

TAUNTON'S

Fine Woodworking

Tool Test: Brad nailers

February 2004
No. 168

Varnishing secrets

How to build
frame-and-
panel doors

Taming tearout

Guidelines
for good design

Seeing better
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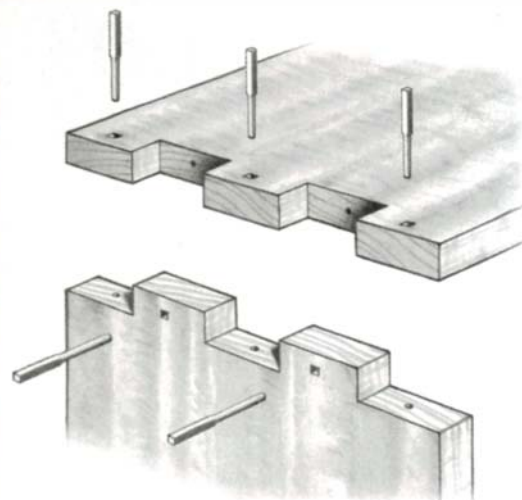
- 6 Contributors
- 8 Letters
- 14 **Methods of Work**
Routing grooves in curved door rails;
Jig for sharpening skew chisels
- 20 **Notes & Comment**
Women in woodworking; Once-in-a-lifetime log
- 28 **Tools & Materials**
Random-orbit sander with variable speed; Aftermarket miter gauges
- 80 **Current Work**
A gallery of our readers' woodworking
- 86 **Index**
Index to issues 161 to 167
- 92 **Rules of Thumb**
Taming tearout on the tablesaw
- 100 **Questions & Answers**
Proper wood storage; Changing speeds on a drill press
- 108 **Master Class**
Windsor leg system stands the test of time
- 121 **Finish Line**
A finish that adds 200 years



Building frame-and-panel doors that last, p. 32



Brad nailers put to the test, p. 74



Pinned box joints, p. 44



On the Cover:

To learn the secrets to applying and rubbing out a flawless varnish finish, see p. 39.

Photo: Michael Pekovich

Articles

32 Frame-and-Panel Doors

Five steps to building a door that will last for generations

BY LONNIE BIRD

36 Uses for Hot-Melt Glue

Quick-drying, weak-bonding glue is perfect for temporary holds

BY MARK SCHOFIELD

39 Varnishing Secrets

A highly polished, durable finish can be achieved with a brush

BY DAVID SORG

44 Pinned Box Joints

Interlocking joinery adds visual interest and mechanical strength

BY SETH JANOFFSKY

48 A Guide to Good Design

Pleasing proportions borrowed from nature

BY GRAHAM BLACKBURN

50 Four ways to construct a golden rectangle



Seeing better in the shop, p. 57

52 Joint-Making Machines

A review of router-driven tools that make quick work of mortise-and-tenon joints

BY MICHAEL STANDISH

ON OUR WEB SITE: Watch a video of the author using one of these machines

57 Seeing Better in the Shop

Lighting and magnification bring work into bright, sharp focus

BY JEFF MILLER

58 Tips for tired eyes

62 Splay-Legged Table

Straightforward design with a refined flair

BY GARRETT HACK

68 Cutting Coves on the Tablesaw

Safe, accurate methods to make your own molding

BY STUART SABOL

ON OUR WEB SITE: Watch a video of the author cutting coves

74 TOOL TEST Brad Nailers

Details make the difference among this group of 18-gauge nailers

BY ROLAND JOHNSON



Simple table with elegant lines, p. 62



Cutting coves on the tablesaw, p. 68

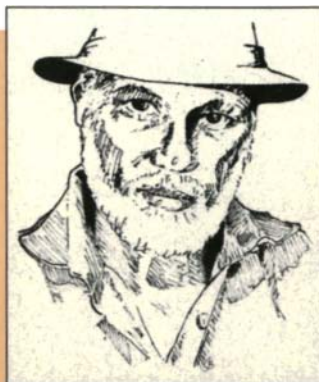
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Contributors

Graham Blackburn ("A Guide to Good Design") grew up in London, where his grandfather was a cabinetmaker and his father a builder. He came to the United States in the 1960s to study composition at The Juilliard School but soon moved to Woodstock, N.Y. In addition to continuing a music career playing flute and saxophone with various musicians, including Van Morrison, Blackburn built his own house in Woodstock and began designing and building custom furniture. He has written and illustrated several articles for *Fine Woodworking*, as well as countless books, and he operates Blackburn Books (www.blackburnbooks.com).



Though **David Sorg** ("Varnishing Secrets") has always loved varnishing wood, he also enjoys applying a final coat of picture varnish to one of his completed oil paintings. In addition to



being an artist, Sorg is a professional finisher who shares his knowledge at finishing workshops and seminars. His videotape series on wood finishing and decorative finishes, *Fine Furniture Finishing*, can be found at hundreds of public libraries or on his Web site www.finefurniturefinishing.com.

Jeff Miller ("Seeing Better in the Shop") just celebrated his 20th anniversary in business as a furniture maker (www.furnituremaking.com). He has written many woodworking books and magazine articles and offers workshops in his Chicago studio. A bout with an eye problem led to his article on better vision in the shop.

Originally educated in literature and the visual arts, **Seth Janofsky** ("Pinned Box Joints") switched over to craft work years ago "in the forlorn hope of finding a useful place in the world." He has been building furniture for the



last 10 years in the coastal town of Fort Bragg, Calif., but is about to "spring himself on an unsuspecting world" by moving back to civilization (read: San Francisco Bay Area) early next year.

Michael Standish ("Joint-Making Machines") has been working with wood for almost 30 years and has contributed many articles and tool reviews to *Fine Homebuilding* and *Fine Woodworking*. But Standish sometimes wonders if his defining woodworking moment wasn't when he joined the select group of artisans who had started a boatbuilding project before measuring the basement door. He lives in West Roxbury, Mass.

Despite losing a house cleaner who refused to dust all of the chairs in his house, **Eugene Landon** (Finish Line) couldn't resist building one more chair for his wife. The most challenging chair so far, it is a faithful copy of one attributed to Thomas Affleck in Philadelphia in the 1770s and now in the collection of Colonial Williamsburg. Landon teaches classes in 18th-century furniture making at the Olde Mill Cabinet Shoppe in York, Pa. (www.oldemill.com).



Stuart Sabol ("Cutting Coves on the Tablesaw"), who has written his first article for *Fine Woodworking*, is largely self-taught. His most recent project was the Pennsylvania secretary featured last year in *FWW* #154, #155, and #156. Among his hobbies are supporting the Boy Scouts. When he wanted to do a woodworking project with them, he was surprised to find that the 1930s manual suggested building a hog trough as a first project. The scoutmaster's comment was "Build it, and they will come!" Sabol lives in Houston, Texas, with his wife and two children.

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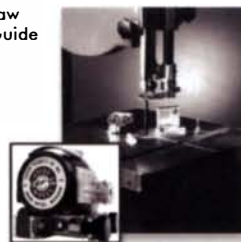
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Letters

More power to hand tools

I would like to compliment you on Mike Dunbar's recent articles. Often, I wonder whether there is really anything new to be said about routers, tenoning jigs, and the like; it's refreshing to see Dunbar's use of time-proven materials, tools, and techniques to produce quality work.

—Tim Nagle, Packwood, Wash.

Cosmic confidence

Chris Minick's "How yellow glue works" in the new department A Closer Look (*FWW* #166, pp. 94-98) was not only informative but also reassuring for those of us who find ourselves relying on that thin yellow line to deliver joints that absolutely must not fail.

To be sure, one might intuit the bonding mechanism of glue being extruded into the respective cellular structure of the two joined wood pieces, but that business about the molecular bond created by oppositely charged hydroxyl groups raises one's confidence in yellow-glue adhesion to cosmic proportions.

—David A. Grey, Los Angeles

Woodworking as a weight-loss plan

Fat Americans have been in the news lately. We started getting chubby in the 1950s and haven't looked back.

During this time the medical and scientific community was asked to help by defining dietary and exercise goals. The results have been typical, unsavory scientific recommendations such as exercising for 30 minutes three times a week with a heart rate at 70% of maximum.

As a result, the body began to be considered nonfunctional, i.e., something that carries the head around and periodically must be placed on a machine to keep it working right.

Well, that approach hasn't worked.

Writing an article

Fine Woodworking is a reader-written magazine. We welcome proposals, manuscripts, photographs, and ideas from our readers, amateur or professional. We'll acknowledge all submissions and return those we can't publish. Send your contributions to *Fine Woodworking*, PO Box 5506, Newtown, CT 06470-5506.

Current estimates are that 65% of Americans are overweight or obese.

I noticed most of my woodworking friends, whether hobbyist or professional, were on the lean side. So I decided to see how they compared to the average American.

To this end, I reviewed 10 years of *Fine Woodworking* (1993-2002) and divided the pictured subjects, who could be seen well enough to estimate their weight, into three groups: normal, overweight, and obese. The result was 349 normal, 16 overweight, and two who appeared obese.

So woodworking, which still requires function from the body, not only results in the creation of beautiful and useful items but also seems to beat the fitness centers and fat farms at their own game.

—James S. Puterbaugh, M.D.,
Portland, Ore.

Food-safe finish

I was surprised that Teri Masaschi, in her article "Four Finishes for Turning" (*FWW* #165, pp. 62-65), didn't mention the food-safe finish, walnut oil.

It seems to penetrate—I am told it polymerizes in the wood—and it doesn't become rancid.

I have used it successfully for years. A once-a-year reapplication can keep the article looking great.

—Frank Van Orden,
San Francisco

Linguistics or just semantics?

Please forgive picking a very small nit. However, in the article "Sharp and Sharper" (*FWW* #157, pp. 36-41), the pictures of the beveled edge of the plane irons and the stone surface were referred to as "microphotographs."

If they truly were microphotographs, they couldn't be seen by the unaided eye.

I believe the correct term is photo-micrograph.

—Richard A. Lee, Boxford, Mass.

Tabletop talk

No, no, no! Regarding the December 2003 issue's (*FWW* #166) front-cover photograph, there were five major mistakes glaring at me when I first saw it.

1. Never, never use galvanized pipe for a pipe clamp. Why? Because galvanized



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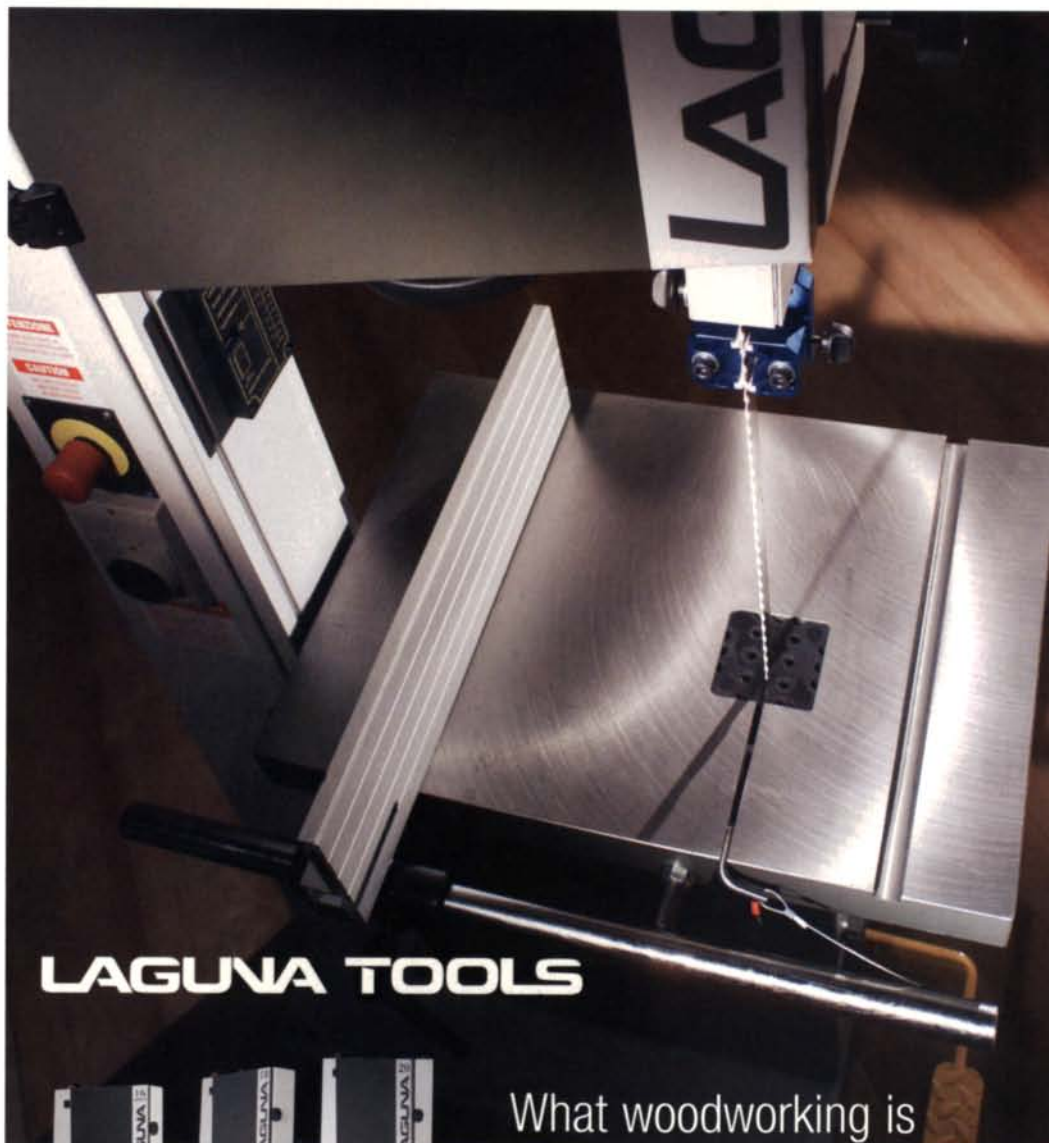
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pipe doesn't have the same holding power as black pipe. When clamping down, galvanized pipe will slip.

2. Never let a pipe rest against a wood project when gluing up. Why? Because a chemical reaction occurs between the metal pipe, the wood, and the glue, causing a dark stain that is too deep to sand out. The solution: Use a thin spacer, to be removed after clamping, or a strip of plastic tape between the pipe and the workpiece.

3. Never use any type of clamp without using some type of protective pad between the clamp and wood project. Why? Because clamps leave indentations and unless you intend on not using that portion of the project, removing the scar left by the clamp will alter the wood.

4. C-clamps to bring boards flush? Good idea; however, it's a bad application because of the reasons I stated in the third mistake.

5. Keep the number of boards being glued together at a minimum, depending on the width of the board. If 8 in. wide, no more than three boards should be glued. Why? Because it gives you better control during glue-up. It may take longer to glue up the wood for the project, but the chance of achieving a flat, wide tabletop is far greater than gluing up all the boards at the same time and then having a cupped tabletop.

—A. Roy Hughes, *Oklahoma City*

GARY ROGOWSKI REPLIES: If you had worked in my woodshop for the past 30 years, you would have seen me successfully use galvanized pipe all those years with no slippage. It is important that the pipe be sized properly; 3/4-in.-dia. pipe should measure 1.0500 in. (outside dimension). Pipe clamps have a gripping tolerance from 1.1125 in. to 1.0188 in. This is plus 0.0625 in. or minus 0.0312 in. If the pipe is over or under those numbers, the clamps won't work. If you are using 1/2-in.-dia. pipe, it should be 0.8400 in. (outside dimension) plus or minus the same tolerances.

With galvanized pipe, you won't get stains if the work, wood, and glue touch. If you use black pipe, a little piece of masking tape will work just fine to cover up the steel where it touches the wood.

As for clamp heads marring the work, I

don't treat a panel like a perfect piece of wood ready for finishing. I glue it up oversize, and then trim and joint all the edges afterward.

You're otherwise absolutely right that the C-clamp heads will mar the work. So when I don't expect to remove a lot of material after glue-up, I will use clamping pads made of 3/4-in.-thick melamine, which won't stick.

And if you have the time to glue only three boards at a time, by all means do so.

Alive or dead?

In "How to Get Square, Stable Stock" (*FWW* #165, pp. 32-37), Gary Rogowski makes the remarkable statement: "Wood is alive. It moves ..." He's surely speaking metaphorically, but a paraphrase of a famous Monty Python sketch seems in order.

The wood isn't alive. It's passed on. It is no more. It has ceased to be. It's expired and gone to meet its maker. It's a stiff. Bereft of life, it rests in peace. It's pushing up daisies. Its metabolic processes are now history. It's kicked the bucket. It's shuffled off its mortal coil, run down the curtain, and joined the choir invisible. This is part of an EX-TREE!

—Donald C. Brown, *Havana, Fla.*

Correction

Jim Vasi was one of several alert readers who noticed our mistake in a drawing that appeared on p. 14 of *FWW* #166. The sawblade as it appears is mounted backward on the miter saw. The teeth should be pointing in the opposite direction.

About your safety:

Working wood is inherently dangerous. Using hand or power tools improperly or ignoring standard safety practices can lead to permanent injury or even death. Don't try to perform operations you learn about here (or elsewhere) until you're certain they are safe for you. If something about an operation doesn't feel right, don't do it. Look for another way. We want you to enjoy the craft, so please keep safety foremost in your mind whenever you're in the shop.

—Anatole Burkin, *editor*



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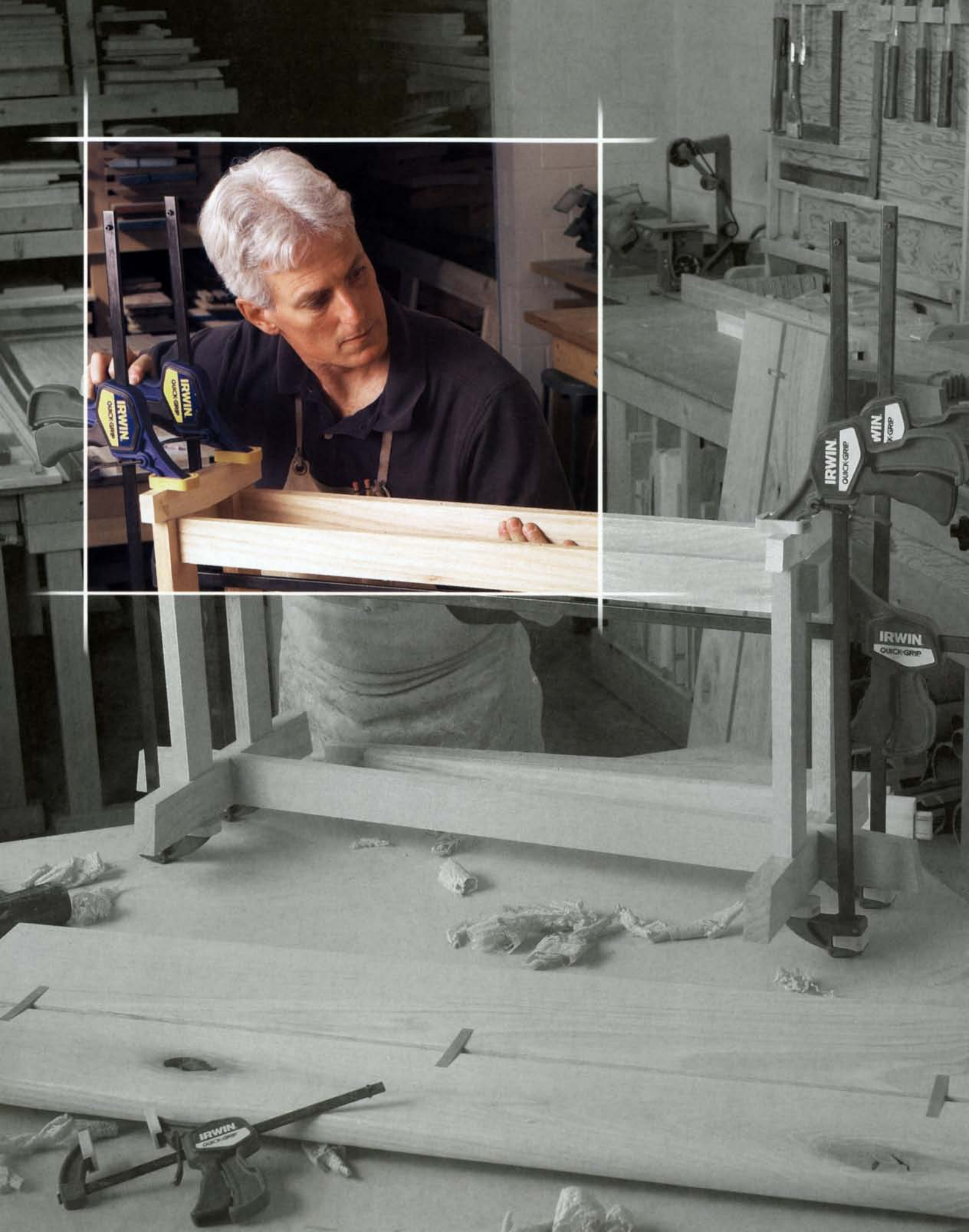
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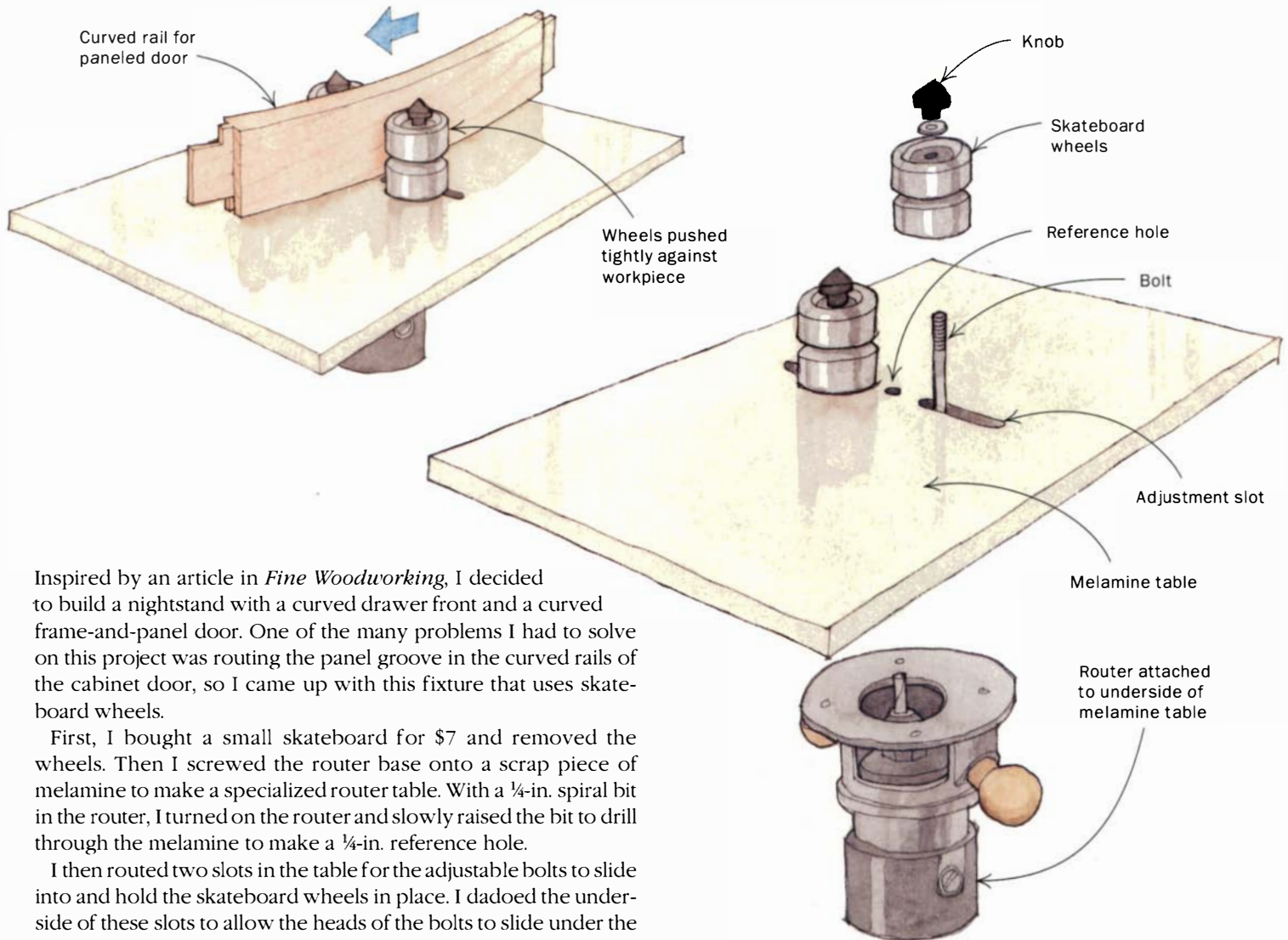
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Routing grooves in curved door rails



Inspired by an article in *Fine Woodworking*, I decided to build a nightstand with a curved drawer front and a curved frame-and-panel door. One of the many problems I had to solve on this project was routing the panel groove in the curved rails of the cabinet door, so I came up with this fixture that uses skateboard wheels.

First, I bought a small skateboard for \$7 and removed the wheels. Then I screwed the router base onto a scrap piece of melamine to make a specialized router table. With a 1/4-in. spiral bit in the router, I turned on the router and slowly raised the bit to drill through the melamine to make a 1/4-in. reference hole.

I then routed two slots in the table for the adjustable bolts to slide into and hold the skateboard wheels in place. I dadoed the underside of these slots to allow the heads of the bolts to slide under the router base when making adjustments later. Finally, I placed two skateboard wheels on each bolt and tightened the wheels with threaded knobs.

To use this setup, I inserted the curved-rail workpiece in the fixture, placing it over the reference hole for the router bit. I loosened the bolts, slid the skateboard wheels tightly against the rail on both sides so that the rail was centered over the bit hole, and then tightened the wheels. After a couple of dry runs to make sure everything was working okay, I raised the router bit to make a shallow

cut, turned on the router, and pushed the rail through the skateboard wheels, keeping the rail pressed tightly against the melamine table. The wheels kept the curved workpiece centered over the bit. I then raised the bit and repeated the process until the groove was cut to the desired depth.

This technique worked very well for my project, and it could be adapted to other curved workpieces—even S-shaped door rails.

—Daniel S. Sweeney, Highland, Calif.

A reward for the best tip

Daniel Sweeney needed a way to keep curved rails steady as he plowed a groove in the edge for curved panels. He solved the problem by making some pinch rollers from inexpensive skateboard wheels. Sweeney works as a registered nurse, and he admits to having too many hobbies (backpacking, biking, and woodworking). For his winning tip, he'll receive a set of hand-forged chisels (www.barrtools.com). Send your best tip, along with any photos or sketches (we'll redraw them), to *Methods of Work*, Fine Woodworking, PO Box 5506, Newtown, CT 06470-5506.



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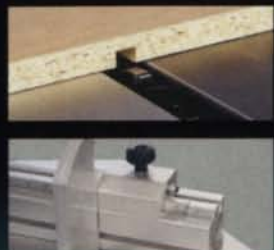
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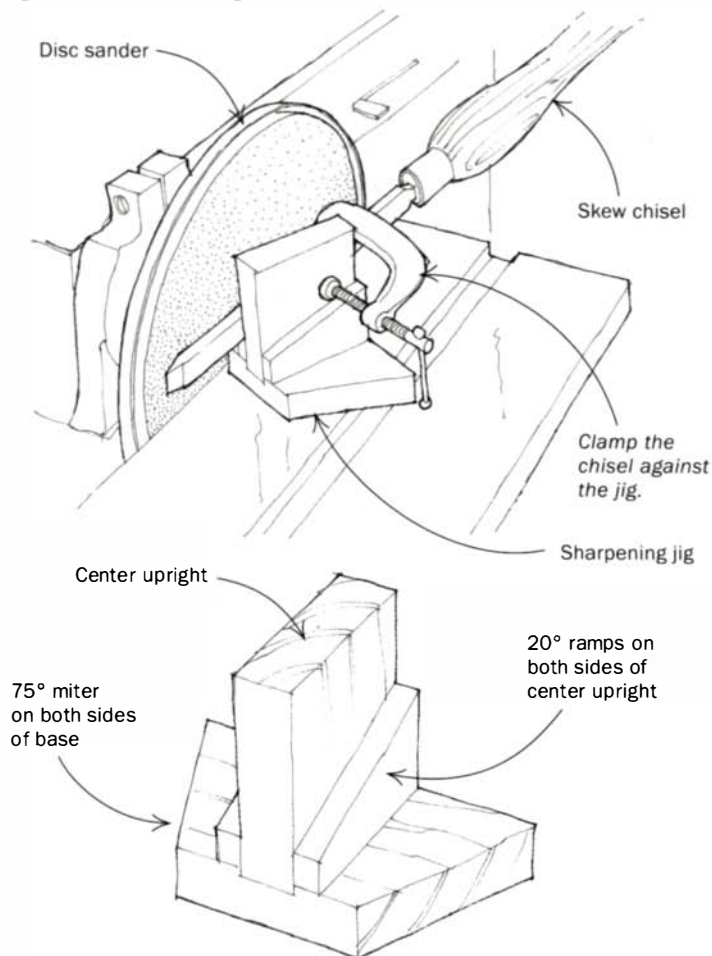
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Jig for sharpening skew chisels



This simple, inverted T-shaped jig makes it easier and faster to sharpen skew chisels with a disc sander. To make the jig, start with a scrap of hardwood for the base that is large enough to give stability. Cut the base on both sides at a 75° miter, which will give access to the grinding disc and act as a visual guide during grinding. Attach a center upright to the base and add ramps to either side of the upright to hold the blade at 20° to the base.

The jig holds the blade so that it can be introduced to the disc at the correct grinding angle, which is gauged by keeping the edge of the 75° mitered base parallel to the edge of the disc-sander table. I clamp the chisel to one side of the upright with a small C-clamp and gently introduce it to the disc. This produces the skew on one side. Then I move the chisel to the other side of the upright to complete the grinding.

I use a resin-bonded, 120-grit aluminum-oxide sanding disc, followed by a honing step using 280-grit wet-and-dry paper glued to medium-density fiberboard (MDF) to polish the bevels. The honing step takes care of the slight burr left by the disc.

By the way, a similar jig, without the angled ramps, can be used to renew the bevels on chisels and plane irons.

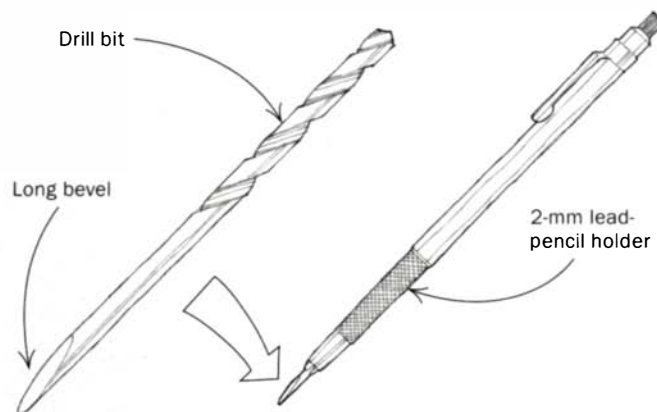
—Brian J. Gerraty, Canterbury, Victoria, Australia

Quick tip: There are times when you are sanding a round piece of stock, such as a bedpost, and you need a strip of sandpaper that will fit in a groove. Unfortunately, a narrow strip of sandpaper will

not take much strain before it tears. To solve this problem, apply duct tape to the back of the sandpaper before cutting the strip to the width that you need.

—Bob Weems, Guthrie, Okla.

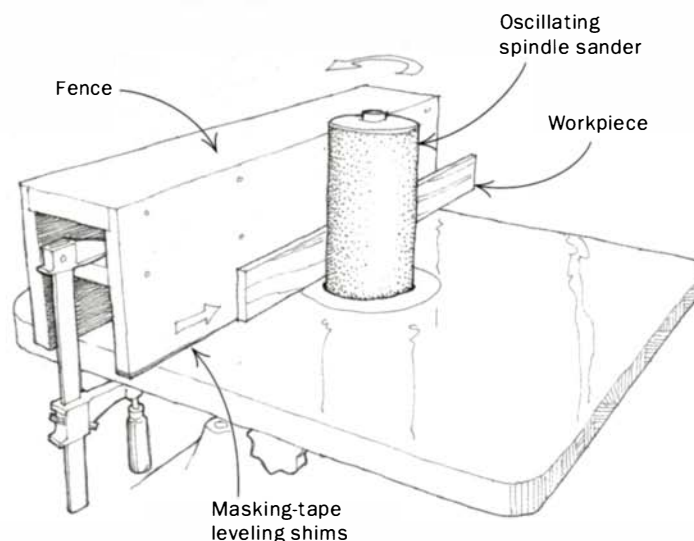
Drill-bit marking knife



I wanted a marking knife that I could safely keep in my pocket and easily operate with one hand. So I made a blade for a 2-mm lead-pencil holder out of an old 5/16-in. drill bit. I ground a long bevel on the shank of the bit. The curved tip of the bit cuts cleanly at any angle and in both directions. The bit retracts inside the holder with the push of a button to protect the tip and the user. You can buy 2-mm lead-pencil holders at most art- and drafting-supply stores.

—Evan Heald, Shipman, Va.

Thickening small pieces with an oscillating spindle sander



My projects typically require small, thin pieces (1/8 in. to 3/8 in. thick) of highly figured wood. Even the sharpest of planer blades can chip and ruin a workpiece with this type of wild grain. To eliminate chipping, I built a jig that converts my oscillating spindle sander into a mini thickness sander. The jig, which is a tall fence that can be clamped to the sander table, can be made from any material—3/4-in.-thick scrap MDF in my case.

It is important for the fence to be parallel to the sander's spindle. To accomplish this, add masking-tape leveling shims, if needed, under

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Methods of Work (continued)

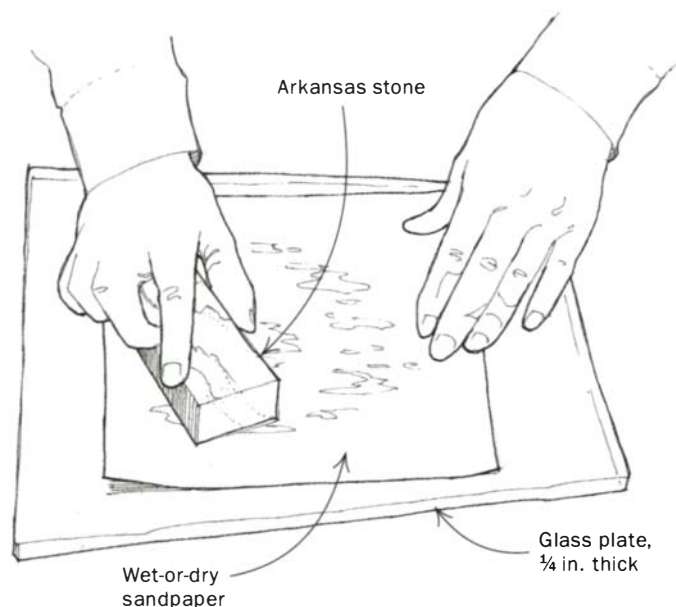
the fence legs. It also is important to position the jig on the table so that the spindle is rotating into the workpiece. In my case, this puts the jig on the left side of the counterclockwise-turning spindle.

To use, set the distance from the spindle to the fence at slightly less than the rough thickness of the workpiece, and clamp the fence in this position. If you wish, install a featherboard on the out-feed side of the fence. You will get better results if you make multiple passes. Using a push stick of equal or lesser thickness than the workpiece, feed the wood into the gap between the fence and spindle. After the first pass, adjust the fence closer to the spindle and take another pass. Slow and steady pressure will ensure even surfacing on any type of highly figured wood, even bird's-eye maple.

—Geoffrey Carson, Issaquah, Wash.

Recovering sharpening stones

Woodworkers with ancient, oily, clogged natural Arkansas stones abandoned in shop drawers may be delighted to discover, as I was, that the stones can be refurbished just like Japanese waterstones. The restoration process (which I confirmed with Doug White, a technical-support associate at Woodcraft Supply Corp.) is to lap the stones with water on 180-grit wet-or-dry sandpaper placed on a scrap of ¼-in.-thick glass. After 20 minutes of lapping and \$3 worth of sandpaper, you can return to service a stone that currently costs up to \$130 new. White and I agreed that water, not oil, is the best lubricant for woodworkers to use on an Arkansas stone.



Also, I was able to resurface my vintage Norton Fine India stone using a coarse DMT-brand diamond sharpening stone. It took about 30 minutes to remove the abuse of my apprenticeship sharpening from many years ago.

—John Grew Sheridan, San Francisco

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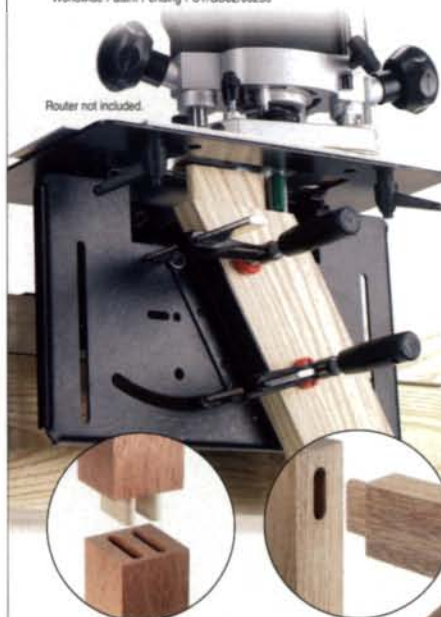


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Notes & Comment

Women in woodworking

Woodworking courses for women only are a growing trend in schools around the country. These classes often are filled to capacity, and each year more course catalogs from prominent schools feature one or two of these single-sex workshops.

Clearly, women are attracted to something in these courses that was missing in their earlier encounters with woodworking. The course descriptions hold the key:

"The purpose of this class is to provide a relaxed and noncompetitive atmosphere for women to learn woodworking..."

—*Woodworking for Women, Country Workshops, Marshall, N.C.*

"In an all-woman group, you don't have to worry about what you don't know, if a question is silly, or compete with an experienced, strong guy for tool time."

—*Boatbuilding for Women, Wooden Boat Workshop of Norwalk (Conn.)*

Collette Sacksteder, a member of the Minnesota Woodworkers Guild, recently started a monthly meeting called "Women



Hands-on instruction. Albert demonstrates how to pin a mortise-and-tenon.



Sense of accomplishment. Aimé Ontario Fraser and Helen Albert of *The Taunton Press* (both at center, seated) teach a *Woodworking for Women* class at Marc Adams School in Franklin, Ind.

in Woodworking." The idea sprang from a women's woodworking class at the Rockler store in Minneapolis, where "16-plus women signed up for a class that would accommodate only eight," Sacksteder said. "It was so obvious that the women wanted to have some way of supporting themselves, to keep going towards this woodworking goal they had set."

The best way to get women into the craft, she said, "is to provide a more exclusive type of environment to start with. Allow the women a place to feel safe."

"Women in woodworking is nothing new, of course," said Aimé Ontario Fraser, who has taught several women-only woodworking classes. "Shaker women were building incomparable furniture more than a hundred years ago. But those were a very few women; this new trend is something altogether different."

The rise of women-only classes also points to an influx of women into woodworking in general. "Woodworking was once considered a man's hobby. These days it's much more accepted as a pastime for both sexes," said Bob Spencer, director of educational programs for Woodcraft Supply Corp. "Attendance of women is steadily rising in our educational programs at Woodcraft stores. This rise is in direct correlation to the increase in traffic we're seeing in our stores by female shoppers."

—*Asa Christiana, senior editor*

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There is a link to each company's Web site, and most of the sites I visited included detailed price lists.

Woodfinder.com also includes a helpful library of wood species, with pictures, characteristics, and sources.

—A.C.



Photos, this page: Aimé Ontario Fraser (left); Zane Powell (right)

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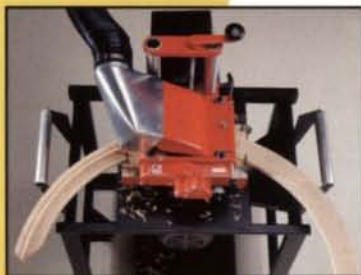


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Furniture-making school in Scotland

Chippendale International School of Furniture in Gifford, nestled amid the lush, verdant hills of southeastern Scotland, is devoted to the thorough instruction of no more than 16 students at a time. In 30 weeks of study, according to principal Anselm Fraser, graduates walk away with the confidence and skills to pursue whatever paths they choose in the woodworking world.

Each day, the intensive course combines 45 minutes of lecture with seven hours of supervised workshop time and an additional three hours of unsupervised workshop time. Students also study design and the business aspects of their chosen industry. Graduates have worked for cabinetmakers, furniture restorers, antiques dealers, interior designers, auction houses, and museums. Some “take the plunge and set up their own furniture-making businesses straightaway,” said Fraser.

Scotland itself is a powerful lure for students, though the cost of living exceeds that of the United States. For more information, visit www.chippendale.co.uk or call 011-44-1620-810680.

—Sara Daniels



Team effort. At Chippendale International School of Furniture in Scotland, students wrestle a steam-bent apron around the form for a table.

A once-in-a-lifetime log



A 16-ft. table in English walnut. At his Connecticut workshop, Ian Ingersoll stands behind the banquet table he built.

There are several factors that add up to a remarkable piece of furniture. A banquet table built recently in the West Cornwall, Conn., workshop of Ian Ingersoll is impressive in many regards—scale, beauty, selling price. What sets this table apart, however, is its raw materials.

Measuring 4½ ft. wide by 16 ft. long at its largest, the table accommodates 22 guests and can break down into three pedestal tables. Even its price tag is grandiose—a reported \$40,000.

But the table also is the last chapter in a remarkable lumber story. Ingersoll used book-matched 5/4 curly English walnut that came from a 200-year-old tree. He and his client were moved enough by the spectacular figure in the boards to pay between

\$35 and \$50 per board foot. “This is the log of a lifetime,” said Sam Talarico, who harvested 6,000 bd. ft. of lumber from the tree at his Pennsylvania mill. One highly figured slab measured 2½ in. thick by 6 ft. wide by 17 ft. long and sold for a whopping \$100 per board foot.

—Matt Berger, assistant editor



Bicentennial tree. The wood for the table (above) came from this 200-year-old English walnut tree, cut down to make room for a new home on a southern Pennsylvania farm.



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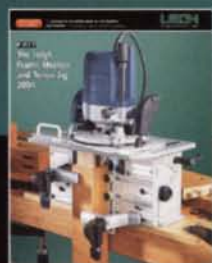
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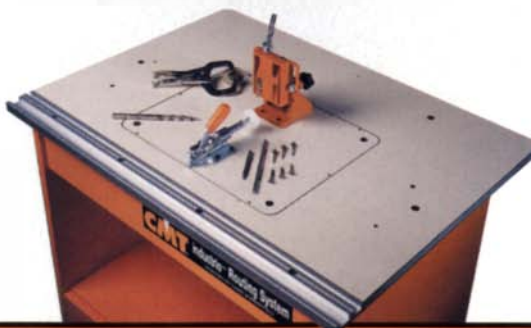
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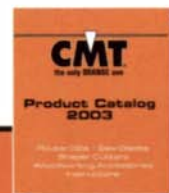
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Tools & Materials



A 5-in. random-orbit sander with variable speed

As part of a new line of power tools, Ridge Tool Co. has introduced the Ridgid R2600, a 5-in. soft-start random-orbit sander. Its 3-amp permanent-magnet motor has a variable-speed feature that lets you adjust the speed of the spinning disc from 7,000 rpm to 12,000 rpm. As the disc spins, it moves in $\frac{3}{32}$ -in.-dia. orbits to create the

random-orbit pattern that keeps sanding scratches to a minimum.

The permanent-magnet motor, usually found only on cordless tools, impressed me in a couple of ways. Compared with other random-orbit sanders I've used, the Ridgid R2600 ran with surprisingly little vibration. Also, no matter how much down-



Smooth sander. The variable-speed motor on the R2600 sander provided plenty of power with relatively little vibration.

ward force I applied, I couldn't bog down the motor when it ran at full speed. Granted, we don't operate sanders while sitting on them, but I came away with a sense that the motor had plenty of power to spare.

The R2600 accepts both hook-and-loop and pressure-sensitive adhesive (PSA) sandpaper discs. Using 80-grit paper, I sanded maple, cherry, and butternut boards. Under close examination, swirl marks were hard to find, and they showed up only on the soft butternut. Any vestiges of those marks disappeared after further sanding through 220-grit paper. Only the slightest amount of dust showed up on the board, and the dust collector filled quickly, evidence to me that it worked pretty well.

The R2600 costs about \$68. Contact Ridge Tool at 800-474-3443 (www.ridgid.com).

—Tom Begnal is an associate editor.

New aftermarket miter gauges from FastTrak and Incra

I recently reviewed a number of replacement miter gauges for the tablesaw (*FWW* #165, pp. 74-79). Since then, two new gauges have hit the market: the Precision Miter Gauge from Woodworking FastTrak and the V27 from Incra Products.

FastTrak Precision Miter Gauge

Most noticeable on this tool is the vernier scale, which mounts opposite a larger scale and allows for angle adjustments as small as $\frac{1}{100}^{\circ}$. Also, the 24-in.-long aluminum miter bar has five graphite plugs that adjust to eliminate any sloppiness between the bar and the slot.

This gauge also features a unique $\frac{1}{100}^{\circ}$ micro-adjuster. When used with the op-

tional fence and a set of dial calipers, it allows for extremely precise angle settings.

I used the miter gauge with the optional 24-in.-long aluminum fence. The gauge was accurate and ready to use out of

Hair-splitting scale. A vernier scale on the FastTrak miter gauge allows for angle adjustments as small as $\frac{1}{100}^{\circ}$.

Woodworking FastTrak Precision Miter Gauge

Overall rating: Excellent

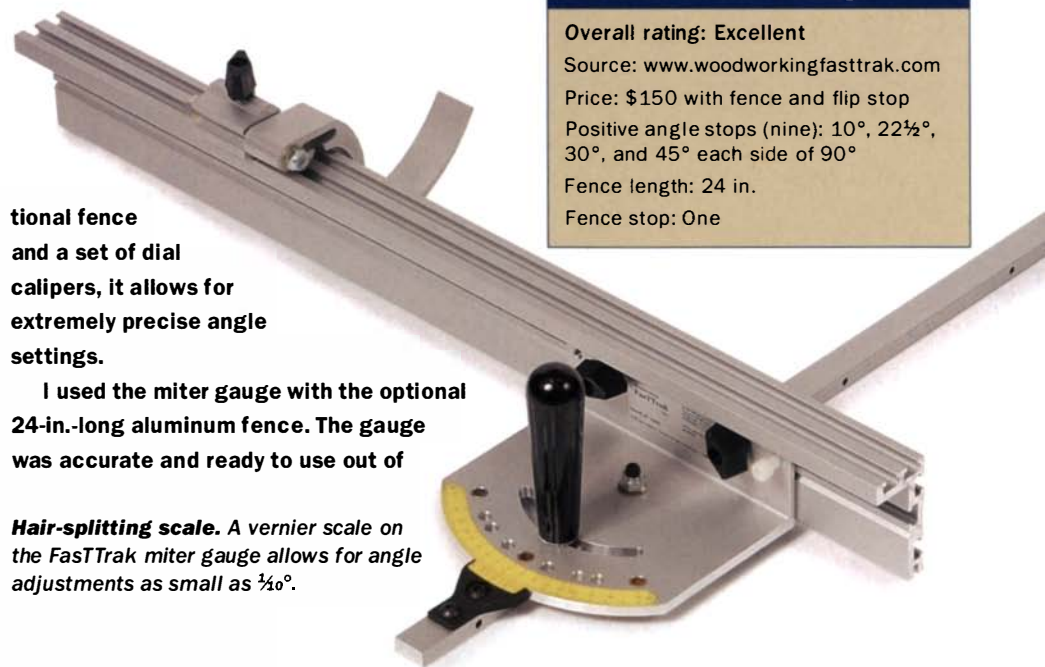
Source: www.woodworkingfasttrak.com

Price: \$150 with fence and flip stop

Positive angle stops (nine): 10°, 22½°, 30°, and 45° each side of 90°

Fence length: 24 in.

Fence stop: One



Veritas No. 6 fore plane

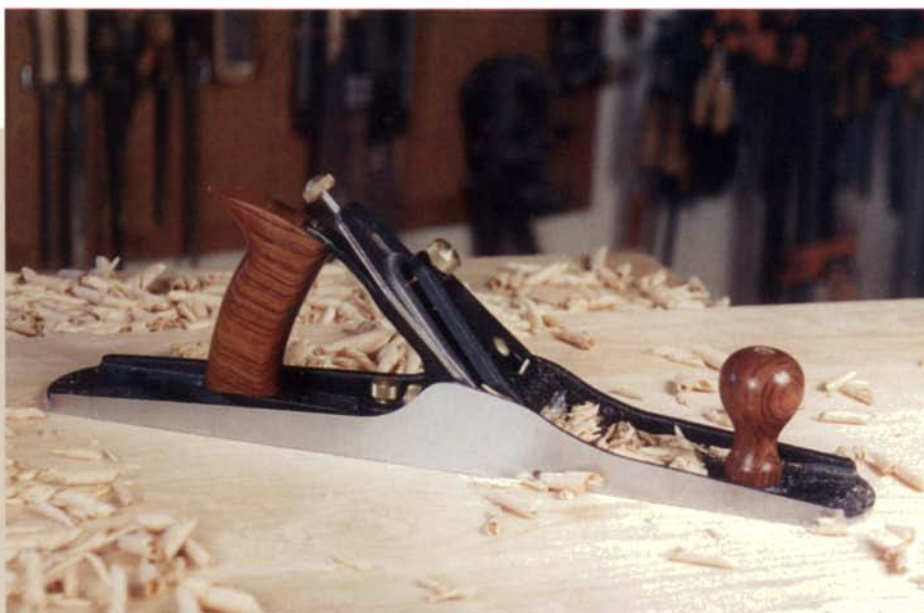
A new No. 6 fore plane from Veritas is designed for truing and smoothing large surfaces like panels, tabletops, and workbench tops. Its long sole is perfect for large surfaces because it will not follow the hills and valleys that a shorter plane would. It also is a great plane for jointing board edges prior to glue-up.

The body of the No. 6 fore plane is made from cast ductile iron, a more durable and stable material than standard gray iron. It is 18 in. long and weighs about 6¾ lb. The blade, made from A2 steel, is 2¾ in. wide and ⅛ in. thick.

The frog assembly is unique in that it extends through the body of the plane to the sole, so the blade is supported all the way to the bevel. The frog is adjustable; you can close the mouth for fine, tear-free cuts or open it up for coarse, aggressive stock removal. The adjustments are easy and, unlike many standard planes, don't require the blade assembly or lever cap to be removed.

The blade-adjustment mechanism is simple. Both vertical and lateral adjustments are made by a single knob. Setscrews in the body of the plane ensure that the lateral adjustment is precise and that the blade is centered near its cutting edge.

The plane was just about ready to go right out of the box. All of its castings were machined clean and true and required no further attention. After I spent a few minutes honing the blade and dressing the chipbreaker, the plane was ready to use.



Long plane is long on quality. The Veritas No. 6 fore plane is a well-designed, well-built tool.

I used the plane to prepare a 20-in. by 40-in. cherry panel, an ideal task for a fore plane. Also, I jointed all of the board's edges to make them straight and true prior to glue-up. The long sole of the Veritas did its job, effectively leveling high and low spots.

After gluing up the panel, I used the plane to surface and smooth both faces. Working with the grain, I was able to plane the panel smooth and flat. I was impressed with the tool's solid feel. This translated into smooth cuts, with minimal torn grain.

For those who enjoy preparing stock with hand tools, the Veritas No. 6 fore plane would be a welcome addition to the workshop. It's well designed, well made, and a solid performer. The selling price is \$195. For more information, contact Veritas at 800-871-8158 (www.leevalley.com).

—Chris Gochmour makes furniture in Murray, Utah.

the box. All of the preset angle settings were right on, and the face of the miter head was machined perfectly square to the table. The angle markings were sharp and easy to read.

The Precision Miter Gauge sells for about \$100. Plan to spend about \$150 for the gauge plus the 24-in.-long fence, which includes a flip stop (888-327-7725; www.woodworkingfasttrak.com).

Inkra Miter Gauge V27

With its toothed protractor-head design, the V27 is similar to other Inkra gauges. It allows for 27 positive stops at every 5°, plus a stop at 22½° on each side of 90°.

To eliminate a sloppy fit in the miter slot, the 15¾-in.-long steel miter bar has four adjustable nylon washers. Like all

Inkra miter gauges, the V27 requires the user to check that the mounting bracket is square to the miter bar and the saw table. If either is out of square, you need to adjust it. On the plus side, these are likely to be one-time adjustments.

Once the initial setup was completed, the V27 was excellent. Adjusting the protractor head between angles was quick and precise; the large clamping handle, combined with the easy-to-read angle markings, allowed for setting the head to any angle between the 5° positive stops.

The Inkra V27 sells for about \$60 at Woodcraft (800-225-1153; www.woodcraft.com).

—Tim Albers is a woodworker in Ventura, Calif.



An affordable price. The model V27 miter gauge from Inkra Products costs only \$60 and has positive stops every 5°.

Inkra Miter Gauge V27

Overall rating: Excellent

Source: www.woodcraft.com

Price: \$60

Positive angle stops (27): Every 5° to 60°, plus 22½° each side of 90°

Fence: None

Fence stop: None

Extralarge cabinetmaker's scorp

Hollowing out the seat of a wooden chair can be either a pleasurable pastime or a chore. A good cutting tool can go a long way toward ensuring the former.

For many years and hundreds of chair seats, I've used an old drawknife bent into a U-shape. The corners of the drawknife enable aggressive cuts, and the straight area between the corners lends itself to making smooth, flat cuts.

So when a scorp made by Barr Specialty Tools arrived in my shop, I was automatically biased against its half-circle shape. However, one chair seat and three settee seats later, I had to admit that my U-shaped tool didn't cut much differently than Barr's 6½-in.-dia. half-round version.

Plus, the new scorp has several advantages over my old standby. It's heavier, so

the blade is less likely to chatter when cutting. Also, the blade is made from high-quality steel. After doing work that would have required two sharpenings of my tool, the Barr was still cutting fine.

Out of the box, the scorp was sharp and ready to cut. It came with a knife edge, which means it had a convex bevel on both sides of the blade. A convex bevel on the outside edge was a plus, as the blade exited the cut easier. On the inside of the blade, that bevel had no cutting advantage or disadvantage, but it did make sharpening more difficult.

At \$125, this scorp is reasonably priced. For more details, contact Barr Specialty Tools (800-235-4452; www.barrtools.com).

—Curtis Buchanan builds chairs in Jonesborough, Tenn.



Big scorp does the job. With its added size and weight, plus good-quality steel, this new scorp from Barr Tools was a solid performer.



Keyless chucks for drill presses

I recently sampled a keyless chuck from Jacobs Chuck that can be retrofitted easily to most drill presses. Jacobs sells several models, but the one that is appropriate for a drill press of ½ hp or less is model JK-130. Once you use it, you'll appreciate the speed with which you can change bits. The JK-130 medium-duty industrial chuck holds bits securely, yet it is easy to loosen by hand.

Before installation, I measured the runout on my old, imported chuck and was surprised by the reading—a whopping 0.020 in. With the new chuck in place, runout was only 0.004 in. (measured 2 in. from the tip of the jaws, using a machined-steel test rod), a huge improvement. That low number translates to more accurate holes and less vibration when drilling.

The JK-130 keyless chuck, which has a ½-in.-dia. bit capacity, is available from MSC (800-645-7270; www.mscdirect.com). It sells for about \$90. Before ordering, you'll need to determine the type of taper fitting on your existing chuck (see the owner's manual or contact the drill-press manufacturer).

—Anatole Burkin is the editor of Fine Woodworking.

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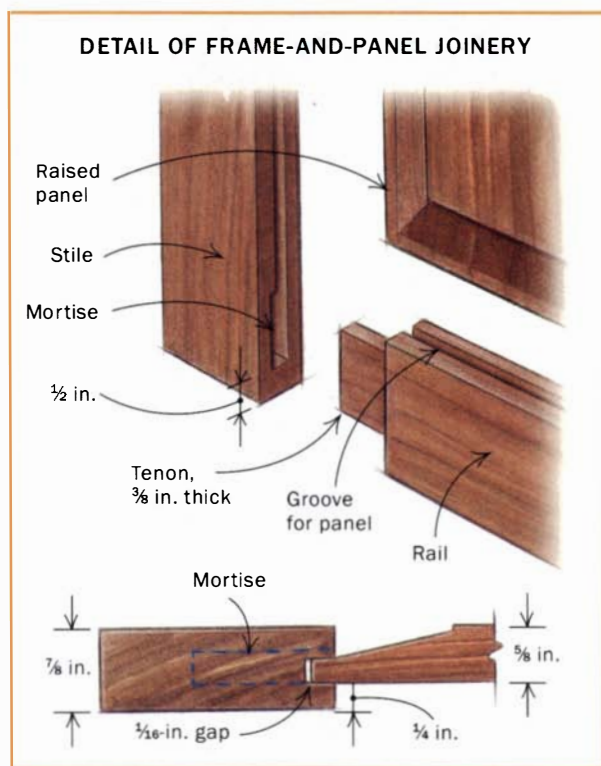


Dynamically balanced, direct drive motor with dual ball bearings never slips or bogs down like belt drive units

Frame-and-Panel Doors

Five steps to building
a door that will last
for generations

BY LONNIE BIRD



There's probably no design element with broader appeal than the frame-and-panel. It's a traditional favorite for doors, such as on this heirloom spice box (above), and for wall paneling and case work. And for good reason—the frame-and-panel covers a broad expanse with only a negligible amount of seasonal wood movement. As the panel expands and contracts, it floats within the confines of the rail-and-stile frame, which helps keep the panel flat.

Frame-and-panel doors are relatively easy to construct, but it can be tricky to get the proportions right. A door with the wrong proportions can ruin a piece of furniture. The door must be proportionate to the entire piece; the frame-and-panel parts must be proportionate to each other; and the stiles and rails must be pro-

portionate to the door as well as to each other. Sometimes, though, I make the bottom rail slightly wider to give it more visual weight. To determine the correct proportions quickly, I begin with a drawing that relies on the golden rectangle, in which the ratio of length to width is 1 to 1.618 (see "A Guide to Good Design" on pp. 48-51). But I make the final judgment with my eyes.

Although flat panels work well, I prefer a raised-panel door, which has beveled edges and a raised appearance in the center. This design catches light and creates an interesting shadowline.

Lonnie Bird runs a woodworking school in Dandridge, Tenn. You can see his course offerings at www.lonniebird.com.

1 MAKE RAILS AND STILES FIRST

LAY OUT THE MORTISES A PAIR AT A TIME



Tandem layout. By clamping the stiles together, you can lay out joinery faster and more accurately. When scribing mortise marks, use a marking gauge with a chiseled point to define the sides of a mortise accurately.



Steady the work. Clamp a makeshift fence to the drill-press table when boring out mortises, to register the stock and keep the bit from rotating the work. To prevent the bit from wandering, leave small spaces between the holes.



Clean out the mortise. With the stile clamped on edge, use the flat side of the chisel to chop out most of the mortise walls.



Pare the walls. The walls of each mortise must be square to their adjacent faces to ensure a good fit.

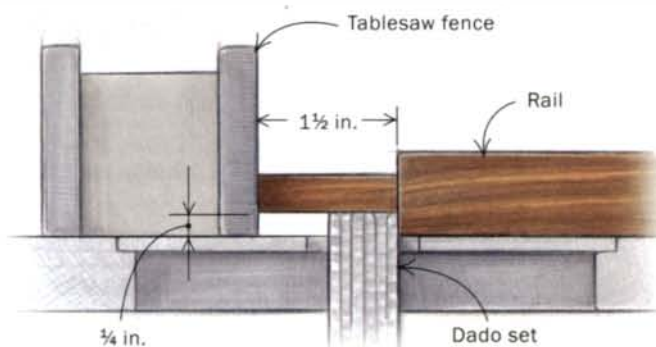
When making a frame-and-panel door, I start with the rails and stiles. Straight-grain stock provides strength and resists warping. The rails are dimensioned to size; the stiles are milled to the correct thickness and width but are left long for cleaner assembly. Leaving ears (extra length) on the stiles makes it easier to dry-fit the piece because you can use a mallet to put it together and tap it apart without denting the finished frame. After glue-up, the ears can be trimmed off on the tablesaw.

At this stage, mark all of the faces of the parts and the height of the door, then work your way inward to locate the mortises. Next, use a marking gauge to mark the mortise widths and then mark the tenon shoulders on the rails. A mortise-and-tenon joint will hold when dry-assembled. Once glued up and secured with a wood pin, the joint will last for years. When cutting mortise-and-tenons, I find it easier to cut the mortise first, then fit the tenon to its mate. Simply drill a row of holes and square the sides with a chisel. It's most important that the walls of your mortise be square to the adjacent sides and parallel to the opposing walls.

2 CUT TENONS ON THE TABLESAW



Use the table saw's fence as a stop. Install a $\frac{3}{4}$ -in. dado set and adjust it to a cutting depth of $\frac{1}{4}$ in. Use a miter gauge to make two or three crosscuts, until the end of the tenon rides against the fence.



Use caution when cutting shoulders. If the shoulder is deep, lower the dado blades and begin with shallow passes before making full-height cuts using the miter gauge.



As with the mortise, there are several methods for sawing the tenon. The table saw with a dado set is a good option. You also can cut surprisingly accurate tenons with a well-tuned band-saw. A backsaw is a great choice, too.

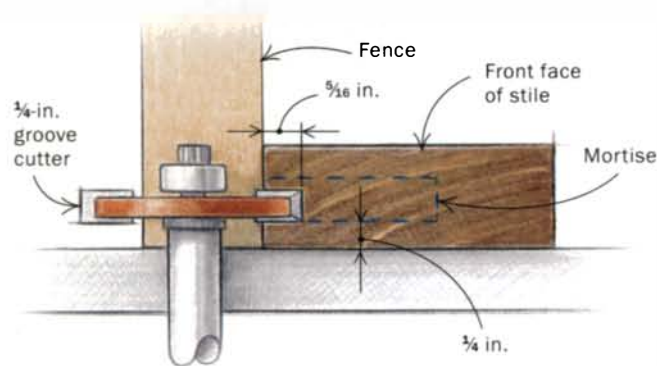
Like the mortises, the tenon faces also must be square and parallel. That is less of a concern when using the table saw, but be careful about dado adjustment. By raising the dado blades just a bit too high, you can overcut the tenons easily, leaving them too thin to fit well. To avoid this, err on the waste side of the layout mark and trim the face of the tenon with a shoulder plane to achieve a friction fit with the mortise.

3 ROUT GROOVES TO HOLD THE PANEL



Cut stopped grooves on the stiles. Hold the end of the stile firmly against the fence, and pivot the workpiece into the rotating bit.

Keep the front face of the stile up. The panel groove is offset from the center, so be sure to keep all parts properly oriented.



Once the joints have been cut, the next step is to cut a groove in the stiles and rails to accept the panel. Choose a bit that will cut standard $\frac{1}{4}$ -in. grooves. Set the cutter to a height that is slightly offset from the center to accommodate the raised panel. Adjust the fence to cut a groove about $\frac{5}{16}$ in. deep to allow for expansion of the panel.

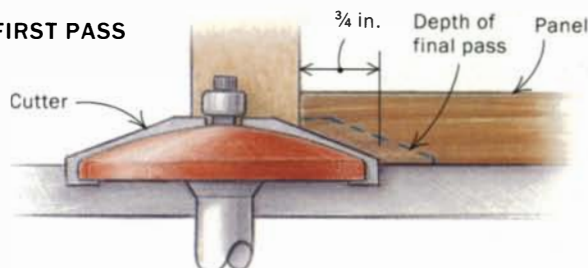
The grooves in the rails are cut all the way along the inside edges. The grooves in the stiles are stopped at the mortises. To cut a groove in a stile, pivot it into the cutter where the mortise has been cut. Rout along the inside edge and conclude at the opposite mortise.

4 MILL THE RAISED PANEL

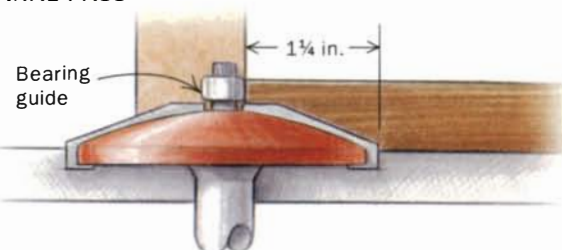


Use a panel-raising bit to rout the panel. Proceed slowly to avoid tearout, especially when cutting end grain.

FIRST PASS



FINAL PASS



With the frame still dry-assembled and clamped, measure the distance between the frame members and add $\frac{1}{2}$ in.; this will leave about $\frac{1}{8}$ in. on all sides to allow for panel expansion. To prevent rattling, the panel should be snug but not too tight in the frame.

When selecting stock for the panel, I always use one wide board. The door panel is an eye-catching area, and glued-up stock is just too distracting. To find the most attractive area on the figured plank, position the dry-assembled frame on the stock and use it as a window to get a perfect picture of how the panel will appear within the frame.

The next step is to mill the panel and bevel the edges (see the photo and drawings above).

Set the fence to make a $\frac{3}{4}$ -in. cut using a panel-raising bit. When using a router table, two or three passes are needed to get the correct depth without tearout. Once the shallow cuts have been made, the router-table fence can be moved back to expose $1\frac{1}{4}$ in. of the panel bit. It will cut a panel that appears 1 in. wide with a $\frac{3}{4}$ -in. lip (edge) that rides in the groove.

5 ASSEMBLE THE DOOR



Dry-fit it. Fit one rail and stile first, then put the panel in place (above) and fit the remaining rail and stile. This order lowers the risk of tearing out the panel corners. Next, make sure the frame is square. With a square on the flat side of the panel, simply tap the long end of a stile (left). Once the glue has set, the stile ends can be trimmed flush with the rails.

Once the panel has been made, the door is ready for assembly. It's always a good idea to perform a dry run, which gives you an opportunity to check the final fit and make adjustments before the glue is applied.

During final assembly, make certain that you clamp the door together on a flat surface; otherwise, you may inadvertently glue a twist into the door. Apply glue sparingly to the mortise walls and to the faces of the tenons. If the joints fit well, they will not require much glue. You'll need to work neatly, or the excess can squeeze out and glue the panel in place. Once the glue has dried, carefully trim the door and fit it to the opening in your case work.

Uses for Hot-Melt Glue

Quick-drying, weak-bonding glue is perfect for temporary holds

BY MARK SCHOFIELD



Choice of glues. Hot-melt glues are available with different open times for different materials. They come in 4-in. or 10-in. sticks.

A recent review of a new hot-melt glue gun system (*FWW* #157, p. 32) that touted its permanent adhesion prompted Hilliard Stone, a reader in Texas, to write in praising the virtues of traditional hot-melt glues. He noted that their weak adhesion makes them perfect for many tasks, including temporarily attaching parts until their final location has been decided on, such as when fine-tuning jigs or placing handles on drawers; attaching furniture parts to templates for routing or sanding; acting as a temporary clamp while other glues set; and holding panels in frames while allowing wood movement. I decided to see for myself how valuable traditional hot-melt glue is, and I came up with a few new uses of my own. Hot-melt glue is available from Woodworker's Supply (800-645-9292; www.woodworker.com).

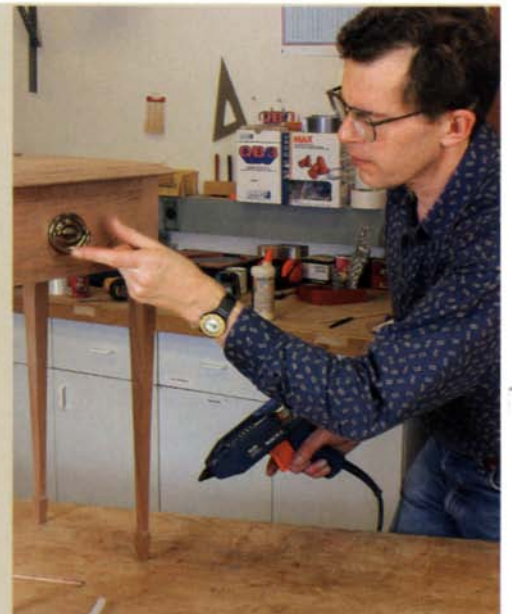
Mark Schofield is an associate editor.

Finding the exact placement of hardware

It sometimes is hard to decide what hardware looks best on a piece of furniture, and locating handles and pulls is always a challenge. You can remove a drawer from its chest to see what hardware looks best on it, but you may discover that the location or hardware doesn't look so hot with the drawer back in the chest. Applying hot-melt glue sparingly allows you to mount handles in trial locations while the drawer is in place, giving you an accurate picture of its appearance. Remove the hardware carefully to avoid damaging the surface. Hot-melt glue also can be used to align false drawer fronts.



Experiment with the location of hardware. To avoid damaging the drawer front, apply only a tiny bead of hot-melt glue to the back of the pull (above) and press it in place (right).



Assembling various jigs

Working with small or curved parts presents many challenges, among which is how to mill them safely. One solution is to attach them to a larger piece of wood, which then can be handled safely when cutting on the table-saw or the router table. It would be impossible to use a miter gauge to guide the piece of gooseneck molding past the sawblade with any degree of safety.



Well secured. Blocks on both sides of the gooseneck molding lock the workpiece to the plywood carrier. Secured to the carrier, the gooseneck miter can be trimmed using the rip fence as a guide.

Clamping help

Crown molding is notoriously difficult to attach without resorting to a nail gun that ultimately mars the surface. A neat trick is to apply beads of hot-melt glue in addition to normal amounts of yellow glue; the former gives a temporary fix while the latter dries to form a permanent bond. Use the hot glue sparingly because large amounts can create a slight gap between the two pieces of wood.

To avoid marring the surface of a piece during glue-up, wood or medium-density fiberboard (MDF) pads are placed between the clamp jaws and workpiece. To keep the pads from slipping, attach them to the clamps with hot-melt glue.

AFFIXING MOLDING



First apply yellow glue to the molding for the permanent bond. Add a few small blobs of hot-melt glue just inside the yellow glue (above). Locate the molding quickly before the hot-melt glue hardens (right). The hot-melt glue holds the molding in place while the yellow glue sets.



PADDED CLAMPS

Blocks of MDF or softwood can be glued quickly to the metal jaws of clamps to protect the workpiece (left). With the pads glued to the clamp, it is much easier to align the clamp while applying pressure. A sharp blow with a hammer removes the pads from the clamps.





Cutting multiples

Furniture makers often need to reproduce intricately shaped parts for their pieces. To ensure uniformity among those parts and to save time, use hot-melt glue to hold a stack of blanks together, and cut the stack on the bandsaw.

Separate with a chisel. The bond of hot-melt glue usually is easy to break with a chisel (right). A stubborn glue joint can be weakened with acetone.



Attaching a template

Hot-melt glue can be used to hold a workpiece to a template when pattern-routing. When finished, pry off the template with a chisel, loosening the glue with some acetone, if necessary. If you are template-routing, the same template can be mounted on different workpieces in succession. Apply the glue sparingly.



Handling small pieces safely. When pattern-routing a small piece, it is safer to attach it temporarily to a larger piece of wood using hot-melt glue.



Building models and mock-ups

When designing a piece of furniture from scratch, it may be hard to envision what it will look like in three dimensions. Making a full-size prototype often requires too much effort, but a scale model held together with hot-melt glue can reveal design flaws.

A scale model. Use MDF or cardboard to mock up a design quickly.



Varnishing Secrets

A highly polished, durable finish can be achieved with a brush

BY DAVID SORG

To bring out the full color, depth, and figure in wood, a finish must be as clear and level as possible. Traditionally, this has been achieved in one of two ways: either by the slow build of French polishing or by the much easier and faster brushing, sanding, rubbing, and polishing of a film finish such as varnish, lacquer, or shellac.

If you've never tried a rubbed and polished finish because you thought it required hours of work or years of experience, please keep reading. You'll be surprised at how easy it is to impress yourself and your friends with a gorgeous finish. Though there are many steps, they're fast and don't require a lot of talent.

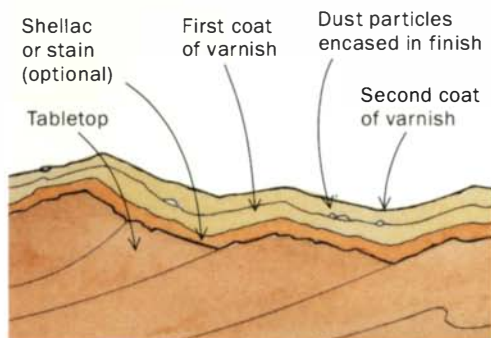


First select the type of finish

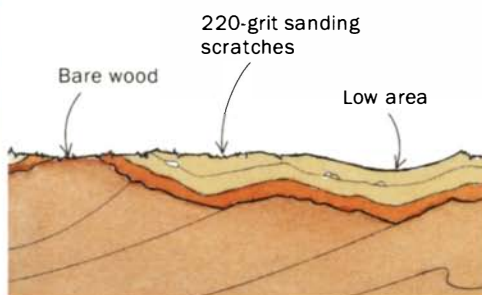
To achieve these impressive results requires using a product that can be polished and that has a brittle hardness as opposed to a rubbery hardness. One product that fits the bill is alkyd varnish, a short-oil varnish that has less oil and more resin, which makes it harder and more brittle. Don't use a spar varnish, which is

1 APPLY TWO COATS...

Sand and dust off the workpiece, then brush on two coats of varnish. There is no need to sand the surface if the second coat is applied within 24 hours of the first. If you want to color the wood, apply stain or shellac prior to the first coat of varnish.



...THEN SAND WITH 220-GRIT PAPER



The first sanding. After the second coat of varnish has dried, use a sanding block and 220-grit paper to partially level the surface for the next coat.

formulated for outdoor use and contains a lot of oil to keep it from cracking due to wide temperature swings. Don't use a non-gloss finish because it will obscure the full beauty of the wood. For a brush-applied finish, I like varnish because of its film-building ability and forgiveness of brush marks. If you prefer lacquer or shellac, the application steps are the same, but you'll have to adjust the number of coats (more than varnish) and the drying time (less than varnish). And with shellac, wet-sanding is

done with mineral spirits, not water, which is used with varnish.

The table I finished for this article (built by Mark Schofield) is made of cherry, a relatively tight-grained wood, so its pores did not need to be filled other than with the varnish itself. With other, more open-grain woods, such as mahogany and walnut, you'll need to use filler or plan on an extra couple of coats of clear finish to level the surface. The wood can be stained before topcoating, but for this table I liked the sub-

tle coloring of an initial coat of orange shellac. The varnish also will color the wood slightly, so make a sample of any and all steps you'll be taking with filler, stain, and finish coats to make sure you're getting the color you want. This sample will give you an idea of how much finish build you're getting and how long you can sand at each step without cutting through the finish.

Build the finish layer by layer

After a final sanding with 220-grit paper, remove the dust using either a vacuum or a tack cloth. Now you're ready to apply the coat of orange shellac (a 1½-lb. or 2-lb. cut is suitable).

The first coat of varnish—Let the shellac dry for 30 to 45 minutes and then apply the first coat of varnish. There's always a debate about whether or not to thin the varnish with mineral spirits: If you thin it 5% to 15%, it's definitely easier to apply and brush marks flow out more easily, but you may have to apply another coat to get a good film build. (See *FWW* #156, pp. 38-42, for brushing tips.) Don't worry about the label saying "Do not thin." It is there mainly

for legal purposes to let the finish comply with air-quality standards.

Let the first coat dry for 12 to 24 hours. Don't worry about brush marks or the inevitable dust in the finish. One of the great things about a polished finish is that you don't have to worry about whether you're in a clean, dust-free environment, because any minor defects will be sanded out.

The second coat—If you apply a second coat the next day, there's no need to sand the first coat because the second will bond chemically to the first. This second coat of varnish is the most difficult to apply because you're applying gloss over gloss. There's more drag on the brush, and it's harder to see where you've been. From the side of the piece, shine a light across the surface so that you can tell whether you're applying the varnish too thin or too thick.

If more than a day has gone by since the first coat, the second coat no longer will chemically bond to the first coat, so scuff-sand the first coat with 220- or 320-grit paper to give the second coat a physical bond.

Level the first two coats—Let the second coat dry for at least 24 hours, then sand it with 220-grit paper. Use a rubber or cork sanding block on the flat surfaces, sanding with the grain, and specially shaped backing blocks where appropriate. Use your fingers when nothing else fits, but switch to 320-grit paper to minimize the chance of cutting through on edges or details.

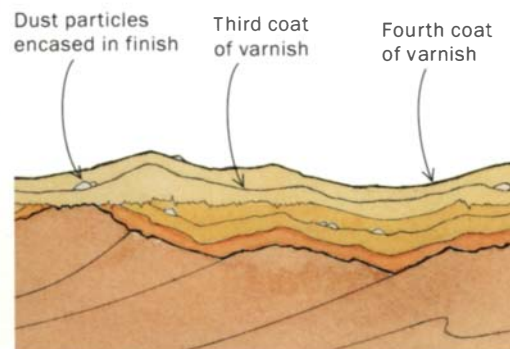
As you level the surface, you probably will reveal a pattern of dull and shiny areas: The dull areas are obviously the high spots being planed down, and the shiny areas are the low spots that haven't been touched. Don't try to remove all of the shiny areas completely, because you'll probably cut through on the edges.

A third coat and an optional fourth—After removing the sanding dust, apply a third coat of varnish. Let it dry for 12 to 24 hours. Here is where you'll have to make a judgment call: If you've been applying fairly thin coats, or if you have an unfilled pore pattern showing, apply a fourth



2 APPLY ANOTHER COAT...

The third coat of varnish is applied over the sanded surface. A fourth coat may be necessary if the pores of the wood are not yet filled.



...THEN SAND WITH 400-GRIT PAPER

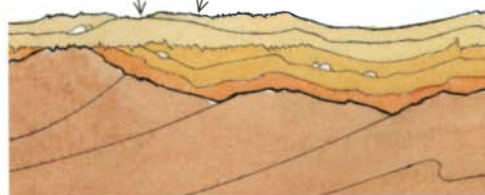


Wet-sand the varnish. Before the last coat of varnish is applied, smooth all of the surfaces with 400-grit wet-or-dry paper lubricated with water and a little liquid dishwashing soap.



Witness lines where third coat is at the surface

Overall surface gets flatter as it is sanded with 400-grit paper.



Dull and flat. Before brushing on the last coat, the surface should be as smooth as possible but without any bare wood showing through.

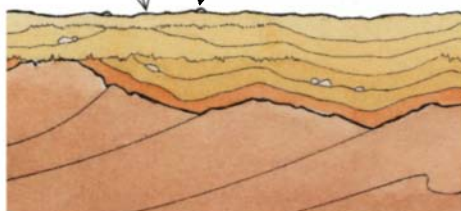


3 APPLY A FINAL COAT...

The last coat of varnish should be thinned about 15% with mineral spirits to allow a smoother and easier flowing topcoat.

Last coat of varnish is level.

Dust particles will disappear after sanding and rubbing out.



the 1,000- and 2,000-grit papers. The 1,000 grit is used to remove the scratches left behind by the 600 grit and to make the surface about 95% dull. You should have only a light sprinkling of low, shiny freckles left behind on the flat surfaces, and some shiny areas near inside corners, such as the cockbeading on a drawer or on moldings or carvings.

Stop here for a satin finish—Go through the same process with the 2,000-grit paper. Again, it goes quickly, but you may find that you have to hold down the workpiece firmly. Your varnished surface is now so smooth that the water creates suction between the sanding block and the surface.

coat directly over the third, just as the second coat was brushed right on top of the first. Let the fourth coat dry for 48 hours.

One more sanding and one last coat—Sand the third or fourth coat with 400-grit wet-or-dry sandpaper, again using a backing block. Lubricate the paper with water, adding a drop or two of dishwashing detergent to prevent clogging. Frequently wipe away the slurry to check your progress. If the varnish is making little balls on the sandpaper, the varnish needs to dry longer. It won't hurt to let it dry for several days. Look for the same dull/gloss pattern as before, but this time you'll aim for having fewer shiny areas and a flatter surface. If you sand through a layer of varnish, you may get some witness lines, which create a pattern that resembles a topographic map of relatively flat terrain. Don't worry, as the final coat will eliminate these lines. Wipe down the piece with mineral spirits to remove any dried slurry.

For the final coat, thin the varnish with about 15% mineral spirits. This last coat is meant to flow on with virtually no brush marks, filling any hollows. The build isn't much, but it's enough to provide a level surface for the final smoothing and polishing. This coat should dry for at least 48 hours, but longer is better. The more the varnish film cures, the harder it gets, and the smoother the final results will be.

Rub out to the desired sheen

Begin with a light wet-sanding with 600-grit wet-or-dry paper, regularly rinsing off

...THEN SAND WITH FINE-GRIT PAPERS



Dull mountains and shiny valleys. Don't aim to achieve a uniform luster from the 600-grit sanding. The risk of cutting through the top layer of varnish is too high.



After sanding with 2,000-grit paper, there will be only a few glossy specks left. For a satin luster, finish with 0000 steel wool and wax.

the paper in a bucket of water. This step will remove the dust nibs and any small brush marks. If the sandpaper clogs, put the piece aside for another day or two. Regularly check your progress until 80% to 90% of the surface is dull. I tend to go light on the edges and small details at this stage, saving them for the next step.

Next, wipe down the piece with a damp sponge. Before switching to a higher grit, change the water in the bucket to be sure that you won't grind any of the larger 600-grit pieces into the surface.

It's sometimes hard to find the higher-grit sandpapers at a paint or woodworking store, but any automotive store will have

Water beads up beautifully on this very attractive satin finish. If you want a lower-luster finish, you could stop here, finishing with 0000 steel wool and paste wax.

Achieving a high-gloss finish—For a high-gloss look, use a rubbing compound to remove the 2,000-grit scratches. The compound can be the type sold at automotive stores (see *FWW* #164, p. 118) or a traditional pumice. This finely ground powder is sprinkled on the surface, sprayed with some water, and then rubbed out with a felt block. Until now you have been sanding with the grain, but for this step you will be moving

the block in all directions. The fine scratches look better if the pattern is random.

This is where you'll really see the gloss develop right under your hand as you wipe away the haze of the pumice. Don't expect a full shine yet, as the pumice is used just enough to get rid of the 2,000-grit scratches. At this stage you should see a fine haze and perhaps some swirl marks on an otherwise good-looking surface.

Wipe off any pumice residue and switch to a toweling sponge or cloth for the final step. You can use an automotive polishing compound in paste or liquid form, but sticking with tradition I used rottenstone,

which is a finely ground limestone that's applied just like the pumice. Be careful at this stage; the compound is an abrasive, and after all of the sanding and rubbing, the finish film is probably getting pretty thin, especially on the edges.

The few minutes with the polishing compound are some of the sweetest: You've spent many hours on your project, from selecting the boards to this final wiping of the powdery haze to reveal a perfectly smooth, gleaming example of workmanship. □

David Sorg is a professional finisher and artist in Denver, Colo.

4 RUB OUT THE FINISH



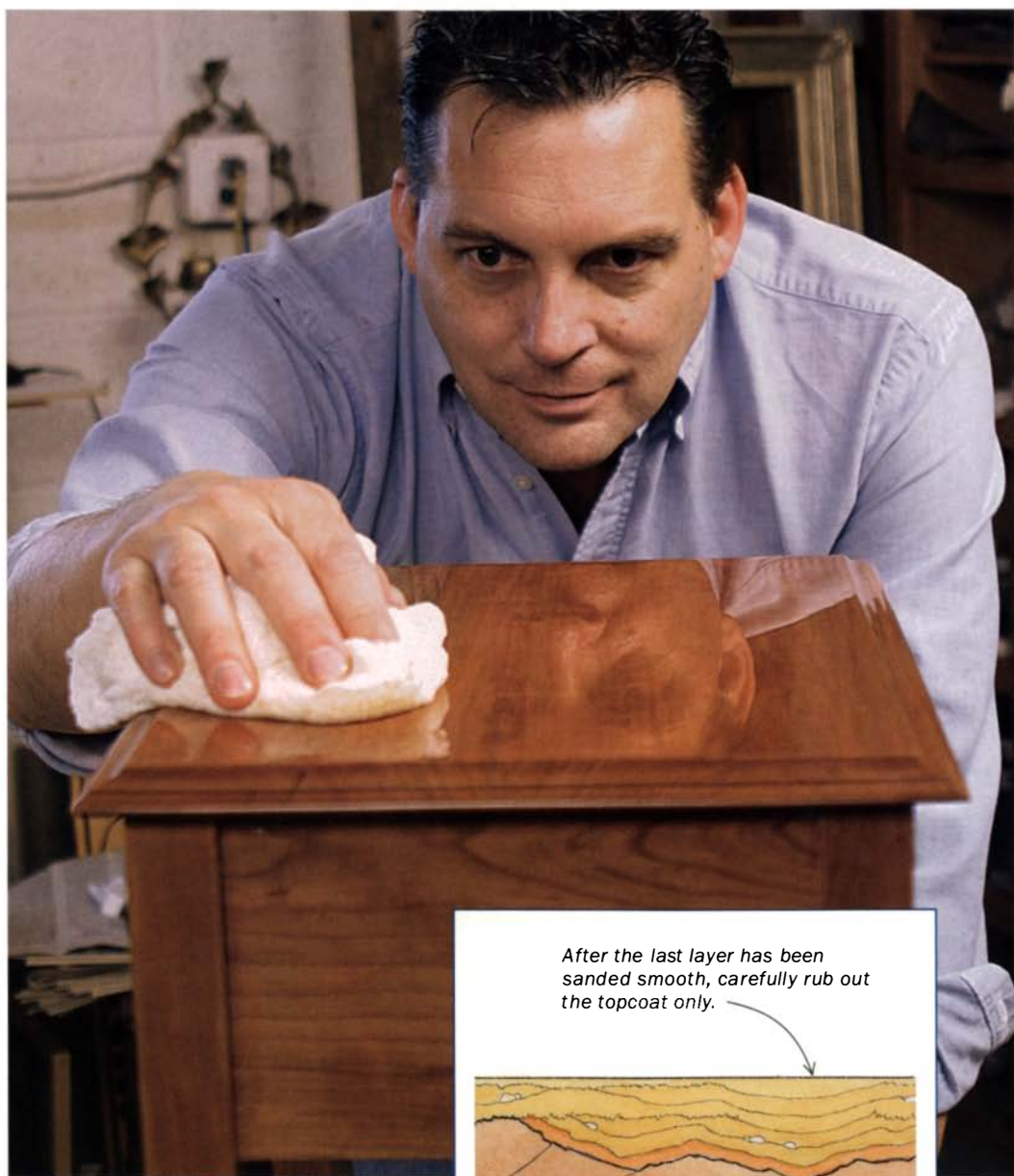
Pumice and water. Sprinkle pumice on the surface and spray it lightly with water in preparation for rubbing out the finish.



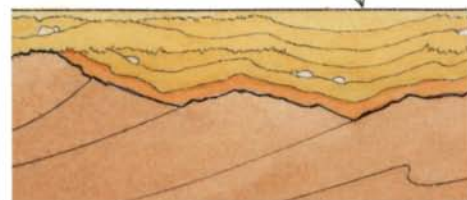
Random rubbing. Unlike the earlier sanding that was done with the grain, rub the pumice in random circles with a felt block.



Rottenstone makes it glossy. Use a toweling sponge, available at auto stores, to rub the rottenstone in random patterns, bringing the whole surface to a uniform high gloss.



After the last layer has been sanded smooth, carefully rub out the topcoat only.



Looking good. The final touch is to remove any rottenstone residue with a clean cloth, which leaves the surface silky smooth.

Pinned Box Joints

Interlocking joinery adds visual interest and mechanical strength

SIMPLE ELEGANCE

Square, broad tabs interlock at the corners of solid-wood cases and boxes, such as this tansu-style chest-on-chest. Because of the lack of long-grain gluing surface, each tab is pinned to add mechanical strength.

Boxes are the essential structure of all case pieces. That means a large part of furniture making boils down to joining pieces of wood to make boxes. There are many ways of doing this. Some, such as dovetails, draw attention to the joinery and the box structure itself, while others, such as post-and-panel construction, hide those aspects.

Enter the box joint, a close cousin of the dovetail that also becomes part of the overall look of a piece. Like the dovetail, the box joint is a way of solidly joining two planks or panels of solid wood end-to-end, appropriate for anything from jewelry boxes to full-size cabinet components. In essence, the box joint involves making a number of interlocking fingers on the ends of the pieces to be joined. The more well-known variety of the box joint, which I call a finger joint, has many small interlocking fingers. The fingers provide plenty of long-grain-to-long-grain gluing surface. The version I introduce here, however, has relatively broad fingers and must be pinned to add mechanical strength.

VARIATIONS ON THE PINNED BOX JOINT

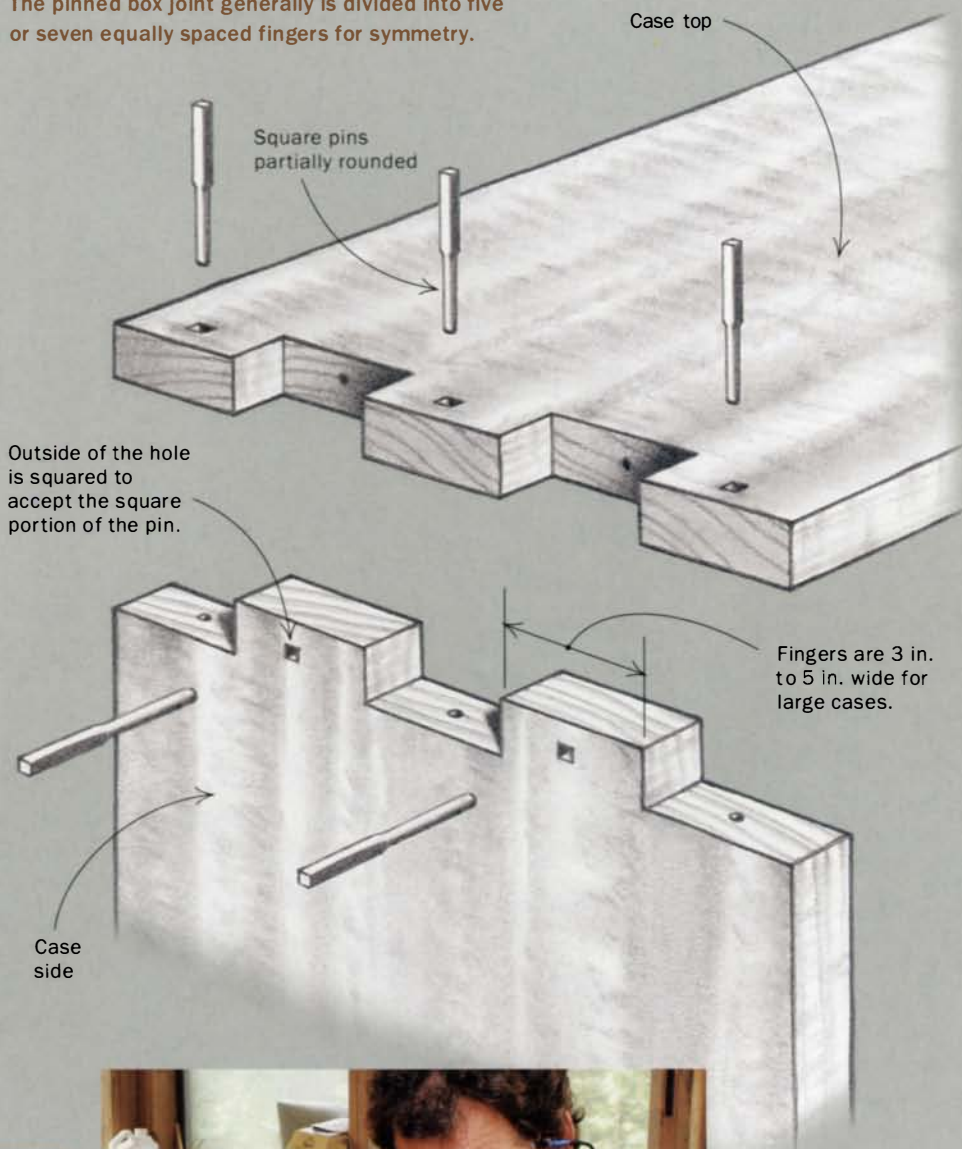
PROTRUDING FINGERS



Greene-and-Greene work often features pinned box joints with fingers that protrude $\frac{1}{8}$ in. to $\frac{1}{4}$ in., with the ends rounded slightly before assembly.

DESIGN AND LAYOUT

The pinned box joint generally is divided into five or seven equally spaced fingers for symmetry.



BY SETH JANOFSKY

The pinned box joint is common in some traditional types of furniture, such as Japanese solid-carcase construction (tansu) and also the Craftsman work it inspired in this country, most notably that of Charles and Henry Greene. The pinned box joint also can be used to give an Asian flavor to contemporary work. There are a couple of attractive variations on this joint (see the drawings below). One is a dovetailed version, which also is seen in tansu furniture. Another is the Greene-and-Greene version, which has longer fingers that protrude slightly.

To me, the pinned box joint, with its large fingers, is most suitable for large boxes and full-size carcasses such as blanket chests. I think of finger joints as being more appropriate for small boxes, trays, and the like.

Cutting the joint

Box joints can be cut by machine, by hand, or as I like to do it, by both. I think it is easiest to cut these large joints in the same manner as hand-cut dovetails; that is, by clamping the workpieces vertically to the

DOVETAILED



Some tansu chests and boxes feature widely spaced, pinned dovetails, which are cut first and then traced onto the mating piece.



Lay out one side of the joint. Mark the cheeks with a square, but use a marking gauge to scribe the depth, setting the gauge to the thickness of the mating piece.

CUT THE FINGERS

Cut one side of each joint, then transfer the layout to the other side. Use a handsaw to make precise cuts where the fingers join.



Saw the cheeks and chop out most of the waste. Janofsky uses a Japanese dovetail saw (left), which cuts on the pull stroke and should be held at the end of its handle for the best results. Cut right to the layout lines, being careful to keep the cut straight and square. Use a bandsaw or jigsaw (above) to remove most of the waste.

bench and sawing down the layout lines with a handsaw. As with a dovetail joint, it's best to cut one half of the box joint, transfer the lines to the other part, and then cut it to match.

On this joint, as on dovetails, I saw right to the layout lines because I think doing so is easier than trying to pare the joint to fit. Next, I remove most of the waste between the sawcuts with a jigsaw or bandsaw. I generally find it easiest to finish the cuts with a dado set on the tablesaw, working right to the sawkerfs and scribe line. This works well unless the pieces are very large and unwieldy. In such cases, I clean up with a router (see the photos at right).

Once the joints have been cut, glue-up is straightforward, but you need to remember all of the basic stuff: to cut whatever grooves are needed for bottoms or backs beforehand (through-grooves on one set of parts, stopped grooves on the other); to finish the insides of the parts before assembly, if it's appropriate to the project; and to do a dry-fit to ensure that everything goes together tightly and squarely.

Reinforcing the joint with pins

The first thing I do is mill the stock for the pins. I consider the wood for the pins rather carefully. On the one hand, I want a

TWO WAYS TO FINISH THE JOB

Depending on the size of the workpieces, the rest of the waste can be removed either on the tablesaw or with a router. Cut right to the sawkerfs and scribe line.



A tablesaw sled will handle shorter pieces. Adjust a dado set to cut to the scribe line. Use a sacrificial fence to minimize chipout on the back side of the cut.



Tall pieces are easier to handle with a router. Clamp pieces in pairs to give the router a wider bearing surface. Set the bit depth right to the scribe mark.



Transfer the layout to the mating piece. Align the pieces carefully and make small tick marks. Then use a square to carry those marks around the mating workpiece.



wood that harmonizes well with the wood of the carcase, neither too close nor too far away in tone. In general, I look for enough contrast to be distinct, yet not look flamboyant or call too much attention to itself. Also, the wood for the pins usually should be darker, not lighter, than the background wood. Often I end up using white oak for the pins. The Greene brothers favored ebony, but for me this is too strong a statement. In traditional tansu, Japanese furniture makers typically used utsugi, which is described as being somewhat similar to dogwood.

Functionally, the important thing is to choose a wood that is quite strong—after all, the point is to add strength to the joint. Also, the pins get hammered in with a fair amount of force.

Once I have milled strips of the stock for the pins, I drill holes through the parts of the joint from the outside, being careful to drill straight. Generally, I use pins between $\frac{1}{8}$ in. and $\frac{1}{4}$ in. thick, depending on the thickness of the case pieces and the overall look of the piece.

Usually I prefer square pins, but this again is a matter of taste. Whether they're round or square, I leave the pins extralong by an identifiable amount (say, $\frac{1}{2}$ in.) to allow for pounding. The extra length also lets me see

when the pins have penetrated the joint to the proper depth. If round, the pins need to be whittled or shaved, ideally in such a way that they are slightly too small at the inner ends and a bit too large at the outer ends.

If the pins are to be square, I whittle each pin almost round as described above but leave the outer portion square. My secret to a nicely defined pin is to square the outer part of each hole, too, by pounding into it a tapered piece of steel before installing the pins (see the top photo at right).

I fill all of the holes with glue and smear some on each pin for good measure. Then I pound the pins into the holes, hammering them down hard, but not so hard that the pins break or the carcase wood splits. Remember that the primary purpose is to strengthen the joint, so success is a matter of sizing the holes and the pins appropriately. Practice makes perfect.

When the glue is dry, I trim the pins and level the entire joint. Usually, a handplane is enough, but sometimes I pull out the belt sander for more serious stock removal.

And there you have it: a beautiful and strong joint you can be proud of, with a truly distinctive look. □

Seth Janofsky is a furniture maker in Fort Bragg, Calif.

PEG THE JOINTS

Be sure to drill the pinholes straight (left). Then square off the top section for the square pins.



Shopmade tool for squaring holes. Janofsky uses a thin, square bar of steel, tapered on a bench grinder, to square the holes. The wood block makes the tool easier to hold.



Whittle the pins. The pins start off square, sized to fit the top of the hole and roughly $\frac{1}{2}$ in. extralong. Then all but the top 1 in. is whittled round.



Drive home the pins. Add glue to the pin and hole, and drive in each pin while holding it in alignment with a wrench.



Trim and plane the joint flush. Use a flush-cutting saw to trim the pins, then plane and/or sand the surfaces flush.

A Guide to Good Design

Pleasing proportions borrowed from nature

BY GRAHAM BLACKBURN

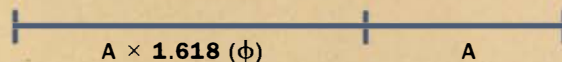
Even if you should be blessed with a good eye, it's not easy to design a piece of furniture without using some underlying paradigm for determining its dimensions and the inner proportions of its parts. Whether it's a design method passed on from craftsman to apprentice or the inherent sense of balance that humans possess, without such a paradigm to follow it is perfectly possible to build something that is structurally sound and functionally adequate but not pleasing to the senses. A piece of furniture that disregards proven design may look clumsy, unbalanced, or awkward.

The geometry of furniture design

Chief among the many paradigms that designers have used—and continue to use—to ensure balance and good proportions in furniture design is the golden ratio (also referred to as the golden mean). Represented by the Greek letter phi (ϕ), the golden ratio can be expressed as the equation $[1 + \sqrt{5}]/2 = \phi$. For practical purposes, we can think of phi as equal to 1.618, and

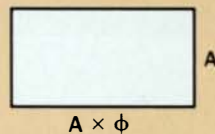
THE GOLDEN RATIO

The golden ratio, represented with the Greek letter phi (ϕ), is based on an equation ($[1 + \sqrt{5}]/2 = \phi$) that produces a decimal that proceeds infinitely without repetition. For practical purposes, it is rounded off to 1.618.



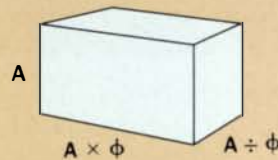
THE GOLDEN RATIO IN ITS SIMPLEST FORM

If you bisect any given line using phi, the longer portion is 1.618 times greater than the shorter portion. Interestingly, the whole line is also 1.618 times greater than its longest bisection.



THE GOLDEN RECTANGLE

The long dimension of a golden rectangle is 1.618 times greater than the shorter dimension.



THE GOLDEN SOLID

A golden solid incorporates multiple golden rectangles that are proportionate to one another.

visualize it by dividing any given line so that the longer part is 1.618 times greater than the shorter part. One of many intriguing principles of the golden ratio is that the shorter portion of the line is in the same proportion to the longer part as the longer part is to the whole line.

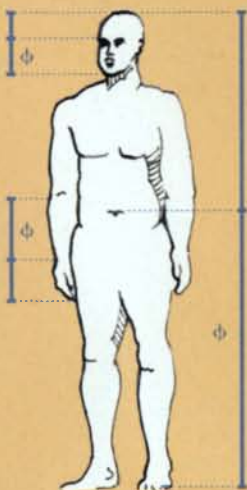
A naturally occurring proportion—

The golden ratio underlies much of nature and the way our universe is constructed. Examples abound on every level from astrophysics to quantum mechanics. Planetary orbits and even the very structure of the human figure abide by it. Being so fundamental and pervasive in nature, the ratio appeals to us at a subconscious level as being essentially right. As such, it has been used for centuries by designers of

everything from the pyramids to furniture masterpieces.

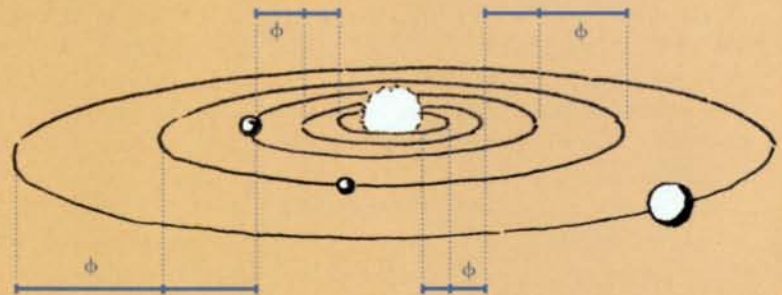
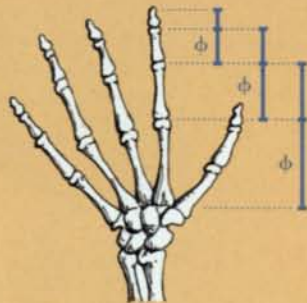
The golden rectangle—The golden ratio relates to furniture design most commonly by way of a rectangle that is constructed

The golden ratio in nature and in art



PHI IN THE HUMAN BODY

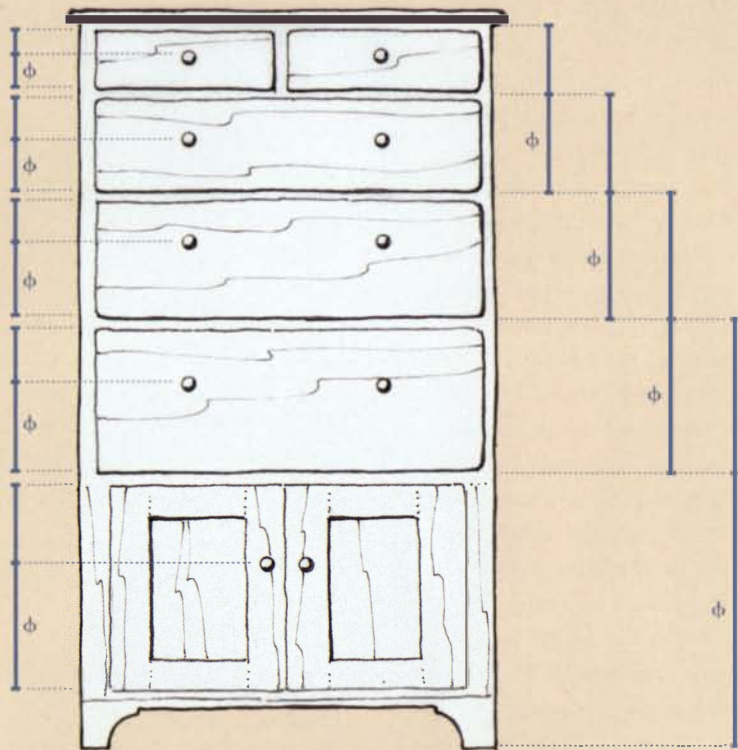
The eyes divide the head at the golden ratio. The navel divides the body's height at the golden ratio. The wrist divides the arm, from elbow to fingertip, at the golden ratio. The bones on an average human hand are related to each other in phi proportions from wrist to fingertip.



PHI IN THE SOLAR SYSTEM

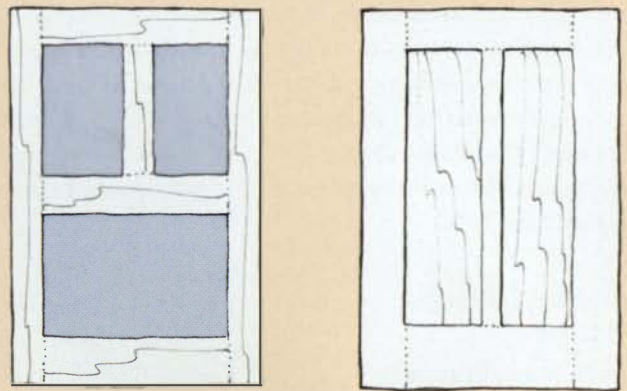
The distances between the sun and the first five planets in the solar system are close to the golden ratio in their relationship to one another, taking into account that they measure different distances throughout their orbits and are not on the same linear plane. Astronomers have used the golden ratio to locate planets in their orbits.

SIZING DOORS AND DRAWERS



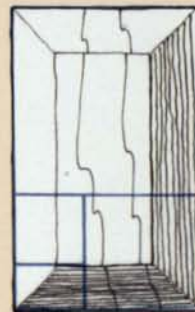
GRADUATED DRAWERS

This Shaker-style chest of drawers uses phi increments, which can be determined with a Fibonacci series (see p. 50), to establish the height of the graduated drawers as well as the positions of the drawer pulls.



DOOR ELEMENTS

In a door, the golden ratio can be used to size the panels (left) as well as the widths of the muntin, stiles, and rails (right), which increase in size by multiples of phi.



PANEL PROPORTIONS

The overall dimensions of this panel form a golden rectangle. Squaring the rectangle to produce smaller, proportionate golden rectangles helps determine how much of the panel should be raised.

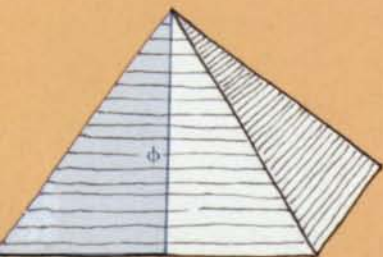
using phi for its two dimensions. Known as the golden rectangle, it is sized so that the length is 1.618 times larger than the width (or vice versa). These proportions can be used to determine the overall dimensions of furniture as well as interior parts, such as doors and drawers.

The golden solid—Furniture is three dimensional, and the golden ratio can be applied to all three dimensions by turning a golden rectangle into a golden solid. Take, for instance, a simple case. When

viewing its profile, the height may be the long dimension of a golden rectangle. However, when viewed from the front, the height may be the short dimension of a proportionate golden rectangle.

Applying the golden ratio to furniture proportions

A word of caution before applying the golden ratio as a design paradigm: Remember that form must follow function. Even the most sublimely proportioned piece of furniture can be a failure if it does not function because it is too small or too large or other-



PHI IN THE PYRAMIDS

The Great Pyramid of Giza is constructed with the golden ratio at its core. The height of its side is equal to 1.618 times the length of half its base.



PHI IN THE PARTHENON

The Parthenon uses the golden ratio for its overall dimensions. When squared, it leaves a second, smaller golden rectangle, which when squared determines the height of the columns. Many other elements and details were determined with this method.



PHI IN THE HIGHBOY

The high chest of drawers, known as the Pompadour, made in Philadelphia between 1762 and 1790, uses the golden ratio to determine many of its measurements. The carcase is a golden rectangle. The position of the waist is determined by dividing the overall height by phi. And the two lower drawers also are golden rectangles.

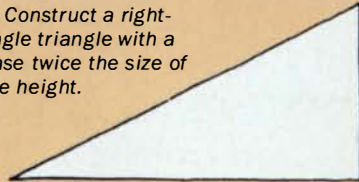
Four ways to construct a golden rectangle

Before you can conveniently use the golden ratio to design a piece of furniture, you must know how to produce it. You could simply multiply or divide any given measurement by 1.618, but this typically results in very clumsy numbers. It is much easier to construct an arbitrarily sized golden rectangle and then adjust the size to match your requirements. There are several simple methods to do this.

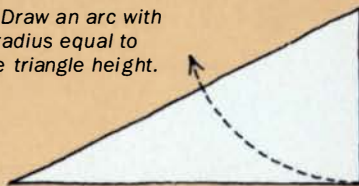
Use the triangle method

Construct a right-angle triangle with a base that is twice the length of the height. Then use a compass to draw an arc with a radius equal to the height of the triangle. The center point of this arc is located on the triangle where the vertical line and the hypotenuse meet. Next, using the location on the triangle where the base and the hypotenuse meet as a center point, draw an arc with a radius equal to the first bisection of the hypotenuse. The point at which this second arc bisects the base of the triangle divides the line into two portions that are related by the golden ratio. The two sections can be used to form the width and height of a golden rectangle.

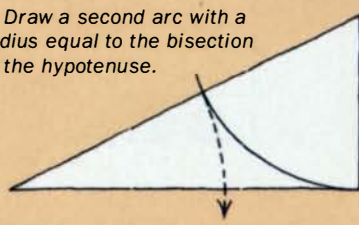
1. Construct a right-angle triangle with a base twice the size of the height.



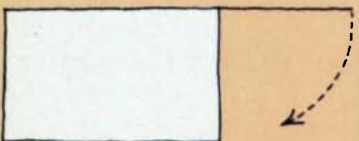
2. Draw an arc with a radius equal to the triangle height.



3. Draw a second arc with a radius equal to the bisection of the hypotenuse.



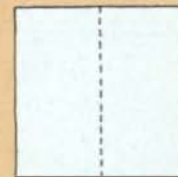
Second arc bisects the base at the golden ratio.



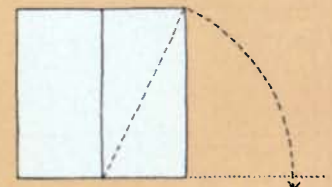
4. Rotate the shorter section 90° to complete the golden rectangle.

Divide and extend a square

Divide a square in half with a vertical line, then draw a line continuing the baseline beyond the square. Draw an arc with a compass using the diagonal of one half of the square as a radius, with the center point on the baseline at the point of bisection. The point where the arc meets the continued baseline determines the extended line. The original baseline is now 1.618 times the length of the extension. These two lengths can be used to form the width and height of a golden rectangle.



1. Construct a square and divide it in half vertically.



2. Draw an arc with a radius equal to the diagonal of one half of the square.



Original base is 1.618 times the size of the new extended section.

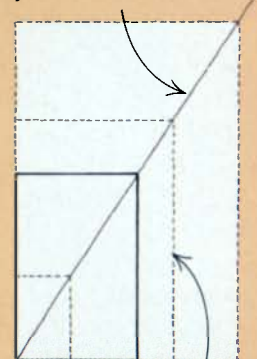


3. Rotate the shorter section 90° to complete the golden rectangle.

Scale a golden rectangle

Using a golden rectangle of any size, you can create another golden rectangle with different dimensions. Simply draw a golden rectangle and bisect it with a diagonal line that stretches from one corner to another. Then extend the diagonal line. Any rectangle that shares this diagonal, whether it is smaller or larger, will be golden.

Draw a diagonal line through the golden rectangle extending beyond one corner.



Any rectangle that shares this diagonal is golden.

Apply the Fibonacci series

Yet another way to derive measurements that reflect the golden ratio is to use a method known as the Fibonacci series, which is a sequence of numbers, with each number equal to the sum of the two preceding numbers. A simple series starting with 1 produces the following: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, and so on.

A Fibonacci series is useful because any number divided by the previous number—with the exception of the first few values—is roughly equal to phi. This explains

why dimensions such as 3 by 5 and 5 by 8 are so common. They are based on phi.

Perhaps more useful to the furniture designer is that a Fibonacci series can be generated using any two numbers. Starting with two given dimensions for a furniture piece, add them together to produce the third value, and continue this pattern to create a series of other potential dimensions related by phi. For example, a case piece with a 15-in.-deep by 22-in.-wide top would produce the following Fibonacci series: 15, 22, 37, 59, 96, 155, 251, 406,

and so on. Once again, discarding the first few values, you now have a series of pairs of numbers with a phi ratio, which might be used as a basis for other dimensions.

One thing to note is that while the first two values are expressed in inches, the successive numbers in a Fibonacci series could be expressed in any unit of measure, such as fractions of an inch. Therefore, a door panel on the case piece used as an example here could measure $25\frac{1}{4}$ in. by $40\frac{5}{8}$ in. and still be proportionate to the 15-in. by 22-in. case top.

wise unable to be used comfortably. Practical considerations, therefore, must come first.

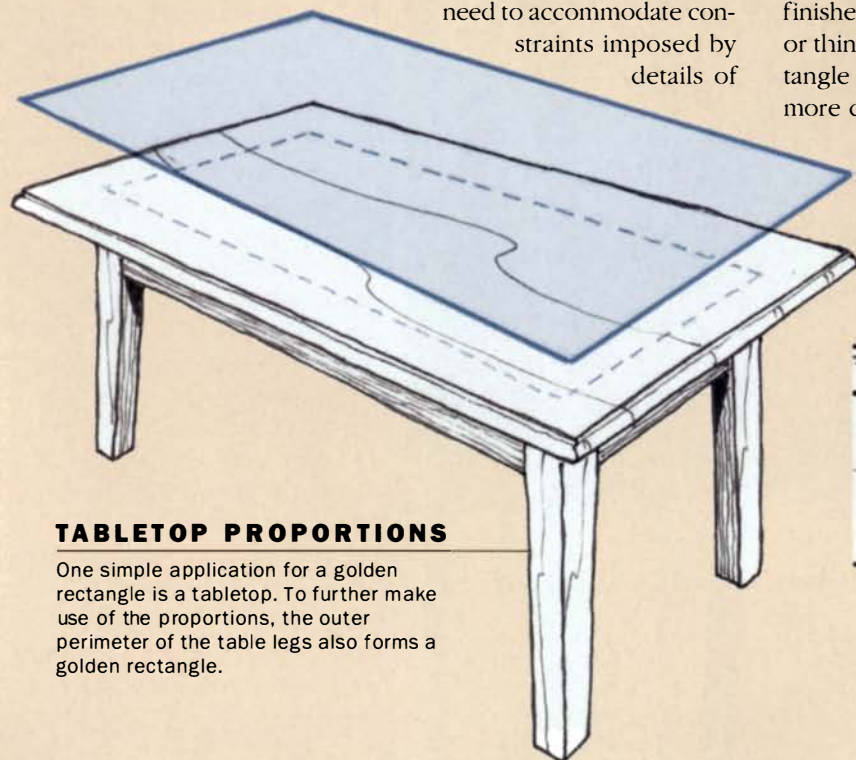
In fact, most furniture designs require that you start with some given dimensions: A table must be a certain height, a cabinet may have to fit a particular space, or a bookcase may require a fixed number of shelves. But almost certainly you will be left with many other decisions regarding dimensions to which you can apply this proportion. It will be worth the effort to see whether the golden ratio might work for these other elements. Deciding on dimensions by eye alone—or worse, on the basis of the lumber that is conveniently at hand—is a less certain way of achieving a well-balanced, nicely proportioned piece.

Individual elements—Whether or not the overall dimensions of a piece are proportioned using the golden ratio, individual parts, such as table legs or even the relative sizes of framing members such as stiles, rails, and muntins, can be determined with the golden ratio. The golden ratio also offers one way to solve the problem of designing graduated drawers. Each consecutive drawer can increase in size by multiplying the depth of one drawer by phi to get the depth of the next-largest drawer. The method can be applied just as effectively to other elements such as shelving or partitions.

Any measurement on a piece of furniture originally may have been determined by functional and structural requirements, but many adjustments can be made that add inner harmony. Using the golden ratio when designing furniture will enable you not only to produce a pleasing whole but also to ensure that all of the constituent parts, such as door panels and drawers, are fundamentally related.

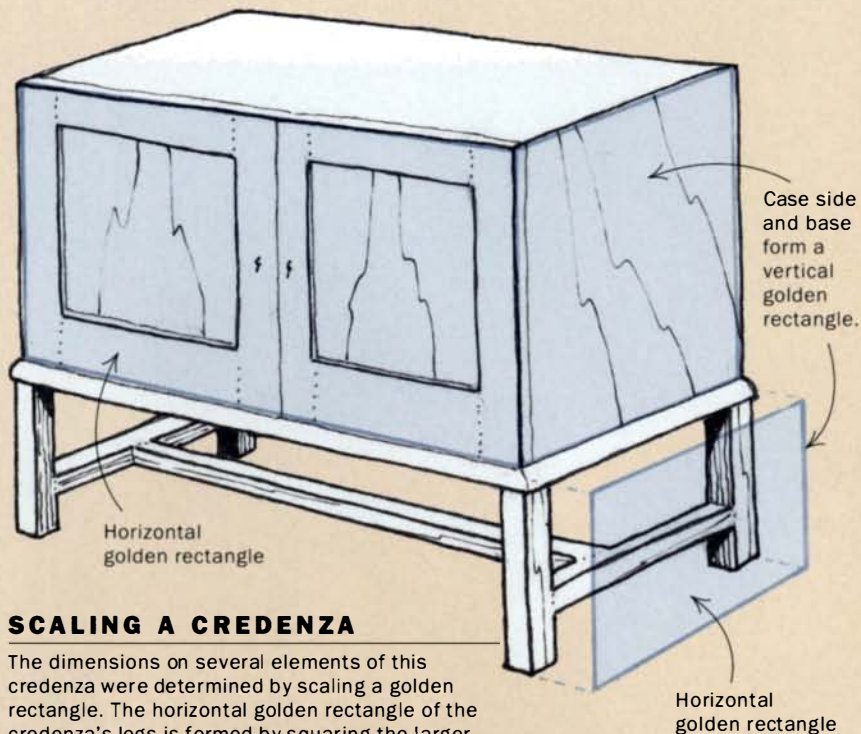
Practical adjustments

Designing something with perfect proportions is rarely possible in the real world. Almost every piece of furniture or woodwork will need to accommodate constraints imposed by details of



TABLETOP PROPORTIONS

One simple application for a golden rectangle is a tabletop. To further make use of the proportions, the outer perimeter of the table legs also forms a golden rectangle.



SCALING A CREDEZA

The dimensions on several elements of this credenza were determined by scaling a golden rectangle. The horizontal golden rectangle of the credenza's legs is formed by squaring the larger vertical golden rectangle of the credenza's overall profile.

function, joinery, or economics. But even the attempt to approach perfection (which may be defined as measurements that correspond precisely to a system like the golden ratio) is virtually guaranteed to produce a better result than designing with no regard for any such paradigm. Even if you are close to perfect proportions, the eye is inclined to accommodate slight imperfections and fill in the gaps. Don't think that everything has to fit the formula exactly.

Last, remember that we often adjust things by eye to make a piece look lighter or better balanced, and we do so by using techniques that are part of the everyday woodworking vocabulary. They include the calculated use of grain direction to imply movement; highly figured grain to help the eye see curves where none exist; finished edges and corners that give the impression of thickness or thinness; the use of molding to adjust an apparent golden rectangle or solid; the use of tapered legs to give the appearance of more closely approximating an ideal proportion; and the mixing and matching of many other design paradigms. □

Graham Blackburn is a furniture maker, author, and illustrator and the publisher of Blackburn Books (www.blackburnbooks.com) in Bearsville, N.Y.

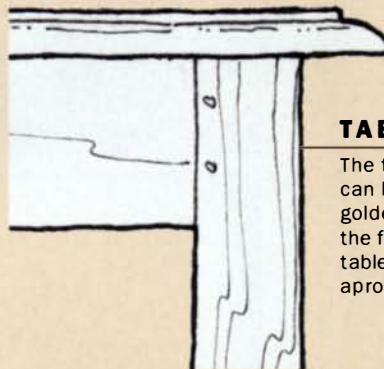


TABLE DIMENSIONS

The tabletop, legs, and apron can be determined using the golden ratio. In this example, the fillet to roundover, the tabletop to leg, and the leg to apron are related by phi.



Joint-Making Machines

A review
of router-driven
tools that make
quick work
of mortise-and-
tenon joints

BY
MICHAEL
STANDISH

Compared with more fundamental equipment such as jointers, mortise-and-tenon machines, or jigs, are woodshop luxuries. They can feature ingenious and sophisticated designs, but in the end, like dovetail jigs, they are adjuncts to routers. Jigs are not cheap either: The models surveyed here are priced from a little over \$400 to about \$700, router not included. With some forethought and care in the making, serviceable shop-made versions are fairly straightforward and inexpensive to construct. So why buy a factory-made one?

A proper jig serves two basic woodworking functions: securing a workpiece and guiding a cutter. The jig should perform without surprises and without

LEIGH FMT JIG

Price: \$689

Source: www.leevalley.com

800-663-8932

The FMT in the name stands for frame mortise and tenon, and this machine was specifically designed for making these joints. Leigh's pin-and-template guide system is as close to foolproof as I can imagine anyone could make it. The auxiliary baseplate has two tapered pilot pins that engage slots in a template for mortising, and they ride the perimeter of the same template to mill matching tenons. Raising or lowering the pins alters the fit of the joint in repeatable 0.001-in. increments. Templates provided with the standard unit allow for more than 20 sizes of mortise-and-tenon joints; additional guides are available individually or in sets, which will give you up to 50 different sizes of joints to cut. For angled work, such as that often found in chairs, the clamping plate can be swiveled up to a setting of 30°.

At about 18 in. wide by 12 in. deep by 9 in. high, the Leigh jig is compact to the point of being portable, and its looks—sporting an exceptional level of finish and engineering—are not deceiving. In operation, this jig was exceptionally smooth and precise. Also, the owner's manual was refreshingly comprehensive, clear, and concise.



Guidance system is finely tuned. Visible on the left and right of the underside of the baseplate are the two tapered pins that engage grooves in the two black plastic inserts fitted into the top of the table. By changing the inserts you can cut various sizes of matching mortises and tenons.



Align the workpiece. Scribe pencil lines on the workpiece at the center-line of the joint. Align them with crosshairs on the sliding black plastic alignment gauge.



Secure the workpiece. Two cam clamps accommodate any thickness up to 3 in. and any width up to 5 in. The stock length is limited by how high the jig is mounted off the floor.

**Watch it
on the Web**

To see a joint-making machine in use,
go to www.finewoodworking.com.

fail. Also, a jig should enhance the advantages of machine joinery by adding control (and thus precision) and speed to the process. The jigs in this article meet all of these demands, allowing you to cut a mortise-and-tenon joint in the time it takes to hone a chisel. Although some of them also feature ways to cut other joints (through-, half-blind, and sliding dovetails; box joints; dadoes; fancy pin-and-crescent joints), for this review I wanted to learn only

how well the jigs could cut basic mortise-and-tenons—the most commonly used joint in furniture and cabinetry.

The makers of these machines have already done much of the head-scratching for you (How to center the cut? Will the clamps interfere? Is the router adequately supported?). The streamlined clamping arrangements of these very different designs drastically reduce stock-handling hassles, and their refined adjustment mecha-

nisms allow precisely and predictably fitted joints.

All of these jigs will require an hour or longer for assembly, and you'll need several times that to familiarize yourself with how they work. Some particular operations, such as cutting the joints for a set of different-size cabinet doors, will entail additional



Price: \$699

Source: www.woodworker.com

800-645-9292

time for individual setups. Regardless of your woodworking style or mechanical aptitude, the latter prep work typically is measured in minutes, while the machining itself takes even less time. Results, of course, will vary. But with a good router and a sharp bit, you reasonably can expect to produce between one and four consistently crisp mortises or tenons per minute with any of these jigs.

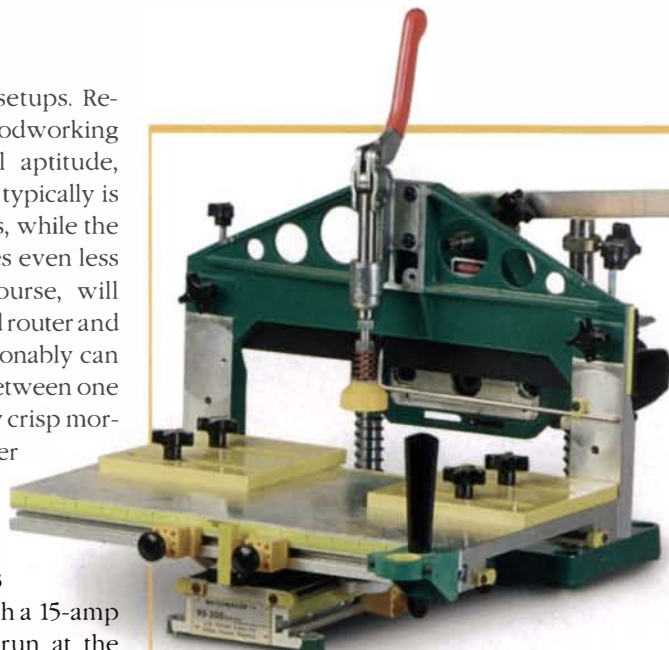
Testing procedures

I tested these jigs with a 15-amp Elu plunge router, run at the same speed setting, using the same solid-carbide spiral upcut bit. I machined mortises and single tenons, approximately 1 in. by 3 in. in profile, with all of these jigs. Material for the test samples came from the same bundle of mahogany-like substitute decking purchased from a local lumberyard. I tested these machines by cutting roughly two dozen mortises and two dozen tenons on each of them.

I then measured the results with a dial caliper. Manufacturers of polyvinyl acetate adhesives (most conventional white and yellow glues) usually recommend tolerances within 0.005 in. for optimum performance. Shooting for this level of accuracy may seem pretty ambitious, but attaining such precision goes a long way toward justifying the use (and, not incidentally, the purchase) of one of these jigs, even for relatively small-scale production work. The majority of all of the test samples measured within 0.002 in. of their intended dimensions—well within the tolerances recommended by adhesive manufacturers.

The choice is not only budget-driven

In a survey like this, it's customary to choose a winner, but on this score I feel a bit like a bus



Mortising with the MatchMaker will be familiar to anyone who's ever used an industrial-level horizontal mortising machine. The design is similar to that of the JDS Multi-Router (see p. 56). For mortises, the workpiece carriage is levered in and out and left to right along roller bearings on guide rods, moving against a router that is mounted horizontally in a fixed position. For these X and Y axes movements, you can use a simple tapered handle or a pivoting joystick, depending upon the range of motion required to cut a given joint. The tapered handle provides a larger range of motion.

For tenons, the router carriage is freed so that its integral stylus, or guide pin, can bear against a template, and the router is moved up and down on a Z axis with a sturdy, pivoting handlebar. The operation is like a cross between a duplicating lathe and a pantograph, and although it takes a bit of getting used to, it's more complicated in the telling than in the milling. The tenon templates are made to be 0.003 in. to 0.005 in. smaller than their nominal size. The manufacturer (Woodtek) recommends fine-tuning the fit of the joint by wrapping one or two layers of cellophane tape around the stylus.

The MatchMaker is the only jig that I surveyed that mills tenons with the workpiece oriented horizontally. As a result, it will accommodate long workpieces, such as bed rails and aprons for large dining tables, without the operator having to modify or adapt the machine in any way.



Secure a template to cut a tenon. The yellow plastic template is fastened into threaded holes in the yoke assembly with two Allen-head screws.



Locate the tenon cut. Vertical adjustments in the yoke assembly will affect where a tenon is cut on the workpiece. The steel stylus shown here is mounted at a fixed distance from the cutter, and you can use either the small or large end of the stylus to follow the template, which affects the size of the cut.



Center the workpiece on the sliding table. A toggle clamp holds the workpiece tight to the sliding table, and two yellow plastic plates bear against the edges of the workpiece to prevent any lateral movement.



QUICKTENON

Price: \$418

Source: www.quicktenon.com; 301-746-8092

In the midst of handsomely finished, powder-coated or anodized-metal, and precision high-tech plastic extrusions, stands the modest-looking QuickTenon. Bare bones it is, but in the best sense. It is essentially a freestanding plywood table with a built-in side vise and a sliding phenolic plate. A router-mounted collar guide tracks against the center slot of this plate, whose left-to-right travel is limited by adjustable stop blocks. Placing shim stock (or an automotive feeler gauge) between block and plate makes for simple, accurate, and virtually instantaneous adjustments. This fixture also is designed to mill dovetails, such as for a table's apron-to-leg joints, and flipping a small sub-plate allows you to change from making the usual round-end tenons—matching the profile of its router-bored mortises—to square ones, such as you'd want for through-tenon work.

Built-in vise holds the workpiece in place. The crank (at left in photo) controls a plywood box that pushes against the workpiece to hold it secure. The top surface of the workpiece should be flush with the top of the plywood table.



Adjust the plate to center the cut. The phenolic plate rides left to right on four loose bearings that rest on the plywood tabletop and is held in place by the two aluminum bars on both ends.



Round or square tenons. By varying the shape of the adjustable inserts in the phenolic plate, you can cut either round or square tenons.

WOODRAT

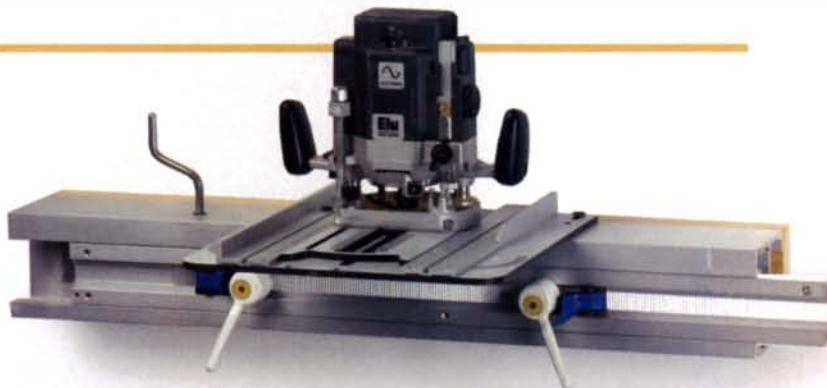
Price: \$545

Source: www.woodrat.com; 866-966-3728

Although you can make a stand for this fixture, the recommended wall-mounting (the manual provides details) is better because it's simpler, sturdier, and saves floor space. Unique to the WoodRat is a power feeder that moves the workpiece side to side against the router bit, which is mounted vertically overhead. Although the power feeder is a hand-cranked system, it's a smooth and sure way of climb cutting. Workpieces are held in place against an aluminum angle by a locking cam lever that slides along a slotted track. The slotted track, aluminum stop, and brass gauge blocks and spacers all speed up the setup time required for making joints with this jig. An overhead plunge router is mounted to a sliding plate that can be moved front to back.

The WoodRat produces square-edged tenons and rounded mortises, so you'll have to either round off the corners of the tenons by hand or chisel out the mortises to get matching profiles in the finished joint.

The manufacturer also offers a smaller version of this jig, called the LittleRat, with similar but more limited cutting capacities. It's available for about 40% less money, but the sizes of the workpieces you can process with it are smaller.



Cam clamp holds the stock in place. A cam clamp slides along a slotted track and presses the workpiece against a sturdy piece of aluminum angle.



Climb cuts are cleaner. You can virtually solve the problem of chipout on the leading edge of the router cut by moving the workpiece in a clockwise direction around the cutter.

driver sent to test Ferraris against Porsches. For machine joinery, all of these jigs are impressively precise and almost laughably fast once you overcome the initial learning curve.

The Leigh (p. 53) and the QuickTenon (p. 55) are faster in setting up, fine-tuning, and machining mortise-and-tenon joints. The MatchMaker (p. 54) and the WoodRat (p. 55) sacrifice some of this lightning speed in the interest of greater joinery versatility, such as cutting dovetails and louvers. And because the MatchMaker is the only one of these machines that mills tenons with the workpiece oriented horizontally, it will accommodate much longer workpieces more easily than any of the other machines.

Anyone accustomed to routers will feel at home with the Leigh and the QuickTenon. The MatchMaker and the WoodRat initially may seem a bit foreign, but the former's long levers and the latter's stock-feeding system offer exceptional cutter control.

The Leigh, which is easily stored away when not needed, and the WoodRat, which requires minimal floor space, will appeal to woodworkers whose shop space is at a premium.

In the end, I think any of these jigs is worth considering for the combination of speed and precision they offer. Such classic shop variables as available space and the scope or style of work that you do make it difficult to provide a one-size-fits-all recommendation. If you're thinking of buying one of these tools, you might want to remember this: All of these machines come with an unconditional 30-day (or better) guarantee, which would give you a month in which to be your very own final arbiter. □

Michael Standish does custom trim carpentry and cabinetwork jobs in a garage shop just south of Boston.



Handle controls each axis. With the Multi-Router, you have a separate handle for each of the X,Y,Z movements this machine will execute. Van Benten has used this machine in a production shop for more than 10 years, and he reports that the linear bearings on which the tables ride still work flawlessly.

running on ground steel rods attached to ground aluminum tables. The table motion is absolutely effortless, and there is no discernible play in the bearings. The rods have flexible, movable collars and easy-to-adjust stops. In our shop, we clamp pieces as large as bed rails to the table with minimal outboard support, and we get joints that are uniform and repeatable.

The tables come from the factory drilled out with a series of holes to accommodate either manual or pneumatic clamps. If you have a compressor, the air clamps are much faster and stronger than the manual clamps. They hold the work with unbelievable tenacity and facilitate very quick changing of parts.

The holes in the horizontal table allow instant setup for basic angle cuts. Hard plastic buttons fit in the holes in various patterns to create standard angles. We use this feature to mill the ends of large parts for multisided frames, after cutting the parts to approximate size on the bandsaw. The resulting joints are perfect, without the problems you get when using a tablesaw. The setup for angled cuts is not any more difficult than the setup for straight cuts.



Templates guide the cut. This machine comes with 42 different templates and inserts to use with various sizes of router bits. A steel stylus on the vertical router table traces the patterns, which are mounted on the horizontal table.

The JDS Multi-Router is in a class by itself

BY JOSEPH VAN BENTEN

Price: \$2,595

Source: www.thejdscompany.com
800-480-7269

Soon after I started to make furniture for a living, a quick and accurate way to make mortise-and-tenon joints became a necessity. In 1992, when I first saw the Multi-Router, made by the JDS Company, I bought one on the spot. This essentially is a small milling machine, powered by a portable router, with a table that moves on X and Y axes. The workpiece is clamped to this table. There is also a vertical table, to which the router (equipped with a spiral-upcut bit) is mounted horizontally, and this table provides a Z-axis motion.

The beauty of this machine is in its construction. The range of motion is supplied by linear roller bearings run-

ing on ground steel rods attached to ground aluminum tables. The table motion is absolutely effortless, and there is no discernible play in the bearings. The rods have flexible, movable collars and easy-to-adjust stops. In our shop, we clamp pieces as large as bed rails to the table with minimal outboard support, and we get joints that are uniform and repeatable.

Another feature of the Multi-Router is a stylus mounted on the vertical table that contacts and traces patterns mounted on the horizontal table. The stylus arrangement requires considerable setup time, and it does allow some objectionable flex in the cutting. Varying the pressure against the stylus can have an impact on the thickness of a milled part.

We use this machine to make mortises, tenons, and loose-spline joints. After 12 years of use, this machine is holding up beautifully. As a matter of fact, it has outlasted three routers. □

Seeing Better in the Shop

Lighting and magnification bring work into bright, sharp focus

BY JEFF MILLER



It's nearly as inevitable as death and taxes. As we get older, we begin finding it a little harder to see some of the small things that are so crucial to woodworking. Whether it's 1/2-in. graduations on a ruler or scribed lines on a mortise-and-tenon, our eyes are less able to focus sharply on close work as we age. And that can be a problem because accurate work requires visual acuity.

One of the biggest hurdles for most people is to admit that the problem exists. But denial, effective as it is with so many problems, doesn't help with presbyopia (the weakening of the eyes with age). So before doing anything else, get your eyes examined. A good pair of glasses with the proper prescription is a big step toward helping you to see better.

In the shop, however, it might take more than eyeglasses to get everything in focus. Woodworking poses some interesting visual challenges. You not only need to see clearly in a specific area, but you also must have a broad field of vision. You need sharp focus at

a variety of distances, and you need good overall depth perception. You also need two hands free to use tools. Nothing out there is going to solve all of these problems at once, but as I discovered, a number of products on the market can help. Many of them are useful even for woodworkers with good vision.

Add light where you need it

Let's start with the basics. Good lighting is a must (see *FWW* #154, pp. 56-61), but as we age, it's even more important. That doesn't necessarily mean your shop needs to be rewired. Carefully con-

LIGHTS WHERE YOU NEED THEM

Although we see best when there is plenty of available light, many woodworkers toil in shops in which the overhead lighting is far from ideal. The solution can be as simple (and inexpensive) as putting a few task lights in the dimly lit areas of the shop.

AT MACHINES



Thanks to its magnetized base, this utility light mounts instantly to any iron or steel surface.

AT THE BENCH



An inexpensive desk lamp, clamped to the workbench, provides a portable source of concentrated light.

trolled lighting can improve how you see. To supplement the overhead lighting in my shop, I frequently employ task lights at the workbench and at machines.

Overhead, well-diffused light generally is the best for a woodshop. It minimizes shadows that make it harder to see what you're doing. That's why fluorescent lights work well in the shop. When enough of them are properly located, they give even illumination without harsh shadows.

Make use of magnification

Putting a lens between your eyes and your work can make things look either sharper or bigger. And when it comes to lens products, there is no shortage out there: The options range from prescription

Tips for tired eyes

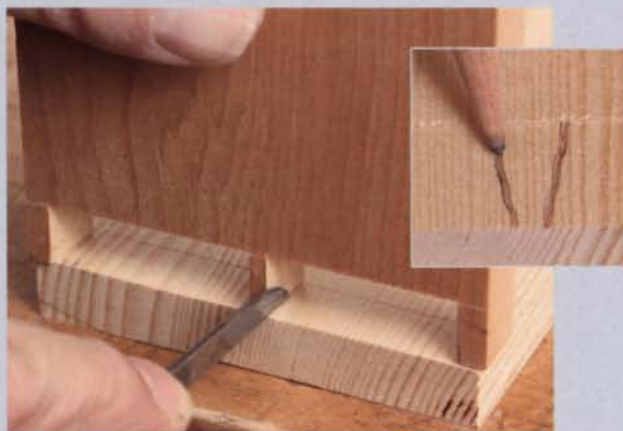
Over the years, as aging eyes slowly blurred my vision, I've discovered a few tricks that help take some of the workload off my peepers.

For example, after scribing a dovetail layout line with a marking knife, I find it helpful to run a pencil along the same line. The result is two pencil lines, one on each side of the knife line. When one of the lines is fully cut away, I know I'm right on the mark.

I've also learned to love a dial caliper. It isn't always a good substitute for a ruler, but a dial caliper helps in a lot more situations than you might think, and you actually can increase your accuracy wherever you use one. The large dial lets me read increments as small as $\frac{1}{4}$ in. with minimal eye strain.

I've also tried to work out ways to avoid the use of a ruler altogether. Instead, I prefer to use jigs or story sticks that eliminate any need for measuring.

HIGHLIGHT SCRIBE LINES WITH A PENCIL



After scribing a line with a marking knife, retrace the line with a dull pencil, effectively highlighting the scribe line.

OVERHEAD

A plug-in, ceiling-mounted halogen light offers a quick and easy way to add a good measure of extra brightness.



HEADLAMPS



When wearing a headlamp, eyes and light point in the same direction, and both hands are free to work with tools.



glasses that sit on your nose to a dinner-plate-size lens that sits on your bench.

If you don't wear glasses, you have it a little easier than the rest of us. You can buy a wide variety of nonprescription reading glasses, also called readers, from any number of sources, such as drug stores, grocery stores, and Internet sites. They are available in a variety of strengths. Readers simply are magnifying lenses that help bring near objects into better focus. They don't necessarily make things look bigger.

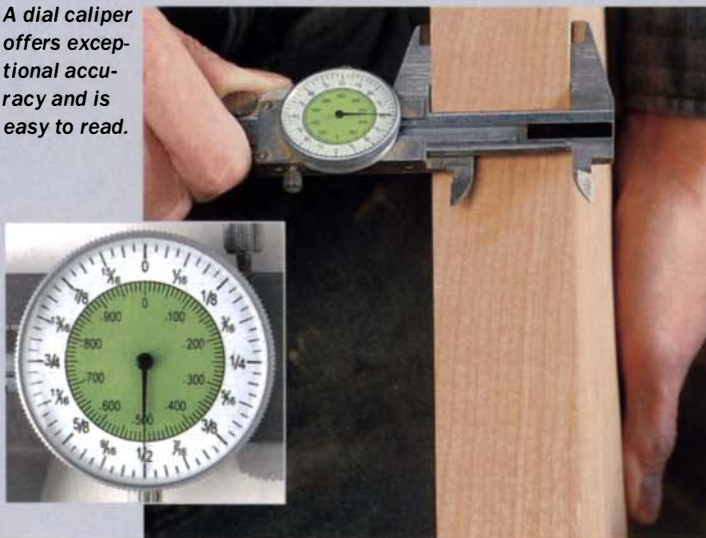
Another option is to go to an optician or optometrist for prescription reading glasses. When shopping for either prescription or nonprescription reading glasses, you should bring a ruler and tape measure, not only to check if you can see all of the gradu-

tions but also to pay attention to the working distance, or focal length. When looking at an object through a pair of glasses, the focal length is the distance from the lens to the object when the object is in focus. Depending upon what you are doing, the focal length is going to be different. For example, if you're using the tablesaw, glasses that provide a focal length of around 30 in. are best. But when cutting dovetails, you might want the focal length to be in the 12-in. to 20-in. range.

It helps to know the focal length in advance by checking it for various tasks in the shop. Once you've settled on the power, or powers, of magnification you need (you might want more than one), you only have to choose a style of glasses and figure out a way to keep them handy. I bought a pair from my optician, but the

MEASURE WITH A DIAL CALIPER

A dial caliper offers exceptional accuracy and is easy to read.



CUT WITHOUT MEASURING



A story stick, with important dimensions marked along one edge, allows you to make machine cuts without repeated measuring.

LENSES BRING WORK INTO FOCUS

Woodworkers have plenty of good options when it comes to choosing magnifying lenses for workshop use, including those that slip on, stick on, strap on, and flip up.

EYEGLASSES

NONPRESCRIPTION READING GLASSES

You can find them in several strengths at drug stores, grocery stores, and on the Internet.



CLIP-ON MAGNIFIERS

When extra magnification is needed, simply clip these lenses onto a pair of reading glasses or prescription glasses.



nonprescription glasses are available on the Internet and from woodworking catalogs, too.

A couple of manufacturers make safety glasses with bifocal lenses. These are worn either with or without eyeglasses and are available in a variety of standard strengths. I ordered a pair and found they worked very well. They were fully adjustable for fit and very comfortable, even over my regular glasses. I still prefer a corrective lens that covers the full visual field.

Recently, I tried a pair of safety readers that functioned well. Either way, it's great to have safety glasses combined with vision correction.

Head-mounted magnifiers are available in a wide

variety of styles and magnifications. The lower powers of magnification are much more practical in woodworking because the focal length is more useful. A 1.75-power magnifier has a focal length of about 20 in., which is almost perfect for laying out and marking lines, cutting dovetails, paring with a chisel, and the like. The magnification is just enough to make objects appear sharper, without distorting the image.



Flip up clip-ons. Clip-ons with a flip-up feature require only an instant to switch from one lens strength to another.



STICK-ON LENSES

Prescription lenses can be transformed into bifocals by applying stick-on bifocals available at many drugstores.

Freestanding magnification—Some magnifiers simply sit on or attach to a workbench. With one of these types of magnifiers, you don't have to change your glasses to do close work. But magnifiers also have limitations: They must be moved to the work, or the work must be moved to them; they have a smaller field of vision; and they don't always allow room to get a tool between the lens and the workpiece.

Illuminated magnifiers, sometimes called articulated-arm magnifiers, are useful when doing layout, inspection, and close work, particularly when tools aren't required. I find them especially useful when taping intricate veneer patterns. If you have a choice, look for one with a lower magnification because it will have a longer focal length. Also, I prefer one with a large diameter because it has a wide field of view to help reduce distortion. Illuminated magnifiers with a circular fluorescent bulb provide an even, shadow-free light.

Of course, it's unrealistic to expect any of these products to give you back the vision you had as a teenager. But they can help you see better. Just bear in mind that most of these products require some extra time to get used to them. However, once you become accustomed to these optical tools, you just might find your eyes are enjoying woodworking as much as you are. □

BIFOCAL SAFETY GLASSES

Safety glasses with bifocal lenses are another option. Some brands will even fit over prescription glasses.



Jeff Miller is a furniture designer, craftsman, and teacher in Chicago.

MAGNIFIERS

HEAD-MOUNT MAGNIFIERS

Compared with eyeglasses, these magnifiers provide a bigger image on a smaller field of vision, which is useful for detail work.



CAP-MOUNTED MAGNIFYING LENS

Some magnifiers simply clip to the bill of a baseball cap.



Flip up or down, as needed.
With a clip-on magnifier, you just flip down the lens when you need a closer look.



RULE MAGNIFIER

With its magnetic base, this gadget sticks to a steel rule, making it easier to read increments as small as $\frac{1}{16}$ in.



Illuminated magnifier. With a built-in light and an extralarge lens providing a wide field of view, illuminated magnifiers are useful for close layout and inspection.

SOURCES

HALOGEN CEILING LIGHT

Hartville Tool
800-345-2396

DIAL CALIPERS AND HEAD-MOUNT MAGNIFIERS

Highland Hardware
800-241-6748

RULE MAGNIFIER

Veritas Tools
800-871-8158

CAP MAGNIFIER AND HEADLAMP

McFeely's
800-443-7937

BIFOCAL SAFETY GLASSES

Klingspor
800-228-0000

Splay-Legged Table

Straightforward design
with a refined flair

BY GARRETT HACK

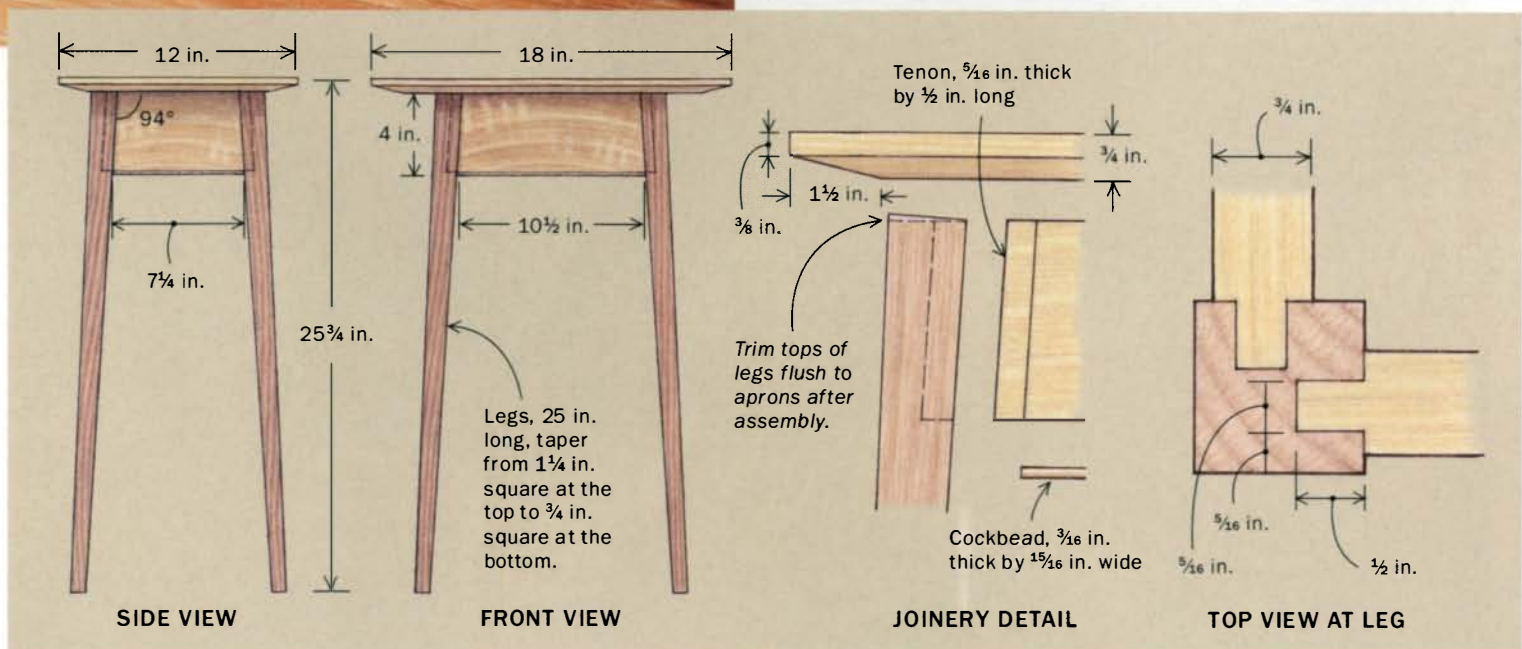
Few furniture legs are as elegant as square, tapered ones. Splay those same legs, and your table will have a personality quite out of the ordinary. This small table is a perfect project for you to demystify tapered and splayed legs and add them to your skills as a designer and craftsman.

I took a simplified approach to both hand and machine work. I used a pattern to lay out and build the table legs, which taper from top to bottom on all sides, creating an elegant profile.

The table is constructed using machine-cut joinery. I've even designed in cockbeads to hide any discrepancy of the mortise at the bottoms of the aprons. Finally, the tabletop features an elegant, underside bevel.

Make a pattern to lay out all four legs

Because of the taper and splay of the legs, a three-dimensional leg pattern will prove useful and will ensure uniformity. To make the



A pattern makes layout and tapering easy



1

LAY OUT THE LEGS ON ROUGH STOCK

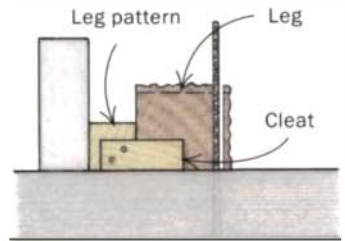
Use a three-dimensional pattern to lay out the table legs. Cut each leg oversize on the bandsaw and joint two adjacent faces.



2

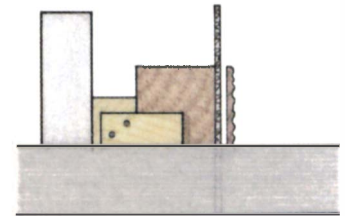
TAPER THE LEGS

Nail a small wood cleat to the bottom of the leg pattern and use it as a guide to rip the leg tapers.



1. Place the jointed faces of the leg against the leg pattern and the bandsaw table to cut the first taper.

2. Rotate the leg clockwise so that the freshly sawn face is on the bandsaw table. Then cut the second taper.



pattern, lay out pleasing tapers on all four faces of your stock with a straightedge, cut to the lines on the bandsaw, and then refine the shape with a bench plane.

Use the leg pattern to lay out the entire set of legs. Rather than cutting square legs and then tapering them—which wastes material and time—use the bandsaw to cut out each tapered leg from the rough plank. The advantages are that you can lay out the cuts with the taper of one leg nested opposite the next (for the least waste), and find the most pleasing grain pattern for each finished leg. This method probably will save you enough material for an extra leg, worth having in case of mishaps. Allow about $\frac{1}{8}$ in. to $\frac{3}{16}$ in. of extra width in each rough leg blank, and 1 in. to 2 in. of extra length.

Next, joint two adjacent faces of each leg square to one another. Look for the best two faces, keeping in mind that minor defects can be removed when cutting to the final tapers. While you're at it, mill up an extra piece of scrap, squared to match the tops of the legs and as long as the legs. This scrap will be ripped to exactly double the taper angle of the legs. It will be a long, tapering wedge that will be used to help you cut the outside mortises.

Now use the leg pattern as a tapering jig

Because the legs taper top to bottom, you can use the leg pattern as a tapering jig to cut the two remaining faces of each leg. The pattern ensures that the legs are tapered equally on all four sides and are identical. Don't cut the legs to length just yet. Instead, tack a

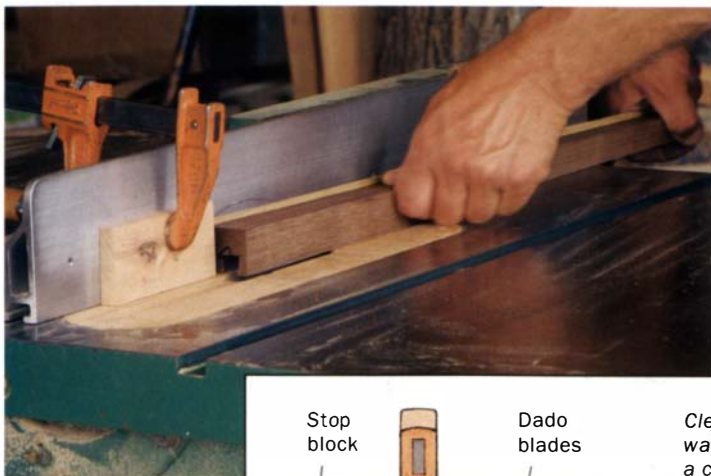


3

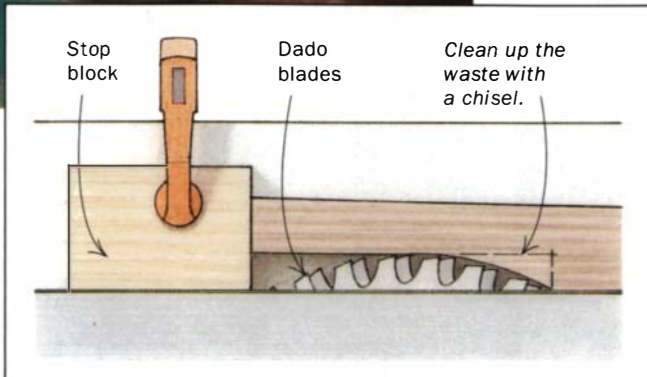
CROSSCUT THE LEGS

Tape two spacers at a 90° angle, then secure them to the fence to hold the leg at a 94° angle during crosscutting.

Use a dado set to cut mortises



Stop block ensures consistent results. Place a stop block a few inches behind the dado blades. After the cut, turn off the saw and wait for the blade to stop before removing the leg.



small wood cleat to the bottom of the leg pattern to act as a stop for the leg blank. One of the jointed surfaces should be against the leg pattern, and the other against the bandsaw table. Set up a rip fence on the bandsaw so that the resulting cut on the leg is close to the dimensions of the leg pattern.

After the first pass through the saw, rotate the leg clockwise so that the freshly sawn surface rides along the bandsaw table, and one of the jointed faces rides against the leg pattern. Cut all four legs, as well as the extra leg, using the same rip-fence setting.

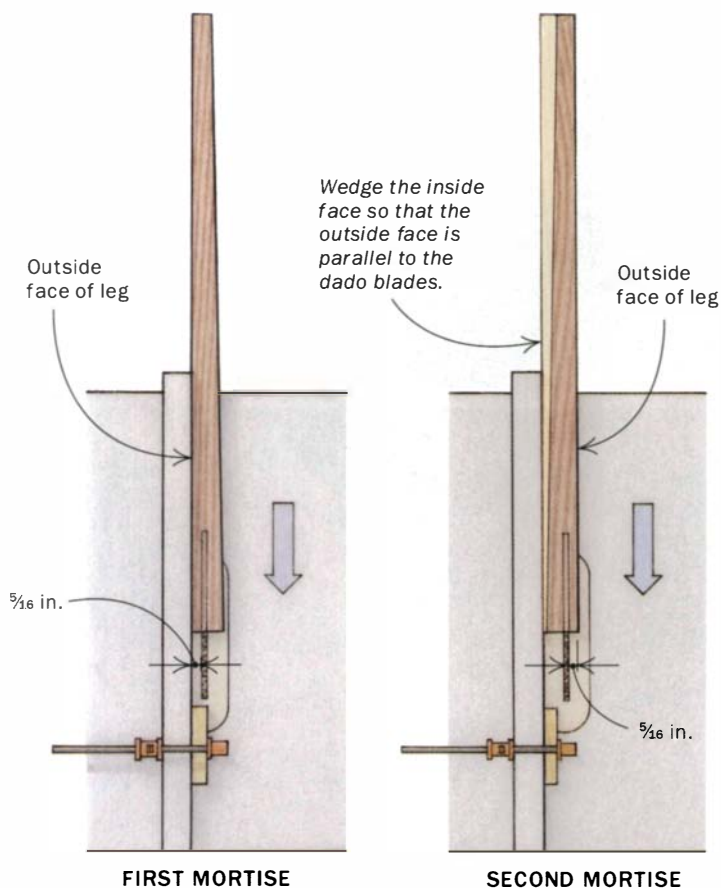
Clean up each sawn surface with a long bench plane (a No. 5 works well), checking that adjacent surfaces remain square. With the legs slightly long, small variations in width can be accounted for by cutting off more or less from the top of the leg. Make tick marks at this point to denote the top of each one.

To crosscut the leg tops to that rough length, make a guide using two small tapered spacers, taping them in an L-shape and then taping that to the table saw's miter fence. The sticks provide enough fill behind and beneath the legs to hold them square to the blade during the cuts. Each of these four cuts demarks the top of a leg but is not intended to be a finished cut. So after the table base has been assembled, the tops of the splayed legs will not align with the tops of the aprons and will have to be leveled with a handplane.

An advantage of legs that are tapered top to bottom is that, at this stage, any leg can be placed in any position in the table. Rotate and shift the legs around to get harmonious figure on the outside faces. Mark these faces with a bright crayon, and mark the position of the leg with a 1 (front left), 2 (front right), 3 (rear right), and 4 (rear left).

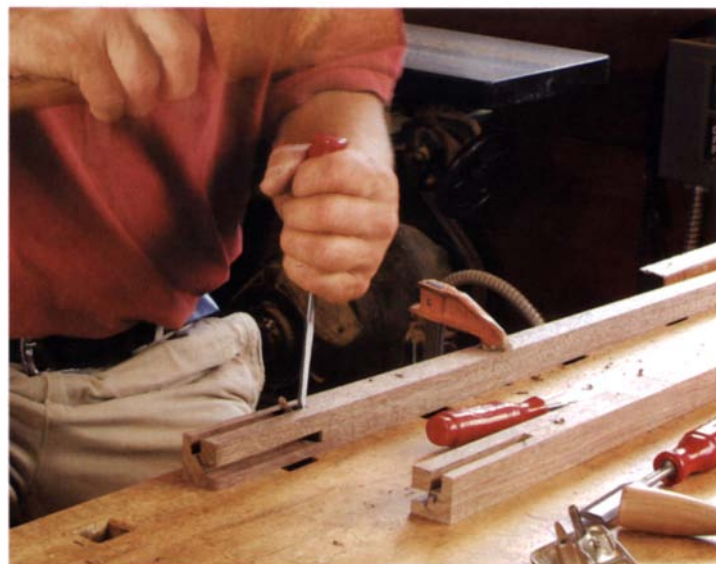
Determine the splay angle

Now that all of the leg tapers have been cut, it's time to decide on a pleasing angle of splay—the angle of the legs in relation to the aprons (for this table the splay angle is 94°). The easiest way to do



TABLESAW SETUP FOR MORTISING

One mortise on each leg is cut with the outside face against the fence. The second mortise is cut with the outside face away from the fence. A wedge is used for alignment.



Chisel out the mortises. The dado blades can't cut a square mortise. You'll need to square up the bottom edge of each mortise with a chisel and mallet.

Angle the apron ends to create the splay



Determine the leg-to-apron taper angle. Set a bevel gauge to match the angle at which the legs will meet the aprons.



Set the miter-gauge fence angle. Place the tongue of the bevel gauge against the blade. Then adjust the miter-gauge fence until it sits flat against the bevel-gauge fence.



Cut the aprons to length. When determining the lengths of the front, rear, and side aprons, be sure to account for the 1/2-in. tenons on the ends.



Tablesaw makes fast work of angled tenon shoulders

Cut the tenons with the help of a tenoning jig. To ensure accuracy, cut tenons on scrap stock until you get a perfect fit in the mortise.



Clean up the shoulders. First backsaw the waste, then hold the end of each apron against the fence to cut the shoulders.



Carve screw pockets. Cut triangular screw pockets near the top of each side apron. The pockets make for quick and neat tabletop attachment.

Glue up the base first



Assemble two sides first. If the splay angle is minimal, as in this case, there is no need to add wedges under the clamps.

this is to create a quick mock-up on the benchtop of two legs and one apron. The splay angle should be the same on all sides of the leg. From this same setup you can mark out the cut at the tops of the legs.

Mortises can be cut quickly on the tablesaw

The $\frac{5}{16}$ -in.-wide mortises are cut on the tablesaw with a dado set raised to make a $\frac{1}{2}$ -in.-deep cut. For the first mortise in each leg, set the fence $\frac{5}{16}$ in. from the inside face of the blade. Clamp a stop block against the fence as far from the leading edge of the blade as the aprons are wide—in this case, $3\frac{3}{4}$ in. The first mortise is cut with the outside face of the leg against the fence (see the bottom left drawing on p. 64). The safest way to do this is to pass each leg through the saw until it hits the stop, turn off the saw, and then lift the leg off the blade once it stops spinning.

The second mortise in each leg is made with the outside face of the leg away from the fence (see the bottom right drawing on p. 64). Place the long wedge (cut earlier) between the leg and the fence, with the thin edge forward, so that the cut will be made parallel to the leg face away from the rip fence and identical to the first set of mortises. Move the fence so that the cut is made $\frac{5}{16}$ in. from the outside face. Again, cut up to the stop and lift off the leg.

Chop out the wood remaining at the bottom of each mortise where the blade could not cut full depth. If you want to be very precise, the lower end of the mortise should be cut at the taper angle, or undercut somewhat. But the more important point is to make sure that the mortises all are the same length relative to the top.

Tenons follow the angle of splay

Mill up the table aprons and rip them to width. Set the tablesaw's miter gauge to the splay angle, and cut each apron to length at this angle, accounting for the length of both tenons (see the photos



Glue in the front and rear aprons. Tap the aprons into their mortises with a hammer and block.

on p. 65). Be sure to mark the outside face of each apron and the top edge, which is shorter than the lower edge.

Using a tenoning jig on the tablesaw, cut one of the cheeks on each apron. The apron will tip slightly forward or backward because it is resting on an angled end. Cut a little less than full tenon height. Once this first cheek has been sawn, reset the saw for the second cheek cut. The most accurate way to reset for the remaining cheek cut and perfectly sized tenons is to begin by cutting some scrap pieces. By initially measuring and then by trial and error, make the second cheek cut on scrap until the tenon just fits the mortise. Then you can make the remaining cheek cuts on the remaining aprons with confidence.

Cut away the waste with a backsaw, keeping well away from the shoulder line. This removes wood that can drop onto the tablesaw blade in the next step and come flying out.

Using a miter gauge on the tablesaw to cut angled shoulders can be tricky but is possible if you mark carefully and stay focused. Far simpler is to guide the angled end of each apron against the fence and cut identical shoulders. Lightly wax the table and fence and set the blade height to less than the shoulder depth (you don't want to

Plane the legs flush, then add the bead and top



Plane the top edges flat. A low-angle plane is the best tool for planing the tops of the legs flush with the aprons.



Install the cockbeading. After cutting the beading stock to length, secure it in place with glue and a few brads.

cut into the cheek and weaken the tenon). Guide each apron against the fence to cut all 16 shoulders. If necessary, trim the tenons with a shoulder plane.

Assembly is straightforward and fast

Before assembly, chop small, triangular pockets on the inside faces of the two side aprons. These pockets will house screws to attach the top. Finish planing each leg and apron, and chamfer all edges except the top outside edge of the aprons.

Glue up the two side assemblies first, seating each apron against the bottom end of its mortise. With such an easy glue-up, you can add the front and back aprons right away. If all has gone well, the tops of the legs and aprons will nearly align, needing only a small amount of leveling with a plane once the glue has set. Take extra care planing across the tops of the legs to avoid chipout.

Cockbeads and beveled top add elegance

The cockbeads add a decorative touch, plus they eliminate the need for a shoulder on the bottom edge of the aprons. They are a



Screw the tabletop onto its base. Chamfer the underside of the tabletop to give it an appearance of lightness, and attach it to the base with screws.

little wider than the apron thickness and cover any small gaps in the leg-to-apron joint. Cut the cockbead profile with a scratch stock or router, using stock that is wider than the thickness of the aprons. Rip off the bead, bevel, and fit the ends against the legs. Glue them in place and clamp or secure them with a few brads. I projected the bead about equal to the radius of its edge profile. Plane or sand the inside surface of the apron and cockbead flush with each other.

Cut out a top and bevel the undersides of the edges. I made the major bevel cuts on the tablesaw and refined them with a plane. Chamfer all edges. Attach with screws and finish the table. □

Garrett Hack is a contributing editor.



Cutting Coves on the Tablesaw

Safe, accurate methods
to make your own molding

BY STUART SABOL

Coves often are used as a decorative element in the design of furniture and architectural moldings. Whether in the feet of a chest, in a transition section between upper and lower cases, or in crown molding, coves create delicate shadow lines that accent and enhance a workpiece.

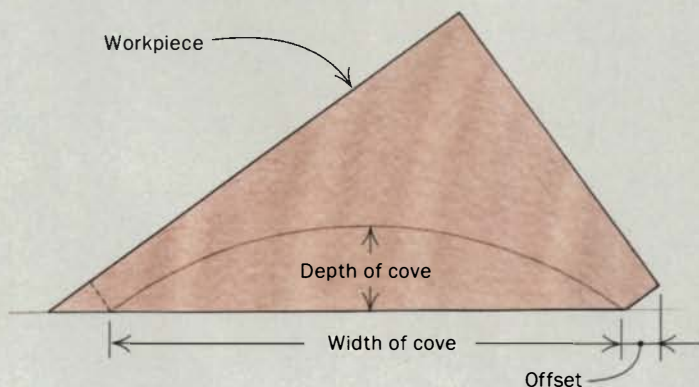
There are two broad categories of coves: symmetrical and asymmetrical. A symmetrical cove has its apex (highest point) in the center. The apex of an asymmetrical cove is offset from the center (see the photos and drawings on the facing page).

Large professional shops cut coves on a shaper, but few ama-

MAKING A SYMMETRICAL COVE

START WITH A FULL-SIZE DRAWING

To set up the tablesaw for cutting a cove, first make a full-size drawing of the desired cove. To vary the depth and width of a cove, adjust the height of the blade and the angle at which the workpiece approaches it. The cove's offset is determined by the distance between the fence and the sawblade.



Setting the blade height for a symmetrical cove. Raise the blade to match the depth of the cove. The blade is lowered after the setup to cut in $\frac{1}{8}$ -in. increments.

teurs can justify the expense of one of these industrial machines. The alternative method is to cut coves on a tablesaw; no expensive attachments are needed, and an infinite variety of coves is possible. The drawback, however, is that it can be difficult to set up the tablesaw to cut coves to precise shapes.

I use two methods that simplify the tablesaw setup: The first involves the use of a simple shopmade parallelogram for cutting symmetrical coves; the second uses a computer spreadsheet program to establish the correct angles when cutting the more complicated asymmetrical coves.

Symmetrical coves are cut with the blade at 90°

A cove has two defining dimensions: the depth of the cut that equals the height of the blade above the table, and the width of the cove measured at its base (see the drawing on the facing page). These two dimensions are varied by adjusting the height of the sawblade and by varying the angle at which the workpiece approaches the sawblade. Make a scaled drawing of the design or use a scaled plan, and measure the depth of the cove and the width at the base.

Use a shopmade parallelogram to set up the cuts—The parallelogram makes it easy to determine the fence angle for a symmetrical cove. The parallelogram is roughly 1 ft. by 2 ft. and is made from any straight-edged scraps of wood. Join the pieces with machine screws and wing nuts, and countersink the heads of the screws so that the parallelogram can lie flat on the saw table.

Raise the sawblade to match the depth of the cove. Measure the width of the cove and set the inside gap between the long sides of the parallelogram to match it. Lay the parallelogram on the tablesaw so that it straddles the blade. Rotate the parallelogram until the front tooth of the saw is just touching the front of the parallelogram and the back tooth is just touching the back (see the drawing below). Mark the front inside edge of the parallelogram. Set the miter gauge to this angle and use it to determine the angle of the fence. Before clamping the fence to the saw table, allow for the offset of

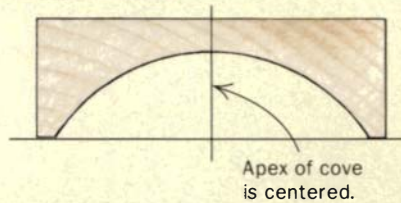
SYMMETRICAL VS. ASYMMETRICAL COVES

The waist and crown moldings on this cabinet were made on the tablesaw by feeding the stock across the blade at an angle. The symmetrical waist molding was cut with the sawblade perpendicular to the tablesaw top. The elongated crown molding was created by tilting the sawblade.



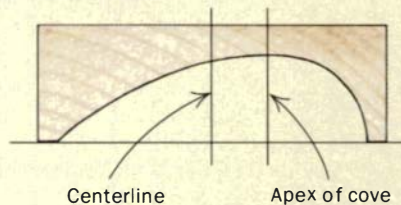
SYMMETRICAL

An upright blade produces a cove that has its apex at the center.



ASYMMETRICAL

A tilted blade produces a cove with an off-center apex.



USE A PARALLELOGRAM TO DETERMINE THE FENCE ANGLE

The shopmade parallelogram (about 1 ft. by 2 ft.) is made from scraps of wood, joined with machine screws and wing nuts. The screws are countersunk so that the parallelogram can lie flat.

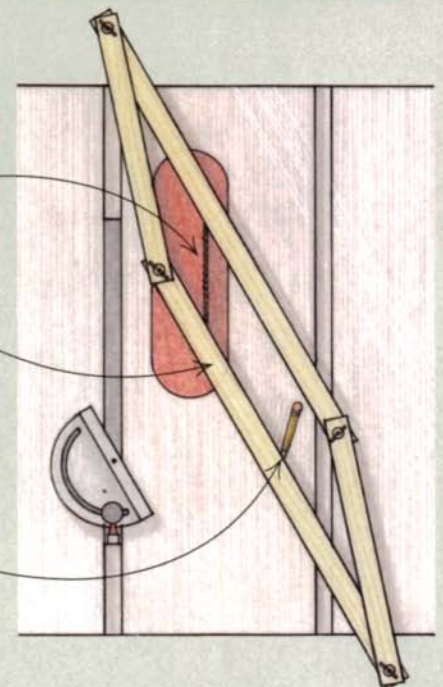


Setting the width. Adjust the parallelogram to match the width of the cove. Then place it on the tablesaw and rotate it until the teeth at table level just touch both sides.

1. Set the blade height to match the cove depth.

2. Set the width of the parallelogram (photo left). Rotate the parallelogram until its two internal long sides just contact the blade's teeth.

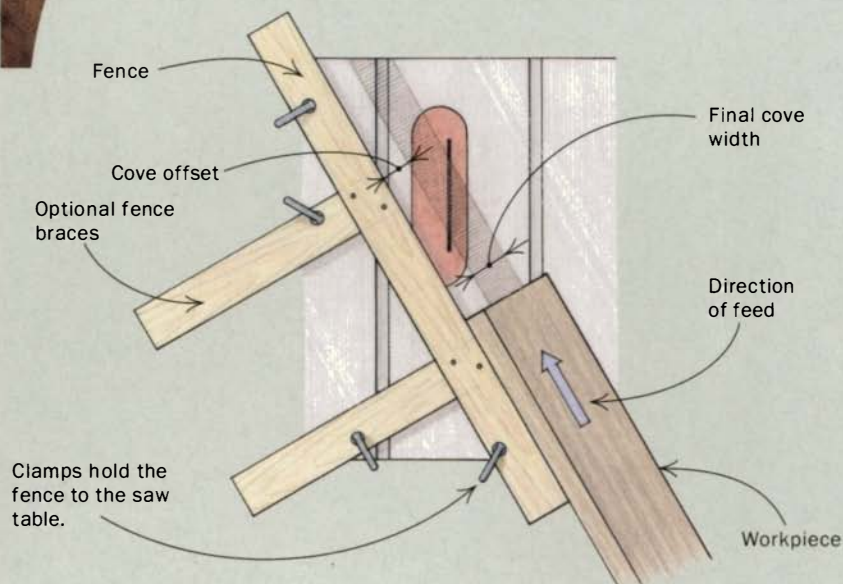
3. Draw a pencil line on the inside front edge of the parallelogram. Align the miter gauge with that line (see p. 70).



MAKING A SYMMETRICAL COVE (continued)

LOCATE AND SECURE THE FENCE

Rest the fence against the miter gauge and measure any offset required. The fence should be at least $\frac{3}{4}$ in. thick by 3 in. wide and jointed on two adjacent sides. Clamp both ends of the fence to the tablesaw. Add braces, if necessary, for additional support.



Set the offset. If the cove does not reach the edge of the workpiece, this gap, known as the offset, must be allowed for when setting the fence. The distance is perpendicular from the fence to the edge of the front sawtooth.

the cove from the edge of the workpiece. The offset is measured perpendicular from the fence to the closest blade tooth.

Symmetrical coves can be cut with one fence. It should be at least $\frac{3}{4}$ in. thick, 3 in. wide, and 3 ft. to 4 ft. long, jointed on two adjacent edges. (If it is difficult to set a clamp on the front rail, clamp braces to an extension table, as shown above.) If your design leaves the workpiece thin above the apex of the cove, add a second fence behind the sawblade to support the workpiece as you bear down on it. The rear fence also lessens the chance of the wood splitting along the line of the apex.

Lower the blade to just below the table, noting how many turns

of the handle this takes; as a backup, mark the final depth of the cove on the end of the workpiece. Make a dry run to practice the feed rate, to make sure the fence gives adequate guidance, and to check that none of the clamps is an obstruction.

Cut in small bites, and feed slowly—The cut is made by passing the workpiece at an angle over the blade rather than straight into the cutting edge. This means that the blade teeth are in contact over the full arc of the cove and remove a considerable amount of wood; therefore, a cove must be cut in small increments, no more than about $\frac{1}{8}$ in. at a time. Also, you need to employ a slow feed



Extend the range of angles. If your miter gauge has a limited range, cut a wedge, subtract that angle from the desired angle, and set the miter gauge to that angle. In this case, 75° is obtained by using a 30° wedge and setting the angle at 45°.

Coving with different miter gauges

There are two main variations in the graduations of a miter gauge: The first is the number of degrees that the fence of the gauge can swing through. Most gauges that come with a tablesaw can move through 120°, but some are restricted to 90°. Many aftermarket gauges can swing through 180°, making them ideal for this process. Instead of buying another gauge, a simple solution is to cut a wedge that, when placed in front of the gauge, extends the angle range. Thus, if your gauge travels only 60° each side, a 30° wedge will extend that range to 90°.

The second variation is the different numbering methods of miter gauges. On some gauges, the midpoint is 90°, with the numbering system extending to 30° on each side. On other gauges, the midpoint is at 0°, and the numbers extend to 60° on both sides. The spreadsheet program (see p. 72) will work with both types of miter gauges.



Clamp the fence. Once the fence angle and the offset distance have been set, clamp the fence securely to the table. If it is difficult to set a clamp on the front rail, use braces clamped to the extension table.



Apply steady pressure and take small bites. Because the workpiece is being pushed across the blade and not through it, the blade should be raised by only $\frac{1}{8}$ in. for each pass. Push down and toward the fence with a large padded push block, such as this tile-grout trowel, and forward with a push stick.

rate because the thrust is against the side of the blade—a cut for which the blade is not designed. For a deep cove, each pass should remove less and less material because the arc length increases, requiring more power from the saw to make the cut.

To cut coves safely on the table saw, be sure to use push sticks or, better yet, a pair of padded push blocks like those normally used with a jointer.

When you've almost reached the cove's final depth, make a very shallow cut to leave the surface of the cove as smooth as possible. You also can make a second pass with the blade at the final height to further reduce the amount of scraping and sanding.

Asymmetrical coves are cut with the blade tilted

As the sun sets, an object's shadow becomes elongated; circles become ovals, stretching until almost losing their curvature just before night falls. In a similar way, tilting the blade distorts and elongates a cove. As the angles of the blade and the auxiliary fence become more oblique, the apex of the blade is moved to a point away from the cove centerline.

While you can use the parallelogram to measure the angle of approach, it cannot reveal the shape of the cove if the blade is tilted. The traditional method has been to sight across the blade and experiment with blade and fence angles until the profile of the blade matches that of the cove. This method requires repeated trial cuts with scrapwood. A better approach is to use a spreadsheet program to calculate the blade and fence angles (see p. 72). The spreadsheet program also can be used to find the fence angle to cut symmetrical coves.

As with a symmetrical cove, an asymmetrical cove starts with a scale drawing. Measure the cove's depth, length, and apex offset. Enter the data in the spreadsheet. Start with your table saw's blade diameter; then enter the desired depth of the cove, the desired

TABLESAWN COVES NEED CLEANING UP

However slow the final pass, some sawmarks will remain. The two best ways to achieve a smooth surface are either to use a gooseneck scraper, which has a variable profile that should fit any cove, or to sand the surface.



Scrape away sawmarks. A gooseneck scraper should fit any cove profile. Turn an edge on the scraper with the burnisher.

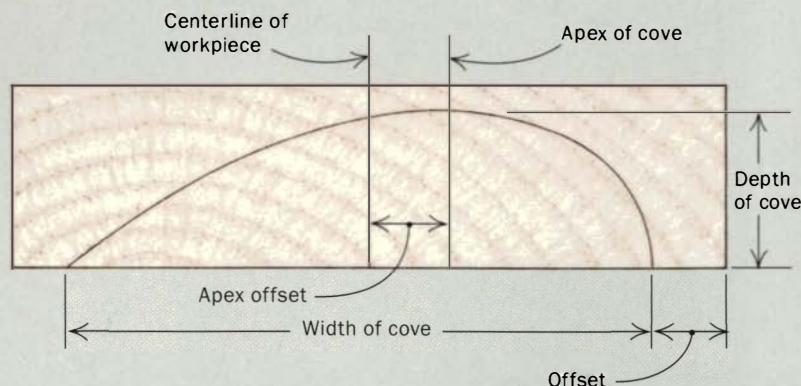


Shopmade profile sander. Transfer the shape of the cove onto some building foam (left) and then cut the foam to shape on a bandsaw. With sandpaper wrapped around the custom-shaped foam block (right), sanding the cove goes smoothly.

MAKING AN ASYMMETRICAL COVE

THE AMOUNT OF BLADE TILT WILL DETERMINE THE COVE SHAPE

As the blade is tilted toward 45°, the shape of the cove becomes increasingly asymmetrical, with the apex of the cove farther and farther away from the centerline of the workpiece.



This cove has three dimensions. Record the width and depth of the cove and measure the distance between the centerline of the workpiece and the apex of the cove; in this case, it's just over an inch.

Use a computer spreadsheet to establish blade-tilt and fence angles



Computer help. Sabol's spreadsheet program determines the correct fence and blade angles. It also will tell you if the dimensions of the cove are beyond the capabilities of your tablesaw.

My spreadsheet will help you calculate the proper blade and fence angles to cut coves on the tablesaw (you'll find a link to the program at www.finewoodworking.com). Enter data only in the five squares in the center of the spreadsheet. Simply enter the diameter of your sawblade, the desired cove

depth, length, and apex offset, hit **Calculate**, and the spreadsheet will calculate the correct angle to tilt the sawblade and to set the auxiliary fence. If your cove dimensions fall outside the limitations of your tablesaw, the spreadsheet also will show you the maximum possible dimensions. You can customize the spreadsheet for your miter gauge by entering 90 or 0, depending on your gauge's midpoint setting. You also can use the spreadsheet for symmetrical coves by entering 0 for the apex offset, which eliminates the value for the blade-tilt angle.

coveangles1.0.xls					
1	Cove Calculations				
2	Copyright 2003 Stuart B. Sabol, all rights reserved.				
3	This spreadsheet and formulations contained herein are intended for private use.				
4	Any commercial application, distribution or otherwise is prohibited without the prior written consent of Sabol.				
5	All inquiries should be addressed to The Taunton Press.				
6					
7	(input values in)	yellow background with blue numbers			
8					
9	Blade Diameter	in.	10		
10	Desired Cove Depth	in.	2	Max Possible Values	
11	Desired Cove Length	in.	0.500	5.990	Calculate
12	Desired Apex Offset	in.	0.14	1.996	
13	Miter Gauge Midpoint Angle	90°/0°	90		
14					
15	Fence Angle	*	2.8		
16	Blade Tilt Angle	*	4		
17					
18	Check Cove Length	in.	0.501		
19	Check Apex Offset	in.	0.135		
20					

length of the cove, and the length of the apex offset. Enter 0 or 90, according to the midpoint setting on your miter gauge. Then click on the **Calculate** button, and the spreadsheet will show you the correct angle to tilt your sawblade and the correct angle to align your auxiliary fence.

The spreadsheet also displays the exact cove length and apex offset these blade and fence angles will produce. They should be almost identical to your desired dimensions.

Use extra caution when cutting asymmetrical coves—It's important to use two fences to cut asymmetrical coves: one in the

Watch it on the Web

To see the author cut a cove, go to www.finewoodworking.com.

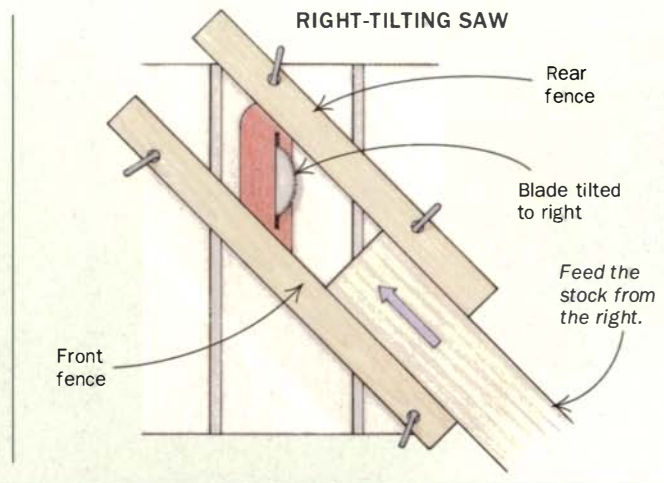
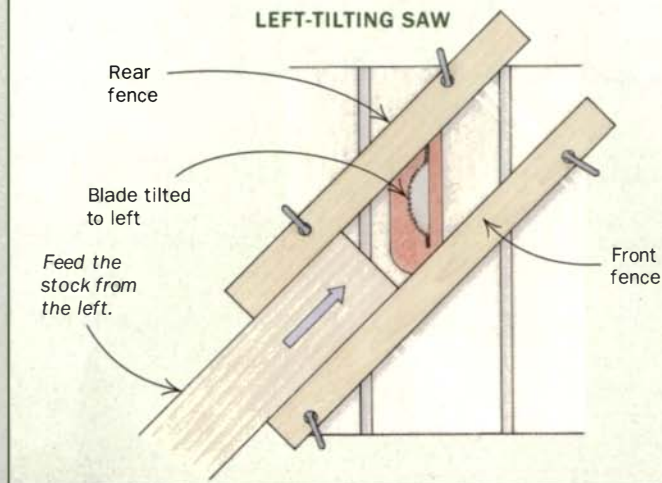
front and one in the rear (see the drawings on the facing page). The extra fence will allow you to apply more downward

force and will keep the workpiece aligned over the blade.

When cutting symmetrical coves with the blade vertical, it is safe to feed the work from either side of the blade. With asymmetrical coves, the blade is tilted, and you must feed the work from the side the blade is tilted toward. If you try to feed the work in the same direction the blade is tilting, there is a risk of the work sliding up the tilting blade, rising above the level of the front fence, and being thrown back at you. For a left-tilting saw, feed from the left front; for a right-tilting saw, feed from the right front.

BLADE-TILT DIRECTION DETERMINES THE FEED DIRECTION

The correct feed direction will prevent the workpiece from riding up the tilted blade. For a left-tilting blade, feed from the left; for a right-tilting blade, feed from the right.

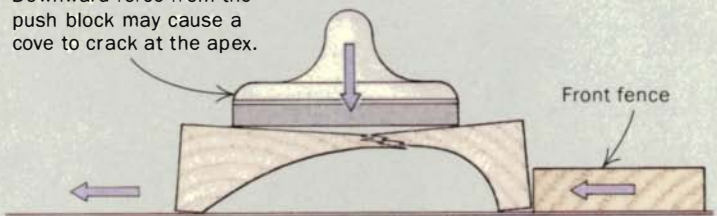


Feed into the tilting blade. The workpiece should approach from the side that the blade is tilting toward. Otherwise, there is a risk that the workpiece may slide up the sloping blade and over the front fence.

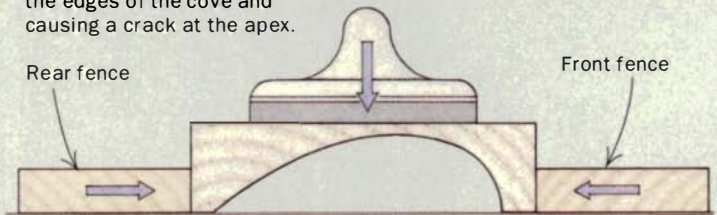
DEEP COVES REQUIRE TWO FENCES

If the design leaves the workpiece thin above the apex of the cove, it is a good idea to add a second fence. Like the buttress of a bridge, this fence supports the workpiece as you bear down on it and lessens the chance of the wood splitting.

Downward force from the push block may cause a cove to crack at the apex.



Front and rear fences prevent the downward force from splaying the edges of the cove and causing a crack at the apex.



Once the feed direction has been determined, set up the auxiliary fence in the correct orientation (see the top drawings above). The apex will be offset from the centerline of the cove in a direction opposite from where you feed the workpiece. Feeding into the blade from the front of the table moves the apex to the back of the workpiece. Lay out the asymmetrical cove on the workpiece so that it will blend with any other decorative elements, and orient the board so that the apex is translated in the proper direction before starting your passes over the blade.

Tablesawn coves have limitations

The maximum cove length that can be cut on the tablesaw is directly related to the diameter of the blade and its cutting depth,

and this relationship cannot be changed. You will be able to lengthen a cove with the same depth by tilting the blade and making an asymmetrical cove, but this technique reaches its limit rather quickly. If a cove with a shallow cut and a long sweeping shape is desired, another method to shape the cove may be required, such as multiple cuts with a router and extensive cleanup.

In addition, narrow coves appear less circular and more elliptical, perhaps distracting from the initial intent of the designer. For narrow coves, using a smaller-diameter blade can produce a cove with a more circular shape. □

Stuart Sabol is an engineer and amateur woodworker who lives in Houston, Texas.

Brad Nailers

Details make the difference among this group of 18-gauge nailers

BY ROLAND JOHNSON



WHAT TO LOOK FOR IN A BRAD NAILER

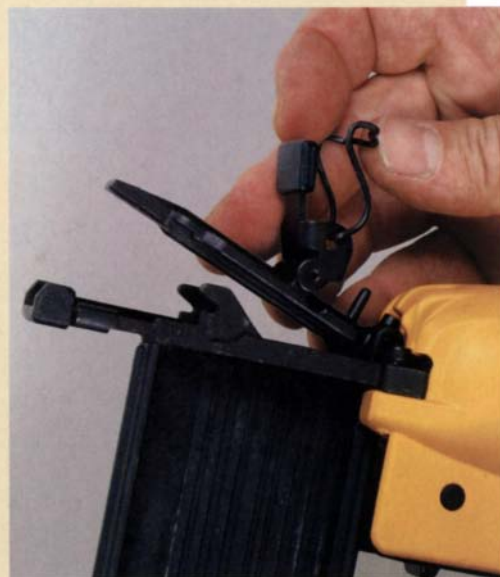
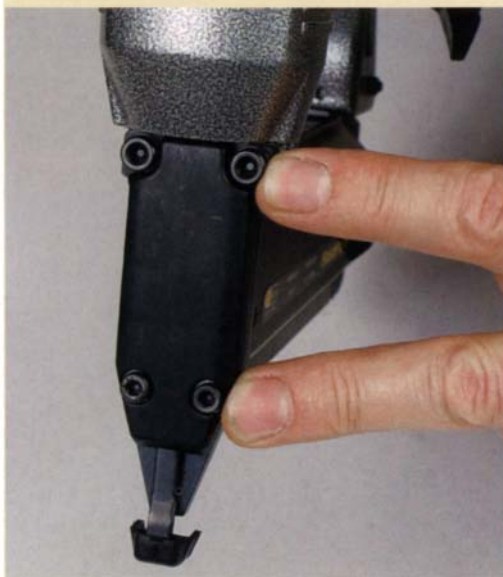
You should expect an 18-ga. gun to drive a wide variety of nail sizes and to place the nail easily right where you want it to go. You want a tool that is easy to load and gives you a clear indication when the nail supply is running low. Jammed nails are a nuisance, but they shouldn't be a problem: Look for a gun that makes it easy to clear them out.

I bought my first brad nailer in 1992 when I was working on an entryway that included scores of small custom-made moldings. Tired of dealing with cracked and split moldings that also were marred by hammer dings, I was thrilled to have the ability to drive and set finish nails with the pull of a trigger.

That first brad nailer was a cheap utilitarian version: It jammed fairly often, and it was a bit clumsy to use. After a few months, I stepped up and bought a top-of-the-line tool that has given me years of good service to this day. When the editors at *Fine Woodworking* asked me to survey the brad nailers currently on the market, I was pleased to discover that several manufacturers have made a number of improvements to earlier models. These tools are better than ever for woodworkers who want to use brad nailers to fasten moldings to fine furniture and cabinetry.

CLEARING NAIL JAMS

Clearing a jammed nail is easier with some nailers than with others. The driver-guide covers on the front of these brad nailers are secured with latches (right) or Allen-head screws (left). Latches allow you to clear the inevitable jammed nail quickly.



The first test: Can it drive a 2-in. nail?

I'm happy to report that by using 100 psi of compressed air, all of these tools were able to drive 2-in. nails into white oak. When I dropped the pressure to 90 psi, the results were mixed, with some of the nailers leaving the nails slightly proud of the surface. Shorter nails were easily driven to the adjusted depth by all of the nailers at the 90-psi setting.

The three top performers were the Grizzly, the Paslode, and the Porter-Cable because they drove the 2-in. nails all the way no matter how fast I pulled the trigger. Because of its light weight, the Paslode tended to kick back more as I drove the 2-in. nails, the same way a lightweight shotgun will kick back harder than a heavy gun. As a result, I had to keep firm hand pressure against the tool on the workpiece. That said, however, I would rather spend a long day in the field with the lightweight gun because it's a lot less tiring to handle.

Senco has a turbo setting on its FinishPro 25XP that is supposed to provide 30% more power than the normal setting. I found that the

turbo setting had to be engaged to drive the 2-in. nails all the way with the pressure set at 100 psi.

Can you clear jammed nails?

If they hit a hard knot or another nail, all of these brad nailers can jam—I proved that when testing them—and you have to be able to clear the jammed nails when that happens. All of these tools have removable driver-guide covers for clearing jammed nails. Some of them were easy to remove; others were extremely awkward.

The Campbell Hausfeld, DeWalt, and Grizzly models have what I call a lunch-pail-style latch to hold the cover in place. Simply flipping the latch lever releases the cover, making nail extraction a breeze. The latch on the DeWalt required the least amount of effort to release.

The Paslode and the Porter-Cable have spring-loaded release levers on the side of the nail carriage. It's nice that they are not in the way of the nose, but the levers can be released accidentally when you set the tool down on a workbench.

On the Makita and the Bostitch, two layers have to be removed to clear jams because the driver guide is behind the front cover and is part of the safety guard, which was cumbersome to remove.

The rest of the nailers have two, three, or four Allen-head screws that have to be loosened to remove jams. The Senco

Why would you want one?

An 18-ga. nailer is a great tool for applying small moldings to cabinets and built-ins. By driving nails with air pressure, you avoid the headaches of hammer marks, and the 18-ga. nail leaves a small hole that is easy to fill. For heavy-duty jobs, such as case construction or more structural house trim, use at least a 16-ga. nailer or a stapler.



BOSTITCH SB 1850BN
800-782-6539



CAMPBELL HAUSFELD NB0040
800-543-6400



CENTRAL PNEUMATIC 46309
(Harbor Freight) 800-423-2567



DeWALT D51238
800-433-9258



MAKE/MODEL NO.	PRICE	WEIGHT	DEPTH-OF-SET ADJUSTER	DRIVER-GUIDE COVER REMOVAL	SAFETY-GUARD LOCATION
BOSTITCH SB 1850BN	\$100	2.6 lb.	Thumbwheel on driver-guide cover	Three Allen-head screws	In front of nose
CAMPBELL HAUSFELD NB0040	\$80	2.8 lb.	None	Lunch-pail latch	In front of nose
CENTRAL PNEUMATIC 46309	\$50	2.8 lb.	None	Four Allen-head screws with keyhole slots	Behind nose
DEWALT D51238	\$100	3.0 lb.	Sliding lever beneath trigger; locking button on side of body	Lunch-pail latch	Behind nose
GRIZZLY G6047	\$100	2.8 lb.	None	Lunch-pail latch	Behind nose
HITACHI NT50AE	\$100	3.1 lb.	None	Two Allen-head screws with keyhole slots	Behind nose
MAKITA AF503	\$150	3.2 lb.	None	Two Allen-head screws with keyhole slots	In front of nose
PASLODE T200-F18	\$100	2.3 lb.	Thumbwheel beneath trigger	Spring-loaded latch on side of nail carriage	Behind nose
PORTER-CABLE BN200A	\$95	2.8 lb.	Thumbwheel beneath trigger	Spring-loaded latch on side of nail carriage	Behind nose
SENCO FINISHPRO 25XP	\$150	2.6 lb.	Thumbwheel beneath trigger	Four Allen-head screws of two different sizes	In front of nose
SENCO FINISHPRO 18	\$120	2.9 lb.	Thumbwheel beneath trigger	Four Allen-head screws of two different sizes	In front of nose

models have two different-size Allen-head screws, adding to the difficulty, but at least the Senco FinishPro 25XP houses the wrenches on the nailer itself. Otherwise, I would have been left digging through my toolbox looking for the correct Allen wrench to get that guide cover off every time it jammed.

Noses and safety devices affect nail placement

All of these brad nailers have safety guards that must be depressed before they can fire a nail. The size and placement of the guard are

critical when it comes to being able to see where you want to drive a nail.

I use brad nailers mostly for fastening small moldings, and often I want to place the nail in the crease between a fillet and a round or in some other spot that will camouflage the nail hole. With a large nose or safety guard, delicate placement can be frustrating, if not impossible.

Guard location is important, too. I prefer safety guards that are located behind the nose. Working at a bench, I usually look down

GRIZZLY G6047
800-523-4777



HITACHI NT50AE
800-829-4752



MAKITA AF503
800-462-5482



PASLODE T200-F18
800-682-3428



EXHAUST-PORT ADJUSTMENT	BELT HOOK	COMMENTS
Rotating plastic cover	None	Overall, the tool was a well-made, solid performer; however, the depth-of-set adjuster was not intuitive for the direction of set, and there was no indicator for which direction to turn
Rotating plastic cover	None	Driver-guide cover releases easily to clear nail jams
Loosen four Allen-head screws	None	Very basic tool with reasonable performance; was the least expensive
Rotating plastic cover	Adjustable; rotates around rear of body	Good performer; made it exceptionally easy to clear nail jams; the depth-of-set adjustment mechanism took two hands to operate
Rotating plastic cover	None	Good performer, a real powerhouse; lunch-pail latch was stiff, but once open it made clearing nail jams easy
Rotating plastic cover	None	Good basic performance; the heaviest of the bunch
Rotating ring around exhaust-port casting	Can be mounted on either side of nail gun	Nailer won't fire when the carriage is empty; exhaust-port adjustment works easily, and the additional deflector is convenient; features easy-to-read nail-capacity view port
Rotating plastic cover	None	The favorite with serious power; lightweight; drove nails consistently; depth of set was easily adjusted; nail jams cleared quickly; has an easy-to-read nail-capacity view port
Rotating plastic cover	None	A real powerhouse; featured an easy depth-of-set adjustment; convenient release for the driver-guide cover
Rotating plastic cover	Can be mounted on either side of nail gun	Decent performer; but it was difficult to clear nail jams
Nonadjustable but located beneath air coupler at rear of body	Can be mounted on either side of nail gun	Excellent performer; exhaust-port location (below air coupler) is ideal; releasing the driver guide was cumbersome because it requires two tools; soft hand grip readily absorbs recoil

PORTER-CABLE BN200A
800-487-8665



SENCO FINISHPRO 25XP
800-543-4596



SENCO FINISHPRO 18
800-543-4596



the front of the tool to see where I am placing the nail. If the guard is mounted in front of the nose, it blocks my view.

The DeWalt, the Paslode, and the Porter-Cable have narrow noses with safety guards mounted to the rear. All three nailers made it easy to see where the nails were going. The Central Pneumatic and the Grizzly also have rear-mounted safety guards with reasonably small noses. Even though the guard on the Hitachi is located behind the nose, it is huge and made of steel (which can mar the surface) with no provision for a soft cover. Also, the nose

itself is wide, and I had a difficult time placing nails in tight quarters. The remaining nailers I tested have guards in front of the nose.

Integral depth-of-set adjusters are convenient

When I change nail lengths or have to nail into soft woods using my old nailer, I change the air pressure to fine-tune how deep the nail is set. With many of these nailers, you can adjust the depth of set instantly simply by turning a thumbwheel or moving a lever.

It's about an even split between nailers that have integral depth

NOSES AND SAFETY GUARDS

NOSE DESIGN

A slender nose makes it easy to see where the nails will go. The nose on the Hitachi (below) is the largest of the nailers tested. The nose on the Porter-Cable (right) tapers to a finer point.



SAFETY-GUARD LOCATION

Before firing a nail, the safety guard must be engaged by pushing the tool against the workpiece. On some nailers, such as the Paslode (below), the guard is behind the nose, so it's easy to see where the nail is going. On others, such as the Senco FP18 (right), the guard is in front of the nose.



adjusters and those that don't. The Bostitch, the DeWalt, the Paslode, the Porter-Cable, and both Sencos have depth-of-set adjusters.

The Bostitch has a small, knurled thumbwheel on the front of the driver-guide cover. However, the wheel features no indicator of which direction to turn for more or less depth of set.

The two Sencos have nicely sized, knurled thumbwheels below the trigger, and the 25XP has a decal on the side of the nail carriage to indicate which direction to turn the knob to increase or decrease the depth of set.

The Porter-Cable and the Paslode also have thumbwheels below

the trigger that have a direction indicator right at the thumbwheel, making it easy to see which way to turn to make adjustments. I liked these best because I could tell at a glance which way to turn the wheel.

The DeWalt has a unique depth-of-set adjuster. A sliding lever mounted below the trigger has four different positions for depth of set, with the highest setting being the deepest nailset, which was sort of counterintuitive to me. The lever locks in place and is released by a pushbutton on the side of the gun. With this mechanism, it took two hands to set the nail depth accurately—one to push the release, the other to slide the lever. It's an interesting design but not the easiest to use.

ADJUSTING NAIL-SET DEPTH

Five of the brad nailers have no control for how deep the nail plunges (or sets) into the workpiece, so you have to control the depth of set by changing the air pressure. With nailers that do offer this control feature, the designs vary. The DeWalt (top) requires two hands to make adjustments. With the Porter-Cable (bottom), a simple thumbscrew with a clearly marked direction indicator does the job.



Nail carriages should be easy to load

I have a friend who owns an older brad nailer with an almost indecipherable method of opening and loading the nail carriage. I use the tool infrequently, and it mystifies me every time I have to load it with nails. A nail carriage with a release that is easy to open makes the task a lot more pleasant. And I'm happy to report that most of the nailers in this test have nail carriages with release levers that are logically placed, view ports for seeing the remaining nail supply, and a groove in the carriage bottom to keep nails from bunching up during the loading process.

Release-lever placement is probably more a matter of taste than function. The Central Pneumatic and the Hitachi nailers have a simple, spring-steel latch at the back of the carriage. The Bostitch, the Campbell Hausfeld, the DeWalt, and the Senco FinishPro 25XP have various styles of spring-loaded releases on the side of their carriages, and all of them were easy to use. The Grizzly, the Porter-Cable, and the Senco FinishPro 18 have various styles of toggle releases mounted on the end of the carriage. I really liked the releases on the Paslode and the Makita—the button on the top

NAIL CARRIAGES

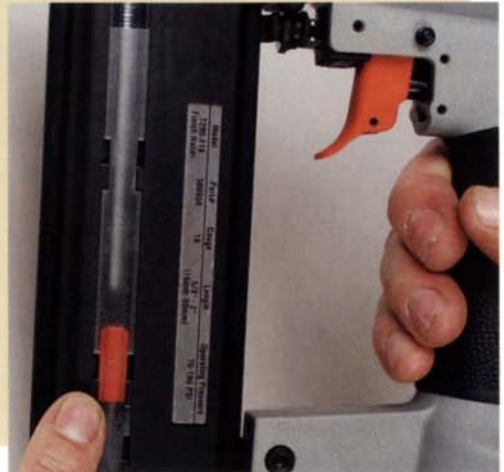
EASY TO FEED

Johnson liked the nail-carriage release lever on the Paslode (right) the best. The Senco FP18 (bottom right) was not as easy to use because he had to push on the lever with his thumb while pulling back with the fingers of the same hand. But the design on the Senco 25XP (bottom left) is more user-friendly.



EASY TO READ

View ports to the nail supply ranged from small holes like the one on the Grizzly (top left) to larger openings such as the one on the Makita (top right). The Paslode (bottom) offered the easiest to see: a large, clear-plastic window with a bright orange marker that moves toward the nose as the nail supply is depleted.



back of the carriage was easy to squeeze with my thumb as I grabbed the carriage with my fingers. I was able to squeeze the button and pull the carriage open in one motion.

I often find myself cleaning up my nail supply by loading several short sections of leftover nails. Without a bottom groove in the carriage to hold the nails in place, they can come flying out of the carriage, especially if I am in a hurry and quickly slam the carriage shut. All but two of these tools—the DeWalt and the Senco Finish-Pro 25XP—have a bottom groove to keep the nails in place.

Keep exhaust away from your face

When I'm using a brad nailer, I often have my face close to it to see where I am placing the nail. With my old nailer, invariably I would pull the trigger and get a blast of exhaust right in my eyes. Manufacturers have addressed this problem, and most of the nailers I tested have an exhaust port on the top of the body that adjusts the direction of the blast of air. The one exception is the Senco Finish-Pro 18, which exhausts the air through the hand grip and out the back of the tool, exiting below the air coupler, where it never will hit you in the face.

Weight can matter

Weight can be a blessing or a curse with a brad nailer. All of these tools are featherweights when compared with larger 16-ga. finish nailers, but you're likely to appreciate the lighter weight if you have to spend a long day driving nails.

The Paslode is the runaway winner here. It's a full ½ lb. lighter than the next-lightest nailer, and it's almost 1 lb. lighter than the porkiest. A plastic composite body is mainly responsible for the lighter weight. Compared with some of the heavier 18-ga. models, I found the Paslode easier to use for extended periods of time.

The drawback to the light weight is that you need to apply more

downward pressure on the tool to counteract kickback when driving long nails into dense woods. But most of the time, I needed to drive nails 1¼ in. or shorter, so the light weight was not a problem.

Without hesitation, I would pick the Paslode as my first choice among all of these brad nailers. The light weight, narrow nose, rear-mounted safety guard, easy depth-of-set adjustment, and good power put this tool at the top of the list for me. □

Roland Johnson is a contributing editor.

EXHAUST PORTS



Most of the nailers, such as the Hitachi (left), have an exhaust port on the top of the head that you can adjust to direct the air away from your face. The Senco FP18 (right) has an exhaust port that is not adjustable, but Johnson liked it the best because the exhaust air is directed through the handle of the tool and out the back, below the air coupler.

Current Work

Current Work provides design inspiration by showcasing the work of our readers. For more details and an entry form, visit our Web site at www.finewoodworking.com. Send photos and entry forms to **Current Work, Fine Woodworking, 63 S. Main St., Newtown, CT 06470**.



◀ **Claude Ruel** Boucherville, Que., Canada

Made of quartersawn white oak, this demilune table (13 in. deep by 28¼ in. wide by 31¾ in. tall) features a diamond-point veneered top. The top and apron are inlaid with ebony, while each of the leg bottoms has ebony accents. The bird's-eye maple drawer runs on full-extension slides made of blackwood. The table has a tung-oil finish.

David Knipfer ▶
Ellicott City, Md.

The Swiss-pear wood used in this jewelry cabinet (7 in. deep by 11 in. wide by 15 in. tall) serves as a calm background to the dramatic book-match of the curly-olive door panels. The wenge and maple drawers feature hand-cut dovetails and olive pulls. The cabinet is finished with six coats of oil and wax. Photo by David Egan Photography



Alan Reams Wimberley, Texas ▶

Reams, a custom-furniture maker, worked with architect John Gutzler to design and build this bow-front cherry sideboard (25½ in. deep by 80 in. wide by 33½ in. tall). The square recesses are filled with cherry end-grain pieces. The sideboard has an oil stain and precatalyzed-lacquer finish.





Marcus Collier Gainesville, Fla. ▲

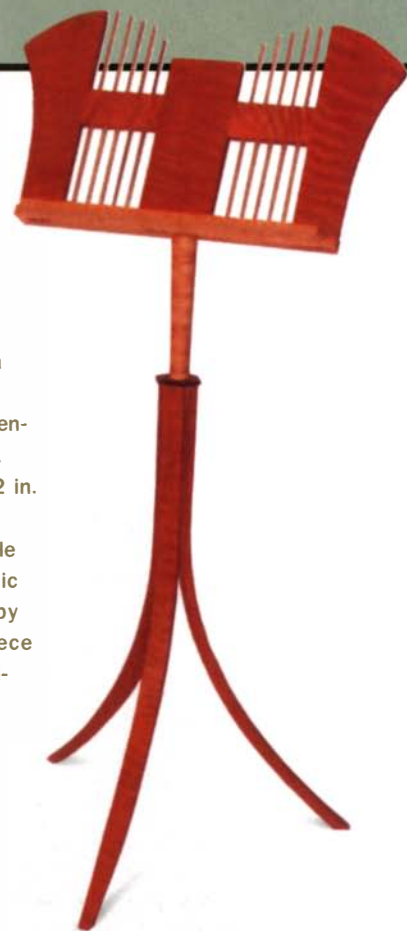
After attending an American Craft Council conference, Collier was inspired to make this tansu dresser. The circa 1850 reproduction (18 in. deep by 28 in. wide by 30 in. tall) is a loose interpretation of a piece he saw in the book *Traditional Japanese Furniture* (Kodansha International, 1986). Made of black walnut, the dresser displays some natural-edged boards and iron drawer pulls. The finish is polyurethane.

Bill Lindau Vilas, N.C. ►

Lindau turned to the influences of Sam Maloof and Robert Erikson when he set out to build this rocking chair and table lamp. The rocker (41 in. deep by 24 in. wide by 48 in. tall) is made of walnut and features a curly-maple back and a leather seat. The Mission-style walnut table lamp stands 60 in. tall and has an antique glass shade. Both pieces have an oil-and-varnish finish.

Daryl Rosenblatt ►
Manhasset, N.Y.

Rosenblatt's oldest son, a trumpet player, needed a new music stand. So Rosenblatt built this one (12 in. deep by 24 in. wide by 32 in. tall) out of curly redwood, curly maple, and ebony. He refined and gave the music rest a touch of elegance by adding brass rods. The piece is finished with an oil-and-varnish mixture.





◀ **Doug Carrigan** Mooresville, N.C.

"I'd always wanted to learn woodworking," Carrigan said, "but I didn't know how and didn't have the equipment." He realized his passion when he befriended a local Windsor-chair maker, Walt Schwinning. Under Schwinning's tutelage, Carrigan built this cradle (44 in. deep by 52 in. wide by 22 in. tall) as his first woodworking project. Working with no plans other than the dimensions of the mattress, he based the design on an 1840s teaser bed. The project took 20 weeks to complete, just in time for Carrigan's first-born. The cradle is made of curly, crotch, and quarter-sawn walnut and has a French-polish finish.

Harvey Orr Portsmouth, Va. ▶

Orr designed a set of these horseshoe chairs to complement the concave end pedestals of a client's dining table. Each chair (21 in. deep by 26½ in. wide by 32½ in. tall) is made of cherry and walnut with leather upholstery. It took Orr 400 hours to make the prototype, and then approximately 100 hours to make each of the four chairs in the set. The finish is a hand-rubbed oil-and-polyurethane mixture and wax.



◀ **Joel White** Idyllwild, Calif.

"After spending most of my woodworking hours building chairs and cabinetry for customers," said White, "my wife convinced me to build her an entertainment cabinet for Christmas." This cabinet (26 in. deep by 71 in. wide by 48 in. tall) is made of white oak, Honduras mahogany, iroko, black walnut, maple, and ebony, and features curly-maple veneered door panels and bronze Craftsman-style hardware. The piece is finished with acrylic lacquer over dewaxed shellac.



◀ **Mitch Mandel**
Schnecksville, Pa.

Having always admired the spare elegance of James Krenov's work, Mandel strove to capture that spirit when he built this display cabinet (18 in. deep by 24 in. wide by 67½ in. tall) to store a set of silverware he had inherited. Made of black walnut, tiger maple, and purpleheart, the cabinet features curved legs set at 45° to the case, and a slightly curved front with flat glass panels. It is finished with oil and varnish.



Matt Long Cumming, Ga. ▲

The design impetus for this unique table (11½ in. deep by 51 in. long by 36½ in. tall) originated with a challenge from a Highland Hardware workshop instructor. Made of mahogany with a cast-iron radiator top salvaged from an 1874 Philadelphia building, the entire table is held together by the tension of stainless-steel cables—an idea Long got from his many years of commuting into the City of Brotherly Love over several cable tension bridges. The table has an oil-and-varnish finish.



◀ **David Gooding** Garden Prairie, Ill.

After taking a class on three-drawer chests taught by Kelly Mehler at Marc Adams School of Woodworking in Franklin, Ind., Gooding used his skills to make this 10-drawer version as a wedding present for his daughter. Of his own design, the chest (20 in. deep by 60 in. wide by 36 in. tall) took approximately 500 hours to complete and was constructed out of a cherry log that Gooding purchased from a local sawmill and dried in his shop. The piece has an oil-based varnish, shellac, and paste-wax finish.

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Index to issues 161 through 167

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A

Abrasives, for sharpening, 165:41-43
Ackerman, Kerry, sewing table by, 162:92
Adzes, elbow, 165:102-4
Air cleaners, with fan and filter, 163:10
Air compressors:
 moisture from, 164:8
 physics of, 165:10
Albers, Tim, on miter gauges, 165:74-79
Allergies, discussed, 161:102-4
American Chestnut Foundation, address for, 165:22
Anderson, Chance, wood-stone table by, 162:108-12
Anderson, Wayne, planes by, 167:88
Arrow, Milton K., Bible box by, 163:89
Art Nouveau, mirror in, 166:132
Arts and Crafts style:
 and Art Nouveau, 162:66
 designs of, 162:64-66
 finishes of, 162:66-67
 material of, 162:63-64
 stand in, 165:72-73
 techniques of, 162:64

B

Backs (cabinet):
 frame-and-panel, 163:37, 73, 76-77, 165:49
 shiplapped, 163:37
 tongue-and-groove, 165:59-60
Banding:
 applying, 166:55-57
 making, 166:116-20
 See also Stringing.
Bandsaws:
 arc jig for, 163:74, 76
 blades for, drift with, 164:14
 circle-cutting jig for, 163:18-20
 curves with, 163:75
 14-in., reviewed, 167:34
 heights for, 167:102-6
 profiles on, 167:67
 resaw, 164:57, 167:32
 tables for, outfeed, 164:20
 tension cranks for, 164:31
 tuning up, 161:10
 See also Fences: Switches.
Barnsley, Edward, bureau after, 164:86
Barnsley, Sidney, furniture style of, 162:67
Barrett, Seth A., table by, 161:85
Barty, Taimi, silver chest by, 163:89
Battery chargers, Skil, recall of, 164:32
Beaders:
 making, 163:62-64, 164:18-20, 166:53-54
 using, 163:64-65
Beading:
 applied, methods for, 163:64
 cock, shooting board for, 164:18
 stone, 162:110
Bearings, removing, 161:10
Bechler, Leonard C., on bureau, 164:66-67
Becksvort, Christian:
 on sawhorses, 161:36-41
 on wood movement, 165:44-49
Beds:
 cherry inlaid, 164:22
 headboard attachment for, 165:46
Bellonby, Mark
 cabinet by, 163:88
 on workshop, 167:46-49
Benchdogs:
 milling for, 167:42
 plastic, 166:31
Benches, maple simple, 166:88
Bench grinders, variable-speed, reviewed, 162:32-33
Bevels, with block planes, 164:70, 72
Bikowski, Leon William, carving by, 164:24
Birch, Lee, and Nepalese carvers, 165:20
Bird, Lonnie:
 on drawers, 166:70-73
 on finials, 163:104-8
 on locksets, 162:80-85
Birdcages, maple, 166:90
Biscuit joiners, choosing, 165:67-69
Biscuit joinery:
 advantages of, 165:66-67
 for carcasses, 165:68, 69
 for drawers, 165:68, 69
 fences for, setting, 165:67
 gluing alignment, 165:70, 71
 layout for, 165:68
 for miters, 162:42, 165:69, 70-71
 for shelves, 165:68, 69
Bits:
 carrying case for, 163:20
 end-mill, for mortises, 165:18
 slot-cutter, reviewed, 167:30-31
Blackburn, Graham, on Arts and Crafts style, 162:62-67
Blacksmiths, locating, 162:77
Bleaching, process of, 161:102
Board foot, defined, 166:104
Bodett, Tom, table by, 165:81
Bookcases:
 built-in, 166:62-68
 cherry-fir post-and-rail, 161:60-65
 Queen Anne cherry, 165:83
 tops of, attaching, 161:65
Bortz, Brian:
 entertainment center by, 162:93
 work by, 164:22
Boulle, defined, 165:94-96
Boxes:
 Bible, 163:89
 book on, 167:112
 mitered, 162:40-45
 spice, Pennsylvania-style, 161:85
 tops of, cutting off, 162:45
 See also Locksets.
Brackets, Arts and Crafts style, 162:66, 67
Breadboard ends:
 construction of, 165:46
 fitting, 162:79
 jig for, 162:78-79
Brennan, Timothy, chair by, 165:80
Brooks, Jon, chair by, 162:24
Brown, Ted, teaches woodworking, 162:26
Brushes:
 care of, 161:16
 recommended, 163:118
 for shellac, 164:40-41
Buckner, Brian, plane by, 167:90
Bureaus:
 antitopple device for, 164:16
 Arts and Crafts style, 161:87
 Barnsley-style, with silver, 164:86
 cherry, 165:81
 designing, 163:36-43
 Krenovian-style, walnut-oak, 164:66-67
 pearwood simple, 163:88
 story sticks for, 163:39
Burgess, Michael, edge-bander bits, 166:32
Burkin, Anatole, interviews Krenov, 162:86-89
Butt joints:

biscuit-joined, 165:66
 explained, 166:36
Byrdcliffe Arts Colony, style of, 162:63

C

Cabinets:
 Art Deco-style, 163:88
 bowfront columned, 165:80
 built-in, 166:62-68
 corner wall, 162:91
 display, 161:87, 162:90
 Krenovian, 161:124
 step-back, 165:54-61 (erratum, 166:12)
 face frames for, 165:57-59, 70-71
 splined, 166:66-68
 floor, with inlaid silver, 161:86
 jewelry, 166:91
 Krenovian, 163:89
 lighting for, 166:63, 65, 67
 occasional, 166:89
 rolling, for shop, 167:71-74
 scribing, 166:66
 small standing, 166:89
 on stand, 162:90
 Arts and Crafts style, 162:67
 by Krenov, 162:87, 88
 tool, freestanding, 167:47
 tree-form, 163:87
 wall, Arts and Crafts style, 162:63
 wine, 164:86
 See also Cornices; Entertainment centers; Locksets.
Cadman, Terri L., music stand by, 161:24
Carcasses:
 assembling, 165:56-57
 bases for, 164:65, 166:68-69
 basic, 163:36
 with biscuit joinery, 165:68, 69
 for bureaus, 163:36-40
 frame-and-panel, 164:43-49
 glue blocks for, 163:42
 molding frames for, 163:40-43
Carter, Jimmy, clamp by, 167:88
Carts:
 for clamp storage, 164:64-65
 for lumber, 160:82-83 (erratum, 164:14)
Carving:
 books on, reviewed, 163:22
 flame finials, 163:104-8
 habits for, 162:96-98
 on mirror, 166:132
 Nepalese, 165:20
 shellac finish for, 164:40-41
 V-block jig for, 163:108
 work heights for, 167:102-6
Carving tools:
 cases for, 167:75-77
 reviewed, 162:33
Catches, magnetic, 163:79
Ceilings, soundproofing, 167:80-81
Cellavalle, Cat, backgammon board by, 165:81
Centers, finding, with bevel gauge, 161:16
Chairs:
 arm, Arts and Crafts style, 162:63, 64-65
 back slats for, 166:86-87
 Chippendale, contemporary, 161:84
 dining, Queen Anne, 165:80
 with marquetry backs, 166:88
 reading, large, 164:88
 rocking
 Esherick-style, 161:87
 Maloon-style, 162:92, 165:116
 seats for
 slotted plywood, 163:54-56
 upholstered slip, 163:54-58
 simple side, 166:80-87 (errata, 167:10)
 Windsor, chestnut, 165:22
Chamfers:
 with block planes, 164:70, 71, 72
 stopped, 165:57-58
Chan, Yeung:
 display cabinet by, 161:124
 on tool case, 167:75-77
Chase, Steven, chair by, 164:88
Cherry (*Prunus* spp.)
 colors in, matching, 161:42-45, 165:113-14
 finish for, 164:49
 shrinkage figures for, 165:49
Chests:
 carved, 165:83
 hinges for, 161:46-49, 51
 lid supports for, 161:50-51
 slab construction for, 165:45
 toy, 161:84
Chests-on-chests:
 Chippendale, 166:78-79
 walnut fluted, 166:90
Children, woodworking tools for, 164:26
Chisels:
 cases for, 167:75-77
 chests for, stackable, 163:16-18
 corners of, rounding, 164:74
 habits for, 162:96-98
 handmade, 167:77
 Japanese, sharpening, 167:118
 as knives, 164:74-79
 rescuing, 165:42-43
 sharpening aid for, 161:20
Christiana, Asa, on combination machines, 161:52-59
Christoph, Ian, bureau by, 165:81
Christy, Ken, music stand by, 161:24
Circles, bandsaw jig for, 163:18-20
Circular saws, Makita, recalled, 164:32
Clamping:
 of boxes, 162:41
 of laminate plies, 164:57-58
 spacing for, 166:96-98
Clamps:
 butt-joint, 165:27
 footed, reviewed, 164:30-31
 handles of, wrapping, 161:16
 spring, storing, 167:18
 storage for, 164:60-65
 V-block, carving, 163:108
 wood "wrenches" for, 162:16
Clark, Joseph S., cabinet by, 162:90
Clarke, Sean and Angela:
 on ebonized finishes, 162:121-22
 on lacquer, 161:121-22
Cleats, beveled, for tabletops, 163:71
Clocks:
 after Newport, 163:89
 Biedermier-style, 161:86
 grandmother, 164:120
 shelf, with bracket, 162:93
Cluchey, Larry, marking gauges by, 167:88
Colley, Cliff, on mobile bases, 167:82-87
Colter, Richard R., vanity case by, 165:83
Combination machines:
 with dado cutters, 167:32
 reviewed, 161:52-59
Compressed-air systems:
 components of, 162:10-12, 163:12
 compressors for,
 choosing, 164:50-53
 maintaining, 164:53

Computers:
 desks for, 164:42-49
 wood components for, 164:28
Conover, Ernie, on mortise and tenon, 164:90-94
Coopering. *See* Stave construction.
Coping, before ripping, 164:18
Corke, Mark, on soundproofing, 167:78-81
Cornell, Keith S., table by, 161:84
Cornices:
 built-up, 165:59
 continuous-grain, 165:72-73
Cost, Evan, vessel by, 166:89
Coves:
 scratch stocks for, 163:62-65
See also Moldings.
Cox, Bill, secretary by, 161:85
Craigdallie, Michael, teaches, 166:24
Crowder, Will, plane by, 167:90
Cupboards. *See* Cabinets.
Currier, Nathan, sideboard by, 162:92
Curves:
 describing, 161:71
 large-radius, 162:20 (*erratum*, 163:8)
 transferring, 164:55
Cutouts, Arts and Crafts style, 162:67

D
Dadoes:
 for drawer bottoms, 166:73
 explained, 166:36
 glue for, 162:106
 hidden, 163:38, 40-41
 router/jigs for, 164:44, 46
Design, golden section for, 162:66
Desks:
 built-in, making, 166:62, 63, 69
 captain's, 166:90
 computer, 164:42-49
 drop-front,
 Arts and Crafts style, 162:62
 cherry, 165:82
 Krenovian kwila-maple, 161:86
 lap, 161:87
 rolltop, 162:91
Diranna, David, on clamp cart, 164:64-65
Doors:
 cabinet, holding fixture for, 163:20
 coopered, 163:72-74, 76-77
 fitting, with block planes, 164:71, 72, 73
Dovetails:
 for case sides, 163:38-39
 clamping, 165:57
 for corner keys, 162:44-45
 explained, 166:38
 glue for, 162:106
 habits for, 162:96-98
 half-blind,
 in curved stock, 163:74-75, 77-78
 pins of, 165:96-98
 jigs for, 164:44, 46
 reviewed, 162:34
 lap, and hidden dadoes, 163:38, 40-41
 sliding,
 for drawer frames, 165:48
 explained, 166:38
 for moldings, 165:49
 smoothed, with block planes, 164:70
 stepped, 163:38, 39-40
 stopped, 163:38-39
 for drawers, 166:70-73
 work heights for, 167:102-6
Dowels, for end-grain reinforcement, 162:20
Drawers:
 antitopple device for, 164:16
 with biscuit joinery, 165:68, 69
 for computer desk, 164:42, 44, 46, 47, 49
 curved front, 163:75, 77, 78
 dividers for, 163:36, 38-41
 elegant quick, 166:70-73
 fitting, 164:72, 73
 flush/r.s. lipped, 163:39, 41, 43
 frames for, 164:67
 slides for, 164:49
 small matching, 162:78-79
 stops for, 163:41
 for tools, lining, 167:18
 troubleshooting, 163:92
 web frames for, 165:48
 and wood movement, 165:48
Drawings:
 full-scale, 161:68-74
 three-view shop, 161:69-74
 tools for, 161:68-70
 for veneer plans, 164:75-76
Drill presses:
 depth stops for, 162:73
 mortises with, 164:96-98
 marking for, 167:16
 reviewed, 162:68-73
 run-out with, 162:69-73
 speed changes on, 162:72
 table-tilt mechanisms for, 162:73
Drills, station for, portable, 162:18-20
Duckworth, William, on sharpening, 165:41-43

Ductwork, soundproofing, 167:80
Duerr, Brook, on clamp storage, 164:62-63
Dunbar, Michael:
 on chest hardware, 161:46-51
 on step-back cupboard, 165:54-61
 on woodworking habits, 162:96-98
Durfee, Charles, on computer desk, 164:42-49
Dust, avoiding, 164:8:
Dust-collection systems:
 as cancer preventatives, 163:22
 for delicate work, 163:20
 designing, 167:24-26, 48-49
 reviewed, 164:30-31
 for tablesaws, reviewed, 167:54-55
Dust masks, non-glasses-fogging, 165:27
Dyes:
 applying, 164:36, 37-38
 color matching with, 165:113-14
 for figured wood, 163:46-47
 recommended, 163:117
 sealers for, 165:114

E
Eason, Allen, table by, 163:24
Edge-banding:
 bits for, 166:32
 cutting, 164:77-78
 gluing, 164:78-79
 making, 164:104-6
Edge joints:
 glue for, 162:106
 method for, 166:47-51
 troubleshooting, 163:90-92
Edmundson, Mark, on veneered top, 164:102-6
End grain:
 of jigs, protecting, 167:63
 planing, 164:69
 sizing, 165:69
 of turnings, filling, 165:63, 65
Endress, Bill, on garage workshop, 167:70-74
Entertainment centers:
 18th-cent. style, 162:93
 1920s-style, 163:86
Epoxy. *See* Glues.
Ernce, Jerry, clamps by, 167:90
Escutcheons, choosing, 162:81, 85
Esherick, Wharton, work by, 161:24
Esherick Museum, music-stand contest by, 161:24

F
Face joints, glue for, 162:106
Faia, Dan:
 on banding, 166:116-18
 on stringing, 166:52-57
Featherboards, magnetic, 166:16-18
Feet:
 bracket, 163:42-43
 cabriole, ball-and-claw, 163:43
 saber, 163:43
 stone turned, 162:112
 thumbnail profile for, 167:38-39, 43
 turned, 163:43
Fences:
 micro-adjuster for, reviewed, 162:36
 stopblocks for, 167:61
 tablesaw, 167:51-53
Fiberboard:
 from straw, 163:14
 surface protection for, 167:64-65
Fillers:
 acetone-based, over shellac, 164:79
 auto-body, using, 164:38-39
 oil-rottenstone, 164:38-40
 touching up, 166:130
Finger joints, explained, 166:36
Finials, flame, carving, 163:104-8
Finishes:
 aerosol, 162:57-61
 handles for, 162:60
 technique for, 162:60
 aging, 163:47
 antique, 164:36-41
 Arts and Crafts style, 162:66-67, 79
 bluish with, treating, 162:61
 books on, 167:112
 cure time for, 164:117
 ebonized, types of, 162:121-22
 and end grain, 165:63, 65
 for figured wood, 163:44-47
 kit for, 163:117-18
 oil, beading with, 161:63-64
 repairing, 164:98-100
 rubbing out,
 automotively, 164:118
 lubricants for, 164:117
 and silicone damage, 163:8
 sizing for, 165:63
 for turnings, 165:62-65, 166:10
 water-resistant, homemade, 167:65
See also Bleaching; Lacquer; Sealers;
 Shellac; Spray equipment; Surface
 preparation; Varnishes.

Finn, Chris, birdcage by, 166:90
 Fisher, Nancy, cabinet by, 161:86
 Flaim, Jeff, bench by, 166:88
 Floors, plywood over concrete, 162:12
 Flutes, scratch stocks for, 163:62-65
 Forms, for lamination, 164:55-56
 Fortune, Michael, on chair seats, 163:54-58
Frame-and-panel:
 for bookcases, 161:60-65
 for desk sides, 164:43-49
 discussed, 165:45
 with integral molding, 165:60-61
 quartersawing for, 165:49
Franklin, Steve, toolbox by, 167:89
Fraser, Aimé Ontario, on wood screws, 162:46-49
 Fretsaws, for boulie, 165:96
 Fry, David M., on box elder, 161:66-67
 Fuhrmann, Kai, cabinet by, 166:89
 Furniture, 18th-cent., wood for, 164:96
 Furniture Society, Philadelphia conference, 166:26

G
Gedrys, Peter:
 on cherry, 165:113-14
 on shellac, 166:40-45
Gibson, Scott:
 on marking tools, 164:80-85
 on sofa table, 162:74-79
Gies, Richard, chest-on-chest by, 166:90
Gimson, Ernest, furniture style of, 162:64-65
Globes, maple, windowed, 163:87
Gloves:
 antivibration, 162:8
 with latex palms, 163:34
Glue blocks, uses of, 163:43
Glues:
 action of, increasing, 166:96
 container for, ever-ready, 161:34
 epoxy,
 inlay with, 163:14
 for lamination, 164:58
 for oily woods, 166:96-98
 hide,
 hot vs. liquid, 162:106
 slowing down, 162:106
 and oily woods, 166:96-98
 plastic resin, for lamination, 164:58
 polyurethane, qualities of, 162:106
 polyvinyl, managing, 165:86-90
 spots from, touching up, 166:129-30
 urea-formaldehyde, for veneer, 164:78
 yellow,
 physics of, 166:94-96
 qualities of, 162:106
Gluing up:
 of boards, orientation for, 166:47
 edge joints, pads for, 166:18-20
 glue problems in, avoiding, 165:86-90
 of laminate plies, 164:57-58
 of miters, 166:98
 of mortise and tenon, 161:78-79, 165:86, 88
 process of, 166:96-98
 squeeze-out with,
 preventing, 165:86-88
 removing, 164:100, 165:88-90,
 166:50-51, 167:10
 of tabletops, 166:47-51, 167:42-44
Gochmour, Chris, on block planes, 164:68-73
Goebel, Martin E., clock by, 161:86
Grace, Michael, table by, 166:24
Grant, Eric, highboy by, 163:24
Greene and Greene brothers, furniture style of, 162:66
Green wood, preserving, 161:8
 in water, 163:12-14
Grinders, wheels for, 165:42
Grooves:
 for panels, 161:61
 router jig for, 162:16-18

H
Haavik, Jay, on texturing panels, 165:102-4
Hack, Garrett
 on side chairs, 166:80-87
 on table joinery, 161:75-79
 teaches woodworking, 162:26, 163:24
Hagood, Bo, chest of drawers by, 163:88
Half-lap joints, explained, 166:36
Hall, David, pulpit by, 164:89
Hammer, Stephen, on small stand, 163:72-79
Hammers, wooden, handmade, 167:77
Handles, tape for, 161:16
Hardware:
 book on, 167:112
 chest, 161:46-51
 leather, 166:32
 lid-support, 161:50-51
See also Hinges.
Harris, Douglas, pulpit by, 164:89
 Hearing protection, and radios, combined, 164:32

Highboys:
 Queen Anne, 166:76
 contemporary, 163:24
 William and Mary, 166:75, 76-78
Hill, Jane F., on box elder, 161:66-67
Hiller, Nancy R., on Arts and Crafts stand, 165:72-73
Hinges:
 butt, 161:49
 butterfly, 161:48
 chest, 161:46-49, 51
 drop-leaf, installing, 164:48
 piano, 161:49
 preattaching, with glue, 166:20
 snipe, 161:48
 Soss-brand, 165:38, 39
 strap, 161:47
Holes (flaws), repairing, 164:36, 38-39
Holzgren, Terry, table by, 165:116
Honing, of scraper blades, jig for, 164:16-18
Hudson, J. Albert, clock by, 163:89
Hutches, Krenovian, 161:87

I
Iles, Ray, smoothing plane by, 165:30
Inlay:
 defined, 165:94
 grooves for, routing, 162:16-18, 164:106
Instruction:
 at Australian School of Fine Furniture, 164:24
 Canadian, 166:24
 Rosewood Studio (Ontario), 162:26
Intveld, Dwayne J., on extension tables, 163:59-61

J
Jewelry boxes:
 carved free-form, 164:87
 of turned components, 163:88
Jewitt, Jeff:
 on finishing mahogany, 164:36-41
 on gluing up, 165:86-90
 on touchups, 166:129-30
Jigs, surface protection for, 167:62-65
Johnson, Roland:
 on compressors, 164:50-53
 on midsize tablesaws, 167:50-55
 on shop vacuums, 163:80-85
Joinery:
 Arts and Crafts style, 162:65
 books on, reviewed, 164:22
 choosing, 166:36-38
 inlay-covered, 164:106
 metal-wood, 162:77
 power-tool, book on, 161:26
 smoothed, 164:70, 72, 73
 troubleshooting, 163:90-92
Jointers:
 and planers, 163:96-98
 sequence for, 165:34-36, 167:10
 stock over, bowed, 162:10
 tearout with,
 avoiding, 165:36
 preventing, 165:98
 wider stock over, 163:98
 Jointing, with routers, 167:16
Jones, Casey, jewelry box by, 163:88
Jungbluth, Chris, chair by, 161:87

K
Kirstine, Dale, lowboy by, 163:87
Kline, Marie, trunk by, 164:87
Klink, John, tools by, 167:89
Knives:
 cases for, making, 167:75-77
 crooked,
 sharpening, 165:104
 using, 165:102-4
 marking, handmade, 167:77
Kolakowski, Brian, music stand by, 161:24
Koopus, Jeff, cupboard by, 165:80
Krase, William, on expandable table, 165:38-40
Krenov, James:
 bureau after, 164:66-67
 desks after, 161:86
 hutch after, 161:87
 interviewed, 162:86-89
 student work from, last, 161:86-87

L
Lacquer:
 aerosol, 162:58-59
 hand-rubbing, 161:121-22
 for musical instruments, 164:100
 pullover for, 161:121-22
 recommended, 166:8
 for turnings, 165:62, 65
Lamb, David W.:
 teaches woodworking, 163:24
 on wood-stone table, 162:108-12
Lamination, process of, 164:55-59

Landon, Eugene, receives award, 163:26
Lathes:

centers for, drive, for small stock, 163:20
chucks for, quick wooden, 161:16-18
duplicator jig for, router, 167:18
mini-, variable-speed, 167:34
reeding jig for, 163:65
steady rests for, 161:34
ball-bearing, 164:20
See also Turning tools.

Lauchle, Gerald C., chair by, 161:84

Layout, on wood stock, 165:33

Leather, hardware of, 166:32

Legs:

adjustable, threaded insert for, 163:60
Arts and Crafts style, 162:66
chair, making, 166:80-85
glue blocks for, 163:42
post-and-rail, 161:61
quartersawn all-around, 162:74-76
splaying, 165:40
twisted, diagnosing, 163:92

Leppo, Jon, on workbench, 162:50-56

LeRoy, Tom, on work heights, 167:102-6

Light fixtures, chandelier, 165:116

Lighting, for built-ins, 166:63, 65, 67

Locksets:

installing, 162:83-85
types of, 162:80-81

Lowboys, high-style, 163:87

Lowe, Philip C.:

on bad joints, 163:90-92
on crown moldings, 166:74-79
on drafting, 161:68-74

Lumber:

board feet of, 166:104
choosing, 161:94-95
crosscutting, 165:37
figured, planing, 161:112, 165:98
growth-ring orientation for, 166:47
honeycomb in, detecting, 165:33-34
quartersawn, 162:63
for wood movement, 165:44, 48, 49
resawing, 165:34-35
ripping, 165:34-35
scrap, dealing with, 167:130
selecting, 165:32
stickering, 165:35-36
storage for, 167:48
urban mill for, nonprofit, 162:24
See also End grain; Green wood; Sapwood.

M

Maas, Bernard, on drill presses, 162:68-73

MacDonald, Tom, secretary by, 165:22

Machinery:

backlash in, 161:80-83
bases for, mobile, 167:47, 48, 82-87
rolling cabinets for, 167:71-74
surface protection for, 167:62-65
work heights for, 167:102-6
See also Switches; *specific machines, mechanisms.*

Malayko, Dale, workbench by, 167:89

Malooof, Sam, juries chairs, 162:24

Marking:

of reference surfaces, 166:47
triangle method for, 164:90

Marking gauges:

habits for, 162:96-98
handmade wooden, 167:88
knife-style, 164:81-83
modifying, 164:82
pin-style, 164:80, 81
sharpening, 164:82
steel, handmade, 167:89
wheel-style, 164:83-84
See also Mortise gauges.

Marquetry, defined, 165:94

Martinelli, Ric, backgammon board by, 165:81

Masaschi, Teri:

on bird's-eye maple finish, 163:44-47
on rubbing out, 164:117-18
on sapwood concealing, 161:42-45
on turning finishes, 165:62-65

Mason, Michael A., chest by, 167:91

"Master cabinetmaker," defined, 166:104-6

McCaskey, Rick, on workshop, 167:22-26

McLain, Jim, globe by, 163:87

McLaughlin, Tom, teaches woodworking,

163:24

Mehler, Kelly, on tablesaw basics, 167:56-61

Mendel, Joe, chest by, 165:83

Millard, Robert L.:

clock by, 162:93
on scratch stocks, 163:62-65
Minasian, Ken, chair by, 165:116

Minick, Chris A.:

on aerosol finishes, 162:57-61
on glue, 166:94-98
on protecting surfaces, 167:62-65

Mirrors, oval carved, 166:132

Miter gauges:

features of, 165:75
fences for, auxiliary, 167:60

reviewed, 165:74-79, 166:8

Miters:

biscuited, 162:42, 165:69, 70-71
for boxes, 162:40-45
columnar, clamping, 166:18
for curved pieces, 164:106
explained, 166:38
jig for, 165:60
keyed, 162:40-41, 43-45
on small stock, 166:14-16
smoothed, 164:71, 72
splined, 162:40-45
in veneer, 164:77

Miter saws:

compound, shooting board for, 164:18
fences for, auxiliary, 166:14-16
rolling cabinet for, 167:74

Mobile bases:

foot locks for, 167:84, 85

reviewed, 167:82-87

Moisture meters, miniature, reviewed, 162:34

Moldings:

astragal, 165:59
Chippendale, 166:78-79
cove,

lamb's tongue for, 161:64
with planes, 161:112
on tablesaw, 161:64

crown,

for built-ins, 166:68-69

shapes of, 166:74

tablesaw cutters for, 161:33

dovetailed, 165:49

Federal, 166:79

frame-integral, 165:60-61

frames for, 163:36, 40-43

ovolo, 165:58

profiles for, 165:55

Queen Anne, 166:76, 78

router jig for, 163:18

scratch stocks for, 163:62-65

swan-neck, making, 166:76-77

thumbnail, 164:43

William and Mary, 166:75-78

Mortise and tenon:

Arts and Crafts style, 162:65, 67
for coopered panels, 163:76, 78-79
for doors, 165:60-61
double, 162:76, 163:75-76
explained, 166:38
gluing up, 162:106, 165:86, 88
habits for, 162:96-98
housed, in grooves, 161:61-63
making, 164:90-94
pinned, 161:76, 79, 167:40
for tables, designing, 161:75-79
troubleshooting, 163:92
wedged for, 163:48-53, 165:61
through, 167:41, 43
for wood movement, 165:47

Mortise gauges, reviewed, 164:84-85

Mortises, horizontal, homemade, 161:77

Mortises:

angled,
jigs for, 166:82-83
for wedges, 163:50, 52
bits for, end-mill, 165:18
boring, 164:96-98
doubled, 161:79
by hand, 164:90-94
jigs for, 167:40
routing, 161:77
templates for, 161:77, 78
wide, 161:79
work heights for, 167:102-6

Motors:

induction, discussed, 167:96-98
tablesaw, 167:53-54

Moyer, David F., spice box by, 161:85

Music stands, contest for, 161:24

N

Nailers, cordless, reviewed, 167:30-31

Nails:

cut, 165:57
holes from, filling, 167:16

Neptune, Will, on bureau design, 163:36-43

Nessey, John, on wedge joinery, 163:48-53

Newport, secretary after, 161:85

Night tables. *See* Tables: bedside.

Noise, controlling, for basement shop,

167:78-81

Nuts, wing, wooden, 166:16

O

O'Brien, Tim, clock by, 164:120

Odors, in wood, removing, 163:100

Oil finishes:

recommended, 163:117-18
thinning, for sealer, 163:45-46
for turnings, 165:62, 65

Olechiw, Peter, work by, 164:26

O'Malley, Tony:

on biscuit joinery, 165:66-71
on built-ins, 166:62-69

Outfeed tables:

basic, 167:57
rolling cabinets for, 167:74

P

Packard, John C., entertainment cabinet by, 163:86

Paint, milk:

applying, 167:118

oil over, 167:118

Panels:

Arts and Crafts style, 162:64
raised, 165:61

Patterns:

computer-generated, 161:14
making, 161:71

Pediments, types of, 166:76-78

Pegs, smoothed, with block planes, 164:70, 72

Pekovich, Michael, secretary by, 161:96

Percifield, John, buffet by, 164:89

Perez, Omar A., jewelry box by, 164:87

Petrovich, Joseph, plane screwdrivers by, 167:91

Philadelphia Furnishings Show, winner at, 164:22

Picture frames, stand for, 161:16

Planers:

backlash in, dealing with, 161:83
benchtop, reviewed, 161:32-33
parallelism of, correcting, 166:106-8
stands for, building, 167:16-18
twisted stock with, 166:16

Planes:

backlash in, dealing with, 161:83
block,
low-angle *vs.* standard, 164:68-69
uses of, 164:68-73
cases for, making, 167:75-77
chisel, handmade, 167:77, 89
with figured wood, 161:112
hammer for, brass-wood, 163:34
hollows and rounds, 163:8
infill handmade, 167:88
irons of,
blanks for, 162:104, 106
making, 162:102-6
sharpening, 161:20, 108
jack, handmade, 167:77
low-angle, handmade, 167:77
molding, tuning up, 161:108-10
plow, handmade, 167:91
scraper, handmade, 167:89
shoulder, handmade, 167:90
smoothing,
after Norris, 165:30
angles for, 163:31
handmade, 167:77, 90
tuning up, 164:72-73
using, 161:110-12

Planing, work heights for, 167:102-6

Plans, photographs for, 164:20

Plywood:

biscuit joinery for, 165:66-71
dollies for, skateboard, 162:18
edge-bander bits for, 166:32
extension tables for, making, 163:59-61
ripping, technique for, 167:59
surface protection for, 167:62-65

Pneumatic tools, caps for, 163:34

Polishes, automotive, for gloss, 163:118

Precision, reference surfaces for, 163:100

Probst, Jim, sideboard by, 165:82

Pullover lacquer solvent, using, 161:121-22

Pulls, ebony contrasting, 163:72, 79

Pulpits, laminated oak, 164:89

Push blocks:

basic, 167:57
reviewed, 163:31, 164:10, 166:10-12

R

Rabbets:

for coopered panels, 163:79
explained, 166:36

Racks:

for clamp storage, 164:60-63
magazine, Arts and Crafts style, 162:67

Rails, production method for, 164:18

Reams, Alan, screen by, 164:87

Recht, Phillip, cabinet by, 166:89

Reeds:

lathe jig for, 163:65
scratch stocks for, 163:62-65

Refinishing, touch-up techniques for, 166:129-30

Resawing, grain-matching with, 162:40

Resh, Bernard, sideboard by, 164:88

Respirators, necessity for, 163:22

Rodriguez, Mario:

on joinery, 166:36-38
on rules, 165:50-53
on tabletops, 163:66-71

Rogers, Keith, desk by, 165:82

Rogowski, Gary:

on mitered boxes, 162:40-45

on stock preparation, 165:32-37

on tabletops, 166:46-51

Rohlf, Charles, style of, 162:62

Roller supports:

height marks for, 165:18
making, 166:61
reviewed, 166:58-60
using, 166:58-60

Rosewood Studio (Ont), instruction at, 162:26

Rottenstone, for reproducing old finishes, 164:38-40

Roundovers, with block planes, 164:70, 71

Routers:

Craftsman, recall of, 164:32
dados with, 164:44
dovetails with, 164:44
groove jig for, 162:16-18
horizontal mortiser from, 161:77
jointing with, 167:16
as lathe duplicators, 167:18
mortise jigs for, 166:82-83
variable-speed, 167:31-32

Router tables:

dovetails on, 164:44
miter keys with, 162:44
molding jig for, 163:18
rolling cabinet for, 167:73, 74

Routing, work heights for, 167:102-6

Roy, Réjean, bookcase by, 165:83

Roycroft Community, furniture style of, 162:67

Rules:

choosing, 165:50-53
types of, 165:52-53

Rust:

and plastic wrap, 165:10
removing, 167:62-63

Rustproofing:

dessicants for, 164:98
paper for, 164:98
for toolboxes, 164:98

S

Sandarac, source for, 166:42

Sanders:

and cancer threat, 163:22
drum, reviewed, 163:32
Makita, recall of, 164:32
random-orbit, recommended, 163:117
stationary belt, sharpening with, 165:14-16

Sanding:

cut-throughs, touching up, 166:130
for finish rub-out, process of, 164:117-18
with foam pads, 164:117, 118
grain-raising for, 164:36
pads for, making, 165:18
stopping point for, 164:98-100
for turnings, 165:63

Sandingblocks, recommended, 163:117

Sandpaper, recommended, 163:117

Sapwood, concealing, 161:42-45

Sawblades, dado, shimless, 167:32-34

Sawdust:

as carcinogen, 163:22
"logs" of, 165:16
safety of, 161:102-4

Sawhorses:

adjustable, 161:36, 40-41
quick and easy, 161:36-41

Sawmills, urban nonprofit, 162:24

Saws, veneer, sharpening, 164:75

Schleining, Lon:

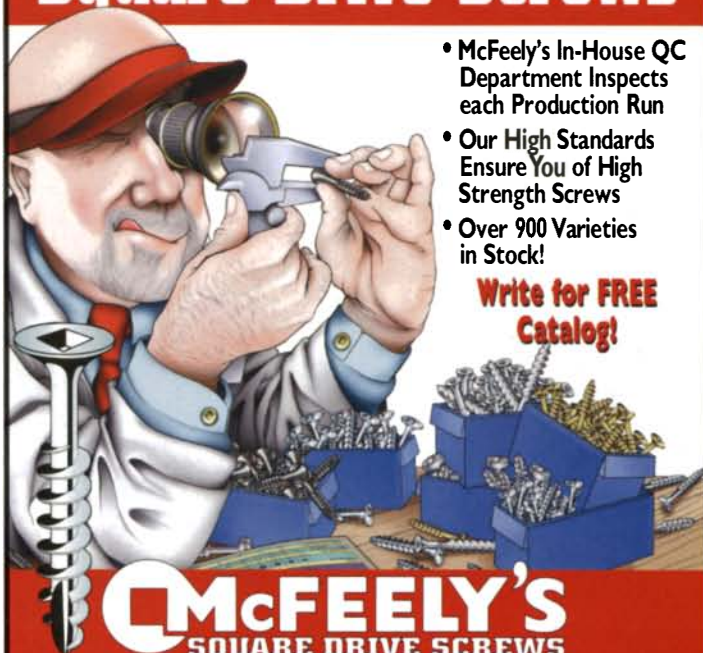
on lamination, 164:54-59
on workbenches, 167:38-45

Schofield, Mark:

on finishing kit, 163:117-18
on support stands, 166:58-60</

- rs.* drywall, 162:46-48
pocket holes for, 163:67
"sloppy" holes for, 163:40, 41, 167:8
square-drive *vs.* Robertson, 164:14, 166:10
- Scrollsaws:
from motor tools, 166:18
rolling cabinet for, 167:73
- Sealers, tinted-oil, 164:38-31
- Secretaries:
Federal, 166:79
Newport-style, 161:85
Salem blockfront, 165:22
Shaker-style, 161:96
walnut for, 165:94
- Selkirk College (Canada), instruction at, 166:24
- Sharpening:
adzes, 165:102-4
belt-sander jig for, 165:14-16
of chisels, Japanese, 167:118
crooked knives, 165:102-4
finger stops for, 166:20
with granite plates, 161:10
holders for,
magnet, 161:20
pad, 165:16-18
of molding profiles, 161:108
with powdered abrasives, 165:41-43
of saws, veneer, 164:75
of scrapers, 161:18-20
jig for, 164:16-18
tolerances for, 163:100
- Sharpening systems, tool supports for, 167:32
- Shellac:
acetone over, 164:79
aerosol, 162:58-59
applying, 164:40-41, 166:44-45
as colorant, 166:42-43
impermeability of, 167:63-64
mixing, 166:40-43
for odor containment, 163:100
sandarac for, 166:42
as sealer, 163:45-46
seedlac, dewaxing, 164:40
shelflife of, 163:117, 166:40
for turnings, 165:62, 64
uses of, 163:118
waxed *vs.* waxless, 166:41-42
-wax mixture, 165:64
- Shelves:
astragals for, 165:59
with biscuit joinery, 165:68, 69
built-in, making, 166:62-68
cleats for, 165:59
knockdown, 163:12
See also Bookcases.
- Shepherd, Stephen, on scraper, 167:66-69
- Shooting boards, for miter saws, 164:18
- Shope, Randall, desk by, 162:91
- Shop vacuums:
as cancer preventatives, 163:22
muzzling, for delicate work, 163:20
for surface preparation, 164:8
- Sideboards:
Arts and Crafts style, 162:64-65
maple, Asian-style, 165:82
rounded veneered, 164:89
small,
alder, 162:92
carved, 163:120
country, 164:88
wine, 164:86
- Sizing, as jig protectant, 167:64-65
- Slip seats, upholstery for, 163:54-58
- Smith, Allan, coffee table by, 164:88
- Smith, Paul N. II, table by, 161:84
- Society of American Period Furniture Makers, honors Landon, 163:26
- Sorenson, Todd, bureau by, 161:87
- Soule, Robert M., plane by, 167:91
- Spline joints, for miters, 162:40-45
- Spokeshaves, new bronze, 166:31
- Spoons, from fruitwood, 166:24
- Spots, touching up, 166:130
- Spray equipment:
booths for, minimal, 162:61
high-volume low-pressure (HVLP), reviewed, 166:30-31
See also Air compressors.
- Squares, bevel, habits for, 162:96-98
- Stains (finishes):
gel, uses of, 161:8-10
for mahogany, 164:36-37
for sapwood blending, 161:42-45
transparent, 165:63
water-based, applying, 164:36-37
- Stands:
curved-front, 163:72-79
hall, Arts and Crafts style, 165:72-73
- Stanlaske, Robert, captain's desk by, 166:90
- Staples, Robbi, wine cabinet by, 164:86
- Stave construction:
clamping, 166:18
jig for, 165:16
for containers, 164:89
for small door, 163:76-77, 78-79
- Steady rests. *See* Lathes: steady rests for.
- Steam bending, with microwave, 161:20
- Stearns, Joe, table by, 163:86
- Steel:
layout fluid for, 163:64
tapered, source for, 162:106
- Steel wool:
magnet fragment removal for, 163:14
recommended, 163:118
- Stickley, Gustav, style of, 162:63, 64
- Stiles, production method for, 164:18
- Stock preparation:
milling, 165:35, 36, 167:10, 57-59
rough, 165:32-34
for mortise-and-tenon, 164:90
process of, 165:32-37
stickering, 165:35-36
- Stonework:
for demilune table, 162:108-12
templates for, 162:108
- Stop blocks, simple, 167:61
- Storage, for unfinished projects, 166:104
- Story sticks, for bureaus, 163:39
- Stringing:
applying, 166:54-55
inlaying, 164:106
making, 166:52-54
production of, 164:76
- Surface preparation:
dust-free, 164:8
for finishes, 164:98-100, 166:96
importance of, 163:90
for stains, 164:36-37
- Suszynski, Alice and Edward, chandelier by, 165:116
- Switches:
for machinery, heavy-duty, 161:104
for tablesaws, reviewed, 167:54
- Syron, J. M., clay-wood work by, 161:26, 162:12
- T**
- Tables:
aprons of, gluing, 165:47
Art-Deco French-style, 161:84
bedside, 165:116
bridge-style, 161:85
card, Queen Anne, 162:91
coffee,
Chinese-motif, 164:88
panga panga-cherry, 163:86
demilune, wood-stone, 162:108-12
dining,
Arts and Crafts style, 162:66
expandable, 165:38-40
extension, for tablesaws, 163:59-61
joinery for, 161:75-79
maple laminated, 164:54
minimalist, 165:116
oval extension, 166:88
Pembroke Hepplewhite, 163:24
piecrust, 166:91
serving, Arts and Crafts style, 162:66
sewing, 162:92
side, Arts and Crafts style, 165:81
sofa, Arts and Crafts style, 162:74-79
stretchers for, steel, 162:74-75, 76-78
torsion-box construction for, 163:59-61
- Tablesaws:
backlash in, dealing with, 161:82-83
Black & Decker, recalled, 164:32
books on, reviewed, 167:110
crosscutting on, 167:59-61
sleds for, 167:14-16
extension tables for, making, 163:59-61
hybrid, 162:32-33
inserts for, zero-clearance, 167:57
key carriage for, 162:43-44
midsize, reviewed, 167:50-55
miter carriage for, 162:42
moldings on, cove, 161:64
ripping on, 167:58-59
job-site, 161:14-16
safety features of, 167:57
tables for, sliding, 167:34
10-in., reviewed, 165:26-27
tenon jigs for, 161:78, 163:76
throat plates for, zero clearance, 166:30-31
tuning up, 167:56, 57
See also Dust-collection systems; Fences; Motors; Outfeed tables; Push blocks; Sawblades; Stock preparation; Stop blocks; Switches.
- Tabletops:
attachment methods for, 161:65, 163:40, 66-71, 164:10, 49, 167:8
button, 165:47
blocks for, 163:69
tongue-and-groove, 163:70
cleats for, 163:71
clips for, 163:68
constructing, 166:48-51
designing, 166:46-48
ends of, trimming, 166:51, 167:43, 44
growth-ring orientation for, 166:47
- jointing, 166:51
making, 162:79
marking, 166:47
massive, 167:42, 43-44
pivot mechanism for, 165:39-40
pocket holes for, 163:67
stock for, 166:46-47
stone, 162:108-12
veneered inlaid, making, 164:102-6
wood movement in, 163:96
See also Breadboard ends.
- Tansu*, dyed ash, 165:82
- Tape, masking, easy-release, 166:104
- Templates:
for curves, 164:102-4
for edge-banding, 164:104-6
for veneer plans, 164:75-76
- Tenons:
angled, 163:76
floating, 165:48
pins for, 165:47
by hand, 164:90-94
haunched, 161:76-79
shoulders of, angled, 166:84-86
step, with tablesaw, 161:61
for table rails, 161:76-78
with tablesaws, 161:78
wedging, 163:50, 165:61
wide, gluing, 165:46, 47
- Tompkins, Keith P., vessel by, 164:89
- Tongue-and-groove, explained, 166:36
- Toolbox, maple, 167:89
- Tool cases, making, 167:75-77
- Tool chests:
Duncan Phyfe's, design after, 167:91
rustproofing for, 164:98
- Tools:
habits for, 162:96-98
hand, book on, 162:26
making, advantages of, 167:77
old, source for, 163:26
organizing, 167:130
Web site for, 161:24
work heights for, 167:102-6
- Tredinnick, Don, wall cabinet by, 162:91
- Trunks, curved carved, 164:87
- Turner, Ken, table by, 162:91
- Turning:
by children, 164:26
finishes for,
oil, 165:62, 65
shellac, 165:62, 64
wax, 165:62, 64
of flame finials, 163:104-8
lacquer for, 165:62, 65
staining, 165:63
- Turning tools, stand for, 162:16
- V**
- Vacuums, shop:
decibels of, 163:80-81
reviewed, 163:80-85, 164:8-10, 165:28
- Van Horn, Richard, chest by, 161:84
- Vanities, with gilded mirror, 165:83
- Vargas, Cindy, nightstand by, 165:116
- Varnishes:
aerosol, 162:58-59
recommended, 163:118
- Veneer:
book-matching, 164:74-76
bubbles in, 162:20
decorative, 164:74-79
finishing, 164:78-79
glues for, 162:106, 164:78
sizing for, 167:120
wavy, bath for, 167:120
- Vessels:
briar-root, 166:89
stave-constructed, 164:89
- Videos:
on aerosol spraying, 162:60
on beveled cleats, 163:71
on keys, 162:43
on lacquer, 161:121
on strap hinges, 161:47
on wedging tenons, 163:50
- Vises:
bench, position of, 162:102
bench slave for, 165:14
end, building, 162:53-56
front, quick-action, 167:41-42, 45
installing, 167:44-45
patternmakers', 162:50, 54
- Voysey, Charles, furniture style of, 162:65
- W**
- Walker, Earl, Jr., cabinet by, 162:90
- Walker, George, on backlash, 161:80-83
- Wappett, Andrew, rocking chair by, 162:92
- Warning, Stephen, cabinet by, 166:91
- Water, for raising grain, 164:36-37
- Waters, Lauren, cabinet by, 163:87
- Waxes:
as jig protectant, 167:64
-shellac mixture, 165:64
- for turnings, 165:62, 64
- Web sites:
for calculator utilities, 165:20
on exhibitions, 163:26
setting up, 166:108-10
- Webster, George, clock design by, 164:120
- Wedges:
angles for, 163:49
fixed, 163:50-52
loose, 163:52-55
for through mortise-and-tenon, 163:48-53
- Welch, Ed, hutch by, 161:87
- Wendland, Thomas, *tansu* by, 165:82
- West, John, on clamp storage, 164:60-61
- White, John, on support stands, 166:61
- Whittlesey, Stephen, chair by, 162:24
- Willard, Joseph H., table by, 166:91
- Wiseley, David L., on workshop habits, 167:130
- Wissack, Thomas, on molding planes, 161:108-12
- Wixey, Barry, on induction motors, 167:96-98
- Wood:
for exterior use, 166:108
movement of,
allowing for, 163:66-67, 96
explanation for, 165:44-45
joinery allowing, 165:45
reference guide to, 167:34
See also End grain; Green wood; Lumber.
- Wood, Timothy, desk by, 161:87
- Woodworking:
learning, book on, 167:112
reference manual for, 167:110
- Workbenches:
bases for, 167:42-43
bench slaves for, 162:50-53, 165:14
building, 162:50-56
covers for, photographic-paper, 162:20
designing, 167:38-40
drawer knobs for, 163:10
finishes for, 167:65
heights for, 167:102-6
surface protection for, 167:62-65, 64-65
traditional, 167:89
vise position for, 162:102
See also Benchdogs; Vises.
- Workshops:
basement, noise control for, 167:78-81
books on, 167:112
cabinetry for, book on, 167:110
designing, 167:22-26, 46-49
floors for,
matted, 167:24
plywood, 162:12
in garages, 167:70-74
insulation for, soundproof, 167:79-80
power for, 167:24
trash management for, 167:130
- Wright, David, on straight grain, 161:94-96
- Wright, Frank Lloyd, furniture style of, 162:64
- Y**
- Yaffe, Rebecca, desk by, 161:86
- Z**
- Zakurdayev, Leonid, mirror by, 166:132
- Zito, Debey, sideboard by, 163:120
- Zizzi, Tony, spoons by, 166:24
- Zuerner, Peter, on bookcase, 161:60-65
- Zytowski, Carl, bureau by, 164:86

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Rules of Thumb

Taming tearout on the tablesaw

BY STEVE LATTA

One major factor that separates a good piece of furniture from a mediocre one is how cleanly it is constructed. Nothing will kill the look of a finished piece more than tearout. Those rough edges are inexcusable and can be avoided if you pay attention to how wood fibers react to different types of tooling.

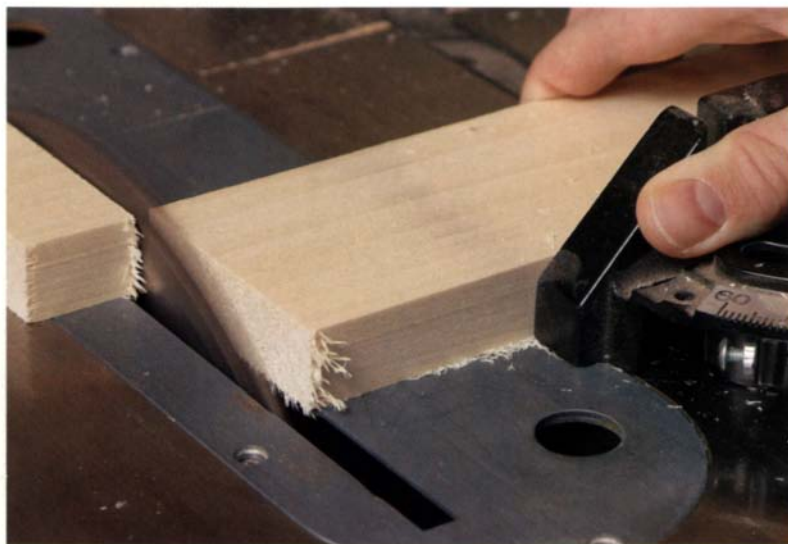
Most tearout on the tablesaw occurs when the blade exits the stock and breaks the wood fibers rather than cutting them. As a result, splinters may show up on the underside, back corner, and back edge of a workpiece. This is especially relevant to crosscutting on the tablesaw. But tearout is not hard to eliminate or manage. The first item to look at is the sawblade.

The correct blade is the first line of defense

It is important that the blade is designated for the type of cut being performed and that it's sharp and clean; a dull blade, or one cov-

ered with pitch, will produce a poor-quality cut. Crosscutting blades and many general-purpose blades have teeth with alternating bevels. The staggered teeth on these blades are beneficial because they score the fibers before hogging out the stock.

Avoid trim cuts—Sometimes tearout occurs by taking too light of a trim cut. It often is better to have material on both sides of the blade; that way, the wood fibers are supported across the full



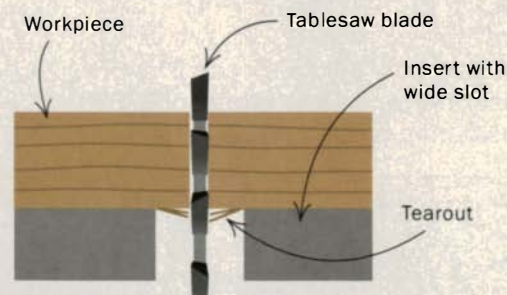
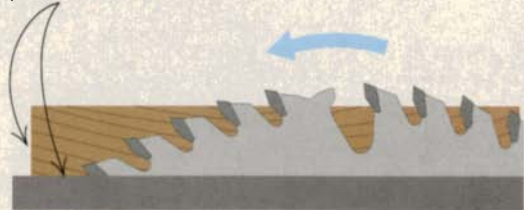
SHOP AIDS TO PREVENT TEAROUT

Tearout mostly occurs on a crosscut when the sawblade breaks the wood fibers rather than splitting them. Once you understand the common causes of tearout, you can follow a few simple guidelines to prevent it.

IDENTIFY TROUBLE SPOTS

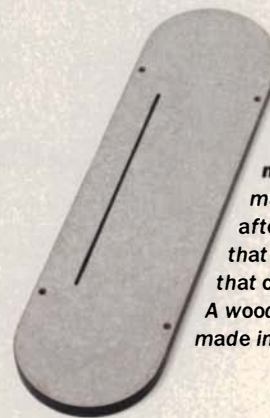
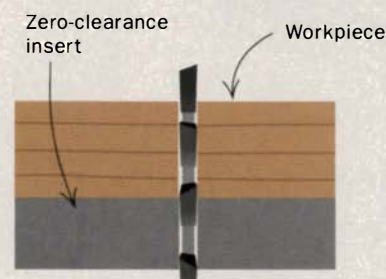
Tearout is most likely to occur on the underside of the workpiece as well as on the back edge and back corners (top). A wide kerf in the tablesaw insert or crosscut sled also can allow tearout (bottom).

The back edge and bottom surface of the workpiece are prone to tearout.



INSTALL A ZERO-CLEARANCE INSERT

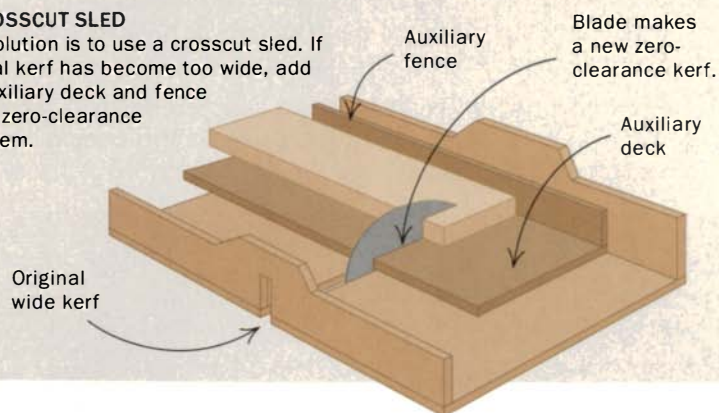
A zero-clearance insert increases the support area under the workpiece and reduces the chance of tearout.



Inserts may be bought or shop-made. Several manufacturers make aftermarket inserts that replace the one that came with your saw. A wood insert also can be made in the shop.

USE A CROSSCUT SLED

Another solution is to use a crosscut sled. If the original kerf has become too wide, add a fresh auxiliary deck and fence and make zero-clearance kerfs in them.



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ORIENT THE WORKPIECE TO HIDE THE TEAROUT



1. TABLE LEGS

Identify the inside edges of table legs. With the legs oriented with the exposed faces outward, mark the unexposed sides of the legs with a crayon.



Place the hidden sides of the leg against the fence and deck. Orient the leg on the tablesaw so that the blade exits the workpiece on a surface that won't be visible on the finished furniture piece.

width of the kerf and onto the offcut. This tension keeps the fibers from ripping away. On trim cuts, the fibers are more inclined to break away, which can be a real problem when working with man-made panel products, such as plywood, and with porous woods, such as oak.

Raise the blade to reduce tearout—The height of the tablesaw blade also is an issue, although a controversial one. The rules of safety declare that the blade should project above the surface about the height of a tooth. Regretfully, a low blade height can lift fibers away from the surface, especially toward the end of the cut.

Raising the blade higher than normally recommended transfers the forces of blade rotation in such a manner that the fibers are pressed into the surface, resulting in a cleaner cut. In many applications, I raise the blade at least an inch above the workpiece and take extra precautions to ensure safety, such as clamping the workpiece to a crosscut sled to keep my hands clear of the heightened blade.

Use a zero-clearance insert or crosscut sled

Another common cause of tearout when crosscutting is a tablesaw insert in which the blade slot is too wide—typical on most stock inserts. This slot is a hot zone for tearout because it creates an unsupported surface for the material being cut. The hard edge where the workpiece finally becomes supported serves as a chipbreaker and allows the fibers to tear as far as the hard edge.

A zero-clearance insert ensures that the workpiece is fully supported as it passes across the blade, thus reducing tearout (see p. 92). I've applied this same zero-clearance concept to my crosscutting sled, which has developed a wide kerf from the various thicknesses of blades I've used. Each time I use a sled for a new operation, I affix an auxiliary deck and fence on which a workpiece will rest as it is run through the saw. Once I've applied the fresh deck and fence, I run it through the saw and produce a new kerf that is the exact width of the blade. As an added benefit, the new kerf also serves as a reference point for lining up successive cuts.

Isolate tearout to hidden surfaces

In my woodworking courses, nothing knocks down a student's grade faster than visible tearout on a finished piece. I've often seen this occur on the top of a table leg as a result of the student improperly cutting it to length.

You should have a good idea how the legs will be positioned on a table before you make any cuts. As noted earlier, the bottom face, back corner, and back edge of a workpiece are most susceptible to tearout. Therefore, table legs should be oriented

2. DRAWER FRONTS



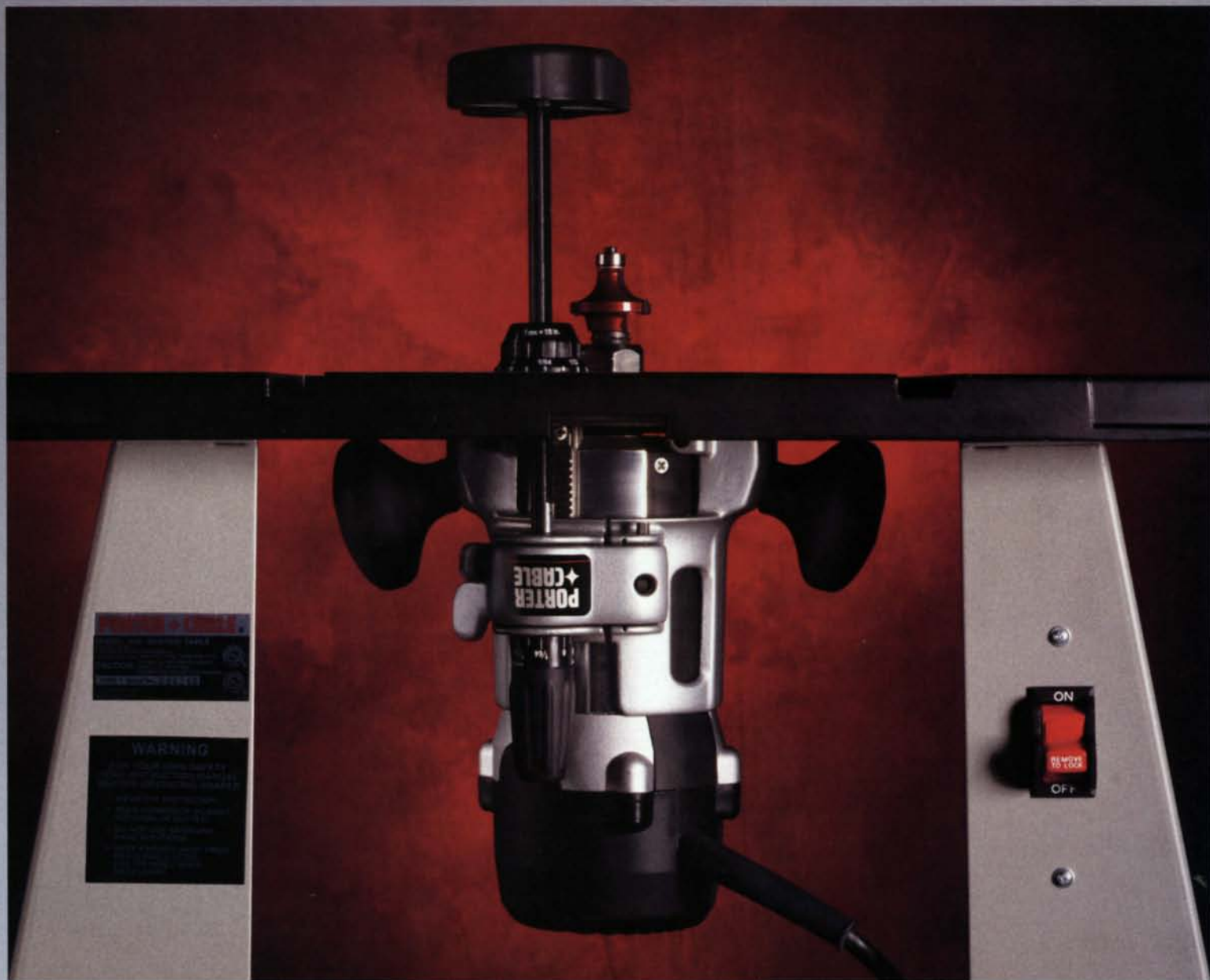
Orient drawer fronts so that tearout is restricted to the inside face.

Crosscut drawer fronts with the exposed face up.



Rotate, don't flip the drawer face. When crosscutting the other end of a drawer front, make sure the exposed face is still on top.

MAKE HEIGHT ADJUSTMENTS UP HERE.



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Which comes first, the dado or the rabbet? The dado comes first, if you follow the general rule that end-grain cuts should be made prior to long-grain cuts.



A rabbet will scoop away tearout caused by the dado cut. Cut the rabbet deeper than the dado to ensure a clean edge.

on the saw so that the outside faces of the leg make first contact with the blade. This way, any tearout that does occur won't be visible once the table has been assembled. I always mark the inside faces and end grain of a table leg before cutting it to length to remind me of the proper orientation. This same concept can be applied to a cut on the miter saw, which will produce tearout in a similar fashion.

Another example of properly orienting a workpiece to limit tearout is when trimming a drawer front to length. The drawer front should be positioned with its inside face against the tabletop so that tearout is isolated to the unseen face. After making the first cut, rotate the stock and cut the other end rather than flipping it. Rotating the stock places all of the tearout on the back face, while flipping it will result in tearout on the inside and outside faces.

Cut end grain before cutting long grain

The proper sequencing of cuts also plays a vital role in how clean a project will turn out. In general, when a workpiece needs to be cut across the grain and along the grain, it's best to cut the end grain first. This old standby holds true for most machining processes, from raising panels to rabbeting drawer bottoms. If tearout does occur from the blade (or cutter) exiting the end grain, the long-grain pass will scoop away any blowout that might have occurred.

There are a number of operations where this rule holds true. One good example is a bookcase that uses dados to fix shelves and a rabbet to hold the back boards. Which comes first—the dado or the rabbet? If we follow the rule of end grain first, the dado would need to come first. Rabbeting the back afterward removes any tearout produced along the back end of the dado.

Scoring and taping can help reduce tearout

Due diligence also will prevent tearout. For example, when working on large cabinet projects, I always make frame-and-panel doors slightly oversize, then cut them to fit once I can determine the exact dimensions of the opening that the door will fill. However, when cutting a door to height, you encroach on a major problem area: the back edge on the door stile where the sawblade is cutting end grain.

Using a marking knife or an X-Acto knife, I score a line on the bottom side and back edge of the stile where it will be cut on the

tablesaw. This scored line will allow the fibers to break cleanly before they have a chance to tear out.

Applying clear tape to an edge that is to be cut also works well to prevent tearout, but special care has to be taken when pulling off the tape. Peeling it off in the direction of the fibers will lay them down. If you peel it off in the other direction, the tape will lift the fibers. Sometimes a very light film of white glue rubbed over a troublesome area will provide enough support to keep fibers from tearing. Just make sure that all of the glue is removed before it comes time to apply a finish. □

SCORE OR TAPE THE WORKPIECE BEFORE CUTTING



Score the cutline. When crosscutting a cabinet door to length, score a line around the underside and back edge of the cross-grain stile to reduce the chances of tearout on those trouble spots.



Tape troublesome areas. The unsupported corners on this workpiece will tear when crosscut on the tablesaw if preventive measures aren't taken.

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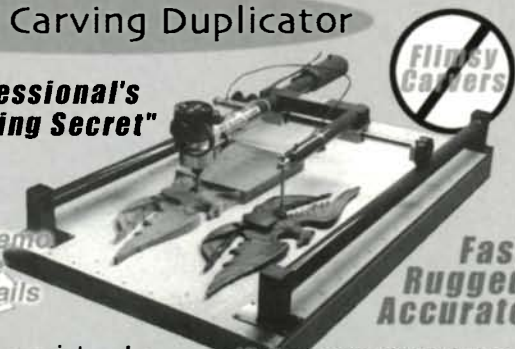
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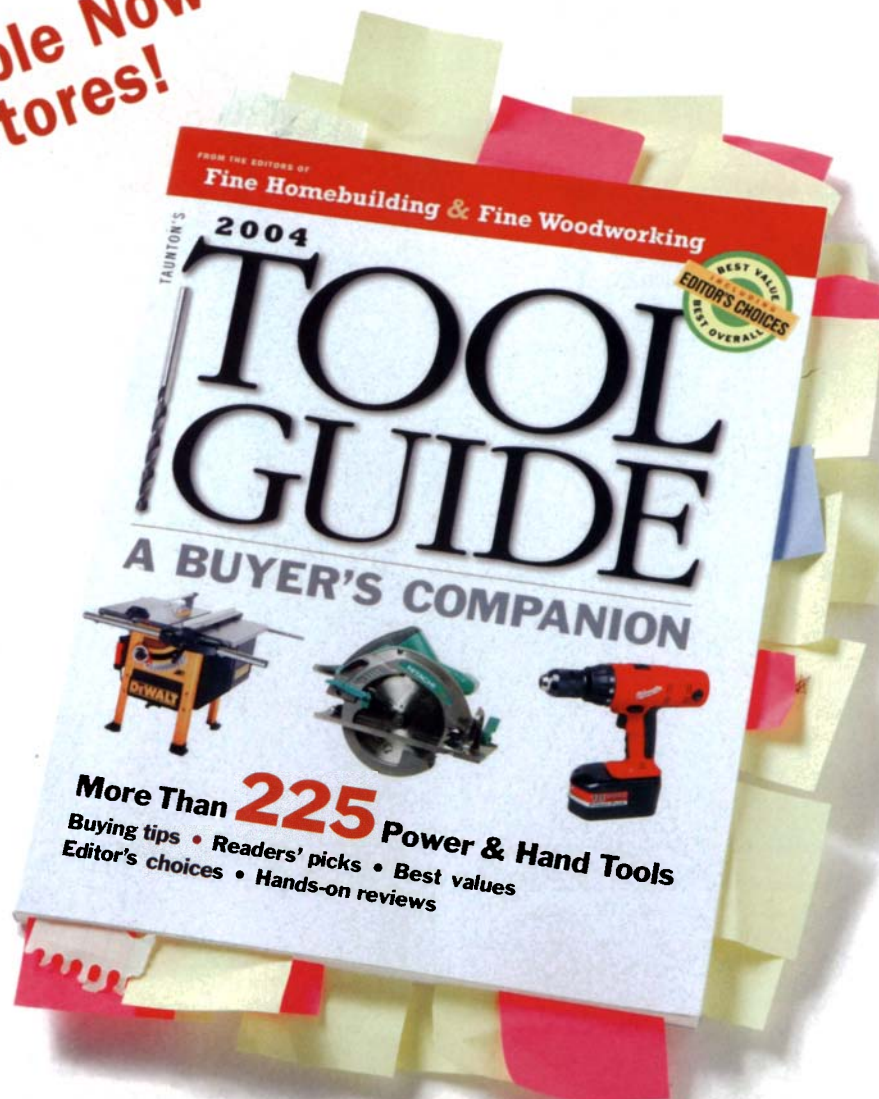
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Proper wood storage

I have a small shop, and I need to figure out a good way to stack wood. I have seen lumber stacked vertically in stores, but most lumber I see in magazines is stored horizontally. Does it make any difference which way wood is stored?

—Patrick Cody, Akron, Ohio

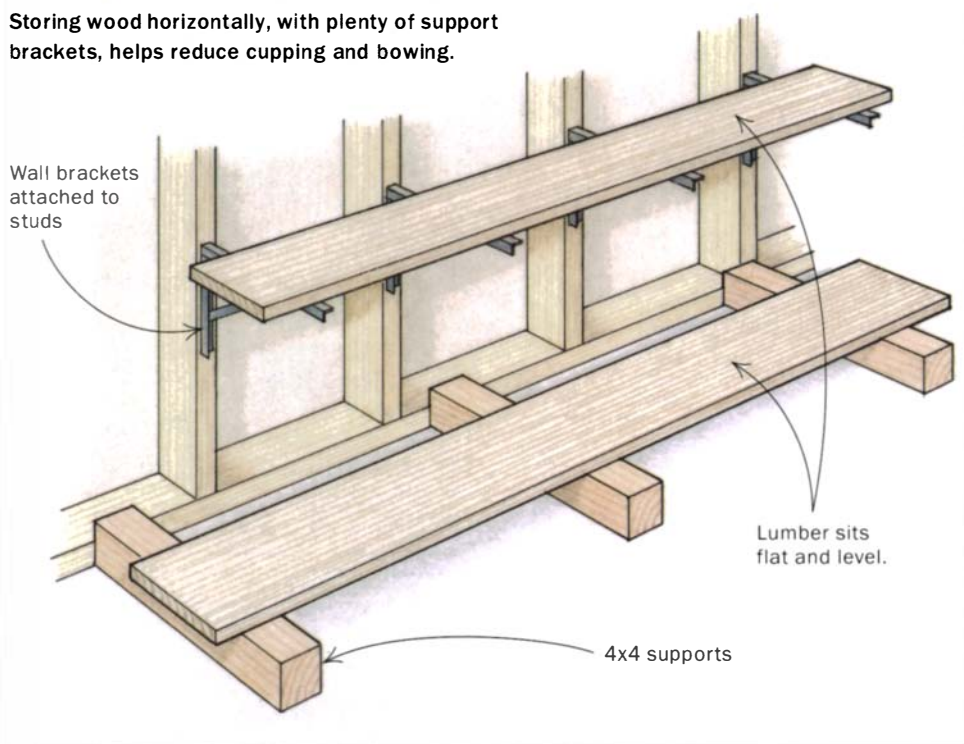
Mike Dunbar replies: I suspect that stores stack wood vertically for a couple of reasons: It takes up less space, and it is easier for customers to sort through, looking for that perfect board.

However, storing wood vertically over the long haul can result in some problems. A board supported at only the bottom and top ends eventually can develop a bow, the severity of which depends on how stiff the piece is. Stiffness is a function of the board's dimensions. For example, a 12-in.-wide by 4-ft.-long piece of 16/4 mahogany is probably not going to bow. There is a lot more risk of bowing with a 10-in.-wide by 10-ft.-long 4/4 piece that you may be reserving for a chest of drawers or a tabletop.

Depending on whether your shop floor is wood or concrete and whether your shop is in a cellar or garage, problems other than bowing may occur. The board's lower end can pick up grit that

HORIZONTAL WOOD STORAGE IS BEST

Storing wood horizontally, with plenty of support brackets, helps reduce cupping and bowing.



will dull machines and tools. Also, moisture may wick up into the end.

Like most of the woodworkers whose shops you have seen in *Fine Woodworking*, I prefer to store wood horizontally. I stack larger piles on the floor, elevated a bit by inexpensive 4x4

hemlock or fir supports. If you place supports under just the board's two ends, gravity can make the center sag. It is better to provide a pile of wood with more even support by placing the 4x4s at regular intervals.

I also store random boards and shorts horizontally, placing them along the walls of my machine room on wall brackets, which are lag-bolted to studs and will hold a lot of weight. The brackets are spaced only 16 in. apart and, like the 4x4 supports, provide even support for the wood.

[Mike Dunbar is a contributing editor.]

Changing speeds on a drill press

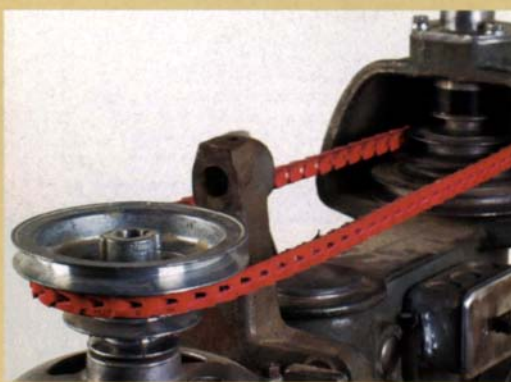
I have a stepped-pulley system for motor speed changes on my drill press. Is there an easier way?

—Carl Vaher, Abilene, Texas

John White replies: A simple solution to the hassle of changing the speed on stepped-pulley drill presses is to replace the standard V-belt with one of those red link belts from Fenner Drives; they're readily available in many woodworking catalogs.

With a link belt, a speed change takes only seconds and doesn't require you to reposition the motor. Link belts have a little bit of stretch, which allows you to change speeds simply by "rolling" the belt from one pulley groove to the next. Also, the link belt will make the drill press run smoother with noticeably less vibration and no slippage.

[John White, author of *Care and Repair of Shop Machines* (The Taunton Press, 2002), is shop manager for *Fine Woodworking*.]



Hit the links. Replacing the stock V-belt with a link belt makes it easier to change belt positions and reduces vibration.

Preventing outfeed snipe

I am experiencing snipe on the outfeed side of boards when I run them through the planer. I always go around to the back of the machine to support and catch the boards when they come out. Also, I believe that my planer is pretty well tuned. Do you have any other suggestions?

—Nickie Parnello, Chicago, Ill.

Steve Rowles replies: Outfeed snipe happens when the roller on the infeed side drops down when the aft end of the board has left it. Whether or not your

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planer is well-tuned, there is a simple trick for preventing the infeed roller from dropping down and causing snipe at the tail end of the board as it exits the planer.

When planing, always have a sacrificial board on hand that's the same thickness as the rest of your stock. Butt the forward end of the sacrificial board to the aft end of the first board while it is in midfeed. Then, by the time the end of the first board passes the infeed roller, the sacrificial board will keep the infeed roller elevated while the aft end of the good board passes under the cutterhead. [Steve Rowles is a woodworker living in Sedgwick, Maine.]

Are glued legs OK?

I plan to build a large, end-grain butcher-block table out of maple. I've been told that legs made from 16/4 stock would be better than glued-up legs from 8/4 stock. However, I am having no luck finding 16/4 maple nearby. On the other hand, 8/4 maple is readily available. It's not quartersawn, but it is dry and stable. I'm inclined to glue up this 8/4 stock for the legs and hope for the best. What do you think?

—Olaf Gerhardt, New York, N.Y.

Christian Becksvoort replies: Because 16/4 maple is hard to come by in your area and you've already found 8/4 stock, go for it. I don't see a problem with a glued-up leg.

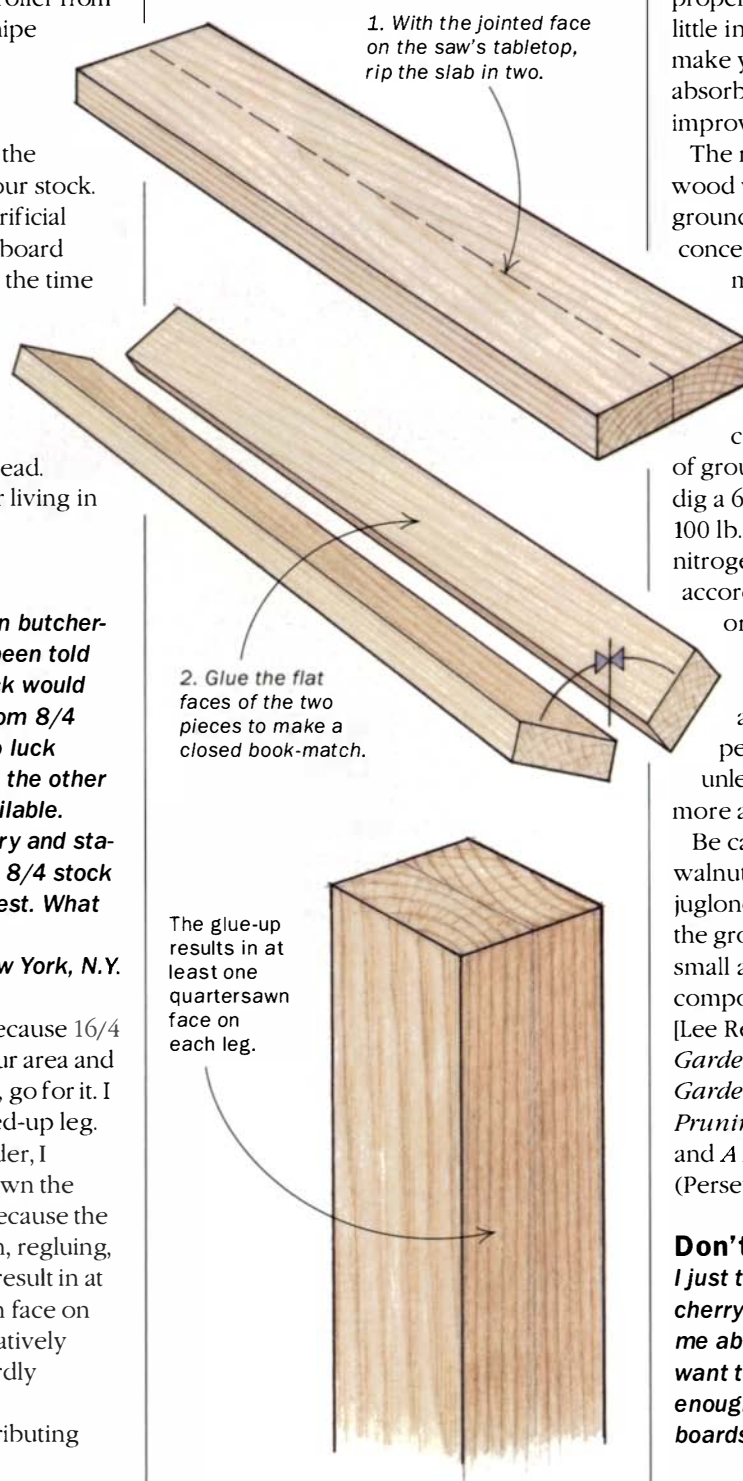
If your 8/4 stock is 8 in. or wider, I would flatten one face, rip it down the middle, and reglue the faces. Because the 8/4 stock is most likely flatsawn, regluing, like a closed book-match, will result in at least one very nice quartersawn face on each leg. Also, if the grain is relatively straight, the glueline will be hardly noticeable.

[Christian Becksvoort is a contributing editor.]

A constructive use for sawdust?

I am a woodworker who generates a lot of sawdust and jointer chips, which I throw out in the trash. I would like to do something constructive with them instead. I use woods such as walnut, pine, and cherry. Do these woods contain

GLUING UP TABLE LEGS



toxins that would inhibit or kill plants? What are the best applications for using chips and sawdust in my yard?

—Fenton Rhodes, Hartford, Conn.

Lee Reich replies: Wood chips and sawdust are excellent materials to

improve the physical and biological properties of your soil. Although they add little in terms of plant nutrition, they'll make your soil—any soil—better at absorbing and holding rainfall, and improve aeration.

The most straightforward way to use wood waste is to spread it over the ground as mulch. Some people are concerned that spreading nitrogen-poor mulch such as wood chips or sawdust over the soil will starve plants. Sidestep this potential problem by mixing in some high-nitrogen material with the chips or sawdust. For every 100 sq. ft. of ground into which you are going to dig a 6-in. depth of sawdust, add 100 lb. of a fertilizer containing 10% nitrogen. (Adjust the fertilizer rate accordingly if you use one having more or less than 10% nitrogen.) Because chips or sawdust make the soil temporarily more acidic, also add limestone at the rate of 60 lb. per 6-in. depth over 100 sq. ft.—unless you're trying to make the soil more acidic.

Be careful using chips or sawdust from walnut, because this wood contains juglone, a natural chemical that inhibits the growth of many plants. Use walnut in small amounts, or let it sit outdoors or compost for a year before use. [Lee Reich is a contributing editor to *Fine Gardening* and author of *Weedless Gardening* (Workman, 2001), *The Pruning Book* (The Taunton Press, 1997), and *A Northeast Gardener's Year* (Perseus, 1993).]

Don't rush air-dried lumber

I just transferred lumber from some cherry logs that my uncle cut down for me about one and a half years ago, and I want to determine when it will be dry enough to use. How can I tell when boards are ready to use?

—Steve O'Brien, Orefield, Pa.

Jon Arno replies: The rule of thumb is that lumber takes a year to season per each inch of its thickness. While this fairy tale provides some guidance, it isn't all that accurate; a slab of lumber takes progressively longer to dry as its thickness increases. Also, the length of time is to-

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tally dependent on atmospheric conditions (relative humidity levels), not to mention the density and cellular anatomy of the species you're trying to dry.

There is no such thing as overkill when air-drying lumber. I typically leave 4/4 stock on the stickers for at least two or three years, and I've been known to let heavier stuff dry for upwards of a decade.

Then the lumber goes straight from the drying pile to the shop. I resticker it in the shop for at least a week or two; this allows it to acclimate to the shop's atmosphere. Performing this final step can be as important as how long the wood was left in the drying pile, because wood doesn't simply dry out and then stay dry. Its moisture content is in constant flux. [Jon Arno is a regular contributor to *Fine Woodworking*.]

Plans for building Shaker furniture

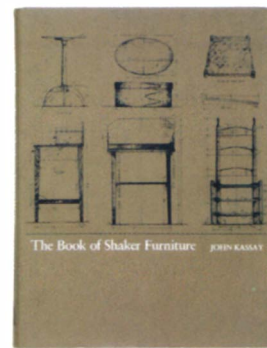
I have just received Christian Becksvoort's book *The Shaker Legacy*

(The Taunton Press, 2000). Having an overwhelming desire to build Shaker furniture, I am now looking for the seminal book on Shaker-furniture plans. Please direct me.

—Warner Franklin, Tempe, Ariz.

Christian Becksvoort replies: There are several books still in print that offer a variety of plans. If there is a seminal title, it is *The Book of Shaker Furniture* by John Kassay (University of Massachusetts Press, Amherst, 1980). It has more than 70 detailed measured drawings.

You'll notice that no new measured drawings have been published after 1980. At that time, museums and collectors began to restrict access to Shaker pieces. That is why there are no measured drawings in *The Shaker Legacy*.



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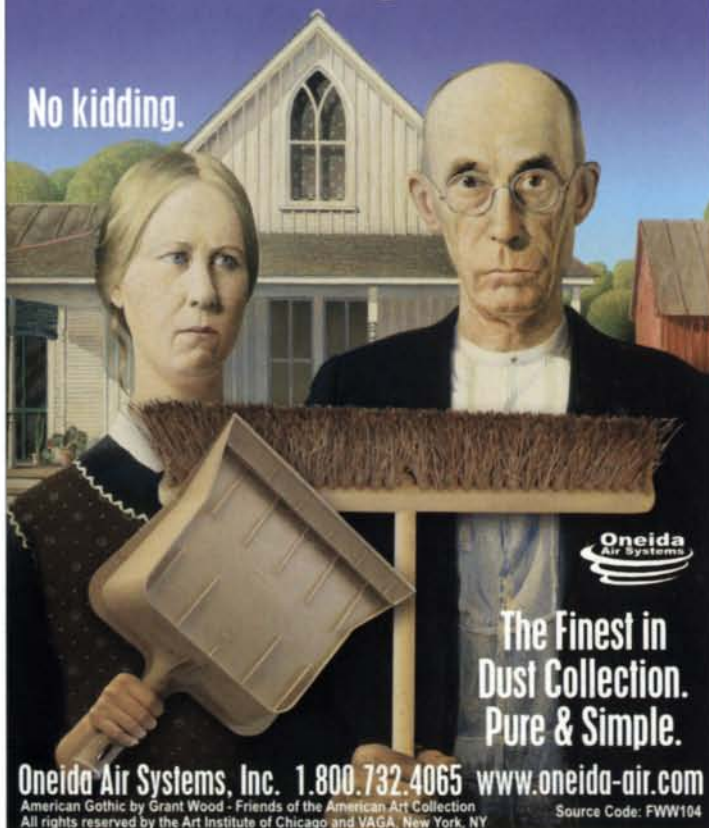
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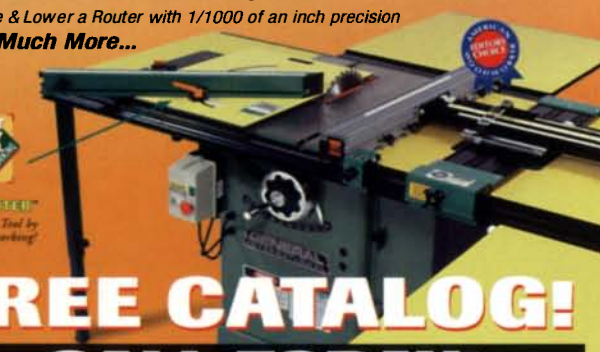
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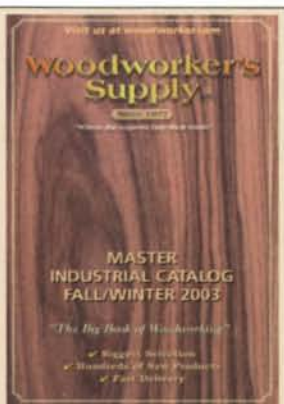
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Master Class

Windsor leg system stands the test of time

BY MIKE DUNBAR

“Can you glue my kitchen chairs?” That’s the first question friends and family ask when they find out you are a woodworker. Why is this experience so universal? Because most kitchen chairs are made with socket construction—round hole and round tenon—a joint that is easy to make. However, it is a joint that is prone to failure. Here’s why: Consider the surface of a hole drilled into a piece of wood. Most of that hole is end grain, which will not result in a good glue bond. People who buy factory-made chairs ought to expect either to reglue them regularly or to get rid of them in 10 years.

However, the antique market is full of 200-year-old Windsor chairs that also were made with socket construction, and most are still as tight as the day they were made. This suggests that chair makers did something then that’s not generally done today: They found a way to use this simple joinery system to produce bombproof chairs.

This stool is a good introduction to the mechanical system that Windsor-chair makers originally developed. I designed the 19-in. stool for use around my shop; now that I run a chair-making school, there are 20 of them in my classroom. If you lengthen the legs and change the angles slightly, you can make this stool 24 in. high.

It all begins with the leg-to-seat joint

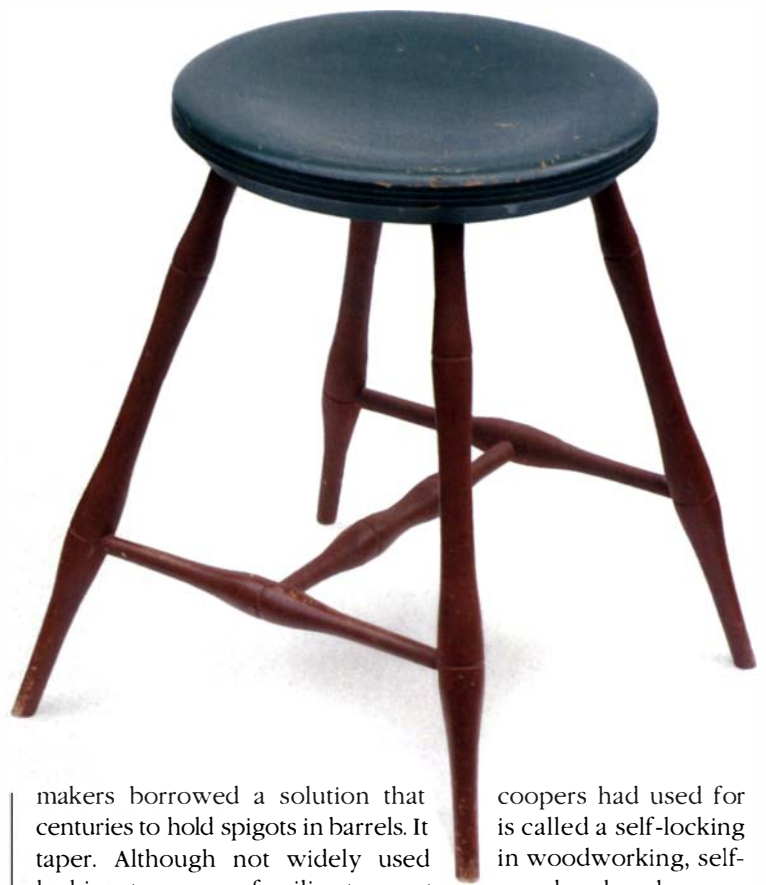
The most important joint in the stool is the one that attaches the legs to the seat. Knowing that glue is destined to fail, Windsor-chair

makers borrowed a solution that centuries to hold spigots in barrels. It taper. Although not widely used locking tapers are familiar to most they are used to hold the centers in a lathe.

coopers had used for is called a self-locking in woodworking, self-woodworkers because

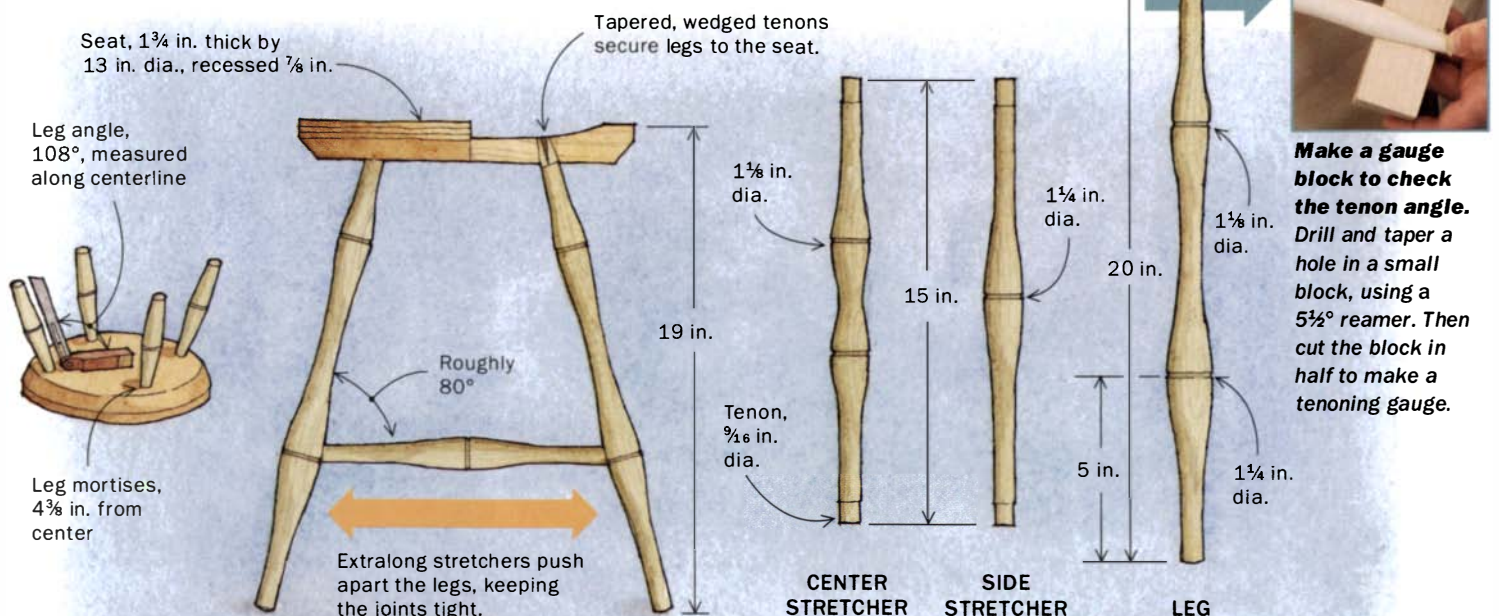
As strong as a locking-taper joint is, it is not permanent in wood. The seasonal movement of the stool’s seat will break the friction. However, the way the joint is used in a Windsor guarantees it will be tightened every time a person sits on the chair or stool.

The locking-taper leg joint does require drilling holes through the seat. In other words, you will be able to see the joints in the seat, and the shrinkage of the seat will cause the ends of the tenons



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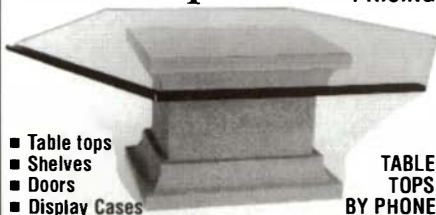
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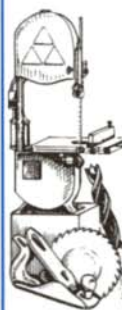
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LEG-TO-SEAT JOINERY



Straight holes, drilled at an angle. After the seat has been turned, lay out and drill four $\frac{1}{8}$ -in.-dia. holes. Set the drill-press table at the required angle, in this case 18° for a short stool.

to project slightly above the seat in drier seasons. This may offend modern sensibilities, but it is the nature of wood.

To make these joints, first bore holes in the seat at the desired angle. The holes then are tapered with a tool called a tapered reamer. The one I use (\$90 from Wharton Valley Chairworks; 607-965-8420) is held in a hand brace. It is possible to alter the hole's angle with the reamer, so while reaming it is important to check the angle of the reamer and hand brace regularly with a sliding bevel gauge.

The tenons are tapered while turning the leg on the lathe. To check for the correct angle, make a simple gauge by drilling a hole in a block of wood, reaming it, and cutting the block in half. Later, these tenons are wedged from above the seat.

Extralong stretchers guarantee strong joints

In 1984 The Taunton Press published the book *Make a Windsor Chair With Michael Dunbar*, in which I described a method



Ream the holes to taper them. The reamer comes with a square, tapered tang to fit a hand brace, which will allow the best control. Check the leg angle as you go (above). Also, check that each tenon protrudes the same amount from the top of the seat.

of making a chair's undercarriage out of green wood and drying the tenons in hot sand, an idea borrowed from ladderback-chair construction. If there is a chair maker's hell, I will spend eternity there drying tenons over a cauldron of hot sand to atone for this blunder. I should have trusted my own knowledge and experience. I knew full well from looking at old Windsors that making the stretchers extralong—which places the joints in compression—is all that is needed for durability.

Having developed a strong joint to secure the legs into the seat, the old-timers came up with an effective solution for preventing the stretcher joints from coming apart. Because glue ultimately will fail, they knew better than to put the stretchers in tension. Instead, they put the stretchers in compression by using them to push the legs apart. Think of these parts as spreaders, not stretchers.

Windsor-chair makers made the stretchers slightly longer than the actual distance between the legs. I call this extra length "preload." For a stool I add $\frac{3}{8}$ in. of preload to each stretcher. The preload makes the center stretcher push the side stretchers apart, while each side stretcher pushes a pair of legs apart. Because the top of the leg is anchored in the seat by the locking taper, the stretchers can't pull

STRETCHER JOINERY

Cut the stretchers to length and tenon their ends. Dry-fit the legs to the seat (top), and use rubber bands to hold the stretchers in position. Mark their overall lengths and add $\frac{3}{8}$ in. to that dimension to create the extra splay. Cut them to length and use a Veritas tenon cutter (bottom) to form accurate tenons.



Drill for the center stretcher. Use a brad-point bit, drilling squarely into the side stretchers.

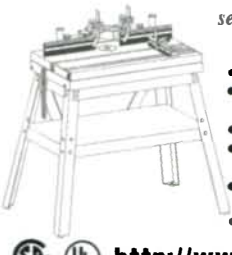


Find the angle for the side stretchers. Align a sliding bevel gauge with two legs to find the angle to drill the mortise.



Drill the legs for the side stretchers. Set up the sliding bevel as shown to maintain the proper angle.

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STOOL ASSEMBLY

Start by gluing up the base. Assemble the stretcher system first and then add the legs (right). Before the glue sets up in the base, apply glue to the leg-to-seat joints and drive the legs into the seat (below). As the leg tenons go home, the extralong tenons will stress all of the seat joints, locking the base together for decades of hard use.



out of their joints, even after the glue fails. A brad-point drill bit will do a good job on the stretcher holes. If you use a power drill, select a slow speed to allow time to adjust the hole angles as you go.

How to figure the compound angles

The compound angles in the joinery are measured in two simple ways. I'll give the angles and dimensions that work for a short stool, 19 in. tall, with stretchers that are 5½ in. above the floor.

First of all, to work with smaller numbers, I assume that 0° is a vertical line. The leg angle in the seat (18°, in this case) is measured along the bottom of the seat, in line with the opposing leg. This works because each pair of opposing legs lies in the same plane.

On the other hand, the angle that joins the stretchers to the legs is measured using adjacent pairs of legs because each pair is connected by a common stretcher and can be measured in a common plane. For the shorter stool, this angle is roughly 10°.

Assembly and glue-up go quickly

After turning all of the parts and cutting the leg-to-seat joints, lay out the stretcher tenons. Because the legs describe a square, all three stretchers are roughly 11½ in. long, shoulder to shoulder. Due to the nature of handwork, however, this dimension can vary slightly and must be determined in progress. To find the shoulder-to-shoulder dimension, dry-fit the legs to the seat and clamp the side stretchers onto the legs with rubber bands. The small grooves in the legs will keep the stretchers at their proper elevation. Then add the tenons to this measurement, as well as the ¾ in. of preload.

After forming the tenons on the lathe or with a tenon cutter, the next step is to drill the two side stretchers at 90° for the center stretcher, and assemble the three stretchers. Next, use a straight-edge and a sliding bevel gauge to determine the exact stretcher angle for the stool, and drill the legs to receive the side stretchers.

Now you can glue the stretcher system into the four legs, and then drive the tapered leg tenons into their tapered holes in the seat, locking together the entire stool. Use glue in these joints as well, and finish by wedging them from above (see the photos below). Not counting the turning, the entire process should take less than one hour—and the results should last a lifetime. □



Wedge the leg tenons. Split each leg tenon with a sharp chisel (above left), aligning the wedging action against the seat grain to avoid splitting the seat. Next, drive a sharpened stick into the split (above right) along with some glue. Now cut off the stick, resharpen it, and repeat the process. Finish by paring the tenons and wedges flush with the seat.

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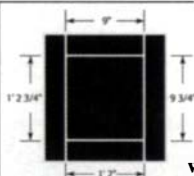
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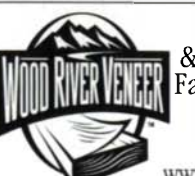
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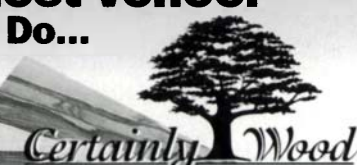
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INDEX TO ADVERTISERS

Use reader service card - inside back cover.

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Reader Service No.	ADVERTISER, page #	Reader Service No.	ADVERTISER, page #	Reader Service No.	ADVERTISER, page #	Reader Service No.	ADVERTISER, page #
	Abacus Chair Parts, <i>p. 101</i>	71	Diefenbach Benches, <i>p. 117</i>	48	Laguna Tools, <i>p. 9</i>	12	The St. James Bay Tool Co., <i>p. 118</i>
192	Accuride International, <i>p. 93</i>		Diefenbacher Tools, <i>p. 118</i>	56	Lee Valley Tools, <i>p. 106</i>	96	Sandman Products, <i>p. 117</i>
168	Adams Wood Products, Inc., <i>p. 84</i>		Dovetail Restoration, <i>p. 118</i>		Leigh Industries, <i>p. 23</i>	43	Sauers & Co. Processed Veneers, <i>p. 118</i>
	Adria Toolworks, Inc., <i>p. 115</i>	108	Drill Doctor, <i>p. 97</i>		Leigh Industries, <i>p. 101</i>	42	Scherr's Cabinet & Doors, Inc., <i>p. 105</i>
158	Airware America, <i>p. 114</i>	5	Dust Boy, Inc., <i>p. 115</i>		Librawood, <i>p. 117</i>		School of Woodworking, <i>p. 118</i>
41	Allred & Associates, Inc., <i>p. 97</i>			28	Lie-Nielsen Toolworks, <i>p. 113</i>	63	Shaker Workshops, <i>p. 9</i>
206	Amazon.com/DeWalt, <i>p. 106</i>	199	Eagle America, <i>p. 103</i>	190	Lignomat Moisture Meters, <i>p. 111</i>	106	Sharp Tools USA, <i>p. 117</i>
126	Anderson Ranch Arts Center, <i>p. 84</i>	120	Eagle Tools, <i>p. 93</i>	98	The Lumberlady, <i>p. 119</i>	59	Shopbot Tools, Inc., <i>p. 111</i>
176	Andrews Toolworks, <i>p. 115</i>	8	Eagle Woodworking, <i>p. 115</i>	137	Luthiers Mercantile Intl., <i>p. 111</i>	6	Space Balls, <i>p. 101</i>
193	Arrowmont School, <i>p. 103</i>	74	Engraving Arts, <i>p. 114</i>		M-Power Tools, Ltd., <i>p. 114</i>	61	Specialty Tools, <i>p. 118</i>
124	Astragal Press, <i>p. 117</i>		Enviro-Safety Products, <i>p. 113</i>	147	Makita USA, Inc., <i>p. 31</i>	212	Stanley Bostitch, <i>p. 27</i>
		103	Epoxy Heads, <i>p. 107</i>	65	Manny's Woodworker's Place, <i>p. 21</i>	114	Stone Turners.com, <i>p. 117</i>
167	Ball & Ball Reproduction Hardware, <i>p. 90</i>	82	Everlast Saw & Carbide Tools, <i>p. 26</i>	118	Mao Shan Machinery, <i>p. 111</i>	34	Stubai Direct, <i>p. 115</i>
	Barr Specialty Tools, <i>p. 115</i>			20	Marc Adams School of Woodworking, <i>p. 93</i>	55	Suffolk Machinery, <i>p. 115</i>
19	Bauhaus Apprenticeship Institute, <i>p. 117</i>	148	Felder USA, <i>p. 15</i>		Marc Blanchette Windsor Chair, <i>p. 117</i>	133	Sutherland Tool, <i>p. 115</i>
123	The Beall Tool Co., <i>p. 117</i>	159	Forrest Manufacturing, <i>p. 85</i>			135	System Three Resins, <i>p. 99</i>
143	Bear Mountain Boat Shop, <i>p. 115</i>	144	Freud, <i>p. 17</i>	180	Mass Bay Wood Products, <i>p. 118</i>	38	Talarico Hardwoods, <i>p. 116</i>
52	Belcher Veneer Co., <i>p. 117</i>	26	The Furniture Institute of Massachusetts, <i>p. 117</i>	185	Maurice L. Condon Co., Inc., <i>p. 7</i>	57	Target Enterprises, <i>p. 21</i>
85	Berea Hardwoods, <i>p. 97</i>	184	Furniture Medic, <i>p. 15</i>	171	McFeely's Square Drive, <i>p. 90</i>		Tool Guide, <i>p. 98</i>
116	Berkshire Veneer Co., <i>p. 116</i>			33	Meg Products, <i>p. 115</i>	188	Tech Mark, Inc., <i>p. 107</i>
170	Better Built Corp., <i>p. 24</i>	187	General Manufacturing Co., Ltd., <i>p. 26</i>	68	Microplane, <i>p. 93</i>	75	Tech-Wood, Inc., <i>p. 118</i>
83	BrandNew Industries, <i>p. 116</i>			87	Micro-Surface Finishing Products, <i>p. 119</i>	13	Thewindsorinstitute.com, <i>p. 115</i>
136	Brookside Veneers, Ltd., <i>p. 113</i>	17	Gilmer Wood Company, <i>p. 115</i>	30	Miller Dowel Company, <i>p. 90</i>	197	Titebond, <i>p. 18</i>
		178	Gizmo Lab, <i>p. 115</i>	139	Mini Max USA, <i>p. 24</i>	25	Tools for Working Wood, <i>p. 116</i>
191	CMT USA, Inc., <i>p. 24</i>	32	Goby's Walnut Wood Products, <i>p. 116</i>	140	Mini Max USA, <i>p. 103</i>		Traditional Woodworker, <i>p. 19</i>
44	CT Valley School of Woodworking, <i>p. 101</i>	78	Good Hope Hardwoods, <i>p. 117</i>	37	Misugi Designs, <i>p. 116</i>	198	Trend Routing Technology, <i>p. 19</i>
3	CT Valley School of Woodworking, <i>p. 119</i>	177	Gorilla Glue, <i>p. 99</i>			89	Turbinaire, <i>p. 7</i>
	Cabinetparts.com, <i>p. 114</i>	166	Gougeon Brothers, <i>p. 117</i>		Nora Hall, <i>p. 114</i>	88	Turbinaire, <i>p. 93</i>
127	CabParts, <i>p. 90</i>	35	Groff & Groff Lumber, <i>p. 118</i>	60	North Bennet Street School, <i>p. 118</i>	21	Vac-U-Clamp, <i>p. 107</i>
	Canvas Goods, <i>p. 114</i>	91	Guillemont Kayaks, <i>p. 115</i>	62	Northwest Timber, <i>p. 21</i>	46	Vacuum Pressing Systems, <i>p. 113</i>
172	Carter Products, <i>p. 7</i>			186	Northwest Woodworking Studio, <i>p. 113</i>	90	Viel Tools, Inc., <i>p. 109</i>
	Center for Furniture Craftsmanship, <i>p. 24</i>	107	H. Gerstner & Sons, <i>p. 99</i>	138	Northwest School of Wooden Boatbuilding, <i>p. 115</i>	10	Virtutex.com, <i>p. 104</i>
161	Certainly Wood, <i>p. 117</i>	153	HTC Products, Inc., <i>p. 114</i>			51	W. Moore Profiles, <i>p. 103</i>
80	Chesapeake Light Craft, <i>p. 84</i>	131	Hamilton Books, <i>p. 21</i>	128	Omer Direct, <i>p. 104</i>	97	WGB Glass, <i>p. 109</i>
122	Chips Fly.com, <i>p. 117</i>	195	Handyman Plans, <i>p. 115</i>	183	Oneida Air Systems, <i>p. 105</i>	205	Waterlox Coatings Corp., <i>p. 26</i>
149	Classic Designs by Matthew Burik, <i>p. 111</i>	45	Harris Woodworking, <i>p. 116</i>	145	The Original Saw Company, <i>p. 111</i>	53	West Penn Hardwoods, <i>p. 116</i>
	Classic Planes, <i>p. 118</i>	189	Hartville Tool Company, <i>p. 113</i>	129	Osborne Wood Products, <i>p. 116</i>	7	Whitechapel, Ltd., <i>p. 9</i>
	Classifieds, <i>p. 119</i>	4	Hearne Hardwoods, Inc., <i>p. 109</i>	14	Outwater Plastics Industries, <i>p. 106</i>	18	Wilke Machinery Co./Bridgewood, <i>p. 84</i>
152	Clayton Machine Corp., <i>p. 103</i>	201	Hersaf/Safranek, <i>p. 113</i>	209	Packard Woodworks, <i>p. 118</i>	113	Williams & Hussey, <i>p. 21</i>
64	Cohasset Colonials, <i>p. 84</i>	2	Hida Tool & Hardware, <i>p. 103</i>	24	Peck Tool, <i>p. 116</i>	99	Wood Rat, <i>p. 109</i>
	Collins Tools, <i>p. 118</i>	194	Highland Hardware, <i>p. 109</i>	101	Penn State Industries, <i>p. 109</i>	125	Wood River Veneer, <i>p. 115</i>
9	Colonial Saw Company, <i>p. 105</i>	16	Hoffman Machine, <i>p. 99</i>	11	Philadelphia Windsor Chair, <i>p. 116</i>	47	Woodcraft University, <i>p. 10</i>
27	Conover Workshops, <i>p. 117</i>				Plans Now.com, <i>p. 117</i>		Woodfinder, <i>p. 114</i>
179	Cook Woods, <i>p. 117</i>	94	Infinity Cutting Tools, <i>p. 7</i>	204	Pootatuck Corporation, <i>p. 115</i>	93	Woodjoy Tools, <i>p. 115</i>
175	Cormark International, <i>p. 116</i>	181	Irion Lumber Co., <i>p. 115</i>	31	Porter Cable, <i>p. 95</i>	165	Woodmaster Power Tools, <i>p. 101</i>
84	Crown Plane, <i>p. 118</i>	58	Irwin Industrial Tools, <i>p. 12</i>	36	Pygmy Boats, Inc., <i>p. 118</i>	164	Woodmaster Power Tools, <i>p. 105</i>
109	Curly Woods, <i>p. 116</i>	146	Iturra Design, <i>p. 19</i>				Woodpeckers, <i>p. 104</i>
70	The Cutting Edge, Inc., <i>p. 118</i>	73	J.B. Dawn, <i>p. 116</i>	203	Quality Vakuu Products, <i>p. 84</i>	22	Wood-Ply Lumber Corp., <i>p. 116</i>
		86	The Japan Woodworker, <i>p. 113</i>	79	Rare Earth Hardwoods, <i>p. 118</i>	54	Woodsmith Store, <i>p. 99</i>
		117	Jessem Tool Co., <i>p. 15</i>	169	Ridge Carbide Tool Co., <i>p. 116</i>		Woodsmithstore.com, <i>p. 114</i>
		162	Jet Equipment, <i>p. 2-3</i>	92	Ridgid Power Tools, <i>p. 25</i>	23	Woodworker's Depot, <i>p. 113</i>
		196	Jet Equipment, <i>p. 91</i>	182	Robert Larson Company, Inc., <i>p. 116</i>	72	Woodworker's Supply, <i>p. 107</i>
102	Dakota County Technical College, <i>p. 111</i>	173	Jointech, <i>p. 106</i>	95	Rockingham Community College, <i>p. 116</i>	76	The Woodworkers Choice, <i>p. 117</i>
211	Dana Robes Wood Craftsmen, <i>p. 118</i>			119	Ronk Electrical Industries, Inc., <i>p. 99</i>	163	Yestermorrow, <i>p. 104</i>
151	Delmhorst Instrument Co., <i>p. 105</i>	160	Katana, <i>p. 26</i>				
155	Delta Machinery, <i>p. 19</i>		Kayne & Son, <i>p. 114</i>	100	Rosewood Studio, <i>p. 109</i>		
156	Delta Machinery, <i>p. 21</i>	142	Keller & Company, <i>p. 93</i>	208	Rousseau Company, <i>p. 90</i>		
157	Delta Machinery, <i>p. 23</i>	174	Klingspor Corporation, <i>p. 23</i>	29	Router Bits.com, <i>p. 99</i>		
154	Delta Machinery, <i>p. 123</i>	134	Kreg Tool Company, <i>p. 97</i>				
		50	Kremer Pigments, <i>p. 116</i>				
		132	Kuffel Creek Press, <i>p. 101</i>				

Finish Line

A finish that adds 200 years

BY EUGENE LONDON

When I examine an 18th-century antique, I never fail to admire its finish: the deep, warm glow of the wood, the surfaces polished by decades of use and care, and the characteristic buildup in the recesses and corners.

Seeking to reproduce this patina, I've developed my own finishing technique. The multiple steps go quickly, and you should be able to finish a chair like this one in a couple of days. As is, this finish can be used on both mahogany and walnut; if used on cherry, skip the yellow dye.

Seal the wood, then sand it smooth

Before staining the wood, apply a 1½-lb. cut of waxy orange shellac that acts as a stain controller. Use a 1-in. artist's brush with fine artificial bristles to apply the shellac in thin but even coats. By the time the whole piece is coated, the place where you started should be dry enough to sand. Use 240-grit sandpaper that is steartared to resist clogging. Don't be afraid of sanding quite aggressively to smooth and dewhisker the surface as well as round over any sharp edges and corners. Follow up by sanding any areas most likely to be touched, such as the crest rail, with 400-grit paper.

Carved areas are best treated with brass wire brushes, followed by rubbing with a minimally abrasive white pad. Leave the sanding dust on the

surface to act as a grain filler in the subsequent finishing steps.

SOURCE OF SUPPLIES

Fast Sol yellow 3R dye, walnut crystals, brass brushes, orange shellac, asphaltum, burnt umber

OLDE MILL CABINET SHOP
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Brush on two dyes, then a coat of linseed oil

The next step is to brush on a fairly diluted coat of alcohol-based lemon-yellow dye. The object here is to highlight the lighter parts of the wood and to make them shine through the subsequent layers of finish.

The second dye is made from the hulls of black walnuts that have been soaked for several months in water. Water-soluble crystals (see Source above) give the same stain. Apply the dye generously, but avoid runs. You may find the dye beads up on the



1 Seal and sand the wood. A thin 1½-lb. cut of waxy orange shellac is applied over the whole surface (left) to seal the wood before a stain is applied. After the shellac dries, smooth the flat surfaces with sandpaper, and use brass wire brushes and a white abrasive pad on the intricate areas (below).



2 Apply two coats of dye. Brush on a diluted coat of alcohol-based yellow dye to bring out the lighter streaks in the wood (right). Then apply a brown dye made from black-walnut hulls (below). This water-based dye needs to soak into the wood overnight.





3 **Apply a coat of oil followed by more shellac.** Brush on a coat of boiled linseed oil to add depth. Next, brush on three more coats of shellac, then use cheesecloth to wipe on a final coat (right).



4 **A shopmade glaze.** Mixing burnt-umber pigment with an oil-based finish creates a slow-drying glaze. Apply the glaze liberally, making sure to penetrate all of the recesses.



surface at first, but let it sit overnight, and by the next day the dye will have penetrated the wood. This deep-brown dye mimics the rich tones found on many antiques.

To bring out the wood's depth, brush on a coat of boiled linseed oil, diluted by one third with turpentine or mineral spirits to aid penetration. Museums have stopped using linseed oil on period pieces because it darkens the wood over time, but this is precisely the effect I am seeking. Before the oil gets tacky, wipe it down thoroughly with clean rags until the wood feels smooth to the touch.

Build the layers of shellac

Ideally, you should let the piece cure overnight before brushing on orange shellac. I use a fairly heavy 2½-lb. or 3-lb. cut on chairs, but on a piece with larger surfaces I might go with a lighter cut that will flow out better. Use the same 1-in. artist's brush. Avoid heavy runs, but don't skimp. The object is to build the finish, fill some of the pores, and leave some residue in the crannies and carved areas.

Because shellac dries fast, you can add several coats in succession. Once the brush starts to drag on the tacky surface, let the piece rest for several hours. Afterward, you either can brush on more shellac or, if the finish has built enough, proceed to smooth the flat surfaces with 400-grit sandpaper and the intricate areas with 0000 steel wool. Remove any steel-wool particles with a brush or compressed air.

The last layer is a 2-lb. cut of shellac applied with a folded piece of cheesecloth. This reseals any wood that might have been sanded bare and leaves a smooth coat.

Two centuries in two steps

To complete the aging process, you must re-create the buildup of grime and wax that collects in corners and carved areas over time. The first step is to combine burnt-umber pigment and a slow-drying oil-based finish to form a glaze. Dip an old brush into the finish, then, on an artist's palette or board, gradually work in some pigment to form a thin paste. Apply the glaze generously, making sure to work it into all of the nooks and crannies.

When the glaze has developed a little tack and has begun to lose its wet look, remove it with clean rags. Resist the urge to wipe too thoroughly, as this will ruin the effect. In particular, leave a residue in any cavities, such as the grooves of carvings, and in any corners.

Allow the glaze to dry overnight and then reinforce the aging process with a coat of wax. I combine a good-quality furniture paste wax with a little asphaltum, which is similar in color and consistency to roofing tar. On intricate surfaces, apply a light coat of wax with a dedicated paintbrush, using an up-and-down motion to drive the wax into every corner. When the whole piece is coated, buff the surfaces with clean rags, working the frequently touched areas the most and leaving the recesses barely polished. The dark wax adds a final touch to the aging process. □



5 **Grime of the century.**

Paste wax combined with asphaltum is forced into the corners and recesses to imitate the buildup of dirt and finish over 200 years. Buff the wax with a clean cloth, concentrating on the areas most likely to be touched.

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27 Years Between Visits

Back in the spring of 1977, Gary Upton, then a 22-year-old California woodworker, was featured in *Fine Woodworking* (FWW #6, pp. 32-34). Of his work, we wrote, "His desk in oiled walnut shows great potential." We rediscovered Upton's work recently and were not surprised to learn that this stereo cabinet won the Award of Achievement at last year's American Craft Council show in San Francisco. The piece features spalted maple bow-front doors, sculpted ebony legs and door handles, carved maple drawer pulls, and a Norwegian black-lace slate top. The cabinet handles all of the requirements of modern stereo gear: doors in the back for wire connections and cooling, ventilation cutouts in the shelves, and three drawers for CD storage. To see more of Upton's work, visit his Web site at www.garyupton.com.

