TAUNTON'S

Fine WoodWorking

CELEBRATING 25 YEARS

August 2000
No. 143

A quick and easy wipe-on finish

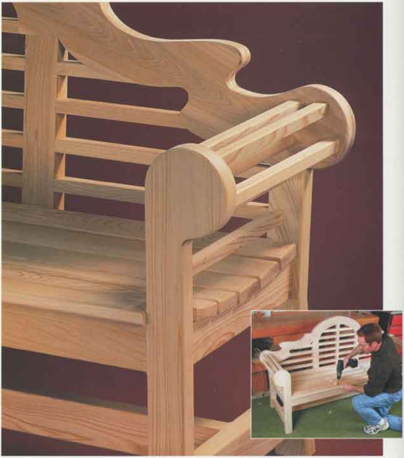
Bandsaw your own veneer

Compact workbench

Full-extension wooden drawer slides

Shopmade dovetail jig

Compound-angle joinery



Classic outdoor bench project

U.S. $6.95
Canada $7.95
U.K. £4.25

08>

0 74851 64797 4

Departments

Bandsaw your own veneer, p. 44

A workbench that works, p. 50

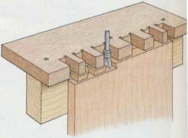
No-brainer varnish technique, p. 57

On the Cover:

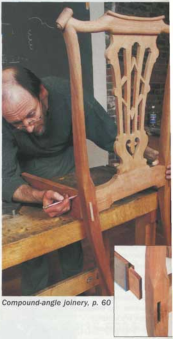
For Tony O'Malley, building a reproduction of the Lutyens garden bench was like putting together a large jigsaw puzzle. He simplified the job by breaking it into manageable steps. See p. 78

Photos: Scott Phillips; Matthew Teague (inset)

Articles



Shopmade dovetail templates, p. 86



Compound-angle joinery, p. 60

Contributors

Christian Becksvoort ("Full-Extension Wooden Slides") is the kind of guy a Shaker would entrust to repair an antique. His restoration work at the last Shaker community in the country, in Sabbathday Lake, Maine, is as renowned as the Shaker-style furniture he builds from scratch at his shop in New Gloucester. The Taunton Press published his book, *The Shaker Legacy*, in 1998. Becksvoort has been a contributing editor to *Fine Woodworking* since issue #72 (September/October 1988).

Jamie Buxton ("Shopmade Dovetail Templates") has been designing and building furniture for more than 30 years while supporting himself as a computer engineer. Two years ago he finally quit his high-tech day job and now does custom furniture full-time. He says, "I'm having so much fun I can't imagine why I didn't do this sooner."

Phil Lowe ("A Workbench That Works") has been making and repairing museum-quality furniture since 1972. He completed his formal training in the cabinet and furniture-making program at North Bennet Street School in Boston. After graduation, he was an instructor at the school for 10 years. His shop, situated on the waterfront in Beverly, Mass., is now the home of his own school, The Furniture Institute of Massachusetts. You can visit his web site at www.furnituremakingclasses.com. When he's not teaching or working wood, you can find him out in the harbor on his sailboat.

Lee Grindinger ("Three Simple Moldings") paid his dues in the construction trades, doing everything from floor installations to trimwork, before he settled into making and carving furniture for a living. After several years working and living on the East Coast, he and his wife moved to the wide-open spaces of Montana. They built a home and workshop in the Paradise Valley just north of Yellowstone National Park, where they take frequent day trips to dodge the geyser eruptions.

Tony O'Malley ("The Lutyens Garden Bench") has been woodworking since college in the early 1980s. He has worked for shops specializing in custom furniture and architectural millwork and as a book editor at Rodale Press. He currently combines freelance writing, editing and furniture making from his home in Emmaus, Pa.

Will Neptune ("Compound-Angle Joinery") graduated from North Bennet Street School in 1979 and has been an instructor there since 1985. He also teaches short courses at various woodworking schools and maintains an active schedule of commissioned custom furniture, the latest of which was a set of Chippendale chairs.

Steve Brown (Master Class) graduated from the cabinet and furniture-making program at North Bennet Street School in 1990, then spent eight years building custom furniture with Phil Lowe. He now teaches at North Bennet Street School and runs his own business, turning out a steady supply of custom furniture. He came up with the idea of a tablesaw jig to cut compound-angle joinery when his former instructor, Will Neptune, asked if he could lend a hand on a chair commission.

Fine WoodWorking

EDITOR **Timothy D. Schreiner**
ART DIRECTOR **Bob Goodfellow**
MANAGING EDITOR **Anatole Burkin**
SENIOR EDITOR **Jonathan Binzen**
ASSOCIATE EDITORS **William Duckworth, Matthew Teague, Asa Christiana**
SENIOR COPY/PRODUCTION EDITOR **Thomas McKenna**
ASSOCIATE ART DIRECTOR **Michael Pekovich**
IMAGING SPECIALIST **William M. Godfrey**
WEB MANAGING EDITOR **Timothy Sams**
ART ASSISTANT **Erika Marks**
EDITORIAL ASSISTANT **Chris Baumann**
CONTRIBUTING EDITORS **Tage Frid, R. Bruce Hoadley, Christian Becksvoort, Mario Rodriguez, Chris Minick, Gary Rogowski, Mike Dunbar**
METHODS OF WORK **Jim Richey**
INDEXER **Harriet Hodges**

PUBLISHER **Jon Miller**
MARKETING MANAGER **Karen Lutjen**
MARKETING ASSISTANT **Diana Rabito**
SECRETARY **Patti Dobson**

CIRCULATION MANAGER **David Pond**
CIRCULATION PLANNER **Jeanne Todaro**

ADVERTISING DIRECTOR **Sam Vincent**
ADVERTISING MANAGER **Brian M. Ziff**
NATIONAL ACCOUNTS MANAGERS **Tom Brancato, Linda Abbett**
ACCOUNTS MANAGER **Jason W. Clark**
ADVERTISING SECRETARY **Hilda Fernandes**

WOODWORKING BOOKS & VIDEOS
ASSOCIATE PUBLISHER **Helen Albert**
EDITOR **Tom Clark**
ASSOCIATE EDITOR **Jennifer Renjilian**

Fine Woodworking: (ISSN: 0361-3453) is published bimonthly by The Taunton Press, Inc., Newtown, CT 06470-5506. Telephone (203) 426-8171. Periodicals postage paid at Newtown, CT 06470 and at additional mailing offices. GST paid registration #123210981. U.S. distribution by Curtis Circulation Company, 730 River Road, New Milford, NJ 07646-3048 and Eastern News Distributors, Inc., One Media Way, 12406 Route 250, Milan, OH 44846-9705.

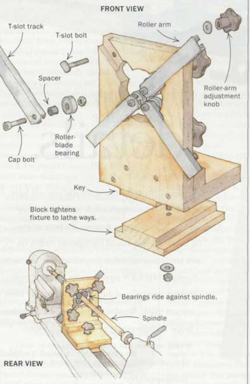
Subscription Rates: $32 for one year, $56 for two years, $79 for three years (in U.S. dollars, please). Canadian residence GST included. Single copy, $6.95. Single copies outside the U.S. and possessions, $7.95.

Postmaster: Send address changes to *Fine Woodworking*, The Taunton Press, Inc., 63 South Main St., P.O. Box 5506, Newtown, CT 06470-5506.

Printed in the USA

Shopmade steady rest

In the process of turning dozens of spindles for a bed I was making, I found I needed a steady rest to stabilize the thin spindles during the later stages of turning. I came up with a design that is easy to build, easy to adjust and works admirably. The steady rest consists of a main body and four roller arms. For the body, I laminated two pieces of ½-in.-thick Baltic-birch plywood. I made the roller arms by mounting roller-blade bearings (available from large sporting-goods stores) to the ends of 6-in. lengths of T-slot track. The roller arms adjust and lock into position with T-slot bolts and plastic knobs. T-slot hardware is available from Woodcraft (800-225-1153) and other mail-order suppliers.

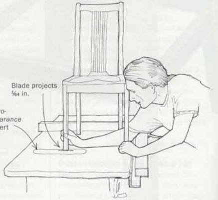


To make the steady rest, start by cutting out the vertical part of the body from the Baltic-birch plywood and locating the lathe's centerline on it. You can find and mark the centerline's height above the lathe bed by placing the vertical piece on the lathe bed and squeezing it between pointed centers. Cut two dadoes into the vertical part of the body (for the T-slot tracks) in an X pattern, with the X centered over the centerline point. Cut a circular opening through the body that is big enough for the largest spindle you will be turning, then drill holes for the hardware as necessary. Add a key to the bottom of the body to keep it centered and straight on the bed of the lathe. You will need to tailor the key and the fixture's bed-locking mechanism to your lathe.

To use the steady rest, slide it onto the spindle, lock the fixture to the bed, then adjust the roller arms so that the bearings ride gently against the spindle and support it during turning.

—Robert D. Eberhardt, Eau Claire, Wis.

Stabilizing the legs of a wobbly chair



You've just built a chair, and you need to see if it wobbles. So you take it to the one guaranteed flat spot in your shop, which is probably the top of your tablesaw. You mark the high leg and then try to decide which torturous way you are going to trim that little bit off. Here's how I do it. Put a zero-clearance insert into the table-

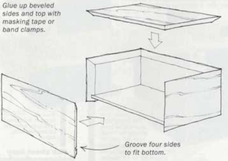
A reward for the best tip

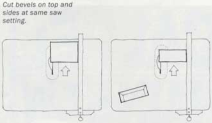
Robert D. Eberhardt won an engraved Lie-Nielsen handplane for the winning tip shown above. He got his start in woodworking by soaping screws for his grandfather, who built wooden fishing boats. Forty years later, Eberhardt is still using his grandfather's tools. He designed this steady rest to turn some spindles for his own bed. 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.

saw. Drop the sawblade until it is below the bed and then raise it until it projects just a few thousandths of an inch, 1/64 in. max. With your chair still sitting on top of the saw, turn the saw on and pass the offending leg sideways across the blade back and forth until the wobble is gone. This technique works equally well with small tables.

—Tai Lake, Holualoa, Hawaii

No-measure mitered boxes





Here's a technique for making mitered boxes that eliminates all of the measuring and fussing to get the mitered parts to fit perfectly. I use the technique on veneered boxes with medium-density-fiberboard (MDF) cores, but the basic approach will work with any box where the four sides and top join with miters.

Start by applying veneer to a core piece for the top and the sides, including a little extra material for the mitered bevels. Rip all four sides of the box to width (box height) and then square the sides to a little over their final lengths. With the tablesaw blade set at 45°, bevel one long edge and one end of each side piece. Then bevel one edge and one end of the top.

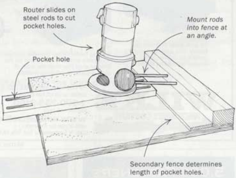
Now set the fence to the desired width of the top. Bevel the other long side of the top and—without changing the fence setting—bevel the two short sides to length. Reset the fence to the desired length of the top and bevel the short side of the top. Again, without changing the fence setting, bevel the two long sides to length.

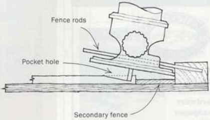
Run a ¼-in.-wide by ¼-in.-deep groove on the inside of each side piece, ¼ in. up from the bottom edge. This groove will hold the bottom of the box. Cut the bottom from ¼-in. plywood to fit the groove and glue up the box with web clamps or masking tape. Later, after the glue has set, saw the top off the box to produce the lid.

If your fence is square to the blade and your blade is accurately set at 45°, the joints are guaranteed to be perfect. The top will drop into the bevels in the sides with a satisfying precision.

—Pat Griffith, Ottawa, Ont., Canada

Router-cut pocket holes revisited





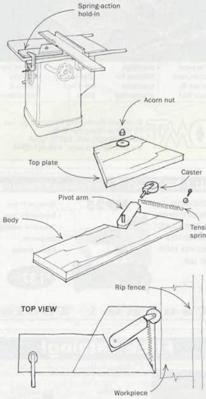
I liked Michael Csontos' idea for making pocket holes with a router and a sliding ramp (see *FWW* #134, p. 20). But the fixture seemed complicated to build, and it limited the width of workpiece that could be used. Here's another approach that doesn't limit the size of the workpiece. This approach uses the router's steel fence rods as sliding rails.

Start by making a full-sized, side-view drawing of the fence, the router base and the desired pocket holes. The drawing will give you the rod angles and locations in the fence. These two variables, along with the router-bit depth, control the length and depth of the pocket hole. Drill angled holes into the fence spaced at the right width to fit the router's fence rods. Attach the fence to a generously sized, ¾-in.-thick plywood base. To use the fixture, slide the workpiece into position and clamp. With the router suspended above the workpiece on the fence rods, start the router and slowly slide it down toward the secondary fence to cut the pocket hole.

—Timothy Dalton, Middleton, Wis.

Quick tip: Paint tea onto raw wood for an inexpensive and natural-looking stain. The stronger the tea, the darker the stain. After it dries, seal with shellac or varnish. *—Sam Bruin, Brooksville, Fla.*

Spring-action hold-in

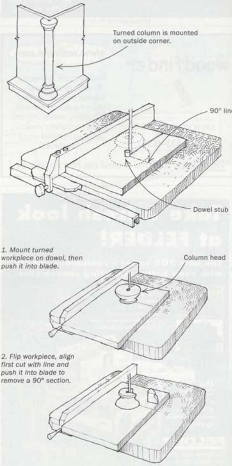


To make a safe, consistent cut on the tablesaw, it is important to hold the workpiece firmly against the rip fence. I have seen feather boards used for this purpose, but they are not very forgiving of variations in stock size, and they're awkward to clamp to the table. So I made this spring-action hold-in from wood scraps, a surplus caster and other hardware from my junk box.

The hold-in has several parts: a body laminated from ⅛-in. Masonite and ¾-in. plywood, a ⅜-in. plywood top plate, a pivot arm, a stem-type caster and a tension spring. The Z-shaped cutout in the body creates a positive stop for the pivot arm and allows a full 1½ in. of spring-tensioned displacement of the caster wheel to accommodate lumber of different widths.

—Steve Stern, Brooklyn, N.Y.

Making decorative turned columns for furniture



Turned columnlike decorations look great mounted on the outside corners of furniture or paneled walls. But to make the columns you have to remove much of the turned pieces to mount them properly. Here's how to remove the waste.

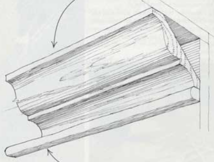
Start by turning the column midsection, head and foot from solid stock. Through the center of the head and foot, bore a hole to fit a commonly sized dowel. Remove a 90° slice from the midsection by screwing square blocks to each end of the column, run the column through your tablesaw and turn it 90° for the second cut.

To perform the same operation on the head and foot, construct a simple jig by mounting a dowel in a scrap of plywood or MDF. Mark a line on the top of the jig at 90° to the line of the cut. Mount the column head on the jig by pushing it onto the dowel and set the bandsaw fence with the cut line centered on the dowel. Push the jig into the blade and cut halfway through the head. Flip the workpiece, rotate the first saw kerf so that it is aligned with the 90° mark on the jig and cut again to remove the 90° wedge. Repeat the same operation with the foot.

—William Nyffeler, Newmill, Keith, Scotland

Installing crown molding

When I got the job of installing 200 linear ft. of large crown molding in a room with 10-ft. ceilings, I quickly discovered that this was no simple task. The main difficulty was holding long sections of crown in alignment along the wall as I tried to nail them in place. To achieve a consistent alignment, I first tried snapping a chalkline and placing the lower edge of the molding on the line. This procedure helped enormously but still allowed for too many variations. Finally, I came up with a method that is almost foolproof.



Install half-round molding on chalkline to support crown molding during installation.

I tacked a half-round molding of suitable dimension to the snapped chalk, flush to the wall. The half-round molding not only ensured consistent alignment but also provided a solid and stable ledge on which to place the crown and position it for nailing. If left in place, the half-round strip provides an additional architectural detail to the molding. This approach improved the quality of the job and simplified the installation.

—George L. Ziff, Southern Pines, N.C.

Quick tip: To protect my hands around the shop, I use inexpensive latex examination gloves, available by the box from wholesale supply stores (such as Sam's Club). The tight-fitting gloves are sensitive enough to operate machinery but strong enough to protect from splinters when handling rough lumber. They are surprisingly durable. As a bonus, the gloves leave my hands in dramatically improved condition at the end of the day, reducing the need for moisturizers and rehabilitation.

—Lawrence A Salibra II, Gates Mills, Ohio

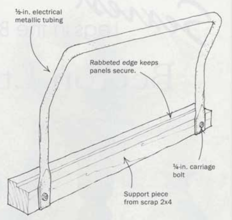
Shopmade plywood carrier

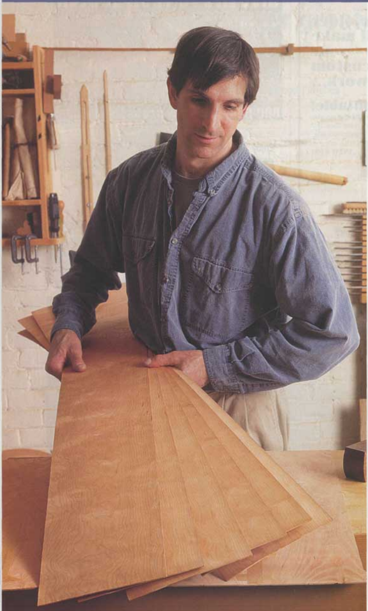
Here is a carrier that makes it much easier for one person to handle full sheets of plywood or drywall. I know you can buy similar tools at home-improvement centers, but this shopmade version can be customized to fit your height and arm length, and it costs next-to nothing to make.

Dimensions of the tool are not critical. A height of about 12 in. works for many people. You should size the tool so that you don't have to stoop too far to lift a panel.

Make the handle from ½-in. EMT (electrical metallic tubing). The bend in the handle gives some clearance for your hand between the handle and the panel. Flatten and drill the ends of the EMT for ¼-in carriage bolts. Cut the wood-support piece from a scrap 2x4. Bending the EMT is pretty tricky: Bend the U-shape first, then bend the uprights.

—James A. Meier, Brighton, Mich.





Bandsaw Your Own Veneer

Tips for smooth slicing in any kind of wood

BY TIMOTHY COLEMAN

It is a wonder to me that I can take a piece of solid wood, with its unforgiving properties of seasonal movement, resaw it into veneer and glue it to a stable substrate, and it will suddenly behave quite demurely. Much of my work consists of decorative cabinets and tables, and on the broad surfaces of these pieces veneer really shines. Most often, I cut my own veneer. Shop-sawn veneer gives me the stability of commercial veneer and a measure of flexibility that is missing from its commercial cousin. It lets me mix solid wood and veneer from the same stock, offers more integrity on an exposed edge and has enough thickness that I can work the surface as if it were solid wood. I can hand-plane the material or do shallow carving or sculpting on the surface. Building with solid wood may be faster than using band-sawn veneer, but I can seldom resist the

Photos, except where noted: Jonathan Binzen magic of sawing a board into thin slices and spreading it out over the surfaces of a piece of furniture.

There are times when I use commercial veneer. The exotic figure and wide dimensions of the material can be an advantage. In recent years, however, the standard thickness of commercial veneer has gotten thinner and thinner. There is no margin for error when working with this material, and I am on pins and needles until the piece has a finish on it. When I saw solid stock into veneer myself, I have no such worries.

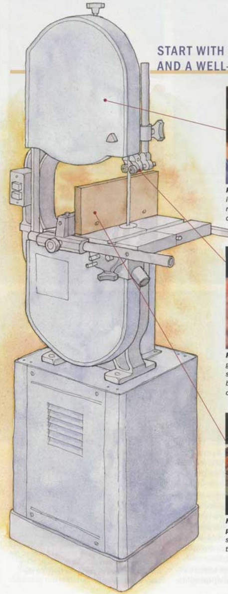
Bandsaw: the essential veneer tool

At the heart of sawing your own veneer is the bandsaw. If yours is running correctly, cutting veneer will be a pleasure. If not, prepare for pain. I have spent many hours fine-tuning my bandsaw. I have replaced the tires on the wheels, replaced the original guides with Carter roller-bearing guides and modified the factory-supplied fence so that it can pivot a few degrees, which allows me to adjust for the drift of the blade. Just about any bandsaw carefully tuned can be used for sawing veneer. I use a 24-in. European saw, and it works very well. A smaller saw will work, but its limitation will be in the width of the stock it will cut. If needed, you can always rip the plank into narrower pieces, resaw it and rejoin the veneers edge to edge.

I typically use silicon-carbide hook-tooth blades, ½ in. or ¾ in. wide. The teeth are set in a raker-5 pattern, which means they alternate left, right, left, right and then have an unset raker tooth. Bimetal blades reportedly work well on abrasive woods. However, because they are designed for cutting metal at slower speeds and are more than twice the price of standard blades, I do not use them.

Bandsaw tune-up and setup—Always go over the bandsaw from top to bottom before starting. Use a fresh blade and clean the tires with a stiff nylon brush. Screw an auxiliary fence of medium-density fiberboard (MDF) or melamine to the factory fence. The auxiliary fence provides the

START WITH A FRESH BLADE AND A WELL-TUNED BANDSAW



Keep it clean. *For best tracking, brush the bandsaw's tires regularly and start a veneer-cutting job with a fresh blade.*

Fine-tuning. *Raise the upper guides to cutting height before setting the bearings. The roller bearings should be set just aft of the blade's gullets.*

High fence provides full support. *The auxiliary fence should be at least as high as the veneer will be wide.*

Drawing: Jim Richey

ALIGN THE FENCE TO THE BLADE'S DRIFT

Get the drift? *To cut veneer accurately, the fence must be set to the natural cutting angle, or drift, of the blade. Find the drift angle by cutting freehand along a line drawn parallel to the edge of a scrap. Stop cutting after 8 in. or so.*

Bevel records the drift angle. *With one hand, keep the scrap from shifting. With the other, use a bevel gauge to measure the angle between the scrap and the front of the saw table.*

Angle the fence. *Use the bevel gauge to set the auxiliary fence to the scrap's cutting angle.*

height necessary to support veneer stock, which can be up to 10 in. wide. It is critical that this fence be smooth and flat.

I readjust the guides every time I cut veneer. Begin by loosening and backing off all of the guides. Then raise the post for the upper set of guides, locking it in at the correct height for cutting the veneer. Set the bearing guides to within a dollar bill's thickness from the blade and pull them forward until they are just behind the blade's gullets. Then set the thrust bearing so there is no more than a small space between it and the back of the blade.

Now set the fence to accommodate the drift of the blade (see the photos above). If this step is skipped or done improperly, you can be certain to have a bad day at the veneer-cutting shop. Begin with a piece of scrap about 2 ft. long. Mark a pencil line parallel to one long edge. Then feed the scrap into the blade freehand, cutting right on the line for about 6 in. or 8 in. Stop cutting and hold the scrap in place. Then place the body of a bevel gauge against the front edge of the bandsaw table and push the gauge's blade against the scrap. Lock the bevel gauge to record the angle at which this blade wants to cut—the drift of the blade.

Now bring the fence over to within a veneer's thickness of the blade, using the bevel gauge to establish the proper fence angle. At this point, I adjust the bar my fence rides on until the fence is at the drift angle. If you don't have a sliding fence or one that can be modified to pivot, you can cut veneer just as well with a shopmade, clamped-on fence.

To check the drift angle, run a scrap through the saw while holding it against the fence. If the scrap pulls away from the fence or requires excessive force to feed, check the drift setting again.

Kerf test. *To cut uniform sheets of veneer, the fence must be parallel with the blade. If the two are not parallel (as in the text), tilt the table until they are.*

Finally, check that the blade is parallel to the fence. Using your veneer plank or a wide piece of scrap, cut a kerf about 1/16 in. deep (see the photo below). If the cut is off from top to bottom, adjust the tilt of the table to correct it. Don't worry about whether or not the blade is square to the table. When the blade and fence are parallel, it won't matter if the table is slightly out of square with the blade.

Preparing the plank

To prepare a plank for being sawn into veneer, mill both faces and both edges. When you cut the plank to length, add at least several inches to the longest veneers that you'll need. You may need the extra length later, if you put the veneers through the planer. When you cut the plank to width, however, stay as close as possible to the finished width of the veneer. If you plan to make lipping or molding or other solid wood parts to match the veneer, cut them from the plank before you rip the plank to the veneer width. When you are ready to cut the veneers, mark a triangle on the end or edge of the plank so that the sliced veneers can easily be restacked in order.

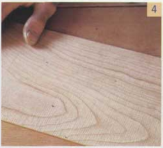
At the same time you are machining your plank for the show veneer, prepare material to use as a backer on the veneered panels. To keep the panels balanced, it is

SLOW AND STEADY RESAWING

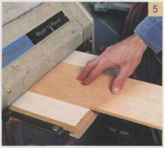
A little off the sides. *To make veneered panels with perfectly matched edge-banding, rip strips off each side of the plank before slicing it into veneer.*

Support ahead of the cut. *Use a slow, steady feed rate when slicing veneer, keeping the plank tight to the fence with pressure applied just ahead of the cut.*

Go to the back of the bandsaw. *It is safest to move around to the outfeed side of the saw and pull the plank through the end of the cut.*



Keep an eye on the saw marks. *If the marks from the bandsaw are even across the width of the piece, the cutting is going well. If the marks are heavier or lighter at the middle, the blade is bowing in the cut. Try a slower feed rate or a sharper blade.*



Smoothing between slices. *Joint or plane the sawn face of the plank after every slice. Use the jointer when the plank is still thick, switch to the planer for safety when the plank approaches ½ in. or so. A piece of melamine laid across the planer's bed rollers keeps the thin material from getting chewed.*

Slicing it fine. *It is dangerous to have your fingers near the blade when slicing the last sheets of veneer. Use a block to support the cut.*

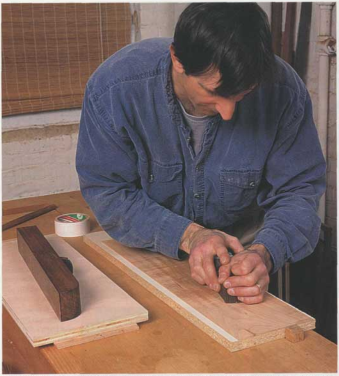
important that this backer material be the same thickness as the face veneer and of a compatible species.

Slicing the veneer

Set the fence for the desired veneer thickness. I shoot for $\frac{1}{16}$ in., and I can usually get six leaves of veneer from a 4/4 board. Feed the wood slowly and continuously, supporting the work just in front of the cut. Develop the habit of pushing the stock through the end of the cut with your hand on the face of the board rather than behind it. And try to develop a feel for the rate that the blade wants to take the stock. When the blade is cutting just what it can handle, it will barely touch the guide bearings. And when the blade is tracking properly in the cut, the back edge of the blade will be centered in the kerf. If you are cutting a lot of material, it is likely that the feed rate will slow as the blade begins to dull.

When the plank gets thin, be extra careful not to run your hand beside the blade. If the stock tapers in its thickness at all, there is potential for the blade to run out the side of the board. For safety, when I'm cutting the last few slices of veneer in a plank, I keep my hands well away from the blade by moving to the outfeed side of the table and pulling the material through the end of the cut. I use a block of scrap to keep the workpiece tight to the fence.

After cutting each slice of veneer, make a trip to the jointer and smooth the sawn face of the plank. I have my jointer set up just to



Smoothing after sawing. *Double-stick tape keeps a sheet of veneer still for a quick smoothing with handplanes. At 3⁄16 in. thick, the veneer can be planed and worked like solid wood.*

Shoot the edges. *A stroke or two with a jointer plane prepares the veneers to be joined edge to edge.*

Taping under way. *Short pieces of veneer tape are moistened and stretched across the joint; when they dry, they pull the joint tight. A lengthwise strip of tape reinforces the temporary joint.*

the right of the bandsaw to make this procedure easy. Don't worry about removing all traces of the bandsaw. Jointing enough to remove most of the bandsaw marks will be more than sufficient for a good glue joint. And the bandsaw marks that remain will tell you how you are cutting. Too fast a feed rate will often show up as bandsaw marks that are deeper or shallower in the middle of the board than at the edges, because the blade is distorting during the cut. As the plank becomes thinner, it will not be practical to joint the face. Instead I run it through the planer between slices.

Keep the veneer pieces in order as they come off the saw and cover them with a board to keep them from cupping. On the last cut I am sometimes splitting the board into two equal veneer slices. This is a very satisfying way to complete the cutting.

Surfacing the sheets of veneer

A well-bandsawn surface is quite acceptable to glue down, but if the thickness of the veneer varies much, it will have to be surfaced. There are several ways to do this.

If the pieces are manageable in size and number, they can be smoothed with a handplane. To hold the veneer still while you are planing, use a piece of MDF with a lip at the end to serve as a stop, or hold the veneer down with very thin, double-sided tape. Don't use too much tape—just a few small pieces—or it will be impossible to get up. A scraper or scraper plane can also be used for this type of surfacing.

Often I will surface the veneer by running it through the planer. But this procedure is not for the fainthearted. I have seen beautiful leaves of veneer go in one end of the planer and come out as crumbs. Check and make adjustments on the planer as carefully as you did on the bandsaw. Pay particular attention to the setting of the pressure bar. I use a piece of melamine to cover the bed rollers to keep the veneer from bending up into the cutterhead. Do not wax this surface because it will transfer to the surface of the veneer.

Use a slow feed rate and sneak up on the thickness very slowly. Feed the pieces one at a time, and be sure that one piece comes out before the next goes in to prevent one from riding up on another. If a piece begins to chip, stop immediately. Sometimes the failure is a result of feed rate or feed direction and can be solved by reversing the pieces. Sometimes the ends of a slice are damaged in the planer, but the rest of the piece is fine. Hence the need for extra length. It is difficult to predict how a batch of veneer will fare in the planer, so it is always good to cut a couple of extra leaves of veneer so that one can be a test piece.

A third alternative for surfacing shop-sawn veneer is an abrasive planer or wide-belt sander. These work very well on veneer, and it is often possible to rent time on one of these machines as more shops are using them. Before committing your precious veneer to be sanded, however, make sure that the operator knows what you are after and that the machine can handle the job. I'd rather ruin the material myself than pay someone to ruin it for me.

Working with shop-sawn veneer

Now the anxious moments are behind, and the fun begins. If you are laying up broad surfaces from two or more leaves of veneer, play around with different combinations. You might try slip-matches, bookmatches or reverse matches.

I edge-joint the veneer by lifting it off the surface of the bench on a piece of plywood and shooting the edges with a handplane. I make sure the joint is tight along its entire length.

Some people edge-glue adjacent pieces of shop-sawn veneer before gluing them to the substrate. This works fine, but I don't think it is necessary. I simply hold the unglued joint together with veneer tape the way I would with commercial veneer. I use a heavy-weight tape, running it across the joint in several places, then down the entire length of the joint. The veneer tape goes on wet and shrinks slightly as it dries, pulling the joint tight.

On a typical panel, I glue the face veneer and backing veneer at the same time. I roll yellow glue onto the substrate, put the veneers in place and slide the whole package into the vacuum press. Before I had a vacuum press, I used cauls and deep-reach clamps to accomplish the glue-up, and that worked perfectly well, too. The veneer tape comes off easily with a hand scraper after the panel comes out of the press. □

Timothy Coleman makes custom furniture in Greenfield, Mass.

THE VERSATILITY OF VENEER

***Marquetry.** The drawer fronts and the upper cabinet face frame of this hutch are marquetry compositions in shop-cut maple and mahogany veneer. The rest of the hutch is solid mahogany.*

***Parquetry.** The design on this cabinet is composed with pieces of cherry and morado sliced 1/16 in. thick and fitted together on a plywood substrate like tiles. On the upper doors, the edges of the tiles were chamfered, creating a handsome reveal.*

***Low-relief carving.** Shop-sawn veneer is thick enough to accept light carved decoration, as on this cabinet in maple and bubinga. The design on the veneered door panels is a combination of lines carved with a V-tool and a background punched with steel stamps. The relieved areas were dyed with tinted shellac.*

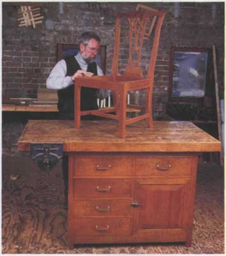
Photos, this page: Will Elwell

A Workbench That Works

A small top without a tail vise has served this master furniture maker for three decades

BY PHIL LOWE

In the early 1970s, having completed my training in furniture making, I found myself in need of a workbench. I figured I'd make one that would be large enough to hold all of my hand tools and small enough to move, guessing that it would be some time before I settled down. I wanted an all-purpose bench for planing, scraping, cutting joints, carving and finishing. Cost was a concern because there was a slew of tools and machinery I wanted to buy, so I decided not to use any fancy or expensive hardwoods in its construction. For the original bench, I chose birch (sturdy and cheap) for the top and the frame, and I used construction-grade fir plywood for the side panels. That first version was a little on the low side, so I later corrected the problem by cutting down the original top and adding a new maple slab over it.



Small but sturdy. *This workbench is almost 30 years old, and it's still used daily for all facets of furniture making.*

The relatively small size of the bench makes it comfortable to use. Unlike many larger benches, I can easily reach a workpiece resting on the top from all sides of the bench. It holds almost all of my hand tools—or at least the ones I use the most—keeping them well within reach. Also, this bench is small enough that it can be moved around the shop when needed. Loaded up with tools, it's heavy enough to stay in place while I'm using it. But I can break it down into manageable pieces, if need be, by removing the drawers and the top. I was particularly glad about this feature when I had to set it up in my first apartment in a third-floor attic space where I worked for a while.

In the construction of the case, I used mortise-and-tenon joints with pins for all of the frame pieces, through- and blind-dovetails for the drawers and housed dovetails for the drawer dividers. I built most of the frame with 8/4 birch, and I used 4/4 birch for the drawer dividers, the center partition and the drawer fronts. I fashioned the side panels with ¾-in.-thick fir plywood, set into rabbets that were cut into the back edges of the legs and rails. Drawer runners—joined with tenons into mortises in the drawer dividers—are held to an inside frame by a screw in the back. The top is 8/4 maple, ripped to 3-in. widths that I glued together on edge for strength and stability.

To make the benchdog holes in the top, I cut a series of ¾-in. by ½-in. dadoes before laminating the top. I also cut the same sized dadoes on every third board in a position that would line up with the dog on the vise, once it was fastened to the top. The overhang of the top is such that the dog holes are clear of the base so that they don't become clogged with sawdust. Also, I needed the overhang for clamping workpieces to the table. The overhang on the side above the drawers is smaller so that it doesn't restrict access to the tools in the top drawers. The new top is secured to the old original top (that I cut down to serve as a subtop) from underneath with lag screws, and that subtop is secured with lag screws through the top rails of the base cabinet.

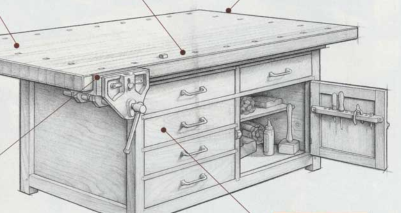
This bench functions quite nicely. The vise will not only hold workpieces between its jaws, but it can also hold them between the dog on top of the vise and one placed into the benchtop. I sometimes set up workpieces, such as panels to be planed, so that they rest against a thinner batten that spans two dogs. With this setup I need to lift my plane on the return stroke to prevent the panel from sliding backward. And sometimes, when planing the ends

Photos: William Duckworth

The vise is an adjustable clamp. *A series of benchdog holes in the top line up with the center of the vise for clamping workpieces of varying lengths.*

Securing the workpiece without clamps. *A hardwood batten thinner than the workpiece butts against two benchdogs in the top to serve as a stop.*

Out of harm's way. *When it's not needed, this 3-ft. Starrett straightedge lives in a slot under the benchtop.*



Drawers do more than hold things. *In combination with the vise, they also support workpieces such as this large mahogany carcase piece.*

Every tool has its place. *The contents of each drawer are custom-fit.*

How it's used and what it holds

This benchtop's small size (32¾ in. by 59¾ in.) belies its versatility. The author's most-often-used hand tools fit compactly but comfortably in storage under the top. Layout tools, chisels, planes and spokeshaves, saws, rasps, files, scrapers, sanding blocks, hammers and carving tools all have specific homes. There's even a spot for one very essential tool—a clipboard to record billable hours of time spent on jobs in the shop.

or edges of panels or long boards, I use the vise to hold the workpiece and one of the drawers underneath to support it.

Looking back at the number of pieces I've built on this bench and remembering the number of workspaces it has inhabited, I realize how well it has served me all these many years. I'm sometimes asked how I could get by with such a relatively small top and without a tail vise. I have the additional work surface of a fold-down table near the bench that I use to lay out and organize parts of furniture I'm working on. And I honestly haven't felt the need for a tail vise, because dogs and a few clamps do the same job. I can proudly say that I have never driven a nail into the top to hold anything in place. There is one thing I would change if I were to make this bench again. The kick space between the bottom rail and the floor is too small, resulting in an occasional pain in my big toe. Also, someday I'd like to replace the fir plywood side panels with something a bit more attractive, but I don't imagine that will happen until my daughters finish school. □

Phil Lowe builds and restores furniture in Beverly, Mass., where he teaches classes on building traditional furniture.

Drawing: Bob La Pointe

Three Simple Moldings

You can learn to carve without spending a fortune on tools

BEAD AND ROD

EGG AND DART

BEAD AND COWL

BY LEE GRINDINGER

If you've ever held a beveled cabinetmaker's chisel in your hands to cut a mortise for a hinge, then you have carved. It's a small step to go from cutting a mortise to carving a pattern on a molding that will embellish your next furniture project. The cutting edge is a different shape, but all of the same principles apply. Moldings are a terrific first step to learn ornamental carving because the steps are repetitive and fairly simple to execute, and the tools required are few. To make the three moldings shown above, you'll need three router bits, three gouges, a mallet and a set of slip stones to keep the cutting edges razor sharp.

Carving chisels come in a vast array of configurations that can be confusing: straight, bent, back-bent, fishtail and spoon gouges, flat chisels, parting tools and veining tools. But to get started, a few straight gouges similar in size to the ones I used here are all you need (for more on gouges, see the story on the facing page). Actually, you can carve any one of these three moldings using only two gouges.

If you're just learning to carve, look for clear lumber without varying and wild grain. Wood is easier to carve if the grain doesn't run out of the board at too steep an angle.

Photos, except where noted: William Duckworth

BEAD AND ROD

I've used a bead-and-rod molding on picture frames, cornices, table edges and pilasters. Also called bead and billet or berry and sausage, this molding looks good from any angle. You can carve variations of it by changing the number of beads from one to three (my favorite). I use two chisels to carve this molding: a ½-in. #7 gouge and a ⅜-in. #3 gouge.

Start with a ½-in. bead, cut with either a router or a shaper. Leave at least some shoulder on each side of the bead to set the depth of the carving. The layout should always begin at the corners or ends of a run of this molding. In a perfect world, the layout will be a repeating pattern of three beads, ½ in. each, and one rod, 1¼ in. long. If you need to fudge the layout to fit, you can change the length of the rods by as much as ¼ in. either way, as long as all of the rods are the same size. After you've determined the length of the rods, lay out the pattern with marks along the crest of the bead using a tape measure or a rule.

With a thin-kerf saw, cut straight down to just above the shoulders at each mark. Be careful not to cut too deeply—the scars left by a saw are hard to remove. Using the #7 gouge and a mallet, cut off the uppermost corners of the beads by holding the chisel at approximately 45° to the line of the molding. This step is called *setting in*. Move along and strike the chisel to remove all of the corners at the saw kerfs, opening the space between the carved shapes. I work as many as five sets at a time, doing all of the corners on one side of the molding first, then the other side on the return run. Work the shapes until—looking straight down from above the molding—you see round shapes in profile. Use the #3 gouge to clear chips away and to make a flat ground around the beads. This step is called *grounding*. You have the outlines done. Next comes *modeling*.

Modeling is the act of shaping the objects you have set in and grounded. Use the #7 gouge and a mallet to cut directly

SHAPING

The first step in making each of the three moldings illustrated in this article is to run the stock through a shaper or a router table. Use standard bead, roundover and Roman ogee bits for each of the three moldings.

Making sense of gouges

When I'm carving, I use straight gouges more than any other kind of carving tool. The profile of the curvature of a gouge is called the sweep, or section, and it's represented by a number (usually from #1 to #11—the higher the number, the more pronounced is the curve in the blade). The width

A few tools will get the job done. *The author completed all of the carving for the moldings on these pages using only these three straight gouges.*

of the cutting edge is expressed in either inches or millimeters, depending upon the manufacturer. You need both the sweep and the width to describe a gouge accurately, and different manufacturers use different sizing systems.

Brand names such as Ashley Iles, Henry Taylor, Marples and Sorby are all sized according to the English Sheffield system. German and Swiss manufacturers, such as Lamp and Pfeil, use the Swiss system. Because the systems are different, gouges labeled with the same numbers will not necessarily have exactly the same sweeps. As an example, the photo at right shows three similarly sized carving gouges from three European manufacturers: Henry Taylor #4, ⅜ in., Lamp #3, 10mm, and Pfeil #3, 8mm. The curvature in the sweep of the #4 Henry Taylor gouge is closer in profile to the other two than the curvature of a #3 Henry Taylor gouge would be. But the sweeps of all three gouges, though close, are not exactly the same. Most carving chisels are hand-forged and hand-ground, so you'll find some variation even in tools from the same manufacturer.

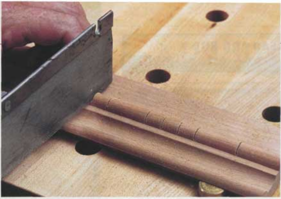
Different brands vary slightly. *The width of cutting edges and the sweep of the curves on these three European chisels vary slightly.*

Drawings: Erika Marks; photo, this page (bottom right): Michael Pekovich

BEAD AND ROD

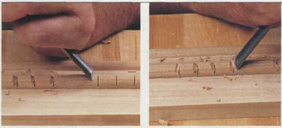
continued

across the grain to define the crest of each bead. In a series of cuts, set the chisel just past the center of each bead and give it a sweet blow with the mallet, going straight across the grain. Do this down the row, taking the same measure on all of the beads and rods before you reverse direction and cut the other sides. It's important to repeat the same strokes all the way down the sets you're working because it helps you make consistent shapes and speeds the whole process greatly. After this cross-grain cut, switch back to cutting with the grain by using the chisel in a nearly horizontal position in line with the molding. As you push the chisel, raise the handle with a slight twisting motion to pare the wood. At this point you can work each bead and rod end until it's done, moving on to the next one when the bead looks like half of a sphere. The last step is to clean up the ground with the #3 gouge.



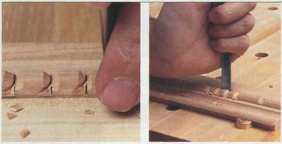
LAYOUT

After marking pencil lines on the shaped molding using a tape measure or ruler, score the divisions between beads and rods with a dovetail saw. Take care to stop the cut just shy of the flat part of the molding.



SETTING IN

Hold a ½-in. #7 gouge at about a 45° angle and cut off the corners of all the bead and rod shapes by striking the chisel with a mallet. Work five or six sets at a time.



GROUNDING

Define the round shapes in profile from above by striking the chisel as you hold it vertically. Work your way around all sides, and then switch to a ⅜-in. #3 gouge to clear away chips around the base.

MODELING

Refine the three-dimensional shapes using the #7 gouge. Work the beads and the ends of the rods from all sides, and carve them with the chisel held at many different angles to the surface of the molding.

EGG AND DART

You can find dozens of versions of egg-and-dart molding. It's a terrific first or second molding for a cornice, and it's great for picture and door frames and on the lip of a table. I use two chisels to carve the version shown above: a ½-in. #6 gouge and a ⅜-in. #3 gouge.

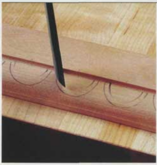
On ¾-in. stock, start by shaping an edge with a ½-in. radius roundover bit and leave a ⅛-in. step on the top. To lay out the pattern, set a compass at 1⅛ in. and mark centerlines on the top face of the molding along the length of the stock. These marks represent the center of the eggs. Set your compass at ½ in. and draw full arcs centered on those marks. These arcs represent the collars around the eggs. To define the eggs, set your compass at ⅜ in. and mark either side of the same center point.

The mallet work for this molding is next. Set the #6 gouge vertically on the upper part of the molding, with one corner on the ⅜-in. mark and the other corner hovering over the center at the bottom of the arc. Give the chisel a swift blow and move on to the next egg. I normally work six eggs at a time. When you reach the last egg, turn the chisel around and go the other way to cut the remaining ⅜-in. marks. Change the angle on the chisel handle and chop out a ⅛-in.-deep groove that defines the edge of each egg. After that, very lightly strike the chisel (held vertically to the molding) to score the outside of the collar. Be careful not to break the thin collar.

Put away the mallet; the rest is handwork. Angle the chisel first left, then right, to cut the finished depth around the eggs. The chisel will leave a clean face on the collars, and you can rough out the eggs by angling the chisel from different directions. Use the same right-left series of cuts to finish the fragile collars, inside and out. Then use the corner of the same chisel to shape the darts, taking care to make them symmetrical. Switch to the #3 gouge to remove material around the dart and the lower edge of the collar. Clean out any chips with the #6 gouge and a toothbrush.

LAYOUT

Use a compass at three different settings to complete the layout. Mark centerlines first, then use those points to scribe two arcs that define the eggs and the collars that surround them.



SETTING IN

Hold a ½-in. #6 gouge vertically and strike it with a mallet to outline the egg shapes first, working six at a time. Change the angle of the chisel to chop out a groove around each egg.

GROUNDING

Still using the mallet with the #6 gouge, score the outside collars; use a light touch to prevent breaking the wood. Then put the mallet away and begin to carve eggs and collars by hand.

MODELING

Refine the egg shapes by hand-carving them. Use the corner of the #6 gouge to define the darts, then switch to a ⅜-in. #3 gouge to finish them and to remove the last bits of debris.

LAYOUT

Use a compass to mark the distance between each bead, the centerline of the beads on the ogee shape and the circular profile of each bead. Mark the entire length of the molding before you begin carving.

SETTING IN

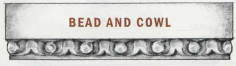
Use a ½-in. #7 gouge and light taps with a mallet to set in the circular shape of the beads. After tracing full circles, go back over them with heavier blows of the mallet to plunge deeper into the ogee.

GROUNDING

Define the cowls around the beads by chopping vertically with a ⅜-in. #3 gouge. Use the chisel to pare away the waste around the beads that have been shaped with the #7 gouge.

MODELING

Use the #3 gouge to carve the small valley at the crest of the ogee between each bead. Chisel into the valley from each direction using the concave side of the chisel to define the shape.



BEAD AND COWL

A bead-and-cowl molding is most suitable when seen above eye level, such as in a cornice molding in a pediment. The shadows created by the shapes of this molding make it a real eye-catcher. I carve it with two gouges: a ½-in. #7 and a ⅜-in. #3.

Begin with ⅞-in.-thick stock and shape a ¾-in. Roman ogee onto the edge. Lay out the pattern with a compass set at 1¼-in. intervals, and "walk" the compass the entire length of the molding. It will be easier to carve the beads if you scribe their perimeters with a compass set at ½ in. As you become more practiced, this mark won't be necessary. You'll be able to trace a sweet circle using only the gouge. Along the foot of the ogee, make a series of marks between the circles that define the outermost limits of the cowl. There is a little give and take in the layout of this molding, so begin from one end of a run and lay it out to the other end, fudging the space between beads, if necessary.

You can work as many as 10 beads at a time. Set in the beads with the #7 gouge, starting with the chisel centered over the scribed marks. Use light taps with a mallet and trace the full circle of each bead, then hit the mallet harder and chop deeper to about two-thirds the total depth of the bead. The finished depth is a line defined by the bottom curve of the ogee, straight down from the top step of the ogee.

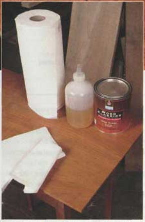
Still using the mallet, turn and strike the chisel so that the concave face removes the corners of the still-flat beads and makes clearance for the chips as you remove the waste. Finish setting in the full depth of the beads and model them with the concave side of the #7 gouge, by hand, without using the mallet.

With the #3 gouge driven home by the mallet, cut straight down to the bottom of the ogee. The vertical lines of the cowl are perpendicular to the face of the molding, and the gouge defines the arcs in the sides of the cowls. After cutting the sides, cut in from the front of the ogee, carving out a flat area at the transition to the flat of the molding. Carve the small valley at the crest of the ogee with the #3 gouge. Hold it straight up, set in a cut dead center on the crest, then open the cut by angling in the concave side of the chisel, rolling the chisel from a vertical to a horizontal position. Scuff the moldings with a light touch of 220-grit sandpaper prior to finishing, but don't sand so much that you remove the facets left by the chisels—those marks are the charm and proof of hand-carving. □

Lee Grindinger builds carved furniture in his shop in Livingston, Mont. (Visit his web site at www.furniturecarver.com.)

A No-brainer Varnish Technique

Applying thinned varnish with a paper towel



Unorthodox, but it works. *This simple method, which uses fast-drying varnish and smooth-textured paper towels, solved the author's need to apply a quick-drying, long-lasting finish.*

BY JEFF JEWITT

About a year ago, I moved my refinishing business. This time around, I was determined to install the most up-to-date spray booth right from the start. Though assured by the designer that it would be up and running within a month after moving into the new shop, inevitable delays stretched that timetable into several months. Somehow I had to keep a furniture-restoration business running that had a reputation of providing a quick turnaround on jobs.

Until the new booth was in order, spraying was out of the question, so I had to come up with a quick-dry finishing system. After some trial and error, I developed a method of wiping on a fast-dry varnish with a paper towel. The varnish provided protective qualities similar to those of a standard nitrocellulose lacquer. It was easy to apply, and it dried fast enough that all the dust kicked up by workmen wasn't a problem. I was so impressed with the results that this technique is now a staple in my teaching repertoire, and students love the results.

What to use

Fast-dry varnishes are similar to typical alkyd varnishes, but the drying time is sped up by adding vinyl toluene to the alkyd resin. These varnishes dry tack-free

Photos, except where noted: Susan Jewitt

The Piece

SIX COATS IN TWO DAYS

After sanding this small table through 180 grit, it took less than a day to apply the first three coats of diluted, fast-dry varnish.

Materials

FAST-DRY VARNISHES WORK BEST

These three brands dry so fast that you can apply a second or third coat within hours of the first one.

USE A SMOOTH-TEXTURED PAPER TOWEL

The author prefers Viva brand towels (left). Heavily textured paper towels (right) can leave streaks in the finish.

Step 1

FOLD IT UP AND SQUIRT

Glue bottles make great dispensers for the thinned finish. Replenish the supply of finish as necessary to keep it flowing smoothly onto the surface of the wood.

in as little as 15 minutes. This means that the conventional problem associated with varnish—dust drying in the finish—is eliminated. The three brands I've used—Zinsser's Quick-15, Sherwin Williams' Wood Classics Fast-Dry Oil Varnish and Benjamin Moore's One Hour Clear Finish (see *FWW* #133, p. 142)—are available in gloss and satin versions. I use gloss for this technique because satin versions tend to dry a bit streaky when applied in thin coats. Gloss can also be rubbed down to satin, as I'll explain later.

When brushing on varnish, bubbles sometimes form in the finish. But by thinning the varnish and wiping it on with a paper towel, bubbles are eliminated. Any nontextured paper towel will work, but my favorite brand is Viva. Avoid textured paper towels.

I use naphtha to thin varnish because it dries the fastest; I can easily apply three coats in a day. Mineral spirits will extend the drying time, so you'll probably be able to apply only two coats a day.

How to do it

Sand the wood through 180 grit. I use a random-orbit sander and then hand-sand with the grain, using the same grit. Remove all sawdust and other debris, and then apply any stain you want. Allow the stain to dry. Dismantle the project as much as you can so that you have flat surfaces to finish. Thin the varnish with equal parts naphtha or mineral spirits and put the thinned solution into a plastic squeeze bottle with a dispensing nozzle—the type you find on a glue bottle.

Fold a single piece of paper towel once perpendicular to the perforated seam. Fold it again perpendicular to the previous fold, then fold it again. You should end up with a rectangular piece of folded towel approximately 2¾ in. by 5 in.

Hold the paper towel so that the tip extends just beyond your fingers and apply a squirt of varnish (about ¼ oz.) to the tip of the towel. Bring the towel down onto the surface of the workpiece and wipe a thin, even coat from one edge to the other. Don't bear down too hard at the beginning or you'll get a pool of finish. Replenish the towel again and make another swipe, overlapping the first one by about ½ in. or so. Repeat this process until you've covered the whole surface. Do the edges last. The thin varnish sets up quickly, allowing you to fix a drip immediately. But your goal

Photos, this page (bottom): Michael Pekovich

LY

AND DRIES FAST WITHOUT DUST

Step 2

LAY IT ON IN LONG STROKES WITH A LITTLE OVERLAP

Wipe on the finish in long strokes in the direction of the grain. Each successive stroke overlaps the previous one by about ½ in. Work from one side of a piece to the other, always rubbing in the same direction. Take care to dispose of used paper towels properly.

Step 3

STRIVE FOR A LIGHT TOUCH

Scuff-sand the dried finish very lightly. A sufficiently dried finish will turn to powder (right); one that's too wet will form gumballs on the sandpaper.

Step 4

REDUCE THE SHEEN WITH STEEL WOOL

Using very fine (0000) steel wool, you can turn a gloss finish into a satin sheen by rubbing the final coat of varnish with the direction of the grain.

should be to get the varnish on as evenly and as quickly as you can and then leave it alone.

The first coat should be dry enough to sand in about an hour. Use 400-grit silicon-carbide sandpaper and scuff the surface just enough to remove any nibs. If the varnish film turns to powder easily when you sand it, then it is dry enough to re-coat. Remove the dust with a tack rag and apply the second coat just like the first. After a few hours, scuff-sand and apply a third coat.

After overnight drying, sand the finish again with 400-grit paper. Wipe all of the residue with a tack rag and build at least two more coats, and as many more as you like. When the finish depth is to your liking, stop. I typically apply six coats to maximize durability.

After a week's drying time you can rub out the finish if that's the look you want. Wet-sand the finish lightly with 600-grit wet-or-dry paper, by hand. Then, using 0000 steel wool and wax thinned with mineral spirits, rub the finish with the grain in long strokes. This results in a very pleasant satin sheen. □

Jeff Jewitt contributes frequently to Fine Woodworking *on finishing topics.*

Compound-Angle Joinery

The Chair

The side-rail to rear-leg joint on a Chippendale chair—and many other types of chairs—must account both for the trapezoid-shaped seat and for the cant angle of the leg, making it necessary to cut and use a compound-angle tenon.

BY WILL NEPTUNE

For me, chairs are easily the most satisfying projects to build, but students often are puzzled by the compound-angle joinery between the legs and seat rails. I learned how to draft, lay out and cut these joints when I was a furniture-making student years ago, and now I teach it at North Bennet Street School. Once you answer two critical questions—"Where do the layout lines come from?" and "How do I get the layout lines on the wood?"—you'll see that cutting these joints isn't all that hard. What's more, once you understand how to cut compound-angle joinery, cutting joinery with a single angle becomes simple.

Recently, I built a set of Chippendale chairs. Most Chippendale chairs—and a lot of other styles of chairs—have rear legs that cant inward as they go toward the floor but front legs that are perpendicular to the floor line. Although this design lends a refined sense of upward motion to a chair, it also introduces a fussy situation when it comes to joining the rail to the back leg. To allow for the cant of the legs and the trapezoidal shape of the seat, most of the time you'll have to cut compound-angle tenons between the legs and seat rails.

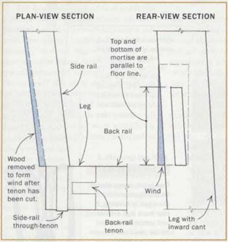
It is tempting to angle the mortises, in either the plan or elevation, to simplify the tenon problem. In the first case, the mortise would angle in the plan view at the

FEDERAL PERIOD

In the high style. *Made by Steve Brown, this heart-back Hepplewhite design has curved seat rails and more complex shaped legs, but the leg-to-rail joinery is the same as the Chippendale chair above.*

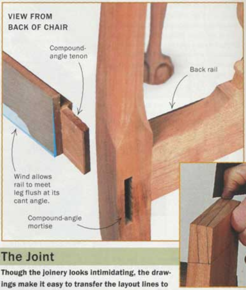
Photos, except where noted: Michael Pekovich; this page and facing page (bottom): Lance Patterson

Careful tenon layout is the key to cutting and mastering this intimidating joint



The Drawing

I teach students to lay out this joint with only two partial drawings—a plan (overhead) view at the bottom edge of the side rail and a front elevation view. This article will show you that simple drawings are all you need to know to cut this joint.



The Joint

Though the joinery looks intimidating, the drawings make it easy to transfer the layout lines to the rail. Once the layout lines are in place, it's simply a matter of cutting the joint—by handsaw, bandsaw or other means.

seat-frame trapezoidal angle. In the second case, the mortise could be cut square to the back rail in front elevation to correct for the cant angle. Both of these moves force you to shorten the back rail tenon, which would weaken this critical joint.

Both historically and for chair making today, I think compound-angle tenons represent the best possible technical solution to this problem. Once you have a system for laying out these joints, cutting them is not that difficult.

Draw simple elevation and plan views

No matter what style chair you're building, there are two angles to consider: the cant of the leg, seen in a front elevation, and the seat-frame trapezoidal angle, seen in a plan (overhead) view. Start by doing a partial drafting job, just enough to get the information you need for layout.

First draw the leg from a front view and show the mortise. The mortise in the rear leg should be as far to the outside of the leg as possible without sacrificing the thickness of the mortise walls. The mortises can be cut square and slightly short in length, then chiseled to the correct angle at the top and bottom, making the mortise a parallelogram. Cutting a mortise in the shape of a parallelogram not only helps you register the rail, because it makes the rail's top and bottom edges parallel to the floor line, but it also makes the through-tenon look better from the back of the chair.

Transferring information from the elevation, draw the sections of the leg at the bottom of the rail. Then you can draw the side

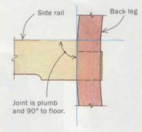
COUNTRY CHIPPENDALE

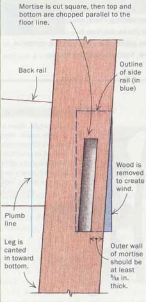
In any style. *Made of curly maple, Mary Conlan's Chippendale chair of simpler form is built using the same leg-to-rail joinery as a more flashy, high-style chair.*

Drawings: Vince Babak

LAY OUT AND CUT THE MORTISE

Set the mortise to the outside of the leg as far as possible, taking care to see that the outer mortise wall is at least 5/16 in. thick for strength. Lay out and cut the square mortise parallel to the side of the leg. Then chop the top and bottom of the mortise parallel to the floor line, making the mortise a parallelogram. The rail joins squarely to a flat section of the leg; cut a wind to keep it flush.





rail and its angle. Notice that the side rail must be thick enough to allow wood for the top outside corner as well as the bottom inside corner, as seen in the elevation drawing on p. 61. I also like to have extra rail thickness to allow for a shoulder at the bottom inside corner.

First draw the line representing the outside face of the rail blank and its angle. Here I'm assuming that the outside face of the rail lands flush to the top of the leg, but you could leave a shoulder if your design calls for it. Then draw a parallel line showing the bottom inside face of the rail, choosing a rail thickness that will allow for an inside shoulder of 1/16 in. to 1/8 in.

As a last check, draw a detail of the top section of the leg in plan view. I draw this as if the leg mortise runs all the way up to the top edge of the side rail. Extend the line that represents the outside face of the rail back through the leg to be sure that the tenon lies within the thickness of your rail.

This construction has the side rail forming a simple angle, which leaves wood sticking out from the canted leg on the outside. These surfaces will be reconciled by fairing a wind into the outside face of the rail once the joinery has been cut. The front end of the rail is left alone for the leg joints, so the rail starts plumb at the front and develops a wind that becomes the cant angle of the rear leg.

To show this, draw a dotted angled line from the bottom outside corner of the rail out toward the rail's front end. This transfers the information from the elevation onto the plan view (as in the drawing on p. 61). The plan view is simplified but contains all of the crucial points seen in the elevation. These two drawings provide the information necessary for laying out the joint.

Follow the drawings to lay out the joint

To make the layout easier, I pretend the mortise is extended up to the rail's top edge. Once the tongue of the tenon has been cut using the method of your choice, it will be easy to shoulder down the tenon to match the real mortise (see p. 64).

Extend the lines of the mortise opening up to where the edge of the rail will land. From the bottom inside corner of the mortise, square up a line to the top edge of the rail. Where these three lines cross the top rail edge will become the source of the layout information.

The important thing to realize is that the information seen here is true only at one location along the rail: the plane of the shoulders (see the plan view on p. 61).

On the inside face of the rail, square a line across that shows the correct shoulder location, measured in from the end. Here I've left extra length for later cleanup. Then, using a bevel gauge set to the seat angle, run the shoulder lines across the top and bottom edges of the rail. These should then connect with another square line, up from the outside face of the rail, describing the plane of the shoulders. Your drawing should now show the location of the tenon at this plane (see the drawing on p. 64).

CHIPPENDALE

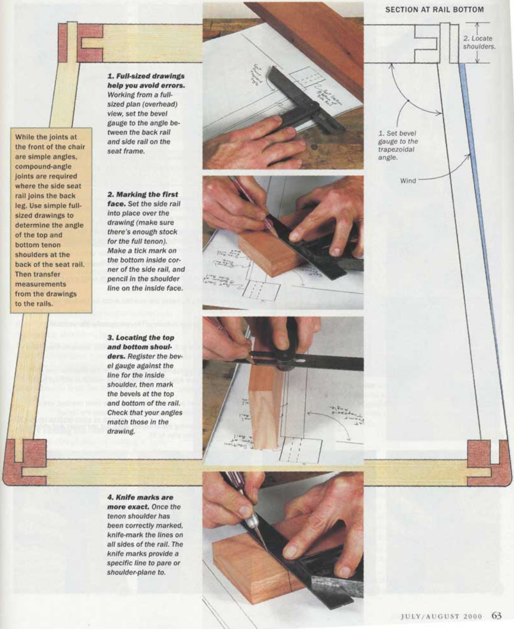
One joint, many chairs. ***No matter what kind of chair you're building, if your back legs are canted and your seat is trapezoidal, you'll need to use compound-angle tenons to join them, as was done with this Chippendale chair by Rich Heflin.***

Working from the elevation drawing, set a marking gauge to x and mark this distance across the top and bottom shoulder lines, measuring from the inside face of the rail. From the mark on the top edge, use a pair of dividers set to the distance y to make another mark along the shoulder. The new mark on the top edge and the first mark on the bottom edge locate the inside cheek of the tenon. From these marks, transfer the size of the mortise to locate the outside tenon cheek.

This may sound confusing, but all you're doing is converting the cant angle to a rise/run problem. The rail width is the run, and y is the rise. The reason for the initial marking gauge line is that it's more difficult

Photo, this page (right): Lance Patterson

CONSIDER LENGTH AND SEAT ANGLE WHEN LAYING OUT TENON SHOULDERS



While the joints at the front of the chair are simple angles, compound-angle joints are required where the side seat rail joins the back leg. Use simple full-sized drawings to determine the angle of the top and bottom tenon shoulders at the back of the seat rail. Then transfer measurements from the drawings to the rails.

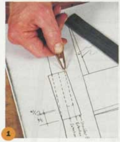
1. Full-sized drawings help you avoid errors. *Working from a full-sized plan (overhead) view, set the bevel gauge to the angle between the back rail and side rail on the seat frame.*

2. Marking the first face. *Set the side rail into place over the drawing (make sure there's enough stock for the full tenon). Make a tick mark on the bottom inside corner of the side rail, and pencil in the shoulder line on the inside face.*

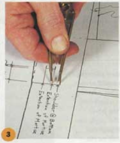
3. Locating the top and bottom shoulders. *Register the bevel gauge against the line for the inside shoulder, then mark the bevels at the top and bottom of the rail. Check that your angles match those in the drawing.*

4. Knife marks are more exact. *Once the tenon shoulder has been correctly marked, knife-mark the lines on all sides of the rail. The knife marks provide a specific line to pare or shoulder-plane to.*

CAREFULLY LAY OUT THE ANGLED TENON ON THE STOCK

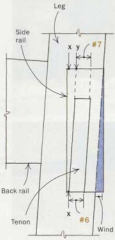

1


2


3


4

Laying out and cutting angled tenons is a methodical process, but it's not a difficult one. Work from simple but accurate drawings and mark out each measurement from a single reference line on both the top and bottom of the tenon.



1. Use a simple elevation drawing, as seen from the front of the chair, and set dividers to x—the distance from the bottom inside corner of the rail to the inside corner of the tenon.

2. Set a marking gauge to the distance x between the inside face of the rail and point x and scribe a line across the top and bottom shoulders from the inside face of the rail.

3. Set the dividers to the distance between x and y.

4. Use the divider setting from step 3 to locate point y on the top edge of the rail, measuring from point x.

5. Set the dividers to match the mortise width on the rear leg of the chair itself.

6. From point x on the bottom of the rail, transfer the width of the mortise.

7. With the dividers still set to the mortise width, measure from point y to mark the tenon width at the top of the rail.

8. Tenon cheeks are marked perpendicular to the shoulder line by registering a square against the bevel gauge—which is still set to the trapezoidal seat angle.

9. After the top and bottom of the tenon have been marked, use a straightedge to connect the points and complete the layout.

10. After knife-marking the shoulder lines, cut the tenon and shoulders with a backsaw, then trim to fit.


5


6


7


8


9


10

to measure from a corner using dividers. The goal here is not just to get a tenon that fits—the rail should also land on the post at the correct location and project at the trapezoidal angle.

Once the base of the tenon has been located, the plan view (see p. 61) shows the next move. The tenon is simply square to the shoulder. Clamp the bevel gauge to the rail and square all four tenon marks out to

Take it slow. *The author uses a shoulder plane to trim the cheeks, checking the tenon frequently against the mortise until he has a tight fit. He then trims to the layout lines with a shoulder plane.*

the end of the rail. Once you've connected these lines across the end grain and knife-marked the shoulders, layout is complete, for now. Once the tenon cheeks and the side shoulder have been planed, the top shoulder can be marked out and cut. After fitting the tenon, mark the wood to be faired directly from the leg (see the photos at right).

Make practice cuts in scrap before cutting the real joint

One very direct way of cutting a compound-angle joint is with a handsaw. First the cheeks would be sawn in the ordinary way. The only tricky part is remembering that the shoulder cuts are at different depths on each edge. Begin sawing with the shallow edge facing you, and avoid cutting into the tenon.

A bandsaw is good for cutting the cheeks, too. Setting the table for the cant angle (remember to keep track of lefts and rights), you can follow the cheek lines on the top edge and the blade will follow the cant angle on the rail's end.

The tablesaw can probably get you closer and thus avoid a lot of cleanup with hand tools, but the explanation is a story all by itself (for more on this technique, see Master Class on p. 108).

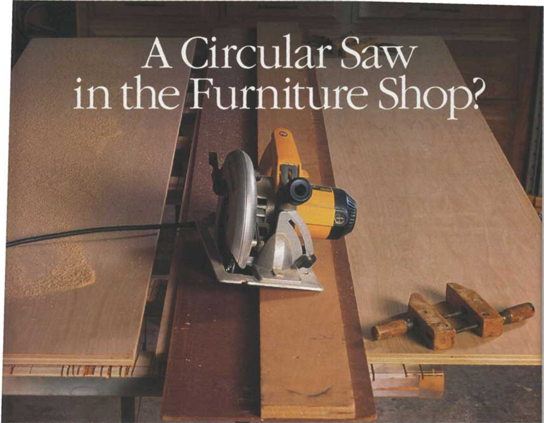
Whatever method you use, lay out with pencil first and confirm that you have things correct. Often, the cant and seat angles are close enough that it's easy to grab the wrong bevel gauge during layout. The shoulder won't look bad, but the front legs will be way off. It's also possible to get the lefts and rights mixed up and lay out the correct angle in the wrong direction. These mistakes make for a long day, so when in doubt, mill a practice rail and check both your layout and cutting method. Once the joinery for the back end of the chair has been cut, the simple angles on the front ends of the rails will seem easy. □

Will Neptune teaches furniture making at North Bennet Street School in Boston.

MARKING OUT THE WIND

Once the tenon has been cut and fitted, dry-fit the joint tightly and mark out the section of the rail that needs to be planed away. Notice that there is no material removed at the front of the rail.

Establish layout lines. *Connect the bottom line of the wind with the bottom front corner of the rail. Planing to this line gives you an even wind and lets the rail meet flush at both the front and back legs.*



A Circular Saw in the Furniture Shop?

For cutting sheet goods in tight quarters, this carpenter's tool, used with a sacrificial table and dedicated cutting guides, produces joint-quality cuts with ease

BY GARY WILLIAMS

Contractors couldn't live without the portable circular saw, but we of the warm, dry furniture shop tend to leave it on the same shelf as the chainsaw. Great for building a deck but far too crude for quartersawn oak. Necessity has a way of teaching us humility, however.

I've been a sometimes-professional woodworker for nearly 30 years, but somehow I have never managed to attain the supremely well-equipped shop. I work alone in a no-frills, two-car garage that I share with a washer, a dryer, a water heater and a black Labrador. My machines are on the small side, and I lack the space for large permanent outfeed and side extension tables for my tablesaw. Perhaps you can relate. Under these conditions, cutting a full sheet of plywood can be a very challenging operation. Even if you have your shop set up to handle sheet goods with ease, perhaps you've run into similar difficulties cutting plywood and lumber accurately on job sites and installations. The solution?

May I suggest the humble circular saw. Cutting lumber and plywood with a handheld circular saw is nothing new. You've probably done it before, with varying degrees of success. You get that 4x8 sheet up on the sawhorses, mark your cut line, rig up some kind of straightedge and cut. Trouble is, in the instant before the cut is complete, gravity happens, and you are presented with an entirely new challenge. Now you have two pieces that either want to collapse in the middle or fall off the end. Meanwhile, the scrap you used as a straightedge bowed a little during the cut; and it wasn't quite long enough to begin with, so the last few inches of the cut were done freehand. And as to the cut produced by that blade you last used to cut creosote-soaked fence posts ...

I've developed methods of tuning the saw, supporting the workpiece and guiding the cut that combine to make slicing up sheet goods and unwieldy planks of solid wood with a circular saw so simple and the results so clean that I don't even daydream about the big shop and the behemoth tablesaw anymore.

You must tune the saw

If you're going to make joint-quality cuts with a circular saw, there are rules:

Rule No. 1: Start with a good saw, one that can be properly adjusted and that has good bearings to prevent the blade from wobbling.

Rule No. 2: Install the best 40-tooth carbide blade that you can find.

Rule No. 3: Always check the blade tilt with a machinist's square before starting a job.

Rule No. 4: Make sure the blade is exactly parallel to the edge of the saw's base. Use a dial indicator if you can. If you can't adjust the base, see Rule No. 1.

Use a cutting table to support the work

The backbone of my system is a sacrificial cutting table with folding legs. Picture that unwieldy sheet of plywood lying serenely on a dedicated cutting table, waiting to be operated on like a patient in surgery. When each cut has been completed, both halves of the sheet will still be lying there, awaiting further disposition. Nothing caves in or falls off the end. Each cut makes a shallow kerf in the table, and when you've chewed up one table, you simply make another (for me, a matter of a couple of years). The table is cheap, easy to build and lightweight, and you can store it in a narrow space when you're not using it. The table's open-grid format serves three purposes: It keeps the table light; it keeps it clean (sawdust falls through, and you can't pile junk on it); and it allows a clamp to be used anywhere on the table surface.

Tuning the saw

To make joint-quality cuts with a circular saw, start with a good saw and a good blade and keep them well tuned.

Parallel base and blade. *Use a dial indicator to check that the blade is parallel to the edge of the saw base. Adjust the base to correct any error.*

Square is essential. *Use a machinist's square to get the blade at 90°. A flat base like this one makes it easier to check for square and more likely that the cut will be square, too.*

Don't worry about what's below. *Set the depth of cut so that a full tooth of the blade extends below the workpiece. You'll be cutting right into the surface of the sacrificial table.*

It doesn't take a 4-ft. by 8-ft. table to handle a full sheet of plywood. I build mine a little under 3 ft. by 7 ft. This size is comfortable to work on and easy to store. If you have to cut a foot or less off one end of the sheet, you can slide it over so that the far end hangs over a foot or two. Same thing with width. As long as there is enough table to support more than half of the piece, it's not going to fall off.

There are various ways to assemble the grid. If you have a regular workbench large enough to lay out all of the pieces on, you can use a couple of bar clamps to snug the assembly together while you insert screws. Alternately, you can lay the pieces out on the floor and use a wall to give you something to push against while driving the screws. I use fir 2x2s for the long rails and 2x4s for the crosspieces. I drive 3-in. drywall screws to connect them, and I drill clearance holes only for the screws at the ends of the long rails, where there is some danger of splitting the wood. If you work on the floor, you can assume the grid won't be perfectly flat, but that's okay. As long as it's not far out of flat, it should perform well.

You can place your tabletop on sawhorses for use, or just put it on a bench or table, but I'd recommend fitting it with folding legs. Folding banquet table legs, available in many woodworking catalogs, are fairly inexpensive and add a tremendous amount of convenience.

To get a heavy sheet of plywood or medium-density fiberboard (MDF) up on the table, there's a simple way to save your back (see the photos on p. 72). Place a couple of wood scraps on the floor and tilt the table down so that the edge of the tabletop rests on them. This gives you room to get your fingers underneath. Then set the plywood on edge on the blocks as well. Lean the plywood against the tabletop, reach underneath and tilt up the table and sheet together.

Make dedicated cutting guides

The difficulty in using a straightedge with a circular saw is that you have to offset the straightedge from the cut line to account for the

Photos: Jonathan Binzen

Setting up the table

A boon to the small shop, a folding cutting table can be stored in a space several inches wide and can be set up in about a minute. To load a sheet of plywood, tip the table onto a pair of scrap wood spacers. Lift the ply onto the spacers, and lift the ply and the table together.

width of the saw's base. My first approach to simplifying this process was to rip a strip of Masonite the exact width of this offset. I would lay this spacer down next to the cut line and then snug my straightedge up to the spacer. It didn't take long to figure out that it would be more convenient to attach a Masonite spacer to the bottom of the straightedge.

Now I simply lay the Masonite base of a cutting guide right on the line, clamp the guide to the workpiece and cut. One bonus is that the saw glides smoothly across the Masonite instead of on my workpiece. And another is that the Masonite backs up the cut, minimizing splintering of the veneer in cross-grain cuts.

I keep several of these guides in the shop, in different sizes and configurations. Together with the circular saw and the cutting table, they make dissecting large panels a breeze. I recommend at least three different guides: an 8-ft. guide for cutting sheet goods in the long dimension, an easier-to-wield 4-ft. version for shorter cuts and a 90° guide for perfectly square cuts (see the photos on the facing page).

To make a guide, begin by cutting an 8-in.-wide strip of ¾-in.-thick plywood for the fence portion. Next, measure the saw's footprint—the distance from the blade to the edge of the base on the side under the motor. Then make the Masonite base. Its width is 8 in. plus the saw's footprint plus ½ in. or so extra, which will be trimmed off. The plywood for the fence should be of good quality—something with good inner plies, such as hardwood or marine plywood. The edge that the circular saw will be running against should be free of voids, if possible. For the Masonite base, tempered is best, ⅛ in. or ¼ in. thick.

To assemble a straight guide, lay the plywood fence, best-side down, on the table, and lay down the Masonite strip with the best side down on top of the plywood. Drill and countersink clearance holes in the Masonite, about every 6 in. along the length of the assembly. Clamp the two boards and screw them together, being careful to get the screws fully countersunk.

Your next move will be to trim the Masonite base. If you haven't bought a good sawblade yet, drop everything and do it now—your guide will be trimmed to match your exact saw and blade combination; you don't want to make a guide with one blade and use it with another. When you get back from the store and put your good carbide blade in the saw, check the blade for square and parallel according to those iron-clad rules on p. 71. Then clamp the guide to your cutting table and trim off the excess Masonite by running the saw down the length of the assembly. Now the guide is ready to go.

The key to making the right-angle cutting guide is getting an accurate 90°. I use a scrap piece of plywood as a form when I join the two legs of the guide. I use a factory corner (checking with a square to see that it is 90°) or cut one corner square.

Using a guide is a snap. The only thing to remember is that the guide is always placed on the good side of the cut marks—that is, on top of the piece you're going to be using—so that the saw kerf is in the waste.

Nonstandard cutting with the guides

Once you've used this cutting system for a while, you will no doubt see other applications for it. Here are several that have come up in my work since I first made these guides.

Straight-lining crooked boards—The 8-ft. guide offers an easy way to straighten the edge of a long, waney-edged plank. Use scraps the thickness of the workpiece to space the cutting guide off the table. Clamp the guide to the table. Then tuck the crooked edge of the board under the guide's Masonite base just far enough

Using the guides

Simple two-part cutting guides—with a Masonite base attached to a plywood fence—make it possible to get accurate cuts with minimal layout.

***Long division.** The long, straight guide makes quick work of ripping a full sheet of plywood. When the cut has been made, the halves of the sheet stay put, supported by the cutting table.*

***Four-foot guide for crosscuts.** The short, straight guide (near right) is used for intermediate rips and long crosscuts.*

***Swift, square cuts.** The 90° guide (middle) makes perfectly square cuts 2 ft. long.*

***The miter option.** To make mitered edges, assemble a guide with its base cut to 45° (far right). Align the angled layout line with the mitered edge of the base.*

that the waney edge disappears. Then clamp the plank to the table and rip.

Mitering—What if you need to rip a wide mitered edge to make a large box? All you need is another cutting guide. Make one with an oversized base, just as you did with the others, and then trim it with the sawblade set to 45°.

When you are ready to cut the miters on the workpiece, mark the cut on the edge of the piece with a 45° marking square and line up the beveled Masonite with the marks.

***Waney edge, go away.** You can use the long guide to put a straight edge on a waney board. Block up the guide so that the workpiece just fits under it. Then nudge the waney edge of the workpiece under the guide's base. Clamp both guide and workpiece, and rip off the edge.*

Ripping skinny pieces—Narrow pieces are typically best cut on a tablesaw. But on site or on an installation, there may be times when you want to cut a piece narrower than the cutting guide. In these cases it's difficult to clamp the two together without the clamps interfering with the saw. The solution is to clamp the workpiece to the table, with the clamps in the waste, and hold the guide down with different clamps. As with the straight-lining, elevate the guide using scraps the same thickness as the workpiece, positioning them under the clamps. Slide the workpiece under the guide, line up the cut marks with the Masonite edge, and clamp the workpiece to the table. Then rip as usual. If you need to rip a number of skinny pieces to the same width, position the spacer blocks to serve also as stops, determining the width of the cut.

A cutting table and guides should make your life a little easier around the shop, especially if it's a small one. You may even find them helpful next time you go out in the cold to build a deck. □

Gary Williams is a technical writer and woodworker in San Diego.

Full-Extension Wooden Slides

Shopmade hardware designed to fit any drawer, large or small

BY CHRISTIAN BECKSVOORT

I admire the resourcefulness of shopmade hardware. If it's entirely made of wood, all the better. I discovered full-extension wooden slides on an antique chest of drawers I restored. They are beautiful in their simplicity and can be made almost any size.

Full-extension slides are necessary whenever access is required all the way to the back of a drawer (file drawers and card catalogs, for example). The drawer must be held in a fully open position and should be easy to remove. This system of wooden slides meets both criteria.

There are a few rules to follow when making these slides. First of all, the drawers must be 13⁄16 in. narrower than the opening. The drawer must have an applied front, obviously, to cover the gap. The carcase must be built with solid vertical dividers or sides, which provide an attachment point for the slides, and horizontal dividers, which may be solid or open web frames.

The slides may be as tall as the drawer sides. For light-duty cases, you may wish to make the slides narrower, about two-thirds the drawer height. For very deep drawers, such as files, there's no need to make the slides any wider than 6 in. At that dimension, they will provide plenty of strength. For inset drawers, the slides must be 1⁄4 in. shorter than the total length of the drawer sides (do not include the applied front when measuring the drawer length).

To make a pair of slides the same height as the drawer, mill two pieces of 7⁄16-in.-thick hardwood 3⁄8 in. wider than the actual drawer sides and the correct length. Measure about a third of the way across one piece, set the rip fence for that dimension and rip all of the stock in two. The exact width doesn't matter as long as everything is cut at the same setting. Put the narrow pieces aside and work on the wider halves, which will become the lower slides.

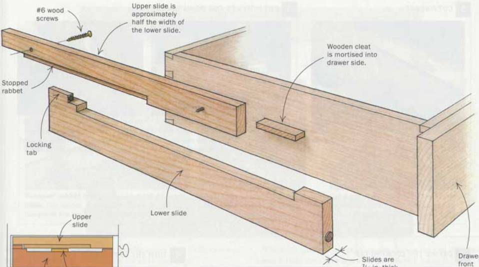
(If you're wondering how the slide parts end up becoming the same height as the drawer, here's what happens: The saw kerf will reduce the width of the stock by 1⁄8 in.; and once the parts are machined for the mechanical connection, the slides interlock, reducing the width by another 1⁄4 in., for a total reduction of 3⁄8 in.)

Begin with the lower slides

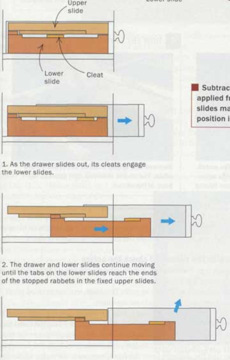
Start by cutting a rabbet 3⁄16 in. wide by 5⁄16 in. deep along the entire length of each lower piece (for more on making the lower slides, see the photos on p. 76). Next, set your tablesaw blade for a 9⁄16-in.-deep cut. Set a slide or slides (same-side slides may be ganged to-

Photos, except where noted: Vincent Laurence; this page: Michael Pekovich

HOW THE SLIDES WORK



Subtract ¾ in. from the length of the drawer sides (not including the applied front) to arrive at the correct slide length. The heights of the slides may be equal to or less than the drawer height. The drawer cleat position is determined once the slides have been installed in the carcase.



1. As the drawer slides out, its cleats engage the lower slides.

2. The drawer and lower slides continue moving until the tabs on the lower slides reach the ends of the stopped rabbets in the fixed upper slides.

3. The drawer can be lifted off the slides when fully extended.

gether) against a miter gauge or sled and make two crosscuts, one 15⁄16 in. from one end and another 1¼ in. from the opposite end. Remember that the left and right slides are mirror images of one another. In other words, while making the crosscuts, the rabbet will be facing the blade for one slide and facing the miter gauge for the opposing slide.

Set up a couple of stops along your saw's rip fence and carefully cut away the rabbet between the notch. Clean up the corner of the rabbet using a handsaw and chisel. Go back to the tablesaw and make another crosscut on the stepped portion of each slide, ⅞ in. from the back and as deep as the rabbet, then remove the waste on the bandsaw to create a locking tab at the rear of the slide. This step engages with the rabbet on the upper slide and keeps the drawer from tipping out. Finally, go back to the tablesaw and rip off the portion of the step on the front of each slide that protrudes above the rabbet.

Machine the upper fixed slides

As with the lower slides, the uppers should be mirror images of one another (for more on making the upper slides, see the top

MAKING THE LOWER SLIDES

1 CUT RABBET

Begin work on the lower half of the slides. *Machine a full-length rabbet 3/16 in. wide by 5/16 in. deep.*

2 CUT NOTCHES FOR DRAWER CLEAT

Set the tablesaw blade for a 5/16-in.-deep cut. *Make crosscuts 15/16 in. from the front and 1¼ in. from the rear of the lower slides. Left and right slides are mirror images of one another.*

Using stop blocks, make a rip cut along the rabbet to remove the center portion. *Be sure to stop short of the notches. Finish the rip using a handsaw.*

3 DEFINE THE LOCKING TAB

Make another notch. *Set the notch 7/8 in. from the rear of the slide and as deep as the rabbet.*

Remove the waste behind the notch. *The locking tab engages with the upper slide and keeps the drawer from tipping.*

4 TRIM THE UPPER STEP

Remove the upper step at the front of the slide. *The step is removed right down to the base of the rabbet.*

photos on the facing page). First joint the edges to remove the saw marks. Then lay out and cut a stopped rabbet—¼ in. wide and 5/16 in. deep—in each slide equal to two-thirds its length, measured from the back. The rabbet must be located on the carcase side of each slide. One way to ensure this happens is to mill opposite slides on opposite sides of the tablesaw's rip fence using a stop block. Square up the rabbets using a handsaw and chisel.

At the back end of each slide, make a notch by cutting off 1 in. from the thin wall of the rabbet. The notch allows the other half of the slide to be inserted or removed. Drill and countersink two or three screw holes on each slide, going in from the sides that will face the drawer.

Fit together the two left pieces and the two right pieces, flat on the benchtop. Use a 1/16-in. spacer to separate each pair, and compare them to the height of the drawer sides. If necessary, trim the bottoms of the movable slides so that the total height (with spacers) is equal to or less than the height of the drawer sides.

Install the slides and check the action

Make sure the slides are lightly sanded and that all sharp edges are broken. I like to add leather bumpers to the slides. Cork or rubber discs would work just as well. The bumpers are applied to all of the parts that bump into one another.

Place an upper and lower slide inside the drawer housing. The movable slide rests on the bottom of a divider. Place the fixed slide atop it, being sure to use a 1/16-in.-thick temporary spacer between them. Now maneuver the lower slide (the one with the bumpers) so that the distance from the front bumper to the edge of the carcase equals the thickness of the drawer front. Clamp both slides in place, keeping the upper slide in line with the lower (wood to

MAKING THE UPPER SLIDES

1 *CUT THE STOPPED RABBET*

2 *CUT THE CLEARANCE NOTCH*

Stopped rabbet engages locking tab of lower slide. *The rabbet, ¼ in. wide by 5/16 in. deep, runs two-thirds the length of each upper slide.*

Square the corners of the stopped rabbet. *Remove the waste using a chisel.*

Cut a notch at the rear of the upper slide. *The notch is 1 in. from the back and as deep as the rabbet.*

wood, not wood to bumper). Screw the upper slide to the case and remove the spacers. Do the same for all of the slides.

The action of the slides should be smooth, with only 1/16 in. of vertical play. When pushed all the way in, the lower slides may be tilted out via the small notch at the rear of the upper slide.

Drawer cleats are added last

Once the slides have been completed, locate and install the cleats (see the photos below right). Pull out a pair of slides as far as they will go. Fit the drawer between them so that the inside of the drawer back is flush with the outside of the case. This is the fully extended position. Clamp the drawer so that the bottoms of the slides and the bottom of the drawer are flush. With a sharp pencil, mark the top of the slide (horizontal) and the step (vertical) on both sides of the drawer.

The antique cabinet that I used for a model had brass cleats set into the drawer sides. Aesthetically, I don't like the look of the metal in the middle of the drawer sides nor the green metallic streak it leaves on the slides. Instead, I use hardwood cleats, the same species as the drawer sides and slides.

Make each cleat ¼ in. thick by 1½ in. wide. For drawers ½ in. thick or less, I make the cleats about 9/16 in. long and cut mortises 3/16 in. deep into the drawer sides, which leaves 3/8 in. of cleat exposed. For thicker drawers, the cleats may be longer; be sure to cut deeper drawer mortises, too. Glue the cleats in place.

When the glue has set, position the drawer back in its opening, lower it onto the slides and shut it. Now pull it out. It should ride smoothly and stop in the fully extended position. (Use a little paste wax if parts stick.) The drawer back will remain in the opening, while the cleats resting on the slides support the weight. If fine-tuning is needed, a little bit of material may be removed (or added) to the front steps of the lower guides.

I think these wooden slides are a pleasing alternative to using metal hardware on fine pieces, whether they're antique or contemporary, small or large. □

Christian Becksvoort is a contributing editor.

LOCATING THE DRAWER CLEATS

After installing the slides in the case, mark the cleat locations on the drawer. *Clamp the drawer at full extension and trace along the step and lower slide.*

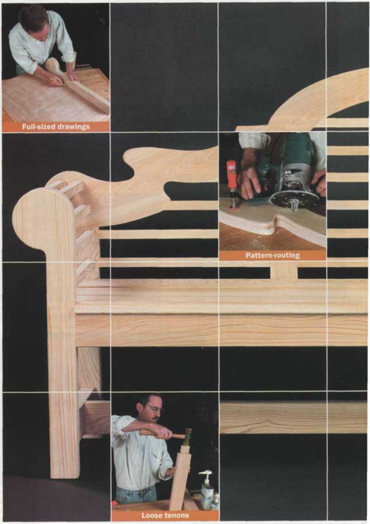
Cut mortises into the drawer sides. *Once the cleats have been glued in place, the drawer is ready to be used.*

The Lutyens Garden Bench

Turning our little yard into a landscaped garden retreat has been one of those back-burner projects my wife and I have managed to avoid since buying our house six years ago. It's been easy to do because neither of us is a gardener. As a woodworker, I'm always able to find constructive projects somewhere inside the house that are better suited to my skills than moving earth and planting flowers. Plus, I've decided that a proper garden should evolve slowly over the years—four years ago we planted a Japanese maple under the fringe of the huge Sycamore that dominates the yard, and last summer I laid down a brick patio outside the back porch. Good things shouldn't be rushed, I tell myself.

Now that I work primarily from home, the prospect of taking daily work breaks in a more pleasant backyard nook has me thinking more about the gardening part of our imaginary garden. But over the winter months all I could do was plan, dream and defer. Then I saw a picture of the Lutyens garden bench in a catalog. The bench had the kind of distinctive elegance that I wanted my garden to have, but with a price tag nearing $2,000 in the catalog, I decided to make one myself.

The original bench was designed 100 years ago by Edwin Lutyens (1869-1944), a British architect and designer. The bench's curvaceous crest rail and lollipop-like front legs form a whimsical frame around the classically regimented slats of the back and rolled armrests. An



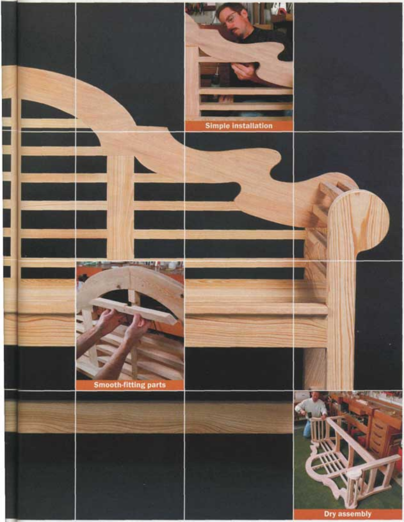
Full-sized drawings

Pattern-routing

Loose tenons

Full-sized drawings and accurate templates help break a classic design into manageable parts

BY TONY O'MALLEY



Simple installation

Smooth-fitting parts

Dry assembly

eye-catching and comfortable three-seater, it's no wonder the Lutyens bench is still copied by dozens of outdoor furniture manufacturers.

Some reproductions I've seen have no bottom stretcher at the front or back, and others have both. As I sketched and worked through drawings, I began to notice that a bottom stretcher even with the front legs would restrict a sitter's feet from going where they naturally want to go—under the seat a few inches. As a compromise, I positioned a stretcher under the middle of the seat, tenoned into the bottom side stretchers.

I worked out the details of the entire bench using full-sized drawings. I drew the bench, at various views, directly onto ¼-in. plywood. Because of the myriad joints, angles and curves in this design, full-sized drawings were crucial to making the project run smoothly. The drawings helped me not only to refine the design of the bench before committing any cuts to lumber but also to figure out the construction and necessary order of assembly.

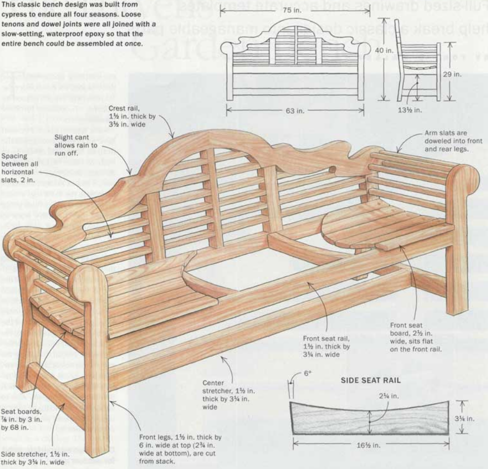
Choose an appropriate wood for outdoor use

Reproductions of the Lutyens garden bench are typically made of teak, but I ruled that out immediately due to the cost. My bench would sit outside permanently because I didn't have a place to store it indoors over the winter, so weather resistance was a main requirement. Spanish cedar is a good mahogany-colored wood that weathers better than real ma-

Photos, except where noted: Matthew Teague; main photo, this spread: Scott Phillips

AN OUTDOOR FAVORITE

This classic bench design was built from cypress to endure all four seasons. Loose tenons and dowel joints were all joined with a slow-setting, waterproof epoxy so that the entire bench could be assembled at once.



hogany, but I couldn't find any locally. I looked at several imported hardwoods being marketed for deck building—ipe from South America and jarrah from Australia among them—but these woods are very heavy, quite abrasive to tools and generally hard to work. High weight also helped me rule out locally grown woods like white oak and locust.

I settled on cypress for its light weight, good moisture resistance and moderate hardness. It was also available from a local supplier at a good price and in thicknesses that would work—I used 8/4 material for the bench frame and 4/4 material for the seat boards, arm slats and back slats. If you want to avoid planing rough lumber, cypress is available as dimensional lumber from many suppliers of deck-building materials.

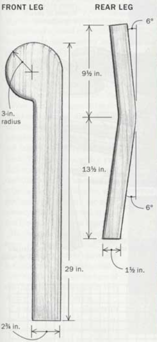
Start with the seat frame

There's no better motivator when making furniture than actual progress, so I like to start with the easier parts of a project and work my way up to the more difficult ones. In this case the back of the bench was by far the hardest part to make, so I decided to build the rest of the bench first.

For each back leg, I face-glued two pieces of 8/4 stock. I

Drawings: Bob La Pointe

FULL-SIZED DRAWINGS AID LAYOUT



***Full-sized drawings lead to accurate templates.** The drawings make it easy to check measurements and make a template for the legs. Simply mark out the profile on the blank (left), then bandsaw the leg to shape (right).*

***Mark legs at intersection points.** With the front leg cut to shape, use a side-view drawing to mark out the position of the rail and stretcher (left). All frame mortises are centered on the stock and are ½ in. thick (right).*

planed down the stock to 1¾ in. thick (the actual thickness is not crucial; just keep it as thick as possible). I ripped the stock slightly oversized to 3 in., then glued the slabs together. The seam is visible only from the side, not from the front or back. Structurally, either approach would be sound, but my approach made the front view a little cleaner. I planed the rest of the 8/4 stock down to its final 1½-in. thickness.

I transferred the profile of the back legs from my full-sized side-view drawing and cut them out on the bandsaw (see the photos above). I sanded the bandsawn surfaces on my 6-in. edge sander, but a block plane and some hand-scraping would work just as well.

Both front legs can be cut from a single piece of stock, 6 in. or wider, with the straight part of the legs overlapping. I rough-cut the legs first, then ripped the inside edge of each one on the tablesaw, stopping short of the top circle. Then I bandsawed the final shape of the circle and the transition into the straight inside edge.

With all of the seat-frame parts cut to size, it was time to cut the mortises. Years ago, when I first learned woodworking, there was a horizontal mortiser in the shop where I worked. With one setup, this machine cuts mortises in both parts that form a joint; a separate piece of wood is used for the tenon (called a loose tenon). In most cases it's a lot easier than cutting a tenon and routing a mortise, and the resulting joint is just as strong. Since then, the idea of cutting mortises with a plunge router has never caught on for me, and I now use the mortiser on my Robland combination machine (see the photo below) for al-

DO COMBINATION MACHINES MAKE SENSE?

The deal I got on my used Robland X31 combination machine seven years ago was too good to pass up. The Robland combines five tools: tablesaw with sliding table, jointer, planer, spindle shaper and horizontal mortiser. Moving from one task to another can be time-consuming, but the tool is heavy duty and high quality. For my small shop and tight budget, the machine definitely has been worth the money.

most all joinery work, including doweling.

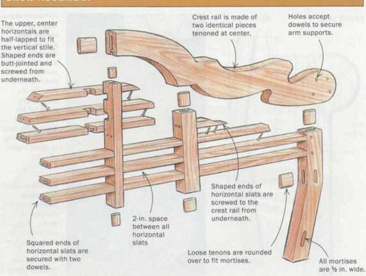
I centered the mortises in the 1½-in.-thick rails and stretchers and in the faces of the legs. After shaping the tenon stock and cutting the separate tenons to length, I glued them into the ends of all the rails and stretchers with epoxy. One caution, however: Before gluing the tenons into the seat rails, dry-assemble the legs and side rails. If the complementary angles formed by the back-leg cant and the rails are off, the joints

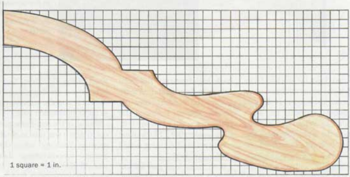
One tenon fits all. *The author mills tenon stock to thickness, rips it to width, then rounds over the corners. By trimming them to short lengths, he can make many tenons from one piece of stock.*

won't close perfectly. To solve the problem, simply scribe a new cut line and recut the back ends of the side rails and side stretchers for a perfect fit. (Be sure to recut the two intermediate seat rails at the same time.)

Also, because the tenons on the front, rear and side seat rails intersect, I mitered them so that each is as long as possible. I cut the curve in the seat rails on the bandsaw and—at long last, it seemed—dry-assembled the bench frame, less its back.

BACK ASSEMBLY





The back is the most difficult section to make

Good design often leads to construction and assembly conundrums, and it's certainly true with the back of this bench. The visual centerpiece around which the bench is designed, the back is deceptively well integrated into the rest of the bench's structure (see the drawings above). But the required assembly sequence was not immediately obvious to me. Looking at the sturdy bench frame dry-assembled, I wanted to glue something up. But each assembly sequence I considered led to a dead end involving the back of the bench.

After scratching my head for a long while, it became clear that the entire bench, starting with the back, would have to be glued up in one continuous assembly. It also would have been possible to glue up the back first and then the rest of the bench frame, but I opted for a single glue-up. I chose an epoxy from West Systems and used a hardener with a slightly longer open time than the company's standard hardener (see the box on the facing page).

First I made a full-sized drawing of the entire back. Then I made a template for shaping the crest rail, which is made of two pieces connected at the centerline with a mortise-and-tenon joint. I drew a half pattern of the crest rail on paper and refined the wavy curves with a lot of trial and error, using catalog photographs as a visual guide. After transferring the pattern to a piece of ¼-in. plywood, I bandsawed the shape, then blended the curves using a belt sander, spindle sander and rasps. I traced the shape onto the rail halves, then cut them out on the bandsaw, staying slightly outside the line. Then I screwed the template to the back faces of the rail halves and trimmed them flush. The first pass with a pattern-routing bit trimmed about two-thirds the thickness of the edge; a flush-trimming bit, with the bearing riding on the edge already shaped, cleaned up the rest (see the photos at right).

Incidentally, each half of the crest rail requires 8-in.-wide stock or wider. I didn't have any 8/4 material this wide, and I didn't want seams in the face of the rail, so I face-glued two wide pieces of 4/4 stock.

I was less than thrilled with my decision for two reasons. First, the front and back boards were not well matched, so the grain is noticeably different when looking at the top edge of the crest rail. And because one of the boards was a lot heavier than the other, the laminated stock bowed slightly after I had planed it to final thickness. The lesson: select boards of similar grain and weight if you have to face-glue.

Next, I cut the mortises in the crest rail and bottom rail of the back, in the two vertical stiles in the back and in the top of the back legs. Because their odd shape precluded clamping to the mortising table in the normal fashion, I could not completely cut the mortises for the two intermediate stiles into the crest rail using my horizontal mortising machine. Nevertheless, I clamped the rail halves at an angle and mortised in as far as possible, then deepened and finished these two mortises with a drill and chisels. I cut the center vertical stile to fit between the crest rail and bottom rail, rounding its top end to match the curve of the arch. Then I cut small mortises to join this center stile to both rails. I could finally dry-assemble the main structural frame of the back, then cut all the slats to fit.

My plan was to fit all of the slats with a pair of dowels in each end and drill the corresponding holes in all of the verticals. At this time I wondered about the assembly sequence of the back, with all of those slats. The main structural parts (bottom rail, crest rail, three stiles and back legs) come together in one direction, while all of the slats are joined in the perpendicular direction. The problem is with the slats that join to the crest rail—if they were doweled, there would be no way to

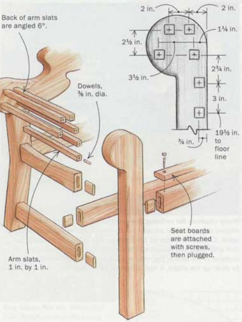
SHAPING THE CREST RAIL

***Many chances for refining the crest rail.** Begin with a pattern shaped on paper, then adjust it as you mark it out on plywood template stock. Cut out the shape on the bandsaw and refine the template further with rasps and various sanding machines. With the template screwed to the face of the crest rail, use a pattern-routing bit in a router to clean up the shape. A flush-trimming bit finishes the job.*

CHOOSE GLUE SET TIME TO MATCH YOUR WORK

This is an outdoor bench, so I turned to epoxy (West Systems Epoxy; 517-684-7286) because it is waterproof. But I learned that adding a slow-set hardener would give me 50 minutes open time—more than the usual 9 to 12 minutes. For simple applications, such as gluing loose tenons into place, I used the regular formula. But the hardener gave me enough time to do the final assembly all at once.

ROLLED ARMS



bring the crest rail down onto the stiles and also engage the dowels in the back slats at the same time.

I'm sure there are other solutions, but I decided that all of the slats attaching to the crest rail would be butt-joined and reinforced with countersunk screws from underneath. Additionally, the slats under the center arch would have to be added after the main assembly by half-lapping them over the center stile. Between epoxy's good gap-filling ability and carefully predrilled holes for the screws, these butt joints should hold up just fine.

I cut all of the slats to fit within the assembled back frame. To get the curved ends of the upper slats, I held them in position and marked right off the crest rail where they intersect. I bandsawed and sanded the ends to fit snugly. After cutting the half laps in the center stile and the two top slats, I used the same process to fit these last two slats. I drilled the dowel holes for all of the slats on my horizontal mortiser.

Build the rolled arms and attach the seat

Once the components of the back had been cut and the joinery fitted, I reassembled the entire bench dry (see the right photo below), then cut the arm slats to fit. First I laid out the position of each slat on the front and back legs, then cut the slats square at the front and with a 6° angle at the back to correspond to the angle of the back (see the drawings at left). I drilled and doweled the ends of the arm slats on my mortiser, then drilled the corresponding holes in the back legs and crest rail with a hand drill using a bevel gauge as a guide (see the left photo below).

After all that, the most essential part of the bench—the seat—still remained undone. The back edge of the rear-most seat board is angled at 18° so that it can snug up against the back legs and stiles. The front

HAND-DRILLED MORTISES

Rolled arms are attached with dowels. *With the back dry-fitted tightly into place, you still have to drill dowel holes for the slats that make up the rolled arms. To make sure the angle is correct, use a bevel gauge canted to 6° to guide a handheld drill.*

ATTACHING THE SHAPED SLATS

Finishing the back. *After the main components of the bench have been glued up, the smaller slats can be set into place.*

A smooth fit. *Using a dado set on the tablesaw, the two top slats are notched to fit over the center stile.*

Scribing the back slats. *The upper slats on the back are scribed for a tight fit. A bandsaw is used to cut them to shape, but final shaping is done with rasps and sanding machines. The shaped ends of the slats are screwed into place from underneath.*

The last touch. *Working from the back toward the front, the author uses spacers and screws down the seat. Once in place, bungs are epoxied into place over the countersunk screws.*

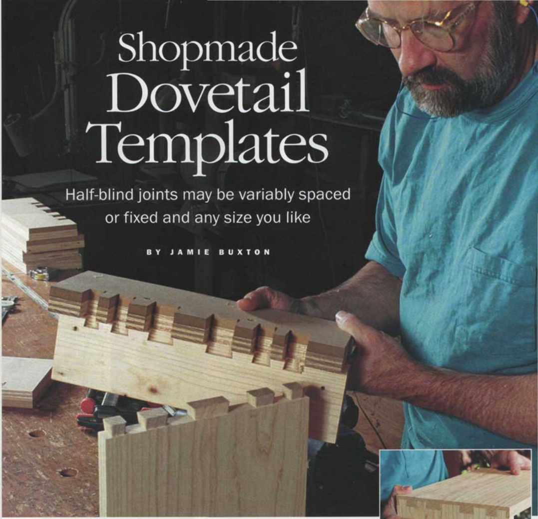
seat board is narrower and sits flat on the square edge of the front seat rail. The four middle seat boards are identical. To promote rain runoff from the seat and reduce the likelihood of splinters, I rounded over the top edges of the seat boards with a ⅜-in. roundover bit.

Using exposed screws in the top of the seat boards would detract from the refined look of this bench and give water a place to pool. And screwing up through the curved rails would require different-sized screws or counterboring a different depth for each board. So I attached the seat boards to the frame from above with galvanized deck screws. The holes were counterbored, and I glued plugs in them for a clean look.

Before the final glue-up, I sanded all of the bench parts, keeping the joined areas good and flat. I went over all four edges of the arms slats with an ⅛-in. roundover bit. I used a ¼-in. roundover bit to soften the exposed parts of the curved crest rail and the front legs, being careful to stop at the joint seams. After sanding, I assembled the bench with epoxy and a lot of clamps.

Well, my garden retreat is still composed of a brick patio, a Japanese maple and a few potted plants. Only now it's also graced by a quite comfortable and distinctive bench. But I'm afraid it will take some inspired landscaping and probably more than a few years to develop a garden that's worthy of the bench. □

Tony O'Malley is an editor, writer and woodworker in Emmaus, Pa.



Shopmade Dovetail Templates

Half-blind joints may be variably spaced or fixed and any size you like

BY JAMIE BUXTON

Hand-cut dovetails are versatile and suitable for projects of any size. The problem, however, is that they're time-consuming to make and require a fair amount of skill. Router jigs solve some of the problems, but the most adaptable jigs cost a lot of money. It turns out that there's another solution: custom-sized shopmade router templates.

I worked on the problem in my spare time, and after a few weeks of number crunching, I was ready to put my theory to the test. In a few hours I succeeded in making my first dovetailed drawer using a pair of shopmade templates.

My method is limited to making variably spaced, half-blind dovetails. Both halves of the joint are cut using a bearing-guided dovetail bit. Then I ease the corners of the square-cornered tails with a chisel so that they fit the round-cornered sockets. With this method I can cut joints faster than I

The variable-spaced, half-blind dovetail joint is complete. *Templates can be custom-made for any project of any width.*

Photos: Anatole Burkin

could by hand, yet it allows me to custom-make templates for individual projects.

Half-blind dovetails are most commonly used to join drawer sides and fronts, but you can also use them to join solid casework. My templates take only an hour or so to build, and I make a new set for each project so that the dovetail pattern is perfectly suited to the width and scale of the piece.

Accurate by construction

My system uses two templates—one for cutting tails and another for cutting pins. Because the initial and critical machining for the templates is done with them sandwiched together, they are mirror images of each other, which makes the joint accurate.

As with all machine-cut dovetail joints, tails cannot be any narrower than the dovetail bit itself. But the maximum width of the tails and the maximum spacing between them are infinitely variable, features that make this technique so versatile.

These jigs have their idiosyncrasies. For example, the height of the tails depends on the thickness of the sawblade used to make the first cuts in the template (see the chart on p. 89).

To join ¾-in.-thick stock and end up with ½-in.-high tails, which look about right, I use a 11/16-in.-dia., 8° dovetail bit fitted with a ¾-in.-dia. bearing. Next, lay out the tails on the stock, keeping in mind the diameter of the dovetail bit at its widest point. Then transfer those marks to the tails template. Clamp both templates together so that they are flush on all sides.

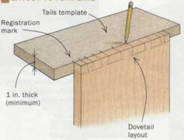
Before making a first template, make some test cuts in scrap using whatever sawblades are available. Measure the kerf with a dial caliper, then refer to the chart. You may find that the measurements (kerf widths) don't exactly match my chart. Don't worry. Find the closest match and make a template that suits your needs. It can be fine-tuned later. I use a blade that's a hair thicker than ⅛ in., but it produces a kerf of 0.135 in. due to runout.

Template stock should be about 6 in. wide so that it can support a router and slightly longer than the workpiece to allow for clamps. I use plywood or medium-density fiberboard (MDF) for the templates and laminate the material to get stock that is at least 1 in. thick. Both templates must be the same thickness.

Clamp the tails and pins templates together and lay out the dovetails. The space

MAKING THE TEMPLATES

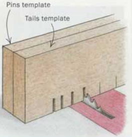
1 TRANSFER DOVETAIL LAYOUT TO TEMPLATE



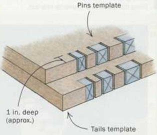
Choose an appropriately sized bearing-guided dovetail bit. *The diameter of the bit determines how close the tails may be spaced.*

Make the first cuts in the dovetail templates using a tablesaw blade. *Clamp the pins and tails templates together and cut notches that define the templates' fingers.*

2 SANDWICH TEMPLATES TOGETHER AND CUT NOTCHES ALONG LAYOUT MARKS



3 DADO TEMPLATES SEPARATELY



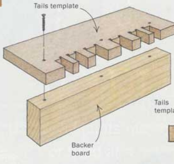
Note: The template fingers are made deeper than necessary. The extra depth allows you to adjust the offsets, if necessary, to get snug-fitting dovetail joints.

Remove the remaining waste with a dado blade. *Be sure the space between fingers is wide enough to allow the dovetail bit and bearing to fit inside.*

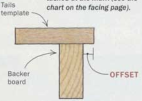
Drawings: Vince Babak

ROUTING THE TAILS

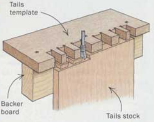
1 ATTACH BACKER BOARD



Mark the offset on the tails template. *A backer board is attached at the mark (see the chart on the facing page).*

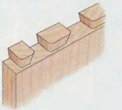


2 CLAMP WORKPIECE TO THE JIG AND ROUT TAILS



The tails are routed with the stock clamped vertically. *The backer board positions the stock and prevents tearout.*

3 ROUND THE TAILS WITH A CHISEL



Chop off the corners of the tails using a chisel. *The corners must be removed for the tails to fit inside the rounded sockets produced by the pins template.*

between the fingers on the tails template must, obviously, be larger than the diameter of the bit's pilot bearing. Next, using the tablesaw, cut out notches along the layout lines. Make these notches deeper than the depth of the tails by about ½ in. (The exact amount isn't important; you'll see why soon.) Separate the halves and mark out the waste sections, which will be opposite for each half. Finally, remove the waste with a dado blade set for a slightly shallower cut than the notches. The exact depth of cut isn't important as long as it's greater than the height of the tails (refer to the chart). For the 11⁄16-in.-dia. dovetail bit, I cut a dado that's about 1 in. deep.

Mark out the offsets on both the pins and tails templates. The offsets are used to register stock. Because the dadoes on the templates are cut deep, the offsets can be repositioned, if necessary, to tweak the fit of the joint. One could make the templates without offsets for an exact fit, but it's not worth the extra effort.

I mark the offsets using a finely sharpened mechanical pencil. For the pins template, measure the offset from the bottom of the dado out toward the edge of the template. For the tails template, do the opposite: Measure the offset from the outside edge of the template in toward the base of the dado. Offsets will vary, depending on the thickness of the stock and the kerf width (see the chart).

Finally, screw a backer board onto the tails template. I use a piece of 2x4 that has been jointed square. The block does two things: It registers the stock to the offset and prevents tearout as the bit exits the tails stock. The pins template requires no additional preparation.

Using the templates

Chuck the bit in the router and set the depth. Refer to the chart and be sure to add the thickness of the template to the depth setting. Some routers with limited travel may not work with my templates. I use a 3¼-hp plunge router that has lots of travel. Use the same depth setting for cutting both pins and tails.

Now for the fine-tuning. If your saw's kerf is a few thousandths of an inch wider than indicated in the chart, set the router bit slightly deeper. Conversely, if your saw leaves a kerf thinner than indicated in the chart, set the bit shallower by a few thousandths of an inch. Make trial cuts in scrap and check the fit. If the joint is loose, adjust the router for a deeper cut.

To make the cuts, secure the tails stock—with the inside face out—to the tails template using a pair of clamps. Place the stock in a vise to hold it upright. Take a light pass along the edge of the board to establish the shoulder cut. Then rout out the remaining waste, taking care that the router-bit bearing rides firmly along the fingers of the template. It doesn't hurt to take a second pass to ensure a clean cut. If you are using a ¼-in.-dia. shank bit, remove most of the waste using a straight bit first to avoid stressing the dovetail bit. I prefer to use ½-in.-dia. shank bits whenever possible.

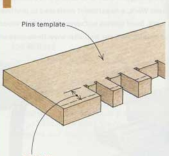
The pins template is clamped to the inside face of the stock, which is aligned to the offset. I clamp the template and stock directly to my workbench with a second pair of clamps. Make the cuts, moving the router from left to right. If your router seems to be straining, especially when cutting thick stock, take several light passes.

After removing all of the waste, only one step remains. Because the tails have square corners and the pins have rounded corners, they won't seat properly. I solve that by chopping off the corners of the tails using a chisel. The corners need not be rounded to match the pins perfectly because most of the joint's strength will be in the long-grained areas. But if you prefer, the pins can be chiseled out and made square to mate cleanly with the tails. This will take longer and, to my mind, defeats the timesaving nature of the jig. □

Jamie Buxton is a computer engineer and woodworker who lives in Redwood City, Calif.

ROUTING THE PINS

1 MARK OFFSET ON PINS TEMPLATE



Use a ruler to mark the offset. *The pins offset will depend on the thickness of the stock used (see the chart below).*

2 CLAMP WORKPIECE AT OFFSET LINE AND ROUT PINS

The pins stock is clamped facedown to the template. *Rout the pins from above using a router bit with a bearing and stop collar.*

DOVETAIL TEMPLATE SETTINGS

Cutter diameter	Cutter angle	Bearing diameter	Kerf width	Depth setting*	Offsets ½-in. stock		Offsets ⅝-in. stock		Offsets ¾-in. stock	
					Tails	Pins	Tails	Pins	Tails	Pins
11/16 in.	8°	¾ in.	0.125	0.445	0.344	0.469	0.469	0.594	0.656	0.781
11/16 in.	8°	¾ in.	0.135	0.516	0.334	0.469	0.459	0.594	0.646	0.781
11/16 in.	8°	¾ in.	0.160	0.694	0.309	0.469	0.434	0.594	0.621	0.781
11/16 in.	8°	¾ in.	0.200	0.978	0.269	0.469	0.394	0.594	0.581	0.781

*Add this number to the thickness of the template for the actual router-bit depth setting. For an expanded chart, see our web site at www.finewoodworking.com.

SOURCE OF SUPPLY

Eagle America (800-872-2511; www.eagle-america.com) offers a good selection of dovetail bits, including 8° bits, which I use frequently. Eagle also sells bearings and stop collars, which are needed with my templates. The collar and bearing fit directly over the bit's shank.

Current Work

In the same way that a painter learns by viewing the work of artists, a woodworker can learn by looking at the work of peers. Enter Current Work, a department dedicated to providing design inspiration. We'd like to see photos of your work. Send entries to Current Work, *Fine Woodworking*, 63 S. Main St., Newtown, CT 06470. For more details, visit our web site: www.finewoodworking.com.

Maurie Conner

As an art teacher, Conner always seemed to lose or misplace pencils. Each medium-density fiberboard (MDF) drawer tray holds 30 pencils, and when pulled open the drawer pivots downward, making the pencils visible and accessible. This walnut pencil box is 9½ in. deep by 18 in. wide by 7¾ in. high. Conner has made several of the boxes and says they are a great project for "using up those hardwood scraps that are hard to throw away."

John Cangelosi

This end table, 17 in. dia. by 24 in. tall, was built as a Christmas gift for Cangelosi's wife. It is made of cherry and finished with a mixture of tung oil and turpentine.

Ramsey Faragallah

Although mostly cherry, this desk, 32 in. deep by 91 in. wide by 30 in. high, also incorporates ebony, bronze and mother of pearl in its construction. Faragallah's client wanted a desk that merged Arts and Crafts and Oriental styles. The client is a musician, and after seeing one of her instruments on a table during a consultation, it seemed logical to Faragallah to use violin and cello tuning pegs for the drawer pulls.

Larry L. Books

Built for Books' youngest granddaughter, Erica, this cradle—24 in. deep by 41¾ in. long by 35½ in. high—is made of black walnut and bloodwood and is accented with brass pins. Books, who has been a high school woodworking teacher for 28 years in Washington state, finished the cradle with an oil-urethane mix.

Joe Willard

This Chippendale chair, 17 in. deep by 18½ in. wide by 36½ in. high, is made of walnut and outfitted with a silk slip seat. Willard started with a photograph from an antique auction catalog and worked out the design without drawings as he built the chair. The finish is linseed oil and turpentine.

Carl A. Morrell

Twenty years after high school woodshop class, Morrell took up woodworking for the second time and made this chest (20 in. deep by 39 in. wide by 48 in. tall) using a vacuum bag and cherry veneers. The six drawers are different heights and are rimmed with bocote. As for the clock in the chest's gallery, Morrell said, "I figured every dresser has a clock sitting on it, so why not integrate?"

John H. Margeson

This eastern red cedar chest, 13 in. deep by 46 in. long by 18 in. high, sits on a base and is supported by ledger strips. The chest is held together with 72 hand-cut dovetails and finished with Danish oil and wax. The chest was a Christmas present for Margeson's oldest daughter. "It knocked her socks off," he said.

Matthew Putnam

For his third assignment at the William Sayre Woodworking School in Massachusetts, Putnam designed and built this cabinet, which features horse-hoof feet, a Chinese-style "roof" and a rising cloud shape throughout the piece. The cabinet is 11¾ in. deep by 17½ in. wide by 62 in. high and is made of bubinga, quartersawn sycamore (drawer sides), camphor wood (drawer bottoms), ebony, nickel-plated brass and hand-blown glass. The finish is a padded blond shellac. Photo by Lisa Clayton

Brian E. Harroun

The carcase of this chest of drawers was made from recycled oak pallets, and the rest of the chest was made from #2 common oak and #2 pine for the drawer boxes. The chest, 16 in. deep by 29⅝ in. wide by 56½ in. high, was fumed with ammonia, then finished with oil-based polyurethane.

Wayne Weatherhead

A self-taught woodworker, Weatherhead has been reading *Fine Woodworking* for 20 years. He has been particularly inspired by the articles of contributing editor Christian Becksvoort. Weatherhead built this cherry chest, 20 in. deep by 42 in. wide by 38 in. high, for his youngest grandson, Benjamin.

Alan Carter

A painter and photographer for the last 22 years, Carter took up woodworking full time just a year ago. The design for this table, 14 in. deep by 14 in. wide by 30 in. tall, was influenced not only by Asian and Art Deco styles but also, Carter said, "by the impressions left from years of photographing and painting urban settings." The table is made of African mahogany and maple with ebony accents.

Robert J. Lentz

This blossom-like vessel, 20 in. dia. by 10 in. high, was turned and sculpted from a cedar stump. Lentz used slow lathe speeds and a grinder to shape the piece. The heartwood, sapwood, bark, knots and gaps made the process difficult. The vessel was made for clients who wanted a keepsake from their property. Photo by William H. Turner.

Ted Blachy

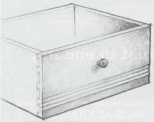
Blachy built this sideboard for the annual auction of the New Hampshire Furniture Masters. The sideboard, 20 in. deep by 61½ in. wide by 34 in. high, is made of cherry and features rosewood pulls. The patron who won the bid on this piece has become one of Blachy's regular clients. Photo by Frank Cordelle.

Tips for photographing your furniture

1. *Use 35mm color print (negative) film of moderate speed (ISO 200-400).*
2. *Clean and dust the furniture.*
3. *No matter how you light the furniture, it will appear more three-dimensional if each plane has a different brightness. Take care, however, to avoid excessively bright highlights or dark shadows.*
4. *To be sure the photos will be free of distortion, avoid the use of wide-angle lenses, and photograph with the camera positioned even with the center of the furniture both vertically and horizontally.*
5. *Photograph the furniture from several angles. Include some head-on shots, as well as some shots that show both the front and side of a piece.*
6. *Keep the background simple. A cluttered or otherwise distracting background may draw the viewer's attention away from the subject.*

Q&A

Matching the beading on an antique



I am restoring a 19th-century Victorian rolltop desk in cherry with a missing drawer. The existing drawer fronts are decorated with a three-bead molding, ⅞ in. from the edge, cut into the surface from one end to the other. To reproduce the three-bead pattern on a new drawer front, I tried using a No. 66 beading tool. But on practice drawer fronts the tool had a tendency to wander, producing an irregular cut. The problem was even more noticeable at each end of the drawer front because there is little stock to help support the tool's fence. Is there a better way to tackle this job?

—Les Katz, Brooklyn, N.Y.

Mario Rodriguez replies: Your impulse to reach for a hand tool to perform a one-off operation is admirable. But the original was probably cut on a molder, run off by the mile, then cut to length, producing identical drawer fronts with clean and straight three-bead cuts. Trying to achieve machine-like results by hand is difficult.

One problem with your chosen method is the ⅞ in. between the beads and the edge of the drawer; with its small fence and widely spaced handles, the No. 66 beader works best along the edge of a board. Another complication is that the handles of the tool are so far apart that you have to deal with torque as you guide the tool, making a straight cut nearly impossible.

First, set the cutter for a very light cut. This will reduce the wood' s resistance to the cut and make the tool easier to guide. Also, try pulling the tool, dragging the profile toward you.

If this fails, cut several lengths of three-bead molding on the edges of a clean board, separate the strips by ripping the board, and select the cleanest and straightest material for the replacement drawer front. Next, cut a shallow groove into the drawer face to accommodate the molding strips, cut the molding strips to length and glue them into the groove.

[Mario Rodriguez is a contributing editor.]

Finish on teak won't dry

Last year I built a small teak desk consisting of veneered panels set into a solid 1½-in.-thick frame and legs. I used a nonurethane varnish that dried normally on the veneer, but the thick sections stayed tacky for days. Is there a way to get around this problem?

—Clyde Seitz, East Aurora, N.Y.

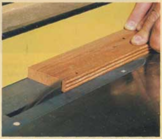
Chris Minick replies: Rosewood, cocobolo, teak and many other tropical hardwoods contain naturally occurring antioxidants, which are responsible in part for the decay resistance, oily feel and distinctive aroma of these species. These natural antioxidants are also responsible for the marginal gluing properties of some tropical hardwoods and, as you have found, can prevent oil finishes from drying.

Oil-based finishes, including alkyd varnish, urethane varnish, Danish oil or plain linseed oil, all dry by a chemical process known as oxidative polymerization. During the drying process, oxygen is abstracted from the air by the liquid finish where it acts as a chemical bridge to tie the finish molecules together (cross-link) and form the dry finish film. Antioxidants chemically alter the process, preventing the molecules from cross-linking; thus the finish remains liquid.

The obvious solution for this problem is to eliminate the offending antioxidants from the wood before finishing—a task easier said than done. Common woodworking wisdom says to wipe

INSETTING A BEAD ON A DRAWER FRONT

Cut the beading. *For a smooth cut with a beading tool, take light passes across the edge of the board.*



Separate the molded edge. *Once the profile has been completed, rip off the edge of the board on a tablesaw.*

Set the beading in place. *The beaded stock is glued into a groove ripped on the drawer front.*

Photos: Michael Pekovich; drawing, this page: Erika Marks down the wood with a rag soaked in acetone or lacquer thinner to remove the oil from the surface. I've found this procedure sometimes causes more problems than it cures. In fact, the evaporating solvent often pulls fresh antioxidants to the surface, negating the reason for wiping in the first place.

A second approach is to abandon oil-based varnish in favor of lacquer finishes. However, many lacquers, especially nitrocellulose, are not immune from the effects of tropical-wood antioxidants. In this case, the antioxidant in the wood tends to migrate into the dry lacquer film and soften the finish over time. This over-plasticized lacquer film will dent or scratch easily and may become sticky.

The best approach is to seal the wood before applying the topcoat finish. Sealers trap the antioxidants in the wood, preventing them from mingling with the finish and eliminating the problem. Special vinyl sealers are sold for use under lacquer finishes, but dewaxed shellac is my sealer of choice. Two or three thin coats of 2-lb.-cut dewaxed shellac form an effective barrier against antioxidant contamination. Best of all, dewaxed shellac is compatible with all common wood finishes. So after the shellac sealer is dry, you can topcoat with an oil varnish, lacquer or even a water-based finish.

Incidentally, the reason your varnish dried on the teak veneer surfaces but not on the solid wood is that the antioxidants are removed from the teak log during the veneer-making process. Even so, putting a coat of dewaxed shellac on the veneered surfaces is good insurance. [Chris Minick is a finish chemist and contributing editor.]

Resawing logs

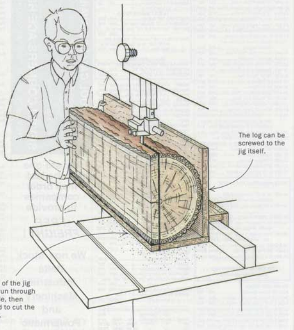
I've heard that it's possible to saw logs into lumber with my bandsaw. What's the best way to go about this?

—Jack Spencer, Hot Springs, Ark.

Lonnie Bird replies: You can saw small logs into lumber with your bandsaw, but this is a labor-intensive process. Green logs are heavy with sap, so don't expect to saw big logs for large woodworking projects. However, depending on the size of your bandsaw, you can saw planks that are suitable for many smaller projects.

FROM LOG TO LUMBER

Made of MDF or plywood, this quick-to-make L-shaped jig helps cut logs that won't sit firmly on the bandsaw table.



Once you've acquired the logs, set up your bandsaw with the proper blade and a simple jig to guide the log safely past the blade. Also, if you own one of the many 14-in. bandsaws on the market, adding a riser block to the column will double your saw's cutting capacity.

The best blade for this job is one with large gullets and few teeth. The gullets will haul the sawdust out of the kerf and prevent the motor from bogging down. A 3-pitch, ½-in.-wide, 0.025-in.-thick hook-tooth blade is a good choice; most 14-in. bandsaws can't adequately tension anything wider.

The jig is simply an L-shaped platform made of inexpensive plywood or medium-density fiberboard (MDF). Fasten the log to the jig with two or three lag screws. It's important that the screws penetrate the soft bark and bite into the fibrous sapwood. The jig runs against the bandsaw fence to guide the log in a straight path (see the drawing above). You can also attach a U-shaped channel to slip over the fence for additional support.

After you saw the planks, be sure to dry them before you use them.

[Lonnie Bird is a woodworker, teacher and the author of *The Bandsaw Book* (The Taunton Press, 1999).]

Trouble drying holly

I have tried to air-dry holly and have gotten mixed results. Much of it has turned a dirty gray color, and even the few nice, white boards have cupped and twisted so badly that I've had to waste a lot just to get them planed flat. The wood

Drawing, this page: Vince Babak

has great working characteristics, and I really like it, but what am I doing wrong?
—Gaylord Stewart, Duncan, B.C., Canada

Jon Arno replies: The trouble you've experienced in trying to air-dry holly isn't the least bit unusual, so don't be so hard on yourself. This is a very difficult species to air-dry. Its average volumetric shrinkage of 16.9%, green to oven-dry, is extremely high, and holly is exceptionally prone to distortion as it dries. And the dirty gray stains are caused by fungi that invade the wood if the surface moisture of the boards is not quickly brought down to below 20% moisture content. Air-drying holly can be particularly troublesome in this regard, because not only does it have very low decay resistance, but the wood's stark white color also makes the slightest hint of staining vividly obvious.

When air-drying holly, it is critically important to ensure that there is adequate airflow through the pile early in the drying process and to keep the top of the pile covered to ward off precipitation. To help prevent the boards from distorting, keep the pile well weighted down. Also, to minimize checking, the ends of the boards should be thoroughly coated with a sealer. However, even when these precautions are carefully followed, it is virtually impossible to avoid at least some degradation, typically in the form of "sticker stain," where moisture is trapped on the surface of boards under the stickers. In the case of holly, having the wood professionally kiln-dried is a choice worth considering. Sometimes kiln-drying gives the wood a slight ivory cast, but this is often the lesser of two evils.

There is no totally acceptable substitute for holly when a pure white wood is required. Its uniform, very fine texture gives it outstanding machining and shaping characteristics, and it is a joy to work with. It is both unfortunate

***Holly.** Though prone to distortion and staining, holly is the first choice whenever a design calls for a pure white wood.*

Q&A (continued)

and frustrating that its propensity to distort and its tendency to blue-stain lead so many woodworkers into what can be described only as a love-hate relationship with this alluring and yet so demanding wood.
[Jon Arno is a wood technologist and consultant in Troy, Mich.]

Flattening a warped panel

I'm having a difficult time keeping solid panels flat. I glued up a panel of red oak about 18 in. square. When I took the panel out of the clamps, it was perfectly flat. Ten days later, it had a decided cup in it. I don't want to plane it because I have the thickness I want. Is there any way to straighten it without making it thinner?

—Steven Diggs, Charlottesville, Va.

Lon Schleining replies: There are several reasons why panels cup, but in your case I'm sure it's because one surface has more moisture in it than the other.

As one surface gains or loses moisture, it grows or shrinks accordingly. If one side of the panel grows or shrinks differently than the other, a cup is the result. Innocently laying your panel flat on the bench can often lead to cupping because one surface is open to the surrounding air (damp or dry) and the other side is not.

One way to perceive the problem and hint at the solution is to remember that boards invariably cup toward the sun. Here's a fun little field test for you to try. In warm weather, lay a nice, flat board, about a foot square, in some grass where it will be in full sun. In a matter of minutes the board will cup toward the sun.

The sun dries out the top surface, shrinking that side. The bottom draws moisture from the grass, expanding it. The result is that the previously flat board now has a cup in it. If you take this same board and simply turn it over, not only will it flatten out again, but if you leave it there a bit longer, it also will cup the other way.

In winter, try laying the piece on a damp towel with a couple of bright incandescent lights shining on the other side to provide heat. If you remember that the board will always cup toward the sun, a bit of trial and error will eventually make the panel flat again, although this method is much slower than direct sun.

When the panel is flat once again, place it inside where air can freely circulate around *both* sides of the piece. If it stays perfect, great. But if it cups again, simply repeat the process. Eventually, the piece will stabilize where you want it, although if you again innocently lay the panel on the bench for a week, it will cup again just as it did before.
[Lon Schleining lives and works in Long Beach, Calif.]

Do you have a question you'd like us to consider for the column? Send it to Q&A, Fine Woodworking, P.O. Box 5506, Newtown, CT 06470-5506, or e-mail it to fwqa@taunton.com.

Tablesaw jig for cutting compound-angle tenons

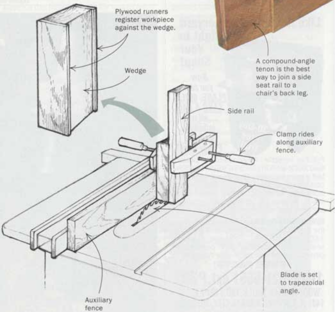
BY STEVE BROWN

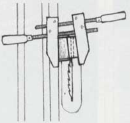
One of the best things about working at North Bennet Street School is that I'm able to work with other woodworkers to discover the best way to solve construction problems. When Will Neptune was making a set of four Chippendale side chairs, I began to wonder if there was a way to jig up the rails to cut tenons at the correct compound angles. (For more on laying out and cutting this joint by hand, see the article on pp. 60-65.) I'm always looking for the most efficient way to execute a task—especially when multiples are needed. I wanted to find a method of making this tenon quickly and accurately. In addition, I needed to deal with the fact that half of the tenons were lefts and half were rights.

When cutting a compound-angle tenon by hand, the layout lines on the rail can come directly from the drawing and, theoretically at least, are reliable. With this approach, there is a temptation to assume that you can take that same

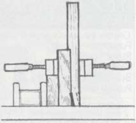
WEDGE IS THE HEART OF THE JIG

The wedge and blade angle allow you to cut an angled tenon to compensate for the seat's trapezoidal angle and the cant angle of the rear leg.





TOP VIEW



FRONT VIEW

Drawings: Erika Marks

information from the drawing and apply it directly to the jig and tablesaw. This, however, is not the case. The reason for this can be somewhat confusing, but once understood, finding the corrections can be simple.

To cut the tenon on the tablesaw, the rail can be held upright with the blade set for the trapezoidal angle and with a wedge between the rail and the fence for the cant angle. Two fence settings will cut the cheeks of the tenons. The shoulders can be cut on the tablesaw as well.

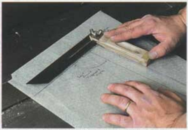
While you are cutting to the layout lines on the rails, the angle settings of the tablesaw blade and the wedge must be adjusted, because you're working with the *combined* angles. When handcutting this joint, the angle orientations are based on the three basic views of the drawing, but with the tablesaw method, the orientations are relative to the rail. We're not just concerned with the cant angle of the back leg from the drawing; we're also concerned with the cant angle as it intersects with the shoulder (at the back of the side seat rail) as seen directly through the end of the rail. That apparent angle would be the cant angle but would appear slightly different. Likewise, when addressing the trapezoidal angle in the blade setup, you need to account for the rail being held at the corrected cant angle from the fence. Simply put, you need to find two angles. One angle is based on the cant for the wedge, and the other is based on the trapezoid for the blade angle.

To form the wedge, set a bevel gauge to the actual cant angle, as measured from the back seat rail. Set the cant angle against the raised blade, but adjust that angle by registering it off the trapezoidal angle. Set the blade at this angle. A blank of wood milled to the exact width as the side seat rails can be ripped to the corrected cant angle. Rip the blank to this angle and plane it to clean up saw marks. The ends should be cut square. Two thin plywood runners can be tacked and glued to the edges—overhanging the face and square to the edges. The runners create a space the exact width of the rail and will hold it securely during cutting. The jig needs to be at least as long as the tablesaw fence is high plus 4 in. For added stability and safety, this extra

MAKING THE WEDGE

Use two bevel gauges to determine blade tilt

Start with an accurate cant angle. *When cutting the side seat rail to the back leg, the tenon must be angled to reflect both the cant angle of the leg and the trapezoidal angle of the seat.*



Reliable drawings save mistakes. *Use the full-sized drawing to set a second bevel gauge to the seat's trapezoidal angle.*

Use both angles for tablesaw setup. *The blade is set to the cant angle (upright), but the cant angle must be twisted to match the trapezoidal angle by holding the bevel gauge flat on the tablesaw.*

Rip the wedge and add runners to register the workpiece

Making the jig. *When the blade is set to the correct angle, and stock ripped to the rails' width, rip a length of stock to use as your jig.*

Line up the jig. *Mark out the tenon on the rail, then fit it between plywood runners glued to the jig.*

Photos: Michael Pekovich

length is needed to clamp the rail in place with a thumbscrew.

The tablesaw blade can now be set for the trapezoidal seat angle. The trapezoidal angle doesn't exist in the chair yet, so it has to be taken directly off the drawing. Any discrepancy in the accuracy of the angle will change the length of the front rail, which can be adjusted accordingly. Again, the trapezoidal angle needs to be corrected according to the cant angle. The new jig can be used for this. With the bevel gauge set to the desired trapezoidal angle, hold the jig against the fence and the bevel gauge against the end of the jig. Now set the blade to the gauge angle.

Whether you are doing one set of rails or 12, you should completely lay out one left and one right tenon and shoulder. One end of the jig can be used for the left and the other for the right simply by flipping it end for end and keeping the same face against the fence. This jig will work with a saw that tilts toward the fence or away from it. As you place the rail in the jig, use the layout lines to avoid confusion. Cut one cheek on all of the rails and then set the fence to cut the second cheek. I cut the tenon a little too thick at first, then adjust the fence until I get a good fit to the mortise. Take care when setting the blade height to account for the angle of the shoulder. One cheek will need a different height setting than the other one.

The shoulders can be cut on the tablesaw as well, but the blade will have to be reset to the trapezoidal angle with no corrections. All inside shoulders can be cut with the miter fence or push block on one side of the blade, then the outside shoulders can be cut on the other side of the blade. Take care to account for the angle of the tenon—cut as much of the shoulder as you can without cutting into the tenon. The rest of the shoulder can be pared with a chisel. Please note that when cutting the shoulders, the waste will be trapped between the blade and the fence and will shoot out. I prefer to remove the bulk of the waste quickly but carefully with a bandsaw or handsaw.

Using this method I was able to execute the joints for eight rails quickly and cleanly with very little handwork.

USING THE JIG

Adjust blade tilt and fence

Set the blade to the correct angle. *After the jig has been made, the tablesaw can be set to the trapezoidal angle of the seat.*

Double-check the cut. *Raise the blade and check to see that the angle of the cut matches the layout lines on your rail.*

Cut the tenon cheeks and shoulders

Use a high fence for a safer cut. *With the rail stock clamped to the jig with a thumbscrew, a careful pass cuts the outside cheek of the rail.*

Once the jig has been set up, multiples move quickly. *A second pass cuts the inside cheek of the tenon. Once you've cut one rail, it isn't necessary to draw layout lines on the rest.*

Cut the shoulders with the blade set to the trapezoidal angle. *Take care to check the angle of the tenon, and be sure you don't cut into the tenon itself.*

BY CHRIS MINICK

Varnish: an almost ideal finish

My ideal furniture finish would penetrate deep into the wood, dry quickly, provide good abrasion and stain resistance, rub out easily and look great. Also, I want the option to apply this finish with a rag or a brush or a spray gun. Unfortunately, no finish has all of these properties, but oil-based varnish comes pretty close.

Walk into any well-stocked hardware store, and you'll find a bewildering array of cans of varnish. Alkyd, polyurethane, spar, wiping, bar-top, floor, fast-drying, interior and exterior varnishes are the more common types available. With all of these choices, selecting one that's right for your project can be frustrating. Knowing a little about varnish chemistry may help you decide.

They're more alike than different

All varnishes have one thing in common: The backbone of the finish molecule is composed of vegetable oil. Varnishes are made by chemically combining a modifying resin with a vegetable oil to produce a finish molecule that is liquid when applied to the wood surface but solid after it cures to an impervious film in a short period of time. Linseed oil and soybean oil are the most common vegetable oils used in the manufacture of furniture-grade varnish resins. Tung oil is also used, but because it is relatively expensive, you find it only in wipe-on varnish mixes and traditional exterior varnishes. The *type* of oil used in a varnish resin has less effect on the finish properties than does the *amount* of oil used.

The long and short of it—The ratio of oil to modifying resin—known as oil length in the industry vernacular—determines the flexibility of the dried film, curing or drying time and application method. Varnish resins containing 75% or more oil are called very long-oil varnishes, and they're typically used for wipe-on finishes, the so-called Danish oil finishes. Very long-oil varnishes dry slowly, have great wood penetration and are extremely flexible when cured; but the dried finish film is extremely soft, has poor abrasion resistance and damages easily. These varnishes perform adequately, provided that no detectable finish film is left on the surface of the wood.

Long-oil varnishes are 60% to 75% oil and are primarily used in the manufacture of oil-based paint but recently have been introduced to the wood-finishing arena as fast-dry wipe-on finishes. Long-oil varnishes do dry faster than traditional Danish oil finishes. However, they share many of the same problems that plague their very long-oil brethren.

Medium-oil varnishes contain 45% to 60% oil and form the basis of all brush-on varnishes used in wood finishing. They have reasonably short drying times, good abrasion and stain resistance, penetrate the wood to accentuate its beauty and form a hard but flexible protective surface film. Best of all, medium-oil varnishes can be applied by the three most commonly used methods: wiping, spraying or brushing.

Short-oil varnishes are less than 45% oil and typically require heat to cure, so they are not used for finishing wood. Short-oil varnish resins are used to make the paint for refrigerators, stoves and metal office furniture.

WITH ALL OF THESE CHOICES, SELECTING ONE THAT'S RIGHT FOR YOUR PROJECT CAN BE FRUSTRATING. KNOWING A LITTLE ABOUT VARNISH CHEMISTRY MAY HELP YOU DECIDE.

Modifying resins vary in strength—The modifying resin used in a varnish will determine how well the dried finish film holds up when it is exposed to moisture, ultraviolet (UV) light and general wear and tear. Alkyd varnishes, a term coined in the 1930s to describe an important class of polyesters, traditionally use phthalic anhydride as the modifying resin. Typical alkyd varnishes have good flexibility, very good abrasion resistance, great adhesion, moderate moisture resistance and take a relatively long time to dry and cure (8 to 10 hours to dry to the touch and 16 to 20 hours to re-coat). Alkyd varnishes targeted for furniture making are difficult to find these days, but they remain a mainstay of hardwood floor finishing.

Replacing some or all of the phthalic anhydride with toluene diisocyanate yields the familiar polyurethane varnish, which is also called uralkyd by finish chemists. This modification to make polyurethane decreases the drying and curing times to more tolerable levels and increases the moisture resistance of the finish film, but it sacrifices the UV resistance in the process.

Fast-dry varnish, also called VT varnish, uses styrene or vinyl toluene as the modifying resin to produce a product with remarkably fast drying times. Properly formulated VT varnishes will dry and cure almost as quickly as nitrocellulose lacquer—dry to the touch in 30 minutes and cure to re-coat in less than two hours. However, fast-dry varnishes have slightly less protective proper-

Photos: William Duckworth, except where noted

ties than standard alkyd varnishes. Still, they are suitable for most furniture applications. But I would not recommend them for heavily used kitchen or dining-room tabletops.

Phenolic resins combined with tung oil produce a varnish with superior water resistance, good hardness, exceptional flexibility and good alkali, grease and UV resistance. It's called spar varnish. Unfortunately, the drying times are excruciatingly long, and spar varnish has a deep yellow color that only gets worse as it ages. Still, spar varnish is the best choice for projects, such as outdoor furniture, that will be exposed to the elements.

Alkyd varnish. *Once the mainstay of the furniture-finishing trades, this class of varnish is increasingly hard to find.*

Polyurethane varnish. *Polyurethane dries fairly quickly and exhibits good moisture resistance, but it does not hold up well to the degradation brought on by ultraviolet light.*

Fast-dry varnish. *The vinyl toluene and naphtha listed on the label identify this as a fast-drying finish.*

CAS No.	Ingredient
64742-89-8	V.M. & P. Naphtha
Unknown	Vinyl Toluene-Oil Polymer
64742-88-7	Mineral Spirits
1330-20-7	Xylene
100-41-4	Ethylbenzene

Spar varnish. *Tung-oil-based phenolic resins are found in most brands of spar varnish, and they are the ingredients that help this product stand up to the elements.*

Ingredient
Tung Oil Phenolic Resin
Alkyd Resin
Stoddard Solvent
Mineral Spirits
Dipentene

Most people choose to brush it on

You can apply varnish with a brush, a rag or a spray gun. Wiping it on is definitely the easiest method (a fast and easy method is described on pp. 57-59), and spraying is the fastest. But brushing is the time-honored technique for applying varnish.

Your success with a brushed-on varnish will depend on practice and attention to detail. I've found that most varnishes are too thick to use right out of the can, so I thin them to about the consistency of whole milk. Prior to dipping the brush into the varnish, you should prewet the bristles with the same solvent used to thin the finish. Prewetting conditions the bristles and prevents the buildup of dried finish at the base of the brush, making it easier to clean later. Shake out the excess thinner, then fill the brush by dipping it into the thinned varnish by no more than half the bristle length. Capillary action will automatically fill the brush reservoir with the proper amount of finish. Tap the bristles on the inside of the can to remove the excess varnish, and always finish the unseen areas of the project first, such as the inside of cases or the underside of tables. You'll be able to judge the flow and leveling properties of the varnish before tackling the show side of the piece. If the viscosity doesn't seem right, add varnish or solvent.

Most finishing projects require more than one brush. I use a 1-in. ox-bristle sash brush for coating small or intricate areas such as moldings and spindles. A good-quality 2-in. china bristle brush is ideal for large, flat areas. Larger brushes are inappropriate for furniture finishing because they're just too hard to control.

You don't want a big brush for varnish. *A 2-in. or 2½-in. china bristle brush works best for laying a varnish onto flat surfaces.*

Avoid the choppy, back-and-forth stroke used to apply house paint—it will result in an uneven surface and lots of bubbles. Instead, slowly pull the brush across the panel in one continuous motion until the brush reservoir is empty. Hold the brush at about a 45° angle when it first contacts the surface and gradually increase the angle to almost 90° by the end of the stroke. As this bristle angle increases, more varnish is released from the reservoir and flows to the wood surface. I usually get a stroke length of about 18 in. or 20 in. with a fully loaded 2-in. brush.

After the entire surface has been coated, "tip off" the varnish by lightly dragging the bristle tips through the wet finish. Tipping off with an unloaded brush levels out the uneven areas in the wet varnish film and removes unwanted bubbles at the same time. You don't need to sand between coats of varnish unless you have to remove some defect. Simply sanding to increase adhesion is not necessary unless the dried varnish coat is older than six months.

Avoid the pitfalls of using varnish—Extended drying time under certain conditions is the biggest problem I've experienced with oil-based varnishes. High humidity drastically prolongs the drying time of most varnishes. Anybody that has varnished during the dog days of summer knows just what I'm talking about. I avoid varnishing on those dripping-wet days, if possible; if not, I let a dehumidifier run in my shop for a few days beforehand.

Also, old varnish dries more slowly than fresh varnish. This too has to do with the metallic driers that gradually lose their catalytic powers as the varnish ages. The best way to avoid the problem is to make sure you always use only fresh varnish. Typically, I don't use varnish that is more than one year old. I may waste a few dollars, but I save a mint in frustration.

Photo, this page (right): Michael Pekovich

A Small Cabinet with a Big History

Forget glue, get out the wax

One thing Americans have learned from the currently popular *Antiques Roadshow*, seen on public television, is that you destroy the value of an antique when you irreversibly repair or refinish it. To replace the missing molding on this cabinet, Phil Lowe hand-carved and finished maple with milk paint, dyes and shellac to match the 300-year-old patina, then attached the molding using a conservation-approved microcrystalline wax instead of glue.

Photos, left: Courtesy of Christie's Images Ltd. 1999; above: William Duckworth

Last January this cabinet sold at auction at Christie's in New York City for $2,422,500, shattering the world record for a piece of 17th-century American furniture. Called a *valuables* cabinet, this is one of four similar pieces attributed to the Salem, Mass., shop of James Symonds, who made it in 1679 as a wedding gift for Joseph and Bathsheba Pope. Through the generosity of an anonymous donation, the Peabody Essex Museum in Salem bought the cabinet for its permanent collection—a deserving home, considering that the Popes figured prominently in historical records as accusers in the Salem witch trials of 1692. The museum hired Phil Lowe, a frequent contributor to *Fine Woodworking* (see the article on his workbench on p. 50), to replicate two missing pieces of applied molding on the center panel of the cabinet door.