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WOOD

THE WORLD'S LEADING WOODWORKING MAGAZINE
AUGUST 1996 ISSUE #89

Cordless Drill/Drivers

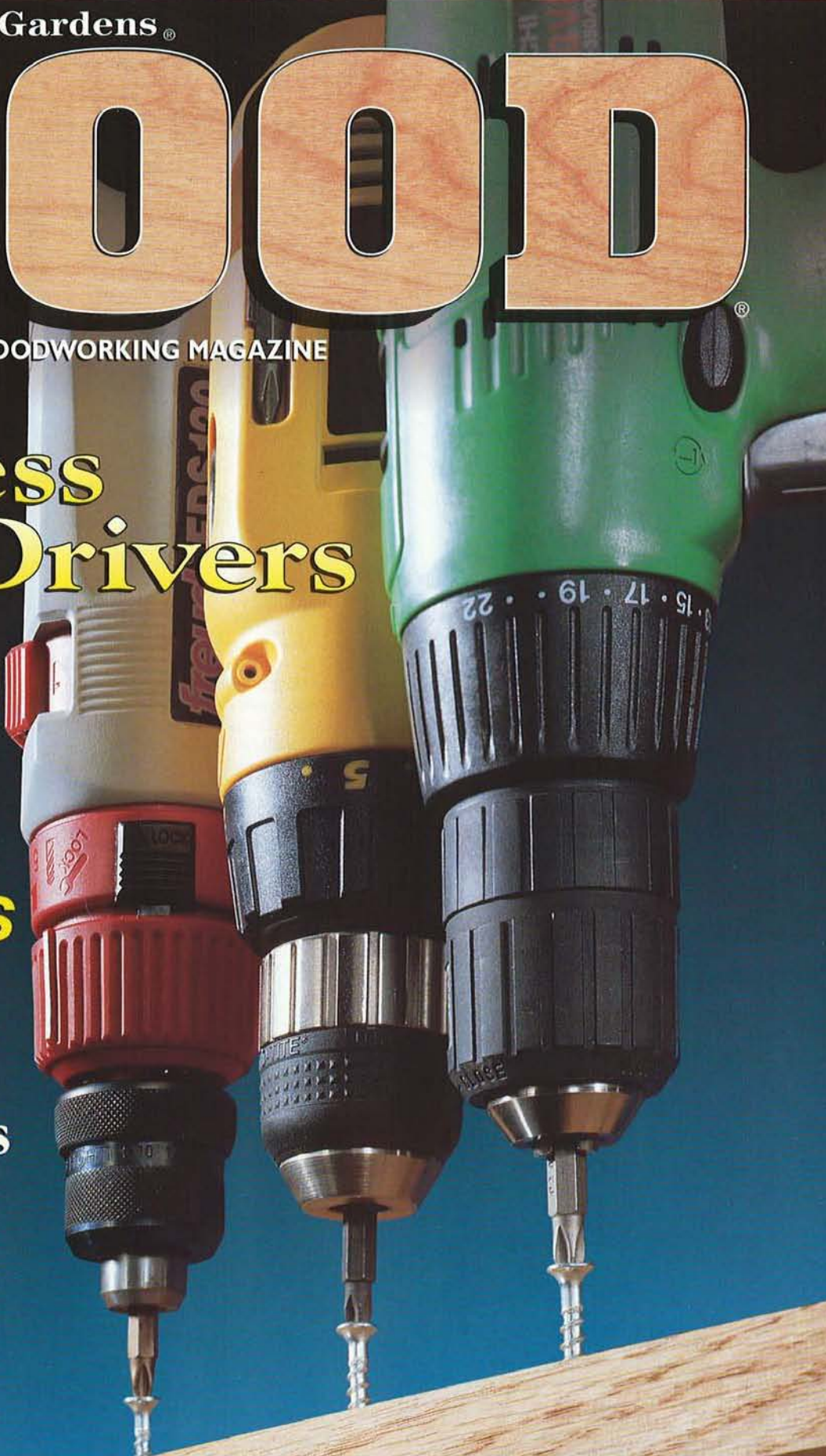
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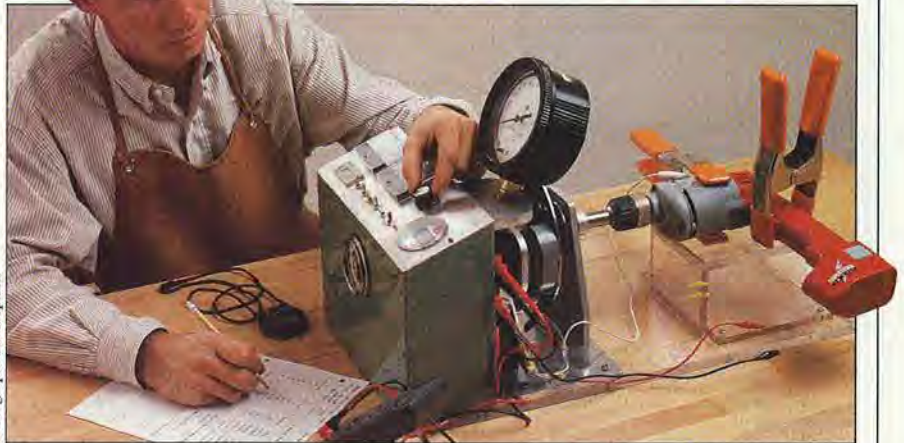
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MPA

Definitely above and beyond the call



Photograph: Bill Hopkins

Tool tester **Bob McFarlin** with his homemade dynamometer, the instrument that allowed him to take an in-depth look at over 40 cordless drills for the article beginning on page 56.

Sometimes, despite our very best efforts, we land in hot water with manufacturers when we publish the results of our tool tests. So you can rest assured that when it comes time to research and write any tool review, we try to be extra-careful that we do our job as accurately and thoroughly as possible.

Take the cordless-drill article in this issue, for example. Until we took on this tool category, the standard test used by evaluators had been to see how many screws a fully charged drill will drive, or how many holes it will bore.

But to **Bob McFarlin**, the tool tester who provided us with the data for the article, that wasn't good enough. He figured that the only objective way to evaluate the tools was by hooking each of them up to a dynamometer. So he built the one shown in the photo above. The "dyno" (that's the way **Bob** refers to it) provides exact readouts of speed, torque output, and total revolutions.

Bob told me that he's always trying to find ways to eliminate

human error and personal opinions in his testing. But why go to all the effort to build his own instrument? He cites several reasons, the chief of which is that with a dynamometer he can put an exact workload on each drill with a pair of electromagnets and maintain it until the battery pack is exhausted.

Bob used other instruments to measure such critical factors as voltage, battery-pack and tool-housing temperatures, and run time. All of these results were used to make the recommendations in the article.

What I'm talking about here folks is the most accurate and informative test ever done on cordless drills by any woodworking publication. Take a look at this article; I think that you'll be mightily impressed.

And **Bob**, thanks to you and **Dave Henderson** (our other tool tester) for your dedication to tool-testing excellence. It shows. 🍀

Larry Clayton

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300 lbs of pressure and 224 mph winds couldn't break this door down. Better not lose your keys.

We don't test our doors at Stanley. We punish them. We punish them with wind. With water. With very large metal objects. And when we're done, we punish them some more.

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we love flowers, birds and other living things. But to make a better door, you have to be tough.

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STANLEY
helps you do things right.

We test two similar drum sanders

PERFORMAX VS. RYOBI

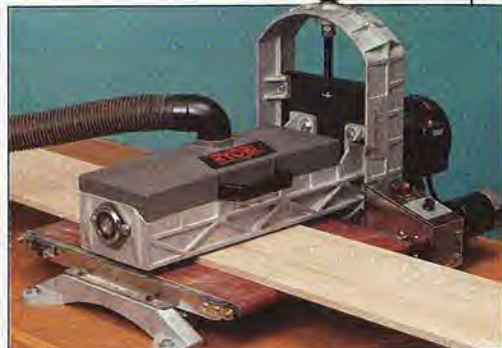
Until recently, the Performax 16-32 Plus was the only open-ended drum sander priced under \$1,000. Then, Ryobi introduced a similar-looking machine dubbed the WDS1600 selling for about \$300 less (\$599 vs. \$899). Both prices exclude an optional stand. This big price difference really stirred my curiosity, so I ordered both machines and put them to the test.

Right out of the box, I noticed several things that account for at least part of the price difference. First, the Performax machine is assembled in the United States from mostly U.S.-manufactured parts (including a Leeson motor). The Ryobi is made in Taiwan. Mating surfaces between critical components are better machined on the Performax. And, I found the assembly and adjustment instructions for the Performax much more thorough and complete. (Representatives of Ryobi tell me they have beefed up the manual considerably since my test. They are sending new manuals to all registered owners.)

Next, I set up the machines, adjusted the drum and conveyor parallel with each other, and sanded a variety of workpieces. Here's what I discovered.

Performax 16-32 Plus

The sanding-head and conveyor-belt mechanisms of the Performax unit come in separate boxes, but were a snap to assemble. Adjusting the conveyor tension, setting the drum parallel to the conveyor, and securing 24-through 220-grit abrasives onto the drum all proved relatively easy and straightforward.



With the machine adjusted, I used a dial indicator to test for deflection at the unsupported end of the sanding drum. Under a sanding load, the Performax drum deflected .003"—well within acceptable tolerances.

My test workpieces did not show any snipe. And, their thickness varied only .002" side-to-side and end-to-end—excellent by my standards.

Ryobi WDS1600

This machine comes with a set of shims for adjusting the conveyor parallel to the sanding head. This difficult task was further complicated because my machine did not have enough shims. So, I had to adjust the two bolts that hold the upright motor/sanding head support. (My Ryobi contact tells me that current units have additional packing to better hold factory-set parts during shipping.)

After making these adjustments, the sanding head deflected .035" at its far end. To remove this play, I tightened the four bolts that hold the motor. This proved tricky because when I tightened the bolts too much, the sanding head would not elevate up and down. I eventually adjusted the machine so it would sand boards to within .004" of parallel over their faces—also excellent. But, at this

tight tolerance the sanding head of the Ryobi does not elevate with the ease of the Performax.

The sandpaper-retaining clips were similar to those on the Performax, but were harder to access and operate. I had difficulty securely fastening abrasives under 80-grit.

The final analysis

Both machines are capable of producing excellent results. But, getting to that point with the Ryobi requires considerable effort and some mechanical aptitude on your part.

Are these trade-offs worth the \$300 savings? Woodworkers I've spoken to are about evenly split on this issue; it pretty much depends on your budget, and how much tinkering you want to do with the machine now and in the future. 🐿

—Tested by Bob McFarlin

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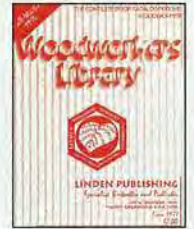
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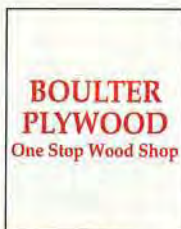
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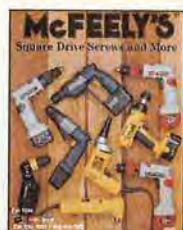
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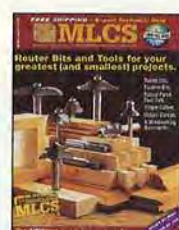
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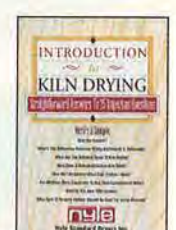
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No more skid marks on plastic laminates



I read with interest "How to Apply Plastic Laminates" in the August 1995 issue. I have a tip for eliminating the router marks when trimming the edge of a shelf or top with a router bit. Just apply a thin coat of petroleum jelly to the laminate on the edge. Then, trim with the router, and wipe off the petroleum jelly after completing the trimming.

—Bob Merrill, Wilbraham, Mass.

Reader wants a slower-setting glue

I found the June 1995 article "Today's Advanced Woodworking Glues" interesting because my current projects require a glue with great strength but a slow drying time. I see that Gorilla Glue and Excel both offer 20-minute open time. Are there other glues on the market that have an even longer open time?

—Paul Nye, Ossining, N.Y.

Yes there are, Paul. We found Slo-Set Glue offered by Garret Wade (1 pint of Slo-Set, part #62J04.01, priced at \$6.95), which has a 30-minute open time. This is a slow-drying aliphatic resin glue with holding properties similar to other woodworker's glues on the market.

Weldwood Resorcinol Glue also has a longer open time than many other wood glues. This two-part glue has a 2-hour pot-life after being mixed, and an open assembly time of 25 minutes. Resorcinol Glue has the additional benefit of being waterproof. However, it will produce a noticeable dark line at the glue joint when used to fasten light-colored woods.

Continued on page 14

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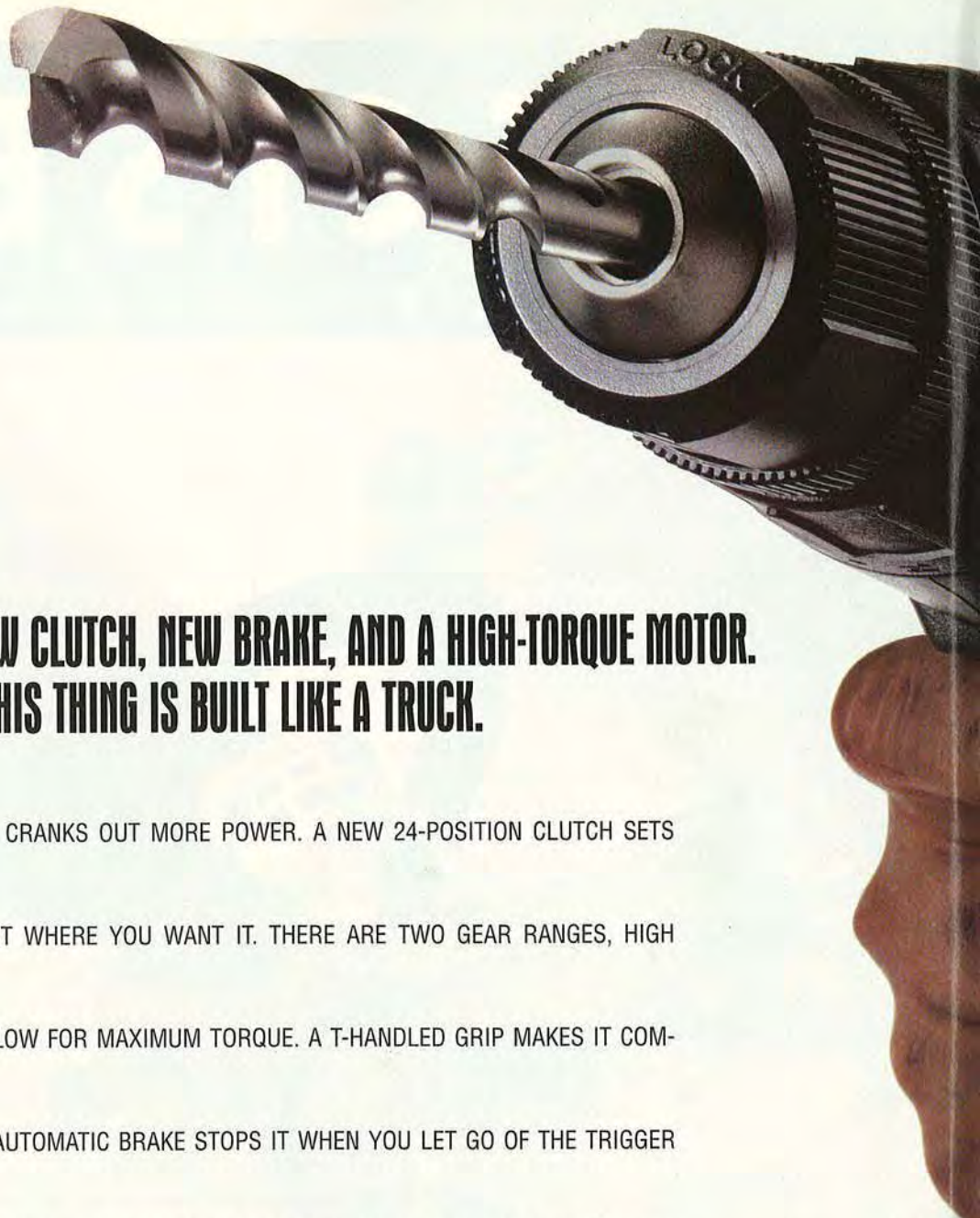
Makita's Model 3901 offers more of the high quality features you want in a plate joiner.

Like a cast aluminum fence and base that's precision machined for accuracy. Rack and pinion vertical adjustment for exact cutting depths. Spiral cut bevel gears for smooth and efficient transmission of power.

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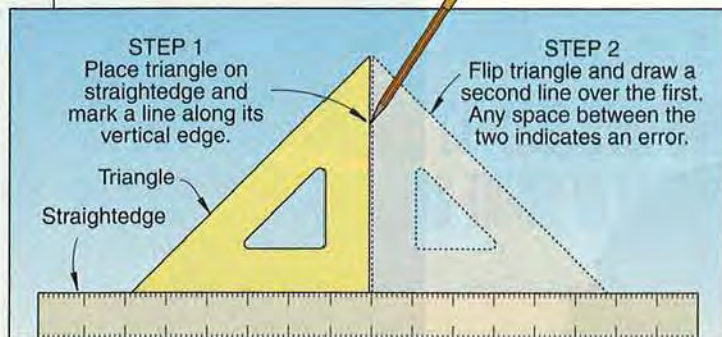
Continued from page 10

Check your triangle for square

The article "Tuning Up Your Power Tools" in the October 1995 issue stated that you used a drafting triangle, but you did not mention a method for testing the triangle's accuracy. Here is one I use:

Place a straightedge over paper on a level surface, and place one of the short legs of the drafting triangle on the straightedge (see the drawing below). Draw a line on the vertical edge of the triangle. Now, flip the triangle horizontally, and redraw a second line over the first. Any visible distance between the two lines indicates an error.

—Alan Phillips, El Cerrito, Calif.



Readers, can you help?

In the January 1992 issue of *WOOD*, we featured a story on John Starr's process of wood "stabilization." John's process of injecting liquid acrylic resins into wood under pressure made the wood stable, water resistant, and colorfast. "Stabilized" wood that would otherwise be too soft or unstable to work could be handled normally after treatment.

But John's company, Material Stabilization Specialists, Inc., is no longer in business. So we're putting out a call to anyone who knows of a company that does wood acrylic-impregnation. Please contact us at the addresses listed on page 10 so we can share the news with our readers.

—The Editors

Continued on page 16



A piece of spalted maple before stabilization (top) and after stabilization.

"Jorgensen" E-Z HOLD™ II

THERE ARE NO TWO WAYS ABOUT IT!

Imagine the ease and convenience of a clamp that provides both bar and spreader applications in one tool! The revolutionary "Jorgensen" E-Z HOLD™ II is performance engineered with a double sliding-head design and in-line advancing handle... maintains greater applied force than other one-handed clamps. It's the most versatile, affordable, high quality clamp you can buy... no two ways about it!



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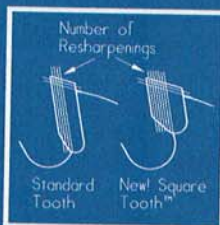
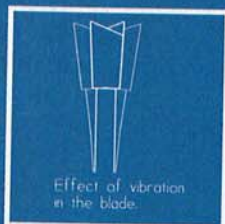
For our catalog
send \$1.00 to:
Adjustable Clamp Co.,
410 N. Ashland Ave., Chicago, IL 60622

Wanna' hear the latest in saw blades?

You can't!

You can't, because these new blades are absolutely quiet and vibration-free. All other blades vibrate. If you don't believe us, take the blade you're currently using, hold it by the arbor and tap it with a pen or pencil. Hear the ringing noise? That's the vibration, the same thing that happens when you make a cut. Now, tap the blade on this page. No really — try it! That's what our new blade sounds like.

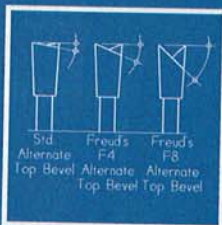
Vibration does more than just make noise. It causes teeth to dull faster and makes the cut less precise. So how do we eliminate vibration? We laser cut patented anti-vibration reeds right into the blade body. The sound gets trapped in the reeds and there you have it, no vibration.



Not only is this the quietest blade, but the most precise. Why? Vibration causes micro-chipping on the edge of the workpiece and the kerf width to vary. We've also incorporated Freud's innovative new Square Tooth™ design — by taking the same amount of carbide as in our other

blades and reshaping the tooth to make it thicker and shorter. A shorter tooth is less likely to follow the grain of the wood, thus permitting a more precise cut. A thicker tooth will also yield more sharpenings, extending the life of the blade. Also, our Titanium super micro-grain carbide lasts longer between sharpenings than other manufacturers' carbide.

A higher tooth angle prevents splintering and chipping. So we increased the bevel angle for each blade to give you a splinter-free cut. We have 3 blades to handle any woodworking project: 40 tooth ATB general purpose, 60 tooth triple chip for man-made materials, and 80 tooth ATB crosscutting.

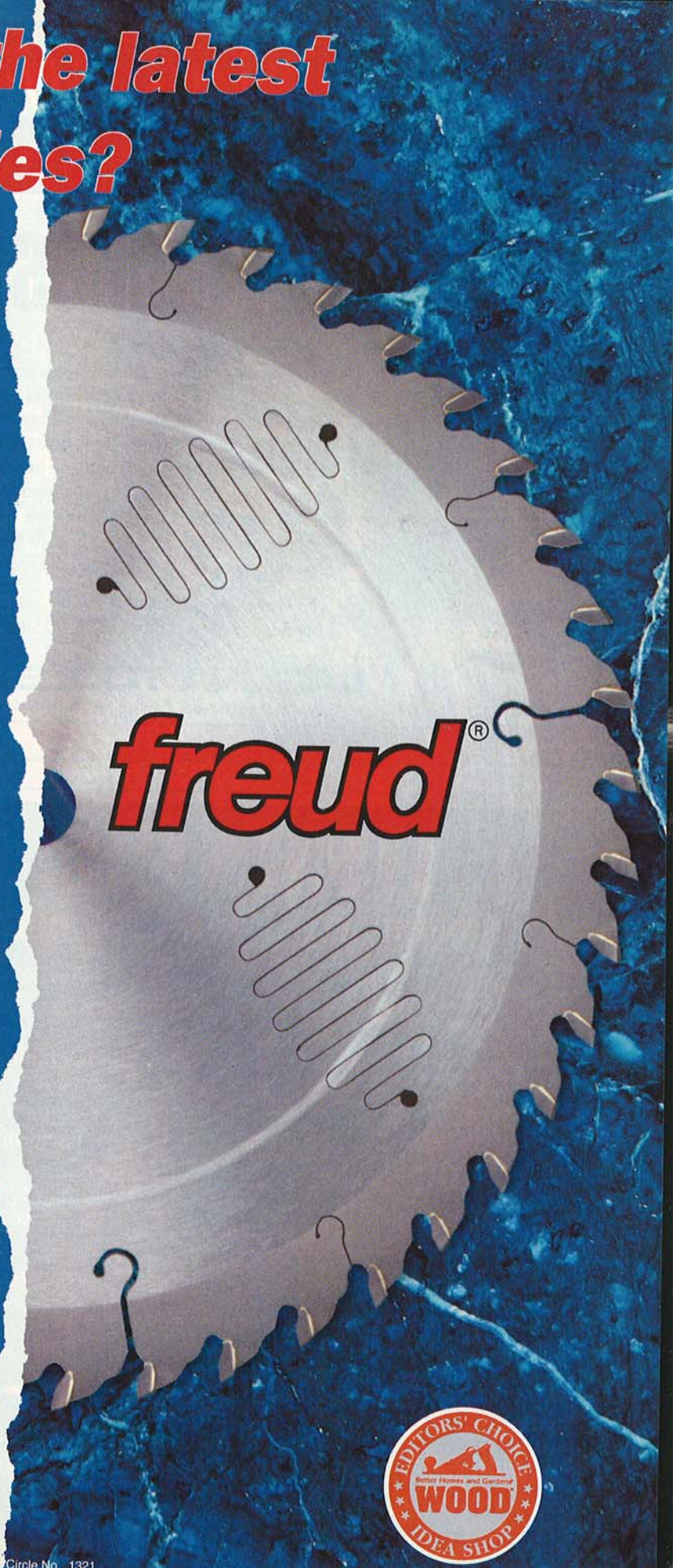


So, there you have it. A new blade so advanced, that it will change woodworking forever! Go see your local dealer and ask them to let you tap our blade. It really is that good.

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Continued from page 14

Mail-order kits no longer available

Grand River Workshop, one of the furniture-kit suppliers mentioned in the article "The *WOOD*® Gang Builds Kit Furniture," in our February 1996 issue, is no longer in business. Although the company was operational at the time we produced the article, its telephone numbers have been disconnected.

Missing patterns for the Treasure Tower

The *WOOD PATTERNS*™ insert in the center of our June 1996 issue is missing the full-sized patterns for the uprights (E) for the "Treasure Tower" project. If you're building this project, please write us at the addresses on page 10, or call us at 800/374-9663, and we'll send you the patterns. Our apologies for the inconvenience.

Using the right double-faced tape

I have been trying to make the intarsia duck design for the "Wild-Kingdom Coatrack" in the September 1993 issue, but I'm having trouble with my scrollsawing. You suggest double-faced tape to hold the pieces of 1/4"-thick wood together while scrollsawing, but I haven't been able to find a tape of this type that will work. What tape do you suggest I use?

—Don Snell, *Cutler, Ind.*



It's important to use the right tape for the job, Don. The most common double-

face tapes are plastic film-backed and cloth- or fiberglass mesh-backed. We use the fiberglass type in our shop. It is available in Ace or True Value store brands. The plastic film-backed tape is not suitable for shop work. ♣

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Isn't that every woodworker's dream? Our team of European Bandsaws give you almost twice the resaw capacity of our competitors, the innovations that go beyond your wildest dreams; dynamically balanced cast iron wheels, heavy duty cast iron tables and huge (well, actually large) blade capacities & professional guides. Our Bandsaws come in a size and budget to fit your needs. Call (800) 234-1976 today for your free demonstration video.

PS - For those of you that size is an issue, our Bandsaws range from 13" to 36" models.

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And its dry suction is just as impressive. Imagine how fast you can clean your workshop with a vac that can pick up two bushels of sawdust in less than a minute.

It's also a versatile blower with 150 MPH blowing velocity.

There are four Craftsman wet/dry vac models to choose from.

You can see them all at your Sears store.

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*One 100' length of 1" hose with a nozzle pressure of 50 psi and engine pressure of 125 psi will deliver 68 gallons per minute.



How do you clamp something that most clamps will crush? For an answer, see the tip *right*.

In our shop here at *WOOD*® magazine, we have clamps that range from 6" to 6' long. But when it comes to clamping small parts and miniatures, most clamps aren't small enough or gentle enough.

So when I saw Bill Rohde's clothespin clamping tip *right*, I knew we had a winner that will please anybody who has ever struggled with small-stock glue-ups. Like Mr. Rohde, perhaps you've come up with some clever jigs or techniques of your own. If so, we want to know about them. We'll pay you \$40 if we select your tip for publication, and you'll be eligible to win a tool prize for the best tip of the issue. To be considered, send a letter with a photo or drawing of the tip to:

**Tips From Your Shop
(and Ours)**

**WOOD® Magazine
1912 Grand Ave.**

Des Moines, IA 50309-3379

We try to publish only original shop tips, so please send your idea to just one magazine. Also note that we cannot return submissions. Thanks!

Bill Krier

ASSISTANT MANAGING EDITOR

Custom clothespins clamp tiny details

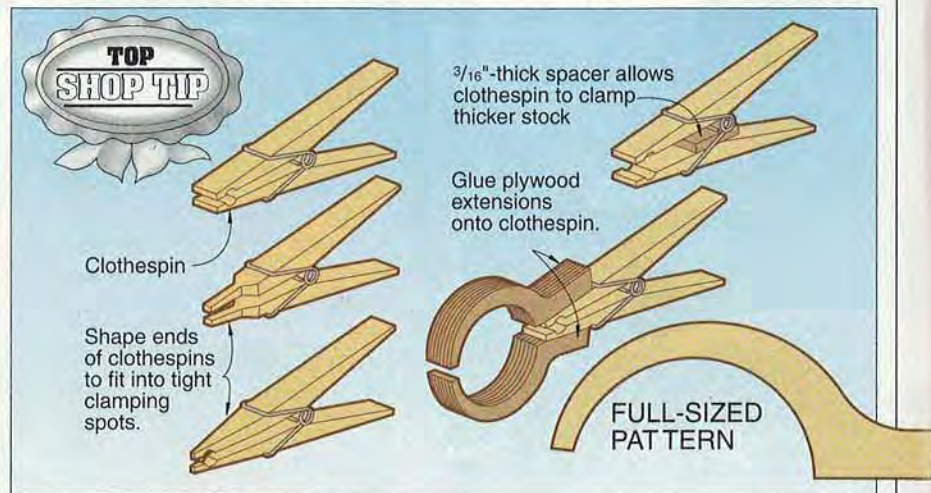
When you're gluing miniatures or small pieces of stock, even the smallest conventional clamps often turn out to be too big or exert too much pressure. So if you sometimes feel like Gulliver wrestling with a Lilliputian-size project, head for the grocery store and pick up a bag of clothespins. You can use the clothespins as they are to clamp flat stock. But for things like half-rounds, buttons, and extra-small details you can custom shape the ends of the



Bill Rohde, our top shop tip winner for this issue, receives a Sears model 23616 23" scrollsaw for his effort.

clothespins like the examples shown *below*.

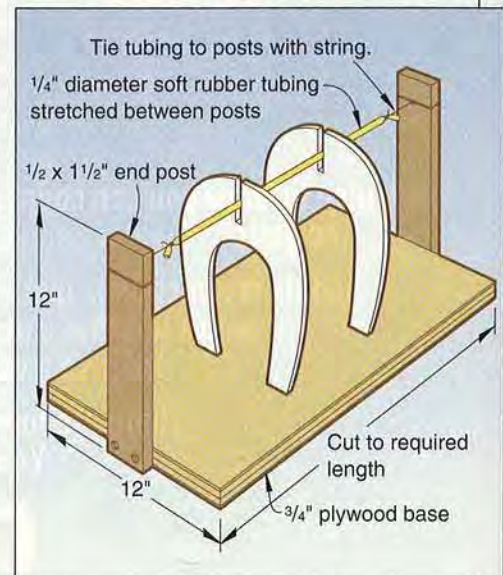
Bill Rohde, Germantown, Tenn.



Try plastic tubing to hold small parts for painting

The next time you need to paint small, notched parts for a project (such as the legs for the tabletop reindeer in the November 1994 issue of *WOOD*® magazine), build one of these racks. Buy a suitable length of clear-plastic tubing at the hardware store with an outside diameter just a bit larger than the notches in your project parts. Then, tie string around the ends of the tubing and stretch it across a rack like the one shown *right*. Slip the notches in your project parts around the tubing and they'll stay put during paint application and drying.

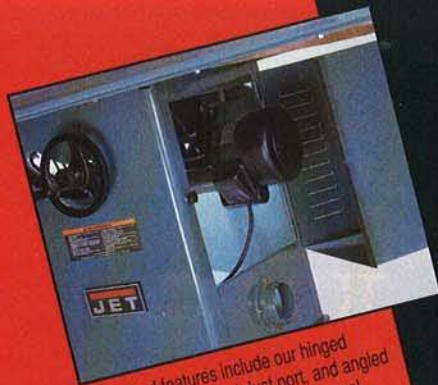
—T.W. Mabr, Whitehall, Pa.



Continued on page 20

Don't just take
our word for it.

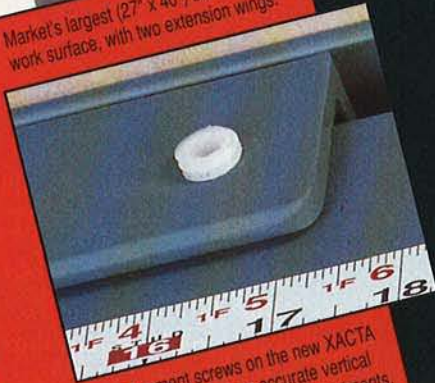
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Market's largest (27" x 40") solid cast iron work surface, with two extension wings.



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JET's 10" tilting arbor tablesaw. The experts were impressed by the cast iron trunnions, three matched v-belt drive, deluxe mitre gauge, and more—all backed by JET's two-year warranty. And now, JET introduces the XACTA FENCE™ System. For more information about JET's complete line of quality woodworking tools, or to order a free demo video of JET's exceptional 10" tilting arbor tablesaw, call 1-800-274-6842.

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Saw and Fence
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Extension table
and legs:
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with purchase of saw
and XACTA FENCE™ System

*"Good features, performance,
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**December '95 issue of
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*"Should prove to be an excellent
shop workhorse and provide
long, satisfactory service."*

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Woodworker's Journal**

*"The first thing we noticed
was that the fit and finish
were exceptional."*

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Fine Woodworking**

Power Up. Size Down.

Don't be limited by the size of your workshop any longer. Now, Europe's finest line of combination woodworking centers is available in the U.S. Introducing EuroShop C-220. The perfect blend of performance, power and price. Call now to receive more information.

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1 HP **\$320⁰⁰**

RF-180 POWER FEEDER



1/2 HP **\$355⁰⁰**

SB-500 14" BAND SAW



1 HP **\$265⁰⁰**

DB-600 BRUSH SANDER



1 HP **\$295⁰⁰**

HP-500 1" SHAPER



3 HP **\$685⁰⁰**

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3 HP **\$750⁰⁰**

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1 1/2 HP **\$420⁰⁰**

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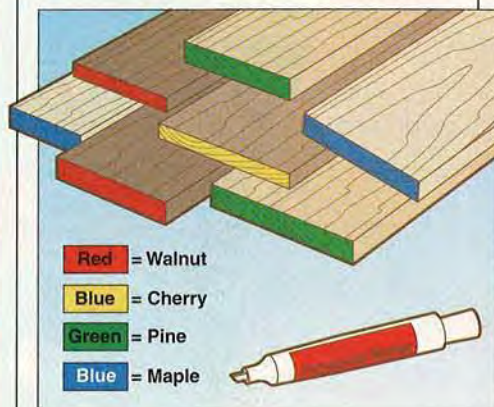
TIPS FROM YOUR SHOP (AND OURS)

Continued from page 18

Color-code your lumber to avoid confusion

When all you're looking at are the ends of boards stacked up in your shop, it's often difficult to tell one species of wood from another. To avoid confusion, take a tip from the lumber stores. Every time you store a board, color-code the species by marking the endgrain with a thick felt-tip marker.

—R. Phillips, Reading, Pa.

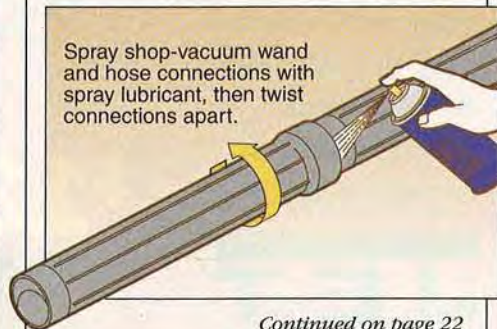


Lubricant loosens vacuum connections

If you get grit and dust on your shop-vacuum wands, they may stick together so tightly that you can't pull them apart. When this happens, try squirting a little WD-40 spray lubricant around the connection. Let the lubricant sit for a minute, give the wands a twist, and they will come apart. To prevent this sticky situation in the future, lightly coat both mating surfaces with WD-40 and wipe them down with a cloth.

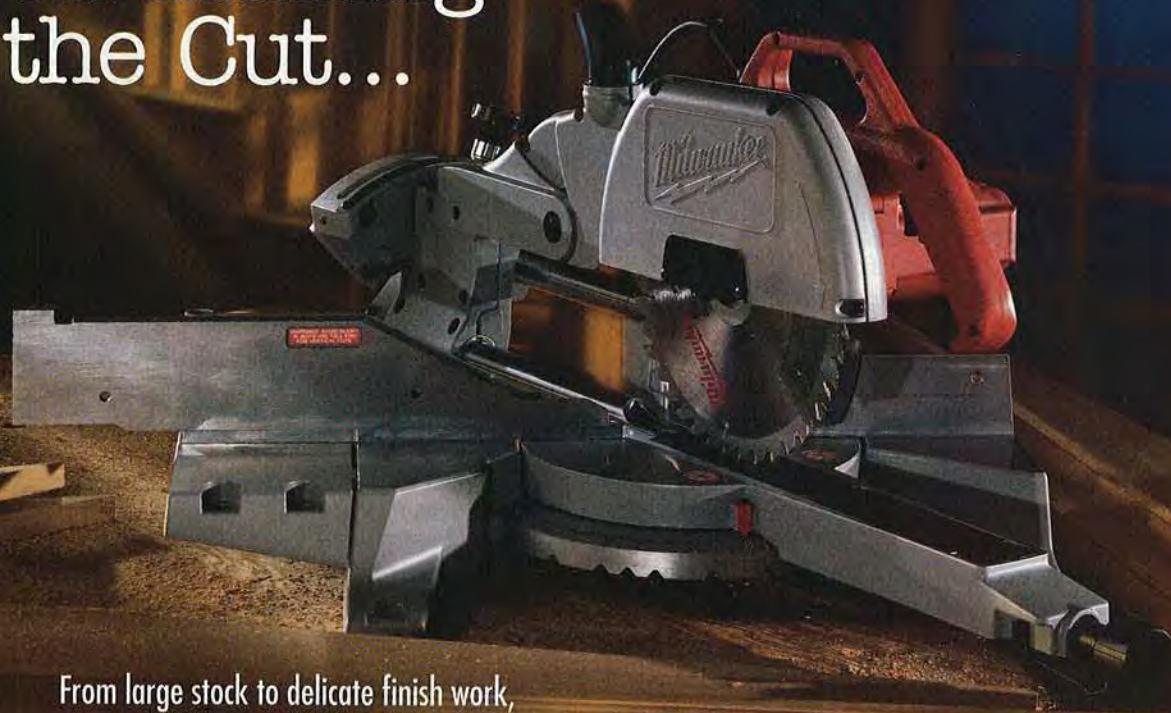
—Dan Wenciker, Jefferson, Ohio

Spray shop-vacuum wand and hose connections with spray lubricant, then twist connections apart.



Continued on page 22

Here's the Angle on Making the Cut...



From large stock to delicate finish work, our new 10" Magnum™ Slide Compound Miter Saw offers the capacity, accuracy and flexibility you demand. With a powerful 15 amp Milwaukee motor, 3-1/2" X 12" cross cut capability and patented Flip Fence, the Slider's got the capacity to handle both short and tall stock. Twin steel rails and the heavy-duty cast base for extra support assure accurate cuts every time. And its revolutionary override device lets you lock the table at virtually any angle. Allowing miter cuts from 59° right to 51° left, bevel cuts from -3° right to 48° left, compound miters and cross cuts, the Slider's versatile, too. The standard 6496-6 is equipped with a 40-tooth carbide-tipped blade and blade wrench.

Also available: the 6497-6 Slider Kit, with extension and stop gauge, vise, and dust bag.

For more information, call 414/783-8311. Fax 414/783-8529 or reach us on the internet at <http://www.industry.net/milwaukee.electric>



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MILWAUKEE ELECTRIC TOOL CORPORATION, BROOKFIELD, WISCONSIN 53005

550-1605

Continued from page 20

Shop-made clamps hold tight and save you money

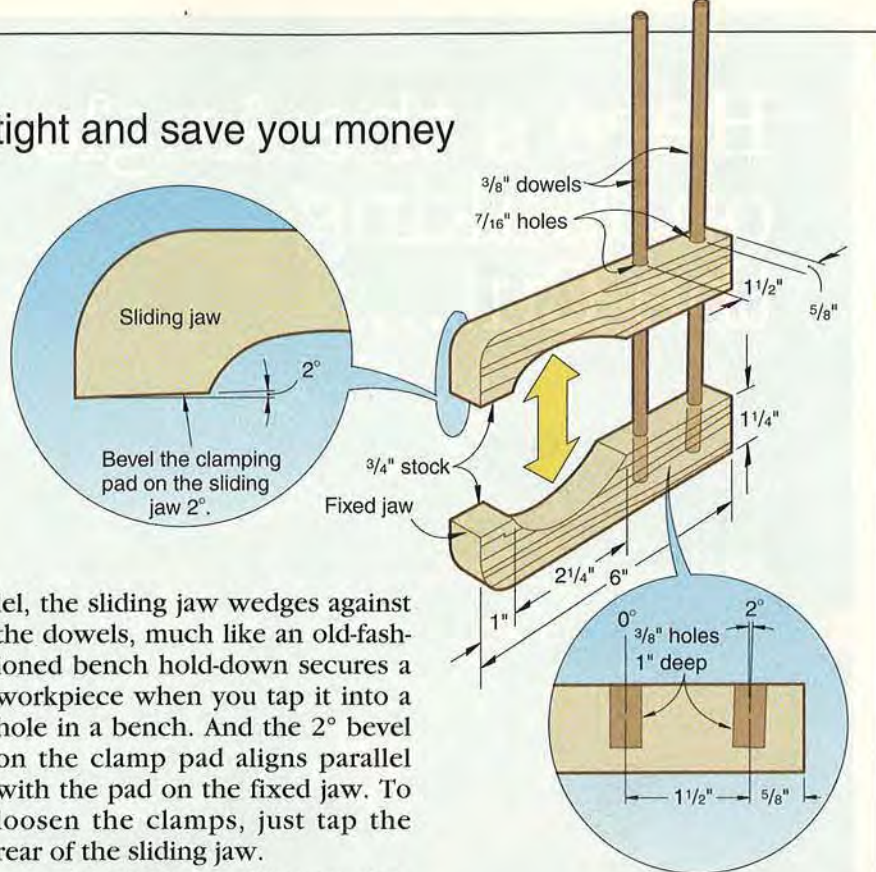
Let's face it; clamps cost a fair amount of money. If you've got more scrapwood than tool dollars, you can help keep your budget in line by making these handy light-duty clamps.

To build the clamps, cut the jaws to the dimensions shown, or choose a size suitable for your needs. Lay out the center points for the dowel holes in the same position on the sliding and fixed jaws, but drill the rear dowel hole for the fixed jaw at a 2° angle as shown. Then, glue the dowels in the holes on the fixed jaw.

The secret to these clamps is in the 2° angle of the rear dowel and the 2° bevel on the clamp pad of the sliding jaw. The sliding jaw will move freely until you place a workpiece between the clamping pads and squeeze the jaws together. Since the dowels are not paral-

lel, the sliding jaw wedges against the dowels, much like an old-fashioned bench hold-down secures a workpiece when you tap it into a hole in a bench. And the 2° bevel on the clamp pad aligns parallel with the pad on the fixed jaw. To loosen the clamps, just tap the rear of the sliding jaw.

—Carl Rasmussen, Winnipeg, Man.



Continued on page 24

TOOLS OF THE TRADE

Any woodworker knows that using the right tools for a project makes all the difference. That's why the Titebond® Family of Wood Glues has been the choice of professionals for more than 35 years. Recognized as the premier name in wood glues, Titebond has five specially-formulated glues for your next woodworking project.

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10", 2 HP BENCH TABLE SAW

- Maximum depth of cut @ 90°: 3"; @ 45°: 2-1/2"
- Blade sold separately
- Motor: 2 HP, 115V, 60 Hz, 13 amp, 4500 RPM
- Shipping weight: 40 lbs.

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10" SAW BLADE

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- 5/8" arbor

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COMBINATION 4" BELT & 6" DISC SANDER

The 36" long belt operates at 2168 feet per minute and will handle both inside and outside curves.

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6" RUFF N' REDD® SANDING DISC (25 pack)

For paint and metal removal. 36 grit, PSA backing.

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• 120 grit

ITEM 34510-0VTA **\$5⁹⁹**

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7" INDUSTRIAL RABBETING JOINTER WITH STAND

- Motor: 1 HP, 110V, 5.9 amps
- Max. depth of cut: 1/2"
- Rabbet cut: 1/2"
- Cutting width: 7"
- Max. table dimensions: 42" x 6-1/2"
- Cutter head speed: 4655 RPM
- Rabbeting ledge: 3-1/4"
- 47-1/2" x 19-1/2" x 36-1/2"
- Fence tilt: 45°

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CONTROLLED PRESSURE, NON-MARRING HARDWOOD CLAMPS

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JAW LENGTH	JAW CAPACITY	ITEM	PRICE
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12"	8-1/2"	04854-5VTA	\$5⁹⁹

CENTRAL MACHINERY

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5 SPEED BENCH DRILL PRESS

- 620 to 3100 RPM
- 8-1/4" maximum distance spindle to table
- 1/2" chuck
- 2" stroke, 8-1/4" swing
- 1/3 HP motor
- 22-1/2" high, 47 lbs.

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DRILL PRESS WITH KEYLESS CHUCK

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12" x 37" WOOD TURNING LATHE

Index pin contains 36 - 10" spacings for accurate fluting and marking on workpieces. Left and right turning face plates and 6" and 12" tool rests. (Stand sold separately). Distance between centers: 37"; Swing over bed: 12"; Spindle speeds: 575, 980, 1560, 2520 and 3580 RPM; Motor: 1/2 HP, 1725 RPM, 115V, 60 Hz AC, swing mounted to headstock; Drive spindle: No. 1 Morse taper plus 3/4-16 threaded; Tailstock: No. 1 Morse taper; 2-3/8" ram travel; Ship. wt.: 80 lbs.

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Make a square hole in the fraction of the time it takes by hand! Easier layout for professional mortise and tenon joints in furniture, cabinets, and restoration. Fence with hold down clamp keeps workpieces from lifting off the table. Large capacity - up to 5" maximum height. Includes fence, workpiece clamp, 1/4", 3/8", and 1/2" mortising chisels and bits.

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- Accepts .745" chisel shanks
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- 3-1/2" swing
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TIN COATED FORSTNER BIT SETS

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- 20 sizes from 1/4" to 3/4" by 16ths, 7/8", 15/16", 1" to 2" by 8ths

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- 16 sizes from 1/4" to 2-1/8" by eighths

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- Precision milled 14-1/2" x 8" table fills 0° to 45°
- 5-1/2" blade length
- Use either plain or pin end blades, 5-1/2" long
- 1/8 HP, 110V, 83 amps
- Heavy duty cast iron frame and base reduce vibration
- 7/8" blade stroke
- 1750 SPM blade speed

ITEM 34618-0VTA **\$59⁹⁹**

5 PC. 5-1/2" SAW BLADES

• Plain end type

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10" PLANER

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- 5-1/8" working distance
- 10-1/8" x 9-1/8" feed table
- 19" x 16-5/8" x 16" overall dimensions
- 10-1/8" blade size
- 2-blade cutter head
- 61 lbs. ship. wt.
- Stand sold separately
- 2-blade cutter head

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ITEM 33272-1VTA **\$17⁹⁹**

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- 10-1/8" blade size
- 2-blade cutter head
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- 2-blade cutter head

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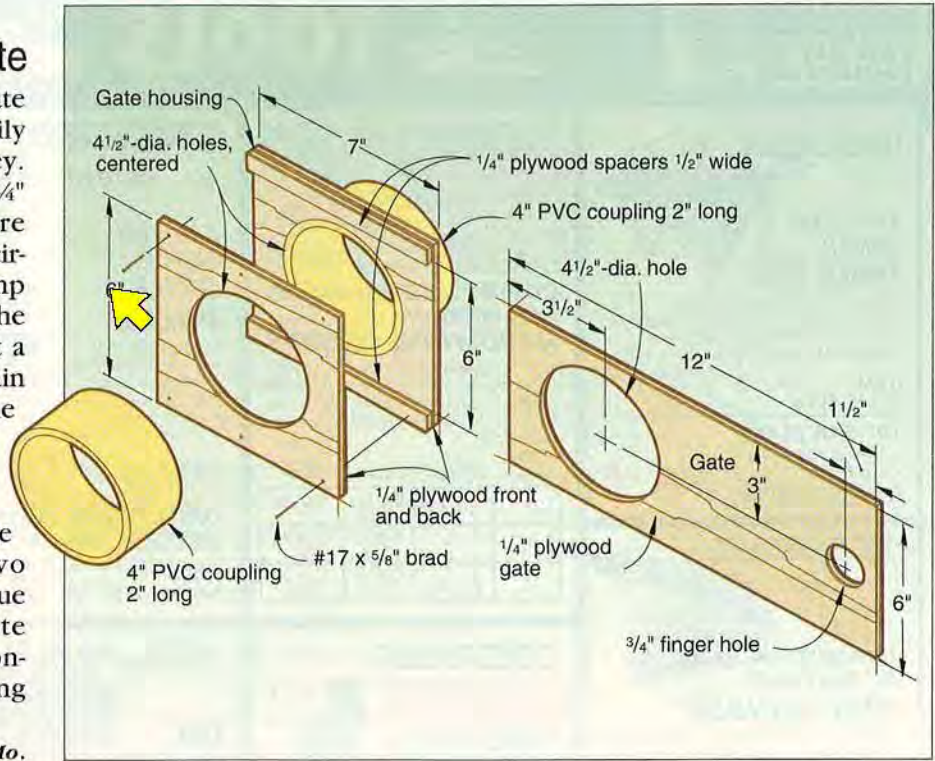
Continued from page 22

A quick-and-easy dust-collection blast gate

Here's a dust-collection blast gate you can build quickly and easily without spending much money. First, cut all the pieces from 1/4" Baltic-birch plywood, and bore the 4 1/2" holes as shown with a circle cutter. Then, glue and clamp the plywood spacers to one of the 6x7" plywood pieces. Now, cut a 4" section of PVC cold-water drain coupling in half, and epoxy the coupling halves to the 4 1/2" holes, flush with the inside surface of the plywood.

When the glue and epoxy cure completely, assemble the two halves of the blast gate with glue and brads. Now, slide the gate into the gate housing, and connect your dust-collection piping to the PVC couplings.

—Eugene O'Hara, Independence, Mo.



Continued on page 26



- Router \$134**
- 100 7/8 hp Router 103
 - 1700 HeatCut 81
 - 2620 3/8" Drill 4.5 amp 86
 - 2621 3/8" Keyless Drill 86
 - 330 Laminate Trimmer 143
 - 312 RO Sander 66
 - 345 Saw Boss 292
 - 361 3X24 Belt Sander 188
 - 363 4X24 Belt Sander 198
 - 410 Betterly™ Underside 147
 - 411 Betterly™ MiterFold 164
 - 5008 12" Dovetail Jig 76
 - 511 Door Lock Kit 241
 - 5116 16" Dovetail Jig 256
 - 556 Buscut Joiner 132
 - 6611 3/8" Drill 5.5 amp 109
 - 6614 1/2" Drill 119
 - 6615 1/2" Keyless Drill 119
 - 663 1.5hp Plunge Router 168
 - 6631 Plunge Base 72
 - 665 Router Table & motor 221
 - 666 Router Table only 127
 - 7116 24" Dovetail Jig 266
 - 7518 Vari Sp 3 hp Router 237
 - 7519 3 hp Router 203
 - 7526 2 hp Router 212
 - 7537 2 hp D-Handle RTT 212
 - 7538 3 hp Plunge Router 264
 - 7539 VS Plunge Router 264
 - 7549 Jig Saw 127
 - 7600 Drywall sander 326
 - 7610 Vacuum 239
 - 9118 3 1/4" Planer Kit 213
 - 9314 Trim Saw Kit 159
 - 9345 Sawboss w/ case 119
 - 96645 Screwgun w/ case 128
 - 97310 Trimmer Kit 184
 - 97335 1/8" Router & case 181
 - 9743 7-1/4" Saw Kit 139
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 - 347K 7" Saw RH&case 127
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 - 97355 5" RO Sander Kit 147
 - 97356 6" RO Sander Kit 153
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 - NS100 1/4" crown Stapler 35

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 - 0236-1 1/2" Magnum Kit 157
 - 0238-1 1/2" Keyless Drill 128
 - 0244-1 0-600 rpm Magnum 139
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 - 0379-1 1/2" Close Qtr Drill 149
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 - 3107-1 VS Ft Angle Drill 225
 - 5369-1 3/4" Falcott Kit 269
 - 5371-1 1/2" Hammer Drill 187
 - 5392-1 3/8" Hammer Drill 126
 - 5397-1 3/8" Hammer Kit 149
 - 5460 7" Polisher 178
 - 5682 2 hp Router 168
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 - 6018 1/2 Sheet Sander 123
 - 6010 1/2 Sheet Sander 127
 - 6148 NEW Mini Grinder 36
 - 6175 1/4 Chop Saw 278
 - 6296 NEW!!! Jig Saw 149
 - 6365 7-1/4" Saw 125
 - 6460 10" Circular Saw 288
 - 6491 10" Miter Saw 276
 - 6528 VS Super Sawzall 177
 - 6539-1 Screwdriver 174
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 - 6975 Heat Gun 58

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- 1587VSKB Jig Saw Kit 189
 - 94050 New! Inline Jig Saw 113
 - 1604A 1-3/4 hp Router 139
 - 1606A D-Handle Router 178
 - 1613EVS Plunge Router 194
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 - 32-100 Plate Joiner 254
 - 36-040 8" Compound Miter 149
 - 36-090 Stepek 10" Miter Saw 218
 - 36-210 10" Compound Mit 248
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 - 40-660 16" Scroll Saw 168
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Outperformed 36 other premium blades, both foreign and domestic!
WOOD® Magazine test, Sept. '93, pg. 45

WOODWORKER I - CROSSCUT For TABLE and RADIAL SAW

	LIST	SALE
12"x60Tx1" or 5/8" 1/8"K	\$198	\$139
10"x60Tx5/8" 3/32"K	\$162	\$129
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NEW SIZES AVAILABLE	LIST	SALE
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Sears 8-1/4" & Delta 8-1/4"x60Tx5/8"	\$170	\$ 99
Hitachi 8-1/2"x60Tx5/8"	\$179	\$109
DeWalt 8-1/2" & Ryobi 8-1/2"x60Tx5/8"	\$179	\$109
Delta 9"x80Tx5/8"	\$204	\$119
Ryobi-Makita & all 10"x80Tx5/8"	\$207	\$129
DeWalt, Makita, B&D, Hitachi 12"x80Tx1"	\$229	\$139
Ryobi-Makita 14"x100Tx1"	\$266	\$179
Hitachi 15"x100Tx1"	\$277	\$189

For good general purpose cuts use Woodworker II 30T & 40T or Woodworker I. Use small stiffener where possible.

I just purchased your WOODWORKER II 3/32 blade, and I AM TICKLED PINK with it. My RYOBI BT 3000 saw acts like it had a 3 H.P. motor in it. Cuts so much easier and quieter and smoother. Don't need my jointer or sander now.

P. Rose, PA

After installing your blade and 5 in. stiffener the vibration in my saw went down another 20%. I ran several pieces of hardwood through the saw, both crosscut and ripping, and was amazed at the smoothness. It was like cutting butter, maybe smoother. I have never had a saw blade that cut this smooth.

I also am going to send you my old Craftsman blade to sharpen. I'm not satisfied with our local sharpening. Now, how to justify another one of your blades... because I don't ever want to be without one.

Rick Price

NEW DELUXE DADO-KING! AS LOW AS \$184 NET AFTER USING SHARPENING COUPONS

C-4 Carbide Tips — 4 on each chipper with special negative face hooks.

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(Bore up to 1-1/4" Add \$25 — Plus \$5.50 S&H)

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Faster feed rates & absolute splinter control. Stops splintering on OAK/ BIRCH PLY VENEERS & MELAMINE.	SIZES AVAILABLE	LIST	SALE
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	9"x80Tx1/8" & 3/32" K	\$207	\$179
	10"x80Tx1/8" & 3/32" K	\$207	\$159
Other sizes available	12"x80Tx1-1/8"K	\$212	\$181

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Dan Nelson, Sacramento, CA.

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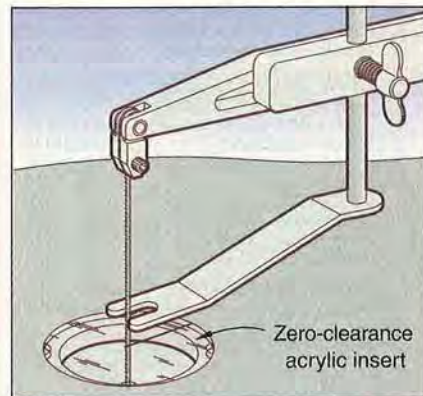
Continued from page 24

Throat plate prevents loss of small parts

Scrollsaws excel at cutting small pieces. But the smallest of these wooden parts have an annoying tendency of falling through the opening in the throat plate of the saw. To prevent this problem, build your own zero-clearance scrollsaw throat plates.

Cut your auxiliary throat plate from a piece of 1/8" acrylic to the exact outline of your saw's standard throat plate. If the 1/8" acrylic plate does not sit flush with your table, try a different thickness of acrylic, or shim the plate from below. Now, drill a 3/32" hole centered in the acrylic plate for the blade to go through. Then, scroll-saw a line from the edge of the acrylic plate up to the hole, and you're ready to go.

—Tony Lammers, Grand Rapids, Mich.



Zero-clearance acrylic insert

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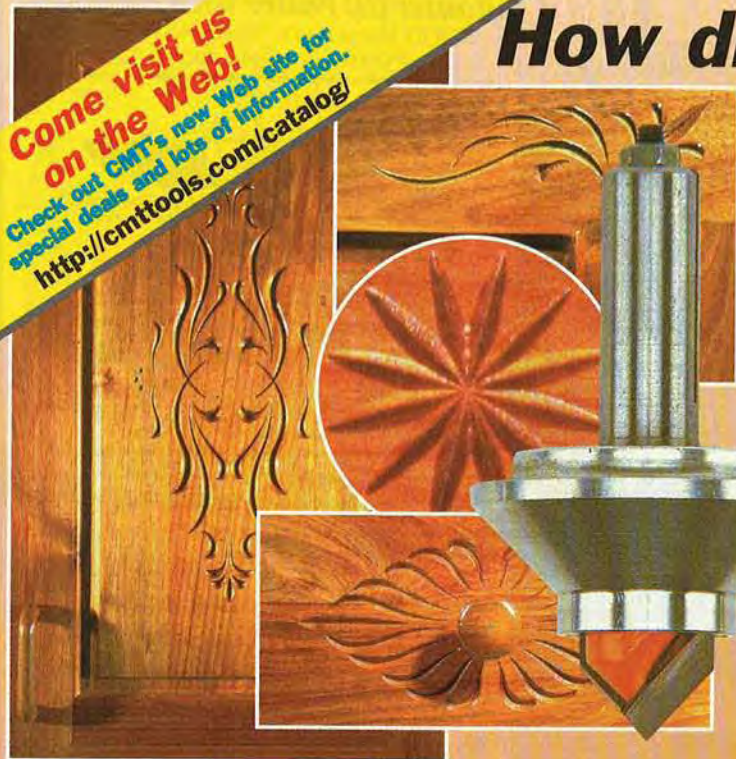
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A FEW MORE TIPS FROM OUR WOODWORKING PROS

- Master furnituremaker George Reid shares tips and techniques from his 50 years of woodworking on *page 35*.
- Learn how to tenon the ends of dowels for custom fitting on *page 50*.
- Breadboard ends dress up the endgrain of edge-glued panels, and allow such panels to "move" with changes in humidity. See *page 36* for how we make this joint. ♣

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on the Web!**
Check out CMT's new Web site for
special deals and lots of information.
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How did I carve these?



I love the look of hand carved wood, with its warmth, beauty and unique personality. But hand carved cabinets, doors and furniture have always been beyond my budget and quite frankly, intricate carving has always been beyond my skills.

In fact, architectural carving is almost a lost art in this age of automation and mass-production woodworking. So when we found this three dimensional router carving system in Tasmania (an island off the southern coast of Australia) we had to have it.

The beauty of this system is that it carves in three dimensions. Router sign-carving systems only have two-dimensional patterns, but our system incorporates a unique angled template guide and special templates to produce true three-dimensional cuts.

Besides the expense and time required, traditional hand-carving has another limitation: it's very difficult to exactly duplicate a carving. The 3D Carving system allows you to produce any design once, twice or a hundred times! With the 3D System, cabinet shops and door makers can add a new dimension to their work. Furniture makers can add rosettes, corner designs and "hand carving" to their pieces.

Best of all, the 3D Carving System is very affordable, providing professional woodworkers with an excellent opportunity to add value and distinctive touches to their work.

Sincerely,
Carlo Venditto, C.E.O.

NEW! **Complete 3D Carver™ Pattern Set**

46 full-size printed patterns!

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3D Carver Pattern Set

Includes 42 pages of accurate drawings packed in a 3-ring binder

3DC-900
3D Carver Pattern Set,
List: \$20.00 SALE: \$14.90

With CMT's exclusive 3D Router Carver™

What is the 3D Router Carver™ System?

The 3D Router Carver System is a unique patented method of producing intricate carvings quickly, economically and with complete repeatability. With the Carver Bit, Carver Templates and your 1/2" collet plunge router you can carve any flat wooden surface with designs that rival the work of a professional carver. In fact, the 3D Carver System's speed, accuracy and economy make it equally attractive to the professional or the serious amateur. Besides your router, the system includes three key elements:

- 1) The 3D Carver Bit:** A 1/2" shank, carbide tipped V-Groove Bit is enclosed in a 45° guide bushing. A threaded shaft within the bit's shank allows precise depth adjustment of the tip of the V-Groove bit. *Bit Specifications: Shank: 1/2" Cut diameter: 3/4" Cut Angle: 45° Cut depth: 5/8" Guide bushing diam.: 1-7/8"*
- 2) Template Holding Frames:** Clamped or tacked to your workpiece, these frames hold the 3D Templates securely in place.

- 3) Carver Templates:** A total of 46 templates (with more in the works) produce a host of designs for cabinet doors, panel doors, door rails and corners, drawer fronts and many other applications.

How does the system work?

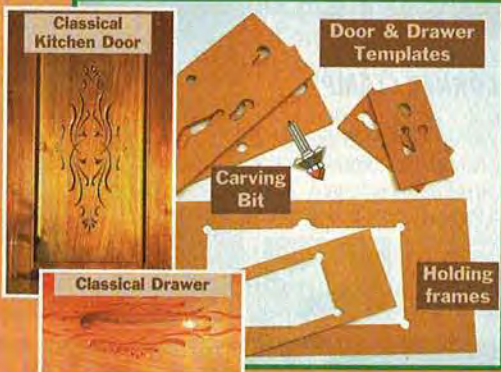
Using the 3D Carver is easy. The bit is installed in the router (1/2" collet only) with the plunge mechanism unlocked so that the router can move up and down as you route. The 45° bushing follows the slots in the template. As the slot gets wider, the router moves downward, so the v-groove gets wider. As the slot narrows, the router moves up and the groove gets narrower. That's it!

How do I get started?

With a great introductory offer on two of our most popular designs! Our Classical Kitchen Set includes templates and holding frames to make the beautiful Kitchen Door and Drawer Front shown at right, plus a 3D Carver Bit, complete instructions and a free copy of our 3D Carver video. You'll save 20% off our regular prices! We also offer Kitchen Sets in five other designs, plus patterns for four-panel doors, door rails, rosettes & more, so be sure to ask for our complete catalog.

499-010X Classical Kitchen Set with 3D Carver™ Bit & free video!

List: \$202.10 Sale: \$159.90



Where can I learn more?

Order our 3D Carver video, a step-by-step demonstration of all of the system's capabilities. Or ask for our free catalog, with nearly four dozen other templates plus our full line of bits, blades, hand tools and much more!

3DC-999
3D Carver Video List: \$13.00 SALE: \$10.00

CMT TOOLS

Even The Masters could use a little help from the 3D Router Carver

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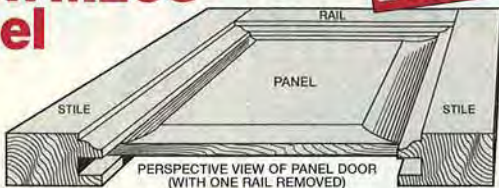
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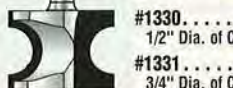
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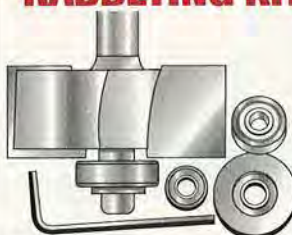
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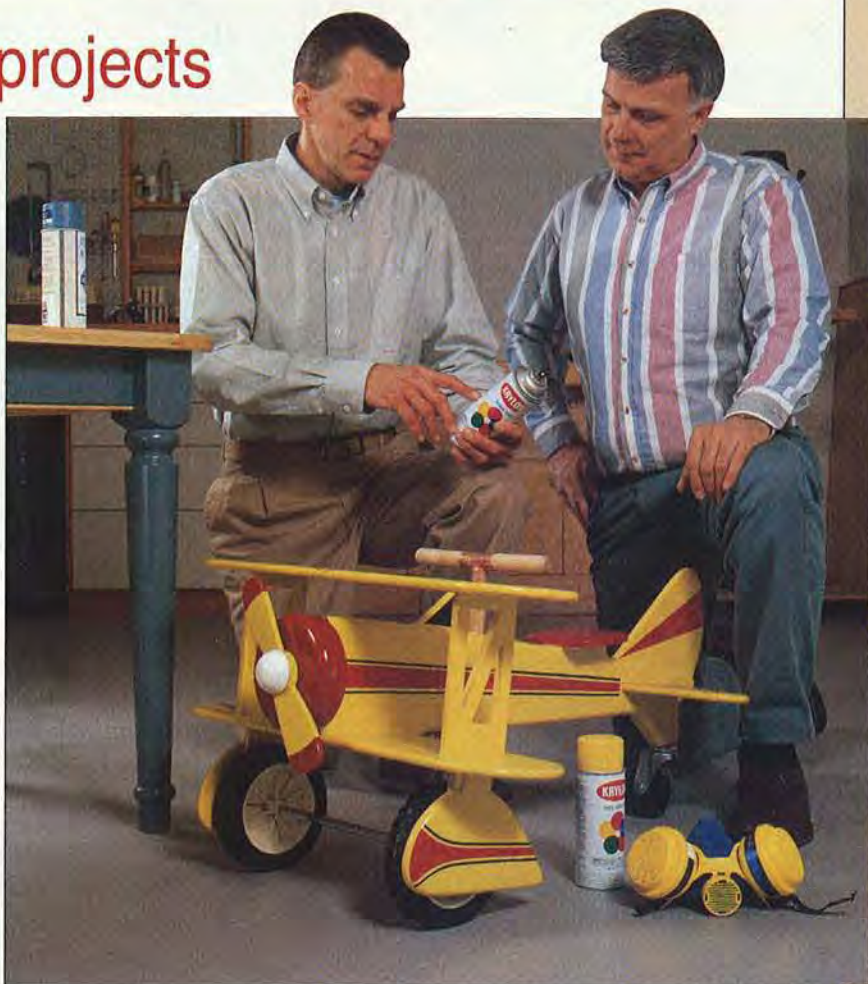
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How to give your projects A PERFECT PAINTED FINISH

In the February 1995 issue, #77, we showed you how to spray-paint your projects with the finishes professional auto body shops use to paint cars. But there is a lower-tech way to a perfect spray finish—the one our project builders Jan Svec and Chuck Hedlund, *at right*, use all the time in the **WOOD**® magazine shop.

They buy off-the-shelf products and use their tried-and-true process to produce flawless finishes time after time. Here's how they do it.



First, fill and sand. No matter how hard you try, a small gap, dent, or scratch can remain on a project after final sanding. To level-out problem spots such as these, Chuck and Jan use Durham's Rock Hard Water Putty. But instead of mixing the powder with water as called for on the can, they mix it with yellow woodworker's glue. By doing this, the filler sets up faster and harder, and doesn't crumble.

After mixing the powder and glue to the consistency of sour cream, use a putty knife to apply the putty to the depression. The smoother you apply and level the putty now, the less sanding you'll have to do later. Let the putty dry thoroughly (about an hour), and sand the repaired area smooth. As shown in the photo *at right*, a sanding block works well. If the

area is not perfectly smooth and flat, repeat the process.

OK, it's time to prime. A white primer coat on bare wood plays many roles in a silky-smooth finish. Primers contain more solids than paints do, making them ideal for sealing and filling a finely sanded surface. Acting as a uniform color backer for the paint to bond to, the primer also allows the true color of the paint to show through. For the projects shown here, we sprayed on Krylon White Sandable Primer. Sprayed directly onto bare wood, paints tend to darken or become slightly more yellow than their natural color. A primer coat also may raise the grain slightly. If it does, sand lightly to smooth the surface. It's better to have the primer raise the grain than the paint.



After filling the edges of plywood with our mixture, a sanding block is ideal for sanding it smooth and flat.

Note: It is critical that you use a paint that's compatible with the primer. For instance, if you want to use a lacquer-based paint, use a lacquer-based primer. And although you can spray an enamel paint over a lacquer primer, the solvents in a lacquer paint

Continued on page 30

A PERFECT PAINTED FINISH

Continued from page 29

will dissolve an enamel finish causing the paint to wrinkle.

To sand the primer, Chuck and Jan prefer 320-grit sandpaper. Not only does sanding level any little imperfections in the primer, it also highlights imperfections that are easier to smooth out now than during the painting process.

Our resident project painters give most projects one or two coats of primer. Porous end grain may need more primer to build up a smooth surface onto which you can spray the paint. Additional primer is also needed if you sand through the primer.

Now, check for imperfections. One of the best ways we know to do this is to shine a work light onto the surface and view the project from a low angle.

And now, for the paint. Chuck and Jan are unanimous in stressing the importance of *light wet coats* of paint, keeping the paint can nozzle the same distance from the project at all times. If you spray on too much paint at one time, you greatly increase the odds of runs and sags—problems that are difficult and time-consuming to even out. As shown in the photo *at right*, a bright light gives you a better idea of just how much paint you're

putting on. But be careful, too, that you don't put too little paint on the surface. If your painted surface feels coarse, you're probably not laying down enough paint. Jan



A can of spray paint in one hand and a bright light in the other is a perfect combination for even coats of paint.

Painted the table with American Accents All-Purpose Enamel (teal), and Chuck finished the plane with Krylon Interior/Exterior Paint (citrus yellow).

How to repair a less-than-perfect paint job

If a scuff, fingerprint, or other surface imperfection mars your painted project, there's still hope. To remove tiny bumps left by shop dust, Chuck and Jan wet-sand painted surfaces with 600-grit wet/dry sandpaper. They're careful to keep the area being sanded and the sandpaper wet as shown in the photo *at right*. They keep a tray of water on hand for this operation. It takes only about six light passes to smooth out the roughness. When doing this, be extremely careful not to apply too much pressure or make too many passes and rub through the thin layer of paint.

If the paint balls up under the sandpaper, the paint is not dry enough. If you notice lots of paint on your sandpaper, your paint is not dry enough or you're not using enough water.

After wet-sanding a painted surface, dry it with a clean cloth. The wet-sanding not only removes the



Keeping the project and sandpaper wet, use 600-grit wet/dry sandpaper to sand away imperfections or runs.

dust-bumps, it also leaves dull spots. To restore the shine, follow these steps. First, rub the entire painted surface with #0000 steel wool (ultra-fine Scotch-Brite pads, the grey-colored ones, also work fine). Again, use a light touch, being careful not to rub through the paint to the primer. Then,

wipe off the dust with a tack cloth, apply a paste wax with another clean cotton cloth, and buff the surface by hand to bring back the sheen. Our guys use Minwax Finishing Wax. 🌲

Written by Marlen Kemmet and Larry Clayton
Photographs: John Hetherington

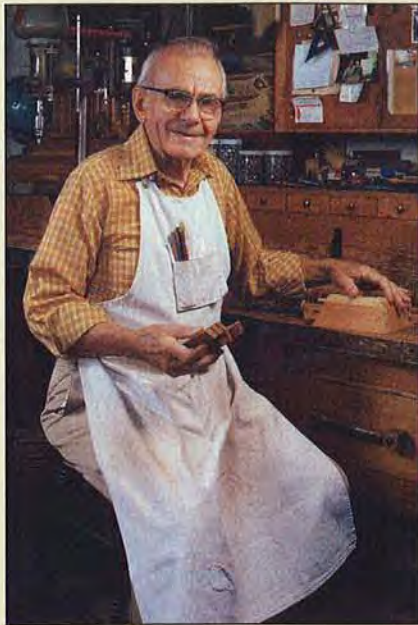
Caretaker of the CLASSICS



Master
cabinetmaker
George Reid
celebrates over
50 years of
craftsmanship.

Continued

Building reproductions of classic furniture requires the ability to carve. At his bench, George works on a mahogany shell decoration that's essential to Chippendale.



Left: At 81, George Reid still spends his days in the workshop. Sometimes he builds reproduction furniture, other times he works on aging classics that have been brought in for repair.

A major component of George's shop is the 10" Delta/Milwaukee tablesaw he purchased in the 1940s, still in operation.

 Print this article

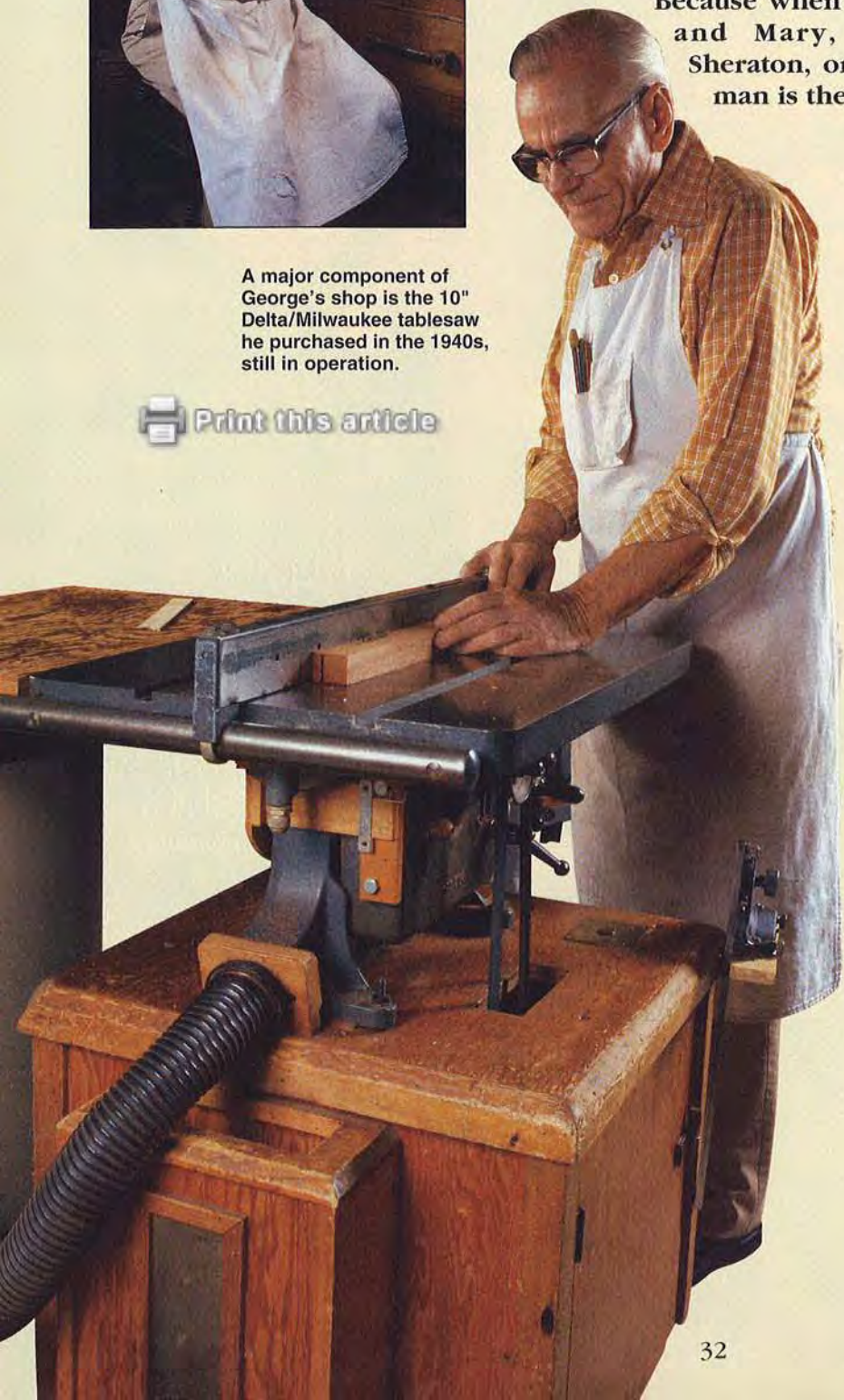
Wilbur and Orville Wright tinkered their way into aviation history from their bicycle shop in Dayton, Ohio. George Reid, a fellow Daytonian, probably won't earn a spot in any history book, yet for over 50 years, that city's most prominent families have turned to him for finely crafted heirloom furniture.

Because when it comes to the classics—William and Mary, Queen Anne, Chippendale, Sheraton, or Hepplewhite—this master craftsman is the authority.

George went on his own as a full-time woodworker in 1947. Before that, he had worked as a clerk in an accounting office and, during WWII, as a civilian modelmaker with the Training Film Laboratory at Dayton's Wright Field. There, he put his skills to use building props and models for training films.

"When the war came to an end, I knew the laboratory would be phasing out the civilians—I'd have to do something," says George. He stops work at his tablesaw, folds his arms comfortably, and continues. "I owned a few tools and was doing some outside work, nothing fancy, on weekends and evenings. For instance, I had picked up some work from the American Optical Co. making wooden lens cases for opticians' testing machines. In February 1947, I set up shop for full-time woodworking in the basement of our house."

A year went by before George fully tooled up. Then, he bought all the power equipment he thought he'd ever need. (With only a minor exception, those tools are the ones he still uses today!) They include: a Delta/Milwaukee 10" tilting-top tablesaw, a Sears bandsaw and lathe (they came with a bright blue finish at the time), a Delta 2-hp shaper with a host of cutters, a Boice-Crane planer, and a Delta 24" bandsaw. Those power tools joined a 1939 Delta drill press that he had acquired earlier. But like many of us, George underestimated his needs, and in 1952 paid out \$156 for a heavy-duty



jigsaw—the last power tool he’s ever bought.

Of course, George added hand tools as he needed them. In that category, his best buy came in the early fifties. “I’d heard about some English-made carving tools for sale by the son of one of the master carvers at the old Dayton Carworks,” George remembers. “As it happened, there were 287 of them, most made by Addis. They’re the finest I’ve ever used.”

A career takes off in the post-war boom

From the first, George was confident that he could make it on his own. As it turned out, though, he did get a little help from a friend.

“A designer whom I had worked with at Wright Field went to work for Dayton’s finest department store. He was in charge of their floor planning,” George recalls. “All businesses then were trying to expand and serve the new post-war buying public. And I got a lot of work building store fixtures—millinery counters, cabinets, showcases, book displays, and that type of thing.”

Indeed, George’s woodworking career was shaped by the consumer demand of the times. In the early 1950s, for instance, hi-fi sound systems were growing popular, but according to George,

there wasn’t cabinetry available to house the components. Opportunity knocked, and the craftsman was sought by several stores to plug the gap.

“Of course, people started wanting hi-fi cabinets to blend with their furniture,” George notes. “As a result, I got into some very good homes.” He was prepared, too. George had always admired classical furniture styles and had studied them diligently, even taking trips East to visit various museum collections.

Eventually, however, cabinet manufacturers caught up, and by the late 1950s George’s hi-fi cabinet commissions were dwindling. In the meantime, his list of prestigious private clients willing to pay for quality, custom-made classic furniture had grown. His skilled hands began satisfying

their often unique and always pricey decorating needs. He fondly recalls examples.

“This one family wanted a very special, Sheraton-style dining table,” George points out as he turns the pages of his scrapbook. “I built it of mahogany with an accordion-type folding mechanism [see photo *below left*] that allowed it to expand to 12½’.”

Another of George’s favorites is the Chippendale chest-on-chest, shown *below*. “It was built to store silver flatware,” says the maker. “I scaled it down to about one-half the size of a full-sized chest-on-chest and faced the drawers with book-matched, figured black walnut veneer.”

While George worked at commissioned pieces like those in the daytime, he spent evenings build-

Continued

Right: George scaled down this walnut Chippendale chest-on-chest to half-size in order to accommodate a customer’s large collection of silverware.

Below: George hand-carved the detailed water-leaf motif on the lyre-shaped legs of this Sheraton-style, mahogany dining table he built.





Left: This reproduction of a 1770 Newport-style shell desk was built as part of George's living "showroom."



Near left: Showcase pieces in George and Pauline's living room include the cherry Chippendale drop-front desk and the mahogany-framed Sheraton sofa with curly elm inlay.

ing furniture for their home, as shown in the photos *above*. "Of course, I made the furniture for us to use, but I also wanted it for a bit of display," says George, his eyes twinkling. "Customers could see my work and pick out the style for a piece—somewhat like a furniture showroom."

Today, George laments that with the passing of time—and money into younger hands—the call for the classic furniture that he made into a speciality just isn't what it used to be. "The money generation now must have different tastes," he speculates.

George built these 3/16-scale pieces as samples. The Philadelphia highboy stands about 18" tall. The Hepplewhite sidetable features handcut satinwood inlays.

Expertise covered by a million bucks

George admits to carrying a million dollars' in liability insurance, "Just in case I go into a house and something gets damaged." Yet, in all this time, that has only happened once.

"It was a steady customer of mine," explains the craftsman from a seat at his workbench. "She had a corner cabinet that held her collection of porcelain pieces, all on glass shelving. And she wanted a lock put on it. I had to work in her home. Before I came, she had taken everything out except what was on the very top shelf.

"She was busy in the kitchen when I got done with the lock," George recalls. "I closed the cabinet door, locked it, and turned to

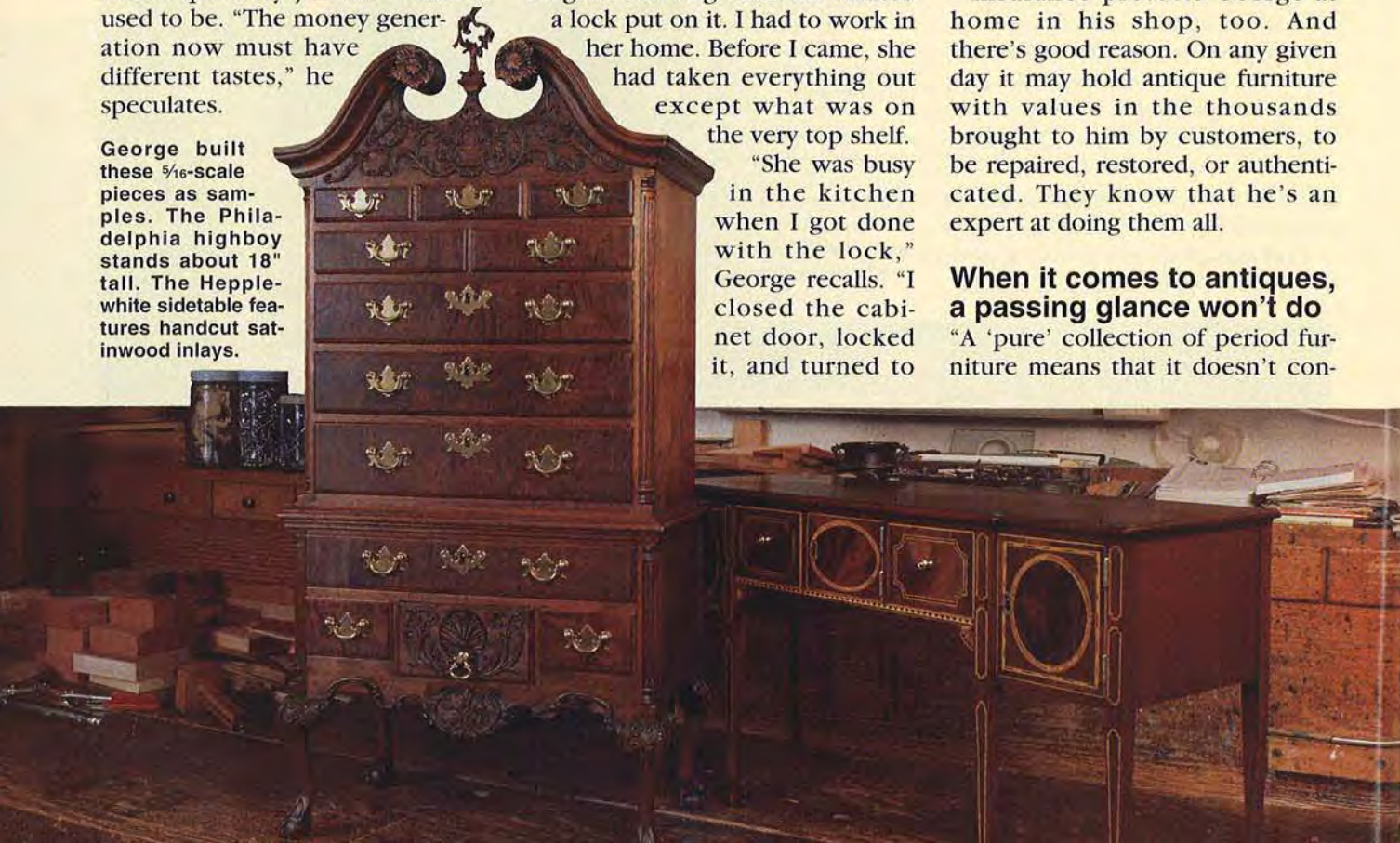
walk away when there was this most awful noise as the top shelf came down. I went to the kitchen and said, 'There's a terrible thing happened in here, ma'am.'"

George never did have to file an insurance claim, though. His customer graciously apologized for having "collected too many things," and told him that dealing with the insurance company would have been "such a bother" for each of them. And that was it.

Insurance protects George at home in his shop, too. And there's good reason. On any given day it may hold antique furniture with values in the thousands brought to him by customers, to be repaired, restored, or authenticated. They know that he's an expert at doing them all.

When it comes to antiques, a passing glance won't do

"A 'pure' collection of period furniture means that it doesn't con-



Right: "Pointed dovetails indicate English craftsmanship," says George. The 1780-vintage Queen Anne lowboy behind him was brought in for repair.



tain pieces that have been altered," George explains in describing Yale University's Garvan Collection. "It's about the purest assembly of furniture I know of because Mr. Garvan wouldn't buy a piece unless he had his old-time cabinetmaker go over it completely."

To mark the importance of that, George tells of the time he was called on to repair an American Chippendale-style blockfront desk said to be from the 1770s. "I worked on that piece for two weeks and just felt that something wasn't right," he remembers. "Finally, I removed the base molding to get to the feet. As soon as I got the molding off, the story of the piece opened like a book. I saw all the new work. The same mahogany stock as the original, but it was definitely a straight-front desk made into a blockfront."

"That's why it's impossible just to give a piece a glance, or pull a drawer out to inspect [see photo above right] in order to determine its history," he continues. "There are few pieces that haven't had

something done to them. And that's okay, but they shouldn't be represented as originals."

Fakes are another story. "A customer brought an American Queen Anne lowboy to me that supposedly was from the early 1700s," George says. "He had bought it from a reputable antique dealer, but he had some doubts. I didn't think it looked bad, but after I got into it, in no time at all I found out that it was totally fake. You see, the end panels were supposed to be mortised and tenoned into the legs, but they were all doweled. That didn't come along until the 1780s or so. He got his money back."

"There was an awful lot of fakery that went on after WWI," George goes on. "Wealthy Americans sent decorators to Europe to buy furniture. Those boys over there were waiting for them. They'd just have parts of some old pieces, and so they would finish them out using old wood, which they had plenty of, then stain and coat the new work to match. And those craftsmen really had the skills. That's

why you can't make a judgement on a piece without actually going through it almost piece by piece."

What about maker's marks, dates, and signatures to help with authentication? "Lots of people think so," George replies, "but in fact I seldom find any such thing. The English, for instance, never put marks on their furniture, whereas the French, and some Americans, left initials or a date, at least to tell you that they did something significant."

This craftsman, though, who has produced nothing but the finest of furniture, erases any future doubt concerning their origin. Somewhere, each is indelibly marked MADE BY GEORGE REID and dated. ♣

Woodworking wisdom from 50 years on the job

With his experience, George could fill volumes with observations, advice, tips, techniques, and finishing tricks. Here's a random selection he offered:

- "There are so many ways to finish, and none of them is the perfect one for me because each piece of furniture requires a different approach."
- "Most of the time, I use two coats of 3-pound cut orange shellac thinned 50/50 with denatured alcohol for a sealer. Then I come back with lacquer or varnish or whatever."
- "If I'm going to fill open-grain wood, I always fill it with a color darker than the natural."
- "I stain mahogany without dis-

coloring any lighter inlay by mixing potassium dichromate crystals with luke-warm water and then put that on the raw wood. It won't attack the inlay like a pigmented stain. Next, I apply a thin coat of orange shellac for sealer."

- "Museums want you to use hide glue on furniture for the reversibility of it. But hide glue grows [gives] with moisture. I've always used Titebond."
- "You can darken cherry by putting it outside in the sun, but you have to turn it regularly to keep it even."
- "There's no way to repair a finish so that it can't be seen unless you redo it all."

• "I clean up an old, but solid finish with furniture refinisher, then rub on lemon oil and buff it. You've got to match the patina of the old."

• "I normally fix a bowed top by making a saw kerf on the side away from the bow, if it's the underside, then glue in a wedge of the same wood. Then, I sand it down and finish it."

• On building classic furniture: "You've got to study. I have volumes on the styles, and lots of books with measured drawings. Then, you have to see it. Once you understand the proportions and features of the different styles, you can scale up or down from there."

Country-style KITCHEN TABLE



Breadboard ends, a rock-solid top, turned legs, and a terrific paint job all add up to one fine dining experience. Built to take the rigors of family meals day in and day out, this project will be around for years. Oh, and don't worry if you're not a turner. See our source for preturnd legs in the Buying Guide. If the painted base doesn't suit your decorating tastes, leave it unpainted or consider an oak base and tabletop.

Let's edge-join boards to form the table

1 From 1 $\frac{1}{16}$ "-thick stock (commonly called five-quarter stock), rip seven straight boards approximately 5 $\frac{1}{2}$ " wide each to form the edge-joined tabletop (A) and two boards 5" wide each for the breadboard ends (B). Breadboard ends are a traditional tongue-and-groove method for capping the ends of projects using edge-joined solid stock. With the grain of the

ends (B) running perpendicular to the tabletop (A), the ends help keep the tabletop flat.

2 Crosscut the maple tabletop boards 2" longer than listed in the Bill of Materials.

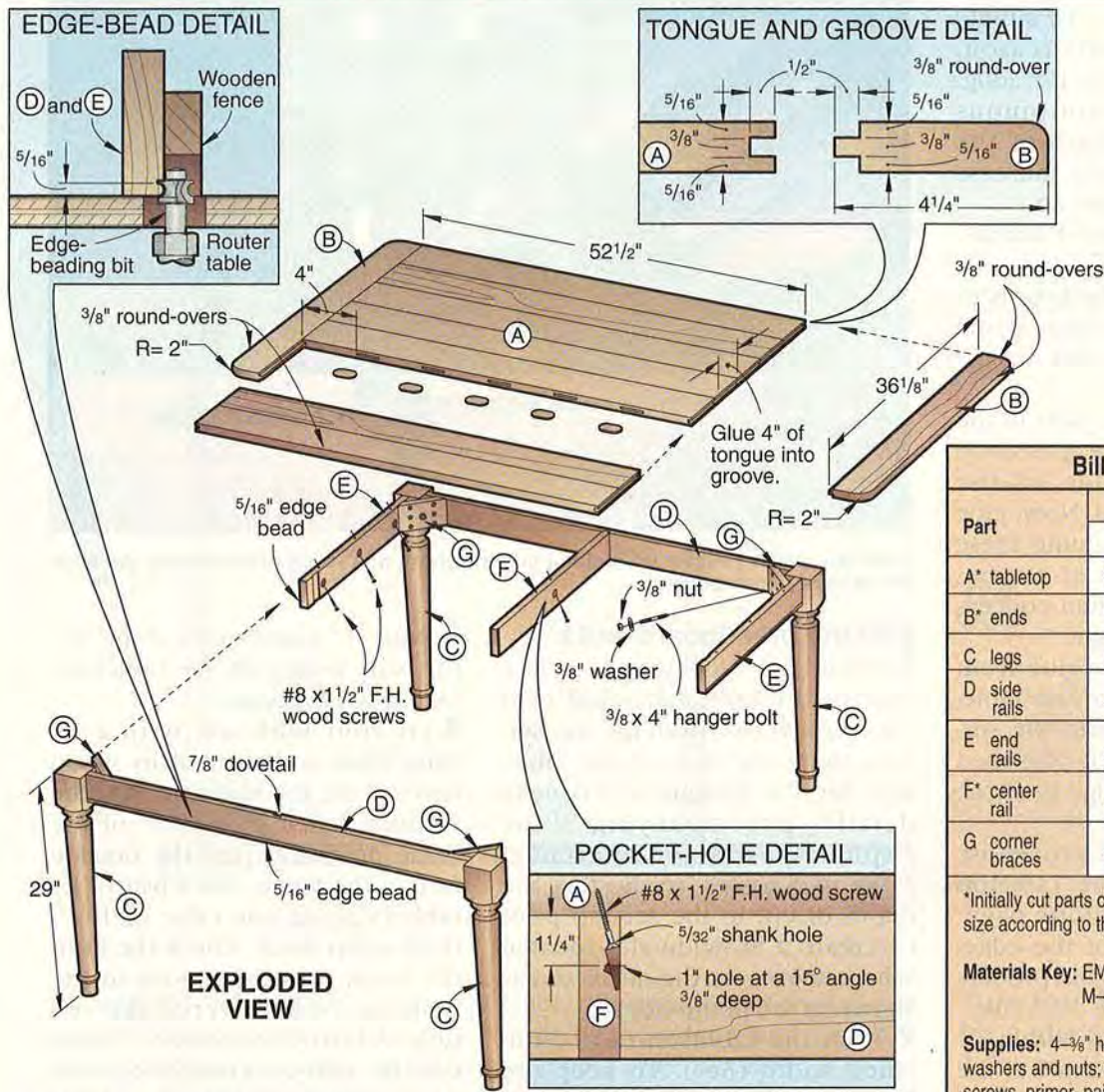
3 Joint one edge of each board. Rip the *opposite edge* of each of the seven tabletop (A) boards to 5 $\frac{1}{4}$ " wide, and joint the cut edge. Rip the breadboard ends (B) to $\frac{1}{32}$ " over width, and joint the ripped edge to final width (4 $\frac{1}{4}$ ").

4 Lay out the boards for the tabletop (A) on your workbench to get the best grain match. Then, mark the order on the ends of the boards, for positioning them in the same configuration later.

5 Separate the tabletop boards into pairs of adjacent boards (there will be one extra), and mark each pair for biscuit or short splines. Start 4" in from the ends, and cut slots for five biscuits. If you don't have a biscuit joiner, a

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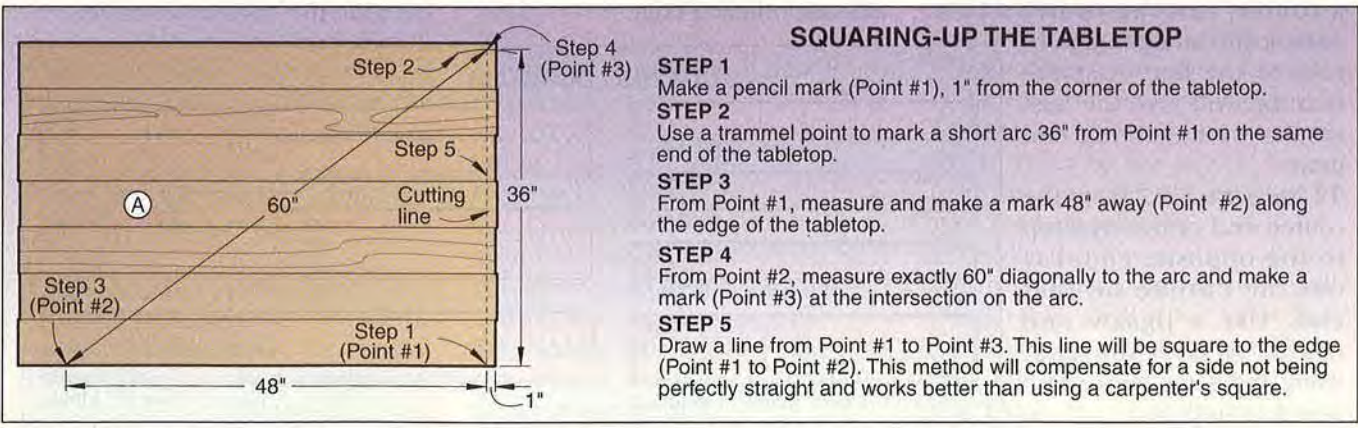
Bill of Materials

Part	Finished Size			Matl.	Qty.
	T	W	L		
A* tabletop	1 1/16"	36"	52 1/2"	EM	1
B* ends	1 1/16"	4 1/4"	36 1/8"	M	2
C legs	3 1/2"	3 1/2"	29"	LM	4
D side rails	1 1/16"	3 1/2"	50"	M	2
E end rails	1 1/16"	3 1/2"	26"	M	2
F* center rail	1 1/16"	3 1/2"	29 1/4"	M	1
G corner braces	1 1/16"	3 1/2"	6 1/4"	M	4

*Initially cut parts oversized. Then, trim to finish size according to the how-to instructions.

Materials Key: EM—edge-joined maple, M—maple, LM—laminated maple.

Supplies: 4—3/8" hanger bolts 4" long with flat washers and nuts; #8 x 1 1/2" flathead wood screws, primer, paint, and clear finish.



KITCHEN TABLE

router with a slotting cutter and shop-made splines will work. Since the purpose of the biscuits or splines is alignment and not strength, they should fit snugly into the slots. For this reason, make the splines about 1½" long. Do not make one continuous spline the entire length of the boards; this will greatly increase the difficulty of the glue-up.

6 Edge-glue each pair of boards. Use scrap strips of wood between the clamp jaws and the boards to protect the jointed edges. When the glue squeeze-out turns gummy, scrape it off.

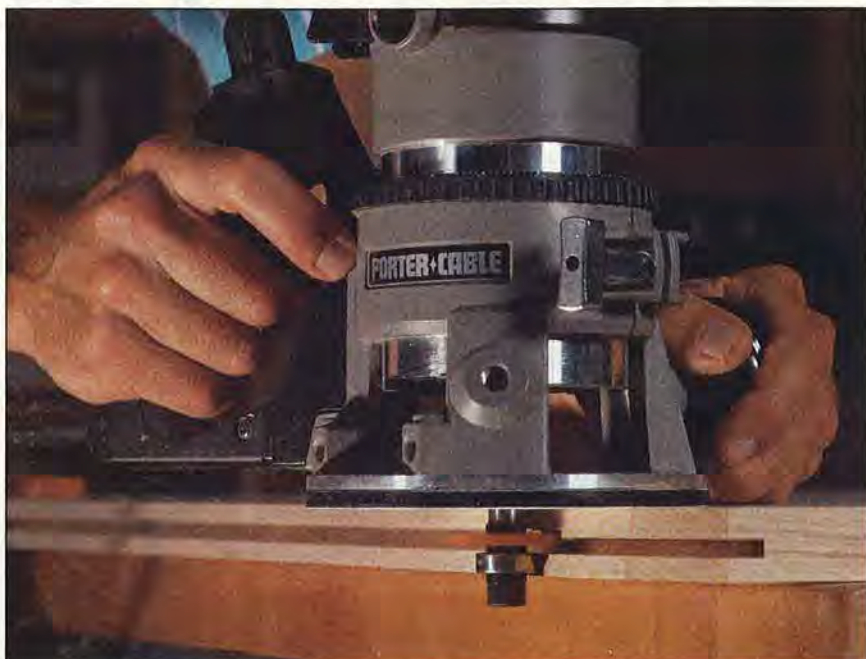
7 Cut biscuit or spline slots in the mating edges of the glued-up boards and one edge of the remaining single board. Now, glue the top together by gluing these four pieces one pair at a time. This allows for maximum concentration on each glue joint.

8 Remove the excess glue from the top and bottom of the tabletop. Hand-plane or sand the surfaces smooth and level. (We used a long metal straightedge to check for level surfaces.)

9 Using the five-step procedure on the Squaring-Up the Tabletop drawing on the *previous* page, square up the ends of the edge-joined tabletop (A). This process is commonly called the 3-4-5 rule.

10 Using a jigsaw, cut within ⅛" of the line marked in Step 5 of the drawing. With a straightedge and a router, run the router's base against the straightedge to rout to the line. A spiral-flute bit will give the best results when routing end grain.

11 Measure 52½" from the routed end of the tabletop to the opposite end. Lay out the outline on that end. Use a jigsaw and router to trim the end, using the same procedure noted in Step 10.



Make two passes with a ¼" slotting cutter to form a ⅜"-wide groove along the ends of the edge-joined tabletop.

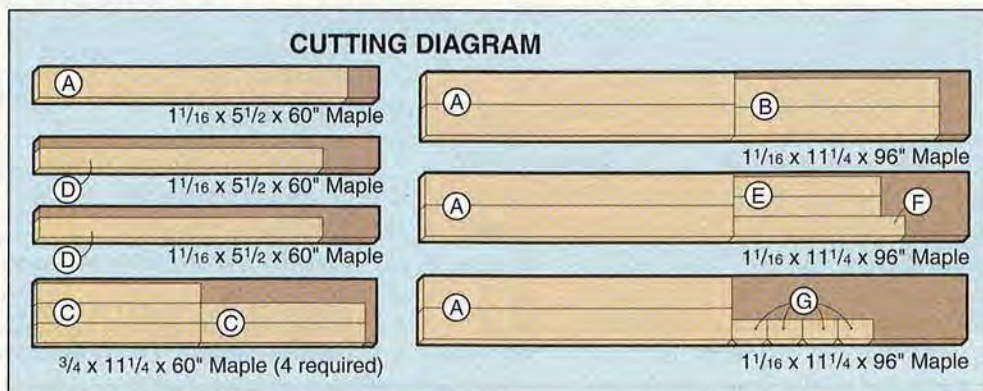
Add the breadboard ends

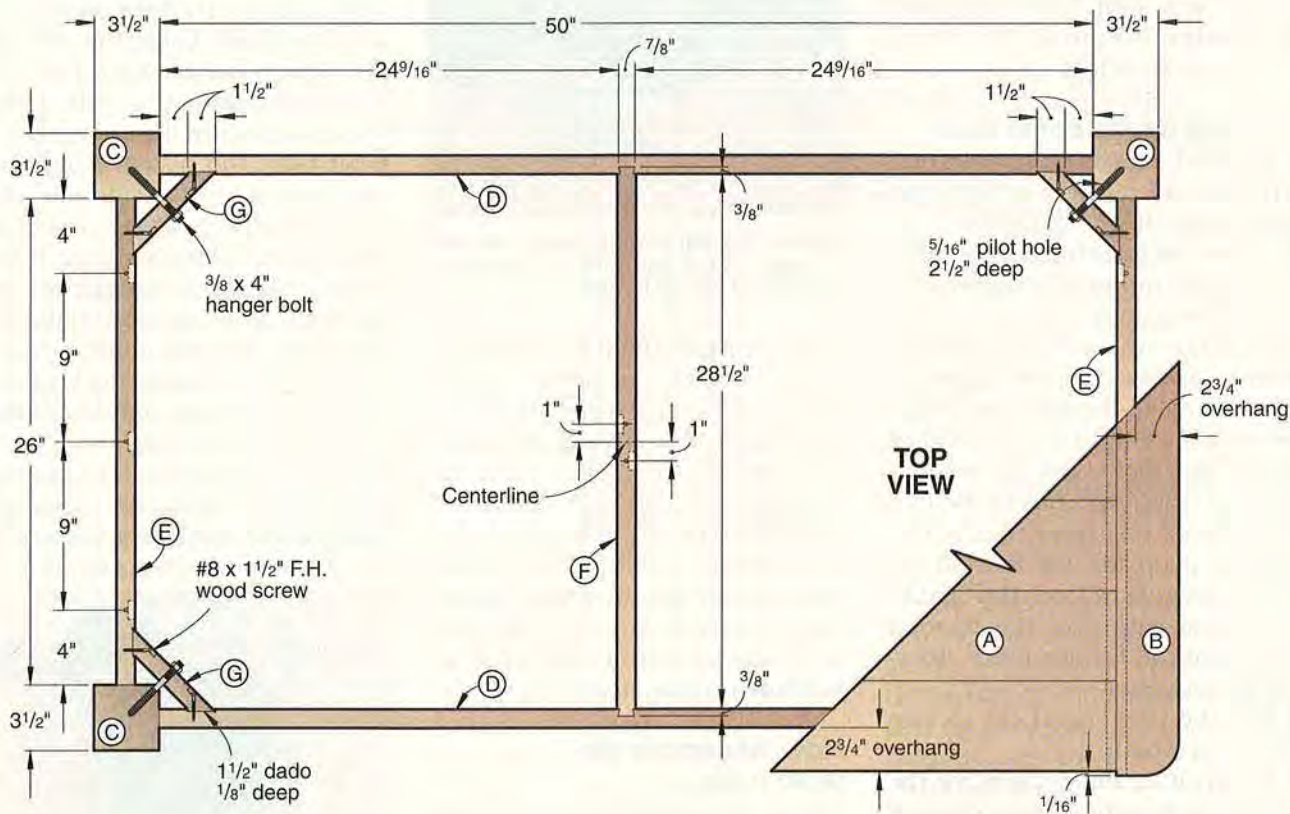
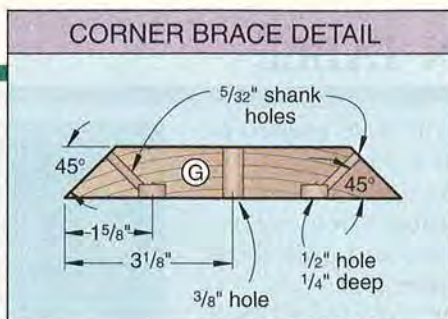
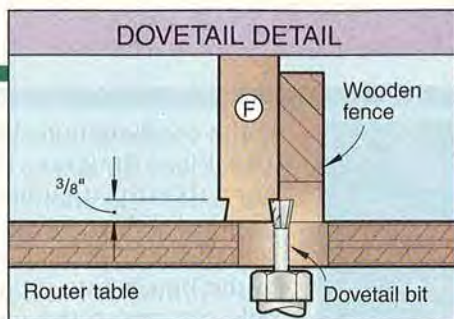
1 Install a ¼" slot-cutting bit in a hand-held router, and adjust it to cut a groove ⅜" from the top surface along the ends of the tabletop. See the Tongue and Groove detail accompanying the Exploded View for reference. Make two passes, readjusting the depth of cut in the second pass, to create a ⅜"-wide slot located where shown on the detail and as shown in the photo above.

2 Trim the tabletop (A) to finished width (36"). To keep the board spacing equal, cut the same amount off each edge.

3 Rout ⅜" round-overs along the top side edges of the tabletop. *Don't rout the ends.*

4 Fit your tablesaw with a ⅝" dado blade and an auxiliary wood fence. Raise the blade ⅜" into the wooden fence so that ½" of the blade protrudes past the outside face of the fence. Cut a pair of ½" rabbets along one edge of 1⅛"-thick scrap stock. Check the fit of the stock into the groove in the tabletop ends to verify the setting. Adjust if necessary. Then, cut the rabbets along the inner edge of each breadboard end. Do not glue the ends in place yet.





5 Carefully measure the width of your tabletop and crosscut the breadboard ends to this length *plus* $\frac{1}{8}$ ". The extra length allows the laminated tabletop (A) to expand without moving past the ends of the breadboard ends.

6 Mark and cut a 2" radius on the outside corners of the breadboard ends. Sand the ends.

7 Rout a $\frac{3}{8}$ " round-over along the *top outside* edges on the breadboard ends.

8 Sand a slight round-over on the corners of the tongue. This eliminates a sharp edge on the tongue that will stick out beyond the outside edge of the tabletop.

9 Join the breadboard ends to the ends of the edge-glued tabletop by gluing *only the center 4"* of the breadboard ends to the *center 4"* of the ends of the tabletop. The rest is left unglued, allowing the two mating pieces (A and B) to expand and contract independently of each other. If you glue along the entire joint, the tabletop—which expands and contracts greater across the grain than the breadboard ends do with the grain—can cause the tabletop to split at its weakest point.

10 Using a finish sander and 100- or 120-grit sandpaper, sand the tabletop top smooth.

Turn four legs for a sturdy base

1 To get the legs for this table, you can either turn your own or order preturned legs from the source listed in the Buying Guide. If you make your own, laminate stock to form legs measuring $3\frac{1}{2}$ " square after final machining. Then, refer to the article beginning on *page 42* to see how to turn the legs to shape.

2 Cradle the top portion of each leg in a V-block jig on your drill-press table. Drill a $\frac{5}{16}$ " pilot hole $2\frac{1}{2}$ " deep and $1\frac{3}{4}$ " from the top end into the inside corner of each leg. (After marking the corner of

Continued

KITCHEN TABLE

the leg where the hole needed to be, we sanded a flat area at the mark, providing a flat surface for the bit to go into. Then, we re-marked the point and drilled the hole for the hanger bolt.)

3 Double-nut a $\frac{3}{8}$ "x4" hanger bolt and thread it into the hole in one of the legs until $1\frac{1}{2}$ " of the bolt protrudes. Remove the nuts. Repeat for each leg.

The apron rails come next

1 Rip and crosscut the side rails (D) and end rails (E) to the sizes listed in the Bill of Materials.

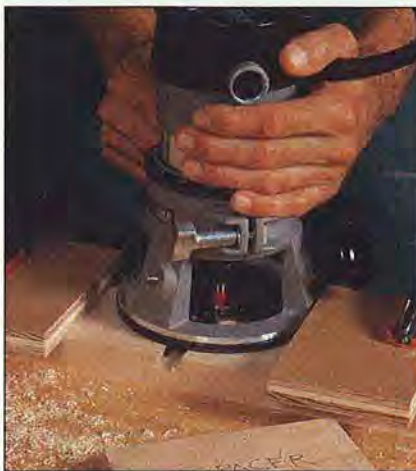
2 Mount an edge-beading bit into your table-mounted router, and rout a bead along the bottom outside edge of each rail where shown on the Edge-Bead detail accompanying the Exploded View drawing. (We used a Freud 80-122 router bit.) Hand-sand the bead.

3 For housing the ends of the corner braces (G) later, cut a $1\frac{1}{2}$ " dado $\frac{1}{8}$ " deep and $1\frac{1}{2}$ " in from the ends of each rail on the inside face (that opposite the beaded face). See the Corner Brace drawing for reference.

4 Cut the center rail (F) to size plus 1" in length.

5 For creating the pockets for the pocket hole screws for connecting the tabletop to the rails (E, F) later, chuck a 1" Forstner bit into your drill press, and drill a hole $1\frac{1}{4}$ " from the top edge on the *inside face* of each rail (E, F) at a 15° angle where shown on the Pocket-Hole detail accompanying the Exploded View drawing. Then, drill a $\frac{5}{32}$ " shank hole through the top inside corner of each 1" hole where shown.

6 Mark a line across each side rail (D), centering the line between the ends. Cut a $\frac{1}{2}$ " dado $\frac{5}{16}$ " deep across the side rails, centered over the marked line. The dado removes most of the material, making it easier to cut the dovetail in the next step.



Rout a dovetail slot centered over the $\frac{1}{2}$ " dado in the end rails for capturing the ends of the center rail.

7 Fit your hand-held router with a $\frac{1}{2}$ " dovetail bit, and adjust it to cut $\frac{3}{8}$ " deep. Using stops to determine the width of your cut, make two passes to rout a $\frac{7}{8}$ "-wide dovetail slot centered over the $\frac{1}{2}$ " dado just cut. To determine how far apart to position the stops, measure the width of your router base and add $\frac{3}{8}$ ". (We test-cut scrap stock first to verify the spacing between the stops.)

Now, assemble the table base

1 Cut the corner braces (G) to size, miter-cutting the ends of each brace at 45° .

2 Drill six $\frac{1}{2}$ " holes $\frac{1}{4}$ " deep in each piece where shown on the Corner Brace drawing and the Corner Brace detail accompanying the Top View drawing. Drill a $\frac{5}{32}$ " hole centered through each $\frac{1}{2}$ " hole at a 45° angle where shown on the detail. (To do this, we placed the beveled end of the corner brace flat on our drill-press table, automatically positioning the bit at a 45° angle to the $\frac{1}{2}$ " holes.) Now, drill a $\frac{3}{8}$ " hole through each corner brace where shown on the drawing and detail.

3 Place the side and end rails (D, E) and braces (G) on a flat surface

in the configuration shown on the Top View drawing. (We placed our tabletop upside down and positioned the rails on the bottom side of the tabletop.) Fit the ends of the braces into the dado in the rails. Square-up the entire assembly, and check that the edges that will be the top of the table base later are flush. Using the holes in the braces as guides, drill $\frac{7}{64}$ " pilot holes into the rails. Drive screws to secure the assembly.

4 Measure the distance between the dovetails in the side rails (D), and cut the center rail (F) to length. Cut a dovetail on each end of the rail where shown on the Dovetail detail accompanying the Top View drawing. Rout dovetails on the ends of scrap stock first to verify the setting before routing the ends of the center rail.

5 Glue the center rail (F) in place between the side apron rails (D), making sure the holes in the center rail are oriented correctly.

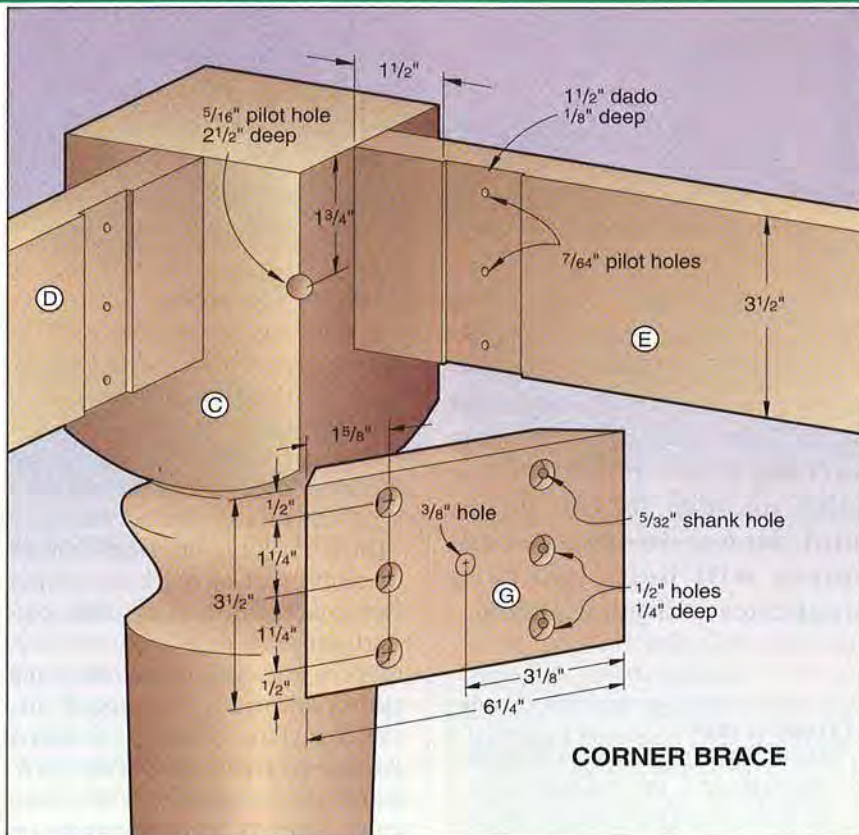


6 Place the tabletop upside down on a blanket or pad on your workbench or sawhorses. Position the apron assembly (also upside down) on the tabletop. Fit the legs (C) into place, sliding the hanger bolt protruding from each leg through the mating hole in each corner brace. Use a washer and nut at each corner brace to draw the legs tightly against the ends of the apron rails.

7 Center the base on the tabletop. Again, check for square and an even overhang. Drill pilot holes, and drive screws through the previously drilled mounting holes in the rails (E, F) to secure the base to the tabletop as shown in the photo below.

8 Make an index mark on the inside face of one side rail (D) and that edge of the tabletop next to it. The marks will allow you to reassemble the table in the same configuration later, aligning the mounting holes.

Drive screws through the mounting holes in the apron rails to secure the base to the tabletop.



Finishing and final assembly

1 Unbolt the legs from the assembly. Sand the tabletop, legs, and apron assembly with a 120-220-320 grit progression.

2 Apply finish to the entire tabletop (top and bottom), the back side and beaded surface of the apron rails (not the area above the bead, you'll paint this later). We used Minwax Fast-Drying Polyurethane, sanding between coats with 320-grit sandpaper. If you get any finish on the front surface of the aprons (the area above the bead) sand it off now.

3 Mask the bead and back surface of the apron assembly with tape and paper. Mask the exposed threads of the hanger bolts threaded into the legs. Prime the legs and apron assembly (we used Krylon Sandable Primer #1315 All-Purpose Primer White). Sand lightly with 320-grit sandpaper after the primer has dried. Paint the primed areas (we used Rust-

Oleum American Accents Heritage Satin Finish Teal 7929). Let the apron assembly dry and remove the masking. (For more information on professional-looking spray painting, see the article on page 29 for our method.)

4 Let the project dry (and the paint harden) for a couple of days. Put a pad or blanket on the kitchen floor and place the tabletop on it upside down. Align the index mark on the apron assembly with that marked on the bottom side of the tabletop earlier. Screw the two assemblies together. Bolt the legs in place, turn the table over, add place settings, and have lunch.

Buying Guide

Turned legs. Four legs, catalog no. A0901-29, \$115 ppd. for maple, \$122 ppd. for oak. Adams Wood Products, 974 Forest Drive, Morristown, TN 37814. Or call 423-587-2942 to order. ♣

HOW TO TURN LOOK-ALIKE LEGS

Turning four matching legs stands as a daunting task in many a woodworker's mind. But don't let that fear keep you from turning legs for the kitchen table on *page 36*. Our layout and dimensioning procedures will help you turn duplicates without distress.

Project prep

Stock: Each leg calls for a blank $3\frac{1}{2} \times 3\frac{1}{2} \times 31$ ". For painted legs, laminated birch or poplar would be good choices. Clear-finished legs should be from solid stock.

Lathe equipment: Spur drive center, live (rotating) tail center.

Turning tools:

- $\frac{3}{4}$ " or $1\frac{1}{4}$ " roughing gouge
- $\frac{3}{8}$ " and $\frac{1}{2}$ " spindle gouge
- 1" skew, $\frac{3}{16}$ " parting tool

Lathe speeds:

- Roughing: 500–800 rpm
- Finish-turning: 1000–1200 rpm

Prepare the stock

For each leg, dress a piece of laminated or solid stock at least 31" long to $3\frac{1}{2} \times 3\frac{1}{2}$ ". Be sure that all four faces meet at 90° angles. Trim the stock to 31" long. (Since our legs would be painted, we laminated 1"-thick birch for our blanks.)

Draw diagonal lines on each end of each piece to mark the centers. Designate one end of each piece as the top.

On one piece, draw three lines across one face—one line 1" from the top (Line A on the Full-Sized Pattern in the *WOOD PATTERNS*® insert in the middle of the magazine), one 5" from the top (Line B), and another $5\frac{1}{2}$ " down (Line C). Using a try square, transfer the lines to the blank's other three faces. Then, transfer the lines from that piece to the other pieces of stock to ensure uniformity.

Install a spur center in your lathe's headstock and a revolving (live) center at the tailstock. Mount the workpiece between centers, placing the top of the leg at the headstock.

Rough out the leg

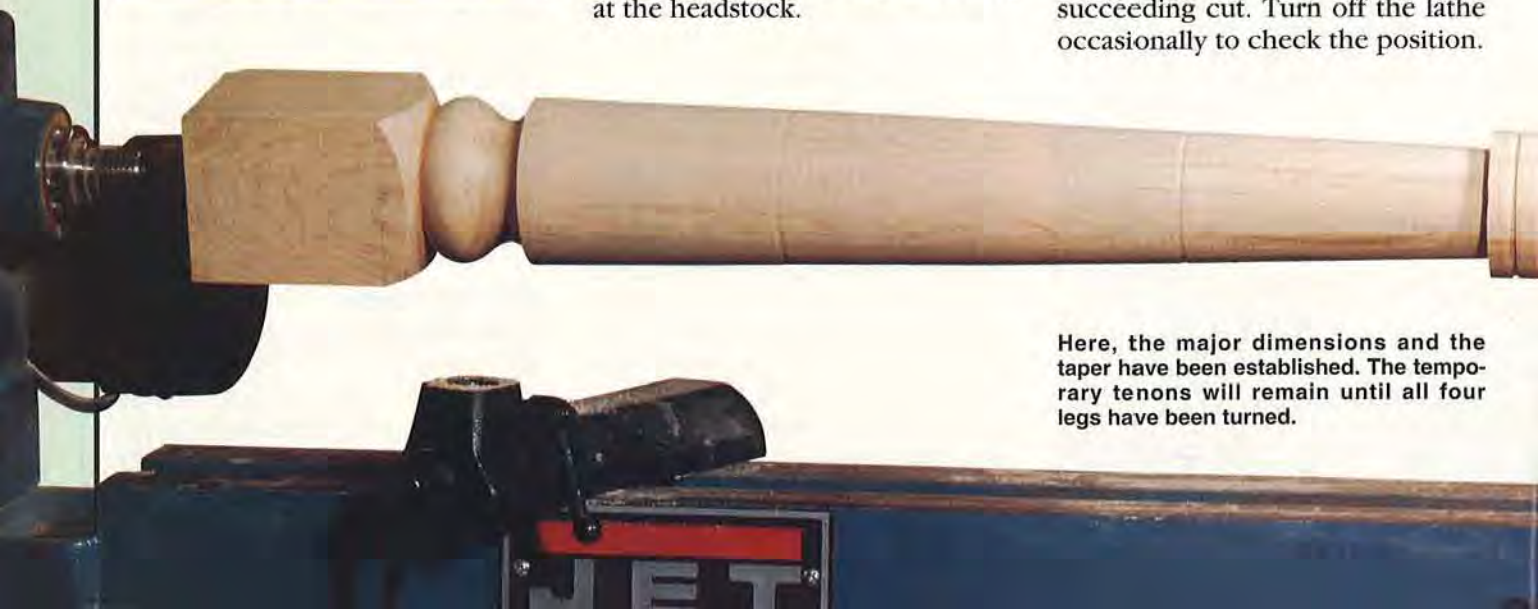
Starting from the tailstock end, round down the workpiece to its maximum diameter, about $3\frac{1}{2}$ ". Note the actual diameter so you can later turn each of the other blanks to the same size. Round the stock to within $\frac{3}{4}$ " below Line C. A $\frac{3}{4}$ " or $1\frac{1}{4}$ " roughing gouge does the job quickly.

Next, form the transition where the leg changes from square to round. The transition occurs between Lines B and C, as shown on the pattern. Taking light cuts

**SEE THE *WOOD PATTERNS*®
INSERT FOR
FULL-SIZED PATTERNS**

with a $\frac{1}{2}$ " gouge, work from Line B down to Line C, cutting inward. From Line C, cut straight down to the rounded part of the turning.

The corner points of the curved transition line should just touch Line B at the corners of the stock. So, start slightly below Line B, and move back toward it with each succeeding cut. Turn off the lathe occasionally to check the position.



Here, the major dimensions and the taper have been established. The temporary tenons will remain until all four legs have been turned.



Accurate sizing cuts ensure that the turned legs will be uniform. Carefully set the caliper for each cut, and don't force it over the turning; wait until it falls freely.



The groove in the middle of the lower bead is the sizing cut which establishes the finished diameter for the feature.

Next, turn away the 1" waste section at the top of the leg, leaving a tenon to support the turning. This establishes the finished top of the leg. To remove the waste and form the tenon, make repeated light cuts from the outside toward the drive center, using your $\frac{1}{2}$ " gouge rolled on its side. Leave a tenon about $1\frac{3}{8}$ " in diameter. Cut to the dimension line, but leave it visible on the faces.

Lay out the features

Refer to the Full-Sized pattern, and draw Lines E-N on the leg. Here's how. Measuring from the finished top of the leg, place a pencil mark at the distance shown for each line. Then, with the lathe running, hold a pencil against the turning at each mark to draw the lines.

At each line, cut in to the specified diameter with a parting tool. These dimensioning cuts will help you place and shape each leg's details accurately.

To make a dimensioning cut, first set an outside caliper to the diameter shown for the particular line. Then, cut straight into the workpiece with a parting tool. While cutting, hold the caliper above and behind the turning, letting it rest lightly in the parting-tool cut as shown *above*. When the caliper slips down over the turning, you have reached the specified diameter. Cut in at every line this way. Be careful as you gauge the cuts; the caliper can catch in the groove. Grip the caliper gingerly as shown. This way if it does catch, it will pull from your grip without hurting your fingers.

Center the cuts for beads and coves on the line. On the tapered section, cut below the line to prevent cutting into the larger portion above the line. Cut on the outside of lines such as J and L, which mark the width of a feature. For that feature, cut Line J with the parting tool on the headstock side of the line, Line L with it on the tailstock side.

Shape the leg

With the dimensioning cuts completed, form the details. Starting at the top of the leg, shape the cove and bead between Lines C and G.

Next, establish the diameter at G, then taper the leg from there to Line J. Shape the taper to about $\frac{1}{16}$ " above the dimensioning cuts. Check the taper with a straight-edge, refining it as necessary.

Then, form the leg's lower end. Starting at Line N, cut a tenon on the bottom of the leg as on top. Shape the leg from Line L to the bottom. At this point, the leg should look like the one *left*.

Finish-turn the taper, using a sharp gouge or large skew. Turn the lower bead with a gouge or skew, as shown *above*, then finish the lower taper. Form the chamfer on the bottom. Lightly sand the leg, and turn the supporting tenons to about 1" diameter. Don't part them off yet.

Dismount the completed leg. Completely turn all four legs following the same layout and dimensioning steps, but don't remove the tenons from any of them. After completing all four, compare them. When you're satisfied that they match, part off the tenons. ♣

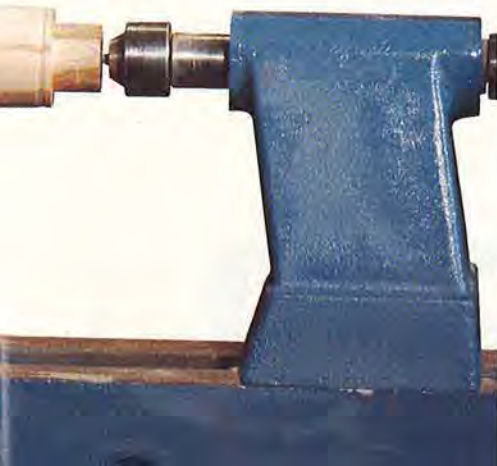
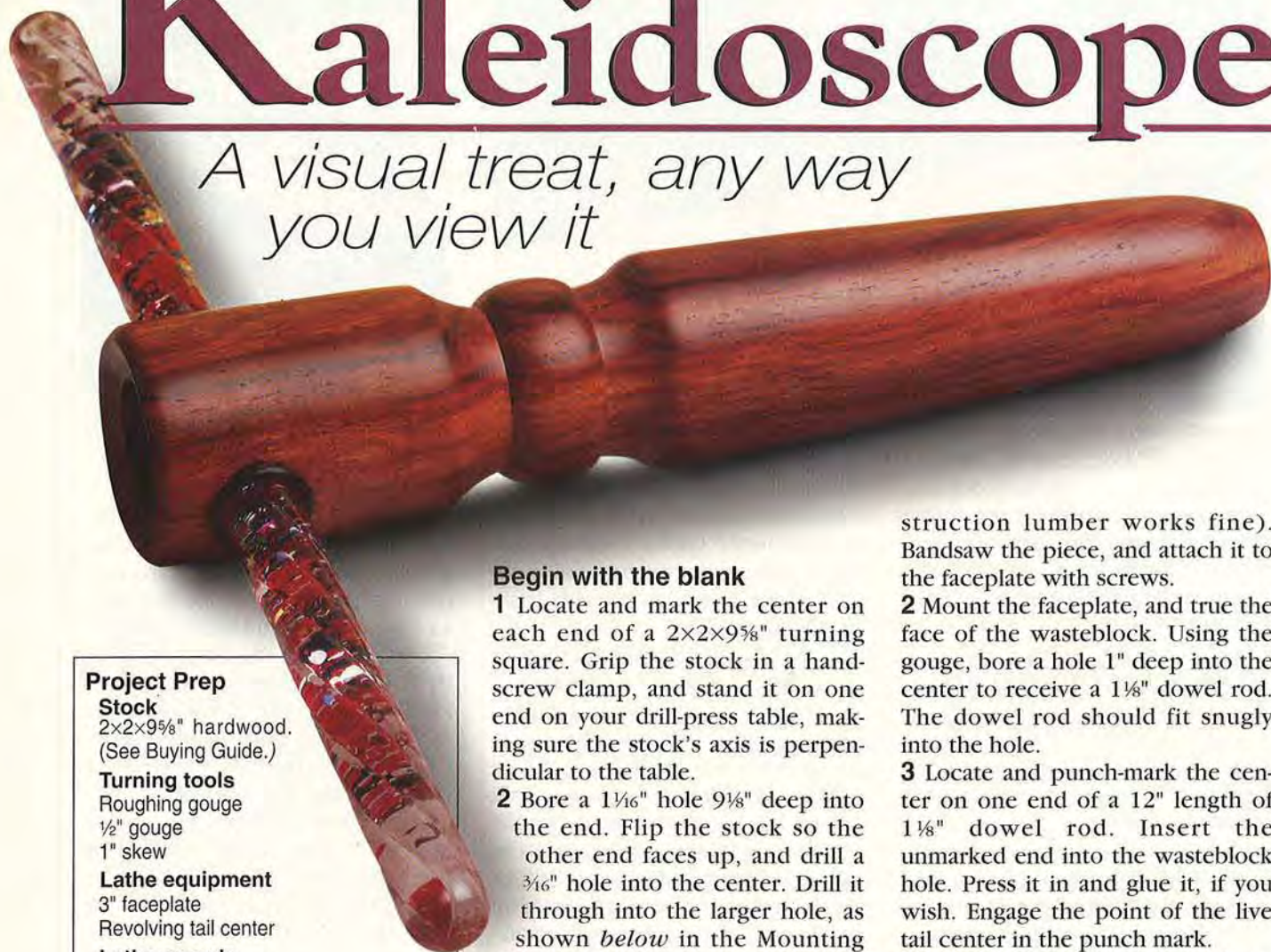


Illustration: Lorna Johnson Photographs: John Hetherington

ONE COOL Kaleidoscope

Print this article

A visual treat, any way you view it



Project Prep

Stock

2×2×9½" hardwood.
(See Buying Guide.)

Turning tools

Roughing gouge
½" gouge
1" skew

Lathe equipment

3" faceplate
Revolving tail center

Lathe speeds

Roughing: 800–1000 rpm
Turning: 1500–1800 rpm
Finishing: 1800–2000 rpm

Buying Guide

Predrilled blank. 2×2×9½" blank with 1¼", ¾", and ⅝" holes drilled. Bocote (WN400), \$12.95; Zebrawood (WN200), \$10.95; Cocobolo (WN300), \$13.95; or Burmese rosewood (WN500), \$12.95.

Kaleidoscope kit. Oil wand with rings, set of three mirrors, and acrylic dust covers. \$13.95 ea. Choice of wand color: red (WN100), blue (WN101), purple (WN102), hot pink (WN103).

HUT Wood finish. Light color, 4-oz. stick, \$9.95

All prices ppd. in U.S.
Craft Supplies USA,
1287 E. 1120 S.,
Provo, UT 84606,
or call 800/551-8876 to order.

Begin with the blank

1 Locate and mark the center on each end of a 2×2×9½" turning square. Grip the stock in a hand-screw clamp, and stand it on one end on your drill-press table, making sure the stock's axis is perpendicular to the table.

2 Bore a 1¼" hole 9½" deep into the end. Flip the stock so the other end faces up, and drill a ¾" hole into the center. Drill it through into the larger hole, as shown *below* in the Mounting the Blank drawing.

3 On one face, 1¼" from the large-bored end, center a mark. There, drill a ⅝" hole through the blank, passing through the center bore and perpendicular to it.

Turn the body

1 Lay out a wasteblock by tracing around your 3" faceplate onto a piece of 1½"-thick stock (2×6 con-

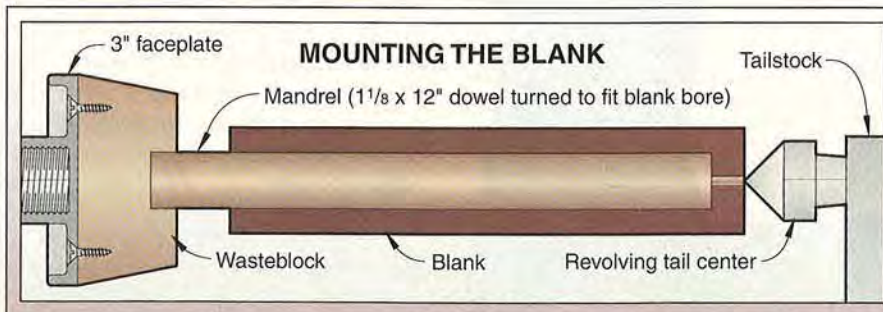
struction lumber works fine). Bandsaw the piece, and attach it to the faceplate with screws.

2 Mount the faceplate, and true the face of the wasteblock. Using the gouge, bore a hole 1" deep into the center to receive a 1½" dowel rod. The dowel rod should fit snugly into the hole.

3 Locate and punch-mark the center on one end of a 12" length of 1½" dowel rod. Insert the unmarked end into the wasteblock hole. Press it in and glue it, if you wish. Engage the point of the live tail center in the punch mark.

4 With the skew or by sanding, reduce the diameter of the dowel rod so the bored-out blank fits snugly over it. The blank must not be able to move from side to side on this mandrel.

5 To mount the blank, fit it over the mandrel, and bring the tail center up to engage the small hole in the end of the blank, shown *below*. Tighten the tail center sufficiently





Tape holds the three mirrors in position to fold into a triangle.



Slide the mirror assembly into the body. It should fit snugly to prevent turning. Slide the mirror assembly into the body. It should fit snugly to prevent turning.

to bottom the mandrel in the wasteblock if you didn't glue it.

6 With the roughing gouge, round down the blank to 2" diameter, or as near 2" as possible. True the side and smooth the cylinder with the gouge or a skew.

7 Referring to the Full-Sized Pattern in the *WOOD PATTERNS*® insert in the middle of the magazine, lay out the coves and bead on the blank. Here's an easy way to do that: Fold the pattern in half along the centerline. Lay it on the tool-rest with the folded edge toward the workpiece. Register the front line on the pattern with the front of the workpiece. Then, with the lathe running, hold a pencil against the blank at the four pattern lines to transfer the lines to the blank.

8 With the gouge, cut from the front of the front cove to the line marking the front of the bead. Cut the back cove, then form the bead. Taper the body to the back, following the dimensions on the pattern.

9 Undercut the front with the gouge, following the general contour of the dotted line at the front of the pattern. Don't cut into the 5/8" holes. You can cut partially into the mandrel for tool clearance as you hollow out the front—just don't go too far.

10 Sand and finish the kaleidoscope body. (We finished ours on the lathe with HUT Wood Finish, a stick containing wax and fine abrasives. With the lathe running, we rubbed the turning with the waxy stick, then buffed it with a cloth.)

11 Dismount the body. Enlarge the 3/16" hole to 1/4". (To drill the hole out, we stood the kaleidoscope on end on the drill-press table and held it by hand.)

Assemble the kaleidoscope

- 1** Test the oil wand's fit in the 5/8" holes. If it doesn't slip in easily, enlarge the holes slightly by sanding or filing.
- 2** The kaleidoscope mirrors are front-surface mirrors; that is, the reflective coating is on the front of the glass rather than the back. The peel-off covering protects and helps identify the front surface, so leave it in place while handling and assembling the mirrors.
- 3** Stick a piece of tape about 3 1/2" long across the

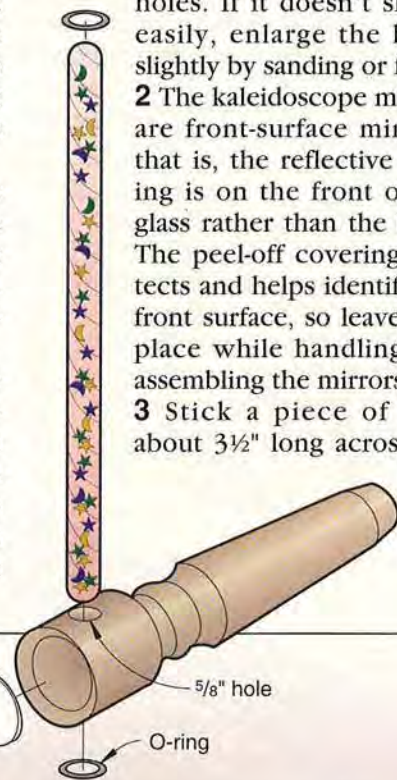
back of the narrow mirror near each end (we used masking tape). Leave a tab about 1" long extending past one edge.

4 Stand one of the wide mirrors on edge on the 1" tape tabs, its front surface adjoining the edge of the narrow mirror. Bring the tape up, and press it to the back of the mirror. Lay the mirror back, then do the same thing with the other mirror on the longer tape tabs. Your mirrors should now look like the set in the photo *above left*.

5 Remove the protective film from the mirrors. Fold the mirrors into a triangle, bringing the two wide mirrors together above the middle of the narrow one. The narrow mirror should fit between the two wide ones, as shown in the Mirror Detail. Bind the assembly together tightly with the tape. Wrap another strip of tape around the middle.

6 Drop one of the acrylic dust covers (in the kit) into the kaleidoscope body, then slide the mirror assembly in, as shown *above right*. (For the best kaleidoscopic visions, align the long axis of the mirror triangle with the wand.) If the mirror set fits loosely, wedge it in with one of the supplied felt dots or tape. Place the other dust cover on the end of the mirrors, securing it with a dab of silicone or a drop of cyanoacrylate adhesive.

7 Slide the oil wand into the holes. Center it, and slip one of the O-rings on from each end to hold it in place. Then, lean back, peer in, and enjoy the show. ♣



MIRROR
DETAIL

Acrylic dust
cover

5/8" hole

O-ring

EXPLODED
VIEW

Tape mirror parts together.

SEE THE
WOOD PATTERNS®
INSERT FOR
FULL-SIZED PATTERNS

Photographs: King Au; John Hetherington
Illustrations: Roxanne LeMoine; Lorna Johnson

RAIL-AND-

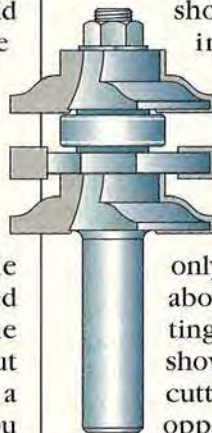
You can choose from four types of bits

All rail-and-stile bits help you make frames such as the one shown *below* from $\frac{3}{4}$ to $\frac{7}{8}$ "-thick stock. These frames typically hold a raised panel and most often are used as cabinet doors. You also can use frame-and-panel assemblies as cabinet sides, furniture components, and for paneled walls and ceilings.

Note that the frame requires two cuts: a coped cut on the ends of the rails, and a profiled cut on the inside edges of the rails and stiles. The profiled cut produces a groove for holding a panel. As we'll describe next, you can make these cuts with a single bit that you lower and raise in your router table to make the two cuts, a single bit with cutters that you reconfigure, or separate bits. We've tried all of the various types on a router table, and here are the pros and cons of each.

• One-piece bits

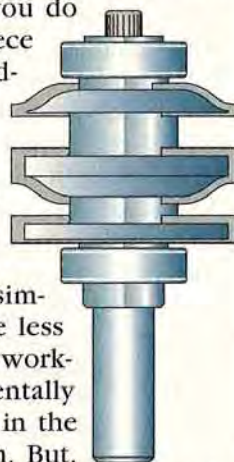
We found two styles of rail-and-stile bits in this type. The type shown *left* has a bearing in the center of the assembly, and two profile cutters in the same orientation. Several companies supply this bit.



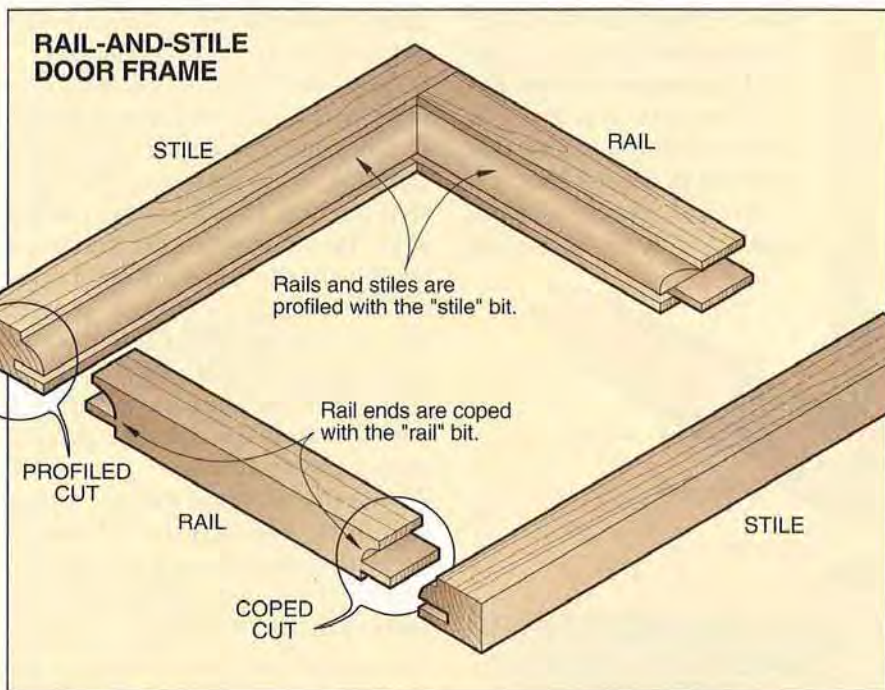
Another style, sold only by CMT, has bearings above and below the cutting portion of the bit as shown *below*. The profiled cutting edges are oriented opposite each other.

These bits fall in a mid-price range, costing \$70-\$105 depending on the supplier. With these bits you do not have to reconfigure the cutters to change from a coped cut to a profiled cut. You simply raise the height of the bit in your router table.

With the one-bearing style of this bit, you make the coped cut with the *face side of the stock up* and the profiled cut with the *face side down*, just as you do with the one-piece reversible models. With the CMT bit you make both cuts with the workpieces *face side up*. This makes the operation simpler, and you're less likely to ruin a workpiece by accidentally placing its face in the wrong direction. But, you still need to plane the boards to exact thickness to ensure that the fronts come out flush.



If you've always wanted to make traditional-style frame-and-panel doors, there's no better way to do it than with rail-and-stile router bits. (They're also called stile-and-rail, cope-and-stick, or cope-and-pattern bits.) In one pass, these bits cut interlocking joints for the frame pieces, impart a decorative profile, and leave a groove for holding the door panel. Here's what you need to know about selecting and using rail-and-stile bits.



STILE BITS

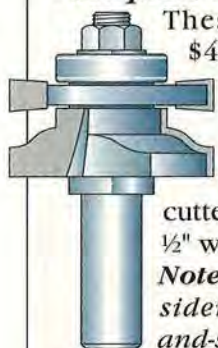
• One-piece reversible bits

These bits sell for \$45-\$65 and are your lowest-cost option. They consist of a bearing, slotting cutter, and profile cutter stacked on a 1/4" or 1/2" work arbor.

Note: Because of the considerable mass of rail-and-stile bits, we recommend only models with 1/2" work arbors or shanks. Also, for safety and accuracy we suggest you use them only in a router table.

One-piece reversible bits require considerable setup time because you need to switch the order of the bearing and cutters for the coped and profiled cuts. This can be tricky because you need to add thin metal washers (called shims) between the components to cut tight-fitting workpieces. Also, you need to remember to make the coped cuts with the rails *face side up*, and the profiled cuts with rails and stiles *face side down*.

Because you don't make both cuts with the face side down, it's essential that your stock be planed to exactly the same thickness. Otherwise, the faces of the rails and stiles will not be flush with each other after assembly.

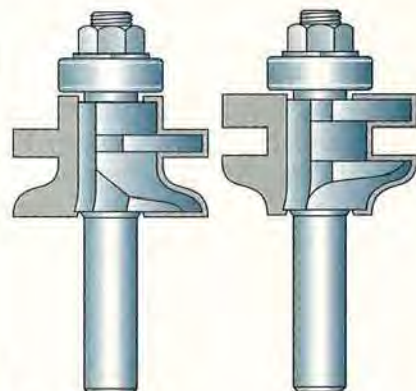
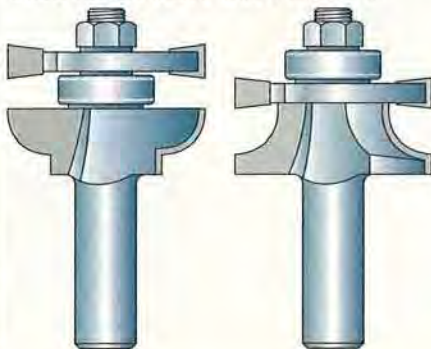


• Two-piece adjustable bits

These bits cost \$100-\$125 per set, making them your most-expensive option. However, they offer a number of advantages that justify their added cost.

With these sets you have separate bits for the coped and profiled cuts. For both cuts, you place all workpieces *face side down*. Since the faces are referenced off the router tabletop, they always come out flush on the face side (provided the bits are adjusted properly), even if your workpieces vary slightly in thickness.

With these bits you also have a greater selection of styles than the one-piece sets. In addition to ogee, straight bevel, and cove-and-bead styles, which are available with all types of rail-and-stile bits, manufacturers of two-piece sets offer you bead and round-over profiles such as the ones shown *below*.



• Two-piece non-adjustable bits

These mid-priced bits (about \$75 per set) work like the two-piece adjustable versions insofar as you position the face sides of your workpieces down for both cuts. In our tests these bits made acceptable cuts, but the joints were slightly looser than those we cut with the other types of bits. And, the joints will become looser each time you sharpen the bits because you cannot adjust the spacing between their cutting edges.

During our trials, we found the bearings located at the top of the bits to be too high to contact a 3/4"-thick workpiece. And, these bearings do not provide an accurate reference for aligning your router-table fence (we'll show you how to do this in the next section).

Continued

So which type is best for you?

Regardless of your budget, your best choice is either the CMT one-piece bit (call 800/531-5559) or one of the two-piece adjustable sets (we've had good results with many brands).

If you want to keep things as simple as possible, go for the CMT bit. You'll get tight joints with no shimming. You do need to plane

your workpieces to exact thickness, but that's a good rule to follow no matter which bit you use.

Because you cannot adjust the cutters in this bit, your joints will become slightly looser with each sharpening. However, this bit will help you make many door frames before it produces unacceptable joints. A home woodworker may

never make enough door frames to require sharpening the bit.

For \$10-\$35 more, a two-piece adjustable set gives you a greater selection of styles (including the ever-popular round-over), and can be adjusted after sharpenings. It also sits lower during the profiled cut, which seems safer than the tall one-piece bits.

How to get great results with rail-and-stile bits

The key to success with rail-and-stile bits is in setting up the bits for coped and profiled cuts that fit tightly together and self-align the faces flush with each other. Although the various types of rail-and-stile bits require slightly different bit adjustments and work-piece orientation, the basic procedure is similar for all of them. Here's how we go about getting great results with our preferred type of rail-and-stile bits—a two-piece adjustable set.

Note: It's always a good idea to test your router-table setups with scrap stock. Also, use scrap stock for Steps 2, 3, and 4 after each bit resharpening. Once you are satisfied that the bits will produce tight-fitting joints (you may need to add metal shims to those bits that accept them), cut your rails and stiles to length. If you've never used these bits before, it's a good idea to first make several complete frames with scrap stock.

Want to know more about making frames and panels?

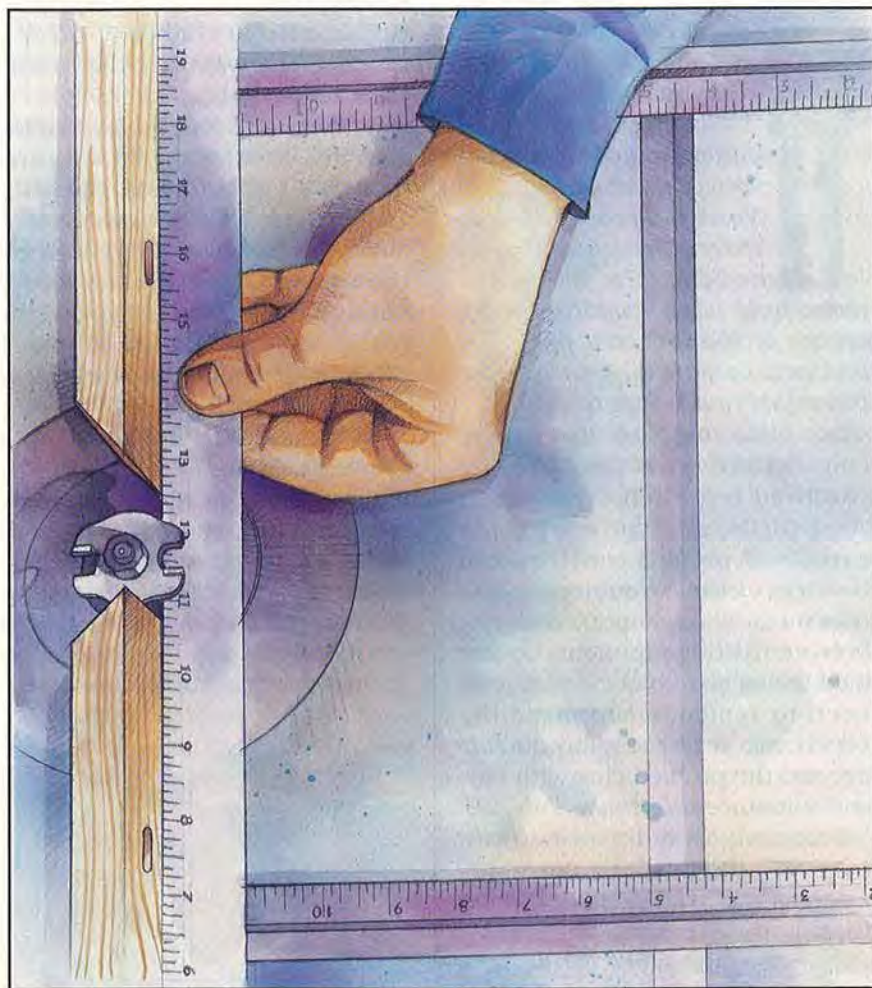
For more information on this topic, see the article "High-Styled Raised Panels and Frames," in the August 1993 issue of *WOOD* magazine. If you don't have access to this article, we would be glad to send you a copy. Simply send \$4 and a stamped, self-addressed envelope to:

Frame-and-panel article
WOOD Magazine, GA310
1912 Grand Avenue
Des Moines, Iowa
50309-3379

1 Set up the fence

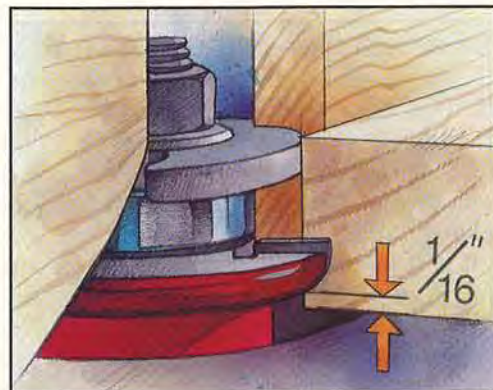
With a straightedge at least as long as your router-table fence, and a pair of 12" rules, align the fence flush with the bearing on the "rail" bit (the bit with the bearing in its

middle), and parallel with the miter-gauge slot. If your router table doesn't have a miter-gauge slot, just align the fence and bearing flush.



2 Elevate the rail bit for the coped cuts

Using a scrap of wood as an aid, adjust the rail bit so there's a space of about $\frac{1}{16}$ " between the table and the profile portion of the rail bit as shown right.

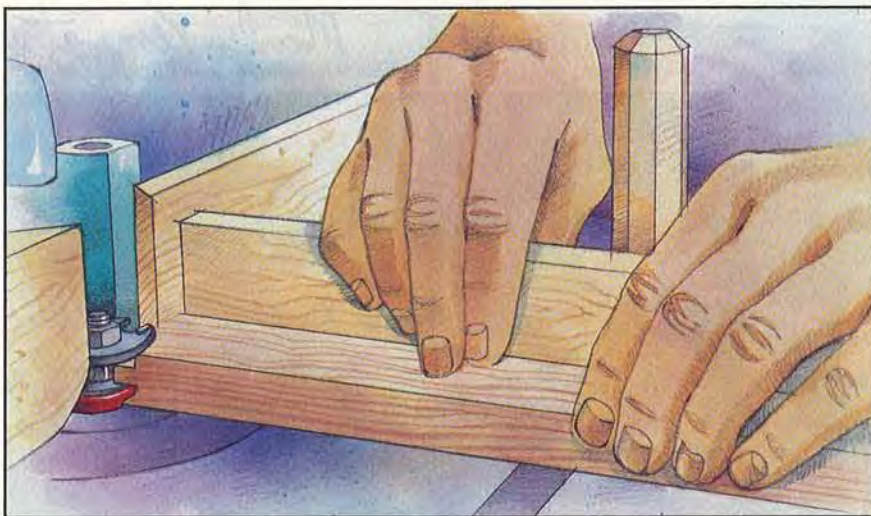


3 Cut the end grain on the rails

First, attach a $\frac{3}{4}$ " plywood auxiliary face to your miter-gauge. The auxiliary face should butt against the router-table fence. (This piece supports the workpiece and helps prevent grain tearout on the exit side of the cut.) Then, hold the rail face side down, with either edge firmly against the miter gauge, and its end butted against the fence. Turn on the router and slowly rout the workpiece to make the coped cut.

Turn the rail around, keeping its face side down, and cut its other end. Repeat this procedure for all of your rails.

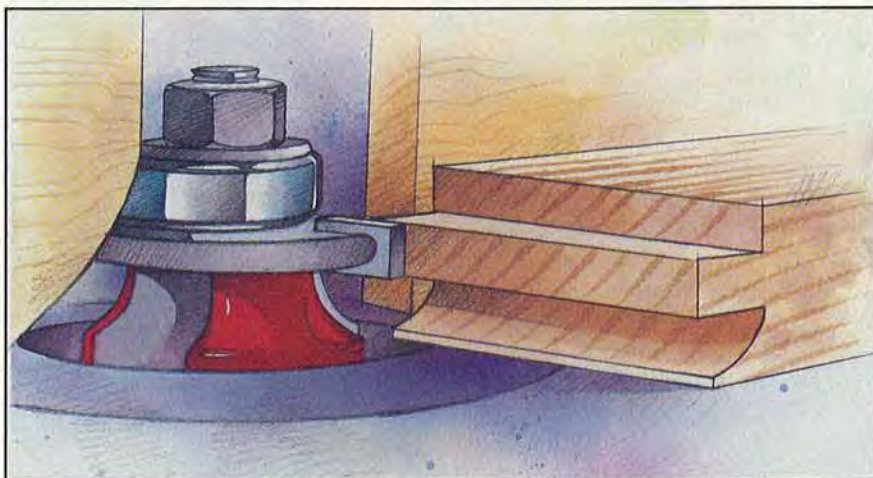
If your router table doesn't have a miter-gauge slot, you can use a $\frac{3}{4}$ " \times 10" \times 12" scrap of plywood in place of a miter gauge. Simply butt the long edge of the plywood against the fence, and hold the rail against the adjacent edge facing the router bit.



4 Set up the stile bit for edge-grain profiled cuts

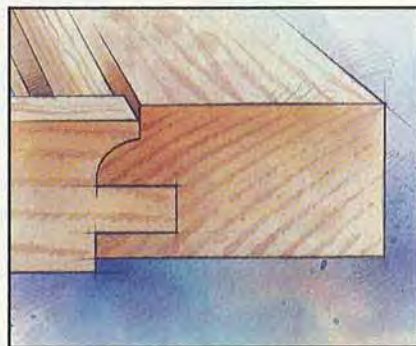
Install the stile bit and elevate it so its slot cutter aligns with the tenon on a rail end as shown *below*.

Make an edge-grain cut in a piece of scrap stock of the same thickness as your rails and stiles.



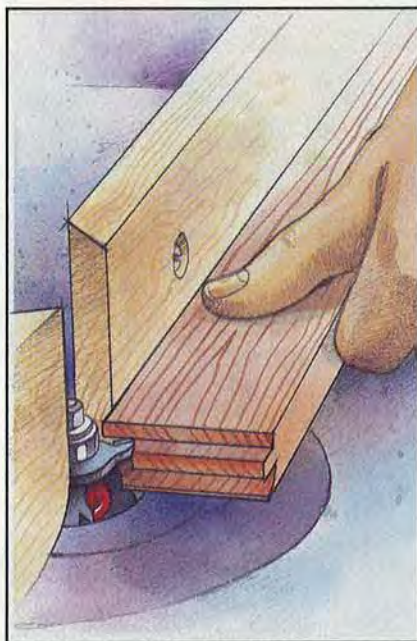
5 Check your results and make adjustments

Fit together the scrap piece you just cut and one of your rail ends. Both faces should align flush. If they don't, you'll need to adjust the height of the stile bit. In the example *below*, the stile bit needs to be adjusted down.



6 Make the edge-grain cuts

Pass the inside edges of the rails and stiles through the stile bit, face side down. That's it. You should have the components for a perfect rail-and-stile frame! ♣



Written by Bill Krier with Chuck Hedlund
Illustrations: Kim Downing, Brian Jensen
Photograph: Doug Hetherington

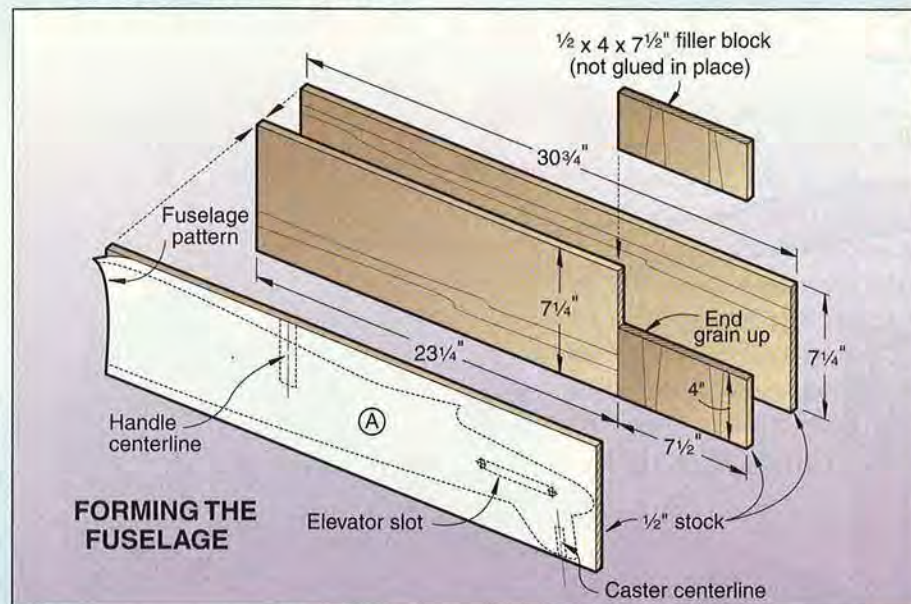
Kid-powered **BARNSTORMIN'**

Over the years we've found kids to be the best toy testers around. You can count on their being honest. That's why after building our first prototype, we took it to my son's day-care center for some "expert" advice. We found out that we needed to spread the front wheels apart and move the seat farther back for greater stability. And, that pinning the front wheels to the axle helped the plane track straighter. Now, after making the necessary adjustments, we're sure that we've got a project that will suit your young aviator and provide him or her with many enjoyable hours of fun.

Marlen Kemmet
Marlen Kemmet Senior Editor/How-To



Barnstormin' biplane



3 Using spray adhesive, adhere the full-sized fuselage (A) pattern from the *WOOD PATTERNS*® insert in the center of the magazine to one surface of the 1½"-thick fuselage lamination (A).

4 To minimize chip-out when machining the top rear edges of the fuselage, cut a filler block to ½x4x7½" and fit it into the rudder notch in the fuselage. Bandsaw the top and rear portions of the fuselage to shape. *Do not cut the bottom edge* of the fuselage to shape now, this needs to remain flat for positioning on the drill-press table when drilling the hole for the handle-upright. When cutting the top edge of the tail, bandsaw the filler block. You'll need the shaped block in the rudder notch to ride on when routing the top of the fuselage in the next step.

5 Fit your router with a ½" round-over bit, and rout the bandsawed edges of the fuselage.

6 Using a 1" Forstner bit in your drill press, position the fuselage on the drill-press table, and align the bit with the handle centerline on the full-sized pattern adhered to the fuselage. Bore a 1" hole 2¾" deep *centered* in the top edge of the fuselage. (We used two large

handscrew clamps to steady the fuselage on the drill-press table when drilling the handle hole.)

7 Bandsaw, sand, and then rout the bottom edge of the fuselage (A) to shape.

8 Using a ½" bit in your drill press, tilt your drill-press table to align the bit with the caster centerline on the full-sized pattern (it's angled). Bore a 1⅝"-deep hole *centered* into the bottom rear edge of the fuselage for the tail wheel (caster). You also could use a doweling jig to align the bit when drilling the hole.

9 Turn the fuselage on its side, and drill a ½" hole at each end of the marked elevator slot.

10 Using a scrollsaw or jigsaw, cut between the holes to cut the elevator slot to shape. Sand the entire fuselage smooth.

Add the elevator, rudder, seat, and windshield

1 Transfer the patterns from the *WOOD PATTERNS* insert to ½" stock, and cut the elevator (B), rudder (C), and seat (D) to shape.

2 Drill a pair of countersunk mounting holes through the elevator where marked on the pattern. Remove the paper pattern, and rout ¼" round-overs along the

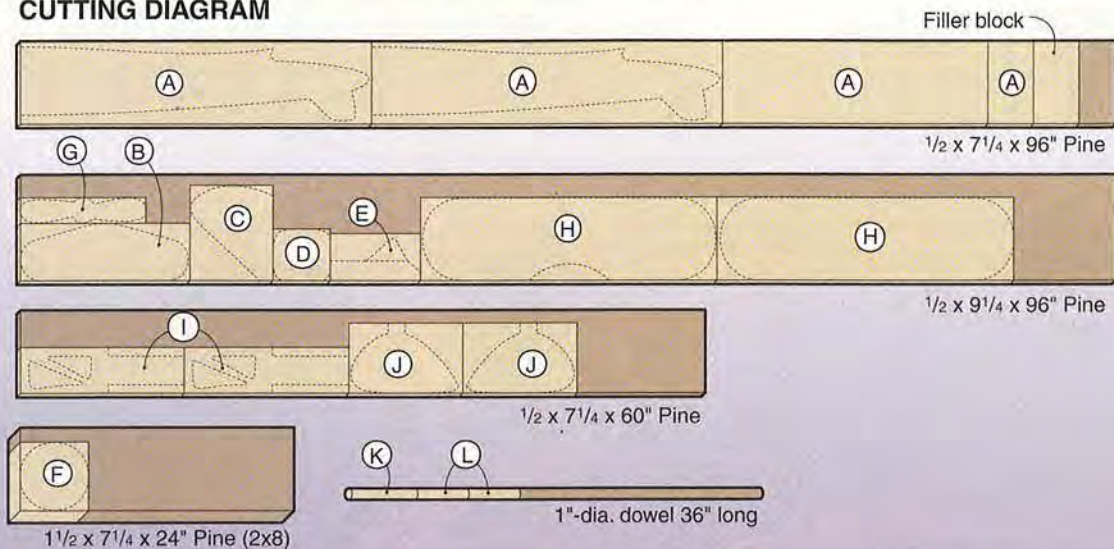
Bill of Materials					
Part	Finished Size			Mati.	Qty.
	T	W	L		
FUSELAGE ASSEMBLY					
A fuselage blank	1½"	7¼"	30¾"	LP	1
B elevator	½"	5"	14⅞"	P	1
C rudder	½"	8⅝"	7¼"	P	1
D seat	½"	4½"	5"	P	1
E* windshield	½"	2"	3¾"	P	1
F cowling	1½"	6" dia.		P	1
G propeller	½"	2¼"	10⅞"	P	1
WING ASSEMBLY					
H wings	½"	7¼"	26"	P	2
I struts	½"	4"	14⅜"	P	2
J wheel pant blanks	½"	6⅞"	10"	P	2
HANDLE					
K handle upright	1" dia.		6¼"	D	1
L handles	1" dia.		4½"	D	2
*Initially cut parts marked with an * oversized. Trim to finished size according to the instructions.					
Materials Key: LP—laminated pine, P—pine, D—dowel.					
Supplies: 12—#8x1½" flathead wood screws, 7—#10x2" flathead wood screws, 2—¼x1" fender washers, 12—½" washers, 2—7"-dia. rubber wheels, ½" steel rod 17" long, 2—⅜x¼" cotter pins, ¾" copper tee, 4"-dia. stem swivel caster, 2¼" rubber door bumper, primer, enamel paints.					

edges. Sand the elevator smooth, and check its fit into the elevator slot in the fuselage. Once properly fitted, use the holes in the elevator as guides to drill pilot holes into the fuselage. Secure the elevator in the slot with a pair of wood screws.

3 Rout ¼" round-overs on the rudder (C) and the seat (D) where indicated on the patterns and Exploded View drawing. Remove the paper patterns, and sand the pieces smooth. Glue the rudder into the notch in the fuselage. Drill counterbored mounting holes, and screw the seat in place. Plug the holes in the seat.

4 To form the windshield (E), cut a piece of ½" stock to 4x8". Adhere the full-sized pattern to the stock where indicated on the Cutting Diagram. Bandsaw along

CUTTING DIAGRAM



the dotted line. Sand the cutlines smooth, and rout 1/4" round-overs along the cut edges. Working with an oversized piece of stock makes it easier and safer when routing. Now, use your tablesaw to rip along the second cutline to form the flat bottom edge of the windshield. Glue the windshield in place, centered on the top edge of the fuselage and 1/2" ahead of the handle-upright hole.

Form the cowling and propeller next

1 From 1 1/2"-thick stock (we used a scrap piece of 2x8, but you also could laminate thinner stock to form the blank), mark a 6"-diameter circle on the stock for the cowling (F). Bandsaw the cowling to shape.

2 Drill a 3/16" shank hole through the center of the cowling. Then, mark the location of and drill a pair of counterbored holes through the front face of the cowling for attaching it to the fuselage front later. Sand the cowling smooth (we used a disc sander to sand the bandsawn edges). Rout a 1/2" round-over along the front edge.

3 Glue and screw the cowling to the fuselage, and plug the holes.

4 Transfer the propeller (G) pattern to 1/2" stock, and cut it to shape. Drill a countersunk hole in the center of the propeller. Rout or sand 1/8" round-overs along the edges of the blades.

And now, add the wings

1 From 1/2"-thick stock, cut the two wings (H) to the size listed in the Bill of Materials.

2 Adhere the full-sized pattern to the top surface of the lower wing. Bandsaw and sand the wing to shape. Drill blade start holes and scrollsaw the strut slots in the bottom wing to shape.

3 To attach the lower wing to the bottom side of the fuselage and struts later, drill three 3/16" holes and four 5/32" holes through the the lower wing where marked on the pattern. Flip the wing over, and countersink all the holes on the *bottom side* of the wing.

4 Using the lower wing as a template, transfer its shape to the upper-wing blank. Mark a radius centered along the back edge of the upper wing. Cut the upper wing to shape.

5 Place the lower wing on the top surface of the upper wing, with the edges and ends flush. Using the holes in the lower wing as

guides, drill four holes for attaching the upper wing to the struts. Separate the wings.

6 Rout 1/4" round-overs along the edges of each wing.

Next, machine the struts that separate the wings

1 Cut two struts (I) to shape from 1/2" stock. Test-fit the struts in the slots in the bottom wing.

2 Adhere the strut pattern to one of the pieces. Drill blade start holes, and scrollsaw the openings in the strut to shape. Sand the scrollsawed edges smooth.

3 Using the first strut as a template, trace the openings onto the second strut, and scrollsaw those openings to shape.

4 Drill a 1/2" hole through the struts for the steel axle.

5 Rout 1/8" round-overs along the edges of the struts where shown on the full-sized pattern and Exploded View drawing.

Fashion the wheel pants next

1 Cut two pieces of 1/2" stock to 6 1/8" x 10" for the pant blanks (J).

2 Using your tablesaw, cut a pair of 1/4"-deep dadoes across each blank where shown on the Wheel Pants drawing. *The width of the dado needs to be the same as the*

Continued

Barnstormin' biplane

width of the bottom end of each strut (ours measured 2½"). Check the fit of the struts into the dadoes in the pants.

3 Place the pants dadoed surface to dadoed surface, and cut a filler block to fit between the mating dadoes. Tape the pieces together with the filler block in place, and bandsaw the pants to shape.

4 Rout ⅜" round-overs along all but the top edge of the taped-together pants. The filler block gives the bit bearing a surface to ride on when routing the round-over along the top outside edge of each pant. (We darkened the filler block for the photo on the next page so it would be more visible.) Sand the pants, pry them apart, and remove the filler block and paper pattern.

5 Finish-sand the wings and struts. Glue and clamp the struts between the wings as shown in the photo above right. Verify that the struts are square to both wings and parallel to each other. Drive the screws through the top surface of the top wing and the bottom surface of the bottom wing to secure the assembly.

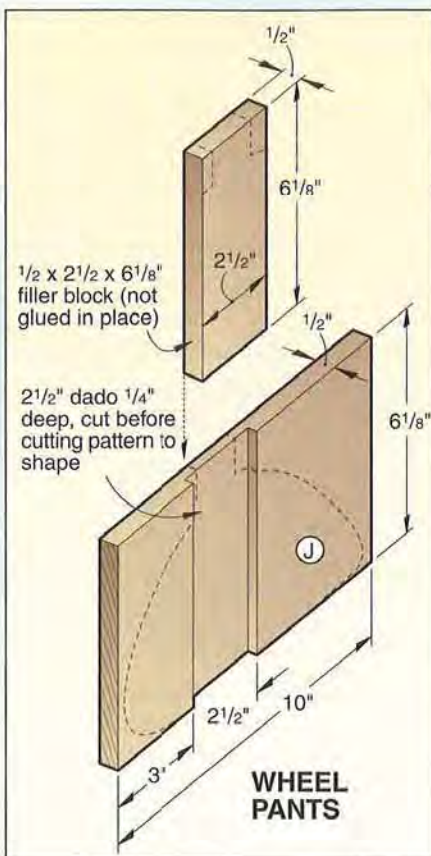
6 Square the fuselage to the lower wing. Clamp the fuselage to the wing. Using the previously drilled holes in the lower wing as guides, screw the assemblies together as shown in the photo on the opposite page.

Next, let's make the handle

1 Cut three pieces of 1" dowel to 8" long each. Fit your miter gauge with a wood extension and stop as shown on the Tenoning the Handle Dowels drawing.

2 Raise your tablesaw blade ⅛" above the surface of the saw table, and position the miter gauge so the center of the dowel is centered over the highest point of the blade. Clamp the miter gauge to your saw table.

3 Turn on the saw, push a scrap piece of dowel over the spinning



Below: After cutting the taped-together wheel pants to shape, rout a round-over along the edges of the pants.

Center: Glue and clamp the struts between the wings. Drive the screws, and plug the holes. Sand the plugs smooth.

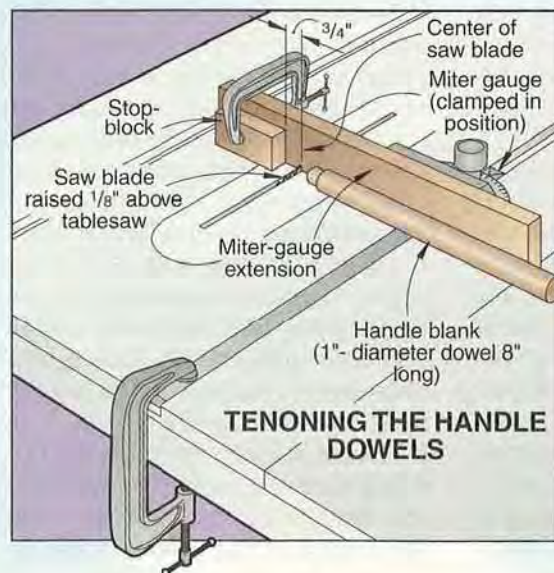
Far right: Clamp the lower wing to the fuselage, and drive the screws to secure the assemblies together.



blade and against the stop. Continue moving the dowel over the blade until a ⅞"-diameter tenon is created on the end of the dowel. Test-fit the tenoned end of the dowel into a ¾" copper tee. Adjust the blade height if necessary until the tenon fits snugly into the tee without having to be forced on.

4 Once you've accurately positioned the blade, cut a ¾"-long tenon on one end of each 8"-long piece of dowel. Once each piece of dowel has been tenoned, cross-cut the handle upright (K) and handles (L) to the lengths listed in the Bill of Materials.

5 Sand a ¼" chamfer on the end of each 1" dowel opposite the tenoned end. Epoxy the tenoned dowels into the copper tee.



Final assembly before taxi and takeoff

1 Fill any gaps with putty, and finish-sand the pieces. Prime all the surfaces except the dadoed area of the pants and their mating location on the strut. These need to be paint-free for a good glue joint. (We masked these areas before priming.)



2 Paint the cowling and seat red (we used Krylon cherry red, #2101). Mask off the seat and cowling, and paint the rest of the plane yellow (we used Krylon daisy yellow, #1813). See our detailed description for painting this project on *page 29*.

3 Paint the propeller yellow. Mask the inner portion, and paint the ends of the blades red.

4 Apply a clear finish to the dowel-handle assembly, masking off the portion of the upright dowel (K) that will fit into the hole in the fuselage.

5 Cut the axle ($\frac{1}{2}$ " steel rod) to length (we used a hacksaw). Use spring clamps (no glue yet) to secure the pants to the struts, with the steel axle, wheels, and washers in the configuration shown on the Wheel Pants detail accompanying the Exploded View drawing. Drill a $\frac{1}{8}$ " hole through each plastic wheel rim until the bit touches the steel axle and leaves a slight indentation or

marking on the axle. Then, remove the axle and wheels from the plane, and drill a $\frac{1}{8}$ " hole through each axle at each of the two marked indentations. (We did this on the drill press using a V-block jig to hold the axle steady while we drilled directly through the center of the steel axle.) Put the wheels back on the axle so the holes in the axle align with the hole in each wheel rim. Using the hole in the axle as a guide, drill through the opposite edge of the wheel rim. (We used a jobbers bit—an extra long drill bit—to drill through the opposite edge of the wheel.) *So the plane will track straighter, it is important to pin both wheels to the axle.*

6 Put paraffin or several drops of oil in the axle holes in the wheel pants. If you don't, the steel axles will squeak. Then, place the wheels and washers on the axle. Fit the axle assembly between the pants, and glue and clamp the pants to the bottom of the struts.

7 Epoxy the rear swivel caster into the hole in the tail of the fuselage. Wipe off excess epoxy.

8 Hand-paint the decorative striping on the plane, or order the vinyl decals listed *below*.

9 Attach the propeller to the cowling so it spins freely. And add the nose cone (rubber door bumper) to the propeller with a piece of two-faced tape.

Buying Guide

Hardware kit. Includes all the hardware (except primer and paint) listed in the Supplies list at the end of the Bill of Materials. Kit #WD-BP, \$34.95 ppd. Miller Hardware, 1300 M.L. King Parkway, Des Moines, IA 50314. Or, call 515/283-1724 to order (no COD's please).

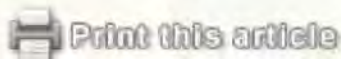
Vinyl decals. Decals plus application instructions, \$29 ppd. Kness Signs, 5291 NW 72 Street, Des Moines, IA 50322. No phone orders please. ♣

Written by Marlen Kemmet Project Design: James R. Downing Illustrations: Kim Downing; Lorna Johnson Photographs: Bill Hopkins

CORDLESS DRILLS

Our exclusive tests reveal today's most-powerful models

Cordless drills have come a long way since their introduction in the '70s. Thanks largely to vastly improved battery technology, today's best models handle any drilling or fastening task with ease and convenience. Of course, some models run stronger and longer than others, and in this article we'll tell you how to get the most for your cordless-drill dollar.



A few words about our testing procedure

Developing a fair and accurate means of testing a group of tools never comes easy. With cordless drills, driving pound after pound of screws, or drilling thousands of holes to see which tool outperforms another involves several hard-to-control variables. Inconsistent wooden test pieces, drill and driving bits that wear with use, and the human element make the potential for error skyrocket (nobody can drill each hole or drive each screw with the exact same pressure and efficiency).

With this understanding, WOOD® magazine tool tester Bob McFarlin built a "dynamometer." (You can read more about his invention on *page 1*). The dynamometer provided us with error-free readouts of each drill's performance in areas such as run time, speed, and torque. And,

with this instrument we were able to apply real-life workloads to the drills as we put them through their paces.

To guarantee the absolute accuracy of our results, each drill's battery pack was "cycled" (completely discharged and charged) six times before the tests began. This vital step puts the drills on equal footing by bringing each battery up to peak performance. (Our tests showed that batteries that haven't been charged for a while may not hold a full charge until being cycled a few times.)

Then, we ran each machine through our dynamometer test six times and averaged the results. As witness to the accuracy of the dynamometer, we found that each drill produced nearly the exact same results with each of the six tries.

Three key performance areas

The charts on the following pages show how the various models fared in three tests performed on the dynamometer. Here are some important points to remember about each performance area:

- **Torque.** This tells you the maximum amount of turning force a drill exerts (measured in inch-pounds). A drill/driver with high torque will bury long screws and make large-diameter holes in tough woods better than a drill/driver with low torque.

How much torque is enough for your needs? In our tests, we found that it requires only about 10 inch-pounds of torque to drive a 2" screw into pine. Screws longer than 2" are best driven with a tool that delivers at least 40 inch-pounds of torque. To drive lag screws into pine without a pilot hole, you will need a drill/driver



TORQUE

It tells how much muscle a drill has

VOLTS	MAXIMUM INCH-POUNDS												
	0	20	40	60	80	100	120	140	160	180	200	200+	
7.2	BLACK & DECKER	VP860	[Bar chart showing torque up to ~50 inch-pounds]										
	MAKITA	6172DWE	[Bar chart showing torque up to ~120 inch-pounds, TWO-SPEED TRANSMISSION]										
	MILWAUKEE	0387-1	[Bar chart showing torque up to ~40 inch-pounds]										
	RYOBI	CD75K	[Bar chart showing torque up to ~50 inch-pounds]										
	SEARS	11173	[Bar chart showing torque up to ~60 inch-pounds]										
	SKIL	2273	[Bar chart showing torque up to ~50 inch-pounds]										
9.6	BLACK & DECKER	PS330	[Bar chart showing torque up to ~100 inch-pounds, SINGLE-SPEED TRANSMISSION]										
	BOSCH	B2110K	[Bar chart showing torque up to ~150 inch-pounds]										
	DEWALT	DW962K-2	[Bar chart showing torque up to ~180 inch-pounds]										
	HITACHI	FDS10DVA	[Bar chart showing torque up to ~90 inch-pounds]										
	HITACHI	DS10DV2B	[Bar chart showing torque up to ~180 inch-pounds, 1.7 AND 2 AMP/HR. BATTERIES]										
	MAKITA	6202DWG	[Bar chart showing torque up to ~180 inch-pounds]										
	METABO	BEAT 9/6.2 R+L	[Bar chart showing torque up to ~150 inch-pounds]										
	MILWAUKEE	0219-1	[Bar chart showing torque up to ~140 inch-pounds]										
	PANASONIC	EY6181CRKW	[Bar chart showing torque up to ~150 inch-pounds]										
	PORTER-CABLE	9840	[Bar chart showing torque up to ~140 inch-pounds]										
	RYOBI	CTH962	[Bar chart showing torque up to ~140 inch-pounds]										
	SEARS	11189	[Bar chart showing torque up to ~80 inch-pounds, SINGLE-SPEED TRANSMISSION]										
SKIL	2375	[Bar chart showing torque up to ~80 inch-pounds, SINGLE-SPEED TRANSMISSION]											
WEN	XP9600	[Bar chart showing torque up to ~80 inch-pounds, SINGLE-SPEED TRANSMISSION]											
12	BOSCH	B2310K	[Bar chart showing torque up to ~200 inch-pounds]										
	CHICAGO ELECTRIC	00308-2AJA	[Bar chart showing torque up to ~160 inch-pounds]										
	DEWALT	DW972K-2	[Bar chart showing torque up to ~200 inch-pounds]										
	FREUD	EDS120B	[Bar chart showing torque up to ~140 inch-pounds]										
	HITACHI	DS10DVAKBE	[Bar chart showing torque up to ~180 inch-pounds]										
	HITACHI	DS13DV2B	[Bar chart showing torque up to ~200 inch-pounds]										
	MAKITA	6311DWHE	[Bar chart showing torque up to ~180 inch-pounds]										
	METABO	BEAT 112/2 R+L	[Bar chart showing torque up to ~160 inch-pounds]										
	METABO	BEAT 12/2 R+L	[Bar chart showing torque up to ~180 inch-pounds]										
	MILWAUKEE	0407-1	[Bar chart showing torque up to ~180 inch-pounds]										
	PANASONIC	EY6100CQKW	[Bar chart showing torque up to ~200 inch-pounds]										
PORTER-CABLE	9853S	[Bar chart showing torque up to ~200 inch-pounds]											
RYOBI	CD125K	[Bar chart showing torque up to ~160 inch-pounds]											
RYOBI	CTH1202	[Bar chart showing torque up to ~160 inch-pounds]											
SEARS	27139	[Bar chart showing torque up to ~160 inch-pounds]											
SKIL	2475;02	[Bar chart showing torque up to ~140 inch-pounds, SINGLE-SPEED TRANSMISSION]											
WEN	XP1200	[Bar chart showing torque up to ~140 inch-pounds]											
13.2	FREUD	EDS132B	[Bar chart showing torque up to ~180 inch-pounds]										
	WEN	XP1320	[Bar chart showing torque up to ~200 inch-pounds]										
14.4	DEWALT	DW991K-2	[Bar chart showing torque up to ~200 inch-pounds]										
	DEWALT	DW996	[Bar chart showing torque up to ~200 inch-pounds]										
	SEARS	27194	[Bar chart showing torque up to ~200 inch-pounds]										
18	DEWALT	DW995K	[Bar chart showing torque up to ~200 inch-pounds]										

with at least 100 inch-pounds of torque. And for boring with a hole saw, get a drill with at least 150 inch-pounds of torque.

For most tasks requiring more than 40 inch-pounds of torque, your best bet is a drill with a two-speed transmission. That's because high torque levels can be achieved in low-speed gear ranges only.

You will note in the chart *right* that we do not list torque readings that exceed 200 inch-pounds. Our test gauge stopped at 200 inch-pounds, but since a drill with 200 inch-pounds of torque did every task we put before it, we don't think ratings over 200 inch-pounds should be a determining factor in your buying decision.

•**Run Time.** In our tests we found that higher-voltage drills do not necessarily run for longer periods of time on one battery charge than

Continued

NOTES:
 Tools were run at full speed in lowest gear. We slowly increased the applied load until the tool stopped. Our test gauge only measures to 200 inch-pounds of torque.
 All 9.6-volt and higher machines have two-speed transmissions except where noted.
 All 7.2-volt models have single-speed transmissions except where noted.

CORDLESS DRILLS

lower-voltage drills. So, the battery of a 7.2-volt drill may last as long as the battery of a 14.4-volt drill. But, as you'll see in the next paragraph, a higher-voltage drill performs a lot more work during that time span.

•**Revolutions.** Because drills with high voltage generally run at higher rpm than low-voltage models, you get more total revolutions on each battery charge. So, you will drill more holes, or secure more fasteners, on a single charge.

Note: Our rpm ratings differ from manufacturers' no-load ratings because we applied loads that simulate working conditions.

Keep in mind, too, that drills with higher rpm will help you work faster and produce better results. For example, a drill that turns at 500 rpm in low gear will drive screws twice as fast as a drill running at 250 rpm in low gear. In high gear, a drill should turn no slower than 800 rpm for most drilling tasks. At slower speeds the drill bit tends to "hack" at the work surface, making for slow going and poor-quality holes.

In the 9.6-, 12-, 14.4- and 18-volt categories, the DeWalt drills ran at the highest rpm. Despite their high rpm levels, these drills keep up with their competition in torque and total revolutions.

Other points you'll want to consider

The world's most powerful cordless drill will be of little use to you if it weighs too much, doesn't have the necessary controls in easy-to-reach places, or doesn't fit comfortably in your hand. Here are some factors, besides power, that you should consider:

•**Ergonomics.** The full-page chart lists five important specifications that largely determine how comfortable you'll find each drill. First,

There's more to a tool's power than just voltage

In terms of power, manufacturers classify cordless tools according to battery-pack voltage. Because these packs typically contain an even number of 1.2-volt cells, they have voltages of 7.2, 9.6, 12, and 14.4. (Freud and Wen sell 13.2-volt models with 11 cells; DeWalt recently introduced the first 18-volt model with 15 cells.)

As you can see in the charts on these pages, high-voltage ratings generally equate to higher torque and revolutions per charge. But, all makes and models of the same voltage do not produce the same amount of work. The reason? Although few tool buyers realize it, batteries come with differing ampere hour (Ah) ratings.

As we discovered in our tests, the Ah rating says a lot about a battery pack's capacity for storing energy. For example, we tested the Hitachi DS10DV2B with three different 9.6-volt batteries with Ah ratings of 1.2, 1.7, and 2.0. With the 1.2-Ah battery, the drill produced 3,970 revolutions under 10 inch-pounds of load. With the 1.7-Ah battery, the tool's chuck made 4,970 revolutions. The 2.0-Ah pack yielded 6,379 revolutions.

Most of the top-performing drills in our test have 1.7-Ah batteries. The Hitachi 2.0-Ah pack was the

first of its type we've tried, but you can expect to see other manufacturers crash the 2.0-Ah barrier soon. Since cordless-drill manufacturers buy their batteries from the same sources (Sanyo, Panasonic, or Energizer), similar technology is generally available to all of them. With many brands, including Hitachi, the high-Ah batteries are compatible with drills and chargers originally sold with low-Ah batteries of the same voltage.

Although high-Ah ratings have a positive effect on total revolutions by increasing the storage capacity of a battery pack, they do not increase rpm or maximum torque output. In our tests, the Hitachi DS10DV2B produced about 170 pounds of torque regardless of the Ah rating of its battery.

The great part about high-Ah batteries is that they don't add any bulk to the tool (unlike high-voltage drills that become bigger and heavier with each increase in voltage). The downside to high-Ah batteries is that they are new technology, so they cost more. For example, a Hitachi 1.2 Ah, 9.6-volt battery sells for about \$45.

The same pack with 1.7 Ah sells for about \$65.

Currently, most manufacturers do not put Ah ratings on battery

you need to choose a *handle style*. As shown in the photo *right*, some manufacturers offer otherwise-identical drills in either a T-handle or pistol-grip configuration. We find the T-handle more comfortable and less fatiguing for most woodworking tasks because it gives the tool a balanced feel. However, if you mostly do work that requires lots of driving or drilling pressure, then the pistol-

grip style places your gripping hand more in line with the direction of pressure.

If you settle on a pistol-grip model, take a look at the *length from trigger to chuck tip* column of the full-page chart. High numbers in this column tell you that the drill is quite nose-heavy.

The *overall length to nose of chuck* and *height* columns give you a good idea of a drill's bulki-

Continued

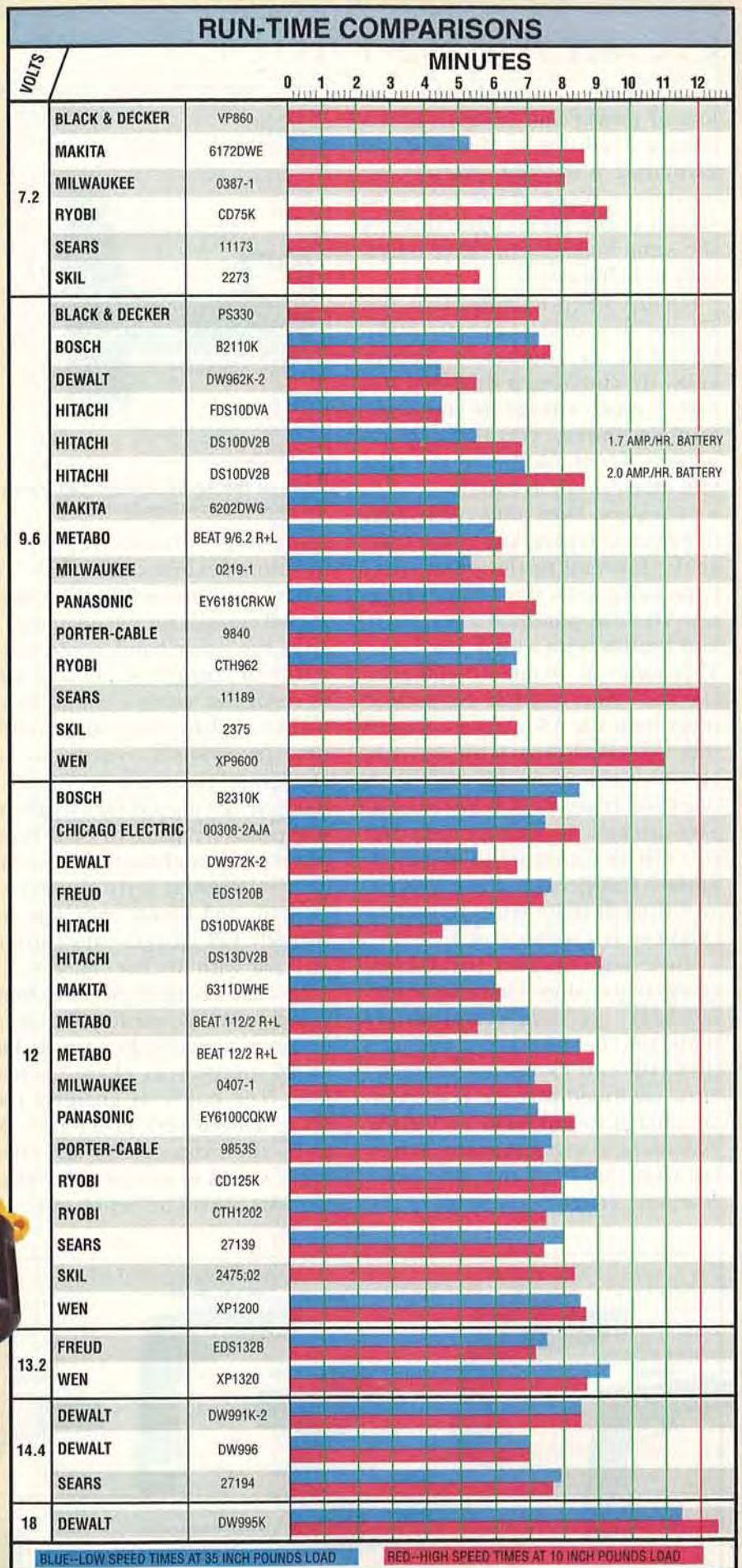
packs or the boxes that contain them. Instead, high-Ah batteries are often referred to as “high-capacity” versions. Since “high-capacity” is no more specific than “high voltage,” we’ve listed the specific Ah ratings for each tested drill in the full-page chart.

So why do cordless drills with battery packs of the same voltage and Ah rating produce different amounts of work? Some manufacturers claim that their motors produce more work because they contain rare-earth magnets. Others say that fan cooling helps their motors run more efficiently. In our testing the fan-cooled machines *did* stay cooler. (The coolest-running models, the DeWalts, were the only ones with two fans.) In the full-page chart we list the fan-cooled models.

Also, we found out that battery manufacturers sell battery cells of various quality grades. A cordless-drill maker that puts performance before price will typically buy batteries of the highest grade.



Several manufacturers offer the same drills with pistol-grip (upper) or T-handle configurations.



CORDLESS DRILLS

ness. Ideally, a drill should pack lots of power and features into a compact housing so that you can maneuver it in tight quarters. So remember, bigger *is not* better. As shown in the photo *right*, drills of the same voltage can differ drastically in bulkiness.

Finally, keep in mind that the *weight* of a drill is greatly influenced by its number of battery cells. By choosing a drill that has just as much voltage as you need, and no more, you'll keep its weight down and make the tool that much easier to handle.

• **Chargers.** Most drills come with one-hour chargers, and some drills at the low-end of the price spectrum come with three-hour chargers. You can purchase a few high-end brands with either one-hour, 15-minute, or 10-minute chargers. (In the chart we list Panasonic drills with the 15-minute chargers that we tested them with, but you can buy the same models with one-hour chargers at a lower cost. You can buy the DeWalt units and the Porter-Cable 9840 with 15-minute chargers, and the Metabo and Hitachi units with 10-minute chargers, at a higher cost.)

Since we consider three-hour chargers too slow for most woodworkers, we concentrated our tests on the one-hour and the "fast" 10- and 15-minute chargers. First, we found that the fast chargers tended to put fuller and more-consistent charges into the batteries than most of the one-hour chargers. That's because all of the



Drills of the same voltage can vary greatly in size. The Panasonic drills (left) were the most compact we tested.

fast chargers have circuitry that monitors the heat of the pack. This circuitry senses when the battery is cool enough for full charging.

On the other hand, some of the one-hour chargers in our test failed to recognize when a warm battery had cooled to the point that the charger should switch to full charging. To avoid problems of this sort, it's a good idea to allow a warm battery pack to cool *before* placing it in a charger. Of the one-hour chargers, only the Bosch, DeWalt, and Freud units put consistently full charges into batteries on a par with the fast chargers.

Because chargers do not charge warm batteries, we found that fast chargers occasionally took as long as 35 minutes to charge a pack fully. The one-hour chargers took up to 1 hour and 35 minutes. So, given the extra cost of fast chargers, it seems to us that most woodworkers would be better served by

investing in extra battery packs (one or more of which should always be cool) rather than a fast charger. Of course, if you can afford it, owning a fast charger *and* extra battery packs is the best possible way to ensure that you're never short of power.

Of the fast chargers, the Metabo version kept its batteries the coolest during charging. (Heat is an enemy of battery longevity.) Battery packs came out of the Metabo charger at a temperature of 90°. The DeWalt 15-minute charger was next coolest with 97° packs after full charging.

• **High/low speeds.** Technically, most of the models in this test are known as drill/drivers. This means that they have a high-speed range for drilling, and a low-speed range for driving fasteners. As you will notice in the "torque" and "total revolutions" charts, many of the drills priced under \$100 have just



one speed range. This single speed range is generally a "compromise" between the ideal drilling and driving speeds. These tools are suitable for most homeowners, but if you're a serious woodworker, you'll need a model with two speed ranges. We did not find any of the single-speed models to be effective at drilling clean holes, although they work well for driving all but the largest fasteners.

• **Clutches.** Nearly all of the tested drills have at least five clutch positions plus a "drill" setting (clutch is locked up). Some Bosch, Hitachi, and Panasonic models have 15 or more clutch settings.

This mechanism automatically stops the chuck from spinning at predetermined torque levels. So, if you adjust a five-position clutch to its "1" position, the chuck will stop turning once it encounters a low workload. Set at "5", the clutch will disengage only under a heavy load. This gives you greater control over screw depth, and can prevent screw breakage. We've found that five clutch settings are sufficient for most woodworking tasks. You may find additional settings helpful if you do precision work in delicate materials such as plastics or thin softwoods.

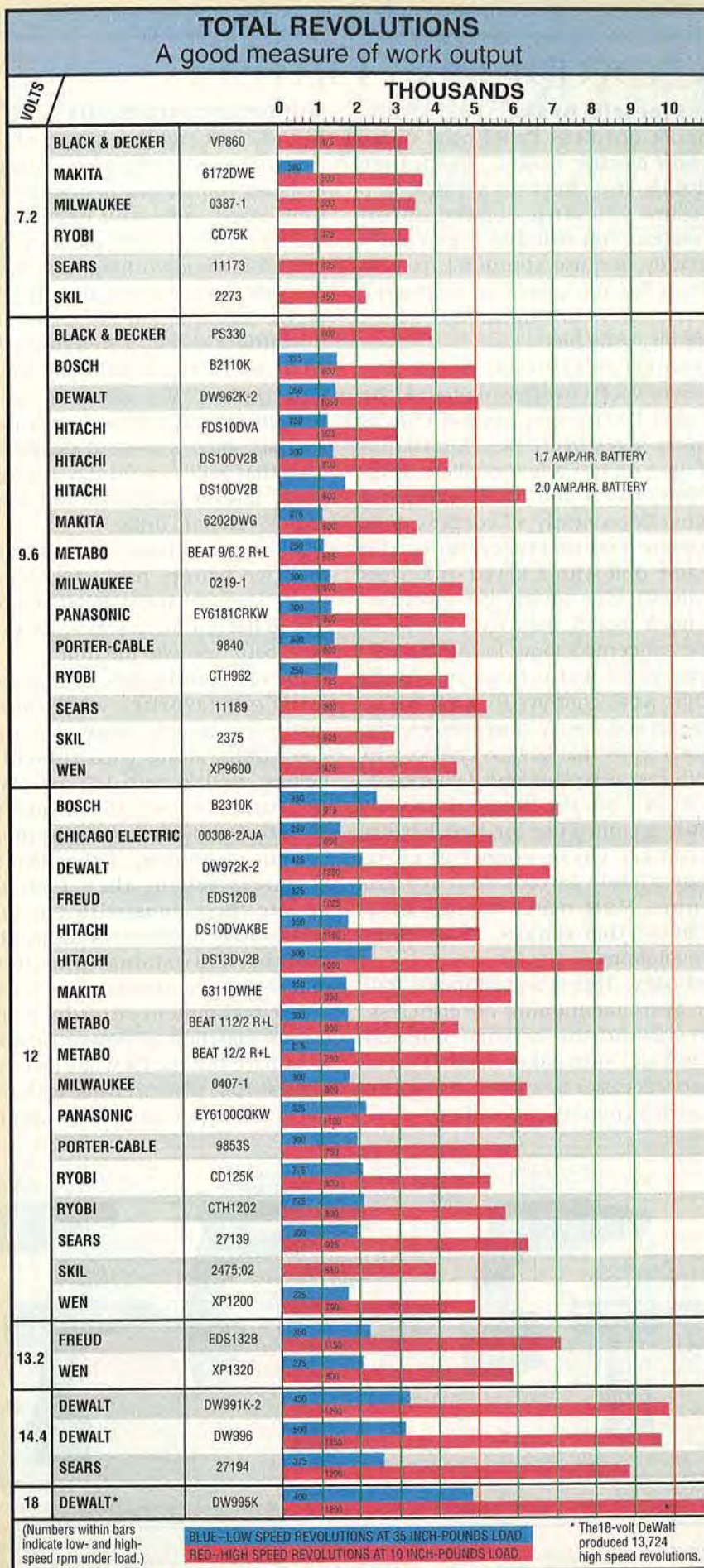
• **Electronic speed control.** This feature helps a drill maintain consistent speed under various loads. Although many of the tested models tout this feature, the Panasonics, Hitachis, and the Milwaukee 0219-1 performed noticeably better in this area.

Continued

Milwaukee
0407-1



Metabo
BEAT 12/2 R+L



CORDLESS DRILLS

•**Electric brake.** Thankfully, most cordless drills now come with electric brakes. This feature brings the chuck to a quick stop when you let go of the on/off switch. You will find it extremely handy because you don't have to wait for the chuck to stop spinning before driving another screw or changing bits.

•**Keyless chucks.** In our last review of cordless drills in the April 1991 issue, keyless chucks were a relatively new innovation found on just a few cordless drills. Now, you'll find these wonderful chucks on nearly all cordless drills (some manufacturers offer the same drill with a keyed or keyless chuck). Our advice: get a keyless-chuck model. You won't have to be concerned about losing the key, and you'll find it easier to change bits. And, contrary to what we've heard and read in many places, our tests show that keyless chucks grip bits just as well as keyed chucks.

As in 1991, the Panasonic models still get our vote for best keyless chucks. These open and close completely in only four revolutions. Most other models have chucks that require 20 or more revolutions.

•**Color.** This is a small point, but it bears mentioning nevertheless. We found the brightly colored DeWalt, Milwaukee, and Hitachi models easier to spot than the others in a cluttered workshop.

Our recommendations

In the chart *right* we group all of the drills according to voltage because you should first settle on how many volts you need. The 9.6-volt drills proved plenty powerful for woodworking, and light enough to be comfortable. If you tackle construction tasks such as building a deck, a heavier 12-, 13.2-, or 14.4-volt drill may serve you better. We see the new DeWalt 18-volt drills as best suited for tradesmen who need a cordless drill that will run all day on one pack, and for tasks typically done with ½" electric drills.

Whatever voltage you opt for, buy two battery packs so you're never short of juice. Retailers get top dollar for accessories, so buy both batteries *with* the drill.

Among both the 9.6- and 12-volt drills our favorites were those made by Bosch, DeWalt, and Panasonic, along with Hitachi's newest models with 1.7- and 2.0-Ah batteries. Not coincidentally, all of these brands feature the most current technology. Other manufacturers tell us they plan to update their lines with current technology within the next six months. This should put their models into the "hunt."

Our recommended drills were evenly matched in power for the most part, but the DeWalts had the highest rpm while staying with, or exceeding, the others in torque.

We give the Bosch, Hitachi, and Panasonic models a slight edge in ergonomics. The Bosch drills have lifetime brushes, and the Panasonics were the most compact models tested.

If your budget won't allow one of these brands, keep in mind that cordless drills are a lot like computers and other electronics. You pay a premium for the latest technology (such as high-Ah batteries). But, the models with the older technology may be adequate for you. As shown by our "top-value" ratings, we came across many lower-priced models that meet the needs of many woodworkers.

Before choosing a model that costs less than \$90 though, be certain that you can live with certain performance tradeoffs. Most of these drills have 3-hour chargers, single-speed transmissions, or low-Ah batteries that tire quickly.

Note: Although the chart lists the specific models that we tested, keep in mind that some manufacturers make similar drills with slightly different features and accessories. The same drill may come with or without a keyless chuck, in T-handle or pistol-grip configuration, with one battery or two, with regular- or high-capacity batteries, or with various chargers. Each version will have a different model number, so discuss these options with your dealer.



Written by Bill Krier Technical consultant: Bob McFarlin Photographs: William Hopkins

MORE SPECS ON TESTED CORDLESS DRILLS

VOLTS	MANUFACTURER AND BRAND	MODEL (1)	AMP. HOURS (2)	NUMBER OF BATTERIES INCLUDED (3)	CHARGE TIME (HOURS)	KEYLESS CHUCK (YES, NO)	CHUCK CAPACITY (INCHES)	CLUTCH SETTINGS	ELECTRIC BRAKE (YES, NO)	NO-LOAD SPEEDS (RPM)	LOADED SPEEDS (RPM) (4)	FAN-COOLED MOTOR (YES, NO)	LENGTH FROM TRIGGER TO CHUCK TIP (INCHES)	OVERALL LENGTH TO NOSE OF CHUCK (INCHES)	OVERALL HEIGHT (INCHES)	HANDLE STYLE (5)	DRIVER-BIT STORAGE (YES, NO)	CARRYING CASE (6)	WEIGHT (POUNDS)	COUNTRY OF ASSEMBLY (7)	SELLING PRICE (8)
7.2	BLACK & DECKER	VP860	1.2	2*	3	Y	3/8	5 + DRILL	N	0-600	0-475	Y	6	9 3/4	8 5/8	P	Y	N	2.72	M	\$ 50*
	MAKITA	6172DWE	1.3	2	1	Y	3/8	--	Y	0-250, 0-600	0-200, 0-500	Y	5 1/2	9 5/8	8 1/4	P	N	P	2.80	E	110
	MILWAUKEE	0387-1	1.3	1	1	Y	3/8	--	N	0-600	0-500	N	5 3/4	9 1/2	8 5/8	P	N	N	2.52	U	N/A
	RYOBI	CD75K	1.5	2	3	Y	3/8	3 + DRILL	N	0-520	0-425	N	7 1/2	10 3/4	9 3/8	P	Y	P	2.88	C	65
	SEARS	11173	1.5	1	3	N	3/8	--	N	300, 600	0, 425	N	6	9 1/2	8 7/8	P	N	N	2.65	C	60
	SKIL	2273	1*	2*	3	Y	3/8	4 + DRILL	N	300, 600	0, 450	N	6 1/2	9 7/8	7 1/2	P	Y	N	2.50	M	55
9.6	BLACK & DECKER	PS330	1.2	1	3	Y	3/8	5 + DRILL	Y	0-700	0-600	Y	6 3/4	8 5/8	10 1/8	P	Y	N	3.04	C	70
	BOSCH	B2110K*	1.7	2	1	Y	3/8	15 + DRILL	Y	0-350, 0-1000	0-275, 0-800	Y	4	8 3/4	9 3/4	T	Y	P	3.49	S	185
	DEWALT	DW962K-2	1.7	2	1	Y	3/8	5 + DRILL	Y	0-400, 0-1200	0-350, 0-1050	Y	5	9 3/8	9 1/8	T	Y	S	4.22	U	180
	HITACHI	FDS10DVA	1.2	2	1	Y	3/8	5 + DRILL	Y	0-280, 0-850	0-250, 0-625	N	5 1/8	8 5/8	8 1/8	T	Y	P	3.28	T	130
	HITACHI	DS10DV2B	2	2	1	Y	3/8	22 + DRILL	Y	0-400, 0-1100	0-300, 0-800	Y	4 1/4	7 7/8	8 1/8	T	N	P	3.27	I	195
	MAKITA	6202DWG	1.7	1	1	Y	3/8	5 + DRILL	Y	0-350, 0-1100	0-275, 0-800	Y	4 1/2	9 1/4	9 1/2	T	N	P	3.95	J	220
	METABO	BEAT 9/6.2 R+L	1.4	1	1	Y	3/8	5 + DRILL	Y	0-300, 0-900	0-250, 0-625	N	6 3/4	9 5/8	9 1/2	P	Y	S	3.62	G	210
	MILWAUKEE	0219-1	1.3	1	1	N	3/8	5 + DRILL	Y	0-350, 0-1000	0-300, 0-800	Y	4 1/2	9	10	T	N	N	3.71	J	200
	PANASONIC	EY6181CRKW	1.7	1	15 MIN	Y	3/8	21 + DRILL	Y	0-350, 0-1000	0-300, 0-800	Y	4	8 5/8	8 5/8	T	N	P	3.56	U	165
	PORTER-CABLE	9840	1.3	2	1	Y	3/8	5 + DRILL	Y	0-350, 0-1000	0-300, 0-800	N	5	9 1/4	9 3/4	T	N	P	3.62	U	165
	RYOBI	CTH962	1.5	2	1	Y	3/8	5 + DRILL	Y	0-350, 0-1000	0-250, 0-725	Y	4 1/2	9 1/4	9	T	Y	P	3.29	C	120
	SEARS	11189	1.5	1	1	Y	3/8	3 + DRILL	N	0-600	0-500	N	7 1/2	10 3/4	10 1/4	P	Y	N	3.35	C	120
SKIL	2375	1*	1	3	Y	3/8	4 + DRILL	N	0-700	0-625	Y	6 1/2	9 3/4	9 1/2	P	N	N	3.02	M	65	
WEN	XP9600	1.4	1	1	Y	3/8	5 + DRILL	N	300, 1100	0, 475	Y	5	9 1/8	9 1/8	T	N	N	3.24	C	80	
12	BOSCH	B2310K*	1.7	2	1	Y	3/8	15 + DRILL	Y	0-400, 0-1200	0-350, 0-975	Y	4	8 3/4	10 1/8	T	Y	P	3.92	S	195
	CHICAGO ELECTRIC	00308-2AJA	N/A	1	1	Y	3/8	5 + DRILL	N	0-300, 0-900	0-250, 0-650	N	6 1/2	9 7/8	10 1/2	P	Y	P	3.74	T	90
	DEWALT	DW972K-2	1.7	2	1	Y	3/8	5 + DRILL	Y	0-450, 0-1400	0-425, 0-1250	Y	5	9 3/8	9 1/8	T	Y	S	4.54	U	190
	FREUD	EDS120B	1.4	2	1	Y	3/8	5 + DRILL	Y	0-375, 0-1300	0-325, 0-1025	Y	7 1/4	10 3/4	10 1/4	P	N	P	4.21	G	200
	HITACHI	DS10DVAKBE	1.2	2	1	Y	3/8	5 + DRILL	Y	0-400, 0-1600	0-350, 0-1150	N	5	8 7/8	10	T	N	P	4.25	I	210
	HITACHI	DS13DV2B	2	2	1	Y	1/2	22 + DRILL	Y	0-350, 0-1200	0-300, 0-1000	Y	4 3/4	9	9 3/4	T	N		4.16	I	220
	MAKITA	6311DWHE	1.7	2	1	Y	1/2	5 + DRILL	Y	0-370, 0-1150	0-350, 0-950	Y	5	9 3/4	9 1/8	T	N	P	4.53	E	205
	METABO	BEAT 112/2 R+L	1.4	1	1	Y	1/2	5 + DRILL	Y	0-300, 0-1100	0-300, 0-900	N	7 1/2	10 1/4	10 3/8	P	Y	S	4.64	G	320
	METABO	BEAT 12/2 R+L	1.4	1	1	Y	3/8	5 + DRILL	Y	0-300, 0-900	0-275, 0-750	N	6 3/4	9 5/8	10 3/8	P	Y	S	3.90	G	245
	MILWAUKEE	0407-1	1.7	2	1	Y	3/8	5 + DRILL	Y	0-350, 0-1000	0-300, 0-800	Y	7	10 1/2	10 1/2	P	N	S	3.87	U	175
	PANASONIC	EY6100CQKW	1.7	1	15 MIN	Y	3/8	21 + DRILL	Y	0-350, 0-1300	0-325, 0-1100	Y	4	8 5/8	8 1/4	T	N	P	3.82	U	200
	PORTER-CABLE	9853S	1.4	2	1	Y	3/8	5 + DRILL	N	0-350, 0-1000	0-300, 0-750	N	7 1/4	10 5/8	9 1/2	P	N	S	4.33	U	165
	RYOBI	CD125K	1.5	2	1	Y	3/8	5 + DRILL	Y	0-300, 0-1000	0-275, 0-800	Y	8	11	10 1/4	P	Y	P	3.53	C	115
	RYOBI	CTH1202	1.5	2	1	Y	3/8	5 + DRILL	Y	0-300, 0-1000	0-275, 0-800	Y	4 1/2	9 1/2	9	T	Y	P	3.58	C	150
	SEARS	27139	1.5	2	1	Y	3/8	5 + DRILL	N	0-350, 0-1000	0-300, 0-925	Y	8 1/4	11 1/2	10 3/8	P	Y	P	4.25	C	150
	SKIL	2475.02	1*	1	3	Y	3/8	5 + DRILL	N	0-700	0-650	Y	6 1/2	9 3/4	9 1/2	P	N	P	3.25	M	85
WEN	XP1200	1.4	1	1	Y	3/8	4 + DRILL	N	0-300, 0-1100	0-225, 0-700	Y	5	9 1/8	10 1/4	T	N	N	3.59	C	90	
13.2	FREUD	EDS132B	1.4	2	1	Y	3/8	5 + DRILL	Y	0-400, 0-1400	0-350, 0-1150	Y	7 1/4	10 3/4	10 1/4	P	N	P	4.31	G	210
	WEN	XP1320	1.6	1	1	Y	3/8	5 + DRILL	N	0-300, 0-1100	0-275, 0-800	Y	5	9 1/8	10 1/4	T	N	N	4.04	C	110
14.4	DEWALT	DW991K-2	1.7	2	1	Y	3/8	5 + DRILL	Y	0-450, 0-1400	0-450, 0-1200	Y	5	9 1/2	9 1/4	T	Y	S	4.81	U	225
	DEWALT	DW996	1.7	1	1	Y	1/2	5 + DRILL + HAMMER DRILL	Y	0-600, 0-1750	0-500, 0-1450	Y	8 1/4	11 3/4	9	P	Y	S	5.19	U	235
	SEARS	27194	1.7	2	1	Y	3/8	23 + DRILL	Y	0-400, 0-1400	0-375, 0-1200	Y	5 1/4	10	10	T	Y	P	4.61	C	190
18	DEWALT	DW995K	1.7	1	1	Y	1/2	5 + DRILL	Y	0-450, 0-1400	0-400, 0-1200	Y	5 1/2	10	9 1/4	T	Y	P	5.55	U	240



BLUE BARS INDICATE TOOLS THAT PERFORMED BEST REGARDLESS OF PRICE



RED BARS INDICATE TOOLS THAT OFFER THE BEST BLEND OF PERFORMANCE AND PRICE



PURPLE BARS INDICATE TOOLS THAT EARNED BOTH AWARDS



NOTES:

- (*) Bosch models B2110K and B2310K also labeled as models 3110K and 3310K in industrial outlets.
- (*) Skil 1.0 AH battery packs will be upgraded to 1.3 AH in mid-'96.
- (*) Two batteries required for operation.
- Loads applied were 35-inch/pounds in low gear and 10 inch/pounds in high gear. Models with a single speed range were loaded at 10-inch/pounds.

- (P) Pistol-grip (T) T-shaped
- (N) None (P) Plastic (S) Steel
- (C) China (I) Ireland (S) Switzerland (E) England (J) Japan (T) Taiwan (G) Germany (M) Mexico (U) United States

8. Lowest selling prices based on advertisements, catalogs, and manufacturer inquiries at time of article's production.
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Back-road Beauty

Scrollsaw this 3-D farm scene

Ordinary farmstead sights provide extraordinary scrollsawing pleasure in this new 3-D scene from scrollsaw artist Judy Gale Roberts. The stacked cutouts show so much detail that you can almost smell the hay.

Finishing materials we used:

Delta Home Decor gel wood stain
maple, 53215.

Delta Home Decor pickling gel
desert white, 54101
cactus green, 54103
ice blue, 54104
cranberry, 54110
goldenrod, 54115

Acrylic artist color
Mars black

First, scrollsaw the scene

1 Cut four $\frac{1}{8} \times 9 \times 12$ " blanks. (We used Baltic birch plywood for our painted scene. You could saw the patterns from solid stock of various woods for a different look.)

2 Photocopy the patterns in the *WOOD PATTERNS*® insert in the middle of the magazine. Adhere one pattern to each of three of the plywood blanks. The fourth blank will be the solid back.

3 Drill $\frac{1}{16}$ " blade start holes in the shaded areas of each pattern. You'll cut out these portions.

4 Select one of the patterned pieces to start sawing. (The order in which you cut the panels doesn't matter.) Insert the blade through the start hole in the smallest area. (We scrollsawed the scene using a #4 blade, .035 \times .014" with 18 teeth per inch.)

5 Scrollsaw the three patterned blanks. On each one, start with the smallest cutout area, and work up to the largest.

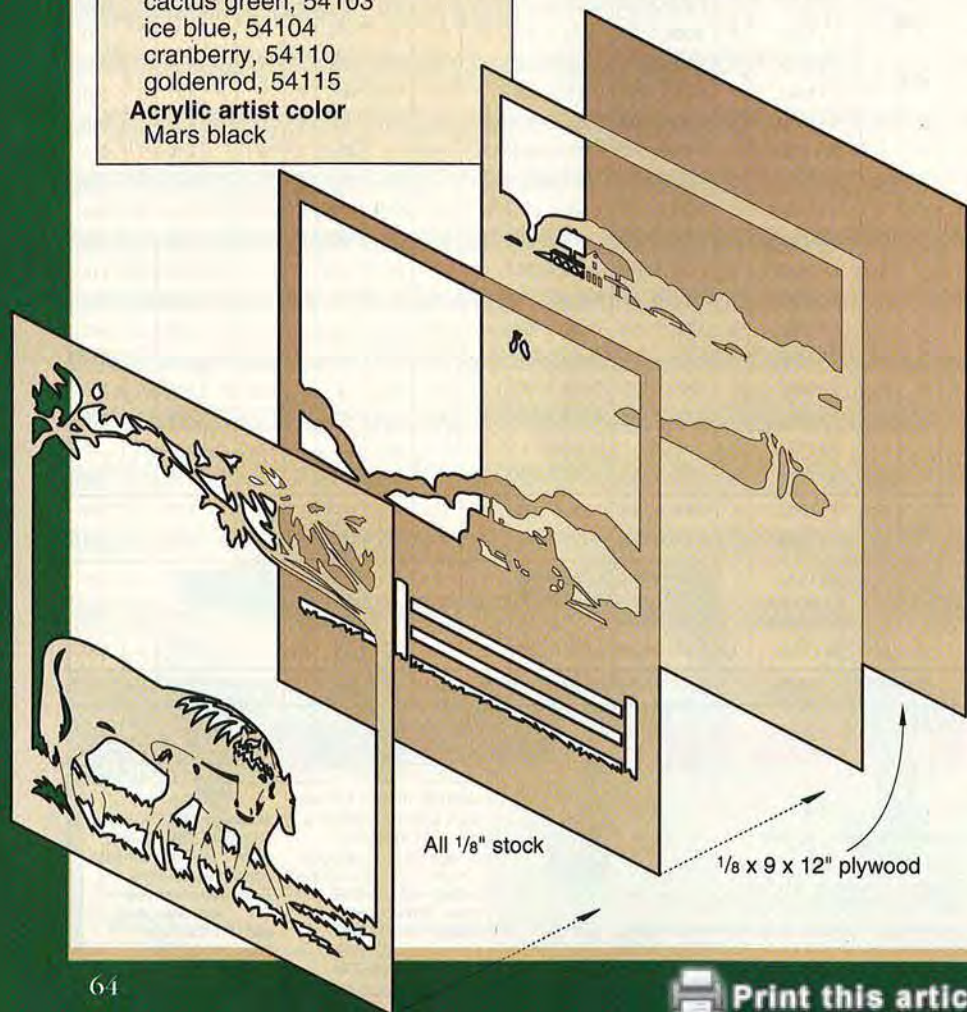
6 Sand the cutouts. Be sure to remove any fuzz from the sawn edges before proceeding.

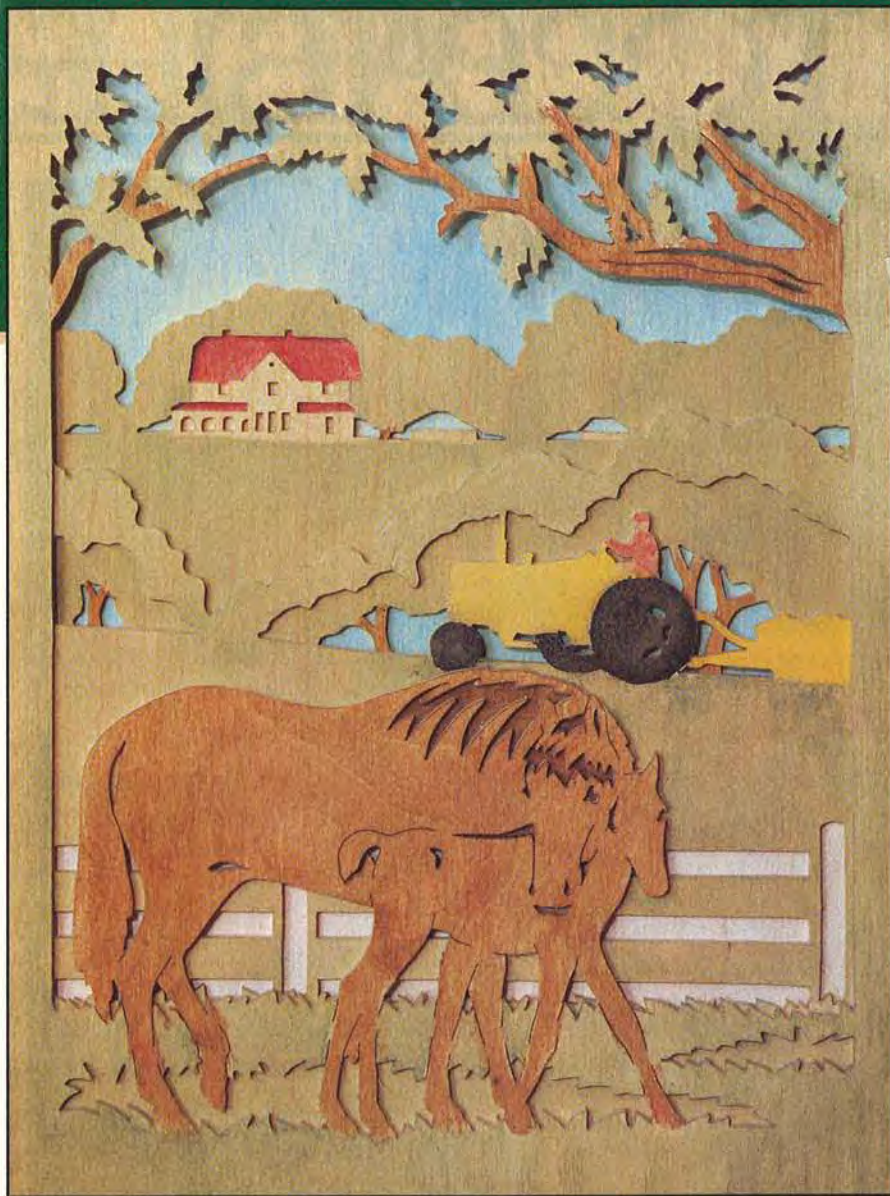
Then, paint the panels

1 Paint each cutout panel with color washes or stains. (We used the pickling gels, gel stain, and acrylic paint listed in the box left, all available from craft-supply dealers. You could use thinned acrylics or watercolors instead.)

2 Color the front cutout green, except for the horses and tree branches, which receive maple stain. Apply the gelled finishes with a rag stretched over your fingertip. Rub them in to give the wood a transparent tint. Color only the face of the cutout, not the edges; the contrast provides additional dimension to the scene.

3 Stack the front cutout (we'll call it the horse panel) on the next layer in the scene (the tractor panel). Brown (maple stain) needs to show through the large horse's cutout mane, forelock, and eyes, the cutouts that separate the colt and the horse, and the cutouts under the colt's tail and on its flank. Mark these areas on the tractor panel. (We pricked marks with





a straight pin in the points on the mane and forelock, and guesstimated where the rest of the brown should go.)

4 Separate the panels. Apply maple gel stain to the marked area on the tractor panel. Restack the layers temporarily to check the color coverage.

5 Lightly pencil in the tractor tires, continuing the lines established by sawing. Stain the tractor and plow goldenrod—or your favorite farm-equipment color. Paint the tires black with thinned acrylic artist color, and paint the farmer. (We applied cranberry to his coat and hat, leaving a spot of bare wood to

represent his head.) Rub green gel into the remainder of the panel.

6 Stack the tractor panel on the house panel. Mark through the fence area onto the house panel, and apply white gel there. (You could stain the house white, too; we left ours plain.) Apply maple gel to the tree trunks, then color the rest of the panel green.

7 Mark the house roof and the porch roof onto the unsawn panel. Pencil in the sides of the house. Color the roof areas cranberry, then rub in blue for the sky. (We brought our blue sky down to the row of trees behind the tractor to break up the expanse of green. If



After cutting out the four panels, color them with stains, pickling gels, and paint before assembly.

you want greater realism, paint that area green.) Leave the area behind the house plain. The panels will now look somewhat like the ones shown *above*.

8 After the stains dry, glue the panels together as shown in the Exploded View drawing. Spots of cyanoacrylate adhesive around the perimeter of each panel will hold them. After the glue cures, sand the four edges flush. You can leave the edges plain, stain them green to match the front, paint them another color, or apply moldings for a frame, as you prefer. 🌲

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Photographs: John Hetherington
Illustrations: Roxanne LeMoine, Lorna Johnson

“UNSTOPPABLE

That's the name for a Craig, Colorado, high school program where students still learn practical woodworking skills in shop class—and earn paychecks for doing it.



Colorado shop teacher Craig Conrad (foreground in dark shirt) echoes the enthusiasm of his Woods II shop class for their class project—the crafting and local sale of oak CD cases that raised \$18,000.

Craig Conrad, a 38-year-old Colorado educator, not only saved his woodshop program by balancing its budget, but turned it into a moneymaker. Now, kids scramble to get in because they actually get paid for taking the class.

But eleven years ago, things weren't nearly so rosie. In 1985, Craig inherited a nearly defunct high school woodshop program at Craig, Colorado's Moffat County

High School. Similar to today's situation in many schools, the woodshop budget was thousands of dollars in the red and enrollment had fallen off to part-time status. But Craig, himself a woodworker, not only wanted to keep his part-time teaching job, he wanted to make it full-time by pulling the program out of its skid.

Now, Moffat County High School has four different-level woodshop classes with a total enrollment of

about 100 students. And the woodshop program more than carries its own weight: its students, not taxpayers, generate the funds for tool-and-material expenditures. As a bonus, industrious students even take home a paycheck of a few hundred dollars or more at the end of the term.

How has he done it? Let's take a look at how the program that Craig has dubbed "Unstoppable Shops" operates.



SHOPS"



In what the instructor calls "mini-mass production," the students produced a run of 25 CD cases to be used as samples in door-to-door selling in and around Craig, Colorado.

They put woodshop production out on the streets

Moffat County High School's woodshop program has four year-long classes. "In Woods I, the kids learn all the woodworking basics, and use them to construct small projects," Craig explains. "I tell them that in Woods I you learn to walk, in Woods II you learn to run, because that's our production class. In Woods III we do a '2x4um,' where I have them build projects of their choice from just a length of 2x4. Then, they also do Santa's Woodshop, where before Christmas they make toys for local children. In Woods IV, students do large projects, such as cedar-strip canoes and furniture." It's Woods II, though, that generates the funds and the enthusiasm for the whole program.

Here's how Woods II works. "At the start of each year, the Woods II students vote as a class on a project that they'll make and sell," says Craig. In that vote, they take six things into consideration:

- The project's difficulty level;
- Its cost to make;
- The number of parts required;
- The availability of the necessary

tools and materials required;

- How the project will sell; and
- The project's appeal to the students, so that they will really enjoy making it.

After the project has been selected, the class sets up to build some prototypes. "We call it 'mini mass production,' because it's a run of 20 to 25, just enough for every kid in the class to have a sample to sell with [see photo *opposite*]," notes the instructor. "That small run is also when we test all the jigs and fixtures we'll use on the real production run."

Over the years, Craig's classes have produced various items—folding chairs, cutting boards with knife drawers, breadboxes, whatever could be carried door-to-door. "One limitation we have is size," explains the teacher. "The kids have to haul the sample product around house-to-house to take orders, and many of the students don't have a driver's license. We could make and sell Adirondack chairs, but how would we get them door-to-door?"

Price also is a factor in what the students produce. "We've found that about the most expensive



Buying \$10,000 worth of red oak stock would put many shop programs in the red. But at Moffat County High School, there's money left over from the students' annual project sales for cash commissions, tools, and shop equipment.

project we can sell is \$55. In our little town [population 8,000], anything over that would be getting pricey," says Craig. "Last year, the kids sold 343 portable compact-disk cases for \$53.50 each."

According to Craig, the cost to build last year's oak CD case was \$33.50. Taking orders for the cases door-to-door, the Woods II class generated just over \$18,000 in sales, from which the students earned \$5,200 in commissions. They'll get paid by spring break, when the cases will be completed to fill the orders.

"The Woods II class meets only 55 minutes a day, so when you have a magnificent order like we did this year, it's going to take until March to get them all done," Craig adds. "To do the quality of work that I require, it takes that long. But the kids understand that, and they're motivated."

Their motivation: hormones to Ho, Ho, Ho

Craig's Unstoppable Shops program has three interwoven, can't-fail elements. He likes to call them "Hormones and Money," "Fill Your Cup," and "Ho, Ho, Ho."

UNSTOPPABLE SHOPS

In his years of teaching, Craig has found that to high schoolers, hormones and money are the two greatest motivators. "They pretty much take care of the first on their own," he comments. "But the money element gets those kids out door-to-door, and that's the quickest way to sell. So I spend three whole days teaching the kids how to sell: what to say, how to say it, how to help the customer over the hurdle of indecision. You can see our sales chart just take off after they've been instructed on how to do it. In fact, I feel sorry for you if one of my students comes to your door because you're going to buy what he's selling!"

Last year's CD cases produced a profit of \$20 each. Craig, however, believes in paying the students well for their efforts. So for every box sold, the student seller received a \$15 commission. That meant that nearly everyone made at least \$200. Some kids made a lot more. "I had one kid last year who earned \$900; another one, \$700 or \$800," says the instructor. The remaining \$5 per box Craig calls "shop profit." That goes for tools and anything else the classes need. "For lots of schools, the \$1,700 we designated last year as shop profit would be their whole shop budget, and they'd be happy to have it," he says.

Because of his students' drive to sell, combined with the limited shop time available during the year to produce the items sold, Craig has to limit the number of days devoted to sales. "Last year, for instance, I limited sales days to five, yet they still went out and broke the sales record," he says.

The second element, "Fill Your Cup," has to do with individuality. "Everyone has a cup; that's their genetic makeup," he explains. "You can't control the size of your



Student Aaron Horrocks dons an elf costume for the woodshop's Christmas open house. He built the colorful biplane to give away to a local needy child. According to the shop teacher, it's important to give something back to the community.

"I had one kid last year who earned \$900; another one, \$700 or \$800."

cup, you can only control how you fill it. And I've seen even physically disadvantaged kids overfill their comparatively smaller cups every day. How much my kids do is a matter of how much they want to do it."

"Ho, Ho, Ho," Craig's third element for success, involves giving back to the community. "We [the school] take a lot from our little town and its people in the form of taxes and everything," he says. "But our woodshop program can give something back. We do that in Santa's Woodshop, where our

Woods III class builds toys for local kids (see photo above). And these are high-quality toys that would sell for \$150 in Denver—riding horses, biplanes, jets, big stuff. We decorate the shop and open it to the public for cookies and other refreshments, with the kids dressed up as elves. The next night is for presenting gifts to kids. And that all ties in with our sales program, because come next fall when one of my kids comes to the door, they'll say, 'Hey, you're the ones who gave away the wooden toys last Christmas. Sign me up.' 🌲

Teachers: Want to learn more about rejuvenating your shop program?

Craig believes that traditional woodshop programs can be saved, and he'd like to help. For a booklet and information about UnStoppable Shops workshops, write with a self-addressed, stamped, business-sized envelope: Craig Conrad, Moffat County High School, 900 Finley Lane, Craig, CO 81625. Call 970/824-7036.

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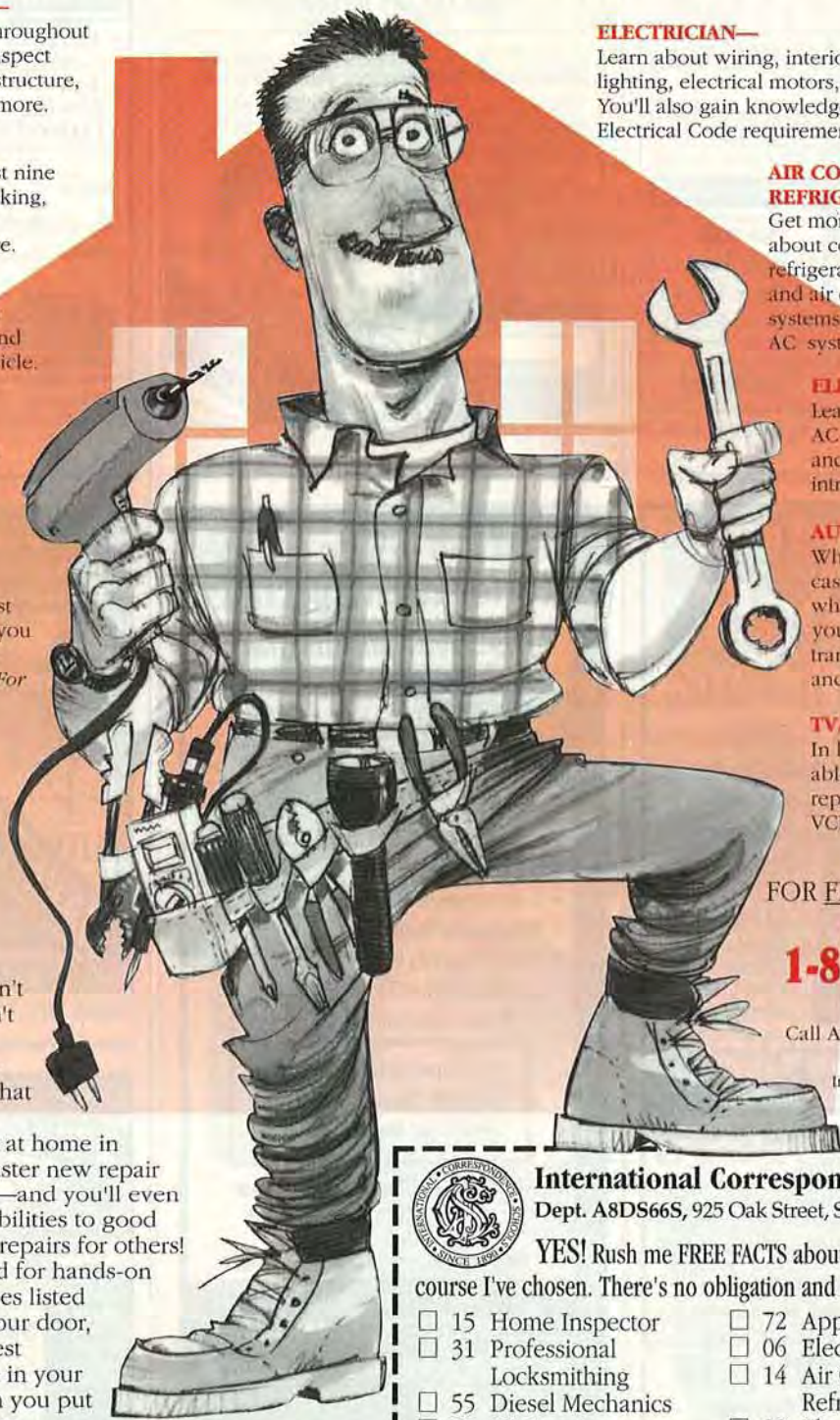
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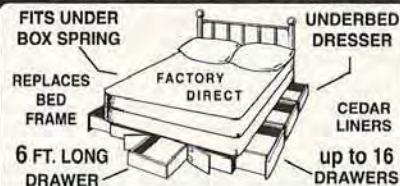
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Yet, to the local people that know it well, the mountain laurel has earned far-from-flattering names. They call it poison laurel, sheep laurel, and ivywood. That's because honey made from the mountain laurel's nectar has a nauseating smell, sharp taste, and indeed can make one ill with cramps and vomiting. For that reason, it has long been a practice of beekeepers to throw out the honey that comes from mountain

laurel's blooms and await sweeter stuff. Even the tree's leaves have a poisonous effect, often causing paralysis in animals that eat them, especially foolhardy spring lambs.

And because the mountain laurel never gets really large—perhaps 30' tall in favorable red-clay soil—its wood has never attained commercial importance, except in one small way. It seems that up until the 1960s, when man-made materials became widely used, the mountain laurel furnished root burls that could be substituted for expensive imported briar in the making of smoking-pipe bowls. The wood of these burls was far heavier, harder, and denser than that in the tree above ground, making it slow to burn from smouldering tobacco.



Famed for its blossoms, mountain laurel once spawned an industry with its root burls.

Although laurel briar was said to be inferior to the imported variety, the production of pipes from it fostered a sizeable industry in the mountain communities of western North Carolina. ♣

Illustration: Jim Stevenson



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Model	Description	List	Sale
31-695	6" Bell/9" Disc Sander	441	330
23-700	Wet/Dry Grinder	206	159
23-710	New Sharpening Center	217	169
23-680	6" Bench Grinder 1/4 HP	80	69
11-950	8" Drill Press	176	128
31-050	1" Belt sander 2.0 amp	95	78
31-460	4" Bell/Disc Sander	198	129
40-560	1/2" 2 speed Scroll Saw	230	175
11-990	12" Bench Drill Press	255	184
11-990	32" Radial Bench Drill Press	405	315
43-505	12" Bench Router/Shaper	398	305
22-540	12" Bench Top Planer	Sale	385
36-220	10" Compound Mitre Saw	294	219
28-185	Bench Band Saw	213	185
28-190	NEW 12" Band Saw	497	399
40-640	20" Bench Scroll Saw	466	359
37-070	NEW 6" v/spd Bench Joiner	351	259
14-650	Hollow Chisel Mortiser	380	285
46-700	12" Wood Lathe	575	479
33-990	10" Radial Arm Saw	981	769
33-055	8-1/4" Sawbuck comp w/flgs	845	665
36-040	8-1/4" Compound Mitre Saw	190	149
36-905	30" Uniflance	346	249
36-906	50" Delling Uniflance	444	305
36-750	10" Tilt Arbor Saw	398	1095
17-900	16-1/2" Floor Drill Press	490	415
33-060	"Sidelink" Miter Saw	541	399
37-190	6" Deluxe Joiner	603	499
36-275	6-1/4" Builders Saw	358	286
36-210	10" Compound Mitre Saw	344	249
36-070	10" Mitre Saw	217	165
34-555	Sliding Table	487	289
22-675	NEW DC380 15" Planer	1439	1175
37-154	8" Joiner DJ-15	1586	1299
34-444	Contractors Table Saw	Sale	649
34-445	34-444 Saw w/30" Uniflance	Sale	839
28-283	14" Band Saw 3/4 HP motor	Sale	779
28-280V	14" Band Saw 1 HP motor	Sale	798
28-245	14" Band Saw 1/2 HP	Sale	598
36-250	NEW 10" Slide Compound Saw	825	489
36-230	NEW 12" Compound Mitre Saw	480	359

Model	Description	List	Sale
6527	NEW Sawzall with case	343	178
6528	above Sawzall w/wired cord	339	178
6508	12V Drill w/keys chuck & 2 batt380	172	102
0206	9.6V Drill Kit with 2 batteries	315	155
0241	3/8" Drill 4.5 amp magnum	236	128
0234	1/2" Drill 4.5A mag 0-850 rpm	256	139
0235	1/2" Drill w/keyless chuck	255	139
0244	1/2" Drill 4.5A mag 0-600 rpm	255	139
0222	1/2" Drill 3.5 amp 0-1000 rpm	213	119
0228	1/2" Drill 3.5 amp 0-1000 rpm	207	115
0375	3/8" close quarter Drill	255	148
0379	1/2" close quarter Drill	288	162
6546	cds Scowdr 200 & 400 rpm	150	84
6547	6546-1 w/bits, 1/4" chuck, & case	105	59
5399	12" D-handle Hammer Drill Kit	356	194
6507	Original SawZall with case	278	152
5397	3.8" var. spd Hammer Drill Kit	275	149
5371	1/2" var. spd Hammer Drill Kit	360	194
3107	1/2" v/spd right angle Drill Kit	411	234
3300	1/2" var. spd right angle Drill	378	219
6896	Router 2 HP w/ 1/4" & 1/2" collets	367	165
6142	4-1/2" Grinder w/ case & access	224	125
6365	7-1/4" Circular Saw 13 amp	229	125
6268	6365 w/ence,carb. blade, & case	259	148
6358	Top Handle Jig Saw	278	152
6490	10" Mitre Saw	496	265
6491	6490 w/ carbide blade & bag	594	325
6494	10" Compound Mitre Saw	585	325
0481	12V Drill w/ 2 batteries	441	229
6266	NEW Top Handle Jig Saw	315	165
6496	NEW 10" Slide Compound Saw	1050	615

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0481			



Woodworkers' response to environment on display

Beginning this September, you can view projects built by skilled woodworkers who responded to a worldwide environmental challenge. "Conservation by Design" exhibits 36 pieces that display the functional and sculptural use of recycled, salvaged, and reconstituted wood, as well as lesser-known or undervalued species. It opens September 13 at the Smithsonian Institution's Renwick Gallery in Washington, D.C. The innovative exhibit runs through January 12, 1997.

Woodworkers from the U.S., Canada, England, and Australia were asked by the Woodworkers Alliance for Rainforest Protection to create objects that demonstrate responsible use of temperate and tropical woods. For example, the wine cabinet *below*, by Oregon's John Shipstad, uses chantaquiro, sucupira, and other lesser-known species, plus madrone from Oregon. For more exhibit information, call 202/357-2247.

For safety, follow the adventures of Goggleman

Power tool safety usually isn't much fun to read about. At least that was the case before Goggleman came along.

Goggleman is the comic-book character created by the Power Tool Institute to carry credos of safety to shop-class students. But the upbeat graphics and situational humor in its 26-page, color publication, *The Adventures of Goggleman*, provide meaningful lessons for anyone new to power tools at home or in the workshop.

Get the comic book alone or an entire teaching packet that includes a lesson-planning and reference guide to power-tool safety. The Power Tool Institute (PTI), a not-for-profit trade association of power-tool manufacturers, is engaged in public education on the use of power tools. For a free copy of the comic book or packet, write: Power Tool Institute, 1300 Sumner Ave., Cleveland, OH 44115-2851.

Beat the deadline!

September 1 is the deadline for entries in the  1996 Build-A-Toy® contest, and you can still make it, if you hurry. For contest rules and prize listing, see the October 1995 issue of *WOOD*® magazine or write: Build-A-Toy, *WOOD* Magazine, 1912 Grand Ave., Des Moines, IA 50309-3379. FAX 515/284-2115.

One more gift from Mother Nature's medicine cabinet

The medical war on cancer continues, now with the help of the ever-useful birch tree (*Betula papyrifera*). Laboratory researchers at the University of Illinois have found that a chemical compound in the tree's white bark shrinks skin-cancer tumors in mice more effectively than the drug normally used to treat the disease. Human testing hasn't yet begun.

Yew, yew, and yew

During the Middle Ages in Europe, England's yew tree (*Taxus baccata*) provided the wood for the longbows used in defeating French armies. In the United States, the bark from the Pacific Northwest's yew tree (*Taxus bevifolia*) became famous as an antitoxin useful in treating cancer.

But according to Walter Overton, writing in the book *Southland Sketches*, there's another yew, one very few know about. The Florida yew (*Taxus taxifolia*) grows naturally only along the east bank of the Apalachicola River. For centuries, writes Overton, Indians of the Southeast traveled there to gather the isolated wood that they treasured for their bows. Otherwise, this little-known and thinly represented yew species has not been commercially disturbed. ♣

Photograph: Scott Landis Illustrations: Jim Stevenson



This 32x31¼x19" wine cabinet by Oregon woodworker John Shipstad is part of the environmentally focused woodworking exhibit "Conservation by Design" at the Smithsonian's Renwick Gallery in Washington, D. C.

THEY

Sand

Buff

Cut

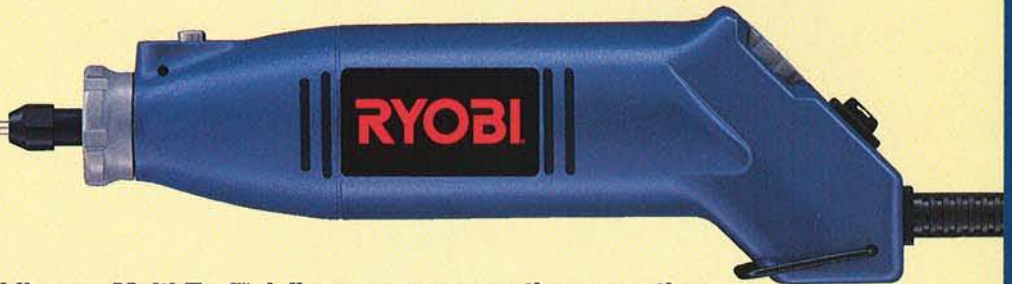
Grind

Polish

Scrape



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Wood Magazine
April, 1996

There's a
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professional
application

The
Hitachi
C10FS
Dual Slide
Compound Saw

Why professionals choose the NEW Hitachi dual slide compound saw

Pro's know the benefits of dual beveling

In fact, nothing compares to the speed and accuracy of the Hitachi dual slide compound saw. With its ability to make both left *and* right bevel cuts by simply "flipping" the cutting head, it makes complex crown molding work easy. The annoying need to keep track of *which side of the molding is next to the fence* is, simply, ELIMINATED. Plus, the C10FS provides *everything* you need in a compound saw with the accuracy you can *only* achieve with a Hitachi.

For example: It can easily cut a 4x4 at angles up to 45 degrees or crosscut 12" material, perfectly.

Pro's know the importance of a twin-rail slide system

Only a *heavy-duty* slide system can provide the stability needed to make accurate, repeatable cuts—with its 1-1/8" stainless steel *twin-rails*, the Hitachi C10FS has the strongest slide system in the business. It can repeat the same *exact* cut for you, time and time again—even after thousands of cuts.

Pro's know the value of an electronic feedback system

With the Hitachi C10FS, you get an advanced feedback system that maintains a constant blade speed, *even in dense materials*. Plus, its electronic controls give you a "soft" start which reduces the effect of recoil—a source of damage with *ordinary* saws—and it minimizes start-up noise.

And, as a pro, you can't afford anything less

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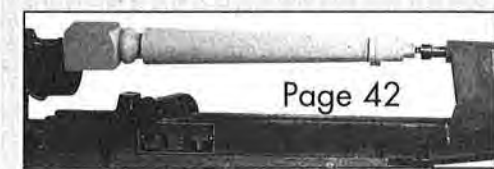
AUGUST 1996

ISSUE 89

Dear Reader: As a service to you, we've included full-sized patterns on this insert for irregular-shaped and intricate project parts. You can machine all other project parts using the Bill of Materials and the drawings accompanying the project you're building.



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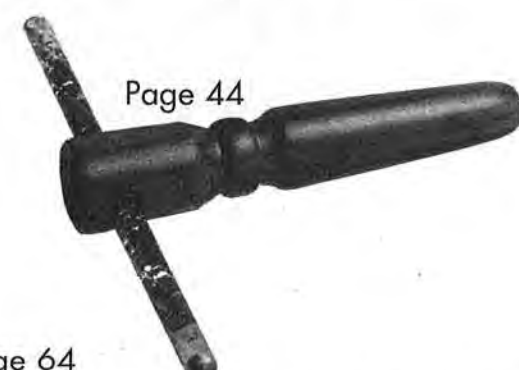


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- Kitchen table leg
- Barnstormin' biplane
- Back-road beauty
- Kaleidoscope

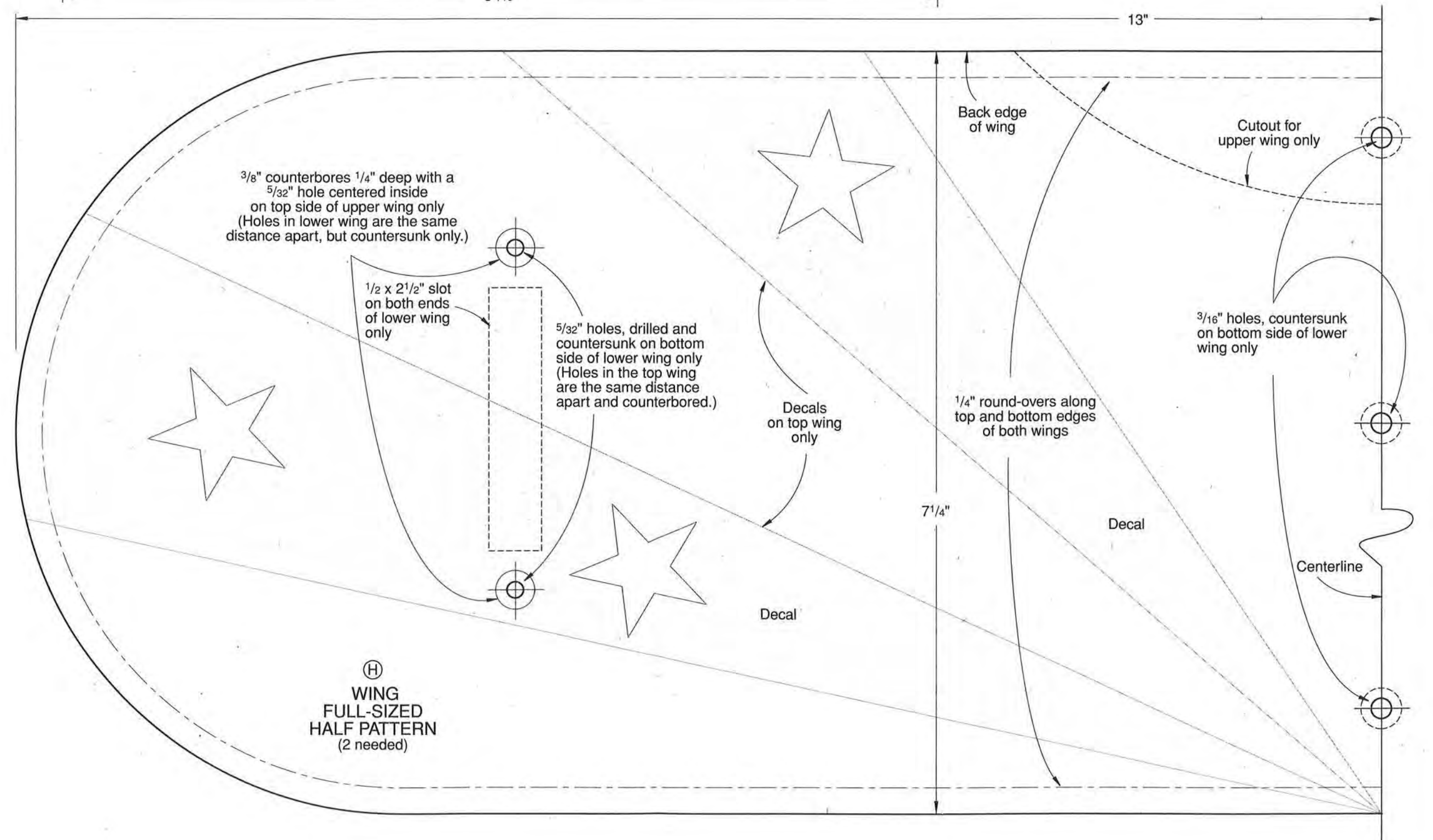
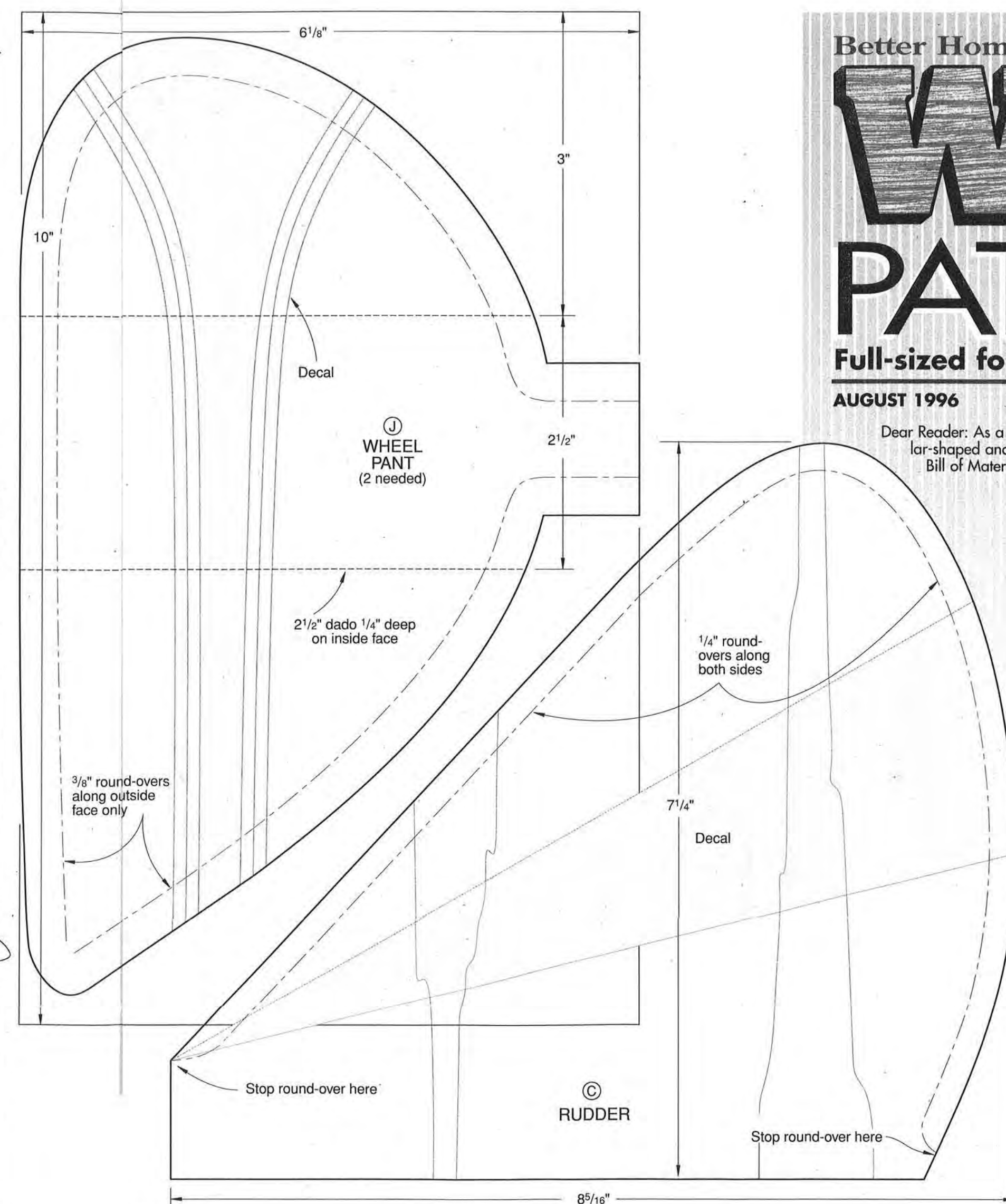
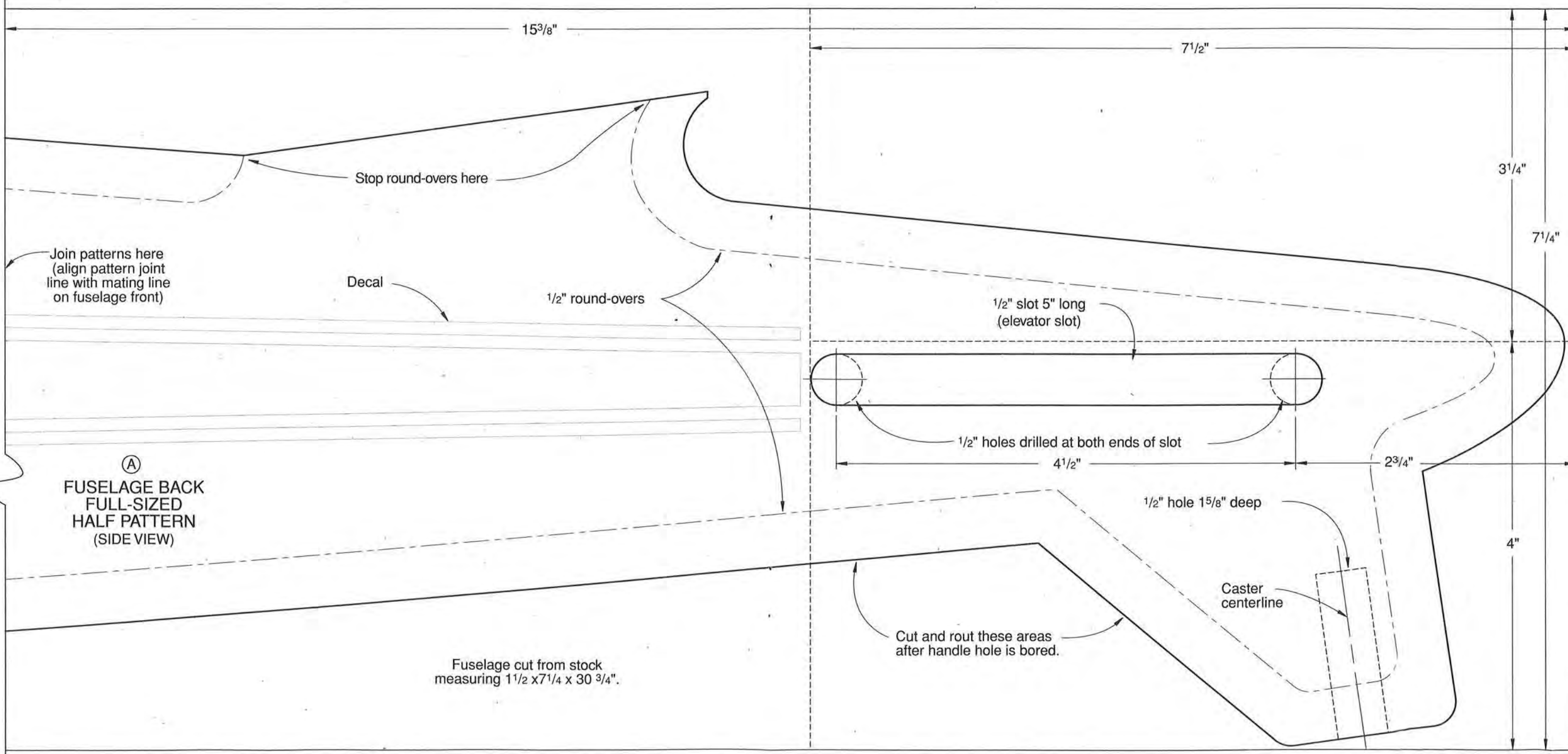
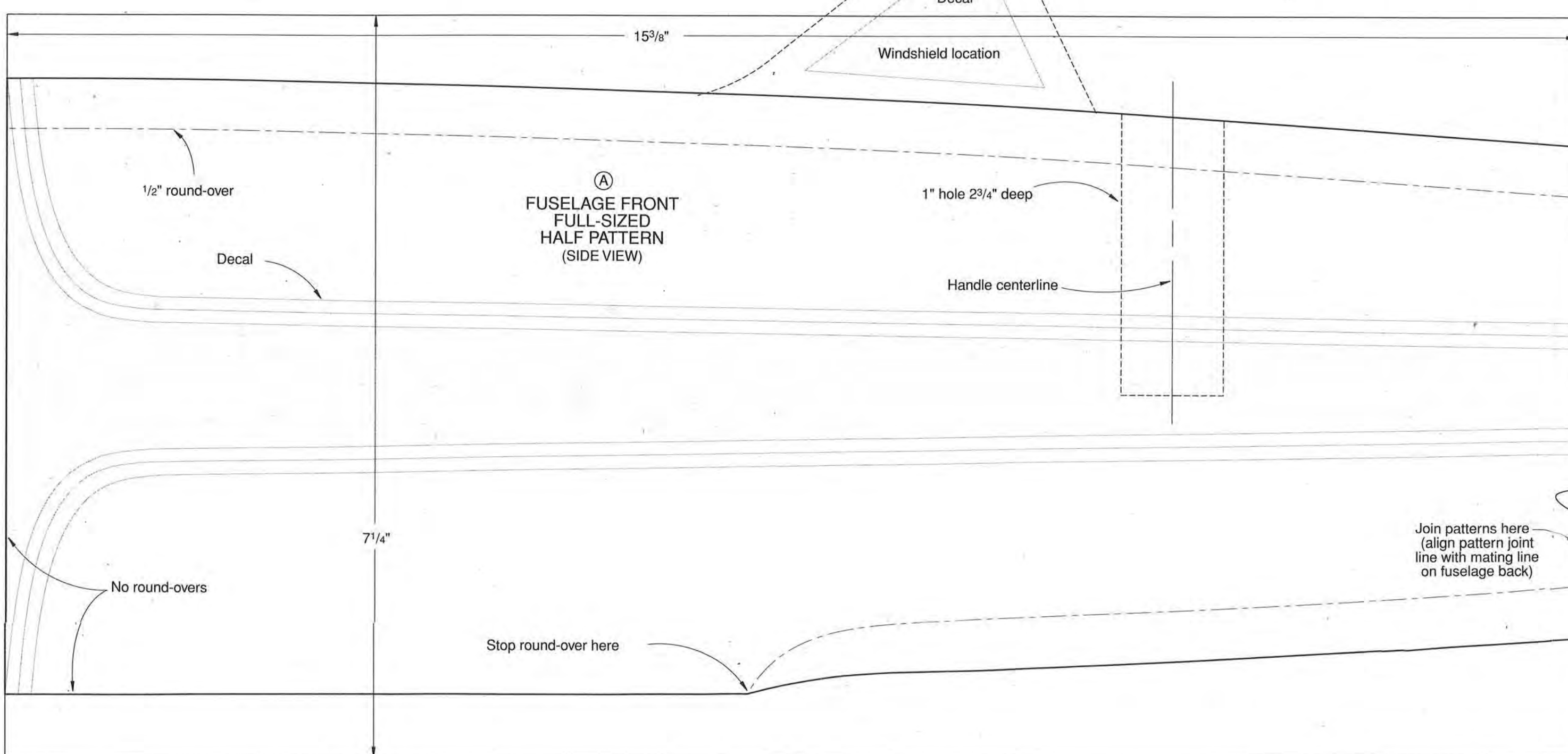
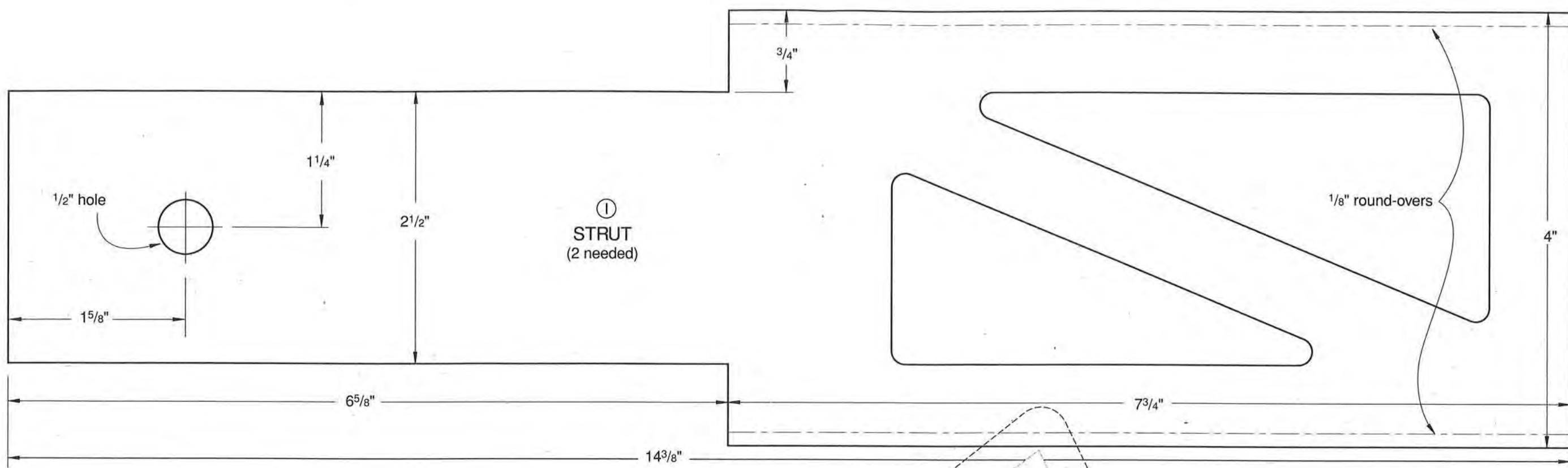


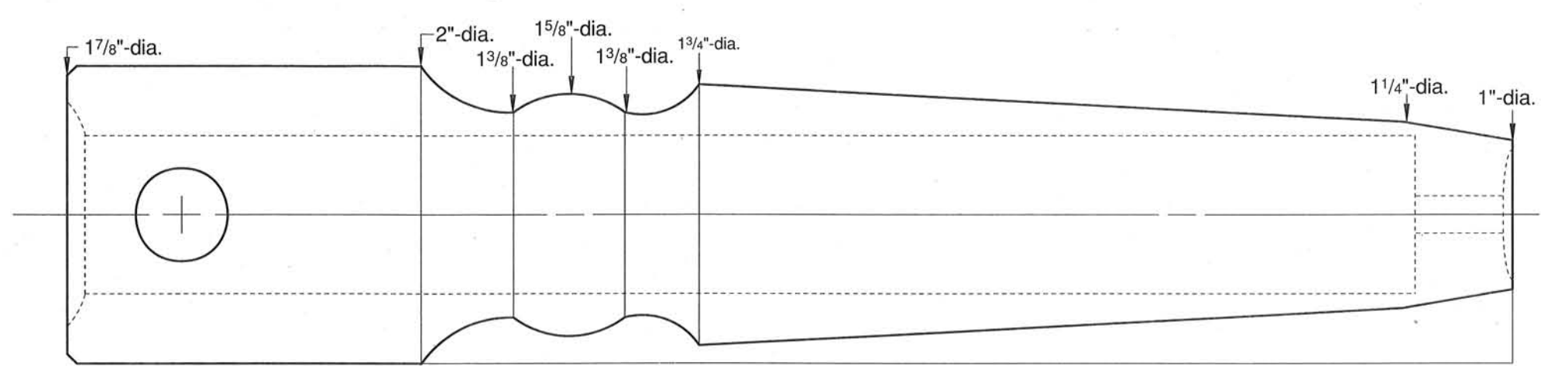
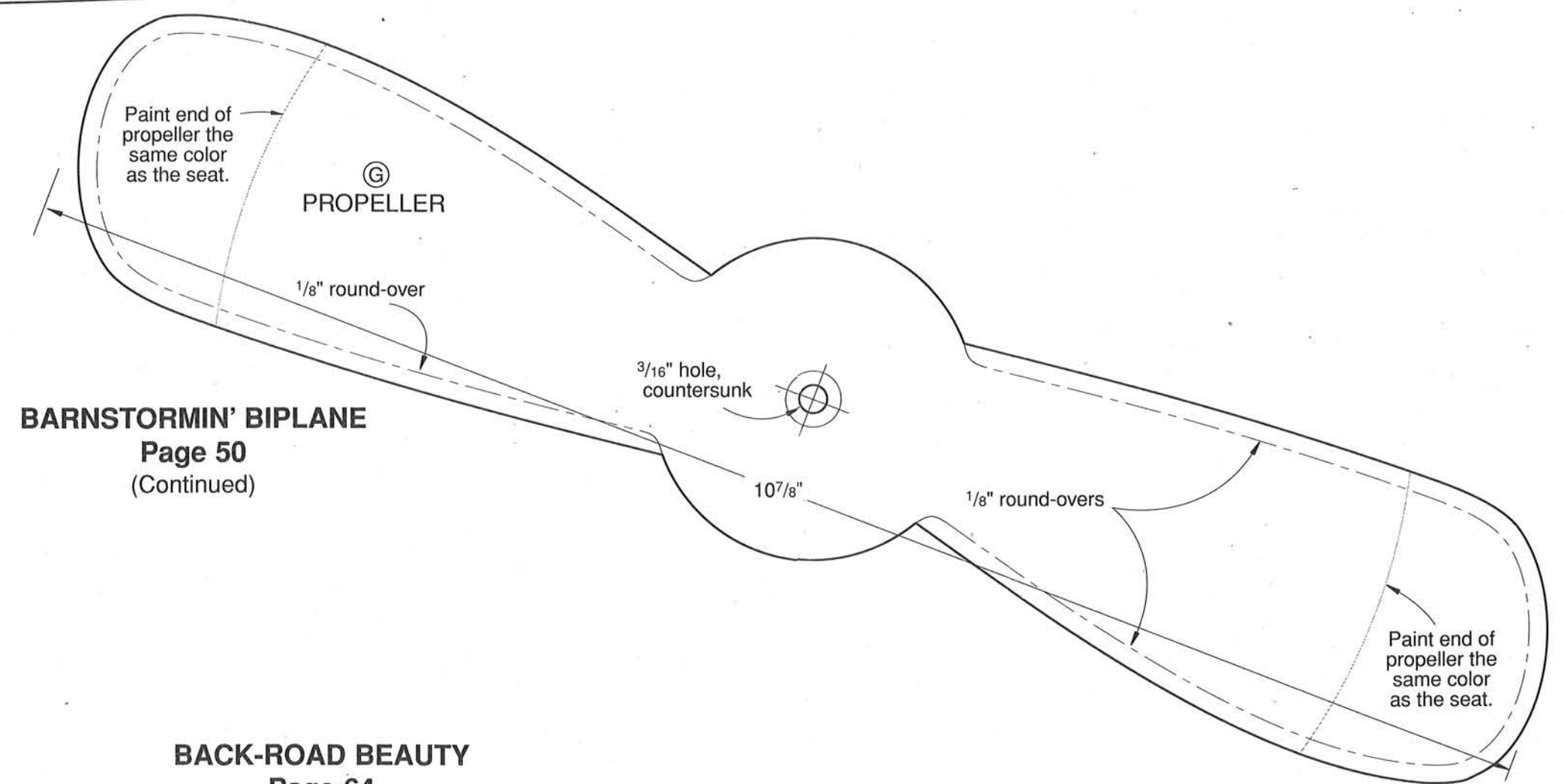
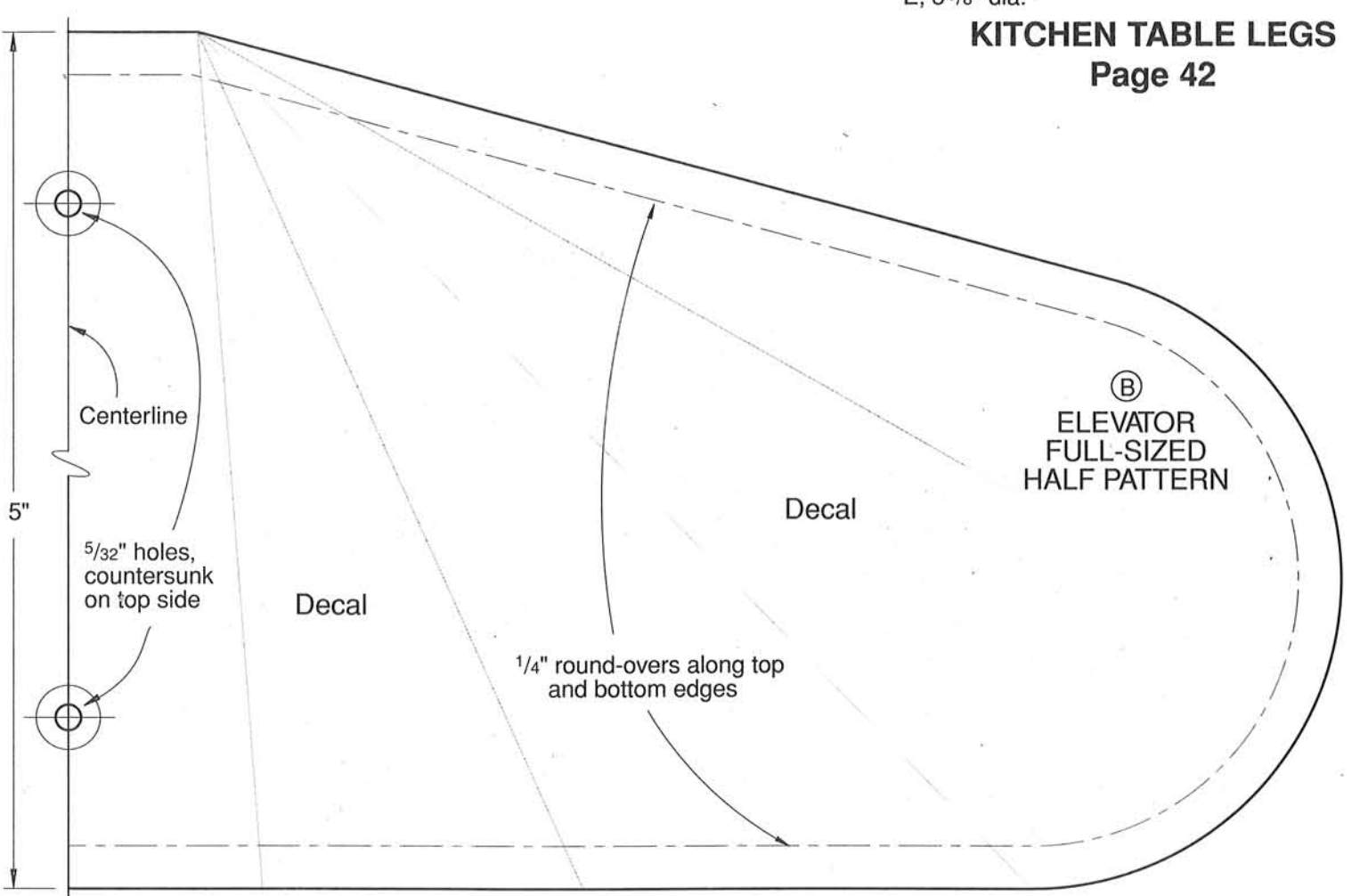
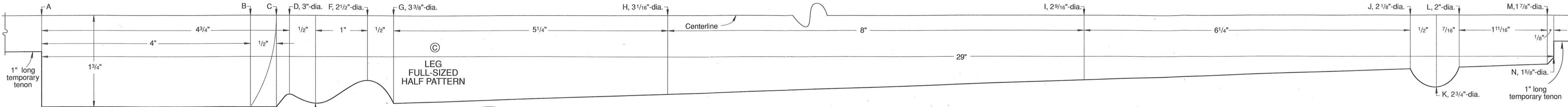
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ONE COOL KALEIDOSCOPE
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BACK-ROAD BEAUTY
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