting.

Dragon  
(57 Pieces)

Rover  
(131 Pieces)

Motorcycle  
(106 Pieces)



## 4 favorite ways to Get Mobile

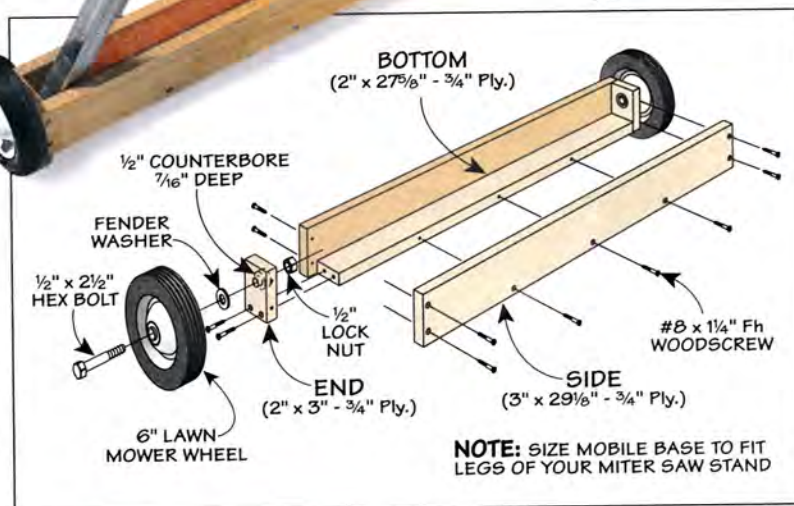
Make the most of your shop space by building one or more of these mobile tool bases.

I used to agonize over trying to find the one "perfect" layout for my workshop. So every so often, I would move things around to make better use of the space.

Then it dawned on me. During the course of building a project, I could reconfigure my shop to suit the task at hand, whether it's stock preparation, cutting joinery, or even finishing. To make this a quick-and-easy process, you can add mobile bases to some or all of your tools. Here are a few ideas that you can use in your shop.

### ▼ Trailer Jack.

An ordinary trailer jack raises one end of the bench. Fixed casters are attached to the other end.



### MITER SAW DOLLY

I bought a folding stand for my miter saw to add capacity and accuracy while making cuts on a jobsite. But I've found the stand is just as handy in the shop. The only issue is that it isn't easy to move around. To solve that problem, I built a simple mobile base to hold the legs of the stand, as shown in the photo above.

The base is just a plywood box with a wheel on each end. Be sure to locate the wheels so the base is raised just enough to provide adequate clearance off the floor. Hex bolts, secured with lock nuts, serve as axles. The nuts sit in counterbores drilled in each end piece of the box. That way, they won't interfere with the legs of the saw stand.

To move the saw, just lift up the end opposite the base and roll the stand around like a wheelbarrow. The base isn't permanently

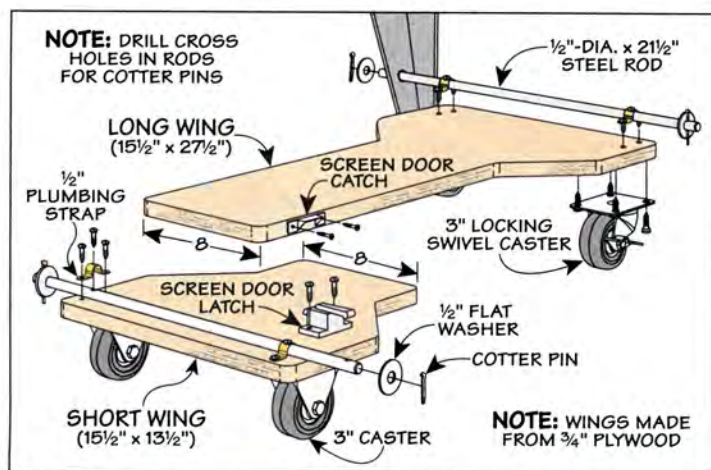
attached, so it can be easily removed for storage.

### WORKBENCH JACK

One key shop fixture that can be difficult to move around is a workbench. Ordinary locking casters won't work because they just aren't rigid enough for heavy use. I came up with a simple way to move the bench and keep it rock-steady during use.

You install an inexpensive trailer jack on one end of your workbench, as shown in the photo at left. On the opposite end, attach two fixed casters flush with the bench legs.

When you need to move your workbench, turn the crank until the jack lifts the bench off the floor. Then, when it's in position, crank it down all the way so the wheel is off the ground and the bench rests flat on the floor. This makes for a stable worksurface.



## EASY-LIFT BASE

The problem with most commercial bases is that the casters are outside of the "footprint" of the tool stand and it's easy to trip over them. The shop-made version shown above places the casters inside the stand. And what's more, the design is easy to operate with light foot pressure.

As you can see in the drawing above, the two overlapping, T-shaped "wings" hinge on ½"-dia. steel rods that are secured to the stand. When the wings are in the flat, or "down" position, the legs of the tool stand should be lifted off the floor about ¾".

To locate and drill the holes in the legs of the stand, you'll need to install the casters on the wings and temporarily clamp the wings together. I placed ⅜"-thick spacers under the legs of the stand. All you do is slide the wing assembly into place under the stand and mark the legs ⅜" above the top surface of the wings.

Then, cut and drill the steel rods and install them. The rods are secured with washers and cotter pins. With the rods in place, you can attach each wing to the rod with a pair of plumbing straps. I drilled and installed a screw through the straps into the rods to keep the wings from slipping side-to-side.

Finally, I installed a screen door latch to secure the wings in the "mobile" position. Simply tapping the latch releases the wings to lower the stand to the floor.

## PLATFORM BASE

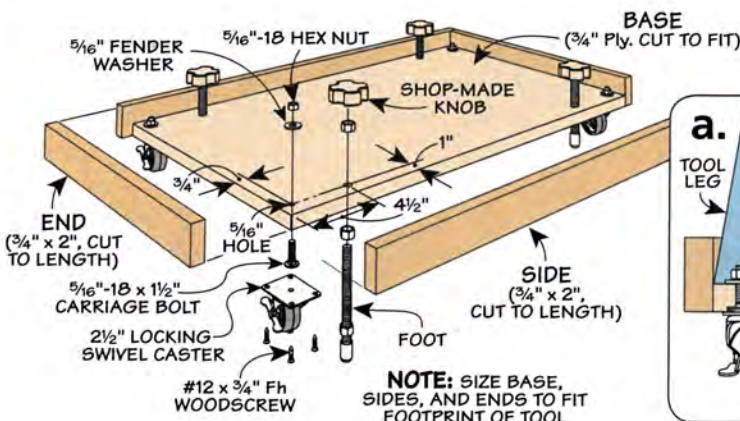
Another shop-made mobile base features adjustable feet, as you can see in the photos below. The feet raise the base off its casters to create a stable work platform.

Each tool is mounted to a ¾" plywood base, as shown in the lower drawing. Size the base to hold your tool stand. Then drill a hole (counterbored from underneath) at each corner for bolts that connect the stand to the base. To make the feet adjustable, each one is made up of a threaded rod, two nuts, and a wood knob.



### Easy-to-Build.

A rolling platform holds a tool stand and adds some extra storage space, as well.



### Easy-Lift Base.

This set of casters is located inside the stand to prevent tripping.



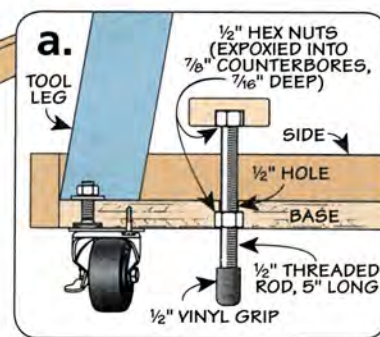
### ▲ Latch Release.

Tap the screen door latch to raise the casters and create a sturdy workstation.



### ▲ Lower Feet.

Shop-made knobs make it easy to raise the platform off the casters.



## MASTERING THE Table Saw



# microdial Tapering Jig

Repeatable tapers and accurate rip cuts are a couple of main benefits of this new tapering jig.

■ The table saw is a great tool for cutting tapered project parts like table legs. But for safety and accuracy, you'll need a jig to make the cut.

A good taper jig should do two things. First, it must hold the workpiece securely while you cut it. Second, it needs to have a method of measuring the cut, so multiple taper angles can be cut easily and accurately. *Micro Jig's* new *Microdial Tapering Jig* addresses these issues.

**Overview.** The photos at the bottom of the opposite page provide some clues as to how the jig works. The short version of the story is that there are two plates — a bottom plate, or base, and a

top plate. The top plate pivots to set the taper angle, and the edge of the plate rides against the rip fence on your table saw. Two *Memorylock* stops allow you to set two taper angles repeatedly.

Beyond these basic parts are an array of scales, knobs, and stops. You'll spend a half hour or so assembling all the parts. The instruction manual makes it pretty clear where each part goes.

*Micro Jig* recommends using their *GRR-Ripper* push block with the tapering jig, as you see above. The jig is designed for attaching one or two push blocks. If you purchase a *GRR-Ripper* with the tapering jig, you'll need some time to assemble it, as well.

**Multiple Taper Options.** The tapering jig allows you to set the taper angle in one of three ways: You can use degrees, inches per foot, or align the layout lines on your workpiece with the jig.

As you can see on the opposite page, there are two scales on the surface of the jig. Both scales are paired with an adjustment knob for setting the desired taper. You can use only one scale at a time.

Each of the knobs has a pin on the bottom that corresponds to each of the pointers on the outer rim of the knob. You lift up on the spring-loaded knob and rotate it until one of the pins slips into a hole aligned with the markings under the printed scale.

The scales and knobs are both color-coded. This allows you to set the taper with greater accuracy. You can set the inches per foot to the nearest  $\frac{1}{16}$ ". Setting the taper by degrees is accurate down to the nearest  $0.125^\circ$ . Each of the scales shows you which color on the knob to use depending on the fractional setting desired. For example, the taper in the center photo below is set to  $14/16$  or  $\frac{7}{8}$ " per foot.

For most furniture projects, you'll mark the beginning and end points of the taper on the workpiece. As I mentioned before, the tapering jig allows for this, as well. The instructions show you how to set the jig up on the table saw to align the workpiece on the edge of the jig and lock in the taper angle. Then you readjust the rip fence to align the start point with the edge of the blade to make the cut.

**Cutting Tapers.** To try out the jig, I cut some table legs with four-sided tapers. I used one of the GRR-Ripper push blocks (main photo). The layout marks on the workpiece helped me adjust the taper. Then I locked one of the Memorylock stops in position. The stop can be used later to reset the jig to the same taper angle while cutting the set of table legs.

After cutting the first taper, rotate the workpiece  $90^\circ$  for the second cut. You'll need to reset the push block for firm contact with the blank and saw table.

Once you complete the second taper, reset the jig angle to cut the remaining two tapers. The second Memorylock stop is set to "remember" this second taper angle for cutting the other workpieces. With the angle set, you can cut the remaining tapers as before, rotating the blank  $90^\circ$  between the cuts.



▲ **Ripping a Straight Edge.** Attach the trailing block to the end of the jig to guide a rough-edged workpiece for smooth rip cuts.

**Ripping.** The jig can also be used to make rip cuts on rough lumber (photo above). The trailing block helps push the workpiece through the cut.

**Results.** The tapering jig offers accuracy and repeatability. If you cut a lot of tapers, you may find it worth the \$140 price. 🛠️

▼ **Trailing Block.** When not in use, the trailing block locks securely on top of the jig in a handy pocket.

▼ **Rise & Run Gauge.** This scale allows you to set the taper angle using inches per foot.

▼ **Degree of Taper.** If you know the angle of the desired taper, you can set it using this scale.



Knob adjusts taper angle

Knob adjusts taper angle

Use keyhole slots to attach auxiliary base

Two Memorylock stops allow for repeatable taper cuts

Loosen these knobs to attach push block

Heel hook engages workpiece

**MICRODIAL TAPERING JIG**  
(Push Block Not Shown)

must-have

# Cool Tools

Check out some of our favorite new tools that you'll want to have in your shop.

■ Every once in awhile, you come across new tools that make you sit up and take notice. The kind that make you think, "I wish I had thought of that!" That's certainly the case with the three products shown here.

## KREG AUTOMAXX CLAMPS

If you've used a Kreg pocket hole jig, you're already familiar with their clamps. They're similar to the classic Vise-Grip locking pliers with larger jaws. But on closer inspection, you'll notice the adjustment screw normally found on the end of the handle is missing.

That's because the *Automaxx* clamps are self-adjusting. The mechanism shown in the lower left photo automatically adjusts for the thickness of the workpiece. What's unique is that the clamping pressure remains the same regardless of the thickness (right photos below). If you need a little more or a little less pressure, you can turn the small thumbscrew located between the handles, as shown in the inset photo below left.

The *Automaxx* clamps are available in two configurations. Their *Bench Klamp* is shown in the main photo above and the face

frame clamps are shown below. Both styles are available in two different lengths. Kreg plans to launch other versions of these new clamps in the future. You can pick up *Automaxx* clamps wherever Kreg products are sold.

## ROCKLER GLUE ACCESSORIES

I'll admit that when I first read about Rockler's silicone glue kits and brushes, I thought it was just another gimmick. But I quickly changed my mind when I tried them out during a glueup.

The flagship product is the glue brush you see in the upper left photo on the opposite page.

It spreads an even coat of glue where needed.

### ► Steady Pressure.

Regardless of the thickness, the clamping pressure remains constant.

**Adjustment.** To change the amount of clamping pressure, turn the small thumbscrew (inset).





### ▲ Easy On & Off.

Silicone rubber spreads glue uniformly — and it makes cleanup a snap (inset).



Glue Scraper

Glue Brush

Mini Brush

Glue Tray

Spreader

The handle of a the tool acts as a spatula for mixing or spreading glue. The tray and large spreader allow you to apply an even coat of glue over large surfaces quickly. The mini brush you see at right is ideal for applying glue inside dowel holes and mortises.

But the real beauty of these tools is easy cleanup. If you're like me and forget to wash out your brush, no worries. Simply peel off the glue, as shown in the inset photo above.

You can buy the two sizes of brushes individually. The other items are available in three-piece or five-piece kits from Rockler. The scraper shown above is included in the five-piece kit. It's perfect for quickly and cleanly scraping dried glue from a joint.

## IMPACT DRIVER BITS

When I bought my first impact driver, I used the old driver bits I had on hand. I soon discovered they weren't designed to withstand the unique forces an impact driver places on a bit. They would deform or break after a short period of use.

If you own an impact driver, you'll want to invest in driver and drill bits specifically designed for it. (You can also use your impact driver to drill holes.) Most tool manufacturers offer a selection of

bits designed for impact drivers. You can see a couple sets from Irwin in the photo below.

Impact bits fit the 1/4" hex chuck on your driver. They're designed to drive fasteners or drill holes easily without deforming or breaking the bit. Each manufacturer has their own method for accomplishing this goal — from hardened steel to thinner shafts to withstand the sudden twisting motion during use.

The great thing is, you don't have to have an impact driver to use these bits. They work great in a regular drill and will last longer than standard bits. In any case, if you own an impact driver, investing in a set of impact bits is a good idea. They'll make a great addition to your toolbox. 🛠️



▲ Impact Bits. A dedicated set of impact driver and drill bits is a good investment.



## questions from Our Readers

# restoring old Oilstones

*I bought an old oilstone at a garage sale. It has definitely seen better days. How can I get it back into shape for sharpening tools?*

Dan Reeves  
Urbandale, Iowa

■ There's a lot of satisfaction in rescuing a neglected and forgotten tool and bringing it back to life. If the price is right, it can be hard to pass up. Unlike other tools, the process for restoring an oilstone may not be obvious. But it actually follows a similar path.

It starts with a good cleaning. From there, you can assess and then correct any problems you uncover to bring the stone into top-notch shape.

**Clean It Up.** Over time, the surface of a stone can clog with sharpening debris (metal filings, oil, and grit) if it isn't taken care of. Add on a few years' worth of accumulated dust and dirt and you'll end up with an oilstone that looks like the 'before' image in the left margin photo.

So the first step is to get rid of the crud. To do this, I soak the stone in a pan of hot tap water with some dish soap added in. The hot water softens the grime, and the detergent

lifts it away. Don't worry — the water won't damage the stone.

After 30 minutes, scrub all the surfaces with a stiff, nylon brush, as shown in the lower right photo. Follow that up with a short soak and rinse in clear water to remove any lingering residue.

**Inspection.** Take some time to allow the stone to dry out. What you need to do then is give it a good once-over. With the dirt and grime gone, any cracks or other flaws will be much easier to spot.

Use a straightedge to examine the wide faces to see how flat they are. In the best-case scenario, no gaps appear below the straightedge and the stone is ready to use.

More than likely, though, the middle of the stone has been worn away into a shallow hollow. Before it can be used, you need to flatten the surface.

**Diamond Stone.** Oilstones can be notoriously hard. So to level the surface, you need a something flat that won't wear out after a few strokes. I've found a coarse diamond plate works great (see page 51 for sources).

► **Scrub Down.** Soak the stone in hot, soapy water. Then scrub away the dirt and grime with a stiff, nylon brush.

It's now a matter of rubbing the stone across the plate until the stone is flat. You'll see a definite color change in the stone as you go. A few pencil lines on the stone help you track your progress. In order to make the flattening job go as quickly as possible, you need to clear away the loose grit, from time to time.

When you're done, vacuum or blow off the surface of the oilstone and wipe it down with light oil. The payoff is shown in the 'after' image in the left margin photo. With care, the stone will serve you for years to come. 🛠️



Before

After



# Sources

Most of the materials and supplies you'll need to build the projects are available at hardware stores or home centers. For specific products or hard-to-find items, take a look at the sources listed here. You'll find each part number listed by the company name. See the right margin for contact information.

The *Woodsmith Store* in Des Moines, Iowa, is an authorized *Rockler* dealer. They carry many of the hardware items used in our projects. And they ship nationwide. Their customer service representatives are available for your calls from 8am - 5pm Central Time, Monday through Friday.

## ROUTER WORKSHOP (p.8)

- **McMaster-Carr**  
Toggle Clamps.....5128A17
- **Rockler**  
1/4" Aluminum Plate .....Varies
- **JessEm**  
Mast-R-Lift II.....02120

## JESSEM MORTISE MILL (p.10)

- **JessEm**  
Pocket Mortise Mill .....08200

## NAILS (p.12)

You can find cut nails online at *Lehman's*, *Lee Valley*, and *Tremont Nail Company*.

## SHOP-MADE CLAMPS (p.14)

- **McMaster-Carr**  
3/8"-16 Knob .....6032K13  
1/2"-13 Knobs .....6032K14  
The clamps were finished with a couple coats of a wipe-on oil/polyurethane blend.

## SHOP STOOL (p.20)

- **McMaster-Carr**  
3 3/8" Pulls .....1647A14  
3" Casters .....2406T16  
The stool was painted with *Aura* satin paint from *Benjamin-Moore* in *Army Green* color. It was then sprayed with lacquer followed by a glaze using *General Finishes' Candlelight* gel stain.

## WATER-BASED FINISH (p.24)

- **Tools for Working Wood**  
1" Brush .....GT-WBBRU.10  
2" Brush .....GT-WBBRU.20  
3" Brush .....GT-WBBRU.30

## WORKBENCH (p.28)

- **McMaster-Carr**  
3" Sq. Alum. Tube ....88875K73  
12-14 x 3/4" Screws...90064A580

3/4" Alum. Angle.....88805K44  
1 1/2" Alum. Angle.....8982K134

The cabinet of the bench was painted with *Benjamin-Moore Aura* satin paint, *Fair Isle Blue* color. The benchtop, totes, and shelf were finished with a wipe-on oil finish.

## MICRODIAL TAPER JIG (p.46)

- **Rockler**  
Tapering Jig.....49979
- **Woodcraft**  
Tapering Jig.....856320

## GREAT GEAR (p.48)

- **Kreg Tool**  
*Automaxx Clamps* .....varies
- **Rockler**  
*Automaxx Clamps* .....varies  
*5-piece Glue Kit* .....48455  
*Mini Glue Brush* .....45495  
*Glue Brush* .....45624  
*3-piece Glue Kit* .....43662  
You can find bits for your impact driver at hardware stores, home centers, and various online retailers, including *amazon.com*.

## OILSTONE RESCUE (p.50)

- **Woodcraft**  
Lapping Plate .....154353

## MAIL ORDER SOURCES

**Woodsmith Store**  
800-444-7527

**Rockler**  
800-279-4441  
rockler.com

amazon.com

**JessEm Tool Company**  
866-272-7492  
jessemdirect.com

**Kreg Tool Company**  
800-447-8638  
kregtool.com

**Lee Valley**  
800-871-8158  
leevalley.com

**Lehman's**  
888-438-5346  
lehmans.com

**McMaster-Carr**  
630-600-3600  
mcmaster.com

**ShopBot Tools**  
shopbottools.com  
888-680-4466

**Tools For Working Wood**  
toolsforworkingwood.com  
800-426-4613

**Tremont Nail**  
800-835-0121  
tremontnail.com

**Woodcraft**  
800-225-1153  
woodcraft.com



## Woodsmith SHOP DVDs

Get the all new season 6 DVD set of the **Woodsmith Shop**! The set includes two DVDs with all the episodes plus a CD-ROM with bonus plans and articles. Collect the entire series by ordering individual seasons for \$29.95 or save with package deals. Learn more at [Woodsmith.com](http://Woodsmith.com)!

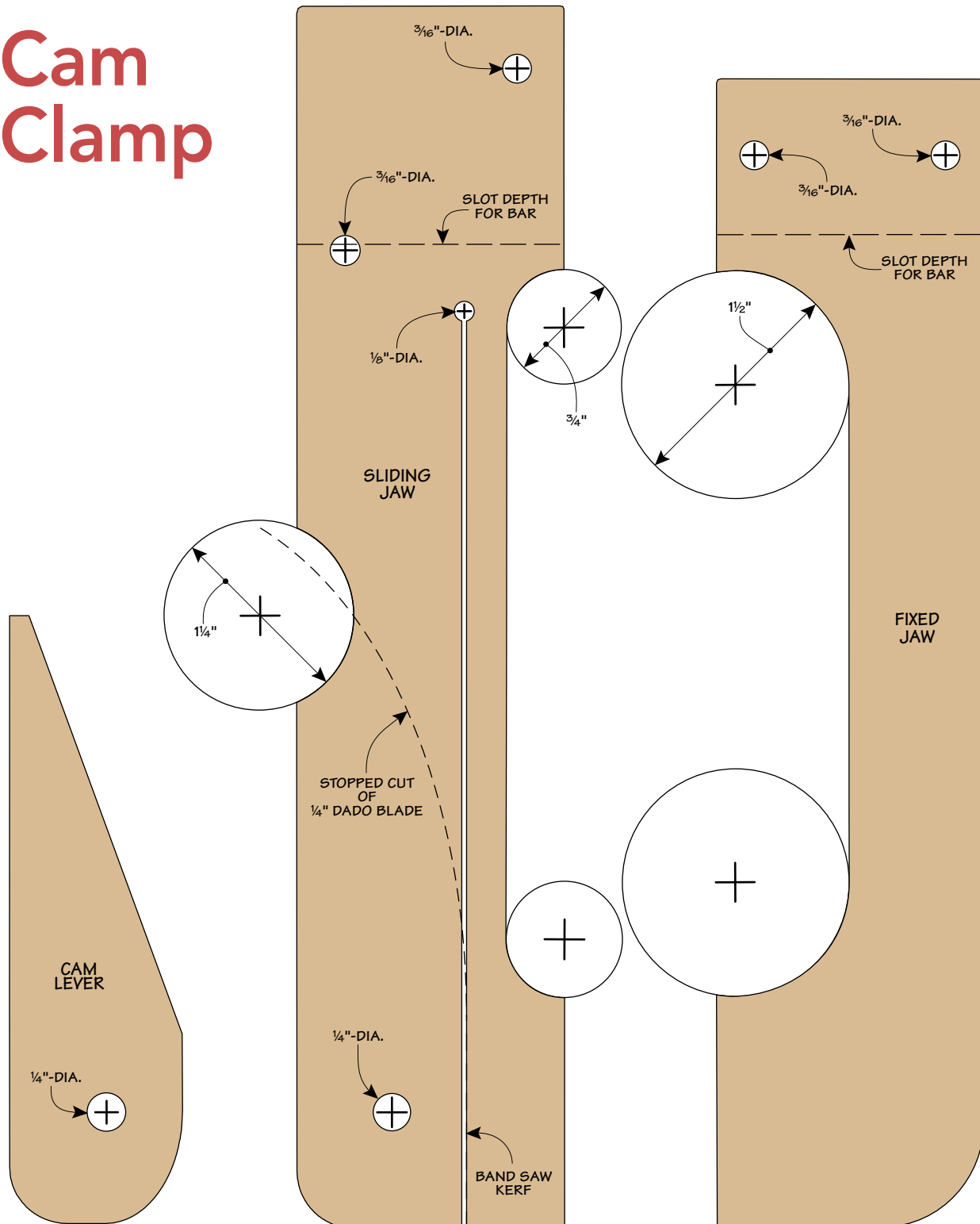
DVD Set: Season 6.....\$29.95

**Go to Woodsmith.com**  
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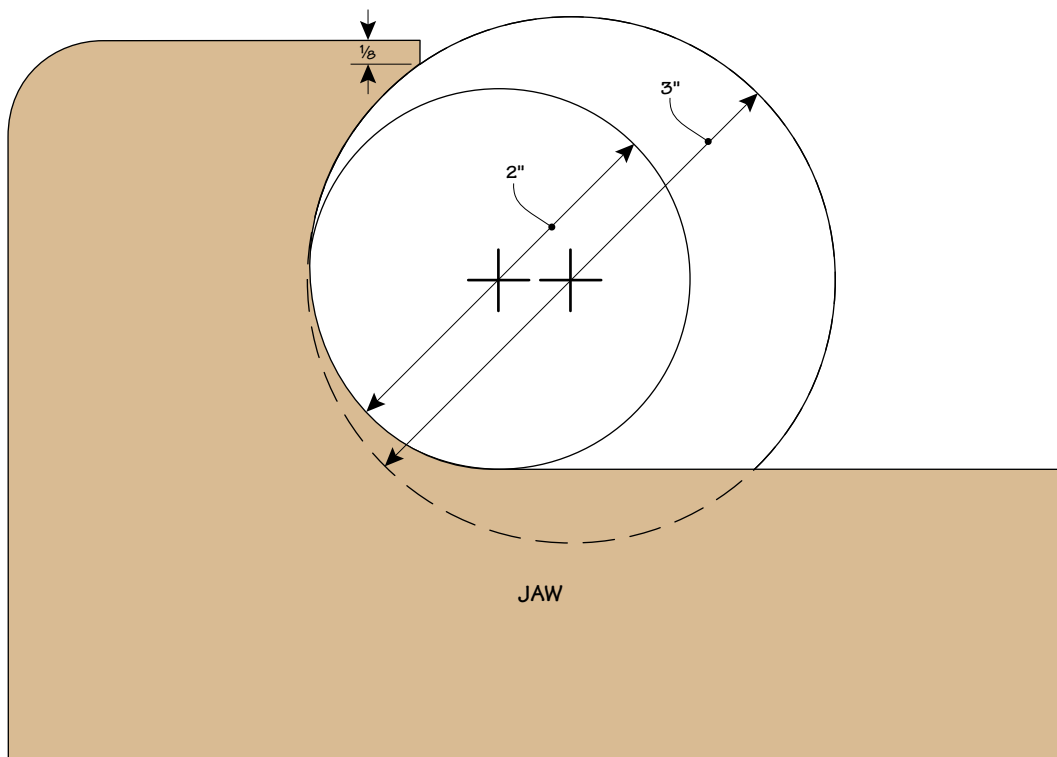
# Shop-Made Clamps

## Full-Size Patterns

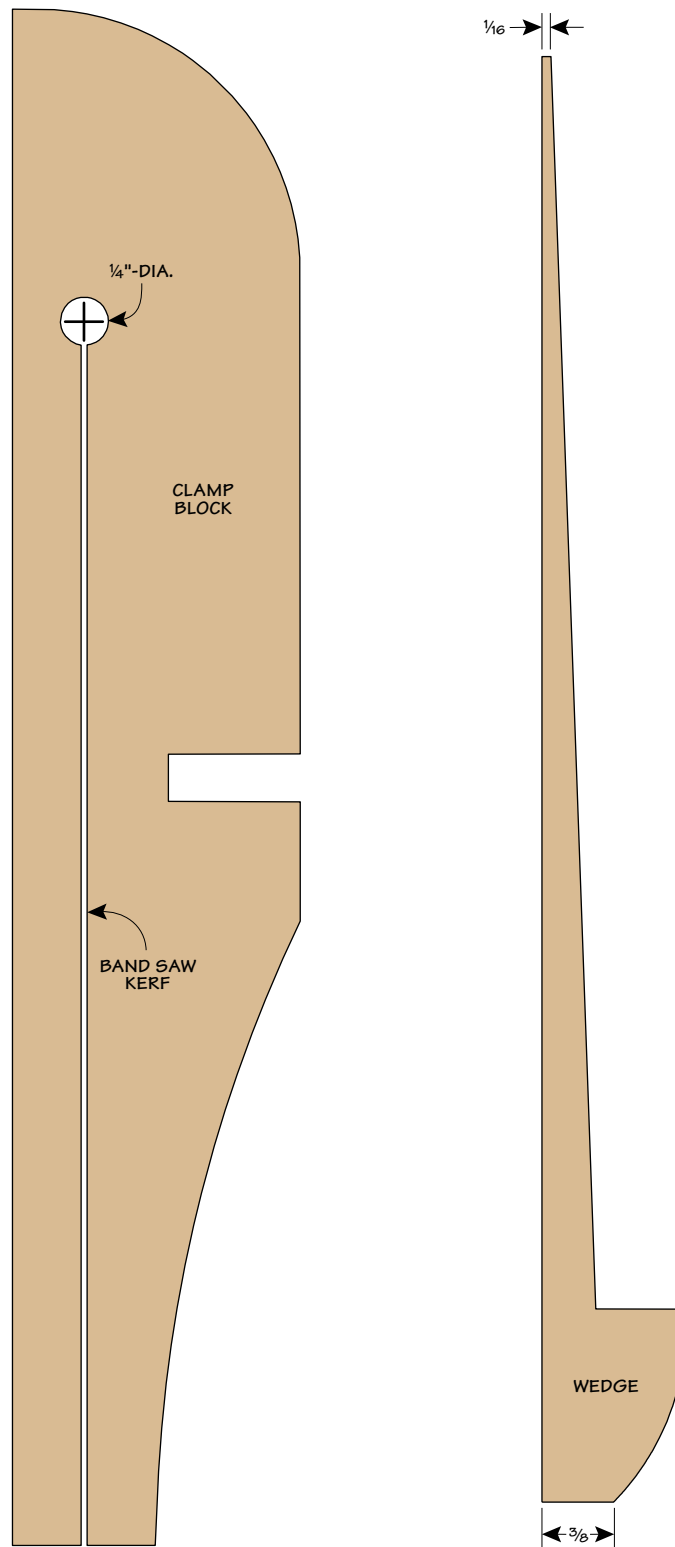
### Cam Clamp



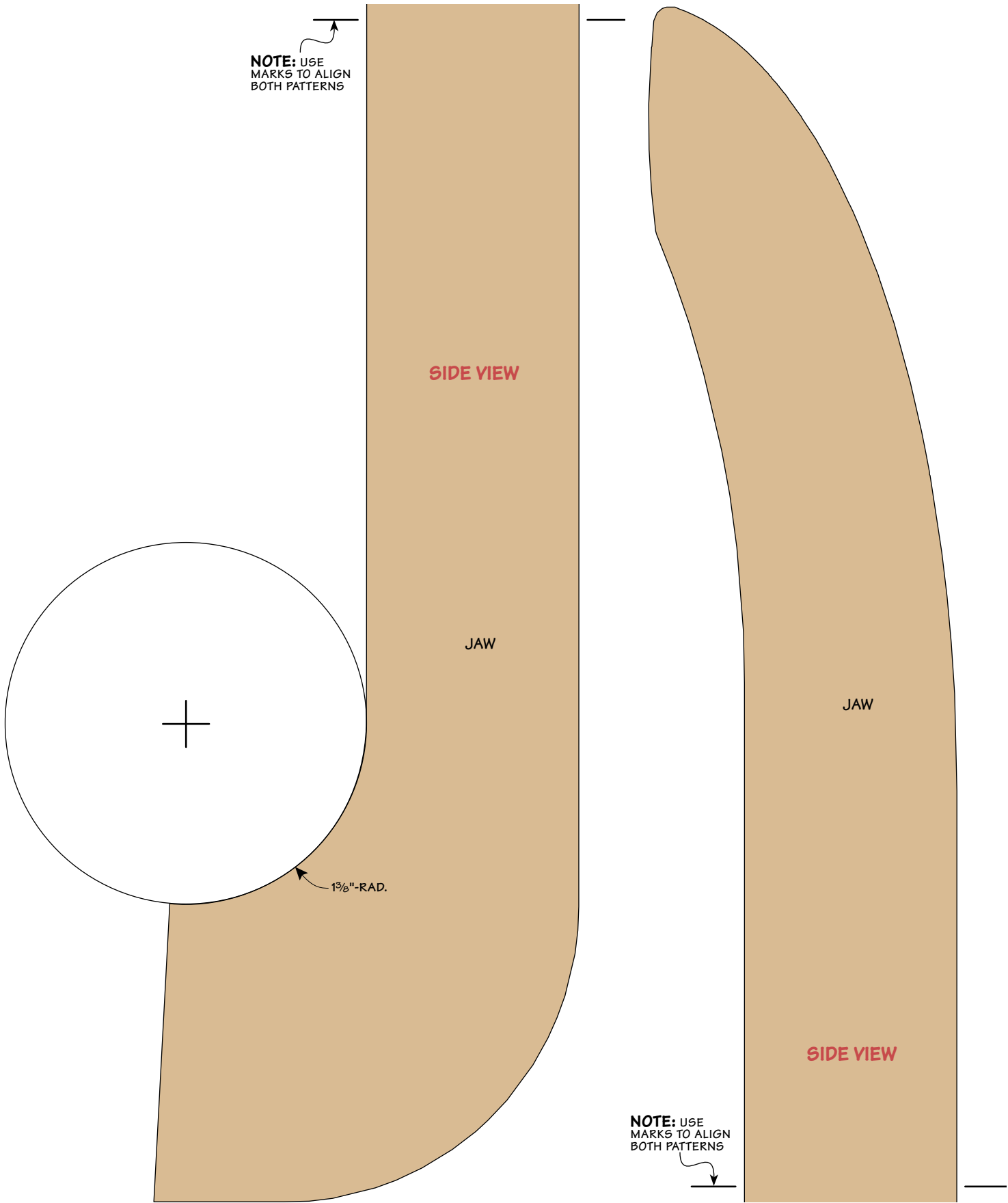
# Chair Clamp



# Edging Clamp

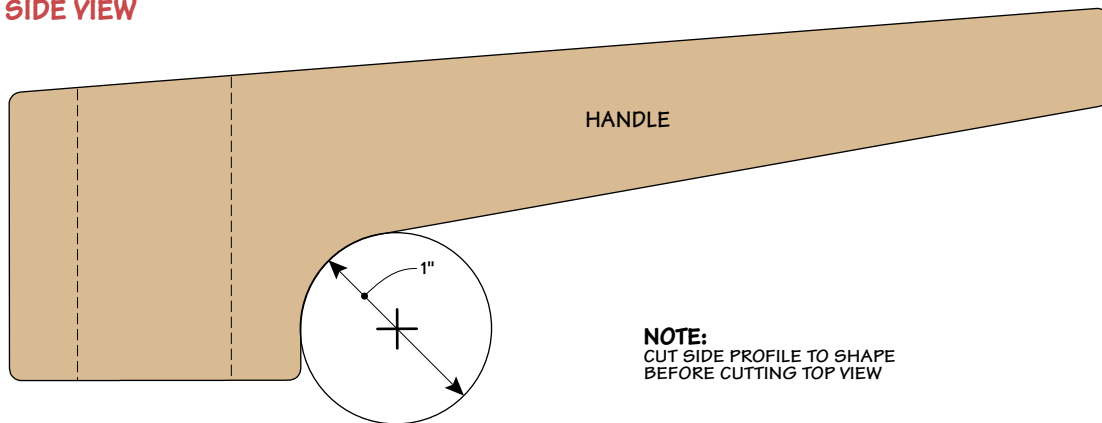


# Deep-Reach Clamp

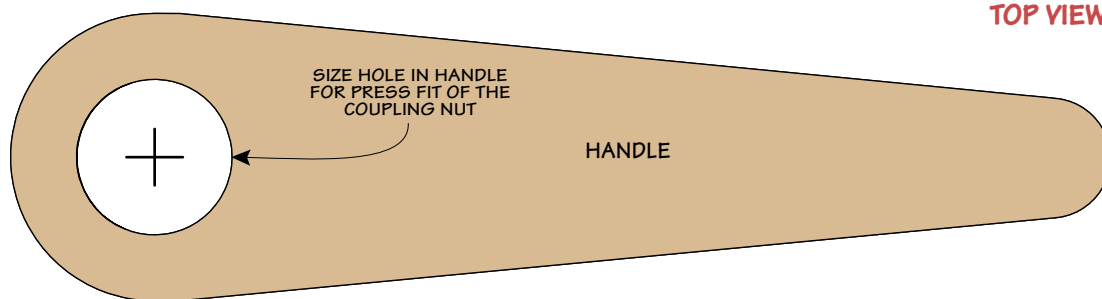


# Deep-Reach Clamp Handle

**SIDE VIEW**



**TOP VIEW**





## cnc Toolbox

Using precision-cut parts made with a CNC router, all you need for assembly is a little glue.



■ This toolbox is designed from the ground up to be cut with a CNC router. The sides and bottom have tabs on their edges to fit into blind mortises in the front, back, and sides. The back and top have a series of recesses on the inside for the individual pieces that form the knuckles of the hinge. The latches and handle assembly are integrated into the top. The top is also engraved with the *ShopNotes* logo. And to finish it off, decorative pocket cuts were made on the outside of the toolbox.

**CNC Files Online.** The design files for the toolbox and the *ShopBot* part files used to cut the pieces are available as a downloadable *Online Extra* at *ShopNotes.com*. If you don't own a *ShopBot*, you can use the design files to create the toolpaths and instructions for your specific CNC machine. We've also exported the files in AI, DXF, EPS, and SVG formats.

**Cutting the Plywood Parts.** The drawings on the next page show the basics of how the toolbox is put together. The tricky part is accurately registering the

two-sided parts when flipping them over to cut the opposite side. You can use the cut marks in the spoilboard as a reference or simply mark the position with a pencil before removing the parts.

There's another thing I want to mention. The width of the blind mortises is sized to match the thickness of the plywood so that the tabs on the mating parts form a friction fit. We used  $\frac{3}{8}$ " Baltic birch, but if you use another material, you may need to adjust the mortise width accordingly.

**Assembly.** Putting together the toolbox is pretty straightforward. I started with the bottom, sides, front, and back. I applied a thin film of glue to the tabs before clamping the parts.

You'll notice that the top and handle are both made up of two layers. When gluing up the handle, making sure the edges are flush. Before gluing the layers of the top together, you'll need to add the handle, handle pins, latches, and thumb slides.

The pins and latch plates are trapped in the grooves cut on the inside faces. Again, just keep the edges flush as you apply clamps.

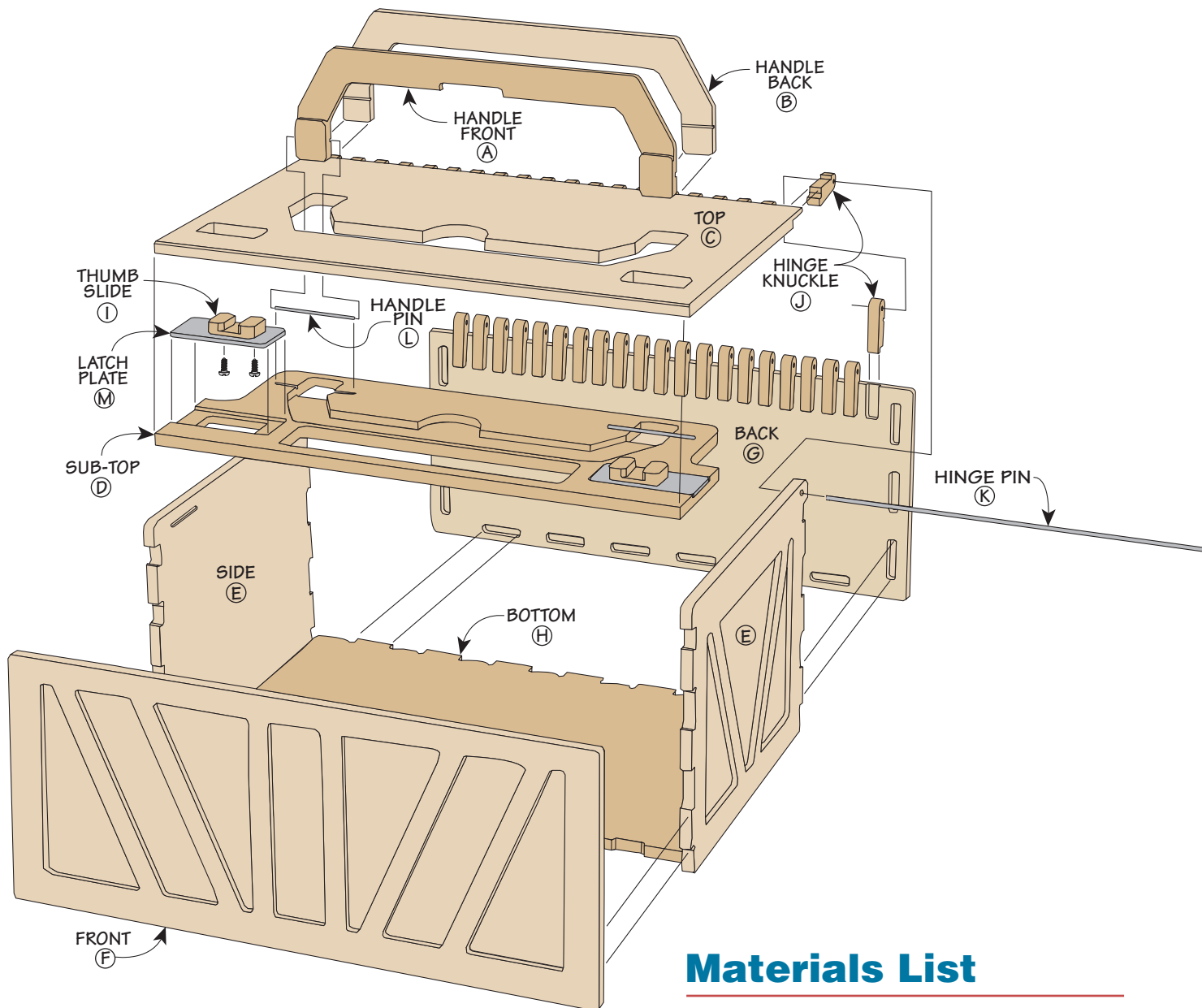
**Long Hinge.** You might think that aligning all of the hinge knuckles would be tricky. But the beauty of having the recesses made with a CNC router is that they're all identical. Just make sure each knuckle is fully seated in the recess after applying the glue.

After the glue dries, you can align the hinge knuckles on the top with those on the back and start feeding in the hinge pin. You may need to coax it with a few gentle taps of a small hammer.

**Finish.** To finish the toolbox, I sprayed on a couple coats of lacquer. Once that dries, you can fill the toolbox with your favorite hand tools and accessories. 🛠️

# Exploded View Details

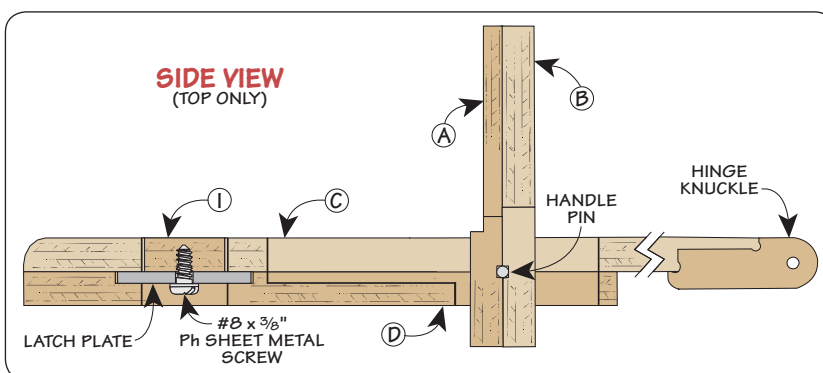
OVERALL DIMENSIONS: 10 $\frac{3}{4}$ "W x 18"L x 8 $\frac{1}{2}$ "H



## Materials List

|   |                     |                                                         |
|---|---------------------|---------------------------------------------------------|
| A | Handle Front (1)    | 3 $\frac{1}{2}$ x 12 - $\frac{3}{8}$ Ply.               |
| B | Handle Back (1)     | 3 $\frac{1}{2}$ x 12 - $\frac{3}{8}$ Ply.               |
| C | Top (1)             | 10 x 16 $\frac{1}{2}$ - $\frac{3}{8}$ Ply.              |
| D | Sub-Top (1)         | 6 $\frac{3}{8}$ x 16 $\frac{1}{2}$ - $\frac{3}{8}$ Ply. |
| E | Sides (2)           | 8 $\frac{1}{2}$ x 10 $\frac{3}{4}$ - $\frac{3}{8}$ Ply. |
| F | Front (1)           | 7 $\frac{3}{4}$ x 18 - $\frac{3}{8}$ Ply.               |
| G | Back (1)            | 7 $\frac{3}{4}$ x 18 - $\frac{3}{8}$ Ply.               |
| H | Bottom (1)          | 10 $\frac{1}{2}$ x 17 - $\frac{3}{8}$ Ply.              |
| I | Thumb Slides (2)    | 1 $\frac{5}{16}$ x 1 $\frac{1}{2}$ - $\frac{3}{8}$ Ply. |
| J | Hinge Knuckles (47) | $\frac{5}{8}$ x 1 $\frac{27}{32}$ - $\frac{3}{8}$ Ply.  |
| K | Hinge Pin (1)       | $\frac{1}{8}$ -dia. x 17 Steel Rod                      |
| L | Handle Pins (2)     | $\frac{1}{8}$ -dia. x 2 $\frac{5}{8}$ Steel Rod         |
| M | Latch Plates (2)    | 1 $\frac{1}{2}$ x 3 - $\frac{1}{8}$ Alum.               |

• (4) #8 x  $\frac{3}{8}$ " Ph Sheet Metal Screws



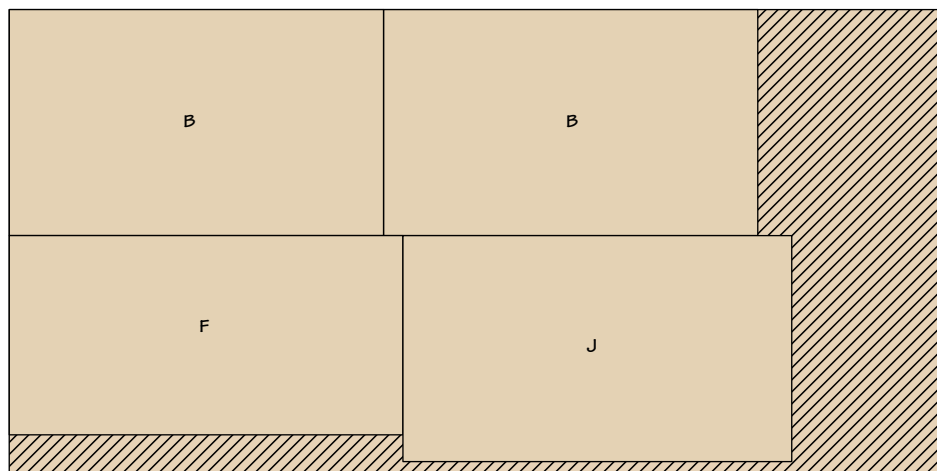
# Mobile Cutoff Bin

## Materials List

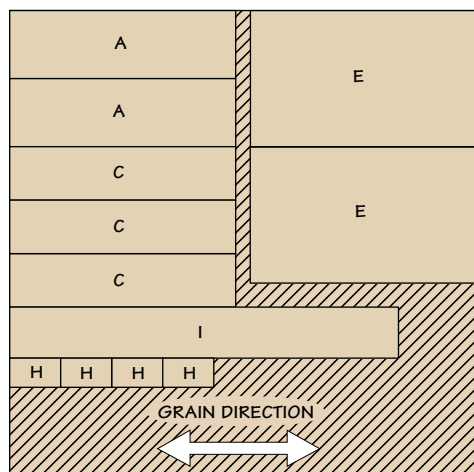
|   |                    |                                                          |   |           |                                                                                                                                                                                                                                                          |
|---|--------------------|----------------------------------------------------------|---|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A | Front Dividers (2) | 7 x 23 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.                | I | Shelf (1) | 5 $\frac{1}{4}$ x 40 - $\frac{3}{4}$ Ply.                                                                                                                                                                                                                |
| B | Bin Front/Back (2) | 23 $\frac{1}{4}$ x 38 $\frac{1}{2}$ - $\frac{3}{4}$ Ply. | J | Back (1)  | 23 $\frac{1}{4}$ x 40 - $\frac{3}{4}$ Ply.                                                                                                                                                                                                               |
| C | Rear Dividers (3)  | 5 $\frac{1}{2}$ x 23 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.  |   |           |                                                                                                                                                                                                                                                          |
| D | Rails (4)          | $\frac{1}{2}$ -dia. x 39 $\frac{1}{4}$ EMT Conduit       |   |           |                                                                                                                                                                                                                                                          |
| E | Sides (2)          | 14 x 23 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.               |   |           |                                                                                                                                                                                                                                                          |
| F | Bottom (1)         | 20 $\frac{1}{2}$ x 40 $\frac{1}{2}$ - $\frac{3}{4}$ Ply. |   |           |                                                                                                                                                                                                                                                          |
| G | Cleats (3)         | $\frac{3}{4}$ x 1 $\frac{1}{2}$ - 12 $\frac{5}{16}$      |   |           |                                                                                                                                                                                                                                                          |
| H | Blocking (4)       | 3 x 5 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.                 |   |           |                                                                                                                                                                                                                                                          |
|   |                    |                                                          |   |           | <ul style="list-style-type: none"> <li>• (69) #8 x 1<math>\frac{1}{2}</math>" Fh Woodscrews</li> <li>• (2) 4"-dia. Locking Swivel Casters</li> <li>• (2) 4"-dia. Swivel Casters</li> <li>• (16) #12 x <math>\frac{3}{4}</math>" Ph Woodscrews</li> </ul> |

## Cutting Diagram

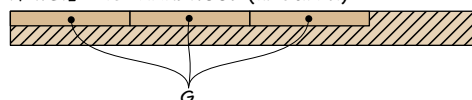
48" x 96" -  $\frac{3}{4}$ " PLYWOOD



48" x 48" -  $\frac{3}{4}$ " PLYWOOD



$\frac{3}{4}$ " x 3 $\frac{1}{2}$ " - 48" HARDWOOD (1.2 Bd. Ft.)





# Power Tool Bench

## Materials List

|                       |                                                    |                    |                                                          |                  |                        |
|-----------------------|----------------------------------------------------|--------------------|----------------------------------------------------------|------------------|------------------------|
| A Legs (4)            | 3 x 3 - 34 Square Alum. Tube                       | N Shelf (1)        | 18 $\frac{3}{4}$ x 28 $\frac{1}{4}$ - $\frac{3}{4}$ Ply. | AA Braces (2)    | $\frac{3}{4}$ x 2 - 4  |
| B Rails (4)           | 1 $\frac{1}{2}$ x 1 $\frac{1}{2}$ - 29 Alum. Angle | O Shelf Edging (1) | $\frac{3}{4}$ x $\frac{3}{4}$ - 18 $\frac{3}{4}$         | BB Cord Rail (1) | $\frac{3}{4}$ x 2 - 25 |
| C Sides (2)           | 17 x 29 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.         | P Stop (1)         | $\frac{3}{4}$ x 1 $\frac{3}{4}$ - 38 $\frac{1}{2}$       |                  |                        |
| D Cleats (4)          | $\frac{3}{4}$ x 1 - 29                             | Q Guides (6)       | $\frac{3}{4}$ x $\frac{3}{4}$ - 28 Alum. Angle           |                  |                        |
| E Foot Pads (4)       | $\frac{3}{4}$ x 3 - 3                              | R Tote Sides (6)   | $\frac{1}{2}$ x 8 $\frac{1}{2}$ - 28                     |                  |                        |
| F Back (1)            | 20 x 60 - $\frac{3}{4}$ Ply.                       | S Tote Ends (6)    | $\frac{1}{2}$ x 8 $\frac{1}{2}$ - 12                     |                  |                        |
| G Bottom (1)          | 30 x 59 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.         | T Tote Bottoms (3) | 11 $\frac{1}{2}$ x 27 $\frac{1}{2}$ - $\frac{3}{4}$ Ply. |                  |                        |
| H Lower Rail (1)      | 6 $\frac{1}{2}$ x 60 - $\frac{3}{4}$ Ply.          | U Tote Cleats (6)  | $\frac{3}{4}$ x 1 - 11                                   |                  |                        |
| I Inner Side (1)      | 29 x 11 - $\frac{3}{4}$ Ply.                       | V Handle Bases (6) | 1 $\frac{1}{2}$ x 1 $\frac{1}{2}$ - 5 Alum. Angle        |                  |                        |
| J Divider (1)         | 29 x 13 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.         | W Handle Caps (6)  | $\frac{3}{4}$ x 1 - 5                                    |                  |                        |
| K Stiles (3)          | $\frac{3}{4}$ x 1 $\frac{1}{2}$ - 13 $\frac{1}{2}$ | X Top (1)          | 1 $\frac{1}{2}$ x 36 - 72                                |                  |                        |
| L Upper Rail (1)      | $\frac{3}{4}$ x 2 - 60                             | Y Rack Shelf (1)   | $\frac{3}{4}$ x 8 - 25                                   |                  |                        |
| M Mounting Cleats (2) | $\frac{3}{4}$ x 2 - 59 $\frac{1}{4}$               | Z Rack Back (1)    | $\frac{3}{4}$ x 7 - 25                                   |                  |                        |

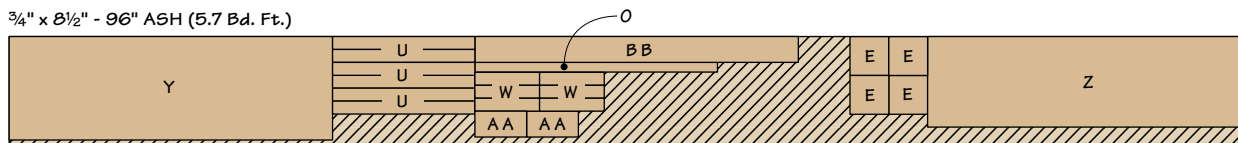
- (16) 12-14 x  $\frac{3}{4}$ " Self-Drilling Screws
- (20) #8 x 1" Rh Woodscrews
- (12) #8 x 1" Fh Woodscrews
- (30) #6 x  $\frac{1}{2}$ " Fh Woodscrews
- (10) #8 x 1 $\frac{1}{2}$ " Fh Woodscrews
- (14) #8 x 1 $\frac{1}{4}$ " Fh Woodscrews
- (1) Power Strip
- (2) #8 x  $\frac{3}{4}$ " Rh Woodscrews
- (6)  $\frac{1}{4}$ "-dia. Shelf Pins

## Cutting Diagram

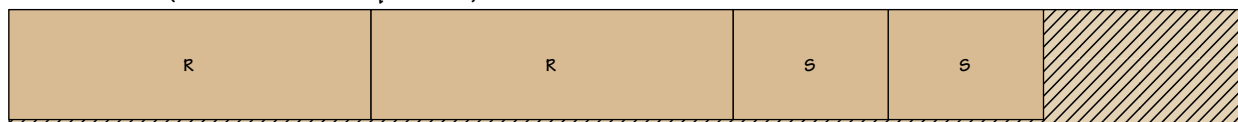
$\frac{3}{4}$ " x 8 $\frac{1}{2}$ " - 96" POPLAR (5.7 Bd. Ft.)



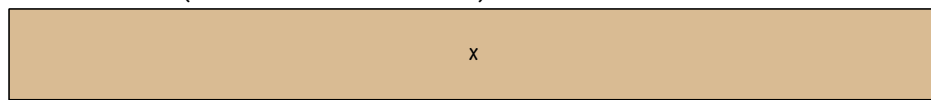
$\frac{3}{4}$ " x 8 $\frac{1}{2}$ " - 96" ASH (5.7 Bd. Ft.)



$\frac{1}{2}$ " x 9" - 96" ASH (THREE BOARDS @ 6 Sq. Ft. EACH)

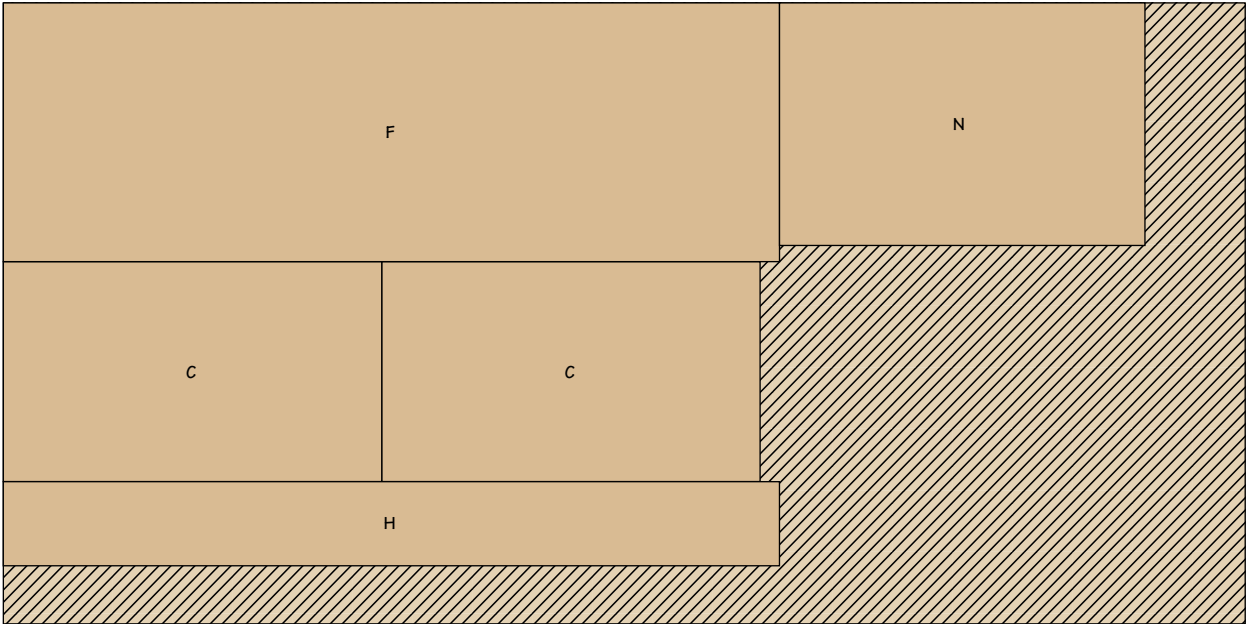


1 $\frac{1}{2}$ " x 7 $\frac{1}{2}$ " - 72" ASH (FIVE BOARDS @ 7.5 Bd. Ft. EACH)

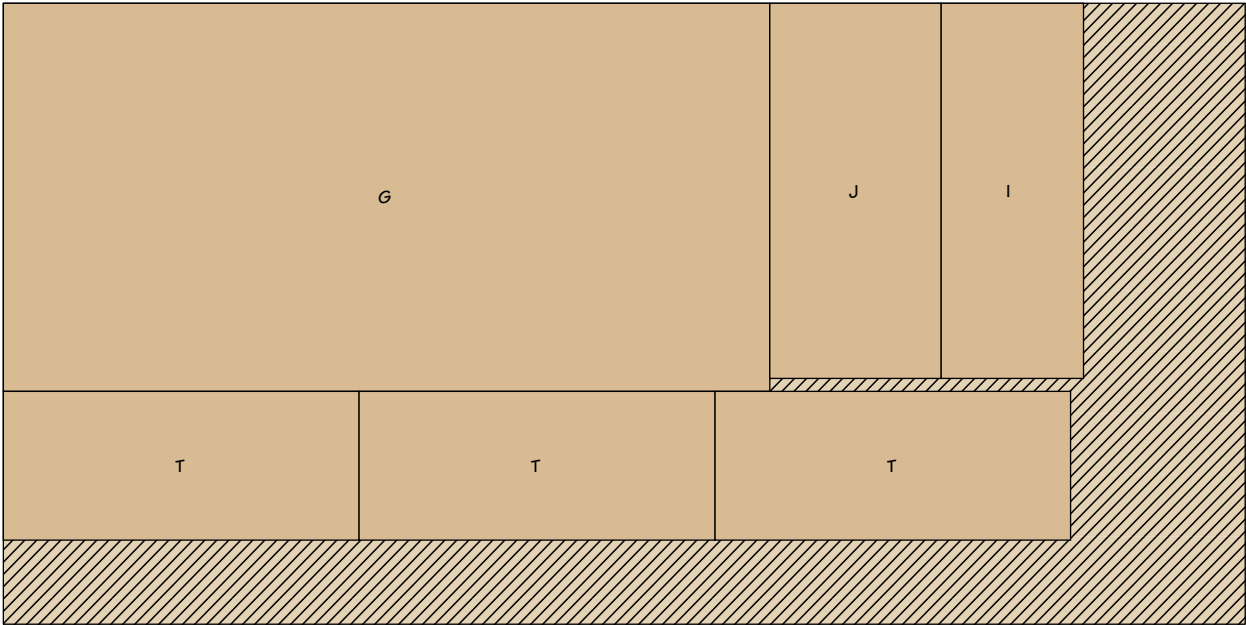


# Cutting Diagram cont.

48" x 96" - 3/4" PLYWOOD



48" x 96" - 3/4" PLYWOOD



# Scenes from the Shop



*Routing is a shop mainstay. Pairing your computer with a CNC router is worth considering. Turn to page 38 to learn about the basics of CNC routing and how you can make use of it in your own shop.*



*Storing and organizing cutoffs is always a challenge. This handy cutoff bin is the perfect solution. You'll find complete plans starting on page 34.*