October 1999
No. 138

TAUNTON'S

Fine WoodWorking

Drill bits: how to choose the one to use

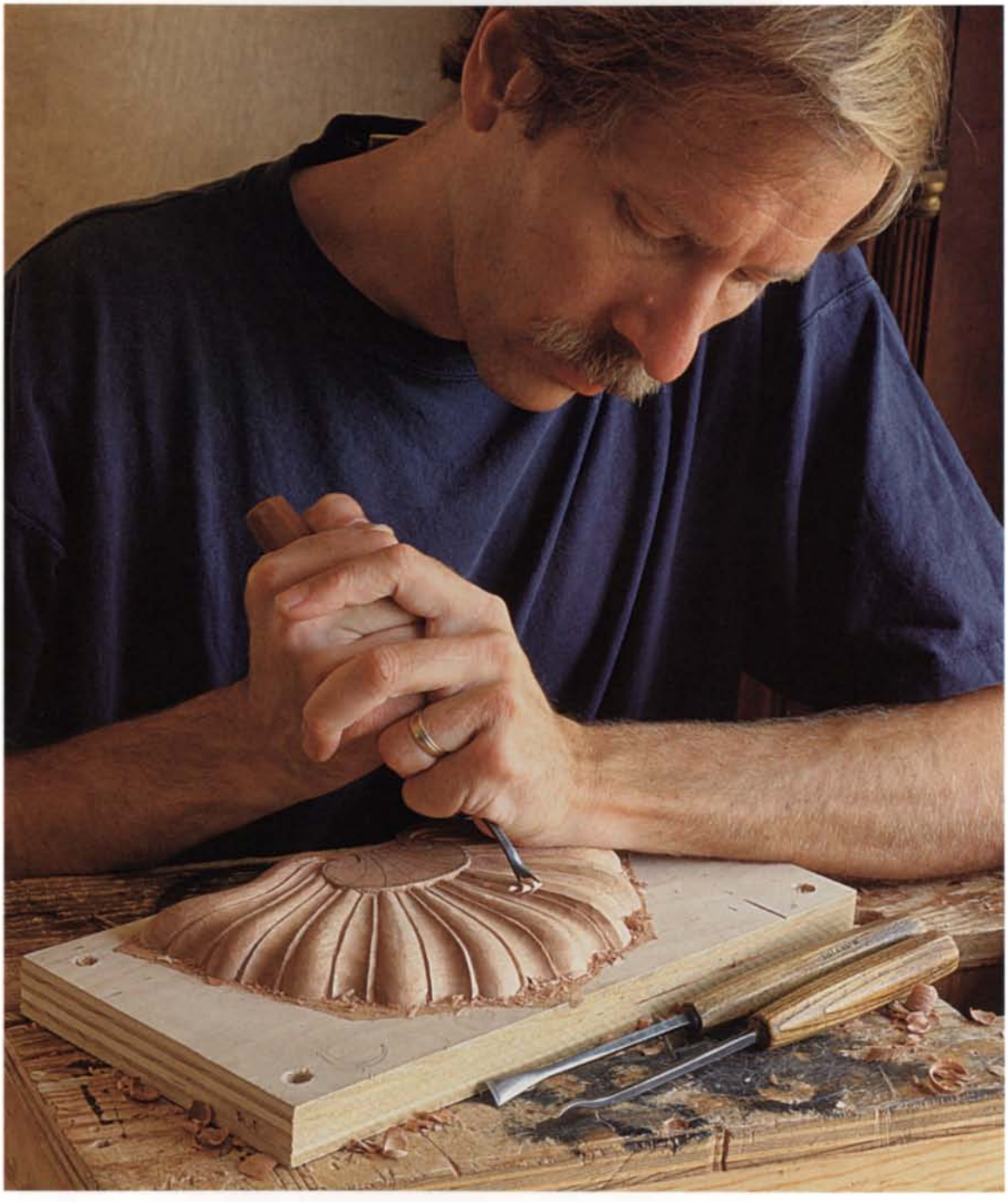
Router tables reviewed

Sideboard strategies for any style

Drop-leaf Pembroke table

Finish strippers

Building rustic: no noise, no dust, free lumber



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Fine WoodWorking®

Departments

Router-table survey, p. 86

On the Cover:
Carving three-dimensional figures in wood is a refined skill. This issue's Master Class author, Allan Breed,

illustrates his steps for making a classic 18th-century Newport shell. *See p. 112.*
Photo: Jonathan Binzen

Rustic furniture, p. 50

Construction system for sideboards, p. 42

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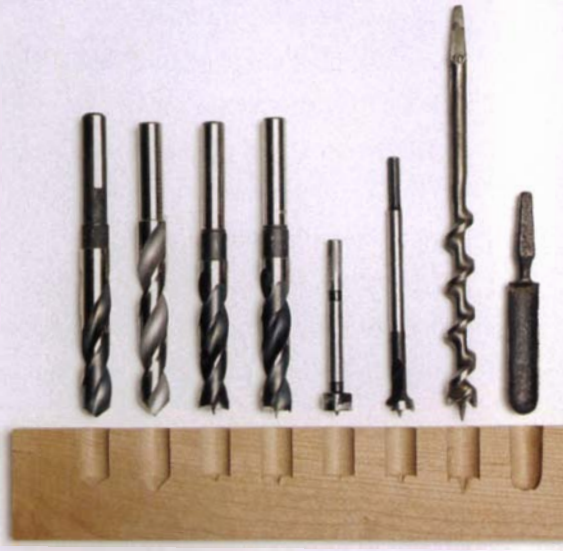
Articles



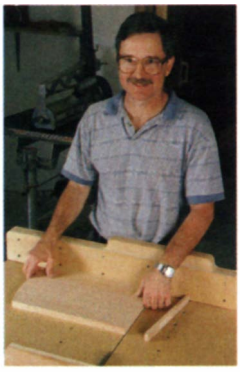
Choosing the right drill bit, p. 64

Pembroke table, p. 58

Contributors

Brian Boggs ("Choose the Right Drill Bit for the Job") makes chairs derived from the traditional Appalachian post-and-rung chair. His chair designs are widely admired for both their technical and aesthetic sophistication, not to mention their comfort. In addition to giving chair-making classes around the country, Boggs has helped establish a self-sustaining chair-making program in Honduras. He lives in Berea, Ky., with his wife and two sons.

Paul Ruhlmann ("The Rudiments of Rustic Furniture") took the normal detour into woodworking. He studied marine biology and clinical psychology in college and then got a job in community mental health. He made his abrupt U-turn in 1975 after visiting the handmade home of New Hampshire sculptor and furniture maker Jon Brooks. After studying with Brooks for several months, he struck out on his own as a furniture maker. Since 1978 he has been the high school woodworking teacher at Buckingham Browne & Nichols School in Cambridge, Mass. And yes, this exponent of rustic furniture is a distant relative of Jacques-Emile Ruhlmann, the French designer of elegant Art Deco furniture.



Bill Ewing ("Arched Top Cabinet Doors") started his woodworking career in the early 1980s by selling Shaker boxes through magazine ads. These days, while kitchen cabinets are his bread and butter, he prefers to build his own designs. Most recently, Ewing designed and built pieces for a local magician. One piece is a dove's cage that disappears, and another is a box called Twister, used to make the magician's assistant appear as though she is tied in knots.

Allan Breed (Master Class) has been making period furniture in a one-man shop since 1976. In addition to his private commission work, he has built reproductions for a number of historical museums. In 1990, he was asked by Christie's auction house to reproduce the Nicholas Brown Desk and Bookcase, a Goddard-Townsend masterpiece. (Christie's auctioned the original for $12.1 million.) Breed also lectures on American furniture at various museums and is a consultant to furniture collectors.

Will Neptune ("Sideboard Strategies") graduated from the furniture-making department of North Bennet Street School in Boston in 1979. For a time he taught woodworking to first- through sixth-graders at nearby Belmont Day School—where an average sixth-grader could turn out a beautifully dovetailed box—and later ran his own furniture and architectural millwork shop in Hartford, Conn. Now back in Boston and teaching woodworking at North Bennet Street School, Neptune still manages to turn out a steady flow of commissioned pieces. He is currently at work on a set of eight Chippendale chairs.

John White ("A Survey of Router Tables") spent many years working as a cabinetmaker and contractor in Vermont. He currently divides his time between managing the *Fine Woodworking* shop (where he keeps the editors on their toes) and his own woodworking and machine shop. On weekends, he, his wife and their son enjoy roaming the Northeast, searching for vintage clothing, jewelry and tools.

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Letters

Router-bit review is criticized and applauded—Thank you very much for the revealing article "Router-Bit Matchup" (*FWW* #137, pp. 84-89). I was surprised at the results in that my latest purchase did not score well. They say such items as router bits are blind items, in that a consumer cannot generally ascertain quality simply by examining the item. Most of us need a router bit when we need it—right now—so we head for our local hardware store or home center. Now prepare yourself for a ton of bad letters from your advertisers. But remember this: There are more of us (your loyal readers). I look forward to your next series of tests.

—Roger S. Apted, Milton, Wis.

In his review of router bits, Anatole Burkin may have had a bright idea (he thought) about the methodology of testing, but he ended up providing very misleading information to your readers. Router bits that work well on CNC (computer numerically controlled) machines have wide-open gullets for easy disposal of wood chips. These types of bits are unsafe for normal router use where operator safety and kickback are an issue. Grizzly's SY brand router bits are of an anti-kickback design, with narrower gullets and radially relieved cutting edges meant to protect the operators from kickbacks and at the same time provide smooth cuts. They are not meant to be used on CNC machines.

All Mr. Burkin has established in his article is which straight bits work best in a CNC router at extremely fast and computer-controlled speeds. You might want to do another extensive test using humans with routers and a variety of bit profiles. We will put up our SY bits against any others within two times our price range.

—S. Balolia, president, Grizzly Industrial, Inc., Bellingham, Wash.

Your article on router-bit comparisons was great. I found it to be very interesting, factual and valid. Your comparison of one product against another is on a par with *Consumer Reports* testing.

I am motivated to write because I am so impressed by the integrity of your articles. This is not the first of its type that you have published where you call a spade a spade in no uncertain terms. It is without parallel that you would describe a product's performance without apparent concern that the company advertises in your magazine, as it was without parallel that you pointed out that 75% of all 15-in. planers come out of the same factory in Taiwan.

As a woodworker, but also as the technical director of a respected research institute, I now know that *Fine Woodworking* is the only woodworking magazine whose product testing I will rely on for honesty and integrity.

—Rob Levin, New York, N.Y.

Your readers knew that Eagle America would find some faults and discrepancies in your router-bit review. Our family has been manufacturing and marketing router bits for over 50 years. In the past 10 years alone, we have brought out 500 new bits and have sold over 1 million router bits.

You shouldn't judge an entire product line with the test of just one bit. We offer over 900 bits in our line. The one bit you purchased and tested started out strong with one of the best ratings. It is difficult for me to comment on your test, as I was not present and did not see the results firsthand. I do, however, have a concern about why it seemed to fail after 140 ft. when the identical bit under a different name made it through all 248 ft. with flying colors.

You might find it interesting that of the 17 bits you tested, only seven different sources made them—and seven of the bits came out of the same factory in Taiwan.

Our loyal customers know that we have a 100% lifetime satisfaction guarantee on all of our products. Our greatest asset has always been a satisfied customer. We are not happy unless the customer is. We want your readers to test this ½-in. straight bit in their own shops. The bit (#102-0905) currently sells for $17.99. Send us a copy of this letter with your check for $8.99, and I will ship you one at half price. You be the judge.

—Dan Walter, president, Eagle America, Chardon, Ohio

I subscribed to *Fine Woodworking* at the beginning and for most of the 25 years you have been published. From time to time I quit subscribing because I was not getting much out of the magazine. I was just about to this point again when I received the August issue, which included the "Router-Bit Matchup." This really caught my attention.

Your router-bit test was a well-thought-out experiment providing very meaningful and useful data. This is the kind of stuff we want from *Fine Woodworking*. I am sure that this kind of a project takes a lot more time, energy and money than the usual build-a-cabinet-type article. But it is much more valuable to us out here doing woodworking. Keep up the good work, and I will continue my subscription.

—Charlie Mead, Rockwood, Tenn.

I enjoyed Anatole Burkin's "Router-Bit Matchup." Between working in a router-bit factory for a brief period, writing *The Router Table Book* and acting as an expert witness in a major router-bit lawsuit, I have spent a good deal of time looking into the quality of router bits. I have also visited router-bit manufacturing facilities in Taiwan, the United States and Europe. I have conducted tests similar to yours, except that I used MDF (medium-density fiberboard) instead of MFB (melamine-coated flakeboard). I have conducted destructive and nondestructive testing of router bits in the forms of microfinish examination, spectrographic analysis of the steel bodies and the carbide, and micrographs of the carbide and the silver brazing that attaches the carbide. My findings generally agree with your generalization that country of origin says much about bit quality.

I take some exception to your test in that you did not have a representative sampling from any company tested. One bit does not make a sample.

A major factor in bit quality, which was not mentioned in the article, is the issue

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.

of virgin as opposed to reprocessed, or recycled, carbide. Top manufacturers use nothing but virgin carbide. Under a powerful microscope, reprocessed carbide shows voids and oversized chunks. When such a void or chunk occurs at the cutting edge, a bad edge is the result. Top manufacturers also grind the cutting faces to a better microfinish. The result is a keener edge that cuts cleaner, quieter (as you pointed out) and lasts longer. This is also why a mediocre bit sent to a first-rate sharpening service will often come back better than new.

Finally, let me say that your readers should not get too excited about any of this. Bits are perishable tooling: You use them up and throw them away. If your bit came out poorly, try another brand next time.

–Ernie Conover, Parkman, Ohio

Thank you so much for the router-bit comparison. Again it is shown that one doesn't necessarily get what one pays for. Unfortunately, most of my bits are Amana (not too bad) and Jesada (not very good). As a rank amateur woodworker, I suspected something might not be right with some of the bits, but I didn't know for sure.

I think that you would be doing your readers a significant service by including reviews of some other basic bit types. We have seen all sorts of reviews of all sorts of products but not of router bits. Considering the price of bits, it is a badly needed service.

–Ron Lutz, Rio Del Mar, Calif.

The "Router-Bit Matchup" article raises several issues that require further explanation. First of all, most good-quality router bits should perform adequately in this type of material. Utilizing a CNC router was a good benchmark to even out the playing field, but the rpm and feed rate were not mentioned. Altering the rpm and feed rate based on tool size, chip load and material type would give differing results. Also, the type of router bits tested would normally be used in a handheld or table-mounted router. No plunging was done in the test, but if it had been, the bits would have dulled at a much faster rate than just straight routing.

Besides these details, it should be mentioned that the geometry of any cutting tool can and will greatly affect its performance, especially in an abrasive material such as melamine-coated flakeboard. Keep in mind that heat is enemy No. 1 to cutting tools. We at Amana Tool Corp. are familiar with some of the other brands in the test. The geometry among them is quite different. Specifically, as the "hook" or "rake" angle of the carbide relative to the center of the bit gets larger, the bit is more aggressive. The advantage of this feature is that it will perform better in certain materials but will most likely dull faster as a result. It would be difficult to know exactly at what point the dulling would take place, but probably beyond the 250 ft. used in the test.

Our latest catalog shows four distinct types of straight bits: standard, high-production, hardwood and super plunge. All have different geometry and are intended for specific applications. The one selected for your test was the standard bit, but the high-production bit should have been chosen because it has a different hook angle.

I do not agree that an entire product line can be judged on a one-time test using a simply shaped router bit. It would be interesting to know the results if, say, different materials and more complicated router bits, like a Roman ogee or rail-and-stile, were chosen.

–Brian Corbley, technical director, Amana Tool Corp., Farmingdale, N.Y.

Fine Woodworking's reputation as one of the leading publications in its field is based on maintaining the highest editorial standards. Our reputation at Jesada Tools is based on establishing and maintaining the highest quality standards in the manufacturing of our tools. We feel your comparison of router bits drew an incorrect conclusion about the quality of the Jesada bit tested, and moreover, a test limited to only one router bit cutting melamine does not evaluate our entire line of tools.

We were troubled by the review, and we asked Steve Potter of Peninsula Woodworks in Largo, Fla., to test the

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.

–Timothy D. Schreiner, editor

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same product. Using your testing procedures, we cut 248 ft. at ¼-in. depth in ¾-in. melamine-coated particleboard, entering from the side on a CNC router with a 7-hp motor. The speed was set at 18,000 rpm and the feed rate was 236 in. per minute. We used a (#612-627) bit from our inventory, manufactured prior to the publication of the article. The bit easily completed the test with the following results: chips per foot on the first 25 ft., 1.12; chips per foot on the last 25 ft., 2.38.

These results are in sharp contrast with your findings. This contradictory outcome suggests that there are many variables in your test that merit further investigation. At Jesada Tools, quality and value are of paramount importance, and we are working harder than ever to maintain and improve our leading role in the industry.

–Carlo M. Venditto, C.E.O., Jesada Tools, Oldsmar, Fla.

EDITOR REPLIES: *Fine Woodworking* is determined to make our product reviews as scientific and objective as we can. We went a long way toward achieving these goals with our router-bit matchup.

Router manufacturers, an engineer and a mill-shop operator helped us design a test that would level the playing field and remove human error and subjectivity. A human would get tired running a handheld router through 4,216 ft. of board, leading to grossly inconsistent feed rate and pressure. So we used a computer-controlled router. As every woodworker knows, solid wood has very mixed density—and knots—from one board to the next, let alone from one tree to the next. So we used melamine-coated flakeboard. We did push the bits hard. You wouldn't think much of an automobile test if the testers only took it out for a Sunday drive. We wanted to test the bits' mettle.

Some have suggested that we should have tried more than one bit from each manufacturer. In the case of the bit that broke, we did. To try to be fair, we tested three bits. The first two broke, and we ordered a third, reengineered, bit for a test follow-up. We bought all of our test bits off the shelf, the way woodworkers do.

Granted, one item from a company doesn't absolutely reflect upon its entire product line, but when we and other publications test tools, whether drill bits or tablesaws, we generally review one sample. How that sample does is akin to a spot check. It's unrealistic to expect that every manufacturer produces flawless products every time. Over time, as other products are reviewed, an informed measure of overall quality and consistency will emerge. And that's what we aim to do by testing more and different router bits in the future.

Sprayer must have been faulty—Chris Minick's review of HVLP sprayers, "Turbine HVLP Sprayers Keep Getting Better" (FWW #137, pp. 62-67) pictures a distorted pattern for the Apollo 700 HVLP spray gun tested. While we do not dispute the results that Mr. Minick discovered, it dis-

appoints us that he did not call us to question his results.

The pattern was so unusual that a red flag should have gone up immediately, especially to someone as knowledgeable and experienced as Mr. Minick. This is what any of our customers would have done if they had discovered a less-than-perfect spray pattern. Mr. Minick knows that Apollo Sprayers has been successfully designing, manufacturing and selling HVLP sprayers for 34 years and has a reputation for offering precision equipment. One does not stay in business selling spray guns with faulty or distorted patterns.

It is unfortunate that the reader is led to believe that all Apollo spray guns are shipped with distorted patterns. This is far from true. While we institute a quality-control procedure on all spray guns shipped, we admit to being human, and it is possible that one spray gun slipped by our testing, and this is the one that ended up in Mr. Minick's workshop. We do not handpick any unit or spray gun for testing. We always supply stock equipment right off of our shelves. All Apollo equipment comes with a 30-day money-back satisfaction guarantee. We at Apollo hope that the readers of *Fine Woodworking* are understanding and will evaluate our products based on our history and our many happy and satisfied customers. We are always pleased to talk with you and share our HVLP knowledge.

–John A. Darroch, Apollo Sprayers, Inc., Vista, Calif.

Comments on dovetail jig review—I would like to thank you for including the Katie Jig system in Gary Rogowski's "Dovetail Jig Review" (*FWW* #134, pp. 84-89). I would like to comment on a few aspects of the review.

It should be noted that with two routers in use, the pins and tails can be cut in the same single setup with the Katie Jig. This unique feature to our system makes cutting just one box a very convenient, fast and accurate event. Mr. Rogowski's comments and photos lead me to believe he cut the joint with two setups per joint, as he would have to with our competitors' jigs. Our method is twice as fast.

As for excess stock or proud ends, our manual shows a setup to add a spacer that reduces the amount of excess stock to trim. My personal advice is to always leave trim or sand stock on the joint, about 1/16 in. to 1/8 in. After the polyurethane glue dries, a sanded corner always looks smoother and tighter. This is the best way to get that joint with an inlayed look, without overstressing the joint.

Mr. Rogowski notes that our backer board can get chewed up over time because the bit cuts into it as a way of preventing tearout. The backer boards can be easily replaced by loosening two screws. The Katie Jig is the only true adjustable spacing through-dovetail jig that offers no-tearout ability.

–Terry Hampton, Hampton House, Inc., Greenwood, Ind.

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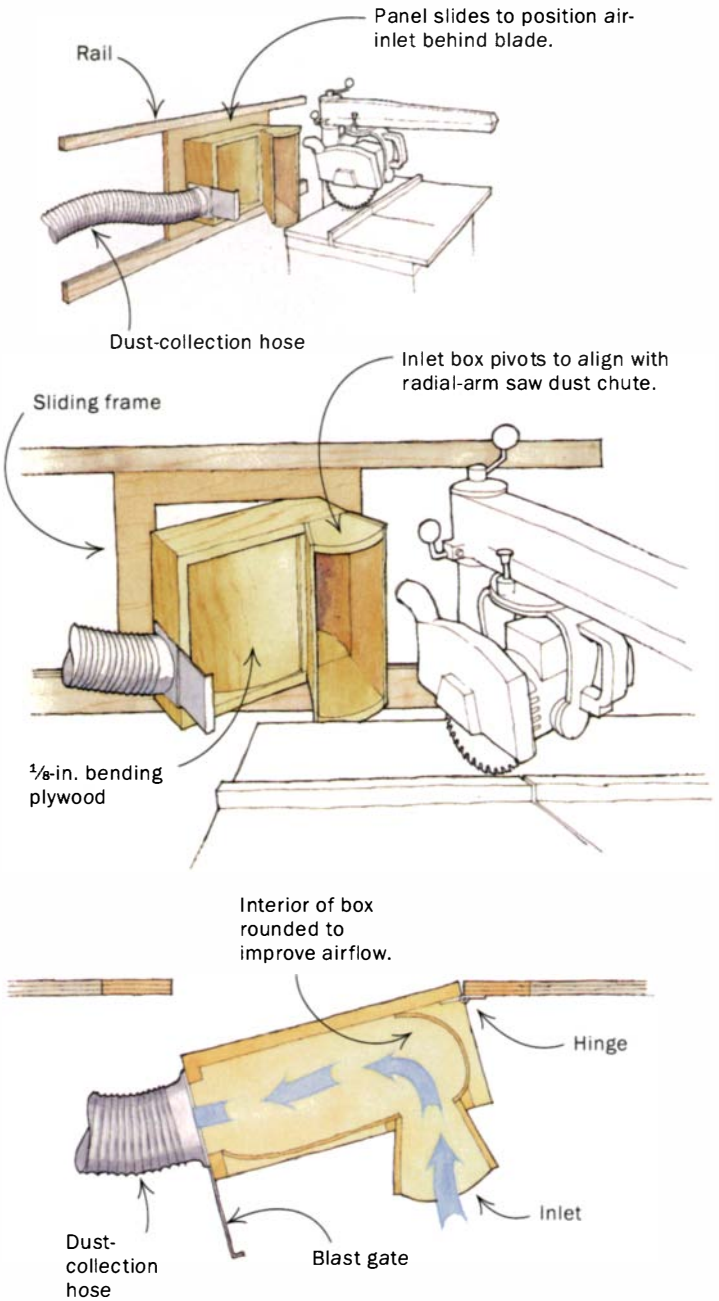
Adjustable dust-collection port

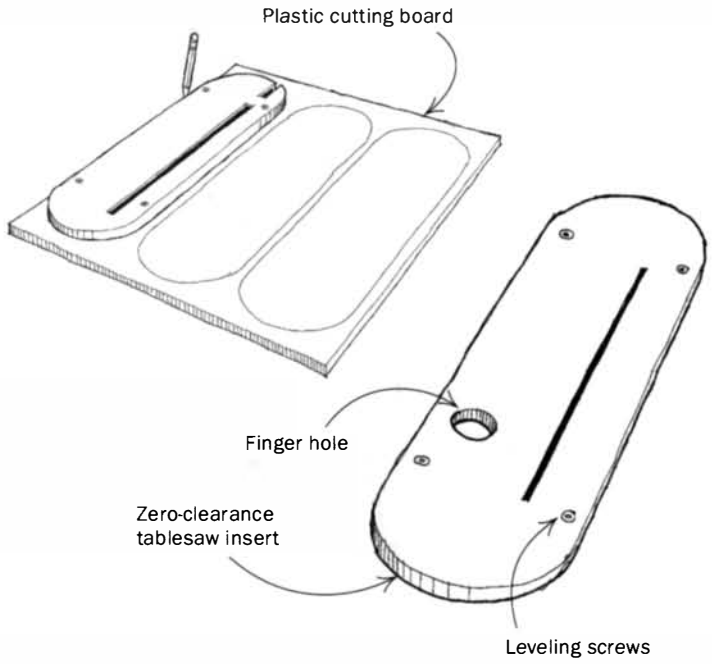


Collecting sawdust from a radial-arm saw is difficult because the sawdust is thrown in different directions, depending on the angle of the cut. Here's a solution that has considerably reduced cleanup at my saw (see the drawings at left). The device is a movable dust-collection port that can be swiveled to catch dust at just about any angle the saw can throw it.

Make the inlet box from ¾-in.- or ⅝-in.-thick plywood, then round the interior walls of the box with ⅛-in. bending plywood to improve the airflow and to avoid congestion. Attach a pair of rails to the wall with a sliding plywood panel between them. Hinge the box to the sliding panel and connect a gated dust-collection hose to the box. Make sure the collection hose is flexible and long enough to allow free movement of the hinged box.

Mount the box on the wall so that the floor of the box is about 2 in. below the level of the radial-arm table. That's it. Just remember to line up the inlet box with the exhaust chute of the saw before each cut. *—William C. Wright, Conroe, Texas*

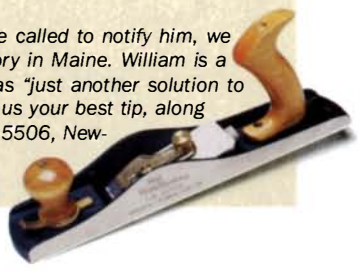
Tablesaw insert from a kitchen cutting board



When I discovered the cost of aftermarket zero-clearance throat inserts for my tablesaw, I decided to make my own. I bought an ordinary white, high-density plastic kitchen cutting board, ½ in. thick. I marked and cut out several inserts, using the existing metal one as a template. I then drilled and tapped four holes in each insert to install leveling set screws. I also drilled a finger hole to make it easy to remove the insert from the saw table. The cutting-board material is ideal because it is inexpensive, friction-free,

A reward for the best tip

William C. Wright received an engraved Lie-Nielsen plane for the best tip in this issue. When we called to notify him, we learned that he already owned six smaller Lie-Nielsen planes and that he once visited the factory in Maine. William is a retired architect who arrived at the design of his adjustable dust-collection port (shown above) as "just another solution to a problem." He keeps busy in his workshop on projects for his children and grandchildren. Send us your best tip, along with any photos or sketches (we'll redraw them) to Methods of Work, Fine Woodworking, P.O. Box 5506, Newtown, CT 06470-5506.

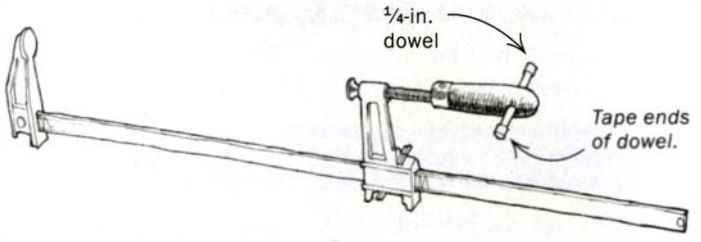


dense and stable. I was able to make several inserts for less than the price of one commercially available piece.

—Scott Spierling, Sunnyvale, Calif.

Quick tip: I live in Vermont where the winters are long and cold, and my driveway is often icy. Instead of spreading sand and salt, once or twice each winter I cover the driveway with a layer of wood shavings. The shavings attract solar heat and quickly begin to melt into the ice, providing an incredibly nonskid surface. When the snow is gone, the shavings that have not yet decomposed simply dry up and blow away. *—Denny DeCoff, Stockbridge, Vt.*

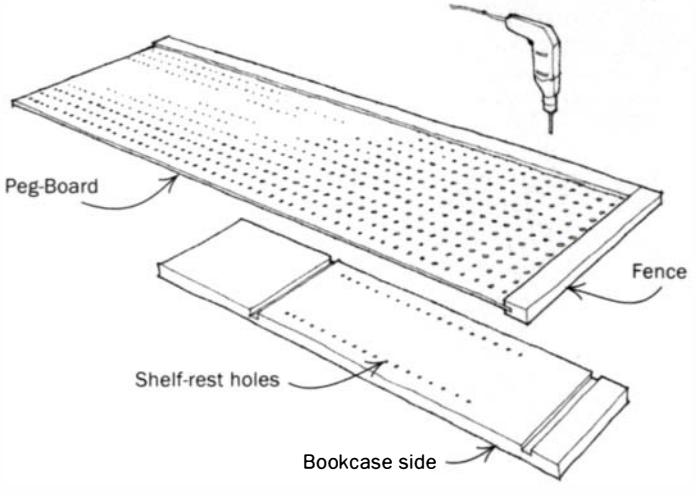
Retrofitting bar clamps for clamping leverage



As a woodworker who occasionally suffers from carpal-tunnel syndrome, I have found a measure of relief by retrofitting my bar clamps with ¼-in. dowels, as illustrated above. I first drill a ¼-in.-dia. hole in the wood handle with a brad-point bit and follow that with a 9/32-in. twist bit to enlarge the hole enough so that the dowel slides freely. In that hole I insert a section of dowel just long enough that it doesn't interfere with the bar, and I tape the ends of the dowel so that it doesn't slide out of the handle.

The increased leverage enables me to tighten the clamps with much less effort and strain on my wrists, and I have yet to break a dowel or a clamp handle. *—Dan DeKoven, Evergreen, Colo.*

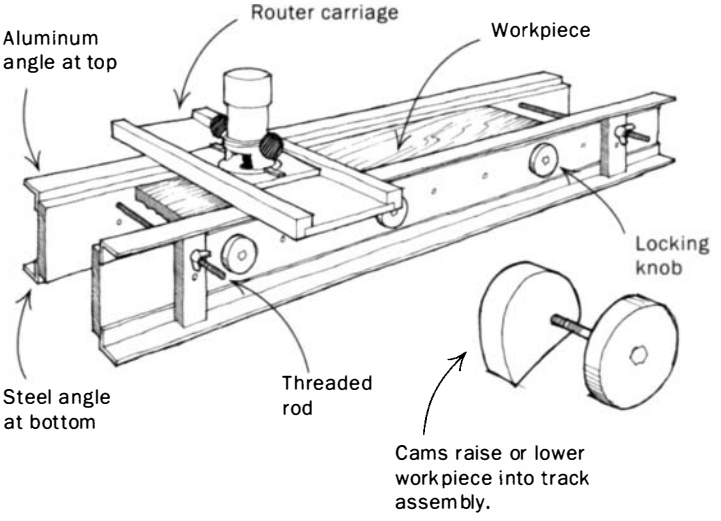
Peg-Board template for adjustable shelf holes



When I recently built a series of bookshelves, I made this simple template that allows me to drill the holes for adjustable shelf rests quickly and accurately. The template takes advantage of the 1-in. spacing of the holes in standard Peg-Board. Starting with a 15-in. by 60-in. piece of Peg-Board, I glued and screwed plywood fences to one side and one end, carefully locating each fence at the centerline of a row of holes. This makes the first set of adjacent holes a convenient 1 in. away from the fences.

To use the template, I simply place it on top of the inside of my bookcase piece. By counting inches, I locate where I want to start and stop the holes, then drill a series of 1-in. spaced holes directly through the template. *—Michael Yost, McLean, Va.*

Surfacing stock with a router



For the woodworker in a small, low-budget shop, Tim Hanson's router-surfacing fixture (*FWW* #77, pp. 42-43) offers the advantages of simplicity, accuracy and small storage requirements. When I set out to build Hanson's fixture, I couldn't find some of the components he used, so I revised the design as shown above.

As a substitute for the square, extruded-aluminum box girders in Hanson's fixture, I made the side rails of ½-in.-thick, 7-in.-wide pieces of hard maple. To stiffen the rails I added two angle irons to each one, iron below and aluminum at the top. The aluminum is a safety feature in case the rotating router bit ever contacts the metal. Other components include six cams with locking knobs, for aligning the top surface of the workpiece, some threaded rod to clamp the workpiece in place and a carriage for my router. For the surfacing I use a 1¼-in. mortising bit.

To use the fixture, set the rough board between the rails and adjust the cams to expose the desired amount of wood to the bit. Then lock the board in place by tightening the threaded rods, and plane the board from right to left, advancing about half the diameter of the bit with each new cut. Try to maintain a regular pattern of movement of the router and bit. When one side is finished, turn the workpiece over, readjust the cams, if necessary, and plane the other side.

There are two important points to consider in constructing and setting up this fixture. First, the height of the rails must remain uniform along their entire length. Second, the rails must both lie in the

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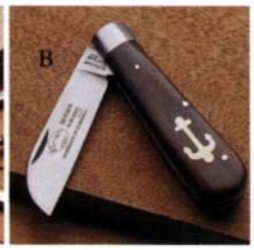


B / Anchor Knife

Made by one of the oldest established knife making firms in Solingen Germany – a solid tool for recreation or day-to-day use in the shop. Single, ready to use 2½" long blade.

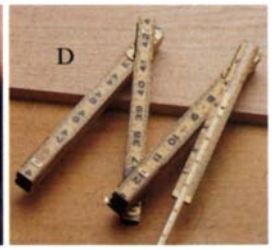
10H07.01 Anchor Knife $29.50

C / A Great Woodworker's Belt Watch

It's a nifty timepiece in a leather carrying case, with an integral belt loop. The snap holds it closed until you want to check the time.

Nothing is on your wrist to be a safety hazard or to be "vibrated-to-pieces" while working with machinery. Great for shop work, yard work – you name it.

02B03.02 Woodworker's Belt Watch $64.50



SALE D / Starrett Classic 6 Ft. Folding Hardwood Rule – At An Exceptional Price

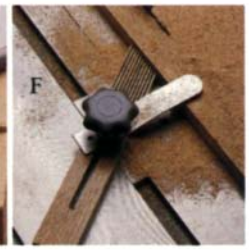
This style of rule is perhaps one of the most familiar "working tools" used in in the USA. Starrett made. Solid Brass fittings. Clear markings. Here it is – at a huge saving to you.

		Regular	*Sale*
20K12.01	6 ft. Starrett Rule	$29.95	$14.95

E / A Self Centering Punch

It's tricky to center pilot holes when mounting hardware. This clever and inexpensive tool does the job easily. A cone shaped nose insures that the prick-pointed plunger will hit exact center.

35K08.01 Self Center Punch $9.95



SALE F / Universal Table Saw Feather Board

Exceptionally effective in controlling a rip cut. Keeps the stock tight against the fence and saw table throughout the cut. Top-mounted hold-down arm ensures smooth feed. Unique expanding table slot bar makes positioning quick and easy in the ¾" wide slot standard on most saws. On large saws use 2 feather boards.

		Regular	*Sale*
88K01.01	Feather Board (single)	$17.95	$13.95
88K01.10	Feather Board (Pair)	$35.90	$24.95

G / Deluxe Dowel Centers

A Full Set of 32 centers, 8 of each size. Outside diameters are: ¼, 5/16, ⅜ & ½", inside measures 3/16, ¼, 5/16, & ⅜".

35K09.01 Set of 32 Dowel Centers $9.95

SALE H / The Historic Stanley "#1 Odd-Job"

Originally made by Stanley from 1888 to the early 1930's, as useful to us today as it was then.

Made in the USA of solid manganese bronze casting, carefully machined to .0015" tolerances on all sides. The screws are stainless steel.

It's an inside mitre and try square, a depth gauge, a scribing tool for arcs and circles, a T-square, a depth marking scribe, a plumb level, and a 6" brass bound rule (also marked in mm). Rules are laser engraved.

		Regular	*Sale*
23N02.01	#1 Odd Job	$54.95	$49.95

I / Get A Gross Of Utility Brushes

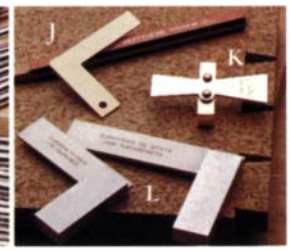
Clean, wipe, spread, rub – and then throw away. At just over $.10 each, these ½" wide metal-clad disposable brushes are endlessly useful in a wide variety of shop tasks.

83K04.01 Gross (144) Utility Brushes $18.50

J / Small Brass Quick Check Square Slips Right Into Your Pocket

This precise, solid brass square has legs 1¾" and 2⅜" long. Weighs less than ½ oz. Perfect to keep with you all the time to check your work as it progresses. Made in England.

70N02.01 Quick Check Square $9.95



K / Solid Brass Dovetail Marker

Overall length 2½", it can mark dovetails up to 1" long. 2 ratios: 1:5 for softwood and 1:8 for hardwood. Made in England.

71J08.01 Brass Dovetail Marker $28.50

L / Engineer's Squares – Made In England

An extremely accurate square (±.0005" per linear inch) that is of particular value in setting up power tools. Beware of competitor's squares made in India or China. They may be cheaper, but our quality is guaranteed according to British engineering standards.

39N04.05	2" Engineer Square	$10.75
39N04.04	3" Engineer Square	$12.35
39N04.01	6" Engineer Square	$15.95

SALE M / "Wonderbar" Makes Your Old Tools Look Like New

These 3¼ x 2 x ¾" blocks work on metal like an eraser works on paper. Won't clog up or load. Can be cut with a utility knife to fit any shape. Can be used dry or with any standard lubricant, including water. Clean rust, corrosion, scratches or stains from most metal surfaces.

		Regular	*Sale*
06K03.02	Set All 3 Blocks	$17.25	$14.95

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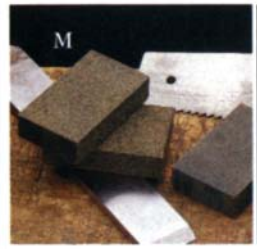

N / Key Knife For Your Key Ring

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02B05.01 Key Knife $19.95

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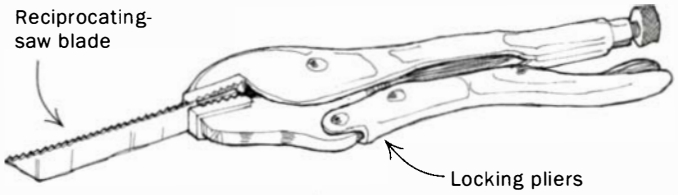
same plane. This must be carefully checked with a level at both ends of the rails. Failure to do this will result in a workpiece that has been carefully planed with a twist along its length. Install shims as needed between the bottom rails and the benchtop to level the top of the rails.

I wouldn't want to tackle 100 bd. ft. of lumber at one time with this fixture. But it does offer those with a small, low-budget shop the ability to work with rough wood and to mill it to any thickness. It joints and tapers with precision. And it produces a beautiful surface on curly woods that are difficult to work with other tools.

—John M. Van Buren, Herndon, Va.

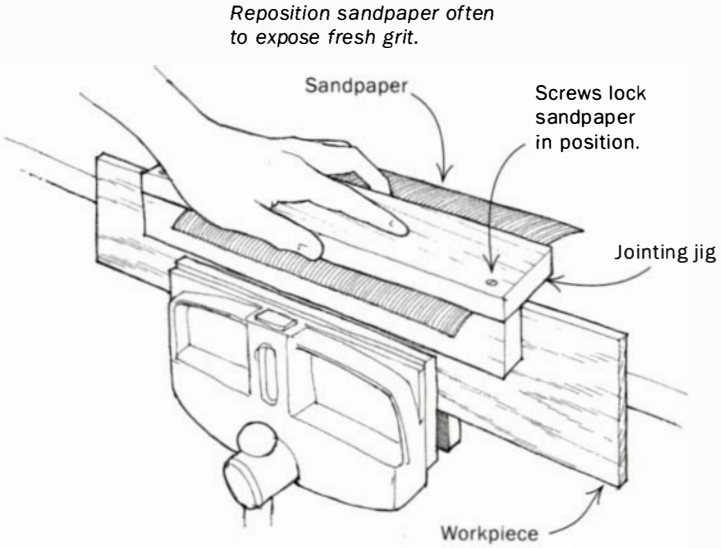
A minisaw in minutes



Need a saw that's useful in tight areas? Or a saw that can cut at odd angles? If so, simply choose the right reciprocating-saw blade to fit your needs and clamp it in the jaws of a pair of locking pliers, as shown above. You can create a wide array of specialized minisaws in minutes. *—R.B. Himes, Vienna, Ohio*

Quick tip—To compress an oversized biscuit, fold a strip of paper over the biscuit and squeeze the paper and biscuit in a vise. This not only compresses the biscuit but might also remove some of the moisture that made it swell. *—Robert H. Gray, San Francisco*

Jointing with sandpaper



I designed the jig shown above for jointing edges when I was using thin, salvaged timber to be glued up into wide panels for cabinet doors. To get nearly perfect joints, I needed square, straight edges on the thin workpieces, and my cast-iron jack plane is too heavy and clumsy for such delicate work. The jointing jig I came up with is a bit slower than a plane, but the finished edges are square and smooth.

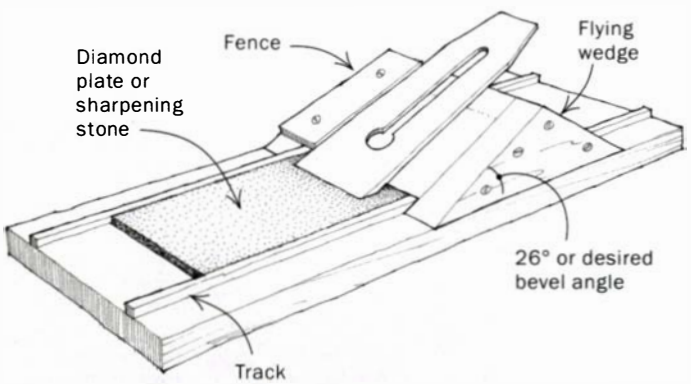
My experiments with this technique have produced two models. One model, shown in the sketch, is handheld and moved against the clamped workpiece like a plane. The other, which is very similar, mounts upside down in a bench vise, and the workpiece is moved against it. I use sheet sandpaper in the handheld model and a strip of abrasive sanding cloth (like the kind used in belt sanders) in the bench model. In both, as the sanding grit wears down, I loosen the screws and move the abrasive paper or cloth to place fresh grit in the sanding area.

—Anthony Clarke, Moonta Mines, Australia

Quick tip—Adjusting the blade guides on my bandsaw is easier now that I don't have to look for the necessary Allen wrench. I use a refrigerator magnet with a clip on it to hold the Allen wrench to the upper door of the bandsaw. I also have one on my tablesaw to hold the Allen wrench that adjusts the throat-plate leveling screws.

—Mike Schwarz, Atlanta, Ga.

Sharpening with a flying wedge



I was looking for a method to sharpen my plane irons that was quick, accurate and didn't remove too much metal. And I have an aversion to roller guides that are messy and push waste metal into the stone. I found the solution with this simple fixture.

Start with a hardwood board that is a couple of inches wider than your sharpening stone. Attach one track (made from a hardwood strip, ¼ in. square) about ¾ in. in and parallel to one edge of the board. Now place the stone against the track as it would be placed during use, and use it to mark where to attach the second track to the other edge.

Make the wedge specific to your own bevel-angle needs. The runners of the wedge must straddle both the stone and the tracks and slide freely without play. A little wax on the runners will help. To complete the fixture, attach a fence to the wedge so that the piece being sharpened will remain square to the stone. If you prefer to use two grades of stones, you can make the board long enough to hold both stones. *—Scott E. Davis, Schofield, Wis.*

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Notes & Comment

New Hampshire furniture on the auction block

New Hampshire furniture. *This Sheraton cylinder-fall secretary is just one of many items on auction through the New Hampshire Furniture Masters Association; tea table by David Lamb.*

These days, you'd be hard-pressed to find a more organized group of woodworkers than the New Hampshire Furniture Masters Association (NHFMA). But it wasn't a woodworker who revolutionized the business. It was Tony Hartigan, a stock broker with Merrill Lynch.

In 1994, Hartigan met with six established furniture makers in New Hampshire. He introduced a new concept for marketing their work outside the state—a curious but successful approach in which underwritten pieces are put up for auction. If a piece sells for more than its original price, which happens often, the craftsman simply builds a replacement piece for the original patron.

The first auction, in 1996, showcased 13 pieces, and the current auction, now an annual event, is showing about 35. The auction has been a booming success, and the NHFMA now regularly holds shows throughout New England.

To see the current items up for bid or to place a bid yourself, point your computer's web browser to www.furnituremasters.org. While there, you can also find impressive portfolios from each of the organization's 26 woodworkers, a library of articles on the craft of furniture making, a calendar of events and help on locating whatever woodworking information you are likely to need. The NHFMA can also be reached by phone at (603) 863-4795.

—Matthew Teague, assistant editor of Fine Woodworking

Wood webs

"Wood webs" features useful and interesting woodworking web sites. For additional sites, check out Sites to See at www.finewoodworking.com. If you have a woodworking web site you would like to share with us, send the address to mteague@taunton.com.

Dating an old plane

Got an old (or new) Stanley plane and want to know when it was made? The Stanley Bench Plane Dating Page (http://peta.ee.cornell.edu/~jay/ww/planes/dating) gives you a flow chart to do just that. It asks you a series of questions about your plane—what is the patent date, how does the frog adjust—to pinpoint when your plane was made.

Chair talk

If you're surfing for information on Windsor chairs, start with Windsor Chair Resources at www.windsorchairresources.com. You won't find a Windsor encyclopedia here, but you will find the names and addresses of nearly 50 Windsor chair makers and 10 instructors, more than a dozen tool sources, a few on-line links, 14 books and a couple of magazines. Take it from there.

Everything you wanted to know about woodworking ...

The Woodworking Companion. *Intellectimedia, Inc., Brossard, QC, Canada (877-966-3975); 1998. $25.95 plus shipping and handling. Requires IBM compatible 386 or higher; Windows 3.1x or later; 8 mb RAM, 10 mb free disc space.*

The amount of information (400 mb) on this CD-ROM is roughly equivalent to a 300-page book, only the CD can fit in your pocket. *The Woodworking Companion* makes an ambitious attempt to cover the basics of just about every topic in woodworking. The attempt falls short in some areas, lacking a sharpening section, for example. But in a lot of ways, this new medium is used to advantage.

There are four sections to the CD-ROM: wood, tools, techniques and safety. The section on wood has an identification program, a wood-movement prediction program and lots of information on the

Photos, this page: Dean Powell Photography (top) and Michael Pekovich (bottom)

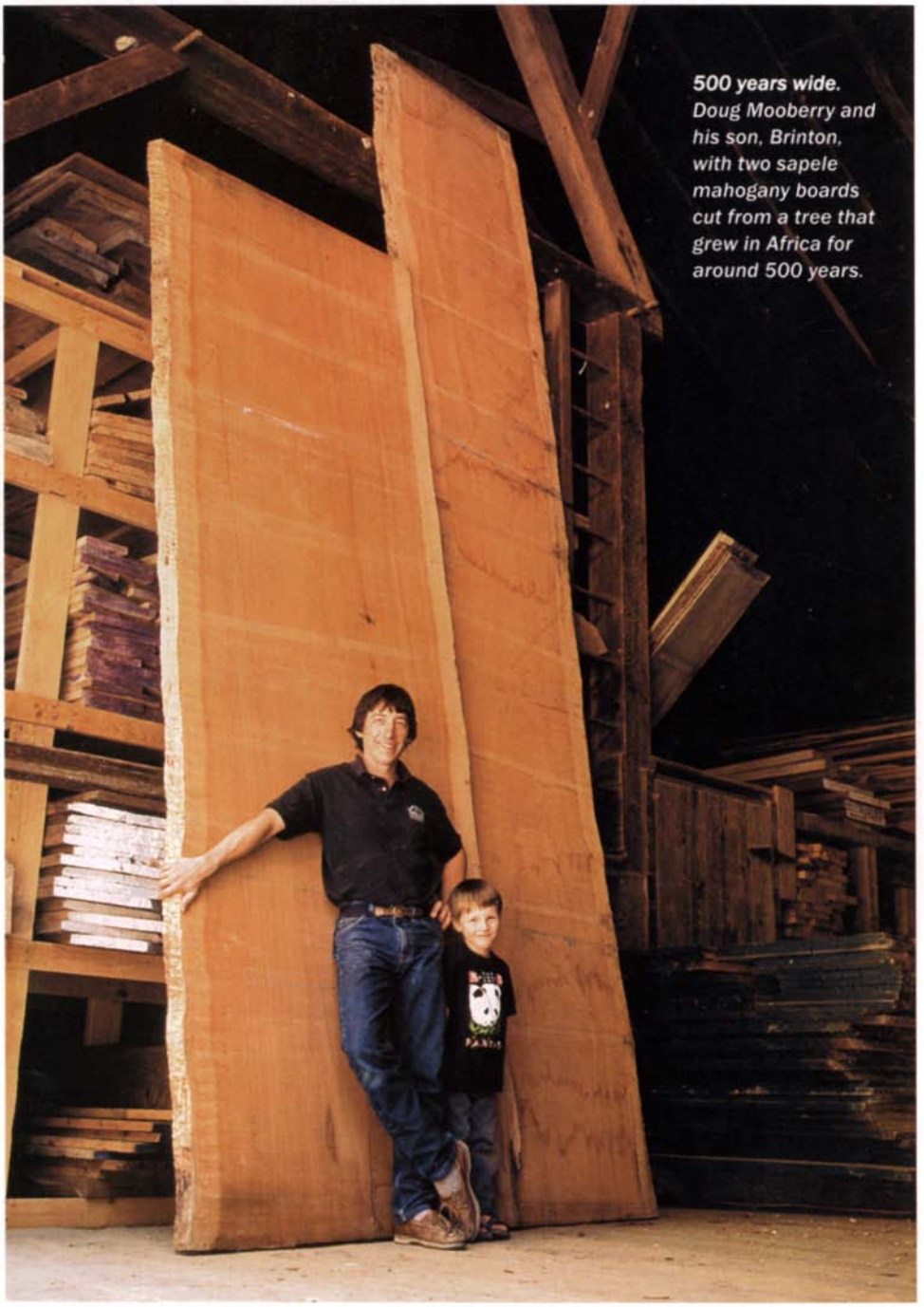
characteristics of different species. The techniques section contains an encyclopedia of woodworking joints, with concise information on the application for each joint and basic instructions for cutting it.

The CD-ROM is perfect for shop math—it has lots of useful formulas that allow you to plug in numbers, and then it computes them. A measurement-conversion feature automatically keeps track of that pesky decimal point.

Although there was a spreadsheet to keep track of parts, I was disappointed that I didn't find a panel optimizer nor even a basic drawing program to help figure the number of boards or sheets of plywood a given project would take. Some parts of the program were very easy to print out, some harder and some I never did figure out. The safety and tools sections were sparse and text-book dry.

Though incomplete in some ways, *The Woodworking Companion* covers a broad enough range of topics to be useful, has enough features to be interesting and is generally easy to operate. And the format certainly opens a new way to package woodworking information. I'll reach for the CD the next time I need to convert millimeters to thousandths or predict the amount of wood movement in a plank.

—Lon Schleining, stairbuilder and woodworking instructor in Long Beach, Calif.



500 years wide. *Doug Mooberry and his son, Brinton, with two sapele mahogany boards cut from a tree that grew in Africa for around 500 years.*

Big boards

We were pretty amazed when we saw this photograph of Doug Mooberry (left), a furniture maker in Unionville, Pa., and his son, Brinton, standing in front of two elephantine slabs of sapele mahogany. The taller board is 35 in. wide by 17 ft. long by 1 in. thick; the shorter board is 52 in. wide by 14 ft. long by 2 in. thick. Both came from the same 5,000-bd.-ft. log. Also from the same log are the boards stacked on the floor and some 24-in.-wide 16/4 stock that took a full year to dry in Mooberry's kiln.

The shorter of the two standing boards is now a dining-room table 10 ft. long and 48 in. wide, with skirts and legs from the same log. To surface the board, Mooberry had to track down someone with a 52-in. abrasive planer and then move the board, which took four strong men to lift. The taller board still sits in the barn.

A woodworking school with its own hotel

Like a lot of woodworkers who are self-taught, I picked up most of my skills from magazines and from my own experimentation. After deciding that a little formal training was in order, I signed up for a Chippendale-style chair class at a little-known school run by North Carolina cabinetmaker Ben Hobbs. Hobbs is a natural teacher with an easy smile and a just-firm-enough approach to woodworking. He easily handled our group of eight, which was about three more than his usual class size. We all walked away happy with our own reproduction of an elegant, Colonial-era, North Carolina side chair.

Hobbs, his furniture and his class pro-

Photo, this page: Bill Deering

jects are steeped in North Carolina lore, even though the mostly hand-tool skills he teaches are universal to all woodworking. By the time our five-and-a-half-day class was finished, we had used not only bandsaws, a scroll saw, a tablesaw and router but also handplanes, scrapers, chisels, drawknives, Surforms, rasps, files, handsaws and a host of other hand tools.

Hobbs and his wife, Jackie, have collected several houses built before 1846 and restored them, outfitted them with Hobbs' reproduction furniture and use them for the bed and breakfast they run on the property. The tuition does not include the modest room charges but does include lunch every day in the family dining room. In a typical year Hobbs' classes include: bedside table; blanket chest; pencil post bed; Chippendale chair; hanging cupboard; and a Queen Anne bench. Tuition runs from $400 to $900. For more information, call (252) 426-7815 or visit his web site at home.inteliport.net/ hobbs.

–Tim Schreiner, editor of Fine Woodworking

Tim Schreiner

Class (almost) dismissed. *A recent class on the morning of the last day at Ben Hobbs' furniture-making school in North Carolina. Hobbs, third from left, makes a piece with each class.*

Restoring the Dearborn Telescope

Courtesy of the Adler Planetarium and Astronomy Museum

A wooden telescope. *Multiple coats of varnish were dissolved off this 1863 Dearborn Telescope, but the original shellac was left intact.*

Until recently, the 1863 Dearborn Telescope, once the largest telescope in the world, was covered in so many coats of varnish that a few members on staff at Chicago's Adler Planetarium and Astronomy Museum failed to see that the wooden tube was covered in beautiful walnut veneer.

The museum, home to the telescope since 1930, contracted Craig Deller, principal of The Deller Conservation Group, Ltd., to remove the varnish and expose the original shellac. "We knew the original shellac layer was there by both microscopy and ultraviolet fluorescence," Deller said. "The trick was finding a safe method to remove the many layers of added varnish without harming the original shellac." Deller and his associates gelled an acetone and mineral spirits blend that worked slowly enough to remove the darkened added layers without attacking the shellac. The conservation process took more than a year and a half to complete, but the telescope is now the museum's centerpiece. *—M.T.*

Notes & Comment

We welcome news stories, anecdotes about the triumphs and pitfalls of woodworking, photographs of unusual work—anything that you think other woodworkers would like to know about. We pay for the material we use. Send submissions to Notes & Comment, Fine Woodworking, *P.O. Box 5506, Newtown, CT 06470-5506.*

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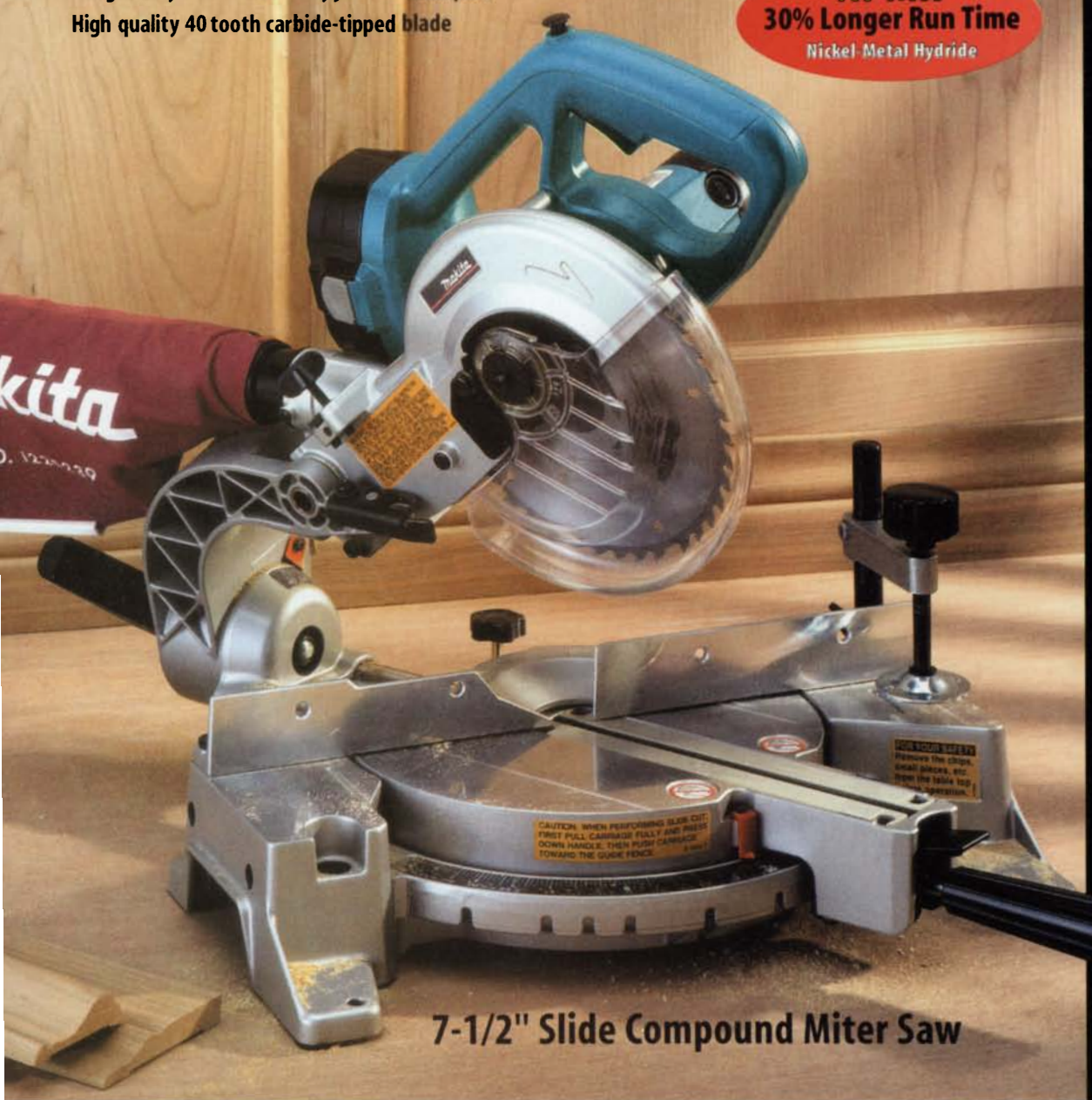

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READER SERVICE NO. 175

Tools & Materials

Y2K cordless jigsaws from DeWalt and Makita

Both DeWalt and Makita are staking their claims to cutting-edge 21st-century technology by offering the latest in cordless tools: jigsaws. The DeWalt DW933K and the Makita 4332D share some common traits: They have variable speed, orbital cutting action, T-slot blade holders, sliding shoes, and they come with one nickel-cadmium (Ni-Cd) battery and charger. The similarities end there.

DeWalt's 7¼-lb. tool is powerful, comfortable and user-friendly. This model is driven by an 18-volt battery. To test the run time of the battery, I crosscut slabs of 2x10 Douglas fir planks. The tool made it through 23 cuts.

The DeWalt's handle, angled toward the rear, is comfortable, well-proportioned and has a vinyl grip insert. Its practical features include a toolless, twist-lock blade holder, a slide-switch safety lock that operates independently of the trigger and a lever-operated shoe-adjustment system. This model is rounded off with a dust blower and a well-marked bevel-angle indicator, and it comes with a removable shoe cover. The tool retails for about $280.

Makita's 6¼-lb. tool is powered by a 14.4-volt battery. I tested the run time using the same Doug fir and managed 16 cuts. Taking into account voltage differences, the tools have nearly the same cutting capacity per volt ratio. But the Makita falls short of the DeWalt when it comes to several other features.

The Makita's safety-lock button is on top of the handle, just forward of the trigger. To operate the saw, you must keep your thumb on the safety lock. After prolonged use, I practically lost all feeling in my thumb. Additionally, the angled handle flares out at its base, and unless you have gigantic hands, the tail end of the grip is too fat.

The Makita hasn't joined the ranks of saws with toolless adjustments, either. It requires an Allen wrench for changing the blade and for adjusting the angle of the shoe. There is no dust blower, and the bevel-angle indicator is not clearly marked. The Makita sells for $200. Even though the DeWalt weighs 1 lb. more and costs $80 more than the Makita, if I were to upgrade to something that won't be out of date soon in the new millennium, I'd pick the DeWalt. For more information, contact DeWalt at (800) 433-9258 or Makita at (800) 462-5482. *—Christopher Baumann*

Jigsaws go cordless. *DeWalt's 18-volt DW933K and Makita's 14.4-volt 4332D have nearly the same cutting capacity per volt ratio.*

Precise holes for pulls. *Euro Handle It simplifies the task of drilling holes for cabinet pulls.*

Self-centering handle-boring jig

The Euro Handle It drilling jig speeds up the installation of pulls and knobs. With easy-to-read scales in both inches and millimeters, setup is a snap. The jig can be adjusted for practically any size pulls and any size door or drawer. Once the adjustments have been made, holes are drilled using the jig's built-in steel guide bushings. Made of tough polycarbonate, the jig should survive years of use and abuse. It sells for $39; for more information, call the manufacturer at (800) 877-3876. *—Anatole Burkin*

Photos, this page: Christopher Baumann (top); Anatole Burkin (bottom)

NOBODY BUILDS A BETTER FULL-SIZE TRUCK THAN FORD F-SERIES.

*Based on an average of consumer-reported problems at three months' ownership in a survey of Ford F-Series under-8500-lbs.-GVWR models and competitive models.

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Porter-Cable takes the 2-hp plunge

Midsized variable-speed router. *When connected to a shop vacuum, the Porter-Cable model No. 7529 router, with its hollowed-out base, greatly reduces the amount of sawdust left behind.*

Two-horsepower routers, plunge or plain, are selling fast these days. Porter-Cable just entered the game with the model No. 7529. This tool has just about everything you could ask for in a plunge router. It's light enough to do handheld work but powerful enough to go into a table and be used with large-diameter bits.

The router has the familiar three-stop setup for plunge cuts. A microadjusting knob, for setting the bit height in a router table, makes precise adjustment a snap once you figure out how it works. The instruction manual seemed a bit fuzzy on this procedure. The arbor lock leaves you with only one wrench to lose instead of the usual two. The router comes with ¼-in. and ½-in. collets.

The tool's speed-control switches allow you to set the speed conventionally via a dial or to control it by squeezing the trigger. The electronics brings the motor up to speed smoothly and puts the brakes on when power is shut off.

The router's plunge-cutting operation feels just right. There is plenty of spring pressure holding the router up but not so much that the plunge is stiff. The spring-loaded plunge-locking lever is easily locked and released with one finger.

The router is as vibration free as any I have ever used. All of the controls are easy to operate without removing your hands from the handles. The baseplate has a large cutout covered with clear plastic, so you can actually see what you're cutting. This single router could replace all seven of the routers I now have in my shop. The router sells for $220; the kit, which includes an edge guide and carrying case, goes for $260. If you plan to use the router in a table, Eagle America (800-872-2511) sells an aftermarket crank-style height adjuster for $35. *—Lon Schleining*

Lie-Nielsen scraping plane may take some getting used to

When I first put the new Lie-Nielsen No. 112 large scraping plane to work, I was dismayed by what happened. The tool chattered terribly and left deep ridges in a plank of hard, curly maple. I angled the blade forward a bit and set it for a very shallow cut. Performance improved, but still I experienced some chatter.

After I looked at the instruction sheet, the answer was plain. I was fighting the tool. A scraper plane, the instructions explained, requires very little downward pressure, especially on the forward knob. And instead of the long, slow, deliberate strokes required by a smoother, the scraper seems to favor quicker, shorter swipes. Pulling the scraper also works well, especially in problem areas.

I practiced on some friendlier lumber; straight-grained mahogany, cherry and, finally, some quartersawn white oak with ever-improving results. Then I went back to the original curly maple plank and was able to turn it into a nicely smoothed board using my improved technique.

The Lie-Nielsen No. 112 requires some fine-tuning and finesse to operate. Once you get that worked out, the tool handles unruly wood well and will spare a lot of burned thumbs on big scraping jobs. Considering what an original Stanley No. 112 fetches at tool auctions these days, the Lie-Nielsen's $195 price tag is a bargain. For more information, contact Lie-Nielsen at (800) 327-2520. *—Michael Pekovich*

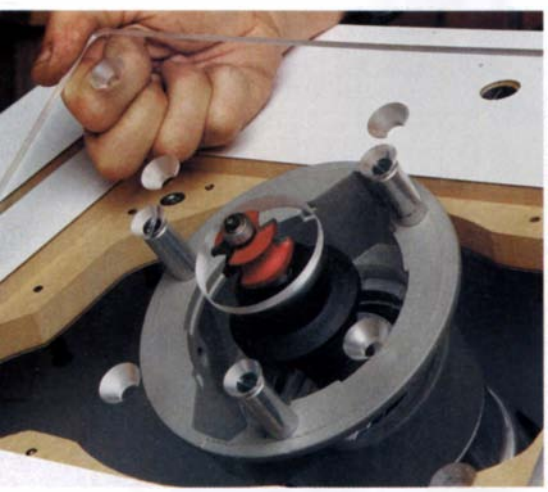
Big scraping plane from Lie-Nielsen. *The No. 112 scraping plane weighs 4 lbs. and comes with a 2⅜-in.-wide blade.*

Photos, this page: Lon Schleining (left); Michael Pekovich (right)

Jacobs PowerCollet for routers has a few bugs

If any machine in a woodworking shop could use a quick release for cutters, it's the router. Jacobs PowerCollet is now available as an accessory to fit many ½-in. routers, but don't get too excited, yet.

I outfitted a new Porter-Cable 690 router with a PowerCollet. The new, bulky unit replaces the stock collet and nut and adds 2 in. to the tool's length, which means the baseplate has to be repositioned. Jacobs supplies 1¼-in.-long aluminum spacers and bolts for remounting the router's plastic baseplate away from the base casting. It works, but it's not the most elegant design, like dressing your router in platform shoes.



Replacement router collet works without wrenches. *Because of the PowerCollet's large size, spacers must be used between the router and the baseplate.*

The PowerCollet requires considerable force, about 50 lbs. of pressure, to snap into the locked position. The release is easier, needing about 20 lbs. Bits seem to be held in place securely by the mechanism.

The PowerCollet seems fine when used with short bits, such as molding cutters, half rounds and bevels. But when I chucked a 1½-in.-long, ⅜-in.-dia. spiral cutter, I couldn't get a chatter-free cut. The tool vibrated excessively. I switched back to the stock collet, and the problem disappeared. Until Jacobs improves the overall performance of the PowerCollet, I'll hold onto my wrenches. The PowerCollet retails for about $50. For information, call (800) 866-5753. *—John White*

Cut moldings on your tablesaw

LRH Enterprises, Inc., recently introduced the Magic Molder: a bright purple tablesaw molding cutter with 70 cutter profiles available. Each profile consists of two carbide cutters welded to 1¾-in. discs. The cutter discs are locked below their centerlines, by means of a cog and an Allen screw, into a 5⅞-in. round head that fits on the tablesaw arbor. Locking the smaller discs within the head makes for fail-safe attachment; there's no way one of the cutters can fly out of the head when traveling at tablesaw speed.

I ran oak, pine and medium-density fiberboard (MDF) through the Magic Molder, and the quality of cut was consistent; the molding came out as smooth as a baby's cheek. No sanding was necessary. The saw never bogged down, no matter how fast I fed the stock. The Magic Molder emits a low, powerful-sounding hum; it is quieter than most tablesaw blades and certainly quieter than any router.

Magic Molder for tablesaws. *Up to 70 cutter profiles are available, as well as blanks for making custom cutters.*

The Magic Molder head sells for $185, and a pair of carbide cutter discs sells for $95. Blank cutters for making your own profiles cost $35 a pair. LRH sells different combination sets of cutters. The company offers a $155 auxiliary fence, although you could certainly make your own from wood and clamp it to your saw's existing rip fence. For more information, call (800) 423-2544. *—Jefferson Kolle*

A precision tool for making ellipses

Anyone who has ever had to construct an ellipse, whether a section of arched casing or a tabletop, knows the difficulty of the task. I've freehanded the shape and sanded to a line. There's also the nail-and-string trick or shopmade jigs. All of these methods produce less-than-satisfactory results.

The Ellipse Master changes that. The tool consists of a cross-shaped base and a beam arm on which you mount a plunge router (any brand of router is easily mounted). Two adjustable slider blocks on the beam fit into dovetailed tracks in the base. As the router is moved in a circular motion, the slider blocks move within the tracks, keeping the router confined to a specific elliptical pattern. The Ellipse Master can also be set up to cut circles.

Master guide. *The Ellipse Master accurately guides a router for cutting ellipses.*

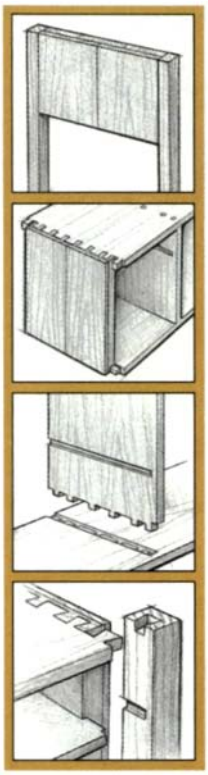
Right out of the box, it was easy to cut accurate ellipses repeatedly, without math and with very little setup. Because of the speed at which you can cut ellipses using this tool, which isn't cheap, it could pay for itself after just a couple of jobs.

The Ellipse Master won't cut an ellipse smaller than 21 in. by 27 in. As supplied, the tool will cut a maximum ellipse of 54 in. by 60 in., but optional extensions can increase the size as needed. The Ellipse Master is available from MBK Enterprises (877-355-4773) for $595. It comes with a lifetime warranty. *—Niall Barrett*

Christopher Baumann is editorial assistant at Fine Woodworking; *Anatole Burkin is a senior editor of* Fine Woodworking; *Lon Schleining works wood in Long Beach, Calif.; Michael Pekovich is associate art director of* Fine Woodworking; *John White works wood in Newtown, Conn.; Jefferson Kolle is managing editor of* Fine Woodworking; *Niall Barrett builds custom furniture in Narrowsburg, N.Y.*

Photos, this page: Michael Pekovich (left); courtesy of LRH Enterprises, Inc. (top right); Niall Barrett (bottom)

Sideboard Strategies



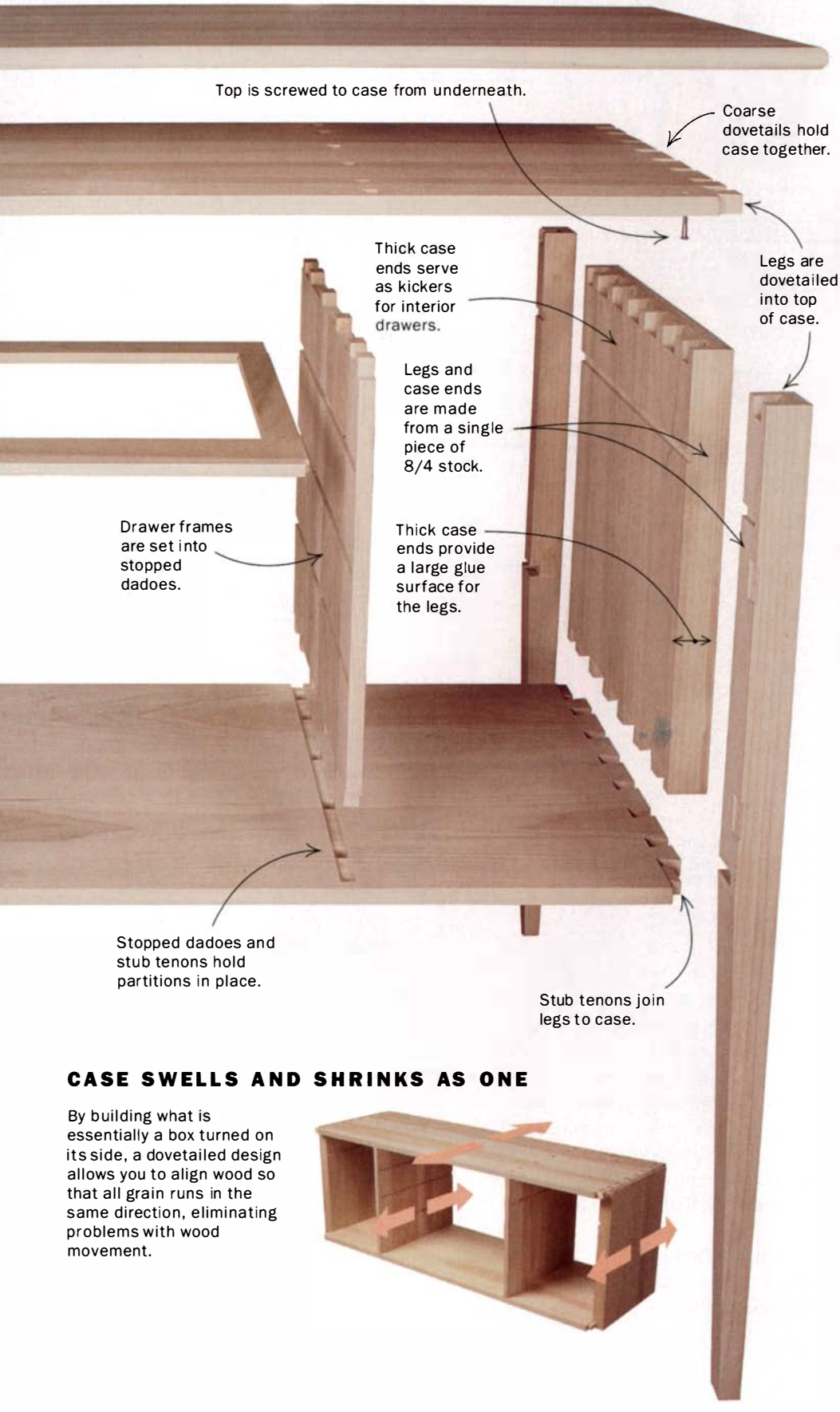
With this four-part construction system, you can design and build in any style

BY WILL NEPTUNE

It is all too easy to sketch something that looks good, only to discover that you have no reasonable way to build it. You either develop overly complex construction methods or sacrifice the design you really want because it's too difficult to build. The solution is to strike a balance between design complexity and construction simplicity. It helps to start by thinking of a piece in its most basic form, then develop a single construction system that can accommodate a wide range of design options.

I like to tell my students at North Bennet Street School that a sideboard is little more than a box with legs attached. Though it sounds oversimplified, this approach puts things in familiar terms—everyone knows

Photos: Scott Phillips (this page); all others: Michael Pekovich



CASE SWELLS AND SHRINKS AS ONE

By building what is essentially a box turned on its side, a dovetailed design allows you to align wood so that all grain runs in the same direction, eliminating problems with wood movement.

how to build a box. It becomes a question of how to build the better box. Historically, sideboards were built using post-and-rail or frame-and-panel construction, but I prefer this method, which calls for a dovetailed box turned on its side. My alternative approach is less familiar, but when you start counting the joints necessary to build a frame-and-panel sideboard, you understand the logic of a dovetailed design. With this method, there are fewer joints to cut, and the ones you do cut aren't seen, so there's no need to be overly meticulous.

This construction system is based on a few rules concerning joinery: If a case part joins another at a corner, dovetail it; if one part meets along another's length, use multiple tenons. Dovetails and tenons are both strong joints that allow for wood movement and resist racking. Because all of the structural parts of the case have grain running in the same direction, the case expands and contracts together. Put simply, the case is still just a long, dovetailed box with legs attached.

Sideboards built using this approach may vary in size, line and style, but they retain a family resemblance based on the construction system. The mocked-up sideboard shown on these pages is the most basic variation of this system, but it lays a foundation that can be used on more complex designs. Once you understand the construction system, you can focus on design and build in styles ranging from Federal to Arts and Crafts (see the story on p. 47).

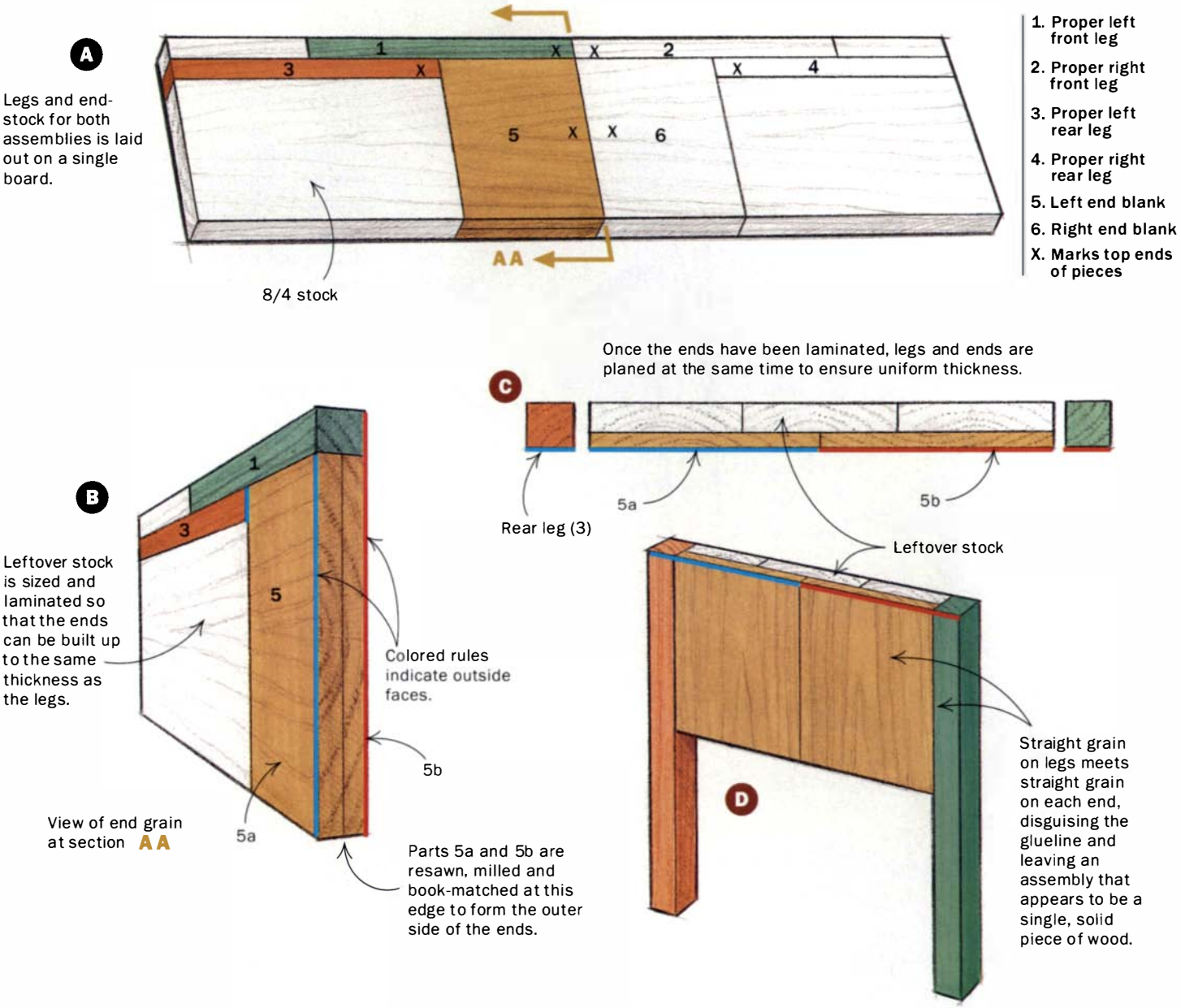
Basic sideboard design

A sideboard is typically a tall case piece that's often 40 in. high and taller, a convenient working height for a standing person. The height of a sideboard makes anything displayed on its top more visible because it isn't overpowered by the forest of chairs surrounding a dining-room table. A sideboard is also strongly horizontal because the tall legs hold the mass of the case off the floor and because the case length exceeds the height. The open space below the case keeps the sideboard from appear-

1. BUILT-UP ENDS

USING THE GRAIN TO MAKE INVISIBLE JOINTS

By carefully planning the cuts, a single 8/4 board can be laid out to form leg-and-end assemblies that appear to be a single, solid board. The legs are cut from the straight-grained edge of the board, and the ends are book-matched and laminated from resawn stock. When the legs join the ends, you're left with virtually invisible gluelines.



ing too massive, an effect you get with many large case pieces. With lengths of 4 ft. and 5 ft. being common, the facade can be divided using a combination of drawers and doors (see the drawings on p. 49).

In designing the mocked-up poplar sideboard seen on these pages, I wanted a simple piece with a country feel. In form, it refers to the Federal period but avoids the use of veneers, inlay and hardware seen in period, high-style examples. To simplify construction, I decided on a small, four-legged version without the curved facade often seen in Federal examples. Country furniture makers made similar design choices in earlier times, using the grain and figure of local woods or even painted finishes to give a piece visual interest. These designs rely on proportion and line to create a sense of balance and harmony.

The construction system

One key feature of this construction system is the use of built-up ends, which are thicknessed to the same dimension as the legs. The thicknesses of the ends provide large glue surfaces for the legs. In addition, the top and bottom join the legs and ends without having to be notched around the legs. This structural solution creates a lined interior for the cupboard areas.

The partitions that divide the facade are not only design variables, but they are also structural elements. The multiple stub tenons tying the long top and bottom together eliminate sagging almost complete-

Drawings: Bob La Pointe

ly. All of the drawers run on frames let into stopped dadoes.

In a real project, if saving primary wood is important, all of the case parts other than the legs can be made of a secondary species and faced or edged with your primary wood. Using a less dense secondary species also saves weight.

Using built-up ends—Even though this entire mock-up is made of poplar, I laminated the ends the same way I might for a sideboard built in cherry or mahogany. By resawing a piece of 8/4 stock, you're able to show a book-matched pattern on the ends. The inner part of each end is glued up from the leftover pieces of the 8/4 stock. This is a nice way to keep the legs from appearing as though they were stuck on as an afterthought. This effect is enhanced by good grain matches on the legs and ends, which make each assembly look like one solid piece (see the drawings on the facing page). This is particularly effective if you can choose an 8/4 board that is flatsawn and wide enough for the edges to have growth rings running at about 45° (as seen on the end grain). This gives you straight grain on the legs, which helps disguise the glueline. As a bonus, the adjacent faces of the legs also match each other.

In the mock-up, I resawed the 8/4 stock thin, trying to avoid the green heartwood, but the thickness of the layers doesn't matter. The object is to calculate the width of each end so that little wood is lost between the ends and the legs, which would disturb the grain match. Also, you must start thick with both layers to allow for later milling. Once the inner and outer layers have been edge-glued, skim them with a handplane before gluing them together.

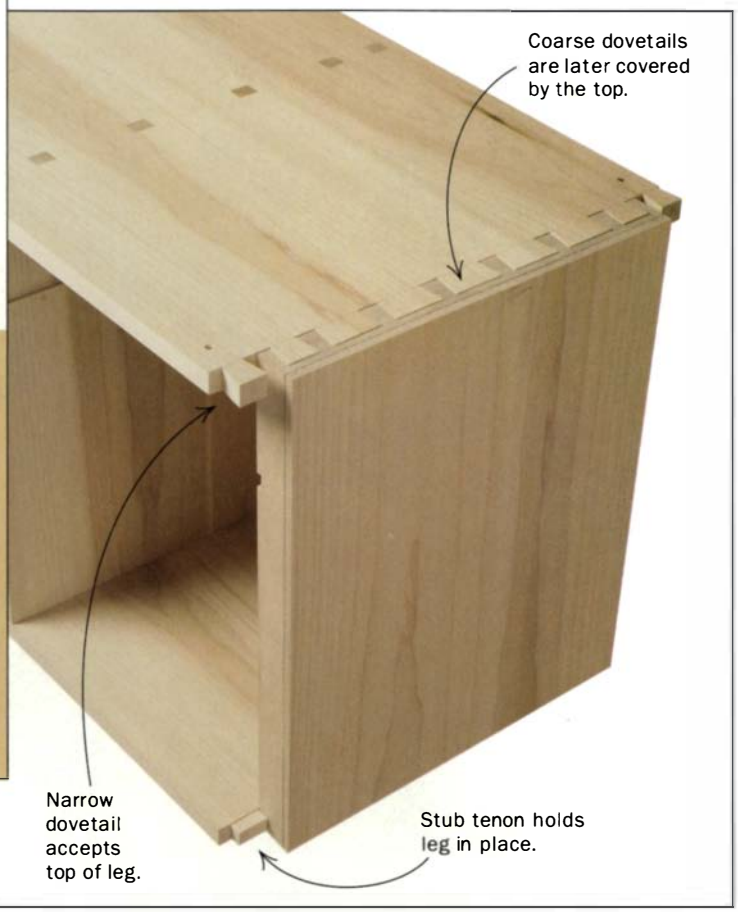
Alignment is much easier if you leave the parts long at this stage. The extra length allows you to nail the parts together in the waste areas when you clamp them up. The laminated parts should be given several days to move and reach equilibrium. After they are done moving, both the leg blanks and the ends can be flattened and thicknessed at the same time. When you trim the ends to finished length and width, remember to keep the book-match line centered and parallel to the edges.

Dovetailing the case—The top and bottom of the case are milled and glued up like any large panels, then cut to final size.

THE BASIC CASE

A simple dovetailed box is modified to accommodate the legs. Dovetails can be cut coarse (with wide pins and tails) because the top will later cover them. Narrow tails at the front and back of the top and stub tenons at the case bottom are later fit to the legs.

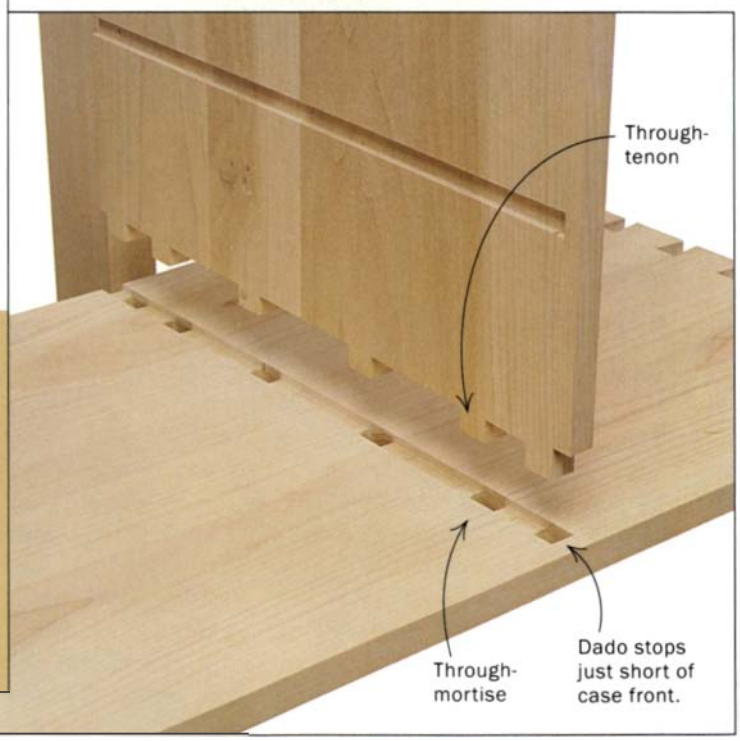
2. DOVETAILED BOX



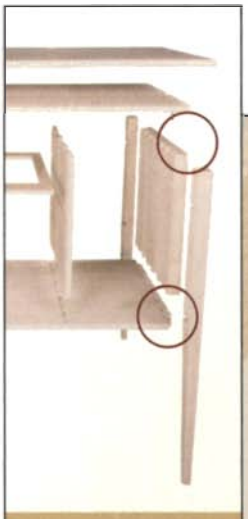
THROUGH-TENONS RESIST SAGGING

The partitions are set into stopped dadoes cut into the top and bottom of the case. Through-tenons on the partitions are housed in mortises cut into the case.

3. PARTITIONS

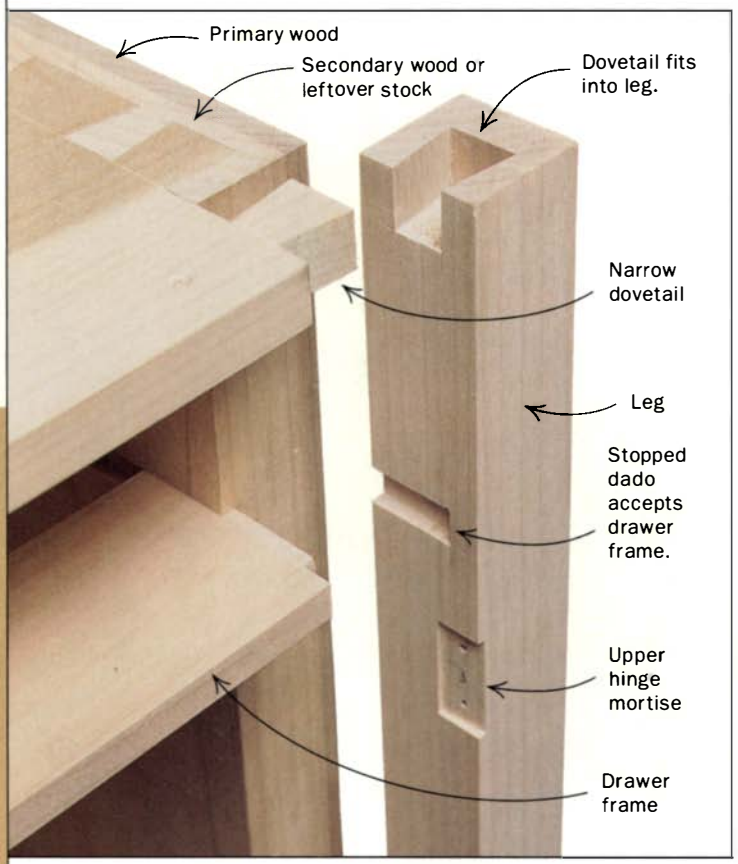


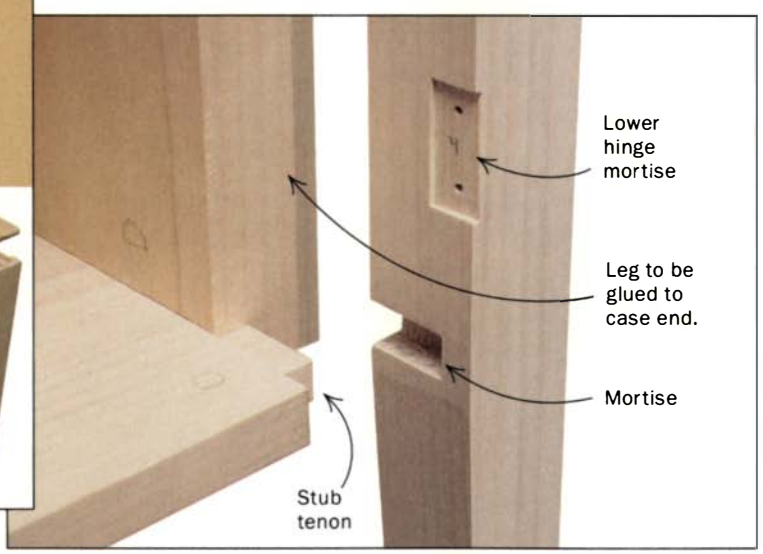
4. DOVETAILED LEGS



LEGS SLIDE INTO PLACE

By housing each leg in a narrow dovetail at the top of the case and a stub tenon at the bottom, the leg can be slipped into place from underneath after the basic case has been assembled. Stopped dadoes are cut to accept the drawer frames. Cutting the dadoes with ends and legs clamped up before assembly ensures perfect alignment. The exposed top is screwed to the top of the case from underneath.





The dovetails that hold the case together are fairly easy to cut, either by hand or machine, but remember that the layout is different at each corner where a leg joins the case (see the top photos on p. 45). The top rear dovetails are cut narrow to make room for the back boards where the leg will be rabbeted. The case bottom has stub tenons that will be housed into the legs. These tenons are shouldered so that any later sanding won't change the fit of the joints. Once the piece is finished, none of the joinery will be visible, so the dovetails can be coarse (with wide pins and tails).

Filling out the facade—The partition joints are somewhat fussy to cut, but they add considerable strength to the case (see the bottom photos on p. 45). Shallow stopped dadoes are used to locate the partitions. Tenons are positioned on the partition ends so that there is extra holding power at the edges with enough tenons across the middle to help the top and bottom resist sagging. The partitions are held in line by the dadoes, which makes fitting the thickness of the partitions to the dadoes careful work. Partitions should be cut a bit longer than the ends to leave some extra tenon length for final flushing.

Because the partitions are fully housed in the dadoes, there are only small shoulders at the front. It is very important that when clamped, the tenon shoulders bottom out in the dadoes, keeping both the top and bottom of the case parallel. Router planes can be fussy, but because the depth should be consistent, I took the time to run one through the dadoes of the mock-up.

To gauge the front shoulders, work in from both ends with a cutting gauge at the front until what's left between the lines equals the distance between the base of the pins cut on the case ends. Then add the depth of the dado and mark the space between the tenons. The trick is to get the small front shoulder to close at the same time that the end grain between the tenons bottoms out in the dado. This ensures that the top and bottom will remain parallel.

Once the tenons have been cut, locate the mortises in the dadoes. Line up the fronts of the partitions with the front of the case and mark around the tenons to establish your mortises. There is no need to run the tenons through, but it does add strength and keeps you from having to clean the bottoms of the mortises. When the partitions fit squarely into place, you've finished framing the basic case.

Attaching the legs to the case—The legs are mortised to accept the stub tenons cut into the bottom board (see the photos at left). Because these tenons and the top dovetails share the same shoulder line, the legs should register flush to the case ends. Once the top dovetails are let into the legs, you can't trim any more wood off the legs and ends, so make sure this joint is accurate before you cut it. This method puts one serious requirement on the legs. They can be sawn to shape, turned or carved, but the solid glue surfaces must meet the case ends.

To guarantee alignment, it's best to cut the dadoes for the drawer dividers using a router with the case ends and legs clamped

Details for any style

By adding an inlaid apron and carefully choosing the leg style, a simple design turns into a Federal showpiece.

Typical of the Arts-and-Crafts movement, this design uses heft and hardware to create a solid sideboard with a medieval inspiration.

Ebony splines and details, rounded corners and carefully recessed legs can be used to build in a softer Arts-and-Crafts style.

With the construction system illustrated in this article, proportion and detail can be used to lend a sideboard a period feel. Working out a new design gives you a chance to try some of these possibilities and find a good fit for the design and style ideas of the piece you want to build. The size, shape and proportions of a piece, along with the choice of materials, finish, hardware and any embellishments, work together for an overall effect.

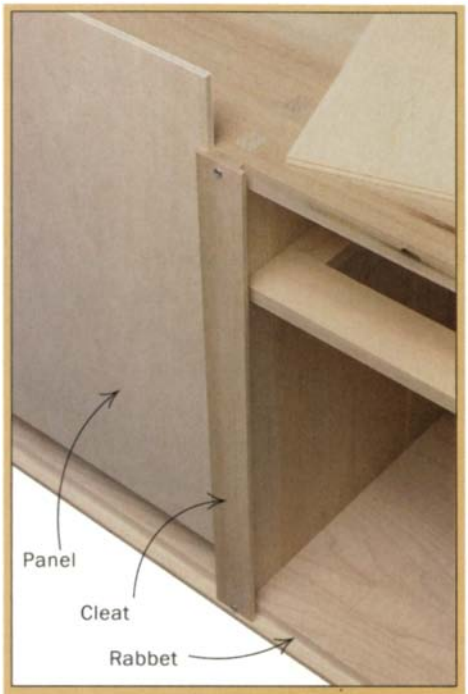
The mocked-up sideboard was designed only as a model for construction, but the size and proportions, along with the tapered legs, give it a country, Shaker feeling. This same design could be made of maple or cherry with a simple molding for the doors. I made the storage capacity as large as possible without losing the horizontal effect of the case. The central bay of drawers is wider than the side bays, partly to allow for some larger drawers but also because the narrow side bays keep the doors from looking too square. The resulting side bays have a vertical effect that frames and balances the strongly horizontal case.

Federal-period sideboards typically rely on large veneered surfaces for decoration. But a simpler, solid-wood construction inspired by the period could be built easily using this construction system (see the top drawing at left). Touches of inlay and the use of simple stringing (inlaid veneer strips) echo the effect of the more complex examples. I would use legs that are either tapered and inlaid or turned below the case bottom. Turned legs could be embellished by reeding the long tapers. The square top section of the legs could have a rectangular panel defined by holly stringing. To maintain the flat appearance of Federal veneered doors, two options come to mind: 1) a solid-wood frame-and-panel door with the panel rabbeted to be flush to the frame or 2) a mitered solid-wood frame with a veneered panel for contrast. A small, curved apron below the bottom edge of the case would soften the shape of the case. The long, slender legs and small case section give the piece a delicate appearance.

Where the Federal piece exhibits delicacy and two-dimensional patterns, a Stickley-influenced, Arts-and-Crafts sideboard should be heavier looking to emphasize its medieval inspiration (see the middle drawing). To support this idea, I would use oak, fumed or stained to look old. Unlike the other examples, the legs could be thicker to stand proud of the case. The case ends as well as the front framing members would be set back ⅛ in. to make the construction distinct. The divisions of the front space enhance the overall effect: The doors are square and severe, eliminating any sense of vertical lift. The large drawer at the bottom has a slablike appearance. The entire piece looks solid and heavy.

Also under the umbrella of the Arts-and-Crafts movement is the Greene-and-Greene sideboard at left, which is based on a "Hall Cabinet" built for the Blacker House in 1907. The furniture and architecture of Greene and Greene are a bit more refined and softer than Stickley's, with more gentle curves. The piece at left is strongly horizontal—even the doors are wider than they are tall. You can incorporate these and other details typical of Greene-and-Greene designs: carved door panels or stepped cloud-iift door rails, ebony splines and details, and bordering surfaces enhanced by setbacks and rounded corners. The overall effect should balance explicit construction with softness in detail.

The designs included here should show the endless variety of styles that can be built using this construction method. Feel free to incorporate ideas from any traditional form or to invent your own to achieve a design that better suits your tastes.



BACK RIDES IN RABBETED CLEATS

Rabbeted cleats are screwed to the rear top and bottom of the case. Three panels of ¼-in. plywood slide easily into place.

up. Once the stopped dadoes have been cut, the case construction becomes fairly ordinary. Mortise-and-tenon frames that separate the drawers are glued in the front 3 in. or so but not at the back. Leaving space at the back ensures that when the case shrinks the frames don't push against the back of the case. Both the frame-and-panel doors and the dovetailed drawers are built using the usual methods, but I put small vertical stops behind the doors.

The rear legs and the bottom are rabbeted to accept the back. The back on the mock-up is a series of ¼-in. panels held by rabbeted cleats that are attached with screws. The top is ripped even with the bottom of the back rabbets so that the back boards run up to the exposed top. (This is not critical, but it does make it easier to fit the back.) A more elegant solution would be to resaw thin shiplap boards and run them vertically across the back. The top can be cut to allow some overhang, then molded and screwed down from below.

Alternative constructions

There are a number of places where construction can be altered to save wood or to produce a slightly different effect. People are often surprised by the use of a full-board top and bottom. While it does use extra wood, it also adds strength to the case, resists cupping at the ends and provides built-in kickers for the top drawers.

As a substitute, you could use two wide rails, with gussets or without. If your design has no cupboard space, you could use similar rails at the bottom. To allow for wood shrinkage, remember to fit any kickers with gaps at the shoulders and leave the rear tenons unglued.

The case ends could also be thinner than the legs, creating either a reveal where the ends join the legs or a recessed nook inside the case. Because of the added complexity of the case dovetails and drawer frames in the latter option, I would use it only if saving weight or wood is an issue.

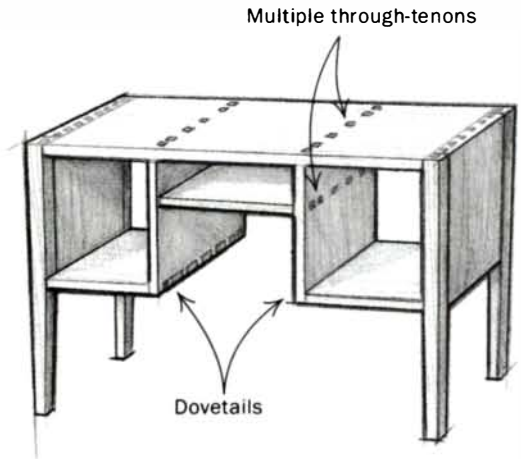
It's easy to add decorative aprons between the legs (see the bottom drawing at right). At the lamination stage of making the case ends, glue on the outer layer long at the bottom. This creates a large lap for the dovetails, which, as before, are cut flush on the inner layer of the end. The outer layer hangs down and can be sawn to shape. To add an apron across the front, the bottom can be cut back and an apron piece glued onto the edge of the bottom. If the apron is wide at the center, it can be braced from behind. If it is wide at the leg, it should be tenoned into the leg to prevent racking and twisting.

The most common change to the case is to have the bottom step up in the middle. This introduces movement, breaks up the strongly horizontal case and allows different ways of arranging the doors and drawers. This type of case construction is more complex, but it uses the same joints as before (see the top drawing at right). Just remember how this system works: If a case part joins another at a corner, dovetail it; if a part meets along another's length, use multiple tenons. When you add a step up in the center of the case, only the fitting sequence changes.

First cut and fit the multiple stub-tenon joints between the inner verticals and center bottom panel. All of the stub tenons can be cut at the same time, but put off dadoing the top until the center panel is in place. The important thing here is to keep the inner verticals parallel. If the center panel clamps up shorter than planned, it's easier to move the dadoes in the top board

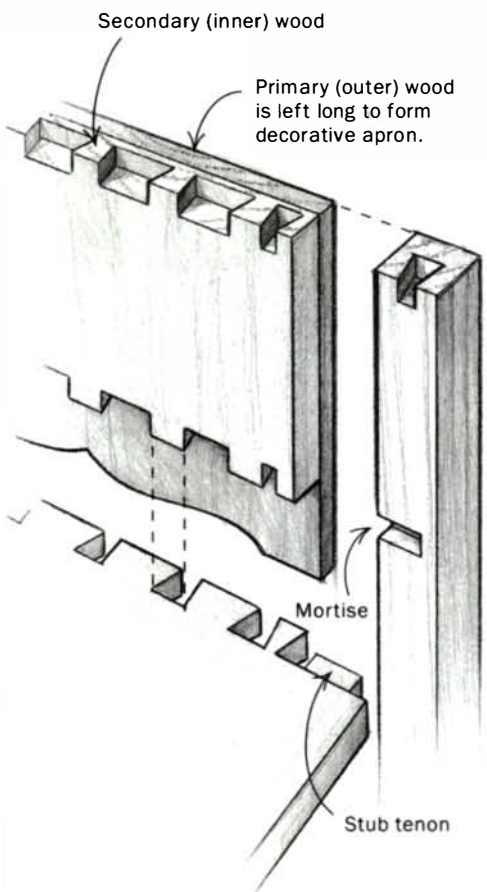
CONSTRUCTION BASICS REMAIN UNCHANGED

No matter how you change the design, the rules of construction are simple—dovetail joinery is used at all corners, and multiple through-tenons are used where a board joins another along its length.



DECORATIVE APRON ADDS TO DESIGN

With the primary wood cut long and glued onto the secondary wood, an apron is formed and can be accented with scrollwork inlay. Cutting the secondary wood shorter allows you to employ the simple construction methods used on the basic case of the mock-up.

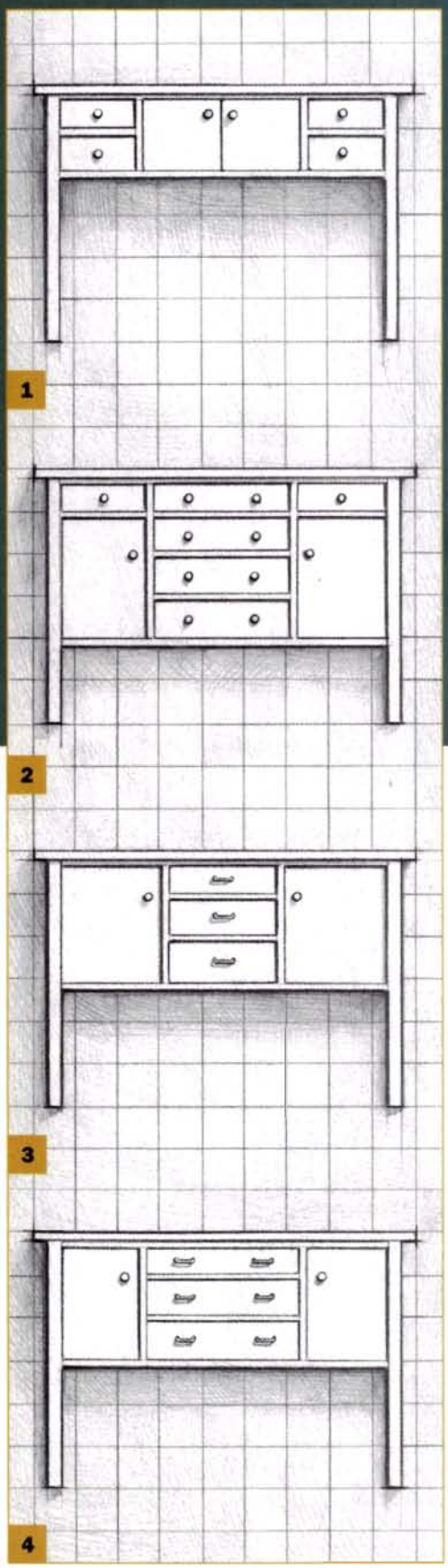


Finding the right proportions

With a sideboard, as the case gets larger and the negative space between the legs grows smaller, the piece begins to look more massive. But take a look and compare cases 1 and 2. Case 1 is far more delicate in size, but the case divisions give a static effect because they are based on squares and 2:1 rectangles. Although case 2 is much bigger, both the vertical rectangles of the doors and the graduated drawer sizes help relieve any sense of heaviness. What if the drawers were the same size and the doors more square?

Putting the doors on the outer parts of case 3 leaves the drawer compartment overpowered, at least to my eye. Even though the initial placement of the partition gives equal divisions, once the central space is divided, it looks too small.

Case 4 uses proportions that I often rely on. Leaving 50% in the middle gives a strong impression but is not as obvious to the eye as halves or thirds. Dividing the total sideboard height in half is also satisfying but remarkably subtle because it takes a moment to see the relationship of the positive space to the negative. Overall, I like the interplay of vertical and horizontal rectangular spaces. But I would still be willing to adjust things by eye to get a more pleasant drawer spacing, for instance. For me, it's less important that the height be exactly divided in half than it is for the divisions of space to produce an impression of these proportions.



(and make the center section smaller) than it is to live with verticals that aren't perpendicular to the case.

Now fit the dovetails of the ends to the top. While cutting the outer bottom panels, you can make any necessary adjustments. The most important thing is to keep the verticals parallel. Many things can creep in to change the exact locations of the verticals, but the top now tells you the actual distance between the inside faces of the verticals, a measurement that is more important than the overall length of the bottom pieces. So if the bottom location changed or you cut the bottom a bit short, adjust the gauge line for the dovetails until the distance between them is the amount required. The slight change of length in the tails is absorbed in the lap of the pin piece. As before, the space below the raised center section can be filled with decorative apron pieces.

Proportions and style

In designing a sideboard, it's important to consider the visual effect that the proportions and construction methods will have, then choose ones that help express the intent of the design. Before considering any decorative effects, sketch a few cases of different sizes and proportions (see the story above). Then use tracing paper to try out a variety of partition locations and to vary the door and drawer sizes. This exercise gives you a sense of how changes in proportion alter the effect. You may find yourself discarding all of these sketches, preferring to develop a second set using your eye to judge correctness.

The methods used on the mocked-up sideboard should provide the basics of construction. Most of the alternatives discussed don't really change the construction methods much. They are additions to the basic case that either save wood or provide surfaces for design options. More complex cases are possible, but they are all offshoots of this basic method. You can choose details to design a sideboard with a refined period look, or opt for something more contemporary. □

Will Neptune teaches woodworking at North Bennet Street School in Boston.

The Rudiments of Rustic Furniture

In a parallel universe, rustic makers build furniture with little noise, dust or lumber

BY PAUL RUHLMANN

Imagine you are invited to teach woodworking to a group of enthusiastic ninth-graders—but there are some restrictions. You can't use power tools because there simply is no electricity. In fact, there is no shop. Workbenches are also lacking, although there are some sturdy picnic tables. The lighting is good if you work during the day, and it's dry if you stay under a lean-to during the occasional shower. Materials, however, are plentiful. Where are you? In the middle of the woods on Bivouac, a two-week program that starts the year for freshmen at the school where I teach.

I accepted this teaching challenge eight years ago with a mixture of excitement and trepidation. Could I really pull it off? Over the years I had grown accustomed to teaching woodworking in the high school's cozy, well-lit, wood-framed shop. How could I leave all of those tools and jigs and teach in the wilderness? The answer I arrived at has affected my woodworking and my teaching ever since: The students and I would make rustic furniture in the woods!

That first year, we drilled mortises with a brace and bit and whittled tenons with a carving knife. The students showed a great deal of enthusiasm and pride in their work, transforming sticks pulled from the brush pile into handsome pieces of furniture. Since then I've taught rustic furniture making on Bivouac every year, enjoying it a great deal. And back in the cozy shop at school, although we don't go the unplugged route, much of

You can afford to be selective. *Digging through a pile of saplings to find just the right curve to make a chair's back post, for example, is part of the freedom and fun of rustic woodworking.*

what I produce and some of what the students make is rooted in the rustic style.

The appeal of building this way is enormous: it is fast, intuitive, inexpensive and requires few tools. The results are immediate, and creativity seems to come easily. It is also quite versatile: In this article I describe how to build a rustic chair, but with the same techniques you can make a whole range of projects, including tables, benches, mirrors, coat racks, garden gates, fences and trellises—all manner of things.

Yes, it's fun, but I also get a nickel a stick. *A butter knife nudged under the bark makes quick work of peeling a sapling. The author's son, Nicholas, is an old pro at the job.*

Gathering materials

Great material for rustic furniture is all around. Freshly cut saplings are ideal. You can cut your own, but I find most of mine by calling local parks, town road crews and tree services. Once these people know what you are using the wood for, they are often happy to give you as many saplings as you could possibly use. Allowing the saplings to air-dry for three months or more will make them easier to work. When you store the saplings for drying, be sure to allow for adequate air circulation so that the wood does not discolor or mold. I try to use almost all of the wood I gather. I use wood up to 2 in. dia. and save sticks as small as ⅜ in. dia. These smaller pieces can be whittled for drawer pulls and salad servers. Maple is my favorite wood for rustic work, but any hardwood will do. Some great woods to use include ash, beech, birch and gum.

I harvest wood in the spring and early summer because I like to use peeled sticks for my furniture, and here in New England the bark peels best from May to early July. If, like many rustic makers, you prefer to leave the bark on, you can harvest from midsummer through early spring. I usually peel the saplings with a butter knife. Just nudge the knife under the bark at one end and pull. Sometimes the bark of an entire sapling will peel off in one or two pieces. Saplings peel especially easily when they are harvested after a heavy rain and peeled within a few days. After peeling a sapling, wipe any surface moisture from it with a dry cotton towel. Coat the ends of thicker pieces with end-grain sealer to keep them from checking.

Marking out and mortising

By its nature, rustic furniture requires flexibility in design. Because the materials are not uniform, it is not necessary to do finely detailed drawings—there will always be discrepancies between your concept of a piece and the final product. To

Marking for mortises. *Working from rudimentary drawings, the author lays out centerlines for stretcher mortises. Because the materials in rustic work are unpredictable, the design of a piece changes along the way. So there is little value in precisely detailed drawings.*

Don't try this on a tablesaw. *A handsaw is the best and safest tool for crosscutting the irregularly shaped saplings. A Japanese dozuki saw, with its thin blade and fine teeth, is excellent for the job.*

Flat clamp tames a wild workpiece. *To make a curved chair leg fit for safe, accurate mortising on the drill press, attach a handscrew clamp to one end. The clamp holds the leg in register and provides a flat surface to mate with the table. To get mortises of the same depth, use the index on the collar of the drill-press arm.*

Dowel sighting. *When cutting mortises with a hand drill, you can ensure that the holes are in the same plane by filling them with dry-fit dowels as you go and then sighting along the drill bit and the dowels.*

build a chair, all I need is a sketch that gives a rough idea of how I want it to look and shows the chair's major dimensions.

I begin a chair by selecting and cutting the upright pieces. I choose saplings for the rear posts first, looking for a smooth curve in the wood that will be comfortable on a sitter's back. One of the pleasures of rustic work is finding sticks with just the right natural curve—for the legs of a chair or the arched top of a mirror, perhaps. But if you can't find the curve you want, don't worry. When the wood is green, you can bend it gently and clamp it, and it will harden in place as it dries. You can also steam-bend saplings to obtain more radical bends or compound curves. (For information on steam-bending, see *FWW* #64, pp. 62-67.)

When you have selected saplings for the posts, cut them to length. I use a Japanese dozuki saw for its accuracy and its fast, clean cut, but any sharp handsaw will do. Cut the posts an inch overlong on the bottom and wrap the extra inch with tape. When the chair is complete, this extra inch gives you latitude for leveling the legs and adjusting the pitch of the chair for comfort. The tape keeps you from inadvertently including the extra inch when you're measuring out the mortises.

Once the posts have been cut, I mark both ends with arrows pointing toward the front of the chair to keep myself oriented during the building process. Then I mark off centerlines for the back-stretcher mortises and get set to cut them. In rustic work, with its irregularly shaped parts, the main challenge in mortising is to drill all of the mortises in the same plane. To solve this problem, I use a large hand-screw clamp to hold the workpiece. When I am in the shop, I cut the mortises on the drill press. Use the arrows on the ends of the post to help align it properly as you secure it in the clamp. The handscrew clamp provides a flat reference surface that can be shifted along the drill-press table as you cut the mortises.

Mortises can also be cut with a handheld drill. Use the handscrew-clamp method to reference the workpiece on a flat table or workbench. After drilling the first mortise, put a dowel in the mortise and use the dowel as a sighting guide to ensure that subsequent mortises are drilled in the same plane.

What's in the middle doesn't matter. *Only the tenons on both ends of an irregular workpiece must be aligned for the joints to fit. That alignment starts with a level held to the stretcher.*

Cutting tenons

Tenons come next. I cut them with a ⅝-in. Veritas power tenon cutter, available from Lee Valley (800-871-8158), mounted in an electric drill. The cutter's curved blade is set in a bugle-shaped mouth that centers even crooked workpieces and will cut a tenon on sticks as large as 1¾ in. dia. (I take particular satisfaction in the prowess of this tool because I invented it!) The tenon cutter has an integral spirit level to help keep the tool horizontal. To adjust the drill left or right, I simply place a straightedge against the square shoulder of the tenon cutter's front opening and then pivot the cutter so that the straightedge is parallel to the stick.

Photos, except where noted: Jonathan Binzen

Like peeling an apple. *It's not uncommon to produce a beautiful spiral shaving. The tenon cutter makes a tenon with a curved shoulder, which is appropriate for rustic work, where a square shoulder would be more difficult to fit.*

On a rustic chair, the only stretchers that need to be even vaguely straight are the ones for the seat. But when tenoning, you need to be sure that the stretcher is horizontal. Fit the stretcher in a vise, hold a long spirit level so that it rests on both ends of the stretcher and adjust the stretcher until you get a level reading (see the bottom photo on the facing page). If both tenons are cut on the same horizontal plane, it doesn't matter how curvy the wood between them is.

Now comes the fun part. While holding the tenon cutter steady and leaning into the drill, switch it on at a moderate speed. Crisp, clean shavings should come out (see the photo above). A tenon takes about 10 seconds to cut. Sometimes you get wonderfully long, apple-peel-like shavings that seem to go on forever. If the cutter squeaks while cutting a tenon, you can rub a small amount of Slipit or paste wax on the cutting chamber. Be careful not to touch the blade, because it is very sharp. If you are cutting tenons on green saplings, you can account for shrinkage by adjusting the tenon cutter to make the tenons a few thousandths of an inch oversized.

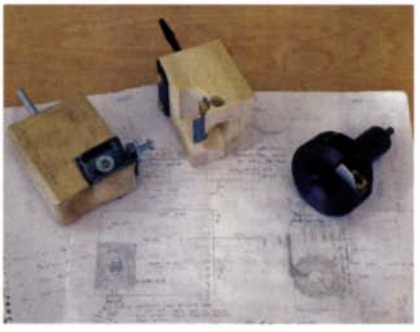
Assembling the front and rear panels of the chair

When you have the first batch of mortises and tenons cut, dry-assemble the rear posts and stretchers as a panel that looks like a ladder. Do the same with the front legs and front stretchers. Because the chair is wider

Evolution of a tool

When I first taught rustic furniture making, the students and I whittled tenons with a knife. Besides being hard to fit, the tenons took a long time to cut. I felt there had to be an easier way. Wasn't there a tool to do this? Because troops of high school kids would be using it, the tool would not only have to be simple and work well, but it also would have to be nearly indestructible.

Failing to find anything that fit the bill, I decided to make one myself. I used a block of wood for the body of the cutter and attached a metal shank to it. Ron Hock helped me by making a curved blade. The students thought that first tool worked fairly well—it was certainly a great improvement over whittling—and several asked if I could make them one. I tinkered with the design a bit, and in 1996 I took it to Leonard Lee at Lee Valley Tools. He and his designers made a few changes and put the tool into production. The next year, they came out with the current aluminum-body tool. Simple, efficient and nearly indestructible (in the photo above, from left to right: my prototype, the first production model and the current model).



For angled mortises, tilt the frame, not the drill. *To establish the angle for the side-stretcher mortises, tilt the chair's front frame forward (left). To help measure the tilt, use a framing square held upright in a kerfed block of wood. The author uses shopmade clamping blocks lined with leather to hold the work without marring it.*

Now drill on the horizontal. *With the proper angle found, tighten the clamps and drill the mortises (right). A spirit level in the drill helps the author drill the mortises accurately.*

at the front, the mortises for the side stretchers must be drilled at an angle. With the panels dry-assembled, finding the angle and doing the drilling is relatively simple.

I clamp a panel near the front of the workbench with quick-release clamps and leather-lined clamping blocks I made (see the bottom left photo on p. 53). Then I tilt the panel either forward or backward to get the correct drilling angle. In the chair I made for this article, the front is 3 in. wider than the back. So if I tilt the panel 1½ in. off vertical, I get the correct angle. To make measuring easier, I kerf a block to hold a framing square upright. I turn the square perpendicular to the frame to provide a vertical reference point from which to gauge the tilt. Then I tighten the clamps and drill the mortises with the drill held horizontally. When drilling the mortises in the front legs, the panel should be tilted forward; for the back legs, it should be tilted backward. I've been known to screw up a mortise now and then, but it's not a big deal because there is plenty of wood in the pile.

Adding armrests

Armrests can be made from saplings, but I like flat armrests, so I split them from thicker pieces of wood. Here I used walnut as a contrast to the light-colored maple saplings. I'll take a straight-grained walnut limb about 6 in. dia. and split it into quarters. Then I saw or split out an armrest about 2½ in. wide and ¾ in. thick. To make a tenon on the back end of the armrest, first saw a tongue approximately ¾ in. by ¾ in. by 1 in. Then use the tenon cutter to make the tongue into a round tenon. Milled lumber could also be used for the armrests.

Sanding and assembly

After all of the pieces have been cut to length and the mortises and tenons cut, shape any areas that are rough or that you feel need work. For peeled-stick furniture, sand any areas that are especially rough. This can be done by hand or with a flap sander such as Sand-O-Flex. If you are leaving the bark on, remove surface dirt by scrubbing the pieces with a Scotch-Brite pad and a solution of Citrasolv and water.

Glue-up begins with the front

Putting the squeeze on. *Final assembly begins with the front and rear panels. The author uses a slow-setting epoxy and pulls the joints home with his bench's tail vise and some extralong bench-dogs (above). Elbow grease and a rubber mallet are used to drive the tenons of the side rungs and armrests home. Then band clamps hold them in place and a bag of sand across the seat rungs keeps the chair from twisting (right).*

and rear panels (see the photos on the facing page). Brush a slow-setting epoxy in the mortises and use padded clamps to pull each panel together. Padded bar clamps work fine, but I often use my tail vise and some extralong wooden benchdogs covered with bicycle inner tube to avoid denting the chair parts. Once the front and rear panels have been pulled together, I glue in the side stretchers and pull them home with padded bar clamps. Then I remove the bar clamps and put band clamps around the chair to keep the joints from shifting as the glue dries. Just after the band clamps go on, I stand the chair on a flat surface and twist out any minor racking before the glue sets.

Mother Nature's tenon pins. *Thorns harvested from the hawthorn tree are excellent for pinning tenons. No machining is needed; just drill and drive.*

After the glue has dried, pin the joints. For pins I use the thorns from hawthorn trees (see the photo above). They are very hard and dense, and when driven in and flushed off, the thorns reveal a decorative bull's eye on the end. The thorns I gather are about ⅛ in. dia. and 3 in. long. I drill holes for them about 1/64 in. undersized. I put a drop of glue in the hole and drive the thorn in with a hammer. Once it's in, I flush it off with a fine-toothed saw.

Finishing the wood and weaving the seat

I put finish on a piece before weaving the seat. I like to use Arm-R-Seal, a wipe-on urethane made by General Finishes. Just follow the directions on the can.

Weave the seat using 1-in. cotton Shaker tape. You can get the tape from Shaker Workshops (800-840-9121) in a range of solid colors and a few striped patterns. Instructions for chair weaving are free with a tape order, and I found them easy to follow. To keep the seat from sagging over time, place a pad of 1-in.-thick, high-density foam between the top and bottom layers of weaving.

Leveling off and taking a seat

To level the finished chair, stand it on a flat surface and put spacers under the chair's legs until you have the seat level across the front and back. Also, the seat should slope from front to back at an angle that will be comfortable. Scribe each leg at the height of the highest stack of spacers and cut the legs at the scribe lines. Then test the chair for comfort. Does the seat feel too high? Put a scrap of ¾-in. plywood under your feet as you sit, and you'll know what it would feel like if you took another ¾ in. off each leg. Does the chair lean forward? Place a scrap of plywood under the front legs to see how much to change the pitch. When you have made these final adjustments, you can sit down and enjoy the chair.

One last thing. *With the chair on a flat table, place shims beneath the chair's legs until it is stable and level; then mark the legs at one height and trim them.*

My early attempts at making rustic furniture brought back memories of the joy and wonder I felt as a child building with simple materials: Sticks and nails and glue and string were transformed into pieces of art and function. It seemed like magic at the time. It's easy to be distracted from the simple delight of those earlier times when surrounded by tablesaws and routers and the like. The rustic furniture I make now may be more refined than the early pieces I made in the woods, but the work still brings joy and wonder and a feeling of deep connection to nature. As I walk through the woods behind my home in Concord, Mass., I am reminded of Thoreau's admonition: Simplify. □

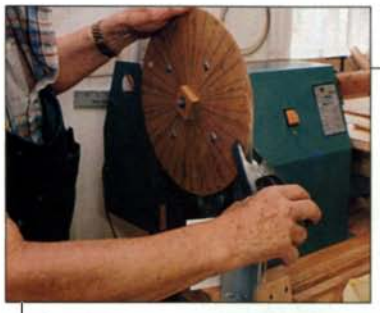
Paul Ruhlmann is a woodworking teacher at Buckingham, Browne & Nichols School in Cambridge, Mass.

Photo, facing page (right): Courtesy of Buckingham, Browne & Nichols School

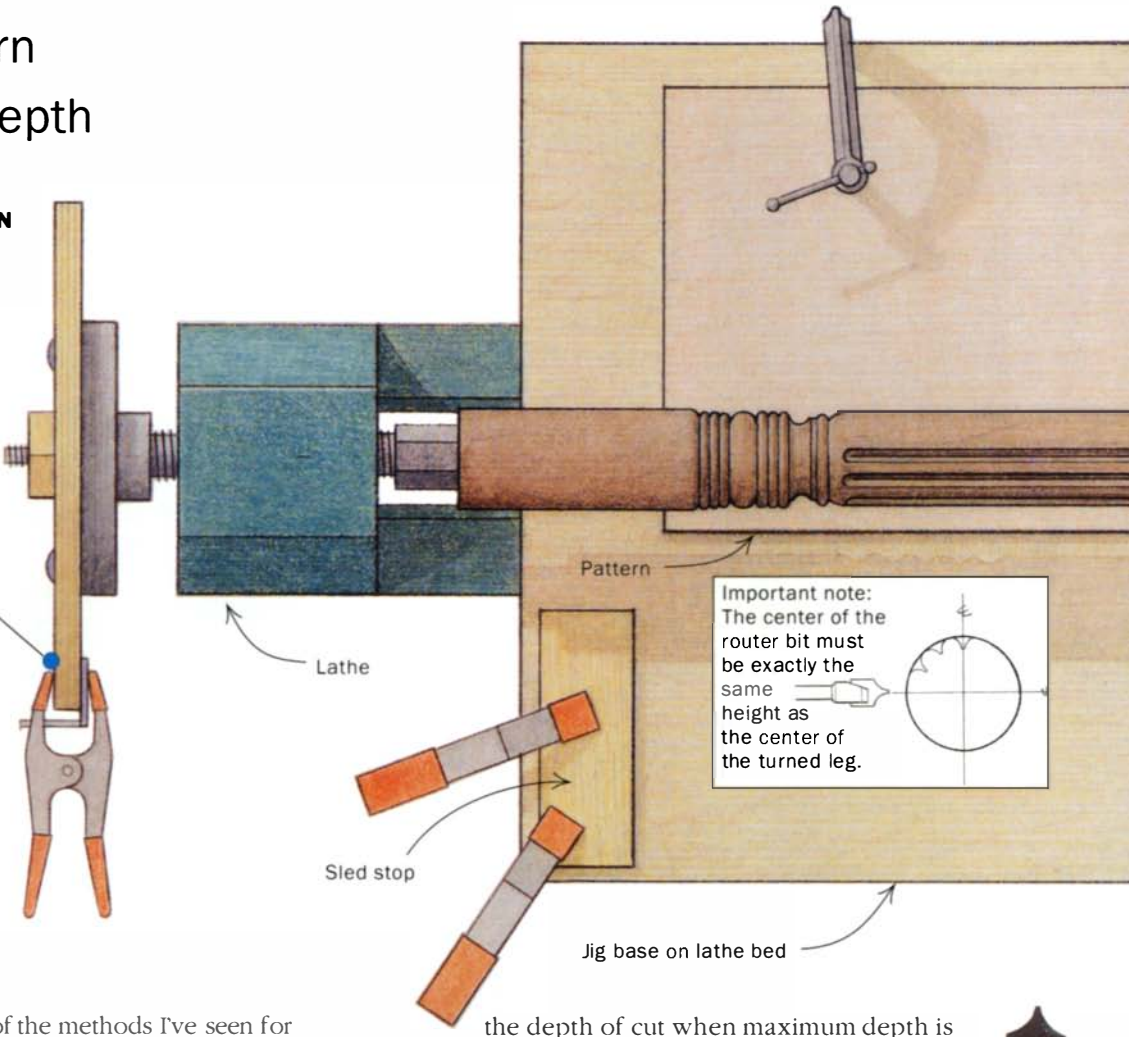
A Jig for Cutting Curved and Tapered Reeds

A router, a lathe and a simple pattern allow for variable depth

BY JOHN VAN BUREN



Reeding a turned, tapered, Sheraton-style leg starts with a wheel. *After the author turns his leg blanks, he leaves them on the lathe. A plywood wheel attached to the lathe's outboard faceplate keeps track of the stops every 30° for each of the 12 reeds.*



I've never been satisfied with any of the methods I've seen for cutting reeds on a turned and tapered leg. The problem is that the variable depth of the reed cannot be adjusted with precision. Obviously, for the reed to stay properly proportioned in the lower, narrower sections of the turning, the router bit must make a shallower cut so that the size of the reed diminishes with the size of the leg. This can be done with a lathe and two simple shopmade jigs: a horizontal router sled and a pattern made of ¼-in. plywood.

A sled for the router

The sled holds the router bit in a horizontal position and has two bearing surfaces cut out of one piece of wood screwed to the vertical face of the sled. The top bearing surface—just below and even with the outer edge of the bit—rides against the surface of the turning and limits the maximum depth of the reeding cut. The bottom bearing surface rides against the edge of the pattern and controls the depth of cut when maximum depth is not desired—for example, at the narrow end of the leg. I use a 3/16-in. radius (#10.24.01) point-cutting roundover bit from Highland Hardware (800-241-6748).

The pattern guides the sled

After turning the leg blanks but before cutting the pattern, clamp or bolt a jig base to the lathe bed. The base is a piece of ¾-in. plywood with a smooth surface for the router sled to ride on and broad enough to hold the pattern and the sled. Mine is 16 in. by 42 in. The height of the jig base is adjusted with shims so that the tip of the router bit in the sled is exactly the same height as the lathe centers.

The pattern is simply a piece of ¼-in. plywood cut in the same profile as the turned leg. To prepare it, set the leg between centers on a lathe, and drop a perpendicular repeatedly from the turning

Photos, facing page (bottom right): Author; all others: Jonathan Binzen

First, drop a line, but make sure it is true. *Using a square, drop a perpendicular repeatedly from the turning to the pattern blank. Connect the points and bandsaw carefully so that the pattern profile is the same as the turned leg.*

Next, check and clamp the pattern. *After the bandsawn pattern has been filed smooth, clamp it exactly under the leg. To make shallower reeds at the bottom of the leg, move the end of the pattern slightly toward you.*

Two guides; one piece of wood. *The sled is made of offcuts. A single piece of wood with two bearing surfaces is attached to the front of the sled. The bottom bearing surface rides along the pattern; the top bearing surface rides against the surface of the turning and limits the maximum depth of cut.*

Cut it "backwards." *Unlike normal routing, these reeds are cut moving the sled right to left so that the bit rotation does not lift the bit and the sled off the table.*

(using a try square) and mark it on the plywood. This line mimics the outline of the piece to be reeded. Bandsaw the pattern carefully—right at the line—then file it smooth. Next, you have to make a decision about where you want less or more cutter depth. Filing away the pattern edge allows deeper cutter penetration. In the case of a uniform taper, you only need to slide the pattern toward the sled at the narrow end of the leg to move the cutter away from the piece for the shallower cut. Clamp the pattern in place on the jig base. Lateral stops for the router sled are clamped to the jig base to limit the length of the reed.

Make a plywood "protractor" for indexing each reed location and fix it to the outboard faceplate. To reed a Sheraton-style leg with 12 reeds, rotate the turning and fix it at 30° intervals for the reeding cuts.

One last tip, usual routing routine would suggest that you move the router from left to right. In this case, such movement might cause the bit to ride up and ruin the adjacent reed. Instead, move the bit from right to left, because the rotation of the horizontal bit tends to hold the cutter down. This method can also be used to cut flutes or facets rather than reeds. All that's left in any case is some hand-sanding. □

John Van Buren is a retired neurosurgeon in Herndon, Va.

Drawing: Vince Babak

Pembroke Table

Drop-leaf rule joints and wood-hinged leaf supports are fussy but fun

BY JEFFERSON KOLLE

Divorce is a nasty thing. Aside from the obvious casualty of the demise of my family, I regret the fact that Eddie will no longer be my father-in-law. Over the course of nearly 20 years, he has become one of my best friends. He always admired a Pembroke table I'd made years ago, and in fact, he commented on it almost every time he came to our house. In appreciation for all that I've learned from him—he'd been more than a surrogate father since my dad died—I wanted to make another one of the tables for him.

Pembroke tables have been around for centuries. Small and graceful, they have been made in forms simple to elaborate. The one I made is on the simple side—the only adornments being the tapered legs and the curved top. What makes the table fun to build are the moving parts: the hinged drop leaves with their attendant rule joints and the short, wood-hinged arms that support the leaves. In the drawings, I've included the dimensions for my table, which is 34¾ in. long at the center of the top. You can adjust the dimensions of the table to suit your needs. Most often, Pembroke tables are

small side tables, but they were built in all sizes. I once measured an antique Pembroke table with a 48-in.-long top.

Two-piece jig is used to taper legs on the tablesaw

I can't claim ever to have had an original thought, and I certainly can't claim to have invented anything as far as woodworking is concerned. The tapering jig I used for the table's legs is no exception. I borrowed the idea from Charles Grivas of West Cornwall, Conn. I'm not sure he invented it, either, but it sure works well. (For a look at Grivas' work, see *FWW* #131, pp. 40-44.)

The tapered legs are cut from 1 9/16-in. square billets, 29 3/4 in. long (see the photos at right). The taper starts 6 in. down from the top of each leg. The legs taper on all sides to 7/8 in. at the floor. It's a good idea to cut the mortises in the legs before you start tapering.

Set your tablesaw fence for about 5 in. and rip two 35-in.-long medium-density fiberboard (MDF) or plywood scraps. After ripping, don't touch that tablesaw. You're going to taper the billets by setting them proud of the edge of the ripped strips and sending them through the tablesaw at the same fence setting, once for each tapered leg side, for a total of four cuts.

Lay out a 7/8-in. square centered on the bottom end of one of the billets and square around the billet 6 in. down from the top. Set the billet atop one of the MDF strips with the 6-in. square line and the outside edge of the 7/8-in. square flush with the edge of the MDF.

Trace the billet onto the MDF and then, using a bandsaw or jigsaw, remove the outline of the billet. After you've made the cut in the MDF, pressure-fit the billet into the cutout and then send the MDF through the tablesaw.

Hold the one-taper billet to the edge of the second MDF strip, just as you did before. One edge of the 7/8-in. leg-bottom square will have been removed by the first cut. Line up the 6-in. square line again and the edge of the 7/8-in. square opposite the side that was removed with the first cut. Trace the one-taper leg onto the second strip of MDF and remove the leg outline as you did before. To distinguish the two MDF strips, and thus to avoid cutting the wrong tapers on the wrong sides—I've been know to make mistakes in my life—I made a red mark on the first-taper strip and a green mark on the other. Then I marked the end of the billets: red for the first cuts and green for the second cuts.

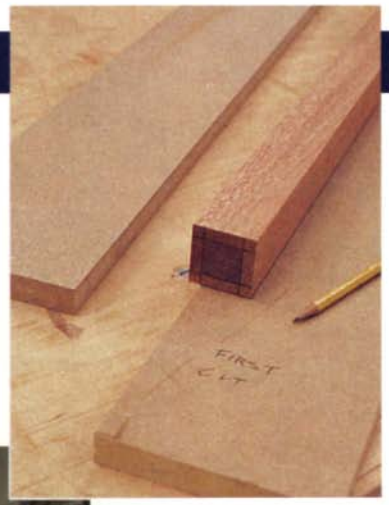
When you have made the cutouts on both MDF strips, you're ready to taper. Fit a billet into the first-taper strip and taper the first side. Then turn the billet and taper a side perpendicular to the first. Fit the billet into the second MDF strip and taper the two remaining perpendicular sides.

Swinging leaf support pivots on a wood hinge

The table's short leaves are supported by flipperlike arms that swing out of the side aprons on wood hinges and fold flush into the aprons when the leaves are down. The five-knuckle wood hinge is pinned at the centerline of the side apron with a length of 1/8-in.-dia. steel rod. Cut two lengths of 4 1/2-in.-wide stock 6 in. longer than the finished length of the aprons. You'll need the extra length to account for the tenons and the wood you waste when making the hinge.

Mark five knuckles of the same size across the apron's width. Crosscut the apron stock through the five knuckle lines and then make a mark 5/8 in. from each end of the cut. In 3/4-in. stock, a 5/8-in.-long knuckle works well. Anything longer and the hinge will bind when it's glued to the secondary-wood subapron. The swinging leaf support has two knuckles, and the stationary apron piece has

TAPERED LEGS



Leg tapering jig is made from two strips of MDF ripped to the same width. *The edge of a 7/8-in. square marked on the bottom of a leg billet hangs over the edge of the MDF strip. The billet, held to the outside edge of the smaller square, is traced on the MDF and cut away to make a pattern for the first two cuts on the four-taper legs. Leg billets are pressure-fit into the cutouts in the MDF and ripped on the tablesaw.*

Rip the first two tapers on one jig. *The part of the billet that sits proud of the MDF strip is ripped away when the MDF strip is sent through the saw at the same setting at which the strips were ripped.*

Color coding can counter confusion. *The author marked two perpendicular sides of each billet end with a red pen for the first cuts and a green pen for the second cuts. The jigs are coded the same way. (The first cuts in the billet in the photo have already been sawn away.)*

Photos: Michael Pekovich; drawings: Bob La Pointe

The drop-leaf supports swing on a wood hinge. *Hinge knuckles—two on the support and three on the stationary piece—are ⅝ in. long. The width of each knuckle is determined by the width of the apron stock divided into five parts. A cyma curve on the end of each support adds a decorative touch.*

Knuckle relief. *The back of the wood hinge knuckles are cut away at an angle so that the hinge can swing freely. If the knuckles were left square, their front sides would pinch one another as they swung.*

Fit to be drilled. *Once the wood hinges have been pared to fit, clamp the pieces together against a backer board and drill a ⅛-in.-dia. hole through the hinge. A ⅛-in.-dia. steel rod is used as a hinge pin.*

Fingerhold is cut with a gouge. *The swinging leaf support, cut on the end with a gentle cyma curve, nests against the apron end, which gets cut with a slightly more exaggerated curve. The back of the support is relieved with a gouge to provide a fingerhold for opening the support.*

three knuckles. Butt the two marked pieces end to end and mark waste lines on each piece (see the left photo above).

Cutting the wood hinges is exacting. To look good, the knuckles must fit tightly but should not be so tight that the hinge won't swing. Prepare to do a lot of test fitting. The back side of the hinges must be relieved at about a 45° angle so that the knuckles on one piece can swing past the knuckles on the other (see the photo, second from left, above).

Once the knuckles fit together, clamp the two pieces to a backer board and drill a ⅛-in.-dia. hole through the center of all of the knuckles (see the photo, second from right, above). Push a long piece of ⅛-in.-dia. steel rod through the hinge and test the action. Unless you're a real ace, you'll have to pare away at the knuckles to get the hinge to swing smoothly. Using a piece of long rod for the test fitting makes it easy to pull out the pin when you have to adjust the knuckles.

Each swinging leaf support has a gentle cyma curve cut into the end, and it folds flat against another, slightly more exaggerated curve cut into the apron end. Use a gouge to relieve part of the back of the leaf support to provide a fingerhold (see the right photo above).

When you are convinced that the leaf support works smoothly and you're pleased with the fairness of the curves cut on the supports and apron ends, glue the stationary part of the hinge and the apron end to a 4½-in.-wide subapron made of a secondary wood (poplar in this table). Because the primary apron is broken by the swinging leaf support, the subapron gives strength to the assembly. Gluing the apron pieces together makes it easy to cut the tenons (see the photo below).

Table aprons are double thick. *After the swinging leaf support has been cut, fit and drilled and the end of the apron is cut with a cyma curve, the primary apron pieces are glued to subaprons. Cutting tenons on the doubled-up aprons is straightforward. In the photo, the swinging support has been removed from the apron.*

Rule joints add decorative touch

The hinged leaves on some unadorned drop-leaf tables simply butt to the tops when folded up. Rule joints—a combination of two moldings, cove and roundover—add a decorative and a structural element to a drop-leaf table. When a table leaf is folded down and hangs vertically from the tabletop, you see a decorative, molded roundover along the edge of the top. And when the leaf is folded up, the cove in the leaf rests on and is supported by the roundover, giving strength to the joint when the table is loaded.

For the first Pembroke table I made, I borrowed rule-joint planes from Mike Dunbar, and in fact, the inspiration for this table came from his Taunton Press book, *Federal Furniture* (1986). Cutting

MAHOGANY PEMBROKE TABLE

Traditionally, Pembroke tables have a wide top and shallow leaves. With the leaves open, this table's top appears almost circular with spurs making four corners. When the leaves are folded down, the spurs line up with the outside edges of the tapered legs. The leaves are held open with swinging leaf supports.

Metal pin, wood hinge. *The top of the pin is peened to prevent it from slipping out. In operation, the swinging leaf support folds flat against the apron when the table leaves are down.*

the joint with molding planes wasn't easy; using a router table with a ½-in. cove bit and a ½-in. roundover bit was a piece of cake.

I don't think it matters whether you first cut the cove in the leaves or the roundover in the top. What's important is that you have a perfectly jointed edge between leaves and top before you cut the moldings. It's also important that the fillets—the flat, vertical section of each molding—above the roundover and the cove be the same dimension. If they aren't, the top and the leaves won't sit flush in the opened position. I used 3/16-in. fillets on my table.

Trust me on this: It's a good idea to run extra lengths of scrap with the cove and roundovers run into the edges. Table-leaf hinges are a different breed of (swinging) cat, and it's a good idea to mount a pair to some scraps before you attack the real top. And later, the scraps can come in handy for tuning up the rule joints.

Hinge installation is exacting

A table-leaf hinge is unusual for several reasons: one leaf is longer than the other; the leaves are countersunk opposite the barrel; and in operation, the hinge folds away from the barrel rather than around it as it does on a regular butt hinge. The longer side of the hinge gets screwed to the table leaf.

Rule-jointed table leaves pivot not from the tabletop's widest point but rather from a point in line with the fillet on the roundover (see the drawing below). The exacting part of setting a tabletop hinge comes in setting the hinge barrel (and thus the pivot point) in line with the fillet. If you set the pivot point a little too far forward or too far back, the rule joint will bind as it swings or the leaf will hang too low, revealing the hinge mortise. Neither case is the end of the world, and both can be remedied with a little fiddling.

Mounting a table hinge requires that the hinge barrel get mortised deep into the tabletop and the hinge body get mortised flush with both the tabletop and the leaves. Transcribe the fillet line—½ in. back from the edge of the roundover—to the underside of the top. Use a ¼-in. chisel to knock out a rough mortise for the barrel, centering the hinge pin on the line you've transcribed. Neatness doesn't count here because the hinge body will cover the barrel mortise. Once the barrel has been mortised and the hinge body rests flush with the underside of the top and leaf, you can mark around the hinge and then cut the mortise for the hinge body into the top and the leaves. Drill holes for one screw in each of the hinge leaves and attach the leaves to the top.

Set the top and leaves on the edge of your bench so that one of the leaves hangs over the side and test the action of the hinges and the rule joint. It's likely that you'll have to fuss with the joints to get them just right. If the leaf hangs too low on either side or both, such that you see the hinge mortise on the underside of the tabletop, you'll have to deepen the hinge-barrel mortise on the tabletop. Don't deepen the end of the mortise on the edge of the roundover, just the barrel mortise and that area of the hinge leaf toward the center of the tabletop; you're trying to sink the hinge deeper into the tabletop and thus raise the height of the attached leaf.

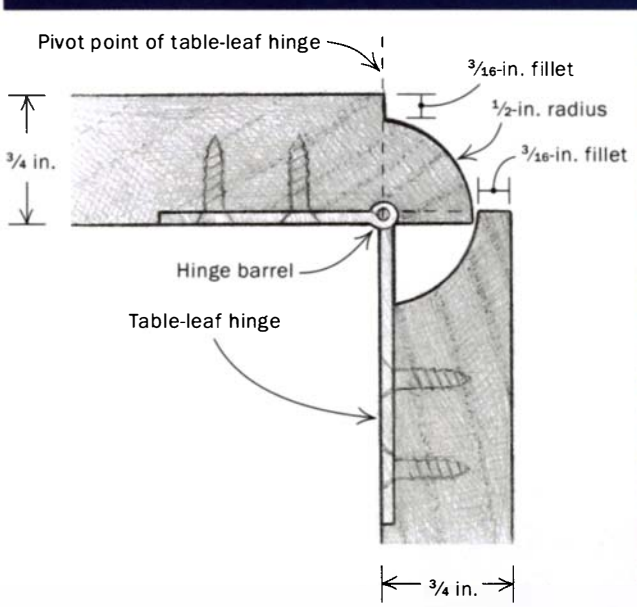
If the leaf binds as it swings open—you'll hear an annoying squeaking, scraping noise—the easiest thing to do is get out the sandpaper. I used spray adhesive to attach a strip of sandpaper to one of the test scraps I made when cutting the rule joint. Use the scrap with the cove cut into it to sand the roundover and vice versa. When both leaves swing well, drill and drive in the rest of the screws.

Trammels lay out the top

When viewed from above, the top of table looks like a circle with squared-off spurs at each corner. In fact, the edges of the table ends and the leaves are sections of a circumference each with a different center point. To my eye, one of the cool things about the table is the way the spurs on the leaves hang even with the outside edges of the legs.

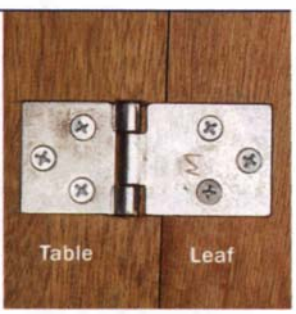
With the hinges mounted and the rule joints tuned, flip the top over on your bench and find the center of the top. Mark two long axis lines through the center point, one line perpendicu-

RULE JOINT AND TABLE-LEAF HINGE



Hinge pivots at the roundover fillet line. *Transcribe a line on the underside of the tabletop equal to the setback of the vertical fillet on the rule joint.*

Mortise the barrel first. *Then scribe around the hinge leaves and mortise them flush with the tabletop.*



Looks like a butt hinge, but it ain't. *A table-leaf hinge has leaves of different lengths, and the screw holes are countersunk on the sides opposite the barrel.*

lar to the rule joint and one parallel to it. Temporarily set the table base upside down on the top, clamp the leaves against the legs and mark lines on the underside of the tabletop along the outside of the four legs (see the drawing at right). It's a good idea to make witness lines so that you can align the table base and the top the same way in the future.

On each table-leg line, mark a point 7 in. from the rule joint. This point will become the end of the spur. Traditionally, Pembroke tables have short leaves, and although the 7-in. point is arbitrary, it's a good size for the leaves.

From that 7-in. point, mark a 1½-in.-long line perpendicular to the table-leg line, and then mark a point 1½ in. back toward the rule joint on the table-leg line. These 1½-in. squared corners will become the four spurs. Now you'll draw sections of circles between the spurs.

I made a trammel out of a pencil and a strip of wood with a drywall screw through one end (see the photo at right). The radii you mark on the top will vary based on the size of the table base you've made and the rough width and length of your tabletop and leaves. To lay out the curve on the table ends, use the parallel-to-the-rule-joint axis line you made through the top's center point. To lay out the curves for the leaves, use the perpendicular line.

First the table ends: Moving the drywall screw point along the parallel line adjusts the radius of the circle you swing from the tips of the spurs. Setting the screw point closer to the center of the table will make a tighter circle, and if you move it farther away, you will make a wider circle.

Hold the trammel so that the drywall screw sticks in the parallel line and the other end rests on one of the spurs. Swing the pencil end of the trammel in an arc to the spur on the opposite side of the table. Move the screw up and down the parallel line and swing arcs with different radii until you find one that's pleasing to your eye. When you find a radius you like, mark the non-screw end of the trammel and drill a hole in the stick so that you can pressure-fit a pencil through it. With the pencil through the stick, draw the circumference from the tip of one spur to the tip of the spur on the opposite side of the tabletop. To swing the same arc on the other end of the table, set the screw point the same distance from the tabletop center point in the other direction.

For both table leaves, you are going to swing an arc using the perpendicular-to-the-rule-joint axis line you drew through the center of the tabletop. And this time, instead of swinging an arc from the tips of one of the spurs, you'll swing the arc from the end of the 1½-in. line that's perpendicular to the table-leg line.

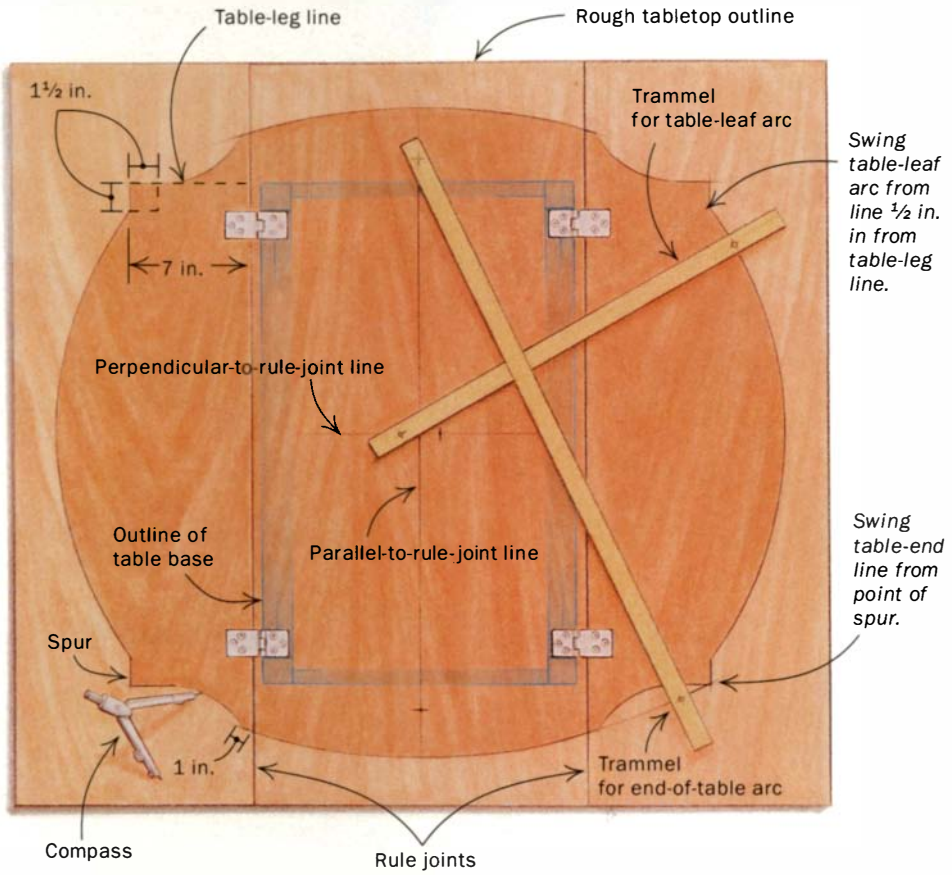
The last thing to do in laying out the tabletop is to relieve the corners of the table-end arcs. Relieving the corners adds to the illusion that the top is a true circle. Using a compass, swing a pleasing arc from a point on the table-end arc 1 in. past the line where the leaf meets the top to the point you've marked 1½ in. down the table-leg line.

After cutting out the tabletop with a jigsaw, I planed, scraped and sanded it until I was blue in the face. I used 340-grit sandpaper to knock the sharp edges off the tabletop and base, wanting to maintain the crisp corners. To accommodate the drop-leaf-hinge barrels and to make the tabletop lie flat on the base, I knocked out a small mortise on the base under each barrel. To attach the top to the base, I used small, L-shaped wood buttons that screw to the underside of the top and fit into chiseled slots in the base.

I was going to use an oil-and-shellac finish on the table, but after the first coat of oil, I didn't like the way it looked on the mahogany, so I'll probably scrape it off and go for a straight shellac finish. Hey, we all make mistakes; we all change our minds. Look what happened to my marriage. I just hope that my ex-father-in-law hasn't changed his mind about Pembroke tables. □

LAYING OUT THE TABLETOP

Two trammels swing different arcs. *By using different center points, trammels of different lengths and a compass, it's possible to lay out a gracefully curving tabletop of any dimension. The curves break at each corner spur, and the spurs are aligned with the table's legs.*



Jefferson Kolle is the managing editor of Fine Woodworking.

Choose the Right Drill Bit for the Job

Comparing the major bits for precision work: what they do, and how they do it

BY BRIAN BOGGS

Drilling is serious business. When I drill a hole for a rung in one of my chair legs, the leg I'm drilling is already sanded and oiled. The rung is turned to fit. Any mistake now would be very expensive, so I'm betting a lot on the performance of my drill. But why not? Drilling clean, accurate holes should be a simple task. A drill bit spinning in a chuck can be jigged to cut a hole in just about any material woodworkers use at just about any angle. But with all of the drill bits to choose from in all of the catalogs overloading our bookshelves, selecting the right bit for the task at hand can be pretty complicated.

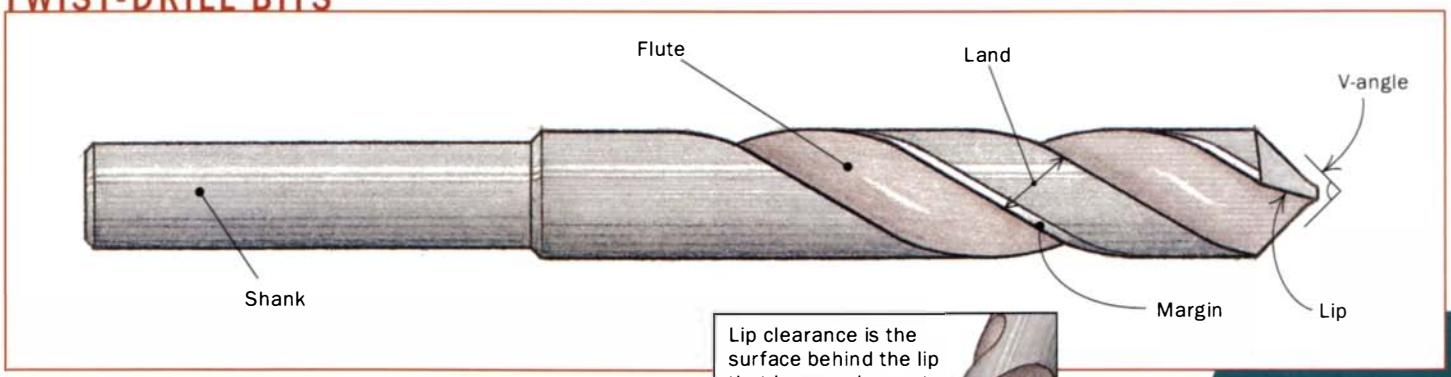
While there is a huge variety of bits available, there are three things that all bits need to do: (1) Stay centered; (2) cut the wood loose to form a round hole; (3) eject the chips. Bits vary in how they accomplish each of these tasks. Improving performance in one area invariably diminishes it in others. No single bit covers all of the bases, but it's not likely you'll need every type available. To know which bit to use when, I think it's important to understand the anatomy of each bit—just how it is designed and how that design affects its performance. Hopefully, this article will steer you toward the bits that best cover the range of your drilling needs.

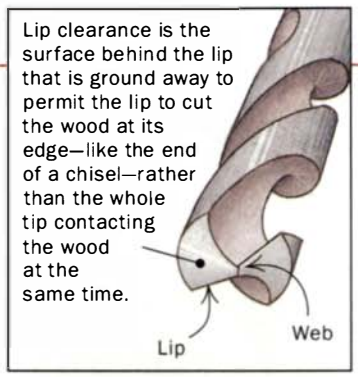
Twist-drill bits

The most common bit, the twist drill, is also one of the simplest. It covers the widest range of cutting possibilities in wood, sheet goods, metals and plastics and is also available in the widest variety of sizes. A twist-drill bit performs adequately or well in practi-

Photos, except where noted: Jonathan Binzen; facing page (top and bottom right): Michael Pekovich

TWIST-DRILL BITS





cally all general drilling situations for woodworkers. A couple of exceptions: drilling at angles over 45° and drilling perfectly flat-bottomed holes. A twist drill is excellent for cutting holes into end grain, where the cutting action of the bit yields the cleanest, fastest and most accurate holes of any of the bits. I keep an index of inexpensive twist drills handy for general shop use, such as making plywood jigs and forms. And a few finely tuned twist drills live on a rack by my drill press, ready for more precise work.

A twist drill's lips work both to center the bit and to cut the wood. With most other precision bits, the cutting action is divided in two: They'll have cutters that score the perimeter of the hole and lips that lift the chips within the perimeter. The sharpness of the lips is more critical with twist drills than with most bits, especially at the outer corners, where any tearout will show in the finished hole. Some tearout is inevitable with a twist drill in all but end-grain drilling; the only way to reduce or prevent it is to use a relatively slow feed rate and a very sharp lip.

The V-angle at the tip of the bit can vary from 60° to 118° for drilling wood. Most bits in the catalogs are ground to 118°, which is standard for drilling metals. Twist drills with 90° V-angles are available (I buy them from Morris Wood Tool; 423-586-0110), but for anything more acute, I grind them myself. When working in wood, the sharper the V-angle, the better the bit centers and the cleaner entry and exit it makes. The longer point that results when the V-angle is sharper reduces the usable depth of a hole, however.

At the very tip of the twist-drill bit, the two lips meet and form a chisellike web rather than a true center point. The web is more durable than a center point, but it can cause the bit to wander just as the bit starts to cut. The web doesn't actually cut any wood; it sort of mangles the fibers as it spins, making it possible to force the bit into the wood. On larger bits a pilot hole is sometimes recommended to accommodate the large web. The smaller the web, the less force is required, the better the bit centers, and the less it walks at the entry. Manufacturers sometimes minimize, or thin, the web for this reason. I like to grind the tips to eliminate the web on my bits, sacrificing durability for performance.

A bit's clearance angle also affects its performance. The clearance angle is the amount of relief behind the cutting edge of the lip. Just as you can't do much chiseling if you

Long-point twist drill takes a sweet shaving. *Ground to a 90° V-angle at the tip and sharpened properly, a twist-drill bit should cut cone-shaped shavings.*

Best bit for end grain. *A twist drill, which cuts like a ripsaw, bores into end grain beautifully. Brad-point and Forstner bits, which score the hole at the perimeter, act more like crosscut saws and perform better than twist drills in cross-grain but not as well in end grain.*

Drawings: Vince Babak

hold the chisel flat on the workpiece, you would struggle to drill a hole if the whole tip of the bit—the cutting edge of the lip and the area behind it—contacts the wood at the same time. If there's not enough clearance, too much pressure is required to enter the wood and the bit gets hot from the friction. Too much clearance, and the bit vibrates in the cut for lack of support. When you sharpen your own bits, these angles should be maintained carefully.

Although it's true that all of the cutting takes place at the tip of the bit—those sharp-edged spiral flutes are merely passive conductors of chips—the flutes of a twist drill are still as important as any other aspect of the bit. In machinist's catalogs there are bits with a variety of flute (helix) angles to more effectively eject shavings of difficult materials. The bits I've seen in woodworking catalogs have moderate spiral flutes, and they work just fine in wood as long as they are kept clean and rust free.

Brad-point bits

A brad-point bit is basically a twist drill with a modified end. The brad-point design addresses two shortcomings of the twist-drill bit when used in wood: The bit overcomes the tendency to walk at the start of a hole, and it reduces tearout at the perimeter of the hole. These modifications make brad-point bits better than twist drills for precision cutting in virtually all cases, with the prominent exception of drilling into end grain.

There are two basic types of brad-point bits—those with scoring spurs and those without. Brad points without spurs—plain brad points—have lips that angle down and outward from the center, so they first contact the wood at the perimeter of the hole. A long point in the center engages the wood before the lips begin to cut. This style still has some tendency to tear the wood at the perimeter of the hole, but tearout can be prevented with a sharp bit and a light cut.

A fairly new variation on this plain brad point is the Vortex-D bit. It has lips that are ground at a severe downward angle and a center point that is ground on only two sides, leaving a flat, chisellike web across the center rather than the standard four-sided point of the other brad points. The bit's steeply angled lips perform like spurs to cut a clean entry, but the web at the end of the point can cause the bit to walk across the surface of the workpiece when drilling freehand. In my testing I could not find any situation where this type of bit outperformed the other brad points.

A spurred, or lipped, brad point is far superior to its spurless cousin. The spurs are extensions of the margins that score the perimeter of the hole, preventing any tearout as the chips are lifted by the cutting lips. A spurred brad point is excellent for its clean entry, clean walls and for drilling at angles. A spurred brad point will even cut a reasonably clean hole after it has dulled slightly, an important feature, especially in production situations.

An interesting variation on the spurred brad point is a double-margin bit made in Austria (available from Woodcraft; 800-225-1153). Instead of having spurs at the ends of the lips, they are located on their own margins. This allows the lips and the spurs to be ground separately, which makes sharpening easier. Performance is virtually identical to a regular spurred brad point.

I use plain brad points for all of my pinning, because they are easier to sharpen than spurred brad points, especially in the smaller sizes. Were I to work with medium-density fiberboard (MDF) and melamine, I would choose these simpler bits over the spurred bits because they cut just as well in this application, and I don't have to risk dulling and burning the spurs on my good bits. I also prefer plain brad points over spurred brad points when drilling end grain. Without the spurs, a brad point cuts more like a ripsaw, leaving very clean walls, even with an aggressive feed. In general, you can think of any bit with a spur or cutting rim to be a crosscutting bit (like a crosscut saw). Choose spurless bits for end grain.

A spurred brad point is the bit of choice for the bulk of the joinery in my chairs because the bit cuts a beautiful hole, even at an angle, and I can feed a little faster than with a twist drill or a plain

Moderate angles are no problem for a brad-point bit. *Angles like this can be handled by a brad point because the spurs and center point are engaged before the lips begin cutting. The Austrian double-margin brad point (shown here) has separate margins for its spurs and its lips.*

Photos, this page (left) and facing page (top): Michael Pekovich

Drill bits and the bites they take. *Eight bits displaying seven different strategies for cutting. The configuration at the tip of the bit determines the usable depth of the hole it makes.*

brad point. Also, the flutes clear the chips well enough that I can plunge to the bottom of a 1½-in.-deep hole in one pass without worrying about clogging.

Forstner and multispur bits

Most bits we use are centered as they cut by contacting the workpiece with the center of the bit. A Forstner bit is unique in that it uses a peripheral rim to keep the cut running true. The rim is so effective in guiding the bit that the center point is optional. For cutting through very thin stock or anywhere a perfectly flat-bottomed hole is critical, a Forstner is the bit of choice. The bit also has the ability to cut overlapping holes, which is handy in mortising and other situations where stock removal is most easily done on the drill press. (Center-guided bits, such as twist drills and brad points, because they need to engage wood at the center of the cut to run true, have trouble with overlapping holes.) A Forstner bit is also very good for drilling at severe angles and for angled partial holes, two more operations that are very difficult for a center-guided bit. All off-angle and overlapping holes cut with a Forstner bit should be drilled on the drill press.

Most of what a Forstner bit is good at requires that the rim be extremely sharp, especially at the leading edge. The rim serves the same function as the spurs on a brad point—it scores the fibers ahead of the cut. Because the rim is continuous and stays engaged in the cut, the bit won't drift laterally. The rim also keeps the bit from taking a heavy cut. This helps prevent tearout at the beginning of a cut, even when drilling into round stock or drilling angled holes, situations where the rim can't cut the entire periphery before the lips start lifting out chips.

The multispur, or sawtooth, bit is a variation on the Forstner. The multispur bit lacks the finesse and slick cut of a regular Forstner in some situations, like overlapping holes, but it cuts more aggressively. This is particularly helpful in larger holes. With larger-diameter Forstners, the rim is quite long and heat build-up gets to be a problem. The multispur design reduces friction and provides much faster entry into the wood. Most sets of Forstners come with solid rim bits up to 1 in. dia. and switch to the multispur design for the larger sizes.

All-terrain bits. *Steep angles, overlapping holes, very thin stock—none of these situations poses a problem for the Forstner bit, with its continuous rim guiding the bit. Unless the bit is backed out of deep holes every ⅛ in. or so, chips become impacted above it and can cause burning.*

For all of its advantages, the Forstner has some serious drawbacks. First, because of the design of the rim, the chip chute narrows at the opening, which makes chip ejection almost impossible in holes deeper than the height of the chute. For deeper holes the bit must be lifted nearly out of the hole every ⅛ in. or so to clear chips. Having a clogged bit going up and down is risky and affects the quality of the hole. Also, while a new Forstner tracks well, with any amount of wear the bit starts to drift slightly through the cut, especially on

end grain. This is probably the worst problem with Forstners, and it is compounded by the fact that the bits are a bear to sharpen.

Because of the way the rim works on both Forstners and multispurs, they are well-suited for cross-grain cutting and perform pretty poorly on end grain. A Forstner cuts well in plywood, but a multispur is a better choice for manufactured sheet goods like MDF and oriented-strand board (OSB). Both bits make an ugly exit if unsupported, so use a backer board.

There is a new type of multispur on the market, a German-made bit called Bormax. Its teeth are formed by grinding the outside of the rim in a pattern that looks like a serrated knife. This results in teeth with a profile like a typical multispur. But the grinding removes metal from the outside of the cutting rim, which is supposed to reduce friction and increase the aggressiveness of the cut. The Bormax bits I tried were aggressive to a fault. They cut quickly, but the holes were rougher than the holes from a regular Forstner. The sides of the holes had a sawn appearance, and after drilling two holes in a scrap of oak with one of the Bormax bits, the bit was too hot to touch. Still, because of the more aggressive cut, the Bormax doesn't require as much feed pressure, and for that reason I'd choose it over a regular Forstner for freehand drilling. And the cleaner machining in the chute of a Bormax does improve the chip clearance, which is an improvement over a regular Forstner. Although the Bormax concept seems sound, I'm not convinced that all of the bugs have been worked out.

Powerbore bits

For drilling accurate holes with a drill press, the three basic types of bits I have described pretty well cover the bases. But there are times when drilling freehand is the most efficient option. In chair making, installing arms on a rocker is a good example. For this job a Powerbore in a bit extension is hard to beat. The bit's long center point is well embedded in the wood before the spur begins to cut, ensuring that the bit does not wander as you start the hole, even on a rounded workpiece. The single lip and single spur allow easier entry into the wood than most bits, making it easy to start a hole with a light cut for a clean entry and pick up the pace once the lip is safely below the surface. The downside of the single-spur-and-lip arrangement is that with each revolution you pull only one helical chip out rather than two, as with most other bits. This means that you are either taking twice as long to get to the bottom of the hole or you are taking a coarser cut and leaving a rougher hole.

Handy for freehand drilling. *The author uses a Powerbore bit for freehand drilling in cross-grain on rounded parts. The long center point of the bit holds its place positively, and the single-spur-and-lip design permits the user to start slowly, speeding up only when the bit is fully engaged in the hole.*

While good work can be done with a Powerbore, these bits are not manufactured for precision. You definitely want to check your hole diameters carefully each time you chuck up a new bit or sharpen an old one. Fortunately, the simple design of this bit makes it a breeze to sharpen and tune. In fact, I always shorten the center point a little because it is too long for my chair work. This is a risky refinement, because the long point is needed to keep the bit centered. The asymmetrical cutting action of the single spur and lip make lateral drift a good possibility with a shortened point, so if you do shorten it, watch the shaft as you drill. If it starts to drift to one side through the cut, it is time to replace the bit.

Chip clearance is another weak point with a Powerbore. It is not quite as bad as with the Forstner, but holes deeper than the diameter of the bit require backing nearly out of the hole several times to clear the chips. The bit will continue to cut whether you do this or not, but the chips can get so impacted above the cutting action that getting the bit back out of the hole becomes a major opera-

Photos, this page (left and top) and facing page (left and top): Michael Pekovich

tion. Setting up to drill horizontally will help. Save this bit for what it excels at: freehand boring through cross-grain. Unfortunately, new Powerbores will be getting harder to find because Stanley has recently discontinued the bit style.

Auger bits

The auger bit has lost popularity over the years with other bit designs improving and fewer people drilling by hand. I used auger bits exclusively when I started out in chair making, but as I began to focus more on precision, I had less use for them. Antiquated though they may be, however, there are reasons to own them.

The lead screw pulls the bit into the work, requiring virtually no feed pressure. This is helpful when drilling with a bit brace because it allows the operator to focus more on sighting the angle and less on feed pressure. And because the feed rate is determined by a screw, the depth of the hole can be calculated by counting the rotations of the brace. For deep holes the auger is a good bit because it clears its chips well and the screw point prevents the bit from wandering almost absolutely.

Most augers you'll see in woodworking catalogs have a tapered square end for bit-brace use only. But several suppliers offer the bits with round shanks for handheld electric drills. And if necessary, the tapered ends can be cut off. An auger should never be used in a drill press because the lead screw will continue to pull the bit into the workpiece until drill rotation is stopped.

For chair makers who prefer the quiet pleasure of drilling with a bit brace, this is an efficient bit to get to know. And for folks in the timber-framing trade, the long, fluted sections of the bit are essential for the deep holes needed for trunnels. But the list of problems with the auger is long. None of the new bit-brace augers I have encountered were machined accurately, and most cut an oversized hole. They all require tuning up before they cut very well, and the quality of cut of even a well-tuned bit pales in comparison with all of the previously mentioned bits.

Drilling angled holes with this bit is something of a trick, too. Because the lead screw regulates feed rate, you can't take a light cut at the entry to the hole. Because the spur can't score the entire hole before the lips engage, you can get a pretty nasty tear at the opening. Starting the hole perpendicular to the work to score the hole first and then restarting at the desired angle can prevent this, but this operation is less than ideal.

Another downside of this bit is that on the larger sizes (⅝ in. and up) the lead screw is big enough to start a split in the wood. I've had such splits go unnoticed until a chair rung is driven into its hole. A most disappointing sight in an otherwise fine chair.

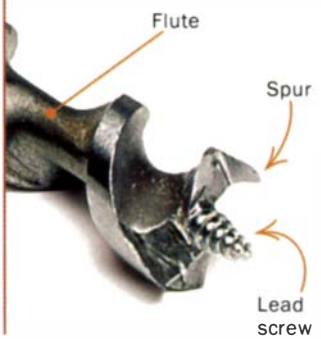
AUGER BITS

ADVANTAGES

- No power cord needed
- Good for hand-drilling moderately clean holes

LIMITATIONS

- Screw point can split wood
- Drilling angled holes is difficult
- Won't drill through thin stock



The auger's lead screw guides the cut. *With its threaded lead screw pulling the bit into the cut, the auger bit requires very little feed pressure. The user can concentrate instead on getting the angle of the hole right.*

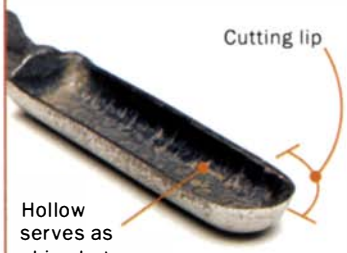
SPOON BITS

ADVANTAGES

- The link to yesteryear
- Fairly clean holes with an unusual bit

LIMITATIONS

- Centering the bit is an acquired skill
- Hole is somewhat oval



You can cut wood with a spoon? *A spoon bit makes fairly clean holes, but it takes a little time to master. The bit won't drill exactly where you start it, but you can learn the bit's eccentricities and even come to enjoy them.*

Spoon bits

The spoon bit is one of the oldest styles of bits still used and has recently seen a burst of popularity among Windsor chair makers. A surprising degree of dexterity is offered with this bit and even a certain degree of precision. A spoon bit is unlike any other in several ways. Probably the most important is that it requires far more skill to use. Not only does the bit need to be powered with a bit brace, but it also requires quite a lot of practice to get it to drill a hole exactly where you want. (Wharton Valley Chair Works makes excellent spoon bits; 607-965-8420.)

The spoon bit's cutting action is similar to that of a twist drill. But it lacks the symmetrical balance that helps hold a twist drill centered, so a spoon bit pulls itself off center at the beginning of the cut. This sounds awful, but it is quite predictable, and with practice you learn where and how to begin your cut so that the hole ends where you want it to. And because the feed rate is determined by pressure, you can take a light cut for a clean entry. Once the bit is in the hole, it follows itself. But more than with any other bit, the quality of the result depends on the skill of the user.

Because of the initial skill development required to use this bit well, and the fact that it has no advantages over the twist drill, I can't recommend it as a practical requirement in your drilling arsenal. But for those of us who enjoy the challenges of mastering traditional woodworking techniques for benefits we can't take to the bank, the spoon bit is definitely a kick. □

Brian Boggs builds chairs in Berea, Ky.

Federal-Style Oval Inlays

For efficiency and accuracy where it counts, take advantage of two marquetry methods: stack cutting and bevel cutting

BY STEVE LATTA

Woodworkers who specialize in 18th-century reproductions tend to be an obsessive bunch. Whether they're turners, carvers or upholsterers, they find a niche and focus—I mean *really* focus—on it. For me, it's inlay and marquetry. I could cut all day and every day and still not get enough.

Federal-style furniture originating from the Chesapeake Bay area is full of wonderful details. Late 18th-century Baltimore card tables are a particular favorite of mine. I love their graceful lines, rich bandings and intricate oval inlays.

Oval inlays tell a lot about a piece of furniture. Just as the styling of ball-and-claw feet suggests a city of origin, inlay patterns also provide clues to a piece's history. The leaf-and-thistle oval shown on the facing page is from a card table made in Baltimore in the early 1800s. Although I've seen this oval on some pieces from Charleston, S.C., only Baltimore cabinetmakers used the style of lower banding around the legs and aprons of this table. This oval appears on numerous tables from the region. I've also seen it adorning the top of a Baltimore sofa, too.

Most cabinetmakers in the 19th century did not make their own ovals. They were purchased from local "stringing" shops or imported from England. Rural shops, without access to manufactured inlays, made their own. These ovals were usually a little more crude in their styling and execution, but they lent their own personality to a piece as well.

The leaf-and-thistle oval pictured here was copied from a card table containing four ovals in all. One of the ovals was exceptional in design and execution while the other three were comparatively crude. In the context of the whole table, however, they look great. When making ovals, don't fret over every little gap, broken curve, irregularity and chip. Ovals are accents to a piece, not the primary focus.

Patterns may be hard to find, but veneers are readily available

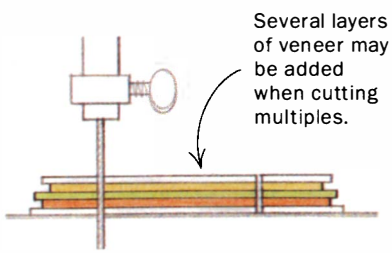
Finding accurate patterns of classic ovals can be difficult. One of my favorite source books for photos is *Southern Furniture: 1680 – 1830, Colonial Williamsburg Collection* by Ronald Hurst and Jonathan Prown (Colonial Williamsburg Foundation, 1998, second printing; ISBN 0-8109-4175-9). I also have a friend in the restoration business, and I check with him regularly to see whether something particularly stunning has come through his shop.

Holly and satinwood are the traditional veneers used in ovals, and they are readily

CUTTING METHODS

STACK CUTTING

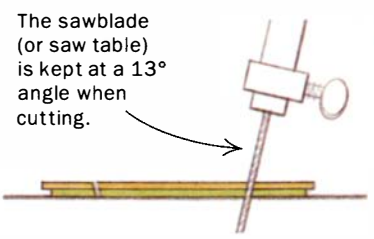
Layers of veneer are piled atop one another and sandwiched between two-ply veneer to prevent tearout.



Stack cutting results in a gap between elements the thickness of the sawblade.

BEVEL CUTTING

Only matching pairs of stacked parts can be cut at once.



There is virtually no gap with this method.

Drawings: Vince Babak

STEPS TO MAKING A BALTIMORE OVAL

Both stack cutting and bevel cutting are used to produce this leaf-and-thistle design.

STEP 1

Parts 1 to 5 are stack-cut to form the thistle and folded leaves along with the background.

Veneer sandwich. *Holly, satinwood and green-dyed holly are placed between two-ply veneer to prevent tearout.*

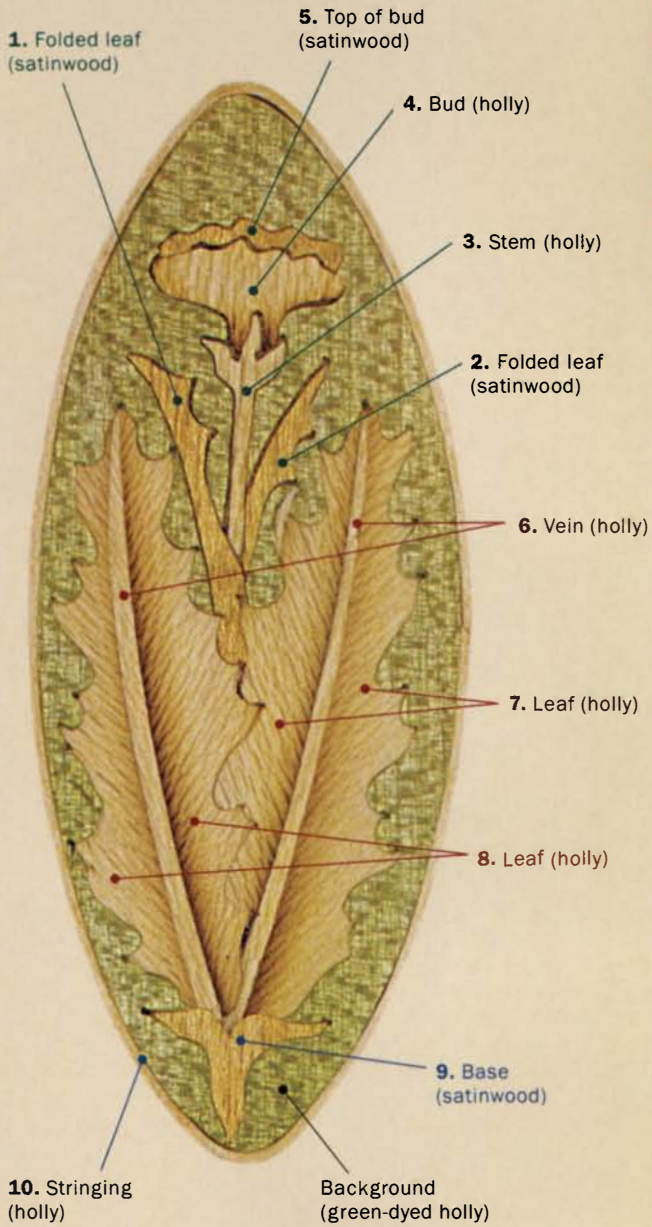
STEP 2

The leaves, parts 6 to 8, are bevel-cut. Each leaf is then bevel-cut into the background as a unit.

Look alive. *Leaves are oriented 45° to the veins for a more lifelike look, and sand-shading adds depth.*

STEP 3

The base (9) is bevel-cut into the background, the finished piece is cut into an oval, and the stringing (10) is applied.



SOURCES OF SUPPLY

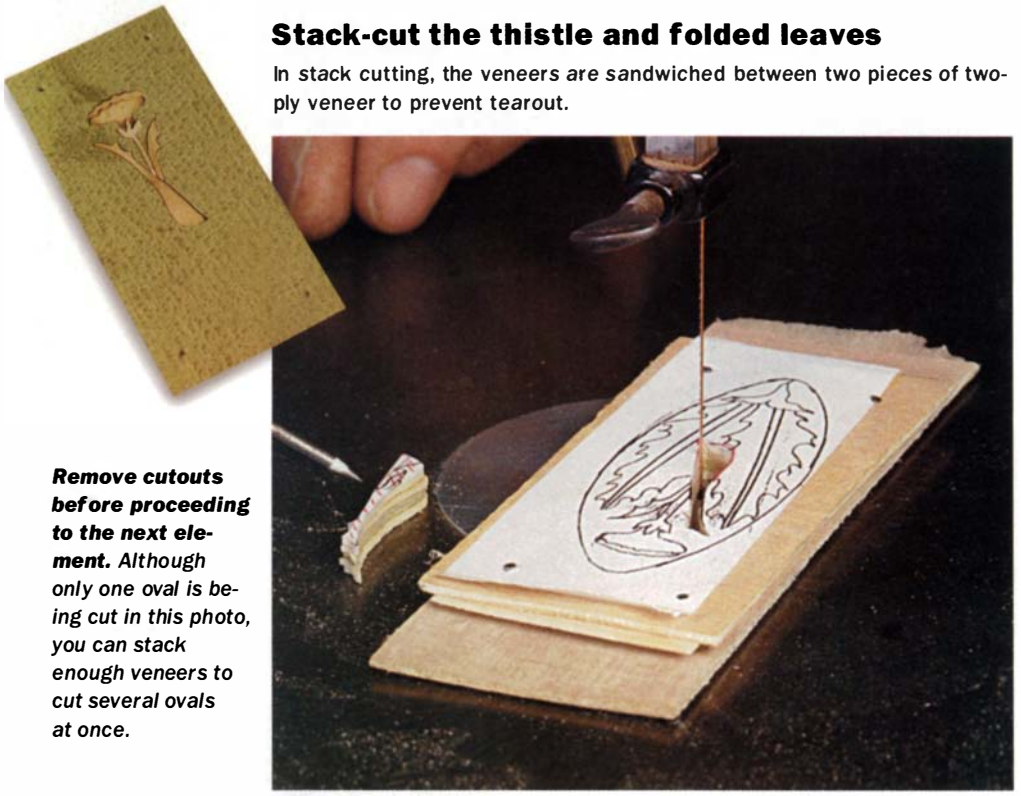
CONSTANTINE'S (800) 223-8087 Sells veneering and marquetry supplies.

DOVER INLAY (301) 223-8620 Source for marquetry, stringing and veneers. On-line catalog: www.doverinlay.com.

WOODCRAFT (800) 225-1153 Supplier of fretsaws and blades.

Stack-cut the thistle and folded leaves

In stack cutting, the veneers are sandwiched between two pieces of two-ply veneer to prevent tearout.



Remove cutouts before proceeding to the next element. *Although only one oval is being cut in this photo, you can stack enough veneers to cut several ovals at once.*

Using hide glue, tack the stack-cut parts onto white paper. *The gaps left by the blade's kerf will be filled later with dark wax, which creates a sharp, thin outline.*

Gluing and clamping. *After gluing a piece of onion-skin or tracing paper to the face of the partially completed oval, clamp it between blocks of wood. Veneers come in many thicknesses. To even out the pressure when clamping mixed stock, use strips of newspaper.*

available. For the background veneer I use dyed holly, which can be difficult to find. Some mail-order catalogs offer dyed and nondyed veneers (see Sources of Supply on p. 71). Burls, crotches and other figured woods make wonderful backgrounds as well, and they are readily available.

Two methods are used to cut this style of oval

Although cutting ovals is fun, it can be a little nerve-racking. You have to maintain a smooth, fluid motion. To establish that rhythm, trace some lines onto scrap stock using a small French curve, then make practice cuts using hand and power saws.

I use two classic marquetry techniques to make this style of oval: stack cutting and bevel cutting (see the drawings on p. 70). In stack cutting, all of the veneers used in the oval are layered one atop another. The upper parts of the oval—flower, stem and folded leaves—are stack-cut. For reasons of economy, most of the original 18th-century ovals were made this way. Layers could be piled upon each other, allowing the cutter to produce 10 to 15 ovals at a time. But this method produces a gap between elements the width of the sawblade.

Bevel cutting eliminates gaps. Parts fit together like a tapered plug going into a cone-shaped hole. Grain orientation is much easier to control when bevel cutting, and that makes for a more dynamic oval. In this oval, for example, the grain of the large leaves is oriented 45° to the straight-grained, skinny center stems. On the downside, however, bevel cutting doesn't lend itself to mass production. Ovals are made one at a time.

Stack cutting goes quickly but leaves gaps

Before beginning an inlay, select the veneer stock, sandwich it between a couple of layers of medium-density fiberboard (MDF) and preshrink it. I place the bundle behind the stove or radiator and let the heat shrink the wood for a few days. Moisture from the hide glue used in assembly will swell the wood back to its original size and reduce gaps between the cutouts. If you don't preshrink the veneers, they'll still swell from the glue but creep back later.

The stack that includes parts 1 to 5 (see the drawing on p. 71) as well as that portion of the background is made up of small rectangles, about 3 in. by 4 in. Place the green background on the bottom and the satinwood, which makes up many small, delicate pieces that are most likely to break, in the middle. The holly goes on top. To make multiple ovals, use a separate piece of veneer for each, keeping like species together. Sandwich the stack between two-ply veneer, which will prevent chipping during cutting. To make the two-ply, glue up pieces of veneer with the grain oriented at 90° to each other.

Next, glue a full-sized photocopy of the pattern to the top of the stack using a spray adhesive such as 3M's Spray Mount. Outside the borders of the oval, tack the stack together with small brads. Predrill the holes for the brads before nailing. Rigid foam or rigid cardboard make a good nailing backer block. Finally, snip off the points and file or grind the stubs smooth.

To cut the stack I use an old Delta scroll saw that I picked up at an auction for $85. It is a beautiful machine that doesn't vibrate. The cutting action is straight up and down. Many scroll saws operate with an orbital motion, which cuts quicker but not as smoothly. I use an electric foot switch, which allows me to keep both hands on the stock while cutting.

In stack cutting, the elements in the foreground are cut first (see the top photo at left). The opposite is true for bevel cuts.

Drill a small hole in the middle of the leafy section of the oval and thread a No. 2/0 Eberle or Olson blade through it. This hole will be cut away later when the large leaves are cut in. Cut out pieces 1 to 5 (see the drawing on p. 71). The hairiest parts to cut out are the little ones, such as the stem. If the blade binds and dribbles the stack like a basketball, there will be lots of broken pieces that aren't easily repaired. It's easy to get frustrated, so take your time, and don't worry if you stray a bit from the lines.

After pieces 1 to 5 have been cut, push the nails out of the stack with an awl and free up the background. Dry-fit the parts to the background. Then sand-shade the appropriate parts (for more on sand shading, see the story on p. 75). Place a drop of glue (I use hide glue for marquetry) on the back side of each piece and tack the assembly down to a sheet of white paper (see the middle photo on the facing page). Glue a layer of thinner paper, such as onion-skin or tracing paper, over the top or face side of the parts. Place several layers of newspaper over the onion-skin or tracing paper to even out the pressure, and clamp everything between two blocks of wood (see the bottom photo on the facing page). A sheet of waxed paper placed between the oval and the newspaper will keep things from sticking. At this point, the oval has a flower, a stem and a pair of folded leaves set into the green background.

The more difficult sections are bevel-cut

For the next phase, work from the back of the oval and cut all of the parts at a 13° angle (see the photos at right). When using a scroll saw, simply tilt the table at the proper angle. When using a fretsaw, support the work with a piece of scrap plywood with a bird's mouth (a slot and a hole) cutout. Bevel back both sides of the slot so that you can hold the saw at about 13°.

To mark the parts from the back side, copy the original drawing using tracing paper. Then flip this tracing over and transfer it to the stock using a piece of carbon paper and a sharpened dowel as a stylus. I use carbon paper with a white backing, which makes it easier to see the pattern.

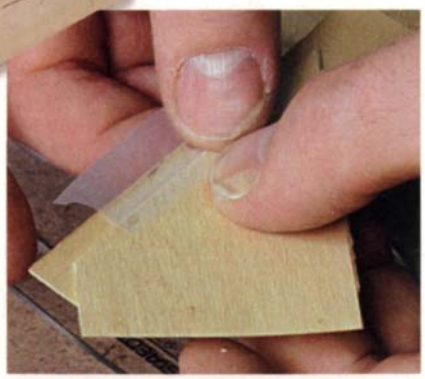
Veneer is also stacked in bevel cutting, but the stack consists only of mating pairs of individual components and a piece of backer material. Bevel cutting produces a good fit between parts because the angle of the blade results in the top piece being slightly bigger than the bottom one. When the parts are fitted together, they fall into place without a gap. I angle the bevel in such a way that when the oval is assembled, the inner parts are all wedged in place. That provides a mechanical fit to reinforce the glue bond.

The leaves are the hardest parts to cut because they have sharp, fragile points along the outer edge. Additionally, a vein runs up the middle of each leaf. Begin by cutting rough stock for the leaves. Orient the grain of the leaves 45° to their central vein to make the leaves more lifelike.

The veins and matching inner edges of the leaves are cut first. Take the left half of

Bevel-cut the large leaf elements

Bevel cutting is *more* time-consuming because only *matching pairs of* parts *are* cut simultaneously.



Using clear tape, attach a vein to one half of a leaf. *Tilt the scroll saw's table to about 13°. Cut the first half of the leaf's vein. Bevel cutting will produce a very snug joint between parts.*

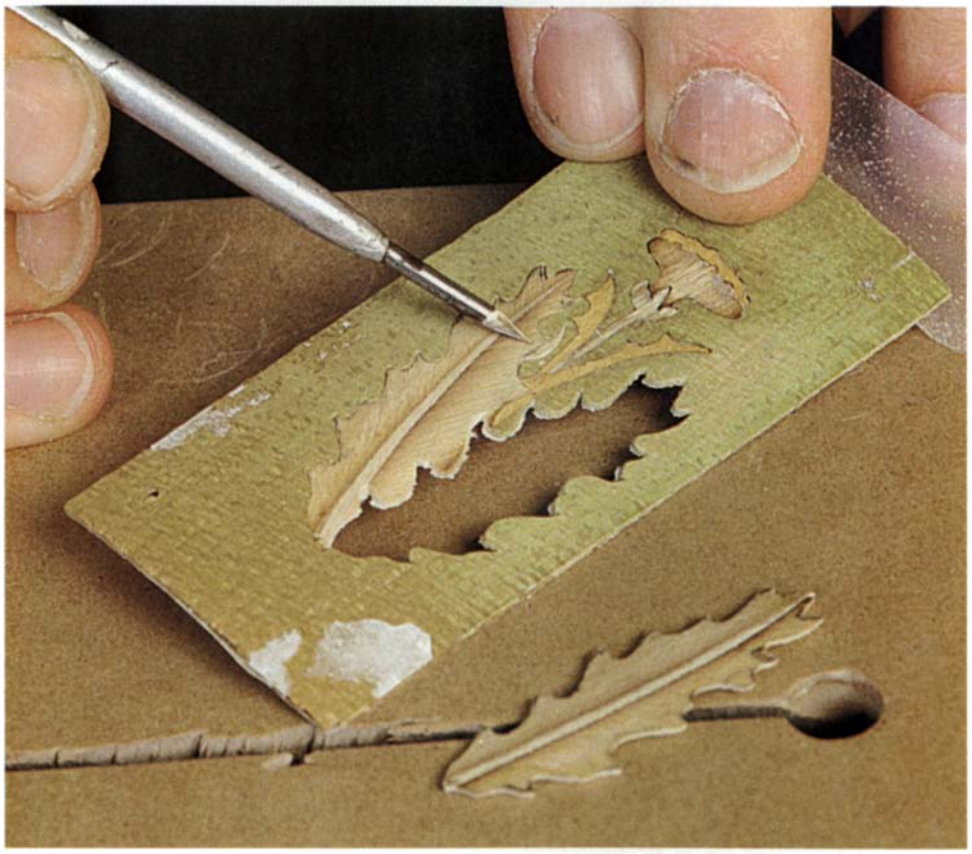
Tape the second leaf half over the vein. *Veneer tape is used on the face side (not shown) to join the first two pieces together. All cutting and temporary taping is done on the back side (shown). The pencil lines denote grain orientation.*

Photos: Anatole Burkin

Bevel-cut the leaves into the background

Make a tracing and flip it over. *Slip a leaf assembly into position. Using carbon paper, transfer the pattern of the leaves onto the veneer.*

Cut carefully. *Keep the fretsaw blade angled at about 13° and cut slowly and steadily, turning the stock as needed. Note the plywood support with a bird's-mouth cutout.*



Leaves fall into place. *Once the first leaf has been completed, place it in the background and secure it with veneer tape. Return to the pattern, align the second leaf and repeat the steps.*

a leaf and place it atop a straight-grained piece for the center vein. Be sure to leave enough overlap (about ½ in.) on the other side for the other half of the vein. Tape the two pieces using ordinary clear tape. Flip the tracing of the pattern to reveal the back side, then lay it on top of the veneer into proper position so that the vein pattern is centered over the matching piece of veneer. Slip a piece of carbon paper between the tracing and veneer and transfer the line marking the left half of the vein. Cut one side of the vein. Remember to place a piece of scrap veneer between the stock and saw table to reduce tearout.

When done, remove the waste that's taped to one half of the leaf. The leaf and vein should mate snugly. Sand-shade the inner portion of the leaf, then attach it to the vein using veneer tape. Repeat the process for the other leaf half and vein. All veined leaves are done in this manner.

Next, cut out the leaves (see the photos at left). First, peel and scrape the paper backer tacked onto the back of the oval. Align the tracing, being sure to work from the back side, over the partially completed oval. Then insert a leaf section and align it. Remember, in bevel cutting, the background elements are cut first. Hold the leaf in place with clear tape. Using carbon paper, trace the outline of the leaf. If necessary, touch up the lines with a pencil.

Now comes the hard part. The thistle leaves have lots of little points, which tend to break off when power sawing. At this point I switch to a fretsaw with a 12-in. throat and a No. 2/0 blade. Because sharp turns are needed when cutting points, I grind the teeth off the bottom inch of the blade using a Dremel tool. I grind the blade nearly round so that I can easily pivot the stock about the axis of the blade without catching a tooth.

Drill a small hole at the leaf's base, thread the blade and, using the wooden support with the bird's mouth, cut in the leaf. Keep the blade tilted at about 13°. Align the saw so that the top is at 1 o'clock and the bulk of the leaf is to the left, and cut counterclockwise. Swivel the leaf—not the saw—to maintain a continuous bevel around the perimeter. The direction of feed is critical. Go the other direction, and you end up with big gaps between parts.

When cutting the first leaf, cut a big arc around the region where the two leaves overlap, and leave material behind. Never cut a section twice; the result will be unsightly gaps. After the first leaf has been completed, tape it into place on the oval with veneer tape. Go back to the pattern, align the second leaf and repeat the previous steps. Lastly, cut out the base (part 9).

A slightly different way of mounting the oval

At this point the oval is still a rectangle. Traditionally, the next step would be to border the design with an oval made from stringing, then inlay the finished piece and, finally, remove the paper to see the result. I prefer to see the face side of an oval before committing it to a piece of furniture. So I glue my assembly to a piece of scrap veneer first, then scrape off the paper face

Size and band the oval

Mark the oval using a Plexiglas template. *After cutting the oval, file the edges fair.*

Bend the stringing using a soldering iron set on low. *A feeler gauge helps nudge the stringing into shape. The author modified his soldering iron's tip by adding different-diameter brass tubes slid inside each other.*

Wrap the oval with the holly. *Cut the miter joint using a chisel held vertically. After applying glue, hold the stringing in place with tape.*

and examine it. Barring complications, the oval is ready to size and border.

Trace an outline onto the assembly. For this I made a Plexiglas oval template (see the left photo above). I cut it out using a scroll saw, then filed the edges fair.

Slice a piece of stringing from a sheet of holly veneer. To help prevent the holly from breaking while bending it into shape, use a thin feeler gauge and a soldering iron with a heat regulator. Place the stringing on the tip of the iron (don't use too much heat or it will scorch) and wrap the feeler gauge around the wood to hold the bend (see the middle photo above). When the tight curves are set, wrap the oval and join the ends in a miter, made with a chisel (see the right photo above). Apply glue to the edge of the oval, wrap the stringing around it and clamp it with clear tape.

If you've made it this far, setting the oval into solid stock will seem like child's play. Place the oval in the correct position and mark its location with a sharp knife. Use a router to remove the bulk of the waste, then finish up using gouges and chisels.

Finishing involves some detail work

Finishing inlaid pieces can be a bit tricky. I have had some nice work ruined by finishers who improperly prepared the work. It tears my heart out when that happens. Although different pieces may require slightly different procedures, here's one that works well. Give the entire piece a washcoat with a 1-lb. cut of shellac. Then, using a 2½-lb. cut, paint the ovals and the lower stringings. With a small brush, lightly stain the leg, avoiding the ovals, banding and stringing. Once a rhythm is established, it goes fairly quickly. Follow up with a couple of coats of orange shellac topped off with a dark wax. The dark wax fills gaps in the oval and, like a fine-point pen, highlights the borders between elements. □

Steve Latta is an instructor at the Thaddeus Stevens College of Technology in Lancaster, Pa.

Very fine sand makes the best shading medium

I discovered the world-renowned, fine, white-sand beaches of Siesta Key, Fla., when I visited my parents there several years ago. The sand is very different from what you find on most beaches. Siesta Key sand is as fine as granulated sugar, the best kind for sand-shading veneer. Before leaving the Keys I filled two plastic bags with the fine white powder, loaded them in my suitcase and prayed I wouldn't have to explain myself to airport security.

The sand passed through without questions, and I have enough to last many years. If you can't justify a trip to Florida for this mission, check out feed and grain stores, flower shops or pet shops for fine sand. Avoid large, coarse sand, which will make it difficult to sand-shade small parts without burning.

Controlled heat. *Heat the sand in an iron skillet atop a hot plate. Spread the sand in uneven piles across the skillet.*

Sand shading takes a little practice. I use an electric hot plate and a cast-iron skillet, which provide controlled, even heat. Spread the sand in uneven piles across the skillet, as shown in the left photo below. The shallow piles will scorch veneer quicker than the taller ones. Mold the sand into the shape of the part to be shaded (see the right photo below). Shade smaller pieces by dipping them in a spoonful of hot sand. If a small part falls into the spoon, you will be able to retrieve it without burning yourself and the part. I've burned many a piece into oblivion after losing it in a deep pile of sand.

Mound, then dip. *Mold the sand into the shape of the piece. Dip the part for a few seconds at a time, checking it frequently.*

After scorching, sand the area lightly with 220-grit paper. This will provide a more accurate picture of what the burn will look like after finishing.

Arched Top

Make arched raised-panel doors

BY BILL EWING

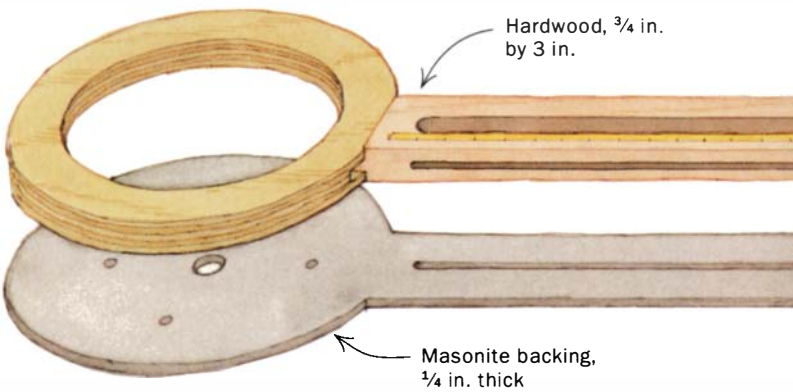
In woodworking, as in architecture, arches can be both decorative and functional. Positioned below the main structure, an arch adds strength without the visual weight of heftier underpinnings. Placed higher up, such as in the upper rail of a bookcase, an arch lends a bit of elegance. Adding an arch to the upper rail of a cabinet door is also an easy way to refine the sometimes boxy look of frame-and-panel construction.

I wanted to find a quick way to cut arched doors so that I could offer this design option to my clients. After a little planning and experimentation, and in one quick afternoon, I was able to make an adjustable jig that allows me to cut arched raised-panel doors of almost any size. The few hours spent building the jig proved worth the time; over the last four years I've used it to make countless doors for the kitchen cabinets that are the mainstay of my business.

The only way to get uniformly fair arches is to work from two accurate templates—one for the rail and one for the panel. Each door width also requires a different set of templates. Using the two-piece jig shown here, I can quickly and efficiently cut a set of panel and rail templates to fit a wide range of cabinet-door sizes. By using these templates in conjunction with rail- and stile-cutting bits, you can cut the door parts for a whole set of kitchen cabinets in a day.

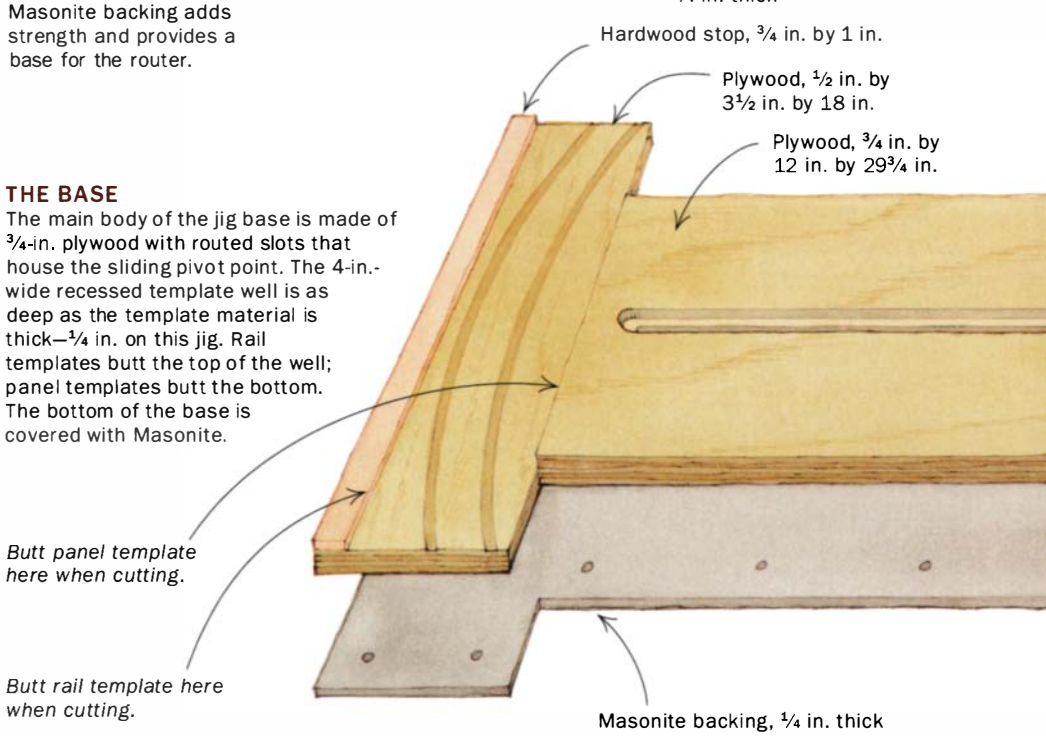
THE RADIUS ARM

The radius arm consists of a piece of hardwood, a wooden circle and a piece of Masonite. Slots in the arm, which accept the adjustable pivot point, are cut on a router table. A tenon at the end of the arm fits into a mortise in the wooden circle. Stick-on measuring tape measures the distance between the pivot point and the router bit. The Masonite backing adds strength and provides a base for the router.



THE BASE

The main body of the jig base is made of ¾-in. plywood with routed slots that house the sliding pivot point. The 4-in.-wide recessed template well is as deep as the template material is thick—¼ in. on this jig. Rail templates butt the top of the well; panel templates butt the bottom. The bottom of the base is covered with Masonite.



The key to this jig is that it can be adjusted in two different ways. The radius arm of the jig (the top piece in the drawing above) allows you to make arcs of different radii. The sliding pivot point in the base (the bottom piece) allows you to move the center point of the arc's radius to accommodate varying widths of door rails. Another great thing about this jig is that it can be adjusted while the router is in place. To cut out the panel and rail templates, I always use a plunge router with a ¼-in. straight bit.

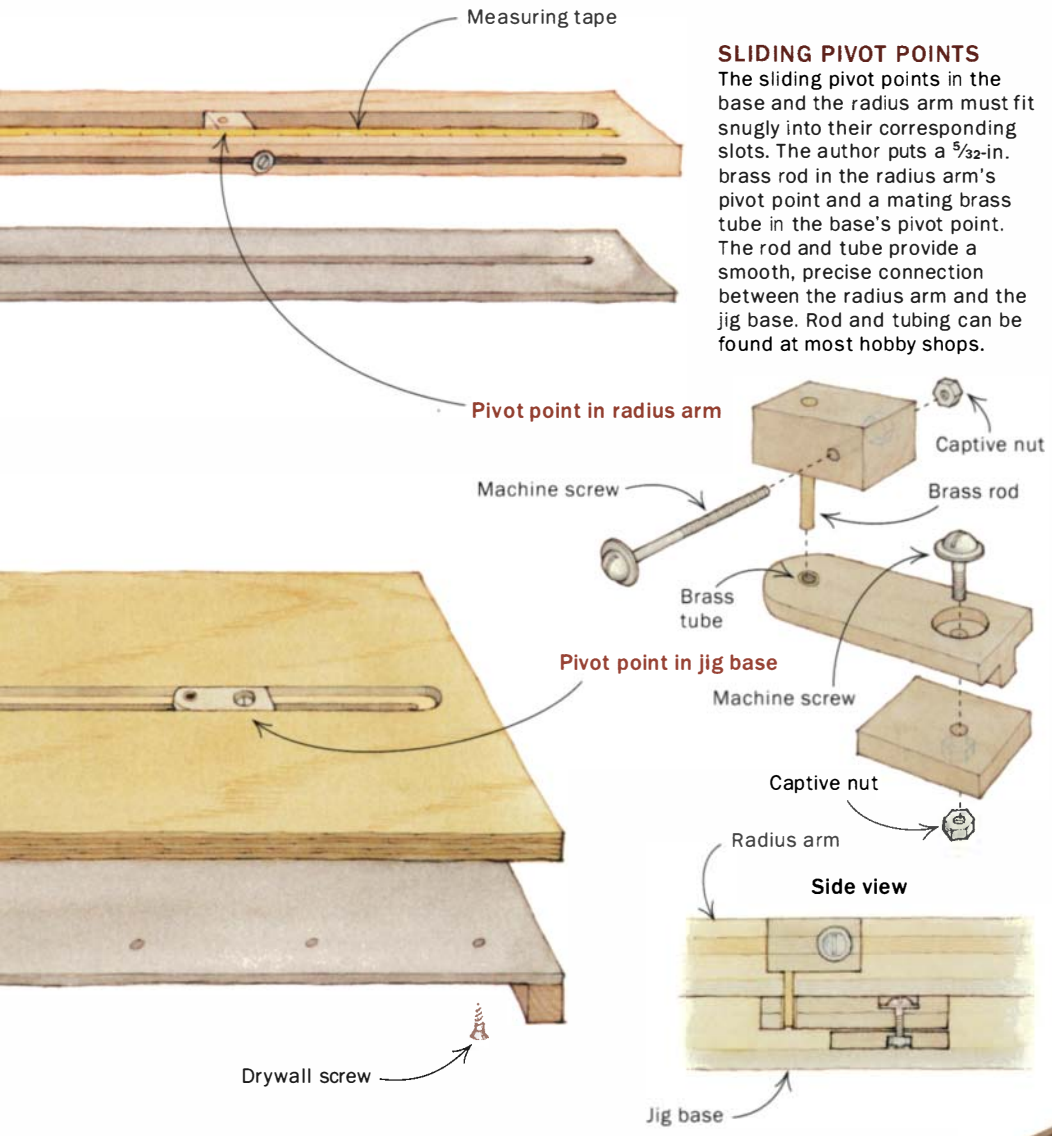
A 1-in. arch looks best on cabinet doors

Before making panel and rail templates, you have to establish a few design parameters: the depth of the arch and the width of the rail. After some experimentation, I've found that a 1-in. arch looks best on most

Drawings: Jim Richey

Cabinet Doors

of any size with an adjustable jig and a router



SLIDING PIVOT POINTS
The sliding pivot points in the base and the radius arm must fit snugly into their corresponding slots. The author puts a 5/32-in. brass rod in the radius arm's pivot point and a mating brass tube in the base's pivot point. The rod and tube provide a smooth, precise connection between the radius arm and the jig base. Rod and tubing can be found at most hobby shops.

JIGS CUT TEMPLATES THAT HELP BUILD DOORS

To build arched raised-panel doors, you must have two templates—one for the panel and one for the rail. The author's jig adjusts so that you can cut a matching set of templates. The templates are used to cut fair and complementary curves on a door's panel and rail.

cabinet doors. An arch of less than 1 in. leaves the rail too meaty and the arch too subtle. Making an arch with a depth of more than 1 in. cuts down on rail width so much that it appears weakened.

For both aesthetics and uniformity, I always use 2⅜ in. for my rail and stile widths. I maintain this 2⅜-in. dimension at the midpoint of the arc and increase this measurement by 1 in. at each end of the rail. These measurements remain constant regardless of the rail length.

Templates are easy to make

Once the jig is up and running, you're ready to make templates. While it's possible to determine the measurements by trial and error each time you set out to make a template, I refer to a graph (see p. 78) that

Photos: Matthew Teague

ROUTING THE TEMPLATES

Making the rail template. *With brads securing the template blank in place, a router outfitted with a ¼-in. straight bit cuts a smooth arch in the rail template.*

A slight adjustment. *To cut the panel template, increase the radius on the jig's arm ½ in. to allow for the bit diameter and the panel tongue.*

A matching pair. *Once the radius has been adjusted, tack a Masonite blank onto the jig's well. Cut the panel template with the router in a single pass.*

Finding the perfect curve

When you have to handle different-sized arches in a single piece of furniture or in a set of cabinets, it's imperative that the height of the arches be uniform. Even small irregularities in the arches can be seen at a glance.

It's possible to use trial and error to determine the measurements each time you make a template of different rail lengths, but I plotted points on a graph (right) that allow me to see quickly what the radius of the arc needs to be. These measurements will give you a height of 1 in., a suitable arch for most cabinets.

RADII FOR COMMON RAIL LENGTHS

Rail length	Radius
6 in.	5 in.
7 in.	6.625 in.
8 in.	8.5 in.
9 in.	10.625 in.
10 in.	13 in.
11 in.	15.625 in.
12 in.	18.5 in.
13 in.	21.625 in.
14 in.	25 in.
15 in.	28.625 in.
16 in.	32.5 in.

FORMULA FOR SUCCESS

I once had to build doors that required an arch with a radius longer than my jig could handle. I found the radius through trial and error—not my favorite method. Since then, I've avoided the trial of all of these errors using a simple algebra formula my son-in-law (an engineer) derived:

$R^2 = (R-X)^2 + L/2)^2$,
Where R = arc radius,
L = cord (the distance between the ends of the arc),
X = height at the midpoint of the arc.

Don't panic—the formula reduces to a more manageable size when you substitute the height of the door arch (in this case, 1 in.) for *X*. It becomes:

$R = ½ + L^2/8$.

For example, if your rail length is 8 in.:

$R = ½ + 8^2/8$,
$R = ½ + 64/8$,
$R = 8½$ in.

For arch heights other than 1 in., such as in the top face frame of a display cabinet, just substitute the desired height for *X*. I've crunched the numbers for 2-in., 3-in. and 4-in. heights.

2 in.: $R = 1 + L^2/16$;
3 in.: $R = 9/6 = L^2/24$;
4 in.: $R = 2 + L^2/32$.

tells the radius and pivot-point measurements needed to cut templates for various rail lengths. If I need to cut an arch with a depth of other than 1 in., I use the simple formula shown on the facing page to gauge the radius.

To make a rail template, first install a ¼-in. Masonite template blank—3½ in. wide and 2 in. longer than the rail length—against the hardwood stop in the recessed well on the jig's base. Set the brass rod in the radius-arm pivot point into the brass tube in the base's pivot point. The pivot point on the radius arm slides and is secured with a machine screw on the side of the arm. Loosen the screw, and move the pivot point to the correct rail length, then retighten it. Then loosen the adjustment screw on the pivot point in the base and retighten it slightly shy of its final position. Measure the distance between the ends of the arc and keep adjusting the pivot point on the jig's base until this end-to-end measurement equals the desired rail length. Now you're ready to rout the arch (see the left photo on the facing page).

Once the rail template has been cut, move on to the panel template. The arc for the panel template will have to be slightly larger than that of the rail template. As you move from making the rail template to making the panel template, you must increase the length of the radius to accommodate the bit diameter because the router is cutting on the opposite side of the bit. You also have to lengthen the radius arm to create a tongue on the panel.

Lengthen the radius arm by ½ in. to compensate for the ¼-in. bit diameter and ¼-in. panel tongue (see the middle photo on the facing page). Start with a template blank that is 3 in. wide and the same length as the rail template. Butt it against the rear stop and attach it with brads. Once the pivot point has been adjusted, simply rout the arc (see the right photo on the facing page). After cutting the templates, you can start building doors.

Build doors oversized and trim them to fit

Somewhere, perhaps in a parallel universe, frame-and-panel doors always glue up square, and the stile ends are always even with the rails. But in my shop, reality reigns. To correct minor imperfections in assembly, I build my doors ¼ in. long—adding ⅛ in. to the width of both the top and bottom rails—and trim them to size with a crosscut sled on my tablesaw.

Using the tablesaw, cut stock for the upper and lower rail 3½ in. and 2½ in. wide, respectively, and leave them ½ in. longer than the finished length. Because each stile is 2⅜ in. wide and you lose ⅜ in. of each edge when you cut the inner edge profile, the rail length is 4 in. less than the overall door width. Cut the stiles 2⅜ in. wide and ¼ in. longer than the finished door height.

Rail-cutting sequence is key

It is important to follow a particular sequence when shaping the rails and stiles, because you could end up trying to shape the upper rail ends without a straight edge to rest against the router table's miter gauge, or you could encounter serious chipout problems when the stile-cutting bit exits the arch in the upper rail.

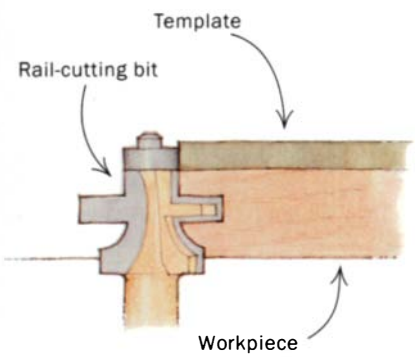
Place the rail template on the back of the upper rail and align the end of the arch with the left (when viewed from the front) end of the rail and draw the arc. With a rail-cutting bit in your router table, shape the left end of the upper rail and the right end of the bottom rail.

Remove the waste material on a bandsaw (see the top photo above), tack the template into position and shape the rail's arch on the router table using the stile-cutting bit with a pilot bearing on top. This is a small piece to cut on a router table, so use a hold-down jig (see the bottom photo above). While the bit is still in place, go ahead and shape the inside edges of the stiles and lower rail, as well as a scrap piece of the same stock to be used in dry-fitting the panel. Finally, cut the upper rail and lower rail to length on a tablesaw or miter box. The only thing left is to replace

SHAPING THE RAIL

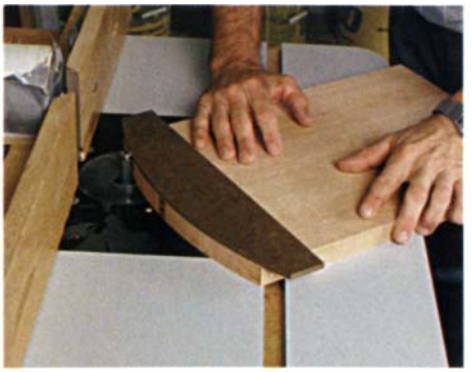
Roughing out the rail. *Shape one end of the rail on the router table, then cut away the excess material on the bandsaw.*

Cut the profile and curve in one pass. *With the template tacked into place, use a rail-cutting bit to shape the profile and fair the edge.*

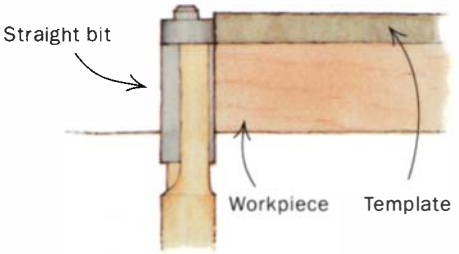


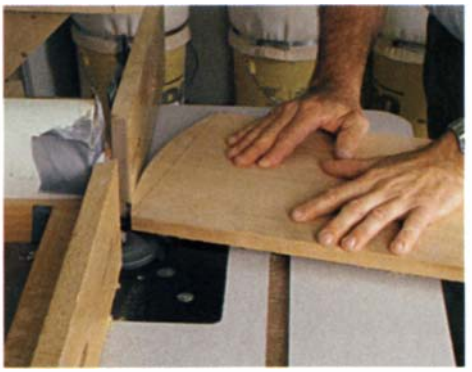
SHAPING THE PANEL

Cut the panel to rough shape. *Trace the arc from the template onto the panel and trim the waste material away on the bandsaw.*

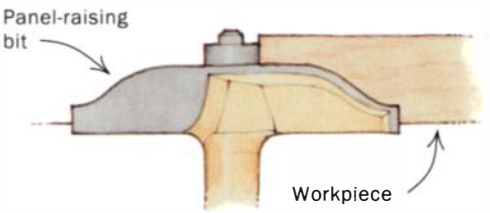


Trim the panel flush. *Tack the template in place and trim the panel flush on the router table using a straight bit with a pilot bearing.*





Raise the panel. *When turning a flat panel into a raised one, you can make a safer cut by using both the fence and the pilot bearing.*



the stile-cutting bit with the rail-cutting bit and shape the remaining rail ends.

A dry run avoids headaches

Dry-fitting the frame allows you to take exact measurements for the panel. Be sure to allow for a ¼-in. tongue on all four edges. Rip the panel to exact width so that the arch of the panel will match up with that of the rail. Leave the length of the panel about 1 in. long so that the arch doesn't have to be cut to the very edge of the panel.

Using a framing square, draw a line across the back of the panel, approximately 1½ in. from the top. Use the square to align the arch of the panel template with the line you've just drawn, making sure that it meets each edge of the panel, and draw the arc. Rough-cut the panel's arch on the bandsaw (see the left photo above) and tack the template back into place. To ensure a nice, smooth edge, clean up the cut with a bearing-driven straight bit on your router table, and trim the panel to finished length (see the middle photo above).

Now you can shape the panel using a panel-raising bit with a top-mounted pilot bearing. Use the fence in the normal fashion for the straight edges. As you shape the curved edge, register the panel against both the fence and the pilot bearing (see the right photo above). This is safe, provided the panel is large enough to grip firmly and you don't try to hog off too much material in a single pass. Use a scrap piece of stile stock to check that you raise the panel to the correct depth.

All that remains is to cut the back rabbet in the panel so that it fits the groove in the rails and stiles. Once everything falls into place, some glue and a couple of clamps bring everything together. Measure the door's exact length off the cabinet and trim the door to length. When you hang the door, the elegant arch serves as a subtle reminder that it was designed with care. □

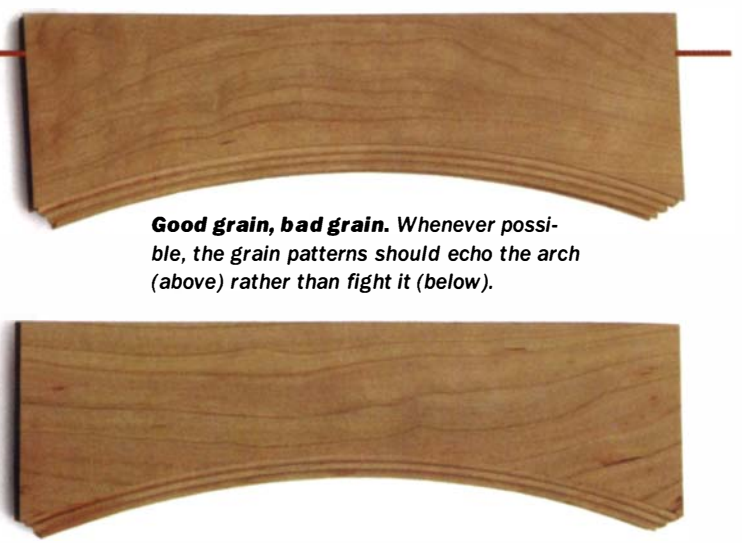
Bill Ewing is a cabinetmaker in Girard, Ohio.

Arched grain for arched doors

When you build custom arched doors, you have the opportunity to use grain that accentuates the design. My general guidelines are simple—straight grain for the frames and more striking grain patterns for the panels.

For the upper rail of an arched door, look for grain with a slight curve that follows the curve of the arch. Don't expect a perfect match, but any slight curve in the grain will help.

Laying out the grain pattern for a door panel is more complex. In general, look for a grain pattern that arches upward so that it draws your eye to the arch in the door. This grain pattern is common in most flatsawn lumber.



Good grain, bad grain. *Whenever possible, the grain patterns should echo the arch (above) rather than fight it (below).*

Stripping Finishes the Right Way

Choose the chemical best suited for the finish you want to remove

BY JEFF JEWITT

Stripping furniture is not one of the more pleasant tasks in finishing. But the lure of finding spectacular wood buried under layers of finish remains strong, so some folks jump right into it, only to find more work than they imagined. As a result, the project often gets postponed or taken to a pro to finish the job. I'm not going to tell you that stripping a finish is fun or easy, but the process can be made bearable and efficient. To strip furniture effectively, after you determine the type of finish that you have to take off, it helps to know which stripper will work best for the finish you want to remove.

Evaluate the finish

A simple series of tests with solvents will help you identify a clear finish by a process of elimination. Keep in mind that furniture that was painted was also often topcoated with shellac or varnish. Start by placing a small puddle of denatured alcohol on a horizontal surface and wait a couple of minutes. Then dab a piece of facial tissue into the puddle (see the top photo on p. 82). If the tissue sticks, the finish is shellac (which can be removed

The tissue test. *You can easily identify an unknown clear finish by dabbing it with different solvents and testing each patch with a piece of tissue to see if it sticks.*

easily with almost any stripper). If the tissue doesn't stick, repeat the same test using lacquer thinner. If the tissue sticks, the finish is probably nitrocellulose lacquer. If neither alcohol nor lacquer thinner softens the finish enough for the tissue to stick to it, chances are the finish is a varnish.

Match the stripper to the job at hand

The strippers available on the retail market can be divided into five categories, based on the chemicals they contain. Manufacturers must list chemical components that are hazardous, so consumers can know exactly what they are buying. As a general rule, the level of hazard to you is an indicator of how efficient the stripper is, meaning how quickly it will work to remove a finish. And if you have to strip the finish from vertical surfaces, a paste or gel will stay put longer than a runny liquid will.

Methylene chloride—Methylene chloride (see the photo at right) has been the main ingredient in strippers for decades. It is the fastest and most efficient stripper at removing all types of finishes. Two big advantages are that methylene chloride is nonflammable and works from the bottom up, meaning that it penetrates and swells the finish until it breaks free at the surface of the wood and comes off easily (see the bottom photo on p. 85). However, there is a downside: Methylene chloride is a suspected carcinogen, and it evaporates very quickly, causing a rapid buildup of the vapors that affect the body's supply of oxygen. For that reason, people with heart problems are especially sensitive to such exposures and should not use methylene-chloride strippers.

A typical methylene-chloride stripper contains about 75% methylene chloride. The rest of the solution contains methyl alcohol to help the methylene chloride penetrate faster; detergents to wet the surface of the finish; and paraffin wax dissolved in toluene to prevent the other solvents from evaporating too quickly. Other than masks that supply air from an outside source, no standard respirators are rated to handle methylene-chloride fumes. So the best place to use the stripper is outdoors or in a well-ventilated area.

Methylene chloride

Methanol, acetone, toluene (MAT)—These strippers are often sold as "refinishers" and are effective only on lacquer and shellac finishes. MAT strippers (see the top photo on p. 84) work from the top down by dissolving the finish layer by layer, and they work best when used with steel wool. MAT strippers will not work very well on paint, and they have hardly any effect on varnishes. Because they evaporate quickly, you must keep the surface saturated, or the stripper will evaporate, and the finish will reharden on the wood. Sometimes MAT strippers contain a small amount of methylene chloride to give them some added kick. The downside of these strippers is that they are extremely flammable, so you must use them in a well-ventilated area and take the appropriate precautions. A standard cartridge-style respirator will properly filter the vapors, except for strippers containing any methylene chloride.

N-methyl pyrrolidone (NMP)—This relative newcomer (see the top left photo on p. 85) provides a safer alternative to strippers containing methylene chloride. NMP is toxic, but the vapors don't build up as much as methylene chloride because the solution evaporates more slowly. This makes the stripper safer and keeps the sur-

Photos: William Duckworth

Head to head, the results varied

I put four different kinds of chemical strippers to the test on an old, painted piano bench. Using the tissue test, I found the top finish to be lacquer, but the tests for the paint underneath were inconclusive, so I assumed it to be an oil-based paint.

On one half of the benchtop, I applied two of the old standbys—a standard, methylene-chloride stripper (Klean-Strip KS-3 Premium Stripper) and a liquid methanol, acetone, toluene (MAT) stripper (Minwax Furniture Refinisher). On the other half, I applied an n-methyl pyrrolidone (NMP) stripper (Peel Away 7) and a dibasic ester (DBE) stripper (3M's Safest Stripper). All of the strippers were applied according to the instructions on the cans. At four different intervals—after 30 minutes, one hour, three hours and six hours—I checked how well each stripper removed the finish.

- The methylene-chloride stripper was the fastest acting of the bunch. It blistered the finish almost immediately and got most of the finish off before any of the other solutions did, but it was ineffective at removing all of the paint from the open pores of the wood the first time around. I had to apply another layer and scrub the surface aggressively with a brass-bristled brush. Even after a good scrubbing, some paint was still visible in the pores.
- The MAT stripper removed the top layer of lacquer soon after application but only by scrubbing the surface vigorously with coarse steel wool. After that, the stripper removed only some of the paint with very hard scrubbing. After about an hour, the finish rehardened.
- The NMP stripper worked the best, but it took six hours. When I removed the paper covering (which is supplied with the stripper), the paint was completely liquefied, and it came out of the pores easily with a light scrub using a brass-bristled brush. At $65 per gallon, this was the most expensive of the strippers I tested. But if your time is worth money, the labor savings may well justify using it.
- The DBE stripper removed the top layer of lacquer in 30 minutes, but after six hours it still hadn't even softened the paint. To be fair, I should point out that the manufacturer suggests allowing 10 to 12 hours for multilayered finishes.

Before and after. *The author tested four categories and brands of commonly available strippers. He checked and compared the results after 30 minutes, one hour, three hours and six hours.*

Methanol, acetone, toluene (MAT)

face wet—and active—longer. NMP is expensive to manufacture, so makers often add other chemicals, such as d-limonene (billed on the label as a "citrus scent"), butyrolactone and dibasic esters (discussed next). NMP strippers work on oil-based and latex paints, polyurethane, shellac and varnishes, and they're sometimes double or triple the cost of other strippers.

Dibasic esters (DBE)—The name may sound intimidating, but DBE is a generic name for some of the same chemicals often found in hand cleaners (dimethyl adipate, dimethyl glutarate and dimethyl succinate are the most common ones). DBE strippers (see the middle photo on the facing page) work very slowly—slower than all of the other kinds of strippers—but they will remove just about any finish if given enough soaking time.

The only stripper I know of in which the main active ingredient is DBE is 3M's Safest Stripper. This stripper also contains water, so the manufacturer warns not to leave it on veneered surfaces for too long.

Lye (sodium hydroxide)—Lye (see the right photo on the facing page) will effectively remove multiple layers of oil and casein (milk) paint. It's the main ingredient used in the large dip tanks of commercial refinishing shops. Unfortunately, lye will discolor any tannin-rich wood (such as oak), and it will swell the fibers, resulting in a stringy surface if it's left on too long. It's

Tips for better stripping results

The most common problem with strippers emerges when you buy one that doesn't work with the finish you're

DO ALL OF YOUR REPAIR WORK BEFORE STRIPPING

This includes regluing joints, replacing broken pieces of wood and regluing veneer. Methylene-chloride strippers contain wax, which can make regluing after stripping difficult. Also, the slowly evaporating solvents in dibasic ester (DBE) and n-methyl pyrrolidone (NMP) strippers may prevent glue from curing.

CARVINGS AND TURNINGS HAVE TIGHT SPOTS

Gather together a bucket of planer shavings. Smear these shavings onto a wet coat of stripper to help remove a finish from the recessed nooks and crannies in irregularly shaped surfaces (see the photo at right). Use a dental pick or a sharpened piece of wood to get into tight spaces (see the photo at far right). A piece of twine will work on turned details.

N-methyl pyrrolidone (NMP)

Dibasic ester (DBE)

Lye (sodium hydroxide)

cheap, and it's a good stripper to use on architectural millwork that will be repainted. Sodium and ammonium hydroxide (lye and ammonia) are sometimes added to methylene-chloride strippers to make them more effective on paint. The discoloration caused by the reaction with tannins can be difficult to remove, so I would never recommend these strippers—except as a last resort—on wood that will get a clear finish. And with lye in particular, you encounter a number of safety concerns.

Treat these chemicals with respect

All strippers should be treated as hazardous, but some are more dangerous than others. Regarding the buildup of fumes, you can safely use NMP, DBE and lye-based strippers indoors, but methylene-chloride and MAT strippers should be applied only outdoors or in a well-ventilated room. Goggles and gloves are a must with any stripper. Any chemical-resistant glove is suitable for use with strippers except methylene chloride. There are only a few kinds of gloves that will provide protection against a methylene-chloride stripper for more than 30 minutes, so it's best to avoid direct contact with it, and use a putty knife to scrape off the finish. Also, a good vapor respirator will work with any stripper except methylene chloride. As I mentioned before, MAT strippers are extremely flammable, so take care to avoid using these near sparks or open flames.

Of all the chemical ingredients in all of the strippers listed here, sodium hydroxide, or lye, is by far the most dangerous. It looks benign as a clear, watery fluid with no discernible smell. But the 30% to 40% concentration needed to strip paint is enough to blind you or eat the skin off your hand. When working with lye, you need to wear heavy-duty rubber gloves, an apron and a full-face shield.

And remember, any paint in the waste sludge that you remove may contain lead. You need to check your local hazardous-waste codes to find out how to dispose of any stripping waste properly. □

Jeff Jewitt is a frequent contributor to Fine Woodworking *and the author of two books on finishing published by the Taunton Press.*

trying to remove. With that hurdle overcome, here are some tips that will help you achieve good results.

SOME WOODS DISCOLOR

Some woods may darken slightly when used with alkali-fortified, or lye-based strippers. If this happens, a wash with the "B" component of a two-part wood bleach—a strong hydrogen-peroxide solution—should remove the discoloration. If it does not, wash the wood with clean water and then apply a solution of oxalic acid dissolved in water.

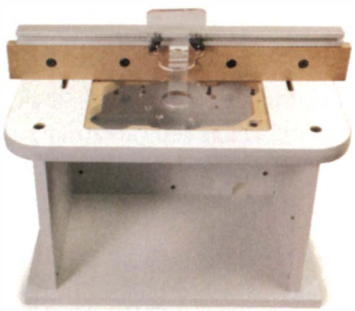
PAINT CAN FOOL YOU

Except for that which has been applied over a lacquer or shellac finish, paint is the most difficult of all finishes to remove. Scrape away a bit of the paint to see if there's any shiny, clear finish underneath. If there is, both methylene-chloride and NMP strippers will work fine, and the wood will strip cleanly. If there's not clear finish under the paint, you'll have a problem with paint stuck in the pores. If there's paint still left in the pores after stripping the bulk of it, reapply the stripper and let it sit. Then use a brass-bristled brush on the wood, scrubbing with the grain to remove the last bits of paint.

LEARN TO WAIT

However long it takes, let the stripper do the work. Patience is a virtue with the slower strippers like DBE and NMP, and you can cover these with wax paper or plastic sheets to make them work more efficiently. Methylene-chloride strippers will blister the finish when they've broken it, so wait until you see the telltale bubbles (see the photo at left) before you start to scrape off the gunk. Methanol, acetone, toluene (MAT) strippers need to be kept wet to be effective.

Bench Dog $415



CMT $259

Craftsman $95

A Survey of Router Tables

The best tables simplify the job of mounting a router and come with accurate, solidly made fences

BY JOHN WHITE

For the small shop, a table-mounted router can do all that a shaper can and maybe more. Raised panels, box joints, dovetails, mortises, tenons and moldings are but some of the operations possible with a router.

It's not too difficult to cobble together a workable shopmade router table. But it may lack some features available from a commercially made table. There are many tables to choose from, everything from basic units costing about $50 to setups costing $500 or more, depending on the options. I looked at 15 tables for this article.

All router tables operate on the same basic concept. A router is mounted upside down, usually on a removable baseplate, although a few mount directly to the tabletop. For many operations, the router table is used in conjunction with a fence.

Most router tables are mounted to a stand, either a short one for benchtop use or a table-height one for freestanding units. Some router tables can be attached directly to the extension wing of a tablesaw. A benchtop model is good for its portability and small footprint. But the best of the freestanding units have larger tabletops and provide a more stable work surface.

Baseplates simplify router-bit changes

It's easier to change a router bit if you can lay the machine on its side. That's why somebody developed the removable baseplate. Without this removable baseplate, you'd have to change the bit from under the router table in an awkward position. That's true with many benchtop models. But some of the newer benchtop models—as well as all of the freestanding tables—come with removable baseplates. For an extra charge, many manufacturers offer predrilled baseplates to fit your router (see the top right photo on the facing page). It's not hard to drill your own from a blank, but you probably won't end up with the

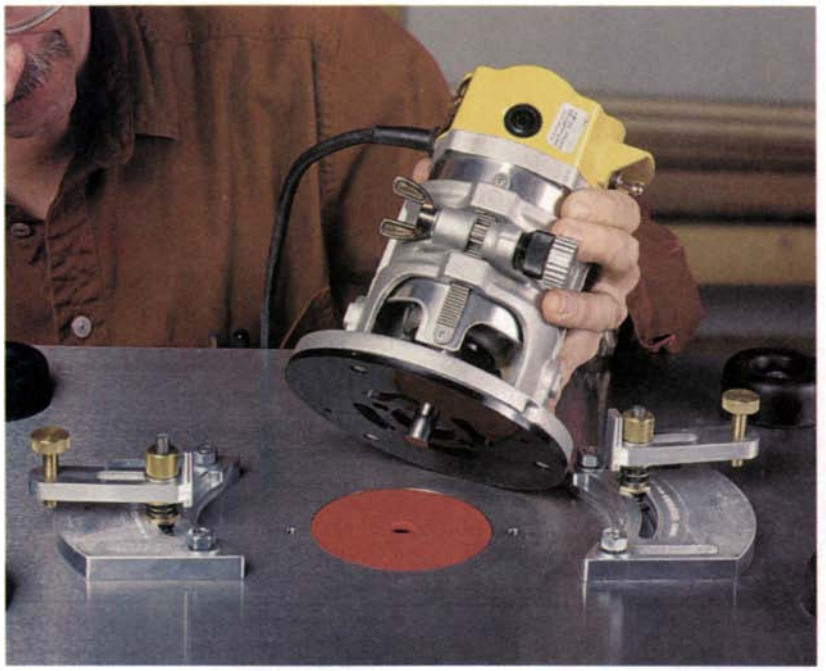
Eagle America $360

Freud $299
Shown with optional $99 on/off switch.

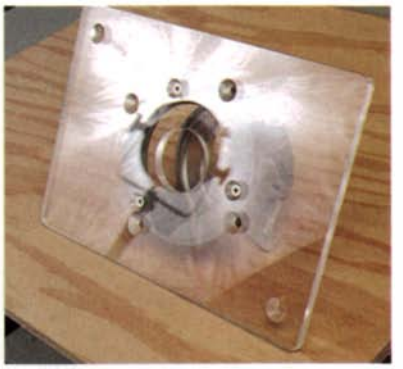
Hart Design $239

MOUNTING A ROUTER NEEDN'T BE A STRUGGLE

To use template-guide bushings with a table-mounted router, the router needs to be perfectly centered in the baseplate hole.



The Veritas router table comes with an alignment pin for centering the router in the baseplate hole. *The unique clamping system doesn't require the user to drill any holes or to remove the router's subbase to mount the tool.*



For a good fit, order a predrilled baseplate. *Many manufacturers offer this option for a few dollars more.*

Rousseau's concentric rings help align a router prior to drilling mounting holes. *Getting a router perfectly centered is possible, but you must have a good eye.*

router perfectly centered over the hole.

The Veritas table is an exception. Although it doesn't have a baseplate, the modest-sized tabletop can be lifted clear of the stand and flipped over to provide access to the router. (You can also prop it up at an angle like a car hood on the stand's hinged support arms.) The router mounting system is also the best I've seen. A pair of clamps and brackets will hold any model of router in place. Additionally, it comes with a pin that centers the router in the baseplate hole (see the left photo above).

Rockler's aluminum baseplate and Nucraft's optional steel unit are very stiff and flat. Among the plastic baseplates, the Woodhaven, Bench Dog and Woodpecker models are very flat and have adjustment screws so you can level the baseplates flush to the tabletop.

The baseplates of the Craftsman and Porter-Cable benchtop tables are predrilled to fit their respective line of machines. The optional steel baseplate on the Nucraft table has radial grooves that accommodate the bases of most routers but not the asymmetrical bases found on most plunge routers. For a plunge router, you'd have to drill new mounting holes in the baseplate. The underside of the Rousseau baseplate has concentric rings molded into it to assist with router alignment, but you must drill your own holes (see the bottom right photo above).

Insert rings decrease the throat opening

Many baseplates come with a set of insert rings. Depending on the diameter of the bit, select a ring that clears the cutter and provides maximum support for the stock. Most insert rings are attached to the baseplate with three or four small screws that are easy to lose in a pile of sawdust.

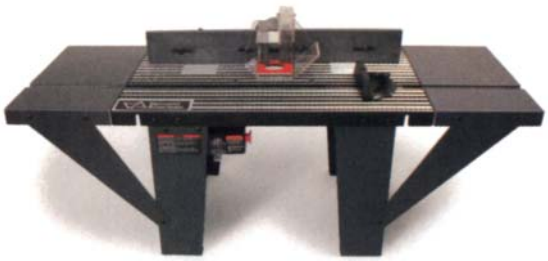
My favorite insert-ring designs are found

Nucraft *$310 (for table only)*
Optional cast-iron leg set costs $151.

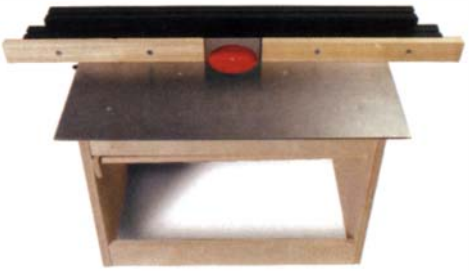
Porter-Cable *$149*

Rockler *$250*

Photos: Michael Pekovich



Vermont American $100



Veritas $269

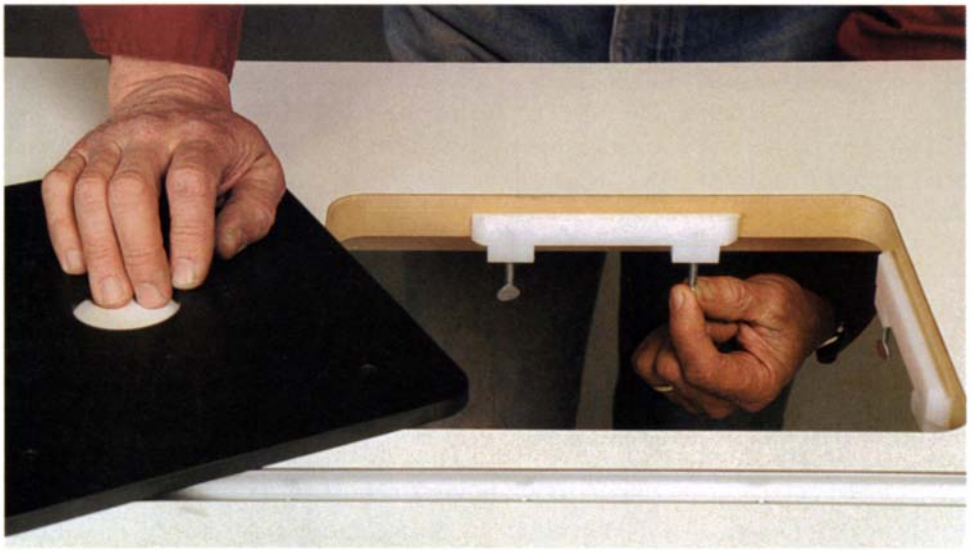
Rousseau $400

on the Woodhaven and Veritas tables. The Woodhaven's rings are cleanly machined and are retained by a snap ring; they're easy to remove and replace, even with a router bit in place. Veritas manufactures its insert rings with an eccentric shoulder. They are locked in place with a special pin wrench that you must make (instructions are supplied; it doesn't take long). I also like the design of the insert rings manufactured by Woodpecker and the optional steel set made by Nucraft because these rings can be adjusted to bring them flush to the tables.

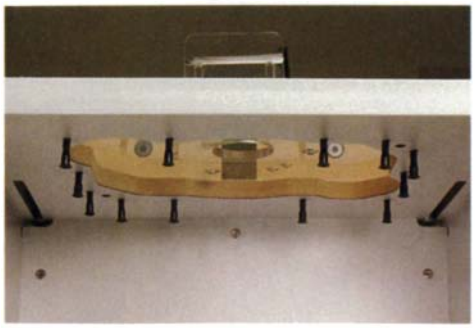
The clear plastic baseplates made by CMT, Bench Dog and Nucraft do not have inserts; the drop-in baseplate for each unit has a 2-in. hole. If you need a larger hole for panel bits or one sized for guide bushings, you must order a second plate.

ADJUST BASEPLATES FOR SMOOTH ROUTING

To feed stock smoothly, a baseplate should be perfectly flush with the tabletop.



Woodhaven uses thumbscrew levelers. *These levelers are adjusted from below the table. They can be purchased separately to retrofit most MDF-core tables.*



The view from below. *CMT's table has 12 leveling screws, accessible from below. The Bench Dog router table has a similar setup.*

Levelers are built into the Eagle America baseplate. *Six Allen screws are easily adjusted from above.*

Tabletop flatness can affect the accuracy of joints

Router tabletops are made of cast iron, steel, laminated medium-density fiberboard (MDF), aluminum or laminated particleboard. They come in a range of sizes. A tabletop ought to be fairly flat. I like one that isn't out of flat by more than a few thousandths of an inch (across its length) if I'm cutting parts that have to mate to one another. For cutting moldings, this degree of flatness is unnecessary as long as the area around the cutter is flat or slightly crowned. Overall, the flatness measurements ranged from a few thousandths of an inch to a few hundredths of an inch. Flatness is also affected by how well a table is fastened to its stand. The flattest and best-mounted tables received the highest ratings (see the chart on pp. 90-91).

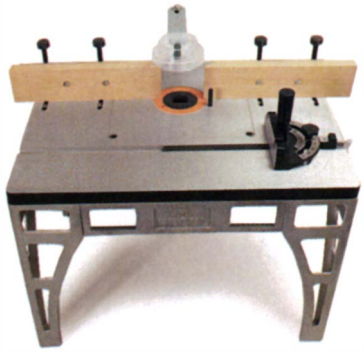
The Veritas table has a very slight crown, which the company claims will flatten out once you mount a router. I found that a slight crown remained, even after mounting a hefty 3½-hp router. But once I clamped the Veritas fence to the table, it flattened right out. In general, a slight crown in the region of the cutter is preferable to a dished table. That's because stock will remain at a consistent height to the bit provided downward pressure is maintained near the cutter.

Nucraft's cast-iron table also stands out in a crowd. At 70 lbs. it's by far the heaviest of the bunch. It's about the shape and size of a tablesaw extension wing and can be mounted as such. For benchtop use, Nucraft offers a set of optional cast-iron legs.

Most router tables are made of laminated MDF. The Rockler table is made of laminated particleboard. Unless it is properly supported, MDF or particleboard will likely

***Woodhaven* $375**

***Woodpecker* $339**



***Woodstock* $188**

sag under its own weight. The materials also are subject to stresses close to any major cutouts. Many manufacturers machine a channel into the tabletop for a miter gauge. And it's here that most of the tables take a slight dip.

All of the MDF tables moved slightly as the humidity changed. One day a table would be flat; the next day it would have a slight warp. This movement affected the fit of the baseplate. As a table swells from increased humidity, the baseplate requires readjustment for a flush fit. The metal tables, obviously, don't get bent out of shape due to weather changes.

The Bench Dog, Freud and Woodpecker tables seemed to stay flattest because they are solidly attached to their stands. Bench Dog and Woodpecker stands have cross braces that add support to the tabletops.

A sturdy stand keeps the tabletop flat

A stand has to fulfill several functions beyond the obvious goal of getting the router table off the shop floor. A good stand keeps the tabletop flat, can be adjusted for floor irregularities and provides stability.

It's a rare shop that enjoys a perfectly flat floor. I expected most stands would come with leg levelers, but that's not the case. Only the Eagle America, Woodpecker and Rousseau stands come so equipped.

The Rousseau stand, with its heavy, welded steel construction, is clearly a standout (Rousseau also offers a sturdy folding stand). The company supplies four screws for attaching the tabletop to the stand. Adding four more screws would keep the top flatter. Among the enclosed stands, the Bench Dog is the best. Because the router is totally enclosed, the unit is less noisy. Also, you can add dust collection from below the router as well as at the fence. But the stand bears directly on the floor, and it did not take long before the melamine edge began to chip. Levelers or glides would solve the problem.

Few fences are perfectly flat and square

Fences found on full-sized tables are of similar design. They consist of an aluminum extrusion or casting with an adjustable two-piece facing made of wood, plywood or MDF. Like insert rings, facings allow you to close gaps around the bit for better stock support.

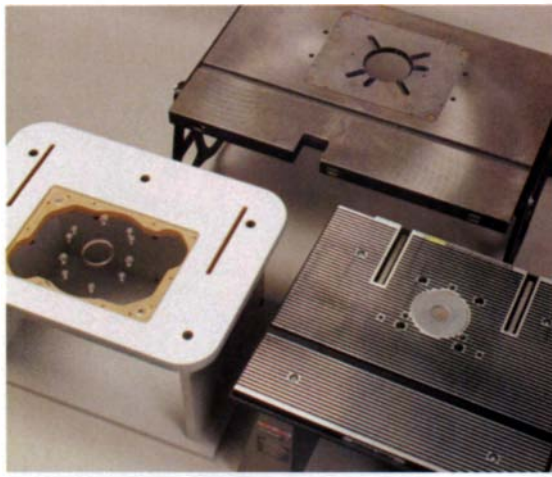
A fence not only needs to be flat and square, but it also needs to be strong, stable and practical to use. Many of the fences are weak in one or more of these areas.

The best fences—those rated excellent in the chart—are out of flat by only a few thousandths of an inch when measured across their lengths. The least-accurate models are off by 10 times as much. I also measured how square the fences were to their tables. Most were off a bit. Depending on what you use a router table for, these measurements may or may not be important. Close tolerances are important if you're using a fence to make tight-fitting joints. But if you're simply running molding, it's not that big a deal.

Not surprisingly, the thickest fences are the stiffest. As I learned from manufacturers, aluminum extrusions and castings don't necessarily come out of the foundry flat and square. You can tune a fence by adding some tape or paper shims either under the fence to help square it or between the facings and fence to flatten them out. But the best-rated fences are machined by the manufacturer. The fences with solid wood facings are generally less accurate because wood has that nasty habit of warping. The fences that rate better have birch plywood or MDF facings.

Besides accuracy, ease of use is important when judging a fence. With clamps on both ends, movable and offset facings, guards and hold-downs, a router-table fence has a lot of adjustments. A fence received a higher rating if its hardware worked smoothly, if it had T-slots for attaching other options and if it did not require additional tools to make adjustments.

The Bench Dog model No. AF 400 fence is a thick aluminum extrusion that has been machined flat and square. Its clamps and face adjustments slide like silk and are tightened via large, easy-to-grasp knobs (see the top photo on p. 90). The same is true for the CMT benchtop fence, which is manufactured by Bench Dog. I also like the Rousseau fence because of its substantial, accurately machined aluminum casting. The Hart Design fence is also nicely finished, although not quite as accurate as the CMT and Rousseau.

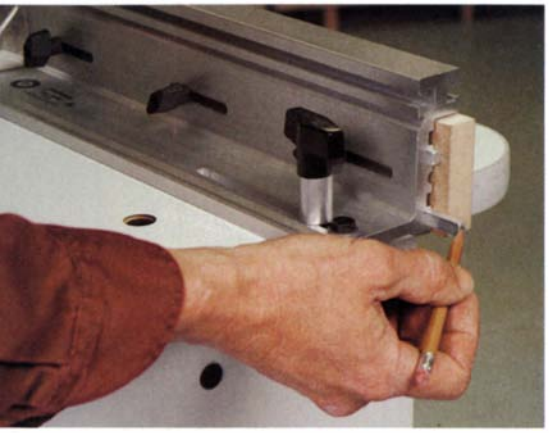


***Tabletops come in a choice of materials.** The most common material is laminated MDF (left). One manufacturer offers a cast-iron model (top). Several portable models have aluminum tops.*

At first glance, I liked the beefy Veritas extrusion, with its T-slots for attaching hold-downs and stop blocks, but the unit is cumbersome to adjust, requiring a Phillips-head screwdriver, a slotted screwdriver

and a straightedge. The locking levers are also too close to the stand.

The Woodstock and Porter-Cable fences are very time-consuming to set up. Each half of each fence must be realigned with the other half every time the fence is moved (see the bottom photo below). In their favor, this kind of design allows you to perform operations—such as jointing or making moldings—that require an offset fence on the outfeed side for support.



The Bench Dog has aluminum rods for shimming the outfeed fence. *One face has been machined to square it up. Also, large knobs are used for all adjustments.*

A fence should be square to the table and easy to adjust. *A split fence, which is found on many benchtop models, such as the Woodstock Rebel, must be realigned each time it is moved, a time-consuming process.*

Dust collection takes place at the fence—Most fences are designed with a vacuum-hose hookup at their midsection. Rousseau provides a blank fiberboard panel that must be drilled out to accommodate a hose. The connector port on the Eagle America fence is slightly undersized, and most hoses in the shop wouldn't fit. The Freud fence has a nonstandard 2-in. fitting.

The design of the Veritas dust pickup is unique and adds greatly to its utility. The heavy plastic hose fitting attaches to the steel table with strong magnets. It can even be attached to the underside of the top to pick up dust from dado-type cuts that force the shavings down.

Woodpecker has an optional router enclosure that mounts under the tabletop. The enclosure has a door mounted on its side. For small and midsized routers, this works fine. When I mounted a 3½-hp router, I was unable to reach all of the controls through the door.

Choose a table based on the type of work you do

If you use a router table only to run moldings or to waste out a joint before finishing up with hand tools, then most of the lower-priced router tables ought to suit you just fine. If, however, you intend to create joints that fit tight right off the machine, spend a few more bucks.

The CMT benchtop router table, which is manufactured by Bench Dog, is a top-notch portable. The CMT has a sturdy, accurate fence, which makes it suitable for a shop as well. The Veritas table is another excellent small unit. Although it's expensive, the Nucraft table makes sense if you prefer to mount a router table to your tablesaw and use its fence for routing.

Among the full-sized tables, the Bench Dog and Rousseau offer the best combination of accuracy, ease of use and sturdiness. For a good value, consider the Hart Design router table.

Or better yet, mix and match components to create a dream router table. My dream table would consist of the Rousseau LS 3310 leg set ($191). For a top, I would buy Woodpecker's jumbo model No. 928 ($129). To help keep it stiff, I'd add a couple of angle-iron cross braces underneath. Next, I'd purchase Woodhaven's large phenolic baseplate, model No. 147 ($50), and the plate levelers, model No. 130 ($15). The Woodhaven plate is an exact fit in the Woodpecker table cutout. Next, I'd order Bench Dog's AF 400 fence ($135). A final addition to the perfect table would be Freud's BF 3700 on/off switch ($99). This combination would cost $619. □

John White maintains the Fine Woodworking *shop and also is a cabinetmaker.*

MAKE AND MODEL	PRICE
Bench Dog (800) 786-8902 Model No. RT 400 table Model No. AF 400 fence Model No. CB 400 base	 $130 $135 $150
CMT (888) 268-2487 Model No. 999.402.00	$259
Craftsman (800) 377-7414 Model No. 25483	$95
Eagle America (800) 872-2511 Model No. 415-0024	$360
Freud (800) 472-7307 Model No. BF3	$299
Hart Design (800) 345-2396 Model No. Hart 1	$239
Nucraft (800) 971-5050 Model No. NU 105 table Model No. NU 200 leg set Model No. NU 1020 steel insert	 $310 $151 $200
Porter-Cable (800) 487-8665 Model No. 698	$149
Rockler (800) 279-4441 Model No. 81267	$250
Rousseau (800) 635-3416 Model No. RM 3508 table Model No. RM 3301 fence Model No. RM 3509 baseplate Model No. LS 3310 leg set	 $91 $79 $39 $191
Veritas (800) 871-8158 Model No. 05J2022	$269
Vermont American (800) 626-2834 Model No. 23463	$100
Woodhaven (800) 344-6657 Model No. 172SHDM table Model No. 202 DF fence Model No. 301 leg set	 $160 $105 $110
Woodpecker(Distributed by Woodworker's Choice) (800) 892-4866 Model No. 928 table with leg set and insert rings Model No. 931 fence	 $219 $120
Woodstock Rebel (800) 840-8420	$188

ROUTER TABLES AND FENCES

TABLE SIZE/MATERIAL	TABLE FLATNESS	BASEPLATE	FENCE QUALITY	COMMENTS
24 in. by 32 in./ laminated MDF	Excellent	Acrylic blank (predrilled plates available)	Excellent	A rugged, well-designed system. The fence is especially well made and easy to adjust.
15¾ in. by 22 in./ laminated MDF	Excellent	Acrylic blank (predrilled plates available)	Excellent	Made by Bench Dog and every bit as good as its big brother.
14 in. by 40½ in. (including wings)/die-cast aluminum and stamped steel	Fair	Not applicable (router mounts to underside of table)	Good	The Craftsman is an acceptable portable unit. Among the lower-cost units, its fence is better than average.
24 in. by 32 in./ laminated MDF	Good	Sheet phenolic blank	Good	A plain vanilla table and fence on a nicely made wooden base.
19¾ in. by 26¾ in./ laminated MDF	Excellent	Glass-filled plastic blank	Fair	The unit comes with a smaller-than-average baseplate and fence. But the stand is very sturdy, and the optional ($99) on/off switch is a good idea.
23½ in. by 31½ in./ laminated MDF	Good	Molded phenolic blank	Good	A good-quality table for the price, with a simply designed, sturdy fence.
18 in. by 27 in./ cast iron	Excellent	Acrylic blank (optional steel baseplate with predrilled holes and insert rings available)	Not applicable	You'd be hard-pressed to wear this table out. It's best used as a tablesaw extension wing. The user must supply a fence.
17 in. by 20 in./ die-cast aluminum	Fair	Not applicable (router mounts to underside of table; predrilled for Porter-Cable routers)	Fair	Rugged, compact table. But resetting the fence is time-consuming.
24 in. by 31¾ in./ melamine	Fair	Machined aluminum blank (predrilled available)	Fair	The top needs more support from underneath to prevent sagging. The fence is prone to flexing when clamped.
24 in. by 32 in./ laminated MDF	Good	Molded phenolic blank (has marked rings to help align router base)	Excellent	This unit has a heavy-duty welded stand. The top could be kept flatter by adding more mounting screws from underneath. The fence is among the best.
16 in. by 24 in./ steel plate	Good	Not applicable (router mounts to unique clamp system under table)	Good	The Veritas is the best solution to mounting a router. Resetting the fence, however, is time-consuming.
14 in. by 40½ in. (including wings)/die-cast aluminum and stamped steel	Fair	Not applicable (router mounts to steel blank under table; drilling templates are included)	Poor	The light-duty fence is prone to flexing.
24 in. by 32 in./ laminated MDF	Fair	Sheet phenolic blank (drilling templates available)	Fair	The top needs better attachments to keep it flat. The baseplate insert rings are well made.
24 in. by 32 in./ laminated MDF	Excellent	Sheet phenolic blank (predrilled plates available)	Good	The top is the thickest of all of the MDF tables and stays quite flat. The baseplate is also nicely made. But the fence clamps are awkward to use.
18 in. by 24 in./ cast aluminum	Good	Aluminum blank	Fair	Insert rings aren't flush with the underside of the baseplate and can interfere with mounting the router.

Rules of Thumb

BY MIKE DUNBAR

Three bench planes

Last month, I pulled into a hardwood dealer's lot and parked next to a woodworker's van. On the van, above the guy's name, was his logo: the silhouette of a bench plane. I wasn't being catty, but I wondered if he knew how to use a handplane. The reality is that most woodworkers do not know how to use one. That's too bad, for these are the most useful and versatile tools in the shop.

Bench planes are so important to woodworking that Mr. Woodworker-in-the-parking-lot is hardly the only one to have it as a logo. The silhouette of a bench plane is used everywhere. Numerous catalogs and other woodworking companies use it. The bench plane implies craftsmanship not only to woodworkers but also to customers.

Ironically, most woodworkers do own a plane even if they can't use it. Around here, we joke about the "requisite plane" that is found in nearly every shop because woodworkers know intuitively that they should own one. For my chair-making classes, I give students a list of tools to bring. The list includes a handplane. So we get to see examples of these requisite planes every two weeks. Usually they are not tuned and are covered with dust. Their blades are dull, sometimes rusty, and often upside down. Many are still in their original boxes.

Some woodworkers are self-conscious about their lack of knowledge about handplanes and feel they should be able to incorporate planes into their work. Well, they should. The handplane is the king of woodworking tools. It can do more jobs than any other tool I can think of. Any shop that is not mass-producing and does not use planes is doing many jobs in ways that are complicated, clumsy, noisy, dusty and inefficient.

Just as the name implies, bench planes are most frequently used for bench work. (The smaller block plane is, possibly, handy enough that it warrants its own discussion in a future column.) Bench planes were originally made of wood, and some—mostly European—still are. Although wood planes are excellent tools, cast-iron ones are far more common, and they are easier to learn to use. The plane we all recognize—the one commonly used as an advertising logo—was developed by an American inventor named Leonard Bailey about the time of the Civil War. Later, Stanley Rule and Level acquired Bailey's patterns and displayed the name Bailey prominently on its planes.

Planes are sharpened according to their use

The cutting edge of a plane is sharpened based on the job the plane is intended to do. The cutting edge of a new cutter is ground square to the sides. This shape is intended for the edges of boards, such as when jointing. However, this shape will not work on a surface that is wider than the cutter. The square corners will dig into the wood, creating an ugly track with a square ridge on both sides. The plane may also choke when face-planing. A cutting edge intended for use on the surface of a board has to be crested—how much depends on function. A curved edge will cut a chip that is thicker in the middle and tapers out to nothing on the edges. You can see this clearly if you unroll the chip and hold it up to a light.

Numbers tell the plane story

Bench planes are divided into three types: smooth, jack and jointer. Stanley developed a system of numbers to identify its various planes, a system that is still sometimes used today. In this system, the numbers increase with the size of the plane: For example, a No. 4 is larger than a No. 1. During some years of manufacture, the plane number was cast into the iron body of the plane.

The smooth planes were designated Nos. 1 through 4. Nos. 1 and 2 do not have much utility and are best left to collectors. The most useful smooth planes are the Nos. 3 and 4. Makers of new planes only offer a size that corresponds to the No. 4, although I saw a No. 3 in a recent Garrett Wade catalog.

As you might suspect, a smooth plane is used primarily

After the jack, use the smooth. *A smooth plane is used for the final dressing of the face of a board. The plane is especially handy for removing the marks left by jointers and thickness planers.*

Photos: Michael Pekovich

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Face-planing starts with a jack plane. *A jack plane, sharpened with a slight crest in the iron, makes quick work of dressing a roughsawn board. The telltale scalloped surface is a sure indication of handwork.*

for smoothing wide surfaces. Before thickness planers and jointers became affordable for even small hobby shops, woodworkers started with roughsawn lumber that they first leveled with a jack plane. (Contrary to what might seem intuitive, the process of face-planing a board is started with a larger plane and finished with a smaller one.)

A smooth plane cleans up after the jack plane, leaving a surface that needs very little sanding or scraping. Today, a smooth plane is most commonly used for removing the milling marks left in lumber that has been passed through a thickness planer or jointer (see the photo on p. 94). The cutting edge of a smooth plane should be slightly crested so that it takes a wide shaving that is just a bit thicker in the middle. The resulting track is very subtle and best seen in a raking light. It creates the true handplaned finish that, curiously, many woodworkers go to great lengths trying to simulate rather than learning to make the real thing.

Jack planes are designated by the Nos. 5 and 6. Today's manufacturers produce only a No. 5. The jack plane is a workhorse, designed for fast stock removal. Before the development of the thickness planer, all lumber was first surfaced with a jack plane. It was the only means for thicknessing wood and, with its strongly crested cutter, could remove a thick chip that got the woodworker where he needed to be in little time (see the photo above). Today, regardless of whether you have a thickness planer or a jointer, a jack plane is still a fast way to thickness parts and small boards.

The Nos. 7 and 8 are jointer planes. Today, plane manufacturers make only the No. 7. A jointer plane creates square edges either when dressing boards or preparing them to be glued (see the top photo at right). To create a square edge, the cutting edge must be straight and square to the sides.

Planes are versatile tools

Although the various planes are designated for certain jobs, woodworking is not that cut and dried. For special jobs you can substitute a plane that is typically used in a different way. For example, I maintain a No. 5 for use on my shooting boards. Shooting is a fast and sure technique for jointing and squaring small parts and trimming miters. A plane used for shooting has to have a cutter that is straight, like that on a jointer.

When making a Windsor chair, I glue small blocks to bent arm rails to create a wider hand. I joint the edges of the rail and the applied block on a No. 7 held upside down in a vise. In other words, I push the work over the plane, rather than the other way around (see the bottom photo below). I am always amazed at students who worry about their fingertips, knowing that at home the same people would do this work by passing their hands over a cutterhead spinning at several thousand rpm.

Obviously, being a versatile woodworker requires more than just the requisite planes. These tools are like rabbits. Buy two, and you will end up with a lot more. I own and use almost two dozen bench planes that I keep on a wide shelf under my bench.

New or used, buy a good plane

If you buy a new plane, buy the best quality. You will seldom find a good plane in a hardware store. Buy from a tool catalog, and make sure you recognize the brand.

Up until World War II most bench planes were of very high quality. Fortunately, these prewar planes were made in such large numbers that they are still plentiful. Buying an older plane has two attractive benefits—you get very good quality at a lower price. The drawback is that you cannot pull out a credit card, call an 800 number and order one. You have to go out and look for them or contact antique tool dealers who will sell via mail.

Jointer plane for straight edges. *The longest of the steel-body planes, a jointer plane, with its 22-in.-long sole, cuts straight edges on long boards (above). Clamped upside down in a vise (left), a jointer plane works well for planing small or odd-shaped pieces of wood.*

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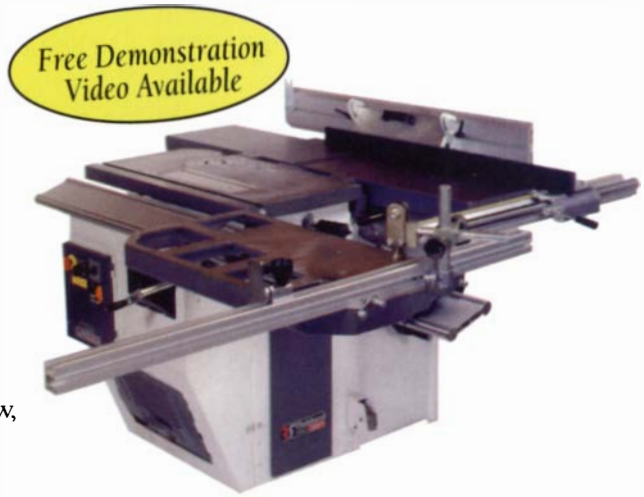

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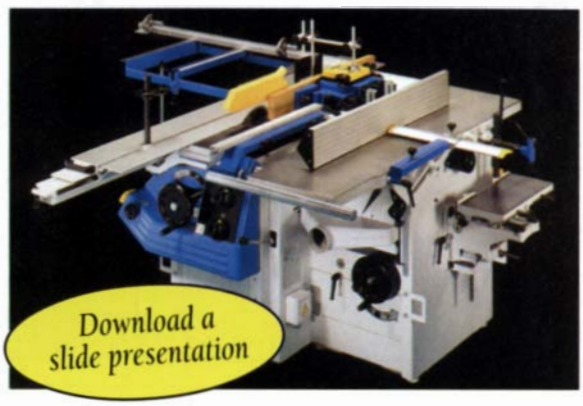

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Q&A

Drop-leaf table with splayed legs

I'm designing a drop-leaf table based on an old Shaker design. I want the legs to be both tapered and splayed outward. At what angle are legs of this style typically set, and what is the best way to splay the legs? ***—Daniel Tanguis, Monroe, La.***

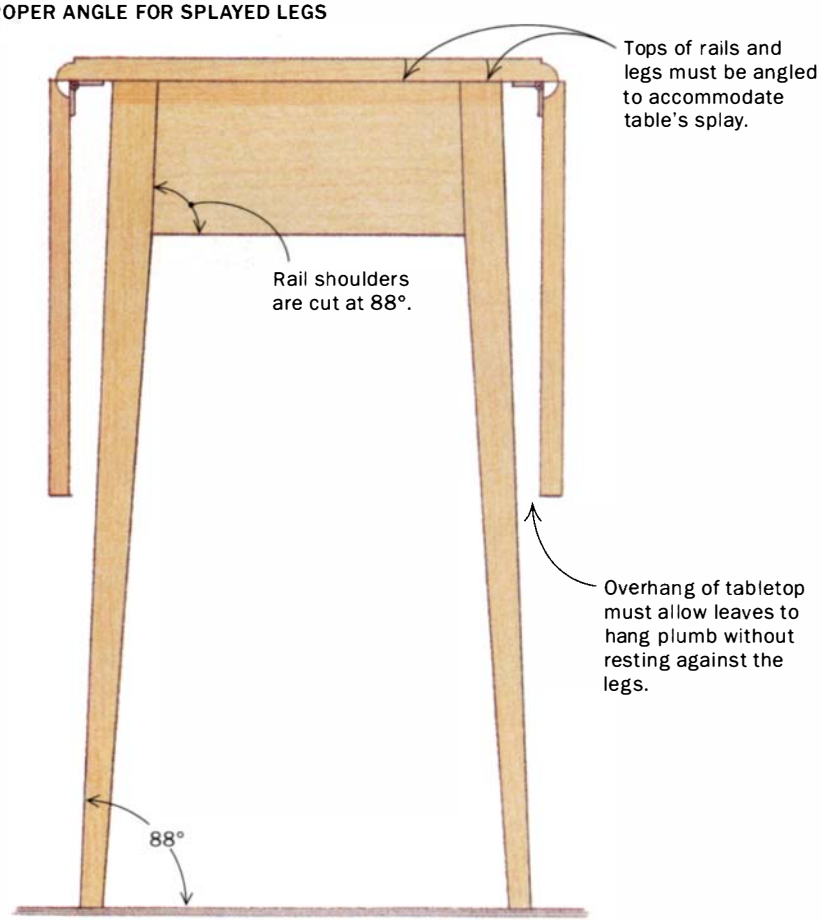
Christian Becksvoort replies: The easiest way to introduce splay into the legs of a table is through the rails. Instead of cutting the rail ends off at 90°, cut all four rails (all eight ends) 2° out of square at 88°. Just remember that the angles have to be cut in opposite directions, so that the top edge of the rail is shorter, and the bottom edge is longer.

As for the angle of splay, I find 2° to be a good compromise. A tablesaw with the miter gauge set at 88° makes it easy to establish the tenon shoulders. Cut one shoulder of the rail with the miter gauge on one side of the blade, then move the miter gauge to the other side of the blade to cut the tenon on the rail's other face. Trim the tenons and dry-assemble the entire base.

You'll notice that the base is now splayed at 2° in all directions. To get the tabletop to sit flat, the tops of the rails need to be beveled outward at 2°. This is easily done on the jointer. The tops of the legs need to be trimmed on the tablesaw. This is a compound cut because they splay out 2° in two different directions. Mark the outer two edges of the legs carefully, then tilt the sawblade 2° and the miter gauge 2°. Placement of the leg on the saw is determined by the tilt direction of the blade and miter gauge.

If the table is a drop leaf, it helps to draw a full-sized cross section when determining the proper overhang for the top. Remember that with a hinged rule joint, the leaves hang mostly under the top. Because the legs are splayed outward, the overhang is dependent on the width of the leaves. You have to make sure that the table has enough overhang so that the leaves hang plumb and don't rest against the legs. Add an additional ½ in. per side if you're building in the summer and expecting the top to shrink. [Christian Becksvoort builds furniture in New Gloucester, Maine.]

THE PROPER ANGLE FOR SPLAYED LEGS



Altering hide glue with additives

Hot hide glue is a great glue, but sometimes it sets up too fast during long glue-ups. Can I slow down hide glue's setting speed to give me more working time? ***—Ben Finowski, Parma, Ohio***

William Tandy Young replies: There are several good ways to slow down the setting speed, or gel rate, of hot hide glue. One is to use glue that has a lower gram strength. The lower the gram strength, the longer the glue takes to set up. Try using a glue with a gram strength of 192 or 164 instead of the more common 251. Glue with a lower gram strength is especially useful in winter because hide glue sets up more quickly in a colder shop.

You can extend hide glue's working time by warming your work with a heat gun or a clothes iron before gluing. Don't overheat the glue itself (beyond 140°F) to gain working time, though, or you'll break down its molecular structure, and it will produce weaker bonds.

Another way to retard hide glue's setting speed is to add a gel depressant, such as urea crystals or table salt. I prefer urea, which is sold at pharmacies and garden centers. Urea is added by weight relative to the weight of the dry glue granules. Weigh the glue granules and urea, make the glue, then add the urea. Start with a ratio of 10% urea, and increase the percentage if you need more working time (the most I ever add is 30%). Glue that contains 40% or more urea will remain fluid at room temperature but will produce weaker bonds.

You can also buy a ready-to-use gel-depressed hide glue, such as Franklin's Liquid Hide Glue. Although not as strong as hide glue, it makes a handy setting retarder if you're feeling lazy or are in a hurry. Just add a squirt to the batch of hot hide glue you're currently using. [William Tandy Young is a frequent contributor to *Fine Woodworking*.]

Arts-and-Crafts faceted pegs

What is the best way to make and seat faceted pegs such as those seen in some

Drawings: Vince Babak

examples of Arts-and-Crafts furniture?
—Gary Bridgeman, Memphis, Tenn.

Garrett Hack replies: Using a square peg to pin a joint, especially when it's made of a contrasting wood, is as intriguing a detail as it is practical. Its square corners bite into the wood and lock the peg in place. It's an old idea used to help secure everything from wood heels on shoes to massive timber frames.

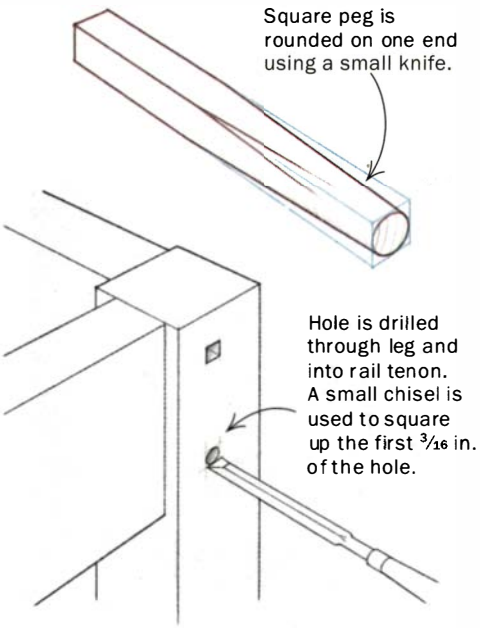
Choose a peg wood that is hard and has long grain fibers, such as ash, oak and rosewood. Ideally, the peg wood should be harder than the wood it will be driven into. Cut strips for the pegs first, then choose a drill-bit size just a trifle under the width of the pegs. Burnishing down a small square of masking tape prevents any fiber tearout when drilling the holes. Then square up the holes about 3/16 in. deep with a small chisel.

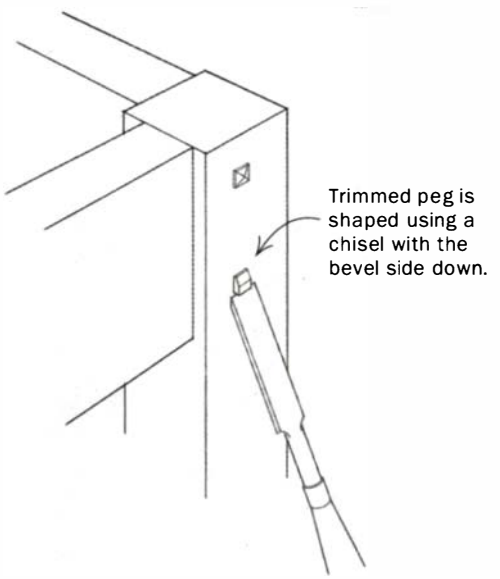
Using a small knife, shape the pegs to the same shape as the holes: square at the top and tapered to a round end. The harder the wood or longer the pegs, the closer the fit you should aim for. If a peg fits too tightly, you risk snapping off the peg or being unable to drive it home. Make some trial holes and pegs to get an idea of the best fit. Place a small crescent wrench on the square end of each peg to help hold and position the peg as you sink it with a hammer.

Saw the pegs off slightly proud of the surface, guiding a small backsaw against a thin scrap so that you get a consistent height. Now shape the top of the pegs. The trick to this is to use a chisel with the bevel side down, tap it lightly with a mallet and lower your angle of attack as the cut progresses. Work from all four sides to level the pegs flush or, if you prefer a faceted look, shape them into flattened pyramids.

[Garrett Hack is an author and furniture maker in Thetford Center, Vt.]

MAKING AND INSTALLING A FACETED PEG





Finishing without fresh air

During the winter it is too cold to finish anything in my unheated shop, so I either have to wait until spring or finish in my kitchen. I seem to have more luck with hand-rubbed finishes, and I especially like oils. Can you suggest a finish that is safe to use indoors? Without ventilation?
—Dave Johnson, Stockbridge, Mass.

Chris Minick replies: Ten years ago the choice of finishes that could be applied without ventilating the room was severely limited. Not so today. Finish manufacturers have developed low-odor, nonflammable water-based finishes and stains that rival their solvent-based counterparts in protective quality and ease of application.

Most water-based finishes are designed for brush or spray application but can be wiped on with a slight change in wiping technique. The normal technique of flooding the wood with oil, waiting 15 minutes and then wiping off the excess finish doesn't work with water-based finishes because they dry much faster than traditional wiped-on oil-based finishes. A better method is to wipe on a coat of water-based finish with a lint-free rag, then immediately wipe off the excess before the finish starts to dry. Multiple coats are needed to form a significant finish film, but the rapid drying time allows six or eight coats to be applied in one day. Several brands of water-based finishes are available, but I've found General Finishes EF line of finishes and stains works best for wipe-on application. These products can be purchased by mail from Rockler Woodworking and Hardware (800-279-4441).

[Chris Minick is a contributing editor to *Fine Woodworking*.]

Gluing up bent laminations

I have formed 16 birch bentwood laminations using urea formaldehyde. The radius of the curve was 14 in., and the thickness of each ply was 3/16 in. I made full-sized male/female forms and clamped them together for 24 hours. About 25% of these delaminated on one ply (generally the outside ply). What would cause them to delaminate, and what should I have done differently? Is there a nondestructive test that I can use to determine if they can be used in a piece of furniture?
—Arnold Nelson, Redlands, Calif.

Lon Schleining replies: Having bent a hundred or so laminated handrails for circular staircases using this technique, I can safely say that there are a lot of ways to get into trouble. The good news is that these pieces failed before you built them into some beautiful piece of furniture. The bad news is that I'm afraid your carefully made parts must go into the scrap bin. If one glue joint failed, all are suspect. In the long run, you'll sleep better knowing that you fixed the problem and didn't just cross your fingers.

One possible cause of the delamination is that the plies you used were too thick. I would suggest using plies much thinner than 3/16 in. for a 14-in. radius. The thinner

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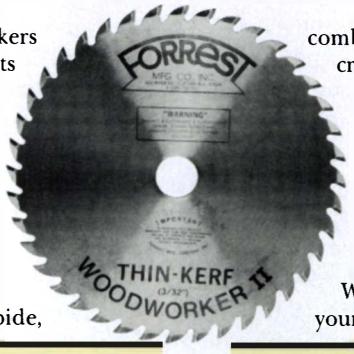

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the plies, the less stress on the glue joints.

The surface preparation of the plies is also critical to proper bonding—if the surface is not porous enough or is dusty, the glue will not penetrate properly. Clean the surfaces with either a vacuum or compressed air. Try to make sure that your planer is sharp and doesn't glaze the surface of the pieces. To test the porosity of a ply, place a drop of water on the surface, then watch to make sure it soaks in promptly.

One thing to remember is that urea glue, a good choice for this project, has a limited shelf life once opened. In powder form, urea should smell very strongly like liquid Pine Sol cleaner. If the smell doesn't bother you when you open the container, the glue may be too old. Get a fresh batch just in case, then mix it to the consistency of thin syrup. If the mixture is lumpy, strain it through a nylon stocking.

If your materials are not the problem, what's left is technique. When I glue up a bent lamination, I apply the glue with a roller and go like a house on fire. If it takes just a little too long to get the pieces clamped up, or if the glue skins over even slightly, the bond will be weak.

It's essential that the pieces come into contact while the glue is still liquid. If you can lightly touch the glue surface after it is spread without transferring glue to your finger, the glue has formed a skin, and you may as well call it a day. Once the glue is spread, especially in a warm environment, this skinning over can happen very quickly. About the only thing to do if this happens is clean off the glue, remill everything and start over. Apply glue to both surfaces, making sure you get complete coverage on both, and always bend all of the layers at one time.

One sure way to improve your speed and technique is to clamp the bundle of plies onto your form without glue. This dry run will give you a chance to test your clamping system and make sure everything you need is at hand.

I would consider doing away with the female part of your bending mold. Bending the bundle around the male portion and then clamping as you go ensures even clamping pressure. As long as your gluing environment is within the temperature range recommended by the glue manufacturer, the 24 hours of clamping time should be plenty.

Lastly, there is no substitute for destructive testing where glue is concerned. I routinely glue up sample pieces then strain them to the breaking point. Nothing reinforces my confidence in my glue joints like seeing the sample break ½ in. away from the joint.

[Lon Schleining builds custom stairs in Long Beach, Calif.]

Repairing blushed rings on a kitchen table

My Danish teak dining-room table is finished in oil and has a white ghost ring from a hot pad that was damp. How can I remove the blush?

—Natalie Stevens, Alamogordo, N.M.

Jeff Jewitt replies: If it's a commercially made teak table, the finish is probably

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lacquer, not oil. Either way, the white ring can be removed by one of two ways.

Using 0000 steel wool, rub the area with baby oil or a wax thinned with mineral spirits. Go lightly, and if this works, you may need to rub down the whole table to even out the sheen.

If that doesn't work, spritz a bit of alcohol (any type is fine) on a clean rag. It should not be wet but should feel damp, like the tip of a dog's nose. Wipe the white area with the rag—lightly and quickly—in a pendulum-like motion. The white should disappear without too much work. Again, if the sheen changes, you can blend it in by rubbing the table with 0000 steel wool and wax.

If neither works—and I'm sure one of them will—the damage is severe, and you'll have to strip and refinish.
[Jeff Jewitt repairs and restores furniture in Cleveland, Ohio.]

Refinishing antique chairs

I really enjoyed Mike Dunbar's article on milk paint (FWW #136, pp. 64-67). I have a set of eight mahogany dining chairs that are family antiques (130 to 150 years old, I think) as well as a younger mahogany desk. All of these are a dark maroon color, similar to the "rocker" in the article. Is this a mixed color or layers of different colors? It seems to me that this dark color was very much used on older furniture, and I always wondered what kind of a finish it is. Now it is obvious to me that it is milk paint, and I like it. What about refinishing these surfaces? Do they need to be taken down to bare wood again and refinished from scratch?

—Ron Lattner, Banks, Ore.

Mike Dunbar replies: It is hard to determine what a finish is without seeing it. Even then, it can be difficult. You could be looking at any one of a number of possibilities. However, I doubt that what you describe is milk paint, as this finish was not usually applied to mahogany.

If your estimate of the age of your mahogany dining chairs is accurate, they were made during the Colonial revival period. This revival was sparked by enthusiasm for the country's centennial celebration in 1876, when things "colonial" became fashionable. Your chairs would have been made in a furniture factory, and you could probably strip them without worry.

However, if your chairs are handmade and from one of the periods preceding the Industrial Revolution, they could be quite valuable. There are lots of cases where someone has lost tens of thousands of dollars of value (and an immeasurable amount of history) by stripping antique furniture. Because of the chance that your chairs are older and far more valuable than you might have imagined, I plead with you to have them examined by an expert before you begin to strip them. You should be able to find an antique appraiser in the phone book. Or contact the curator of furniture at a nearby art museum.
[Mike Dunbar is a contributing editor to *Fine Woodworking*.]

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31-695	6" Belt/9" Disc Sander	441	299
23-710	Sharpening Center	217	149
31-460	4" Belt/Disc Sander	198	119
40-560	16"2 speed Scroll Saw	230	129
40-540	16" var/spd Scroll Saw	249	159
11-990	12" Bench Drill Press	255	184
11-090	32" Radial Bench Drill Press	405	279
43-505	1/2" Bench Router/Shaper	398	299
22-540	12" Bench Top Planer		Sale 259
22-560	12-1/2" Planer w/ extra knives		329
36-865	Versa Feeder Stock Feeder		249
36-220	10" Compound Mitre Saw	294	199
37-070	6" v/spd Bench Jointer	351	265
14-650	Hollow Chisel Mortiser with chisels and bits	380	249
17-900	16-1/2" Floor Drill Press	490	329
17-924	Mortise Chisel Kit		Sale 65
36-285	8-1/4" Builders Saw w/ stand	Sale	275
34-555	Sliding Table	487	315
36-250	10" Slide Compound Saw	825	455
31-780	Oscillating Spindle Sander	253	194
46-700	12" Wood Lathe	575	479
40-650	Q3 18" Scroll Saw	Sale	389
36-905	30" Unifence	346	259
36-906	50" Unifence	444	319
36-444	10" Contractors Table Saw	Sale	589
33-830	10" Radial Arm Saw	851	729
37-285	NEW 6" Jointer w/ stand	424	345
37-380	NEW 8" Professional Jointer	1500	1129

Single Stage Dust Collectors

50-850	1-1/2 HP, 1200 CFM	Sale	285
50-851	2 HP, 1500 CFM	Sale	489

The following tools have a $50.00 rebate! Price shown is before rebate.

36-475	10" Platinum Edition Contractors Table Saw w/ 30" unifence, cast iron wing, table board & carbide blade	Sale	849
22-675	DC380 15" Planer	Sale	1175
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28-280	14" Band Saw 1 HP motor with enclosed stand	Sale	739
28-255	14" Platinum Edition Band Saw - 1 HP w/ mobile base, 18" rip fence, & 3/8" blade	Sale	849
31-280	Sanding Center w/ stand	Sale	789
37-190	6" Deluxe Jointer	603	445
37-195	6" Professional Jointer	625	539

MILWAUKEE TOOLS

6527-6	Sawzall with case	343	169
6537-22	6527 w/quick lok blade change	224	179
0407-22	12V Drill w/kyls chuck&2 batt	380	175
0224-1	3/8" Drill 4.5 amp magnum	236	136
0234-6	1/2" Drill 4.5 A mag 0-850 rpm	255	134
0235-6	1/2" Drill w/keyless chuck	255	139
0244-1	1/2" Drill 4.5 A mag 0-600 rpm	255	139
0222-1	3/8" Drill 3.5 amp 0-1000 rpm	213	128
0228-6	3/8" Drill 3.5 amp 0-1000 rpm	207	124
0375-6	3/8" close quarter Drill	255	148
0379-1	1/2" close quarter Drill	288	168
6546-6	Screwdriver 200 & 400 rpm	150	89
6547-6	6546-6 w/bits, 1/4" chuck & cs	185	112
5399	1/2" D-hdle Hammer Drill Kit	356	225
5397-6	3.8" w/ spd Hammer Drill Kit	275	145
5371-6	1/2" v/spd Hammer Drill Kit	360	194
6142	4-1/2" Grinder w/cse & acc	224	132
6494-6	10" Compound Mitre Saw	585	319
6266-6	Top Handle Jig Saw	315	159

FREUD CARBIDE TIPPED SAW BLADES
5/8" Bore - Industrial Grade

Item	Description	Teeth	List	Sale
LU72M010	Gen Pur. A.T.B. 10"	40	69	42
LU82M010	Cut-off 10"	60	93	32
LU84M011	Comb 10"	50	78	45
LU85R010	Super Cut-off 10"	80	115	68
LM72M010	Ripping 10"	24	69	39
LU73M010	Cut off 10"	60	84	49
LU87R010	Thin Kerf 10"	24	72	48
LU88R010	Thin Kerf 10"	60	88	49
LU98R010	Ultimate 10"	80	128	75
LU91M010	Compnd Mitre 10"	60	88	54
F410	Quiet Blade 10"	40	95	54
SD308	8" Dado - Carbide		230	119
SD508	8" carbide w/case & shims		344	172
FB100	16 piece Forstner Bit Set		338	194
94-100	5 pc. Router Bit Door System		320	169
FT2000E	Plunge Router		Sale	185

HITACHI TOOLS

C8FB2	8-1/2" Slide Compound Saw	1169	449
C10FS	10" Slide Compound Saw	1627	579
C15FB	15" Mitre Saw	1346	645
C10FCD	NEW 10" dual bevel Compound Mitre Saw	550	265
NV45AB	Coil Roofing Nailer	935	379
NT50AE	NEW Pinner 3/4" - 2"	Sale	119

MAKITA TOOLS

Model	Description	List	Sale
5090DW	3-3/8" Saw Kit 9.6 volt	280	139
DA391D	3/8 angle Drill 9.6V	166	95
DA391DW	3/8" angle Drill Kit 9.6V	341	139
6095DWE	9.6 volt Drill Kit w/2 batt	Sale	125
6095DWLE2	6095DWE w/flashlight	Sale	139
632007-4	9.6 volt Battery	47	30
632002-4	7.2 volt Battery	39	28

NEW 18 VOLT MAKITA TOOLS

6343DWAE	1/2" Drill Kit	Sale	255
5620DWA	6-1/2" Circular Saw Kit	Sale	255
DK1016	1/2" Drill & 6-1/2" Saw combo kit	Sale	389

CORDLESS DRILLS WITH 2.0 AMP HIGH CAPACITY BATTERIES

6213DWAE	12V 3/8" Drill Kit	325	169
6233DWAE	14.4V 3/8" Drill Kit	358	205

9900B	3"x21" Belt Sander w/bag	347	165
9924DB	3"x24" Belt Sander w/bag	360	175
N1900B	3-1/4" Planer with case	263	142
1912B	4-3/8" Planer	352	205
N9514B	4" Disc Grinder 4.6 amp	118	65
DA3000R	3/8" Angle Drill	355	185
2708W	8-1/4" Table Saw	637	295
6405	3/8" Drill Rev. 0-2100 rpm	115	65
6013BR	1/2" Drill Rev. 6 amp	270	149
9401	4" x 24" Belt Sander w/bag	458	219
5007NBK	7-1/4" Circ Saw w/ case	250	125
LS1011	10" Slide Compound Saw	995	429
LS1211	12" Slide Compound Saw	1620	695
3901	Plate Joiner Kit	376	159
3612C	3 HP Plunge Router	492	265
LS1040	10" Compound Miter Saw	460	259
LS1013	10" Dual Compound Slide Miter Saw	1088	599
BO5010	5" Random Orbit Sander	142	69
LS1220	12" Compound Miter Saw		379
9227C	7/9" Polisher	350	195
SJ401	16" Bench Scroll Saw	300	175
2702	8-1/4" Table Saw	Sale	299
2703	10" Table Saw	Sale	309

SENCO AIR NAILERS

SFN1+	Finishing Nailer 1 - 2" w/ cs	448	299
SNS45	Stapler 7/16" crown, 1" - 2"	540	365
SLP20	Pinner w/cs 5/8 -1-5/8"	422	205
SKS	Stapler 5/8 - 1-1/2"	390	269
SN70	Framing -Clip Hd 2 - 3-1/2"	725	449
SN65	Framing -Full Hd 2 - 3-1/2"	709	369
SN600	NEW Framing 2 - 3-1/2"	699	369
SFN40	Finish Nailer 1-1/4 - 2-1/2	569	349

BOSTITCH AIR NAILERS

Model	Description	List	Sale
N80S-1	Stick Nailer	Sale	325
RN45	Coil Roof Nailer 3/4 - 1-3/4	845	349
N60FN-2K	Finishing Nailer w/ case	557	269
BT35-2K	Brad Tacker 5/8" - 1-3/8" with case, oil, & brads	279	125
MIIIFS	Flooring Stapler 15 gauge	902	539
S32SX-1K	Finish Stapler-1/2" - 1-3/8" with case & oil	269	135

JORGENSEN ADJUSTABLE HANDSCREWS

Item#	Jaw Length	Opening Capacity	List	Sale	Box of 6
#0	8"	4-1/2"	20.35	12.50	69.95
#1	10"	6"	23.30	13.50	73.95
#2	12"	8-1/2"	26.75	15.75	88.95
#3	14"	10"	33.85	19.35	109.95

PONY CLAMP FIXTURES

Model	Description	List	Sale	Lots of 12
50	3/4" Black Pipe	15.45	8.50	94.00
52	1/2" Black Pipe	12.65	6.95	79.00

PANASONIC CORDLESS

EY6431NQKW	NEW 1/2" 15.6V drill kit with two 3 amp-hr Ni-Mh batteries, 45 minute charger, & case	369	205
EY6431FQKW	NEW 1/2" 15.6V drill kit with two 2 amp-hr Ni-Cad batteries, 30 minute charger, & case	339	189
EY6407NQKW	NEW 1/2" 12V drill kit with two 3 amp-hr Ni-Mh batteries, 45 minute charger, & case	339	189
EY6406FQKW	NEW 3/8" 12V drill kit with two 2 amp-hr Ni-Cad batteries, 30 minute charger, & case	305	169
EY3503FQWKW	5-3/8" 12V Wood Cutting Circular Saw Kit	500	259

BIESEMEYER FENCES

B-50	50" Commer. Saw	443	325
T-SQUARE 52	52" Homeshop	360	275
T-SQUARE 40	40" Homeshop	335	255
T-SQUARE 28	28" Homeshop	325	245

AIRY AIR NAILERS

Model	Description	List	Sale
0241SK	Brad Nailer 3/8" - 1-9/16"	180	98
0626SK	1/4" Crown Stapler 3/8" - 1"	194	89

Above nailers come w/case, fasteners, oil & wrenches

STABILA LEVELS

25010	10" die cast Torpedo Level	Sale 19.95
24640	24" Level w/ hand holes	62.20 47
24670	48" Level w/ hand holes	79.70 59
24632	NEW "Jambor Set" designed for setting door jambs. Includes 78" level and 32" level	Sale 129

DEWALT TOOLS

Model	Description	List	Sale
DW124K	1/2" right angle Drill	590	329
DW321K	Top Handle Jigsaw Kit	300	164
DW364	7-1/4" Circ. Saw w/brake	294	155
DW610	1-1/2 HP 2 handle Router	266	149
DW411K	1/4 sheet Palm Sander w/ cse	88	58
DW682K	Biscuit Joiner with case	448	169
DW705	12" Compound Mitre Saw	734	359
DW621	2 HP Plunge Router	400	199
DW675K	3-1/8" Planer with case	292	164
DW431	3 x 21 v/spd Belt Sander	338	188
DW421	5" Palm Ran. Orb Sander	144	74
DW423	Palmgrip Random Orbit Sander - variable speed	170	89
	DW421 & DW423 come with Free DW4317 case !		
DW272	Drywall Gun, 0-4000, 6.3 amp	160	95
DW276	Drywall Gun, 0-2500, 6.5 amp	160	95

DEWALT CORDLESS DRILLS

DW972K-2	3/8" variable speed w/ two 12V XR batteries	362	184
DW991K-2	3/8" variable speed w/ two 14.4V XR batteries	415	209
	Above drill kits come w/ charger & steel case !		
DW991KS-2	DW991K drill, DW935 trim saw, 2 XR batteries & case	Sale	345
DW911	NEW jobsite Radio & Charger	Sale	149

DEWALT 18 VOLT CORDLESS TOOLS

DW933K	Jigsaw Kit	468	269
DW938K	Recipro Saw Kit	520	269
DW995K-2	1/2" Drill Kit w/ 2 batt.	Sale	259
DW997K	1/2" Drill/Hammer Drill Kit	454	249
DW936K	5-3/8" Saw Kit	458	249
DW995KS-2	DW995K Drill, DW936 Saw and case	Sale	385
DW995KC-2	DW995K 18V drill kit, DW938 18V recipro saw, & case		395

DEWALT BENCH TOP TOOLS

DW708	12" Slide Mitre Saw	Sale	649
DW788	20" Scroll Saw	Sale	469
DW733	12" Planer w/ extra blades	Sale	399
DW744	10" Portable Table Saw	Sale	499
DW756	6" Bench Grinder	164	75
DW758	8" Bench Grinder	184	115

DAVID WHITE INSTRUMENTS

Model	Description	List	Sale
LP6-20A	Sight Level package-20x	329	239
LP6-20XLA	LP6-20A with 9056 tripod and 7620 rod	409	269
LT8-300	Level Transit - 26x	739	539
LT8-300P	above Level with optical plum	869	629
LT6-900	Level Transit - 20x	419	299
LTP6-900	Above Level with tripod and rod	615	395
ALT6-900	Automatic Level - Transit - 18x	666	479
ALTP6-900	above Level with tripod & rod	799	549
AL8-22S	Automatic Level - 22x	583	289
ALP8-22	Above level with tripod & rod	Sale	349
AL8-26S	Automatic Level - 26x	854	325
ALP8-26	Above level with tripod & rod	Sale	389

BOSCH

Model	Description	List	Sale
1587VS	Top Handle "CLIC" Jig Saw	292	139
1587AVSC	1587VS Saw Kit with case and *New* Progressor blades	Sale	155
1584VS	Barrel "CLIC" Jig Saw	288	149
	Bosch Metal Case for above Jig Saws		24
	Bosch 30 blade assortment for Jig Saws		29.99

1584VS or 1587VS
with steel case and 30 Bosch blades
Sale 175

1295DH	5" Random Orb Palm Sndr	145	89
1274DVS	3"x21" v/spd Belt Sander	301	175
1278VSK	1-1/2"x12" Belt Sander	218	129
1275DVS	3"x24" v/s Belt Sndr	379	219
1276DVS	4"x24" v/s Belt Sndr	408	229
1194VSRK	1/2" v/ spd Drill w/ case	303	159
1613EVS	2HP v/s Plunge Router	369	199
1634VSK	Recip Saw 10.5 amp	335	185
3315K	12V T-handle Drill Kit	345	159
3615K	14.4V Drill Kit	354	174
3107DVS	5" Random Orbit Sander	165	98
3107DVSK	3107DVS with case	195	118
3725DVS	5" Random Orbit Sander	256	145
3727DVS	6" Random Orbit Sander	266	149
3915	10" Slide Compound Saw	1050	499
3912	NEW 12" Cmpnd Mitre Saw	638	299
11224VSR	7/8" SDS Rotary Drill	404	229
1703AEVS	5" Grinder - 8.5 amp	245	145
1347AK	4-1/2" Grinder with case	159	92
1638K	Drywall Cut-out Unit	165	105
1617	1-3/4 HP Router - 2 handle	Sale	159
1617EVS2	2 HP Router w/ variable speed - 2 handle	Sale	189
1618	1-3/4 HP Router - "D" handle	Sale	179
1640VS	NEW Power Tenon Saw	200	129
1640VSK	NEW Power Tenon Saw Kit	370	229
3850	18V cordless Drill Kit	Sale	269

JDS AIRTECH AIR CLEANERS

Model	Description	List	Sale
750	12"x24"x28" 1/4 hp 200 CFM - 750 CFM	Sale	249
8-12	20"x24"x44" 1/3 hp 800 & 1200 CFM	Sale	479

RYOBI SPECIALS

RE600	3 HP Plunge Router w/spd.	500	239
WDS1600	16" x 32" Drum Sander	980	569
	Above sander comes with stand		
JM80K	Plate Jointer with case	218	105

JET TOOLS

JJ60S	6" Jointer - open stand	Sale	429
JJ6CSXW	6" Jointer - closed stand and extra knives	Sale	499
JJ8CS	8" Jointer - closed stand	Sale	1189
JWBS14OS	14" Band Saw 3/4 HP - open stand	Sale	479
JWBS14CSW	14" Band Saw 1 HP - closed stand with rip fence and mitre gauge	Sale	579
JWTS10CW2JF	10" Contractor Table Saw with 30" Jet fence and cast iron wings	Sale	649
JWTS10CWPF	10" Contractor Table Saw with 30" Exacta fence 1-1/2 HP	Sale	769
JTAS10X501	10" Tilting Arbor 3 HP Table Saw with 50" Exacta fence, table, and legs	Sale	1399
JDP17MFW	16-1/2" Drill Press 3/4 HP - 16 speed with bits and mortise attachment	Sale	419
DC-650	Dust Collector, 1 HP, 650 CFM	319	199
DC1100	1-1/2 HP, 1100 CFM Dust Collector	425	299

PORTER CABLE

9444VS	Var/spd Profile Sander Kit	207	119
690	1-1/2 HP Router 8 amp	278	149
6931	Plunge Router Base	139	85
693PK	690 and 6931 plus case	Sale	199
9690	690 Router with case	Sale	159
691	1-1/2 HP Router D-handle	303	168
693	1-1/2 HP Plunge Router Base	338	188
697	1-1/2 HP Router/Shaper	418	235
698	Heavy Duty Shaper Table	238	135
352VS	3x21 v/s Belt Sander w/bag	321	175
9352VS	Above sander with case	Sale	189
360	3"x24" Belt Sander w/bag	397	214
360VS	360 Sander w/ variable speed	429	229
362	4"x24" Belt Sander w/ bag	412	225
362VS	362 Sander w/ variable speed	446	239
9125	3-1/4" Planer Kit w/ case	250	145
505	1/2 sheet Pad Sander	249	139
330	Speed Block Sander 1/4 sheet	120	69
556	Biscuit joiner w/ 5556 fence	Sale	135
557	Plate Jointer with tilt fence. Includes 2" & 4" blades for use with standard & face frame plates	400	205
5563	Face frame plates for 557		7.99
7529	NEW 2 HP variable speed Plunge Router	415	215
97529	Above router with guide, dust collection, and case	480	249
7519	3-1/4 HP Router 2 Handle	469	268
7518	3-1/4 HP 5 speed Router	534	295
7539	3-1/4 HP v/sp Plunge Router	534	289
7310	5.6 amp Laminate Trimmer	176	104
97310	Laminate Trimmer Kit comp.	336	194
97311	Laminate Trimmer Kit with underscribe base	390	205
7335	5" Random Orbit Sander	254	139
97355	7335 w/ case & dust pick-up.	274	149
7336	6" Random Orbit Sander	259	145
97366	7336 w/ case & dust pick-up.	284	159
332	Palm Grip Rndm Orb Sander	133	59
333	above sander with dust bag.	148	65
333VS	Random Orbit Sander - variable speed	150	88
334	333 Sander with PSA pad	148	65
335	Palmgrip Random Orbit Sander with dual flip pad	Sale	85
310	Production Lam. Trimmer	270	154
347K	7-1/4" "Framers" Circ Saw with plastic case	250	129
743K	7-1/4" "Framers" Circ Saw with case - left hand version	250	129
9737	Tiger Recipro Saw	307	159
9543	NEW Top Handle Jig Saw	300	165
97765	NEW SDS Rotary Hammer Drill	380	199
9862	12V Drill Kit w/ 2 batteries	382	149
9862F	9862 Drill Kit with flashlight	Sale	159
9872	14.4V Drill Kit w/ 2 batteries	424	185
CDA250	Angle Finish Nailer 1-1/4" to 2-1/2"	500	279
CFN250	Finish Nailer 1" to 2-1/2"	500	279

Porter Cable Pneumatic Nailers

BN125	Brad Nailer -18 ga. 5/8"- 1-1/4"	144	89
BN200	Brad Nailer -18 ga. 3/4"-2"	238	128
FN250A	Finish Nailer -16 ga. 3/4"-2-1/2"	362	185
DA250A	Nailer -15 ga. 1-1/4"-2-1/2"	412	215
FC350	Framing Nailer - clipped head	558	285
FR350	Framing Nailer - round head	558	285
RN175	Roofing Coil Nailer	504	259

Porter Cable Compressors

CF1400	1 HP, 4 gal. Pancake	Sale	199
CF1540	1-1/2 HP, 4 gallon Side Stack	Sale	305
CF2400	2 HP, 4 gal. Side Stack	Sale	329
CF2020	2 HP, 20 gallon wheeled	Sale	425

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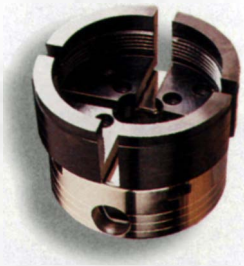

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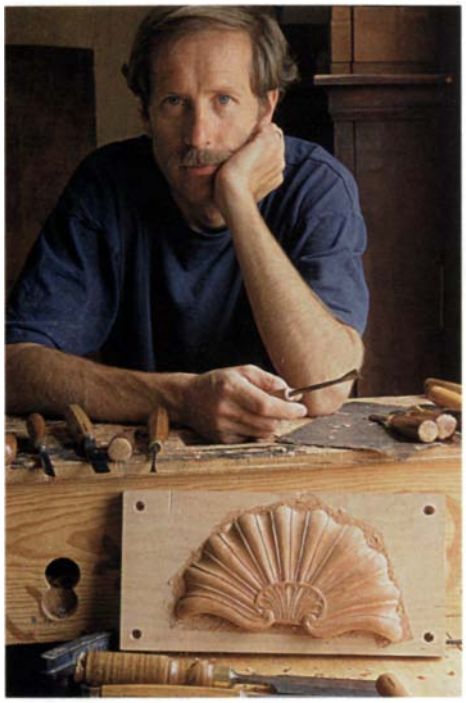
READER SERVICE NO. 178

The shell game

Tips for carving a classic Newport shell



BY ALLAN BREED

Carving can be intimidating. The idea of creating lifelike three-dimensional images from a block of unmarked wood using a confusing array of expensive gouges and chisels is enough to make a Shaker out of many woodworkers. But give even an avowed noncarver a taste of the satisfactions of producing a convincing carving, and you may have a hard time wresting the tool roll away from him.

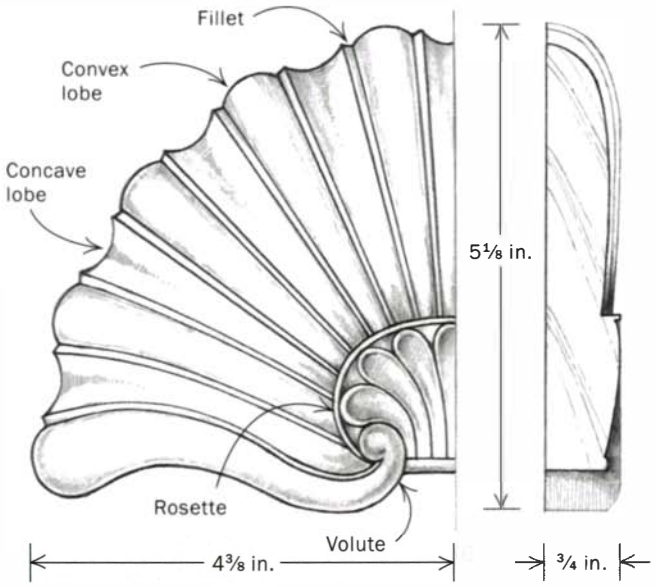
Cabinetmaking and carving are separate trades by tradition. While the cabinetmaker showcases the beautiful properties of his wood, the carver is the alchemist, transforming wood into shells, ribbons and foliage. When you reproduce a piece of fine period furniture, you are likely to be copying carvings done by someone who did nothing but carve every day for decades. Studying these original carvings can be exceedingly helpful to a carver at any level of accomplishment. Such work might look magically good, but a hand lens and a little patient observation can help demystify it, uncovering the tools and sequence of cuts the carver employed.

Carving on period furniture was a finely calibrated status symbol, an indicator of

FOUNDATION OF A FINE SHELL: LAYING OUT AND ROUGHING IN

Precise work at the start pays off at the end. The initial work guides all later cuts and determines the eventual proportions of the piece.

Two saws start things off. *The author uses a bandsaw to make shallow kerfs that mark the transitions, or fillets, between concave and convex lobes. He follows up with a handsaw to carry the kerfs across the top of the shell. The deeper bandsaw kerfs are relief cuts at the ends of the concave lobes.*



Rounding the rim. *Starting in the center, the author uses bench chisels to turn down the perimeter of the shell (left). The shape he aims for is not an arc but a section of an ellipse: The curve begins gently and then accelerates. At both sides of the shell (right), he chops downward instead of slicing through side grain. A few strips of double-sided carpet tape secure the blank to a sacrificial backer board during carving.*

A gentle ramp. *After defining the perimeter of the rosette at the center of the shell with 1/16-in.-deep chops with a gouge, the author wields a straight chisel bevel side down to create a ramp, a slight rise from the rosette toward the perimeter.*

Photos: Jonathan Binzen; drawings: Erika Marks

the wealth of the patron who commissioned it. Remove the carved and applied ornament from a Chippendale chest or secretary, for example, and a simple box on legs remains. To burnish his status in the community, a wealthy patron might request that the box be dressed up with ball-and-claw feet, a fancy base molding, carved drops, quarter columns, blocked or carved drawer fronts, flame finials, paneled doors with pilasters, an elaborate cartouche on top or even statues of political or allegorical figures.

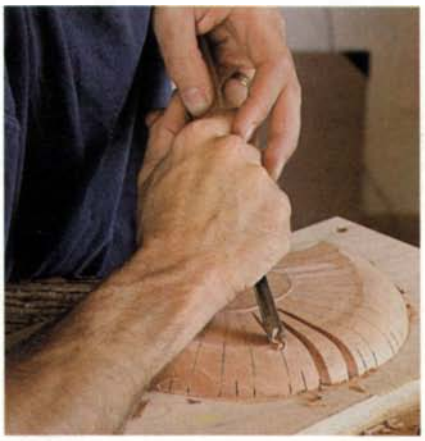
The shell I carved for this article reproduces one found capping the panels on the upper doors of a famous Newport, R.I., secretary built in the 1760s and attributed to John Goddard. Similar shells are found on Connecticut and Rhode Island clocks, desks, tables and chests. Compared with the often elaborate carving from other Colonial cities such as Boston and Philadelphia, this shell is relatively austere.

Although period makers occasionally carved shells right into solid drawer fronts or desk lids, most shells were carved sepa-

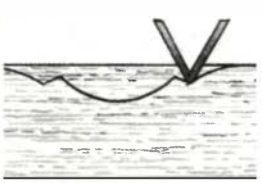
Austere shells. *The six shells on the author's reproduction of John Goddard's 9½-ft.-tall secretary are typical of the powerful and elegant but relatively simple carvings found on Newport furniture in the 18th century.*

DEFINING THE FILLETS

Fillets form the transitions between the shell's concave and convex lobes; carve the fillets carefully, and good lobes will follow.

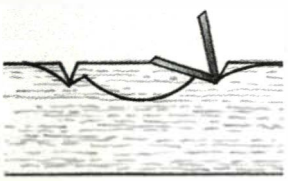


V-grooves start the fillets. *After redrawing the fillet lines in the ramped area, a parting tool is used to establish each fillet with a V-shaped groove. The groove, centered on the line nearest to the convex lobe, should be about ⅛ in. deep at the rosette and deeper as it reaches the perimeter, where it should just erase the shallow bandsaw kerf.*

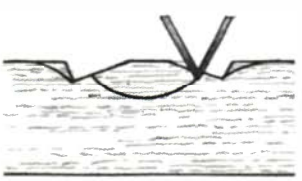


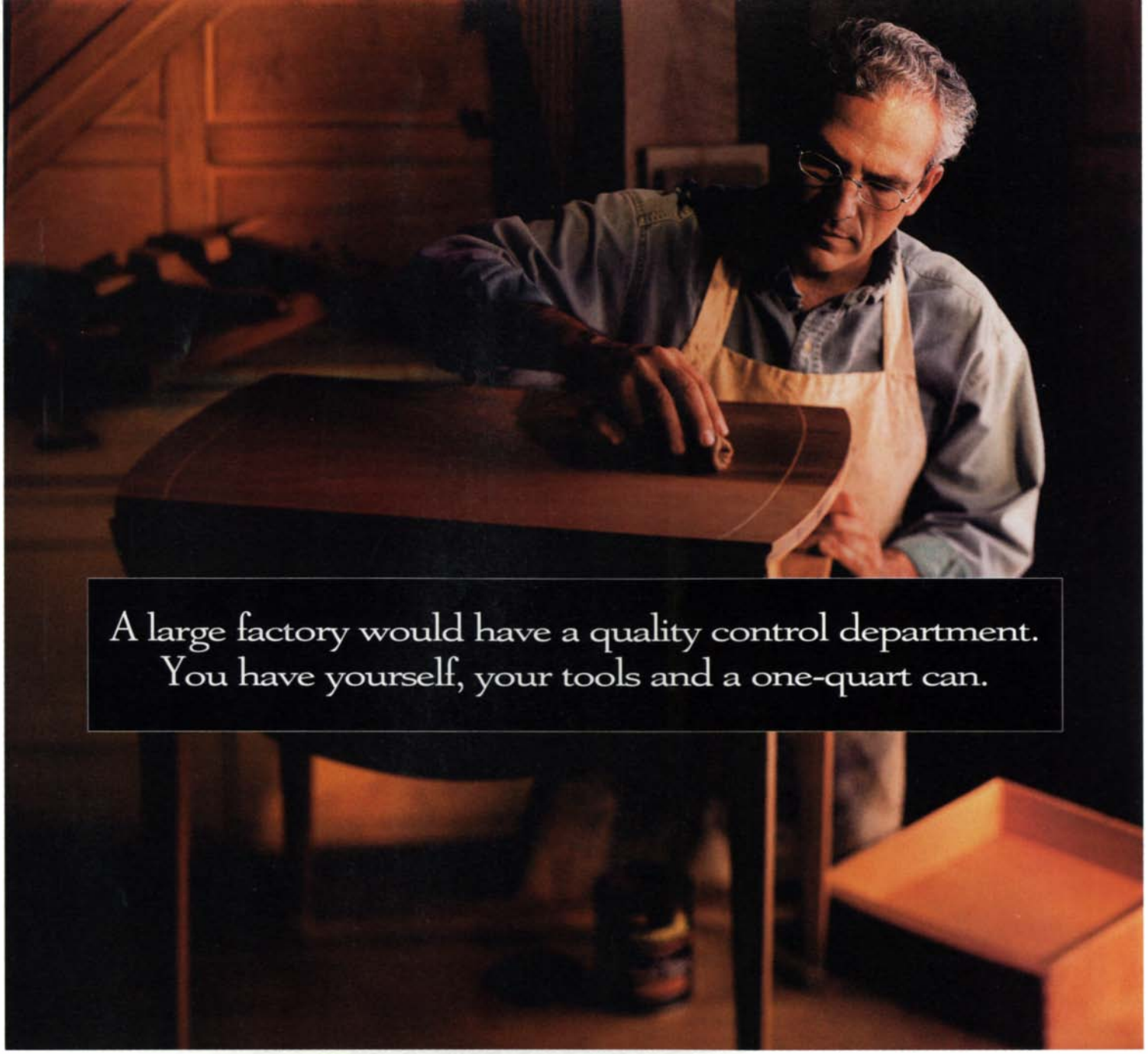
To slice cleanly through changing grain, the author grinds back his parting tool, producing a shearing cut.

Open up the V-groove. *A second pass with the parting tool flattens the V-groove on one side and establishes the fillet surface. The author rolls the parting tool toward the concave lobe and cuts that side of the V-groove so that it is at 20° or 30° rather than at 45°.*



Finishing the fillet. *With dividers or a compass set at 3/32 in., the author scribes the width of the fillet from backer board to rosette (left). One leg of the dividers rides in the bottom of the V-groove, the other on the concave-lobe side of the V-groove. With the parting tool, he makes a shallow cut to the concave-lobe side of the line (below left). This cut both defines the fillet and starts the wall of the concave lobe.*





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rately and then applied to the piece of furniture. This enabled the maker to use thinner stock and to avoid the danger (when carving in the solid) of a tool's slipping and damaging the area around the shell.

For this shell, I used some very cooperative mahogany—the kind of stock a friend of mine calls ego wood, for how good it makes you look when you work it. I sometimes choose wood with figure for shell carvings, but the difficulty increases with every little flip and turn of the grain.

With this Newport shell, as in all carving, the basic shaping of the blank is extremely important. This initial shaping is to the final product much like preliminary sketching is to drawing the human figure: The basic proportions must be correct for the final figure to be convincing. Even carving great details later on will not save a hurried and lumpy roughing out. I try to be patient and treat the initial shaping as if it were an end in itself.

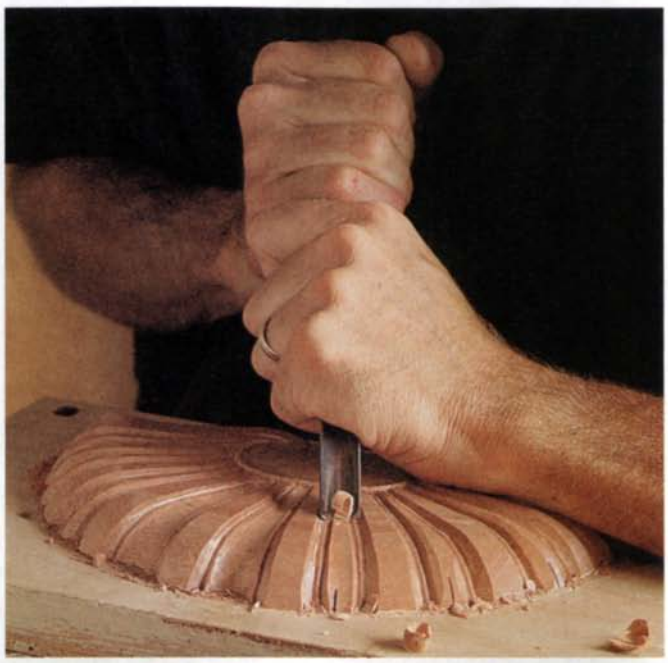
One question—*What tool do I need to create the shape I want?*—should be in mind always. It is worthwhile to take some time to practice with your tools and learn what shapes they leave as they pass through the wood. Carving that looks tentative and worried-over can be very distracting. Ideally, the carving will flow in a seamless and spontaneous rhythm.

I try to use the largest tool possible for the job and use it for as many operations as possible before I put it down, thus saving time switching back and forth from tool to tool. Some students of mine raised their eyebrows recently when I used a 2-in. socket chisel to true up the lobes on a shell. I needed to achieve a long, straight, cylindrical shape, so I chose a tool with a long, straight edge. It can be that simple. Of course, I'm not recommending you do the whole shell with a 2-in. chisel. There are hundreds of different shapes available in carving tools, and the closer the tool is to the shape you want to carve, the better off you'll be.

As you wield your tools, you'll get smoother results if you maintain at least two points of contact with the work—the tip of the tool and some part of your hand or arm. I also find that teaching yourself to be ambidextrous as a carver provides a great advantage. With all of the grain changes you encounter in deep relief carving, you constantly need to change your

THE HEART OF THE MATTER: CARVING THE LOBES

The lobes would seem to be the hardest part of the shell to carve, but if the preliminary work has been done well, the lobes usually flow fairly easily.



Concave comes first. *Starting about a third of the way out from the rosette, the author cuts outward with a gouge of slightly smaller sweep than the widest point of the lobe. He takes increasingly deep cuts until the final pass cuts across the entire lobe, right up to the fillets. He cuts the center third with a smaller gouge, feathering its cuts into the larger ones. The last cut is made back toward the center, and a downward chop with a chisel relieves the waste.*

Giving convex lobes their curves. *Convex lobes are shaped with gouges used bevel side up. A small backbent gouge is useful for the section near the rosette and for areas of tricky grain.*

The ins and outs of lobes. *Grain orientation on all but the center lobes will usually necessitate cutting toward the rosette on one side of the lobe and away from it on the other.*

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angle of approach to the work; having the flexibility to carve from left or right is a tremendous benefit.

There are certain spots in the shell that will be difficult to carve without splintering out, especially where the bottom lobes curl in toward the center motif. If you reach a point where you'd just as soon open paint cans or chip ice off the steps with your carving tools, switch to anything that works. I grind scrapers from hacksaw blades, use saw files, tapered square auger-bit files and rasps to get into those nasty spots, especially in figured woods. You may even want to grind certain tools (such as small skews and gouges) in duplicate pairs for left and right use.

As I work I often pause to feel the carving for flats and bumps, comparing one side to the other for symmetry. But the final test of a carving's quality is the eye. If it looks good, that's all that matters. No one is ever going to pull out calipers and check your work. In fact, enormous discrepancies in proportion will often go unnoticed. So assess the work by eye. If something looks wobbly or out of proportion, go back and work on it until it looks better. If it looks believable, leave it.

Natural light raking across the work or a low-angled floodlight will make it easier to check for imperfections. A light directly overhead will do no good at all. It will not cast shadows, effectively flattening out the carving. Even a little bit of daylight angling through a window or a low-wattage bulb shining across the work will provide far better carving light than a much brighter ceiling light.

When you work with good, oblique light, you realize that it doesn't take a very deep cut to create a desired shadow. Err on the shallow side in cutting—you can define shapes more deeply later if need be.

THE MOTIF IN THE MIDDLE

The much smaller and shallower carving of the rosette goes relatively quickly after the harder work of the lobes.

Shape and shave the rosette field. *Using a gouge with a shallow sweep, the author defines the narrow, curving rib at the rim of the rosette. Then, after he chops in the volutes, he uses a wide chisel to angle the whole field of the rosette, ramping it downward from the rim toward a line between the volutes drawn 3/16 in. below the high point.*

V-grooves stop at the bar. *Parting-tool cuts define the petals of the rosette, starting at the rim and ending at a 1/8-in.-wide bar at the base of the ramp.*

Chop the tops. *After defining the tops of the petals using a gouge with a tight sweep, the author uses a shallower gouge to remove the triangular chip between petals.*

One last bit of gouging. *A large gouge scoops out the petals, dishing them out deeply at the tops and letting the cut feather out lightly at the base.*

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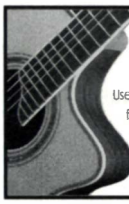
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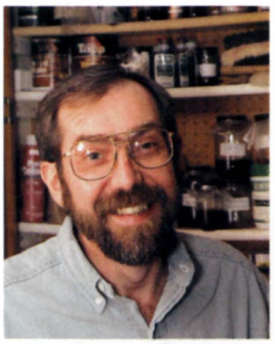
BY CHRIS MINICK

Solutions to common finish problems



Putting a finish on wood can be a convenient way to prove Murphy's Law: What can go wrong will go wrong. I know—from experience and from countless stories I've heard from other woodworkers—you can take that truth to the bank.

It's been said that the difference between a good finisher and a great finisher is that a great finisher knows how to hide his mistakes. With finishes—wiped on, brushed on or sprayed on—no statement is more true. Here are some tricks, most of them simple, that have pulled my fat out of the fire more than once.

The stain is too dark

You stain a piece of furniture, and the color is much darker than you anticipated. If you used a dye stain, you're in luck. Dye stains are soluble in the same solvent used initially to dissolve them—usually alcohol or water. Wiping the stained wood with a rag soaked in the solvent will remove some of the dye from the wood and lighten the color.

Wash that dye right out of the wood. *Dye stains are easily reversible, but pigment stains may require paint stripper.*

If more color must be removed, bleach the dyed wood with regular household chlorine bleach. Woodworking dye stains are similar to fabric dyes, and chlorine bleach will remove color from dyed wood just as it removes color from fabric. Two or three applications of full-strength bleach (typically 5% sodium hypochlorite) will remove about 90% of the color. After the dyed wood has been bleached, it must be thoroughly rinsed with clean water to remove the residual hypochlorite crystals so that the topcoat finish will bond properly to the wood.

Unfortunately, correcting problems with pigment stains is not so easy. If the pigment stain has not completely dried, some color can be removed by vigorously wiping the stained surface with a rag soaked in mineral spirits. Once it has dried, the only way to remove a pigment stain is with paint stripper. I've found that slow-acting, water-based paint strippers remove pigment stains better than solvent-based varieties do.

Dry, glossy spots appear on some woods finished with Danish oil

Danish oil—a name often used for a wipe-on finish—is supposed to be foolproof. Wipe it on, let it soak, wipe it off and forget it. That's the way it works on birch and maple, but it's not quite so simple for oak or ash. Woods with large, open pores will ooze Danish oil for hours after the finish has been applied. If this excess oil dries on the surface, shiny patches of polymerized oil along the grain lines will appear. At that point the only fix is to sand the entire piece and reapply the oil, but you can adopt a strategy to keep it from happening again. Apply the finish early in the day and check the surface every 30 minutes or so, wiping off the excess as it appears. Depending on the saturation level, the oozing should stop after four or five hours.

Some woods bleed oil. *Large open pores in wood drink in oil finishes, then spit some of the oil back out, drying as unsightly glossy spots.*

Some woodworkers claim that thinning a Danish oil finish about 20% with VM&P naphtha and adding a few drops of cobalt dryer (available at art-supply stores) will minimize the problem. I have not tried this fix, so I can't vouch for it. However, I use a homebrew Danish oil finish in my shop and rarely have any bleeding problems. My formulation is simple: 1½ cups of mineral spirits, 1 cup of brushing varnish and ¼ cup of boiled linseed oil.

Craterlike defects appear on the surface of your freshly sprayed furniture

These defects, known as fisheyes, are caused by contamination either in the finish or on the sprayed surface. The contaminant in the center of each crater affects the surface tension of the sprayed finish, causing it to form the small craters. The two most likely causes of fisheyes are droplets of oil (from an inadequate or clogged compressor filter) or the overspray of a silicone lubricant. Each oil or silicone droplet becomes the nucleus of a fisheye. Silicone spray lubricants are so pervasive that, used once, they can contaminate every spray-finishing project in the shop for years.

Fisheyes can be a curse. *When silicone lubricants contaminate spray systems, you can have chronic problems with fisheyes for a long time.*

You can buy additives to eliminate fisheyes, but I advise against using them. Many of these additives are pure silicone oil. They work by purposely contaminating the finish with silicone oil to make it compatible with any stray silicone oil or other contaminant that may be on the wood surface. This approach does work, but the fisheye eliminator thoroughly contaminates the innards of your spray gun. Once you begin using fisheye eliminator, you'll have to add it to everything you

Photos: William Duckworth

spray through that gun from that time forward. A better solution is to find the contamination source and eliminate it.

To salvage an already fisheyed finish, lightly sand it to remove the craters. Wipe away the bulk of the silicone or oil contaminants using a rag soaked with VM&P naphtha. Then spray on two or three light coats of dewaxed shellac. This shellac layer will trap any residual contamination and prevent it from causing subsequent finishing problems.

Brush marks are easy to fix. *Varnishes that went on too thick can leave brush marks that will disappear with a little sanding.*

Brush marks show in your dried varnish

Most oil-based varnishes are too thick to use as a finish straight from the can. They simply don't level well at that high viscosity. For furniture finishing, I thin my brushing varnish to the consistency of whole milk. The varnish should flow from the brush in a smooth, wet sheet as you draw the brush across the wood but not so thin that it causes excessive drips or runs. The type of brush you choose and how you use it are important (see *FWW* #98, pp. 54-56).

To fix dried-on brush marks, sand the rough varnish coat with 180-, 220- and 320-grit nonloading sandpaper until the surface is level and smooth but scratchy. Then wet-sand with 400-grit wet-or-dry sandpaper using a Danish oil finish as the lubricant. Wipe off almost all of the finish and sanding-swarf slurry, leaving just enough on the surface to fill the scratches left by the sandpaper. Don't worry about adhesion problems: The oil/varnish mixture will bond to any other varnish—even polyurethane—providing the varnish coat is not more than three or four weeks old.

White specks appear under lacquer

You stained your project with an oil-based stain and finished it with a nitrocellulose lacquer. The finish turned cloudy, and white specks appeared in the grain. This problem occurs when uncured oil-based stain is topcoated with a nitrocellulose lacquer. Residual, uncured oil from the stain forces some of the nitrocellulose resin out of solution, forming small pockets of crystallized lacquer under the clear finish film. This phenomenon is closely related to lacquer blush, which is caused by water instead of oil—same mechanism, different culprit. (Lacquer blush occurs on humid days at the outer surface of the finish film, while oil-stain-induced cloudiness is trapped underneath it.)

White specks are similar to blush problems. *Often faint (as shown above) but sometimes prominent, this problem occurs when uncured oil is trapped beneath the finish film.*

Unfortunately, there is no easy and reliably consistent fix for this problem short of stripping the finish, letting the stain dry thoroughly and starting over. That said, there is one quick fix that works about 20% of the time. It is worth trying, before you resort to paint stripper. Spray the piece with a 1:4 mix of lacquer retarder and lacquer thinner. If the film is not too thick, this mixture will sometimes dissolve the crystallized nitrocellulose and form a clear finish film when it dries again. Incidentally, this same solvent mix will cure lacquer blush, too.

Runs, drips or sags appear on your furniture

Runs, drips and sags are unavoidable with many types of wood finishes. It's easiest to deal with these unsightly blemishes while the finish is still wet. Wipe off or brush out the drip before it has a chance to set, then apply another thin coat of finish to even out the surface. If you don't notice a run in the finish until after it has dried, slice it off with a sharp chisel or a cabinet scraper instead of sanding it flat, which creates a small halo around the drip that is very difficult to repair.

No runs, no drips, no sags. *Maybe that's your goal, but it's not always what you get. This is a mistake that's easily put right.*

One neat trick my grandfather taught me is to finish cabinet doors upside down. Because we're not accustomed to seeing drips run uphill, a small run that escapes detection in the finishing room becomes almost unnoticeable once the door is installed.

The sprayed surface feels rough and looks dull

This condition is known as "orange peel" in spray-finishing lingo because the sprayed surface looks like exactly that. Many things can cause orange peel: The spray gun is held too far from the surface (6 in. to 8 in. is the optimum distance); the spray gun moves too fast to form a full, wet coat of the finish; the atomization pressure at the spray gun is set too low; and by far the most common cause of orange peel is not properly thinning the finish before spraying. The viscosity of a spray finish must match the requirements of the air cap and fluid nozzle set up in your gun. The proper viscosity for your gun should be listed in the owner's manual.

Here's a nice trick to salvage a lacquer finish that has an orange-peel surface already dried in place. Spray the surface with a full, wet coat of a mixture of one part lacquer retarder to 20 parts lacquer thinner. This thinner mixture will usually flatten an orange-peeled surface in one application, but multiple applications may be needed in severe cases. Once that's dry, spray on another coat of the original lacquer finish to complete the job.

Orange peel has several causes. *A full, wet coat of thinner mixed with a little retarder thinner and sprayed over the dried lacquer will usually correct this problem.*

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Flipped Lid

Jim Moon keeps making toolboxes. He absolutely must—to keep up with his tool collection. So far, Moon, a doctor in Charlotte, N.C., who makes period furniture, has made a half dozen toolboxes. This one, with its unusual lid, is based on a century-old carpenter's toolbox made of chestnut and probably intended for use on a job site. Most of Moon's boxes are filled with tools he uses, but this one stands in his living room and holds special tools he's collected.

The materials in Moon's box are collectible, too. The dovetailed case is made of walnut from Moon's native South Dakota, where the harsh climate, he says, produces walnut that is "harder, denser, finer grained and a real pleasure to work." The crossbanding between the walnut-burl drawer fronts was made in France in the 1920s and intended for the Singer sewing-machine company. And the ivory Moon inlaid in the ebony drawer pulls and used for his initials is also of an unusual age and origin. A by-product of gold mining below the permafrost in Alaska, the ivory is from the tusks of a woolly mammoth and is said to be some 50,000 years old.

Photos: Mark Meachem (top two); Andy Rae (bottom)