

Scott Phillips: How to make a band-sawn box pg. 52

Kirby on design ■ Duginske on band saw blades ■ Dresdner on gilding

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WOODWORKER'S JOURNAL

Our 30TH
Year

Presidential Woodworkers

Kindred spirits ... Jimmy
Carter and Sam Maloof pg. 22

8 Jointers
hit the
home shop

You can build:

A Greene & Greene bureau
The Band-sawn bombé box
Your own handmade plane

February
2006

INSIDE:
Detailing the work
of Sam Maloof



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Features

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By Ian Kirby

A master woodworker leads you down the path that creates all of his projects — starting with his thoughts on project design.

38 Greene and Greene-inspired Chest of Drawers

By Mike McGlynn

Staggered drawers and a mirror comprise a complicated but beautiful project drawing on the influence of Arts and Crafts artists.

48 Band-sawn Bombé Jewelry Box

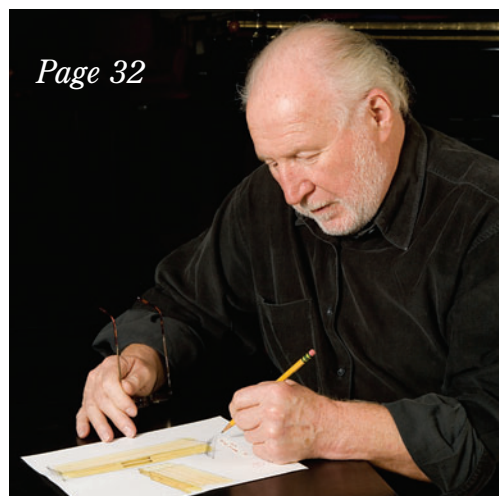
By Scott Phillips

Easy, fun and quick for gifts: get out your band saw and bombé away.

54 Make Your Own Smoothing Plane

By Kerry Pierce

Nothing, says our author, is quite so satisfying as building your own tools.



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SETTING THE STANDARD FOR MITER SAWS. AGAIN.



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Woodworker's Journal

Departments

January/February 2006

Volume 30, Number 1



On the cover and above: Sam Maloof and President Jimmy Carter.
Photos courtesy Louis Cahill Photography, Atlanta, Georgia.

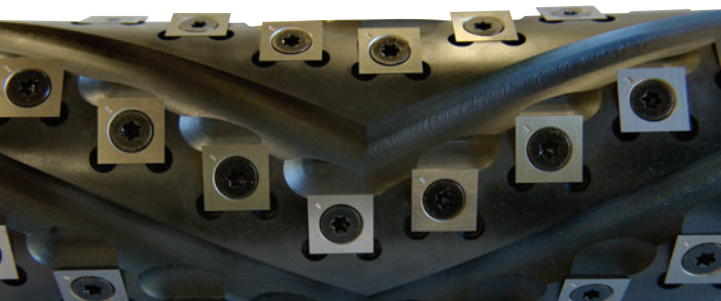
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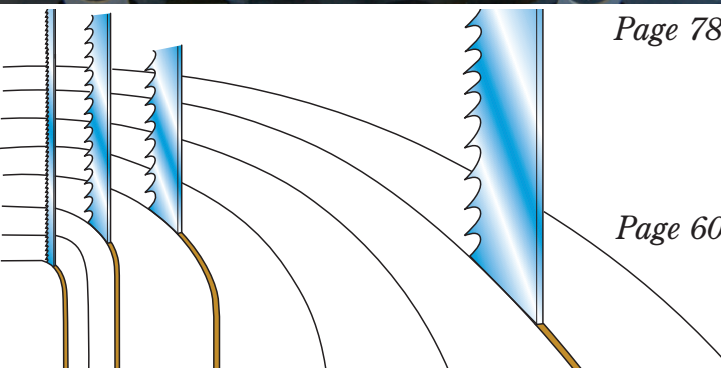
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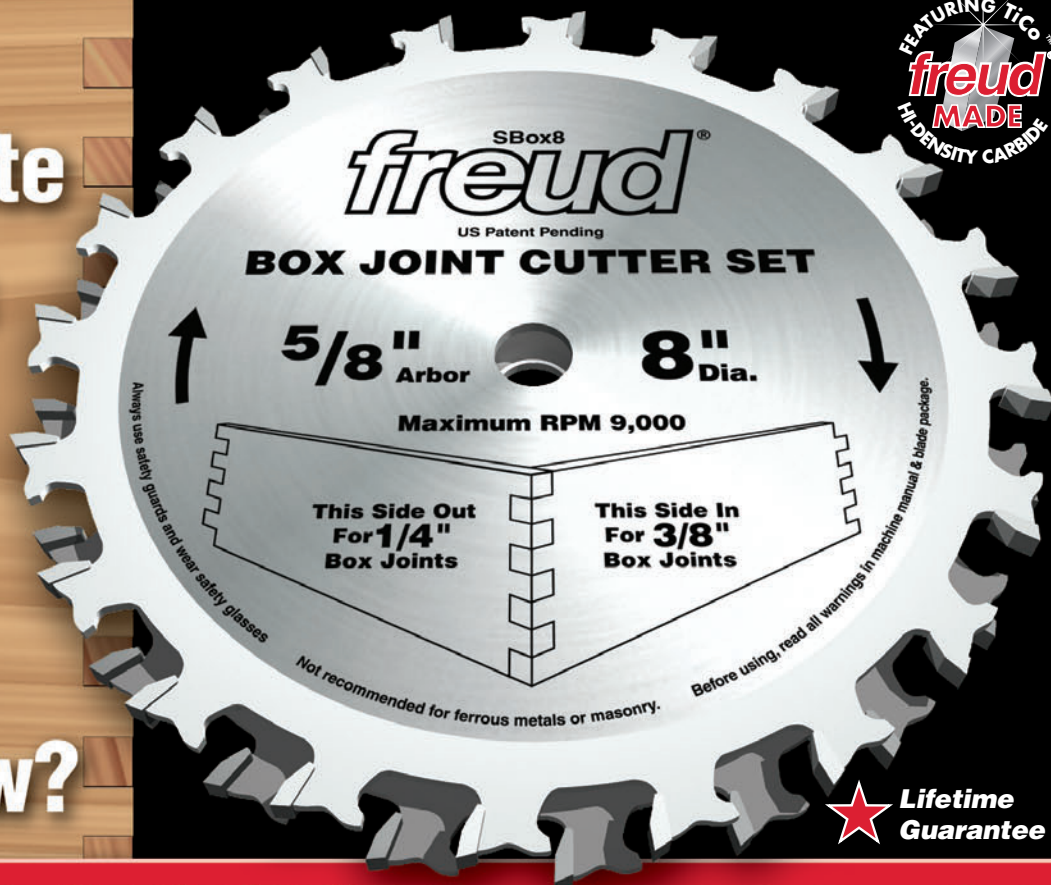
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How Do You Create Flawless Box Joints On A Table Saw?



With Freud's NEW SBOX8 Box Joint Cutter Set

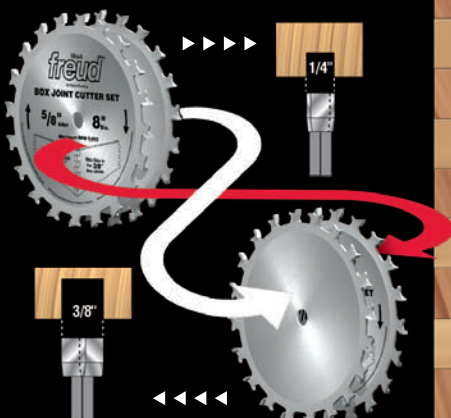
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Celebrating Longevity

"Hey, Rob . . . would you mind flying down to Atlanta and hangin' out with Sam Maloof for a few days? He's going to be making a chair." What would you have said?

Sam's the greatest woodworker of our time, and my editor is a serious shop rat with solid woodworking chops. Plus, Rob had a fair chance of meeting another pretty famous woodworker, President Jimmy Carter. President Carter's collection of Sam Maloof furniture was going to be on display in Atlanta, and word was out that he might be stopping by to pay his respects to the master.



Presidential Woodworkers in the shop: Sam Maloof (a woodworker who makes things for presidents) and Jimmy Carter (a president who loves woodworking).

Rob could hardly contain himself. One of his biggest impressions after meeting the almost 90-year-old woodworker was awe at his grip: "Shaking hands with Sam," Rob said, "is pretty much like putting your hand in a vise clamp for a few seconds." For more details on the event, check out Rob's complete report on page 20.

Rob was also amazed at Sam's artistry on the band saw. "He does things that I would never recommend to any other woodworker," Rob said. Instead, he rounded up two of the top band sawyers in the country, Scott Phillips (*see page 48*) and Mark Duginske (*see page 60*), to present some band saw ideas that are a little more within our collective reach.

It's hard to imagine that Sam was already 60, and well into his prime, 30 years ago, when the *Woodworker's Journal* was producing its very first issue. Thankfully, we've left some stuff from the 1970s far behind, but we've managed to hang onto some of the good things — like bringing you the latest news about woodworking every two months, without fail.

Of course, we've also brought in some new things for you, things we hadn't even thought of back in the 1970s — like the online chats we'll be hosting throughout the year of 2006 with a variety of woodworking experts. You can read about them in our electronic magazine (*the Woodworker's Journal eZine*), another service that would have seemed shockingly futuristic in 1976. "What? You mean you can send out a whole woodworking publication every two weeks, right into people's computers ... um, what's a computer?"

Larry N. Stoiaken

WHOOPS! A TYPO ON THE PENCIL POST BED

The length of the posts for the Pencil Post Bed in the August 2005 issue was printed incorrectly in the *Material List*. The correct length is 80".

JANUARY/FEBRUARY 2006
Volume 30, Number 1

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DAVID BECKLER david@jvgco.com

TERRI MATHIS terri@jvgco.com

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Father of the Plywood Challenge



In WWII our reader's father met an important challenge. Now the *Journal* remembers him in our own reader's challenge.

Father Met the Challenge

I read in the *Woodworker's Journal* of the contest about a single sheet of plywood ["Scott and Rob's Challenge," *October 2005*]. I immediately started looking for the plans that my father designed and made in WWII, but I could not find them. I was going to enter them under my dad's name in the contest. Then I read the entire article and saw that you talked about him (Keith Hettinger) and his table. He passed away eight years ago, but I know that he would have been extremely happy to hear that after all these years, you still remembered his project and kept his information.

I was always proud of him, but my family and I are even more proud of him due to the fact that you mentioned him in your article. He did build a lot of those tables, and would have enjoyed reading about it in your magazine as I did.

Jim Hettinger
Des Moines, Washington

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Bent Over the Chair Angle

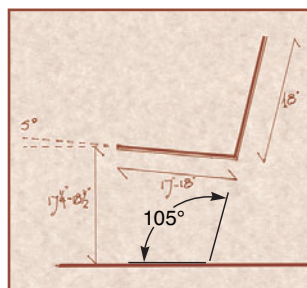
Would you please ask Ian Kirby if the angle between a chair back and a chair seat should be 95° rather than the 105° mentioned in his article on chair design? The illustration on page 63 ["Please, Be Seated," *October 2005*] shows the angle to be about 98°.

I am in the process of designing built-in seating on a deck, and this is the first article I've read with the design parameters I'm looking for. It seems to me that an angle of 15° greater than a right angle between seat and back might be more appropriate in an Adirondack chair.

Ed Harter
Plymouth, Minnesota

WJ Responds:

The 105 degree angle should refer to the angle between the chair back and the horizontal (the floor). The angle between the chair seat and the horizontal, according to Ian, should be about five to eight degrees, and the angle between the seat and the back also about five to eight degrees.



Chair backs should be set at an angle of 105° to the floor.

We've Got Style

I enjoyed the article on chairs by Ian Kirby. I liked the discussion on style rather than an article solely devoted to how to build a piece of furniture. As my woodworking skills improve, I find I'm spending more effort on learning and applying aspects of design rather than how to build the project.

I find that Ian often takes a slightly different point of view in his articles. And I think introducing and discussing the topic of style is important, along with skills and construction technique. What I find when I peruse the magazine stand is that there are woodworking magazines (that's good), and then you need to go to another category of "design" to read about styles and how to furnish a room. And at the library there are books on furniture construction, but an entirely different section for design (style and such). But I have read a few books on Arts and Crafts, and there you get a blend of construction (some have plans) and style. And you often see Arts and Crafts covered in woodworking magazines, but often not other styles. I believe even Norm [Abram] is doing more with elements of style as he is doing more carving and reproductions of more intricate pieces on his show.

Kirby Kirchoff
Park Ridge, Illinois

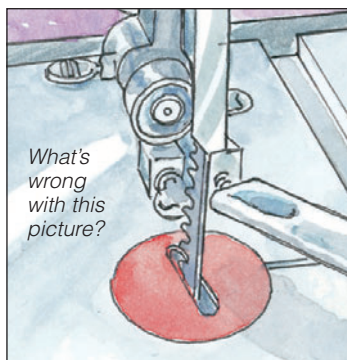


Just Try to Cut This Way!

Regarding *Tricks of the Trade* tip "Taming the Thumbscrew" [August 2005], I noticed that the band saw blade was "drawn" backwards. As professionals, we're all responsible for reader safety and must act accordingly to secure their trust; but, this is stretching it a bit too far. And, those thrust bearings are really going to take a beating! Otherwise, an excellent idea.

Chuck Olson

The Olson Saw Company



WJ Responds:

I wish I had a clever answer explaining why we were actually right ... but we weren't. Rats!

— Rob Johnstone

A Clutch Cordless Drill

I enjoyed the review of cordless drills ["Adrift in a Sea of Cordless Drills"] in the *October* [2005] issue. I found it very informative; however, there is one drill feature that is not mentioned. This is a locking clutch. By this I mean that when the trigger is released, the clutch locks up, enabling the chuck to be loosened or tightened with one hand.

I have a Black & Decker 14.4-volt drill with this feature and, because I have some arthritis in my hands, it makes working the chuck much easier and enables me to get more torque on the chuck, resulting in less drill slippage. Most drills require the use of thumb and forefinger of both hands to work the chuck. Some models have very narrow rings to grip, making it even harder to work. I'm sure there are other readers out there with limited hand strength who would appreciate this feature.

Keep up the good work.

C. Vernon

Kalkaska, Michigan

Safety First: Learning how to operate power and hand tools is essential for developing safe woodworking practices. For purposes of clarity, necessary guards have been removed from equipment shown in our magazine. We in no way recommend using this equipment without safety guards and urge readers to strictly follow manufacturers' instructions and safety precautions.



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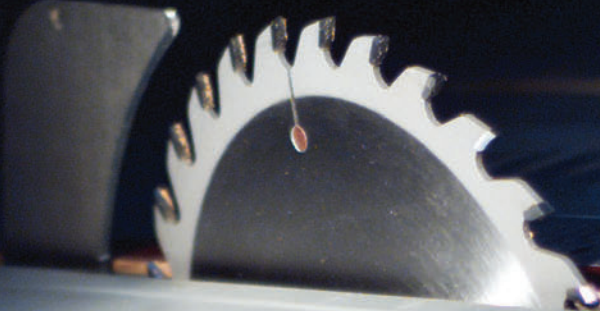
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I like to work with wood from ornamental and fruit trees that are being trimmed or removed. When possible, I reduce the wood to 2" slabs by making vertical cuts with a chainsaw while the tree is still held firmly by its roots. This is safer than working on the ground after the tree has been felled, and gravity is on your side. I've come by some exotic woods this way that are not to be found in a lumberyard.

*Robert Ward
Fallbrook, California*

Band Aids

Broccoli stems are usually sold with large, flat rubber bands which can be used in the shop to add grip to the two parts of a keyless chuck. This is especially useful when chucking large bits such as a Forstner which have no flats ground into the shaft.

*Serge Duclos
Delson, Quebec*

Screw Eyes

Many of my small projects involve inserting a lot of screw eyes. Instead of cranking each one in by hand, I drill pilot holes, insert the short leg of an Allen wrench in the eye, and chuck the other end in a variable-speed drill. Set the clutch at its lowest torque and use a slow speed.

*Andrew Garza
Corpus Christi, Texas*

Don't try this trick without a variable-speed drill!!

This reader lets gravity help him create exotic lumber.

The distance between the rabbet and the fence is exactly the width of your saw's base plate.

PICK OF THE TRICKS

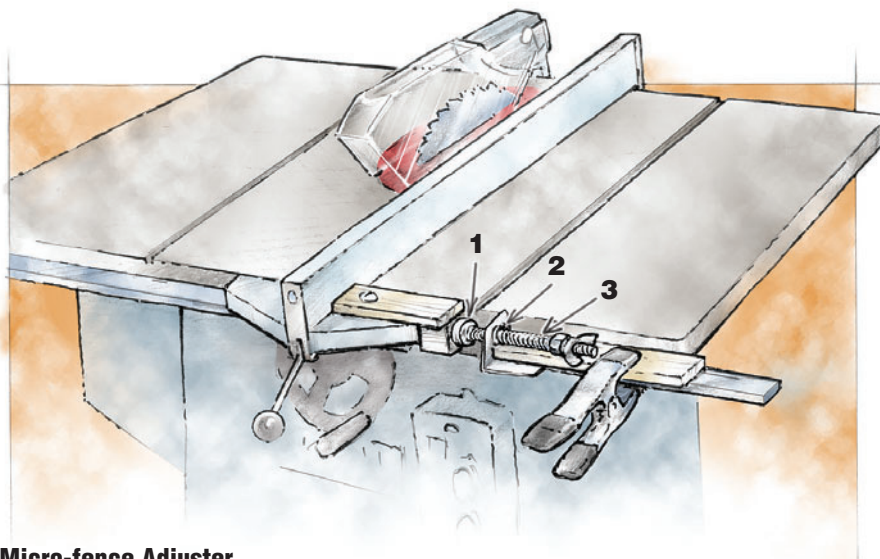
24"

Create an L-shaped fence. Attach it perfectly square to the panel.

Panel-cutting Jig For a One-woodworker Shop

I built this jig to cut panels too awkward for the table saw in a one-man shop. It works better than a radial arm saw with its limited travel. Also, it's safer to cut towards the fence rather than away from it. When not needed, I flip the table over and use it as an extra work surface.

*Lewis Rickabus
Newport, Oregon*



Micro-fence Adjuster

I often need to make fine adjustments to the position of my table saw rip fence, so I devised the following scheme: I attached a rare earth magnet to the fence (1), then made a bracket (2) and drilled it for a 3/8" #16 bolt (3). One complete turn of the bolt moves the fence 1/16"; a quarter turn 1/64" and so on.

To use the gadget, I first make an approximate cut, determine how far the fence needs to move, then slide the bolt head until it touches the magnet, clamp it and rotate the bolt the required number of turns. I then lock the fence and make the cut. The magnet is strong enough to pull the fence as well as push it.

John Calvert
New Market, Alabama



WINNER!

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— Ian Kirby

Q I screwed up the finish on the panel for the top of a jewelry box I’m making — but I don’t want

to remake the piece. Is there some sort of treatment I can apply over the stuff I already have on there that will still look decent?

*Andy MacGregor
Coralville, Iowa*

A Many people find finishing is painful enough without having to re-finish that same piece after a mistake. Gilding is an easy alternative for covering mistakes. I’m partial to it even in the absence of a mistake!



Gilding is essentially covering a surface with metal leaf. You can choose between real gold and fake gold (Dutch metal), as well as silver and copper. Check out the *Finishing Thoughts* article later in this issue for specific how-to instructions.

— LiLi Jackson

Q In Ian Kirby’s *August 2005* article, a photo shows a measurement being made with a “vernier caliper.” It is actually a dial caliper. Tool and die makers in need of bifocals were thankful for the dial type calipers, let alone digitals, which became common in the 1980s or thereabouts. Am I missing something?

*Joel Horn
Palisade, Colorado*

A The metrological genius of Pierre Vernier was in placing a small scale next to the main scale of a measuring instrument. The small scale is divided into 10 or 100 parts to equal one part on the main scale.



WINNER! For simply sending in his question on ISO ratings, John D. Burke of Wai’anae, Hawaii wins a **Porter-Cable 895PK Router Kit**. Each issue we toss new questions into a hat and draw a winner.

RECALL NOTICE!

A recall is in effect involving **JS Products (MAC Tools) cordless drill/drivers**. The battery packs can possibly rupture on **MAC-brand 14.4-volt 3/8" drill/drivers** with part number **CDD14438** or **CDD14438-Kit** and on **MAC-brand 18-volt 3/8" drill/drivers** with part number **CDD18102** or **CDD18012-Kit**.

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You ruined the panel for the top of your box ... or did you? Gilding is an easy-to-learn process that could come to your rescue. To learn how to gild, see *Finishing Thoughts* in this issue.

THIS ISSUE'S EXPERTS

Ian Kirby is the author of *The Accurate Table Saw* from Cambium Press and a regular contributor to *Woodworker's Journal*.

LiLi Jackson is a reporter for *Woodworker's Journal*.

Joanna Werch Takes is a senior editor at *Woodworker's Journal*.



What's the big deal about ISO? I see "Made in ISO 9001 (or 9002 or 9003?) rated factory" often. Should I be impressed or excited? Does a higher number mean a more reliable product? Please enlighten me.

*John D. Burke
Wai'anae, Hawaii*



It's the International Organization for Standardization (www.iso.org).

Standards organizations from 156 countries — some governmental, some private — participate in, well, setting standards in a variety of areas. Numbers like "ISO 9001" refer to a specific standard. In this case, 9001 refers to a set of quality management criteria, including but not limited to, the areas of customer feedback, records, product development, infrastructure — and others. Companies must use and

meet these criteria to earn this designation.

"ISO 9002" and ISO 9003" refer to previous quality standards, which 9001 has replaced. So, no, a higher number shouldn't impress you. (By the way, "ISO" is not an abbreviation: it's from the Greek "*isos*," meaning "*equal*" — and it's what the organization is called 'round the world.)

— Joanna Werch Takes 

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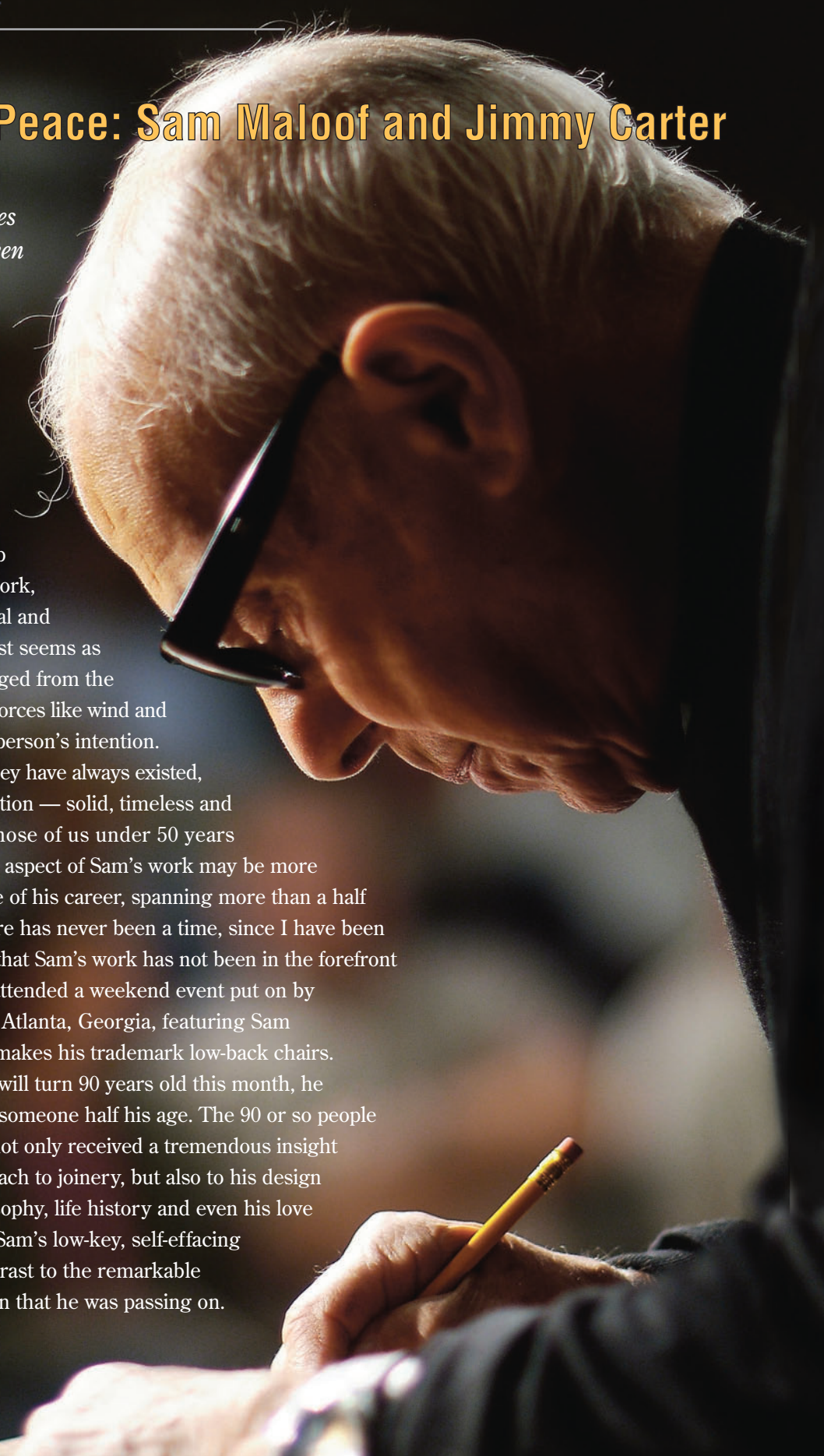
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Grace and Peace: Sam Maloof and Jimmy Carter

Woodworking provides a common bond between respected world statesman President Jimmy Carter and revered world-class craftsman Sam Maloof.

When you first look at the pieces that make up Sam Maloof's body of work, their forms are so natural and harmonious that it almost seems as if they might have emerged from the earth whole, formed by forces like wind and rain rather than a craftsman's intention. The impression is that they have always existed, a significant part of creation — solid, timeless and ever-present. And for those of us under 50 years of age, that ever-present aspect of Sam's work may be more true than not. The scope of his career, spanning more than a half century, means that there has never been a time, since I have been aware of woodworking, that Sam's work has not been in the forefront of the craft. Recently, I attended a weekend event put on by *TurningPoint Studios* of Atlanta, Georgia, featuring Sam demonstrating how he makes his trademark low-back chairs. Despite the fact that he will turn 90 years old this month, he displayed the energy of someone half his age. The 90 or so people attending the program not only received a tremendous insight into Sam's unique approach to joinery, but also to his design process, business philosophy, life history and even his love of Porsche sports cars. Sam's low-key, self-effacing style stood in stark contrast to the remarkable quality of the information that he was passing on.



While it was clear that the folks attending the seminar held Sam in high affection, it was also plain that Sam very much loved those who had taken the time to be there.

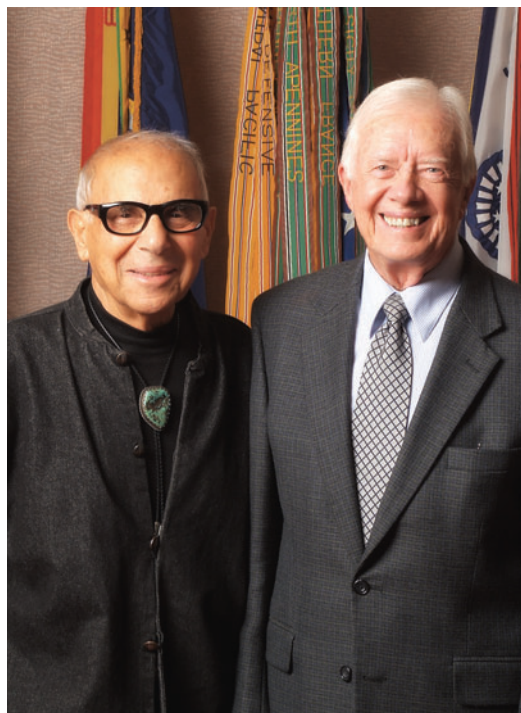
The Carter Connection

As a long-time amateur woodworker, President Carter was taken by the beauty and quality of Sam's furniture and felt moved to call him and mention his admiration. Shortly thereafter, a friendship developed that has continued over the years. So when President Jimmy Carter won the Nobel Peace Prize, an unexpected benefit was that Sam Maloof surprised him with a gift of one of his famous low back chairs. Their enduring friendship makes perfect sense: not only do they share a love of woodworking, but both are driven by a commitment to excellence and a dedication to their goals. Perhaps more significant, both of them couple those characteristics with a humility that speaks volumes — especially when held up to their accomplishments. It is no wonder that they are kindred spirits.

Their long association means that President Carter is the proud owner of one of the most significant aggregations of Sam's work in the country. Last October, President Carter loaned seven of his personal pieces



By virtue of his creativity, unique designs and style of work, Sam Maloof has had an enduring affect on generations of woodworkers. Included in that number is his friend, President Jimmy Carter.



to be displayed at Sam's event at the Hilan Theater in Atlanta.

The three-day event offered a unique insight into the work of one of the most successful woodworkers of our — or any — generation.

"I am so lucky to be doing what I love" he is simply speaking the truth. He works with three other craftsmen in his shop — he calls

continues on page 22 ...

Passion for the Craft

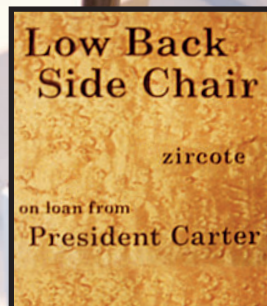
One of the more remarkable things I learned during the Sam Maloof weekend event was that Sam still works six days a week making furniture. So when Sam makes a statement like,



Photos courtesy of Louis Cahill Photography



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Sam Maloof"
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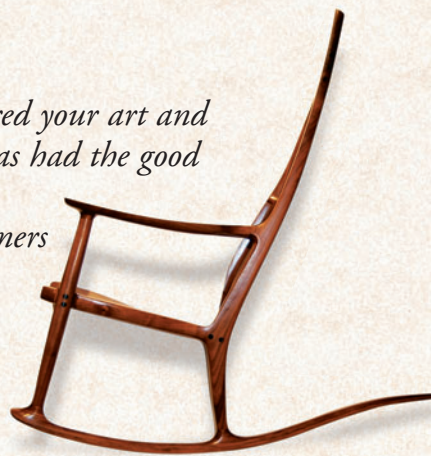
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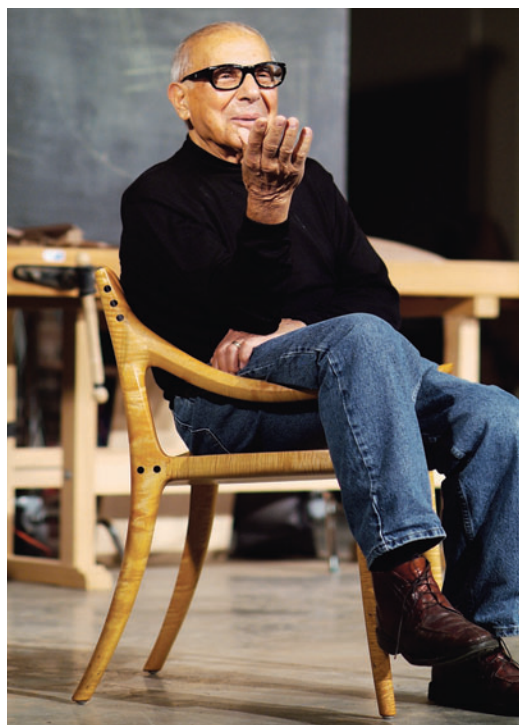
Carter on Maloof

"For more than 50 years, you have shared your art and woodworking skills with anyone who has had the good fortune to know you. Your friends have become your customers, and your customers have become friends. Your passion for life, and for your craft, is obvious in every piece of your exquisite furniture. You richly deserve even more acclaim than has been given you."



— President Jimmy Carter
In honor of Sam Maloof's Renwick exhibition

them "the boys" — and produces a remarkable volume of work. (For those who would like to see a video of this event, it will be broadcast soon via the brand new online woodworking channel, www.thewoodworkingchannel.com.)



Endearing and self-effacing, Sam Maloof offers advice and woodworking tips to an audience of fans.

Looking to the future, Sam would like his legacy to continue in the support of arts and crafts and the people who create them, something that he has made a high priority. To that end, his historic home site will continue to offer

a place to show and encourage all manner of arts and crafts under the auspices of the Sam and Alfreda Maloof Foundation.

This is another way that Sam and President Carter share like interests. Both have charitable works to which they have given their complete support.

The Carter Center is a nonprofit, non-governmental organization that is committed to advancing human rights and alleviating human suffering (with a special emphasis on improving health in the Third World).

To find out more or to donate to either of these good works, use the following contact information.

For the Sam and Alfreda Maloof Foundation; www.malooffoundation.org or call 909-980-0412.

To contribute to the Carter Center, visit www.cartercenter.org or give them a call at 800-550-3560.

The world can be made a better place in any number of ways — great art, good government, acts of charity and good friendship, just to name a few. Sam and President Carter have been involved in all of the above, and we are better for it.

— Rob Johnstone 

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A Wrenching Solution

What's This?



Warren Smith from New Bern, North Carolina, sent in the tool above. He's had it for a while — but thinks loaning it out was a mistake, since one piece is broken. Know what it is? Send in your answer for a chance to win a prize!

If you have your own woodworking mystery tool (or the answer to this issue's entry), send it to Stumpers, c/o Woodworker's Journal, P.O. Box 261, Medina, Minnesota 55340. Or send us an e-mail: jtakes@woodworkersjournal.com

Old Tools: No New Tricks

The stumper [from the October 2005 issue] is a tap wrench. I have one similar to the one shown that I made in ninth grade metal shop. It's a little worn, but I still use it occasionally.

I'd send you a photo if I could, but you really can't

expect a guy who still uses a 50-year-old tap wrench to own a digital camera.

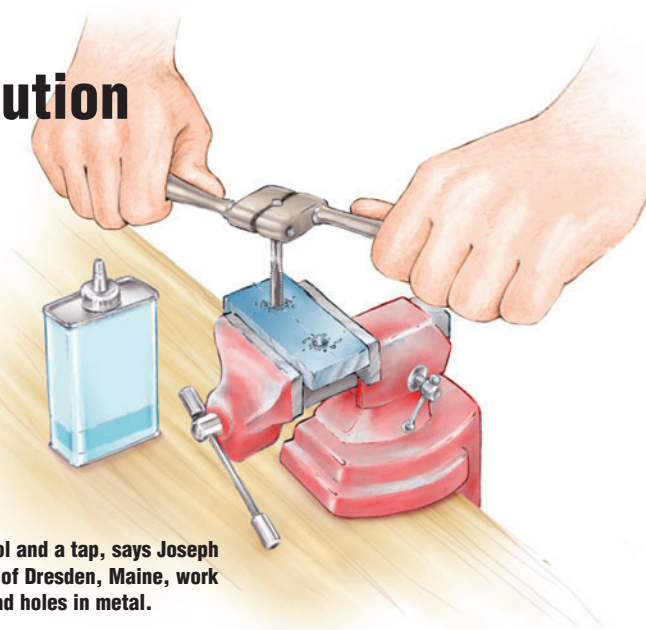
*Ed Wilkinson
Moses Lake, Washington*

High School Memories

Trust me, Ed, not getting your pictures wasn't a problem. In fact, it was hard to stop laughing when **Lawrence Skadauski** of Lockport, Illinois predicted, "You'll probably get a hundred responses" to **Jim Murphy** of Mankato, Minnesota's mystery tool. (What a quaint little number, Lawrence — we heard from about 800 Stumpers readers this time!)

Since, as **Newman Whitmire** of Incline Village, Nevada, noted, it used to be "the standard metal shop project in high school," quite a few readers had personal experience with the tap wrench ... or "tap handle, or tap holder, depending on who taught you," as **John Straub** of Ridgefield, Connecticut, said.

John Truskowski of Plymouth, Michigan, remembers it as one of his first projects in the toolmaker's curriculum



This tool and a tap, says Joseph Murray of Dresden, Maine, work to thread holes in metal.

at a 1961 Detroit high school and says, "I don't think anyone got the knurls right." **Dr. Vern Pidcoe** of Norristown, Pennsylvania, remembering 1941 junior high, however, disabuses that notion: "I recall being very proud of my first metal lathe work, especially the knurled handles."

When **Dan Hiipakka** of Withee, Wisconsin, encounters his tap wrench, his memories focus on "my teenage days when I used it often to keep my car running." Indeed, **Wayne Mailhot** of Prescott, Arizona, notes that "machinists, auto mechanics, etc." are major users of the tool. They "turn the tap into and out of the guide hole drilled into a piece of metal to create new internal threads to accept a bolt," says **Carl Dille** of St. Petersburg, Florida.

Specifically, says **Tom Porter** of Beverly, Ohio, "You

set the tap in the center of the handles and tighten by turning the handles evenly in opposite directions." **Darrel F. Untereker** of Minneapolis, Minnesota added that, "you will find there are two 90° indentations machined into the faces of the tool. These are to clamp around and securely hold the square end of metal taps." **Mike Fogl** of Slinger, Wisconsin, commented on size capacity: "It can be used to hold anything with a square shank that will fit its capacity or, as the layman's term, between its jaws."

Finally, I think we'll end with **Don Grundy** of Grand Prairie, Texas, who says, "I am a tool and die maker by trade, and I use these wrenches in my work a lot. Hopefully, I can someday work with wood only and will not have to use them as often."

— *Joanna Werch Takes*



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Betty's Lathe Sanding Secrets

By Betty Scarpino



Can't afford your own personal shop "sanding sherpa"? The next best option is to follow our author's tips on minimizing sanding misery.

Let's face it, sanding is not fun. It's boring and tedious. But since it's a necessary step in most woodturning projects, especially bowl turning, it's worthwhile to learn as much about it as possible. Just a few extra minutes on the sanding stage can make the difference between a fair project and an excellent one.

There are two categories of sanding: power sanding and hand sanding. Additionally, there are significant differences between sanding bowls and sanding spindle work. The majority of my comments will address the sanding of bowls. Spindle sanding is easier. Or it should be, anyway!

Selecting Sandpaper

Not all abrasive paper is created equal. Like most things in life, you get what you pay for. Higher-priced abrasives work quicker and better than cheap ones. I recently discovered 3M's new product, advertised to last three times longer and work three times faster. It was also three times more expensive. Someone gave me some free samples, and when I ran out of my regular stock, I gave it a try. I was amazed. I now have my own stockpile of this time-saving abrasive.

This turned object is large enough for the author to take advantage of power sanding. She wears a dust mask and runs her dust collector while sanding.

*"Just a few extra minutes
on the sanding stage can make
the difference between a fair
project and an excellent one."*

Hand Sanding

The first step for hand sanding is to acquire decent abrasives, more generally known as sandpaper. Cloth-backed or paper is fine. Or you could buy rolls of those narrow strips. In the past, I have ordered and enjoyed a box of cloth-backed cutoffs from sanding belts.

As you complete the turning of your bowl, be sure you've ended up with the cleanest cut possible before you start sanding. This will make the process go much more quickly. If your bowl is small or concave, you will have to hand-sand it. I will discuss that process first, as it applies to sanding dry wood.

First, fold a small piece of sandpaper in thirds. This may seem like a minor requirement, but it's based on sound advice. First of all, if you use a large section of abrasive in a small curved bowl, you won't be able to conform the paper to the curves. And second, folding the paper in thirds keeps it from slipping, because smooth back will not be positioned against smooth back. And finally, this approach also keeps your paper from rubbing and wearing out, because abrasive doesn't touch abrasive. If your fingers are sensitive, use a foam backing behind the folded sandpaper.



Folding a small piece of sandpaper in thirds before using it on your turned object may seem like a minor thing, but it's a very effective strategy.

Slow down the speed of the lathe. Turned bowls quickly warp just enough to become somewhat oval. Sanding at a slow speed will allow your handheld paper to touch the entire inside and outside of the bowl as it rotates. If the lathe is running fast, you'll hydroplane, and

Woodturning continues on page 28 ...

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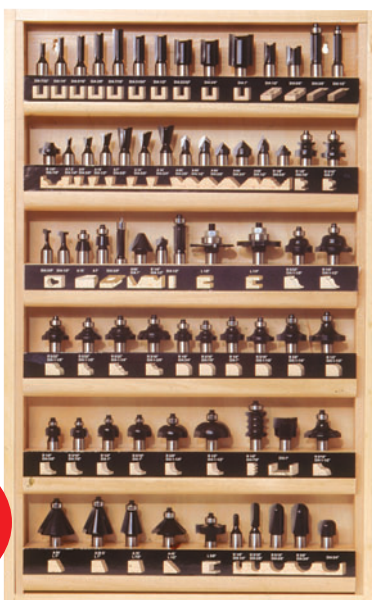
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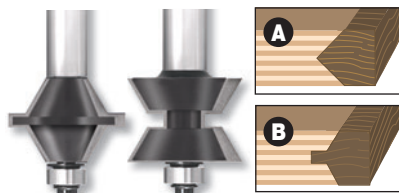
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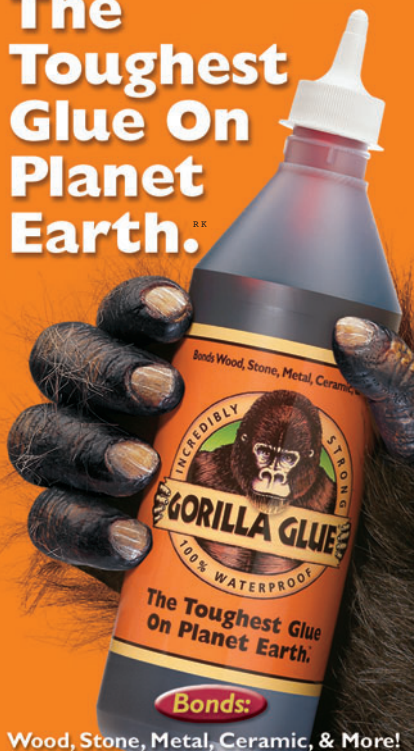
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WOODTURNING



This turned cherrywood bowl is so small that it requires the hand-sanding with a small piece of abrasive. Remember, friction can create heat in a hurry ... watch the pressure.

your abrasive will only touch part of the bowl. In addition, the part of the piece you're touching isn't even the part that needs sanding!

You will most likely need to start with 80- or 100-grit paper for hand-sanding a bowl. At times in the past, I've been known to resort to 60-grit, but now that my turning techniques are improved, even 80-grit usage is rare. After completely removing all tool marks, proceed to the next finer grit. A good rule of thumb is 80-, 100-, 150-, 220-, 320-grit. Don't skip a grit.

Sanding creates a lot of fine sawdust. Wear a mask and have an air filter of some sort running. Another way to decrease the amount of dust is to wet sand. Water works great for this! I've tried several varieties of homemade sanding gunk, but water's the best. Simply moisten a small piece of cloth, then moisten the inside of your bowl. This will magically decrease your sanding time, plus decrease the dust in the air. Yes, it will clog your paper, but in my opinion, the tradeoff (we're talking about your lungs here) is worth a bit of extra expense.

As you progress through each grit of abrasive, you leave behind bits of abrasive imbedded in the grain of the wood. This occasionally causes a major sanding scratch to appear while you are sanding at 220-grit. Several processes help to avoid this occurrence. If your lathe can be reversed, then reverse directions at 150-grit and sand both forward and backward. This will help remove those imbedded coarser abrasives. Another option is the wet sanding already mentioned above. It will raise the grain, helping to release imbedded grits. A third method is to sand by hand, with the lathe off and the bowl still attached. At the 150-grit stage, quickly go over the entire surface with 150-grit. It takes a few minutes, but in the end, it can save time.

Another common sanding annoyance is the small nub often left in the center of bowls and platters. While it might not have been there after the turning stage, it can appear because of the sanding process, especially if you've done a lot of sanding. You can eliminate these nubs in one of two ways:

hand-sand with sandpaper wrapped around a small, flat block of wood or compensate for this phenomenon by turning the center of the bowl just slightly dimpled. By the time you're finished sanding, it's flat.

When you think you're finished sanding, and you take your bowl off the lathe and hold it up to the sunlight, you might discover sanding scratches on the endgrain sections of the bowl. These can be minimized by sanding to a finer grit. Put the bowl back on the lathe and sand to 1,200-grit or even finer. Another option is to use fine or super-fine foam-backed sanding pads and sand your bowl with the lathe off. It only takes a few minutes.

Power Sanding

Power sanding is a much quicker process, but it has its own problems. Also, you can use the process only on bowls large enough to accommodate the discs. Fortunately, some of the newer products have helped decrease these problems. Power sanding can be accomplished using an angle drill with a sanding disc holder attached or by using a handheld rotating sanding device. I've not used one of those non-electric gadgets, but other turners I know have and they swear by them. For power sanding, you can usually start with 120-grit abrasive. It only takes a minute or two to sand an entire bowl or platter with each grit.

Progress through each grit to finer and finer. A good progression is 120-, 220-, 320- to 400-grit. And you can go finer and finer. As you do, the swirl marks diminish. After sanding, you can buff to get rid of remaining sanding swirls, but since I don't care for that much of a shine, I usually hand-sand off the lathe with fine foam-backed abrasive.

I like to use the interface backing pads. They're inexpensive and help

Woodturning continues on page 30 ...

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Sanding discs and interface pads come in a wide variety of sizes and types, including foam-backed and wave-type. Interface backing pads are inexpensive and help to extend the life of the more expensive sanding disc holders.

extend the life of your expensive sanding disc holders. The thick, foam interface pads are great for sanding curves, both interior and exterior. For some sanding tasks, I use the wave-type sanding abrasives. They can help decrease the dig-in that sometimes happens with sharp-edged sanding discs.

When you are power sanding, take care to not over-sand. Run your lathe slowly. This truly is a fast process; if you're spending more than a few minutes, you're over-sanding.

Sanding Spindles

Spindle sanding should be minimal if you are cutting the wood properly to begin with. The tops and bottoms of areas like beads and coves should be the only areas that might need a bit of touchup, and then only with 150- or finer grit to start with. Over-sanding spindle turnings causes the elements to be less crisp and to run together. You can sand spindles at a relatively high speed, but it's also all right to slow down your lathe.

If you intend to paint the surface of a turned spindle, then sanding with 150-grit is recommended, but don't sand below 220-grit. Paint adheres better to a slightly sanded surface than to a burnished surface.

For sanding a spindle like a pen, I recommend a bit of hand-sanding at

320-grit so that you don't end up over-sanding. Use a foam-backed, fine-grit pad, and sand in the direction of the grain. Any minor sanding scratches will run with the grain of the wood and not be noticeable. You can then buff the wood to give it a shine.

Sanding Safety

A few words about safety and sanding. It is potentially a dangerous process. Always remove the toolrest before sanding. I guarantee that you don't want to get your fingers caught between the wood and the toolrest! If you use any type of rag for wetting the wood or for holding the sand paper, be sure that it's a small piece of cloth. Long, loose pieces of cloth can get caught in rotating wood, dragging your fingers into the fray.

Of course, by now you know to not wear loose clothing! Only recently an acquaintance of mine injured his whole arm when his sleeve was caught and his arm was

dragged into a turning spindle while he was sanding.

Now that you're equipped with a bit more information on sanding techniques, the final step is to decide to implement them. Once you make up your mind to give it a try, I guarantee the rest is easy.

Betty Scarpino is the Woodworker's Journal woodturning columnist. She has been turning wood for almost 30 years.



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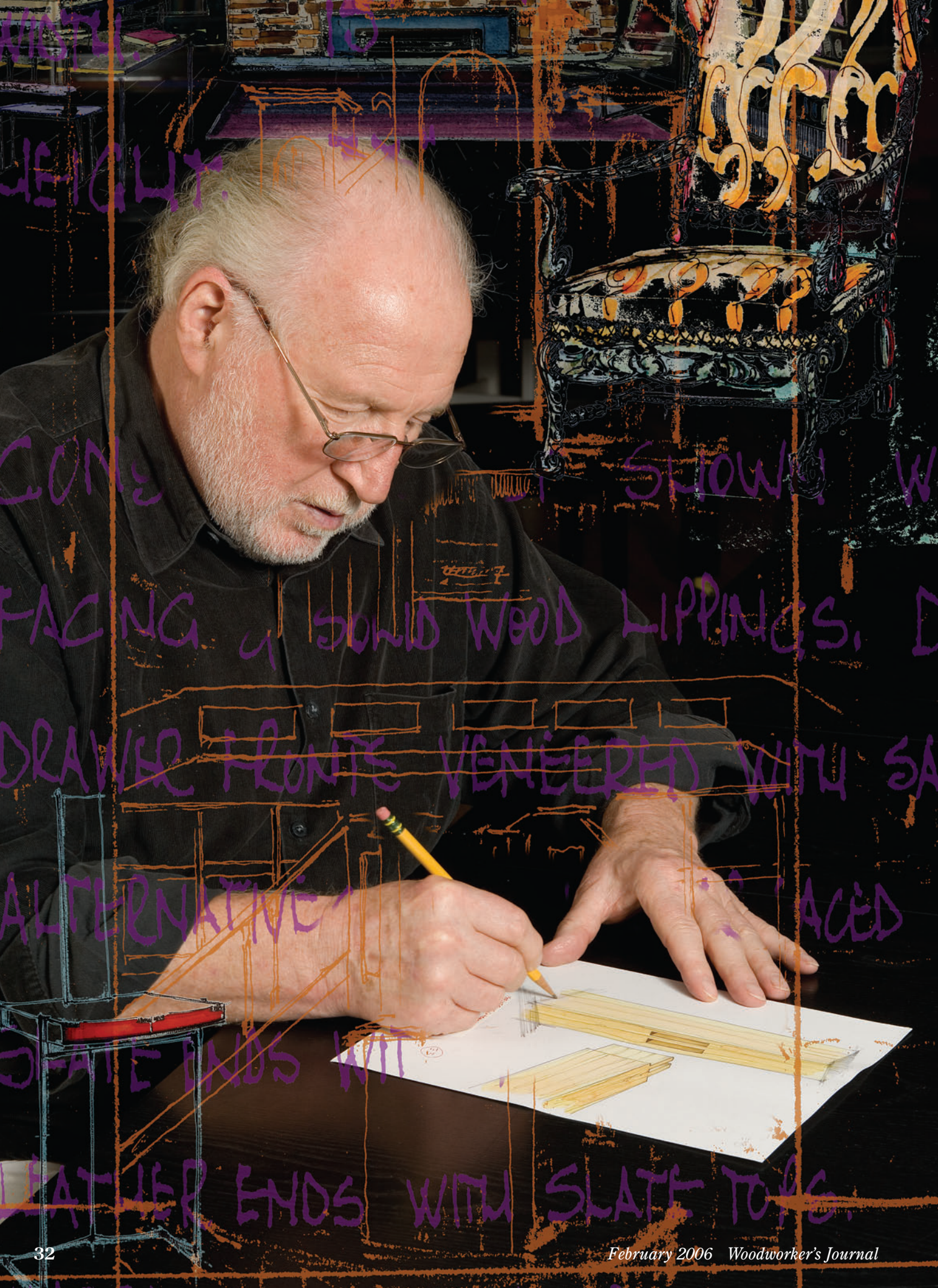
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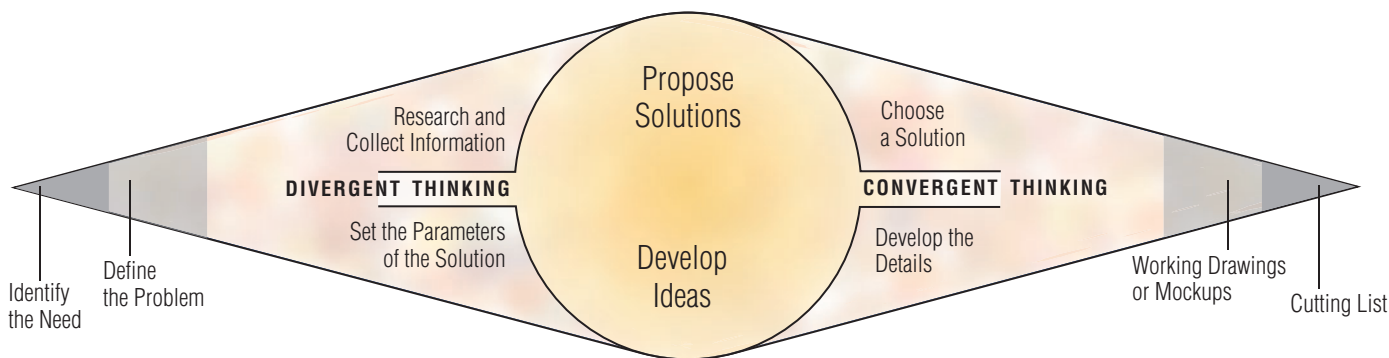
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From Design to Cutting List

The Critical Path, Part 1

By Ian Kirby

This is the first of three articles which focus on how we go about making furniture using wood. The subject is not the physical aspect of making, but rather the path we follow so that our efforts will be the most effective and efficient.

Making a piece of furniture has two parts to it. First, deciding what to make and, second, making it. The first part I call the *design phase* and the second part the *making phase*. Prior to about 1850, there was no alternative in the making phase to solid wood or solid wood and sawn veneer. Today an option is to use dimensionally stable man-made materials — plywood, particleboard and medium density fiberboard.

I will examine the *Critical Path* associated with these three aspects of furniture making: the design phase, making with solid wood and making with man-made materials.

Critical Path may sound fancy or academic, but it's an expression and concept worth embracing. It describes what we do first, second and so on in order to minimize fuss and overlap in getting from here to there in the best way. Consider a typical go-to-work routine: shower, shave, brush teeth, take pills, choose clothes, dress, make coffee, eat breakfast and drive to work. There you have it, a Critical Path in action.

Everyone is a Designer

Just as everyone has used critical paths to get things

done, everyone is a designer at some level. Don't be intimidated by the word "design." It simply means creating solutions to a problem, and that's something you do on a daily basis.

In this case, the problem is furniture design, and woodworkers frequently get into an emotional tangle over it. That's no surprise, because designing and making are two entirely different enterprises that require different physical and mental skills. Although there are countless books as well as a continuous stream of magazine articles devoted to making furniture, there is a dearth of material about designing

furniture. There's nothing, for instance, to indicate that, just as with making, there is a critical path that you can follow to solve furniture design problems. One consequence is that design becomes a highly personalized process exemplified by unsupported "I like it ..." or "I don't like it ..." statements. So your first obligation is to add the word "because" and analyze your likes and dislikes. Put your thoughts to work, not your emotions.

Design Education

Speaking from my experience as a teacher, if you were to study full-time to be a furniture maker, it would take about two years. To achieve a similar level of competency as a designer would take about four years.

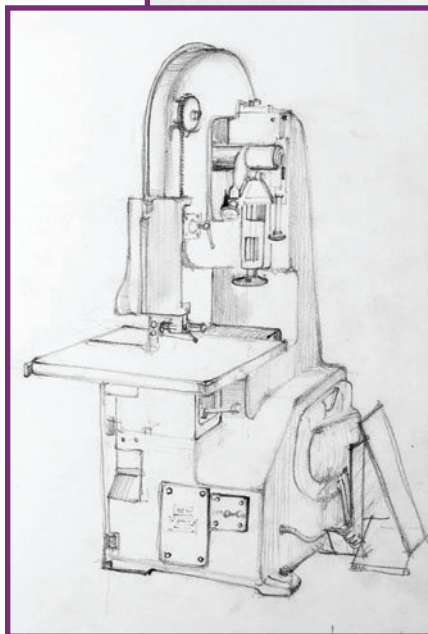
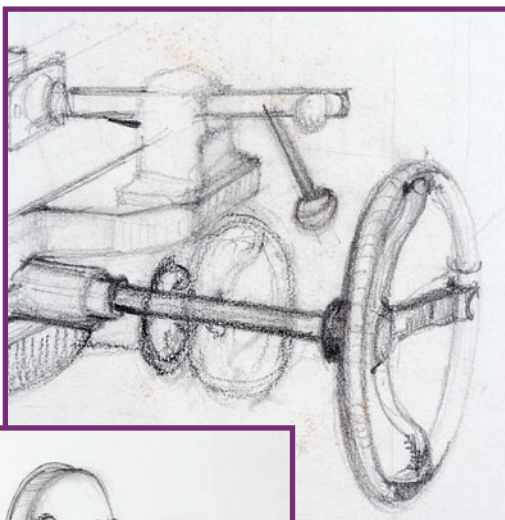
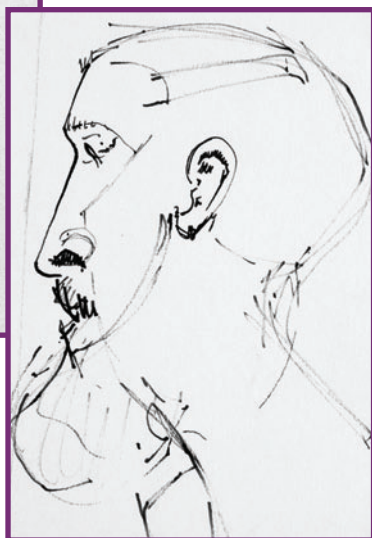
Contrary to popular belief, you don't have to be born with



When it comes to furniture design, woodworkers frequently get into an emotional tangle. That's no surprise, because designing and making are two entirely different enterprises.



These are typical examples of early efforts at observed drawing: it's a lifelong study. Your style and skills evolve and improve, but the horizon still stays out there — even a pro golfer doesn't hit a hole-in-one every time.



a special creative gene to be a furniture or any other kind of designer. You simply need the desire to complete the study time. Chances are that you may have the desire but you don't have the time. Does that mean that all is lost? Of course not. You still have *native taste*, which I'll come back to, but first I'll explain how your native taste would be changed by design studies.

Throughout your study period you would be learning and developing your ability to draw with pencil, pen, and color. Anything you choose to draw would fall into one of two categories: things made by nature or things made by man. This is called *observed drawing* because the subject is in front of you. Let's say the subject is an orchid plant. To get the leaves drawn with the right shape and form is one thing, getting the spaces between the leaves right is another, and getting the perspective of the front leaves in front of the back leaves is yet another. Observing and recording how the leaf is attached to the stem can't fail to inform you how nature solves that particular structural detail. The observation and drawing of the orchid flower brings not only draftsmanship, but immersion in shape and color and wonderment at the intricacy of nature's design solutions.

Now imagine the drawing experience to include trees, animals, vegetables, fruit and, not least, the human figure with and without garments. The result is that all this drawing and study serves as a bank account, but instead of money you have a rich deposit of

drawing skills along with an enlightened comprehension of shapes and

forms. This is the capital to which you have access when you try to draw something that exists in your mind. This type of drawing is called *imagined drawing*.

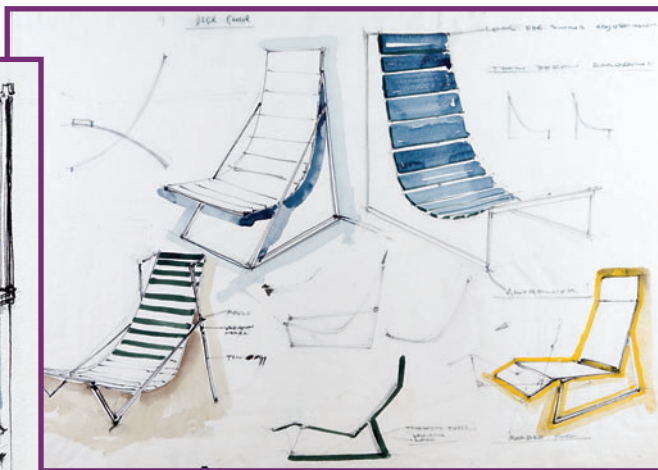
The practice of observed drawing enables you to express imagined drawing. However, there is no evidence that such studies make you more creative, just as education does not necessarily make you more intelligent. Both are innate abilities set free by your study which also provides you with the tools to develop ideas.

The Critical Path of Design

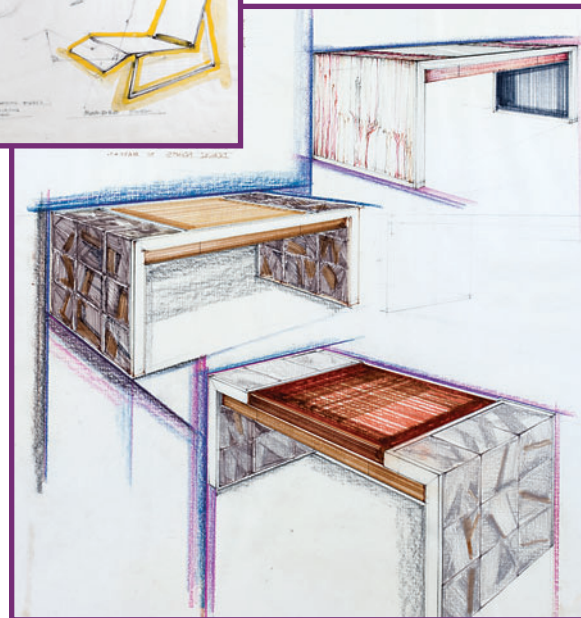
The process begins with first recognizing a need and then clearly identifying it. That allows you to fully define the problem, which is best done by writing it down. The goal is to define the problem in terms so precise that if you gave it to me I would have a chance at offering solutions. That's not as simple as it might appear.

The following statement defines a problem: "A surface in the entry hall to hold small objects — car key, mail, gloves" However, if you write, "A four-legged semi-elliptical mahogany ... with one drawer," that's the solution, not the problem.

Follow the lead of Ben Franklin, who is reported to have said, "A man without a goal is like shooting



This is a mixture of observed historic furniture studies, a stylized rendering of a leather-top desk with slate or veneer facing, and explanatory design drawings of a deck chair. Each is part of a much larger sheet of drawings.



a gun without a target.” On the other hand, get the sequence right. It’s not, “Ready, fire, aim.”

The defined problem sets the scene for gathering information as well as defining the limits of the solution. For

instance, how big is the entry hall and how big could the table surface be and stay in sympathy with the entry hall shape? What’s the budget? Could the top be marble or leather instead of wood? And so on. Armed now with the boundaries, you can go off in different directions and develop a range of ideas, some of which may seem silly. You would be surprised how often silly ideas are the genesis of sound ideas. Developing ideas is like having a conversation with yourself by thinking “at the end of the pencil.” This is similar to the writer who says, “I don’t know what I think until I write it.” The act of thinking widely and, yes, wildly, is called divergent thinking, which in this case we’ll assume has produced three possible solutions.

The next stage is to detail those solutions. This is called *convergent thinking*, because the aim is to select one of the three solutions. From there the chosen solution is finally produced as a working drawing or a mockup.

What I’ve just outlined is indeed an idealized progression. The big difference between a design critical path and a manufacturing critical path is that

the brain refuses to proceed in a prescribed, orderly manner. It leaps ahead; it ranges; we have “gut reactions” and ideas that “come out of the blue.” However, none of this is a reason to abandon the discipline of the process.

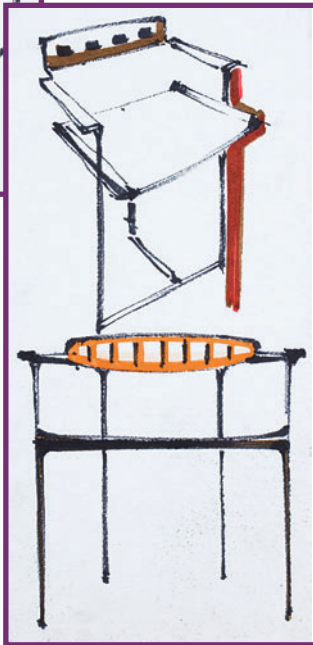
I’ve always been fascinated by the great buildings and design solutions that were drawn on the back of an envelope or a napkin — le Corbusier did it so did Frank Gehry. Recognize that these apparently off-the-cuff solutions were drawn with the advantage of vast experience, which sprang from following a critical path that had become second nature. No matter how hesitant your initial attempts may be along the path, your confidence will grow at each new undertaking. The important thing is to give it a serious try.

Native Taste

For the many readers who may not have the time, inclination or means for four years of design study, I will return to that expression I used earlier, “native taste.” It comes from a wide and complex set of influences. For some, it’s more of a prison than a prairie. To overcome any design deficiency you believe you have, boldly copy an existing design. What serves as your springboard in this process matters little. You may dream it or sketch it; it may be an existing piece you have access to; it may be a photograph or a drawing. Plagiarism may not be admired among writers, but it’s common among



Again, these are selected parts of a typical design sheet of solutions to a set problem. Ideas come tumbling out and are put down very quickly. The aim is to capture an impression, with one idea leading to another. Adding detail to the ideas comes later in the process.



designers, who acknowledge an item's origin with various labels: "inspired by ..." or "from an idea by ..."

A Design Strategy

The first thing to consider is, Does the piece really solve your problem? Conversely, if you haven't defined the problem, this "cart-before-the-horse" approach should help you get that in line. You can accept the piece as is, you can alter it a little, or you can transform it beyond recognition. Change the dimensions, change the proportions, change the shapes. Whatever you finally do, bring your efforts to a conclusion with a drawing or a mockup.

Working Drawing

A working drawing is a collection of lines, words and numbers which together correctly describe an intention. I consider a drawing of some sort to be essential. Sooner or later you will be faced with the work on the bench, and that's the wrong place to be working out details large or small.

There's a standard way of organizing a drawing, but if that method is not part of your skill set, it doesn't matter. Record your intention as best you can. One measure of the drawing's success is that if you passed it to me, it should contain all the information I would need to make the piece exactly as you want it.

Cutting List

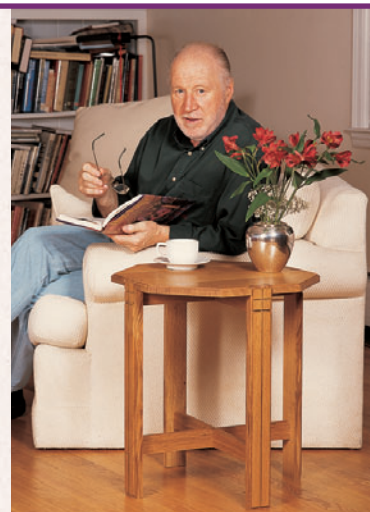
Generating the cutting list marks the end of the design phase and the beginning of the making phase. It's entirely derived from the drawing or the mockup (see the *sidebar* below). I use blank cutting lists upon which every piece of wood that's needed is recorded along with its dimensions. No "extra" dimension is recorded as a "safety net" or for planing. However, an extra piece to help with a machine setup is recommended.

Ian Kirby is a regular contributor. He studied furniture design at the Leeds College of Art and Design in England. He was awarded the National Diploma in Design in 1962.



From Design to Mockups to Living Room

A full-size mockup is an alternative to a working drawing. Until you have used this as a design strategy, you can't appreciate how easy it is to make, but, more importantly, how useful it is. Don't use scrap or otherwise inferior materials. My preferences are any manufactured sheet stock for wide parts and poplar for legs and rails. Assemble the parts with glue, screws or pneumatic nails, then fill all the holes. The mockup should be without blemishes or less-than-accurate details before you paint it white. By putting the full-size mockup in its real setting you can determine if the overall and detail proportions are right. Since the parts are to exact dimension, it is used to generate the cutting list. Joints that are needed on the real thing can be drawn full-size as preparation for benchwork.



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Greene & Greene Inspired Dresser

By Mike McGlynn

This chest of drawers has an extraordinary number of pieces, and putting them together is like a Rubik's Cube® — if you don't do it in the right order, it won't work out. There are a lot of projects that you can go about in a random fashion — making whatever part strikes your fancy, in any order. This is not one of those projects.

This chest is influenced by a Greene and Greene chest of drawers first viewed at the Gamble house in California. Among many other factors, I was especially drawn to the staggered drawers and the small mirror.

Sheet Stock Galore

The *Material List* for this piece contains a lot more sheet stock than you would normally expect with a piece this size. The amount of solid wood is surprisingly small. I started selecting my material by picking out some nice 8/4 mahogany for the legs and some 4/4 stock. For the drawer fronts, I made sure to select boards that I could get the full width of the fronts from, and that were long enough that I could have the grain run across each pair of fronts. I also selected a piece of rough 4/4 that was thick enough to get the 1" thickness of the breadboard ends out of. In addition, I made the entire top out of one board. I made the drawer pulls out of some choice 6/4 quartersawn mahogany that was lying around my shop.

I chose to make all of the interior dividers out of 3/4" (2 sheets, plus) shop-grade birch plywood; there is no reason to use anything fancy for these dividers, as they will never be seen. The back, side and interior panels are made of 1/4" MDF (two full sheets). I made the drawer bottoms out of maple veneered 1/4" MDF. Note: It's only possible to get 11 of the 12 bottoms out of one sheet of ply, so I hope you've got a little leftover lying

around your shop. The last sheetstock that I bought were two sheets (5' x 5') of Baltic birch plywood.

There are two other types of wood that I had to purchase before I could start on the cabinet. The plugs and splines on Greene and Greene pieces are almost always made of Gaboon ebony, but, unable to find any decent Gaboon, I chose instead to make these pieces out of African blackwood. I like the blackwood better than the ebony, as it has a subtle grain, yet is almost black, and polishes just like the ebony. Lastly, I bought two 4' x 8' sheets of paper-backed mahogany veneer, to cover the side panels and back. I selected sheets with seam lines to help me create a balanced looking panel.

■ ELEGANT DETAILS ■



The first thing I did after getting back from the lumberyard was to rough mill all of my solid wood pieces. I generally like to leave all pieces a couple of inches long, and at least 1/4" oversize in the other dimensions. This allows the wood to adjust to my shop conditions, and I end up with milled, straight flat pieces. I marked all of the drawer fronts with chalk so I could quickly tell which fronts went together and in what orientation.

There are four sections that make up this cabinet: The sides, the center section, the top and mirror and the drawers. I started with the sides.

Start With the Sides

My first step with the sides was to create their veneered panels. I cut the MDF substrate oversized and their veneer pieces to match. I chose the



“There were a surprising number of plug holes, mortises and slots that had to be cut in each of the legs. This was an excellent place to completely screw up the project, or at least the four nicely matched legs.”

best pieces of veneer for the face sides of the panels. The veneer can be applied in a number of ways; my choice was a vacuum bag, but most folks use the simple veneer press described below.

While the panels cured, I milled the legs and rails to final dimensions. Again, I took care to keep my orientations marked with chalk.

There were a surprising number of plug holes, mortises and slots that had to be cut in each of the legs. This was an excellent place to completely screw up the project, or at least the four nicely matched legs. So I laid out each and every plug hole, mortise, panel slot and back rabbet so there would be no chance of a mistake.

I use a multi-router to form my mortises and tenons, but I think you would do just fine here with a mortising machine or attachment to your drill press. Look to the *Elevation Drawings* on page 41 for construction details. The last step on the legs is to break (or round over) the appropriate edges with a 1/8" roundover bit.

Next, I milled all of the rails to size and cut their tenons. The bottom rails get the traditional Greene and Greene “cloud lift.” I laid them out, cut them on the band saw and finished them with a file and a hard sanding block. Finally, I rounded over the selected edges of the rails.

By this time, the panels were finished being veneered, so I cut them to size on the table saw. Now I could measure their edge thickness to find the size of the panel slots. In my case, the panels came out to just about 5/16".

I cut the panel slots on the router table using a 1/4" downspiral bit by plowing a 1/2" deep groove down the middle of each piece. To widen the slot, I moved the fence a tiny bit and made two passes — one on each side of the main slot. I did this until I got a nice slip fit.

Prior to staining and assembly, I went through a four-step process to prepare the parts for staining. I first sanded all pieces with 120 sandpaper. Secondly I detailed all of the edges and “cloud lifts.” Next, I went over everything with a damp rag to raise the grain and, finally, I sanded everything with 220 sandpaper on a slightly soft block.

Like most of the Greene and Greene pieces I've built, this chest has a waterbased aniline dye stain on it. I have found that it is almost impossible to end up with a good stain job if the piece is assembled. For this reason I try, as much as possible, to stain all the parts before they are assembled.

With that step completed, I buffed the surface of all the pieces with a fine Scotch-Brite® pad. After buffing, I assembled both of the ends, using epoxy and padded bar clamps. It's essential to handle all the stained parts with rubber gloves, or moisture from your hands will damage the dye.

Getting to Your Center

The center section of this cabinet is very complicated, but I was drawn to this design because of its asymmetrical drawers. Just my luck that they added such a degree of difficulty.

I started by milling the divider edging. As seen in the *Drawings*, there is a subtle difference in width between the horizontal and vertical edges. The horizontal edges are 7/8" wide, and the vertical edges are 3/4" wide. With the divider sheetstock 3/4" thick, I chose to rabbet the horizontal edging 1/4" deep so it would nicely cap the edges. To prevent breaking off the 1/16" lips, I made the rabbet with

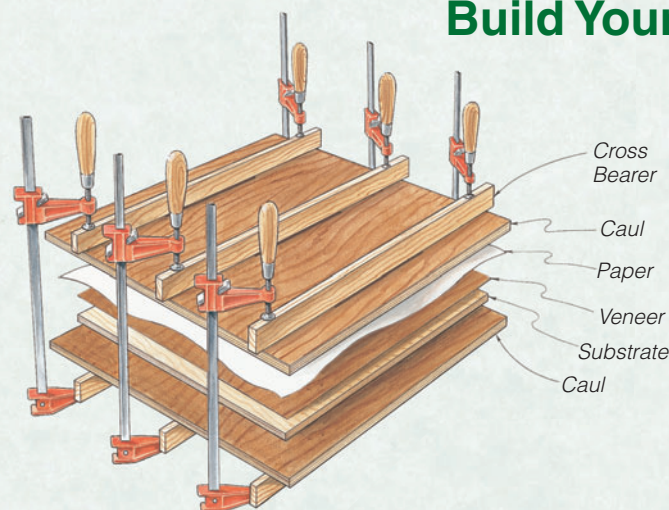
Build Yourself A Basic Veneer Press

While our author has access to a vacuum bag veneer press, not everyone does. The good news is that the time-honored traditional method is still very practical, and with the exception of the clamps, you can fabricate everything else you need in your shop.

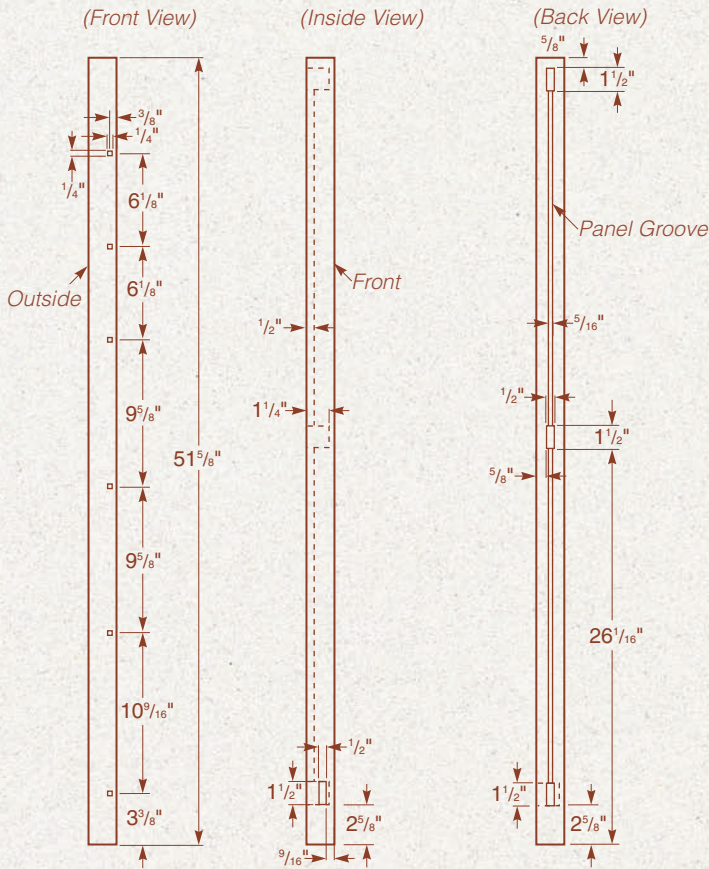
You'll need the clamping cauls (in this case 3/4" sheetstock) and cross bearers (lumber with a slight crown along their length — to apply pressure to the center of the cauls). It's a good idea to layer newspaper or the like between the veneer and cauls during clamp-up.

Apply glue (yellow or white) to the substrate in a thin smooth layer, place the veneer on top of that, then build your “clamp sandwich” as shown in the drawing at left. Wait at least 24 hours for the glue to cure.

— WJ Staff

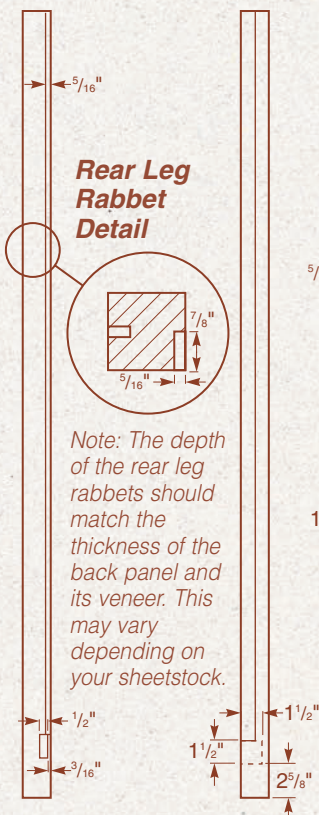


Front Legs



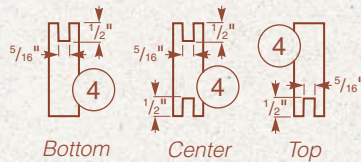
Rear Leg

(Inside View) (Back View)



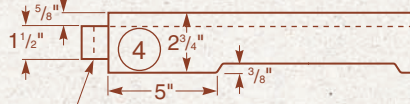
Side Rails

(Section Views)

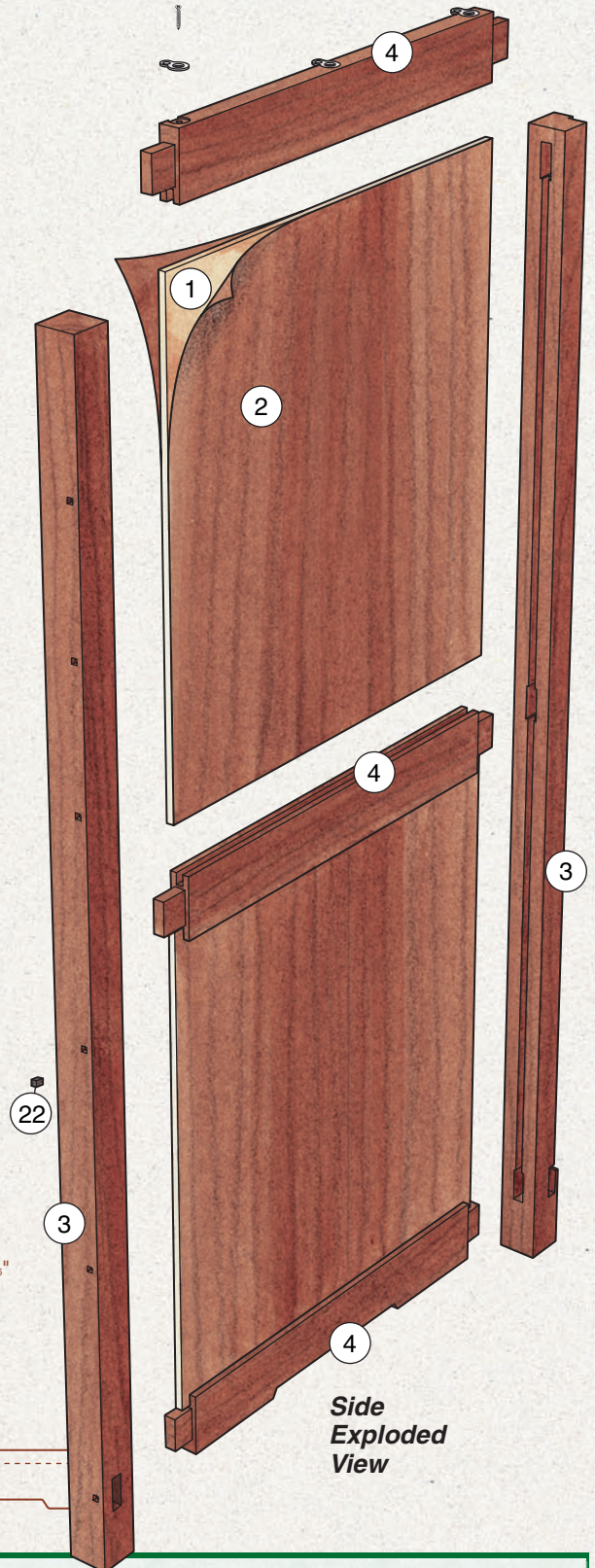


Side Rail

(Front View)



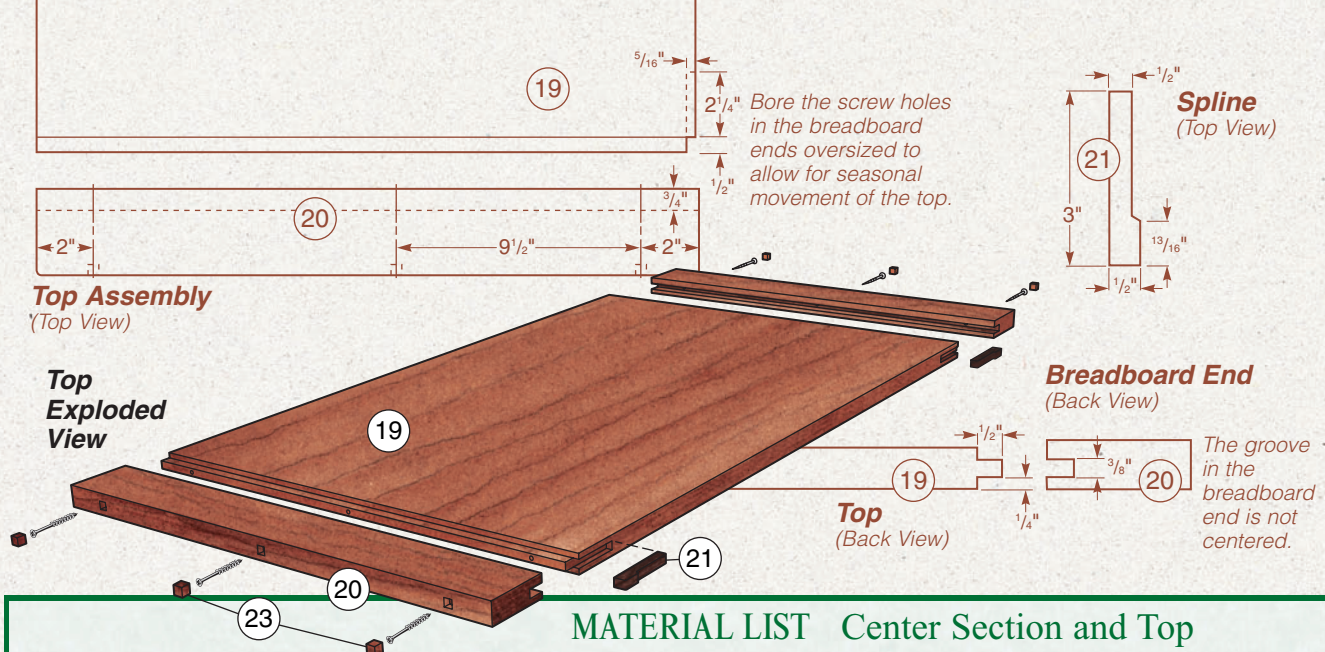
Note: The lower side rails' tenons must be trimmed to 1 1/16" before assembly. The tenons on the other side rails remain at 1 1/4".



Side Exploded View

MATERIAL LIST Sides

	T x W x L
1 Side Panels (4)	1/4" x 19 3/8" x 21 13/16"
2 Veneer (paper-backed) (8)	1/16" x 19 3/8" x 21 13/16"
3 Legs (4)	1 3/4" x 1 3/4" x 51 5/8"
4 Side Rails (6)	7/8" x 2 3/4" x 21"



MATERIAL LIST Center Section and Top

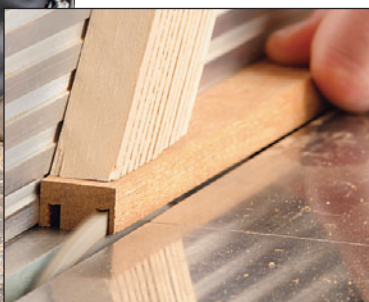
	T x W x L		T x W x L
5 Horizontal Edging (1)	7/8" x 1/2" x 185"	15 MDF Side Panels (2)	1/4" x 18 1/2" x 45 5/8"
6 Vertical Edging (1)	1/2" x 13/16" x 54"	16 Back (1)	1/4" x 38 1/4" x 47 3/4"
7 Horizontal Dividers (5)	3/4" x 21 1/16" x 36 1/2"	17 Back Veneer (1)	1/16" x 38 1/4" x 47 3/4"
8 Bottom (1)	3/4" x 20 1/2" x 36 1/2"	18 Drawer Slides (12 pairs)	18"
9 Bottom Vertical Divider (1)	3/4" x 8 13/16" x 20 13/16"	19 Top (1)	7/8" x 22 7/8" x 37"
10 Lower Vertical Dividers (2)	3/4" x 8 7/8" x 20 13/16"	20 Breadboard Ends (2)	1" x 3" x 23"
11 Middle Vertical Dividers (2)	3/4" x 5 3/8" x 20 13/16"	21 Splines (2)	3/8" x 1/2" x 3"
12 Top Vertical Divider (1)	3/4" x 5 13/16" x 20 13/16"	22 Plugs (12)	1/4" x 1/4" x 1/4"
13 Top Rails (2)	1/2" x 2" x 36 1/2"	23 Plugs (6)	3/8" x 3/8" x 3/8"
14 Bottom Rails (2)	7/8" x 2 3/4" x 39"	24 Glue Blocks (4)	2" x 4" x 4"



several passes on the table saw. I then made the edging for the vertical dividers 13/16" wide so that I could easily flush it up after gluing it on.

When slicing up the birch plywood, I would recommend trying to

The author forms a groove in the horizontal edging. The delicate 1/16" lips of the edging must be handled carefully.

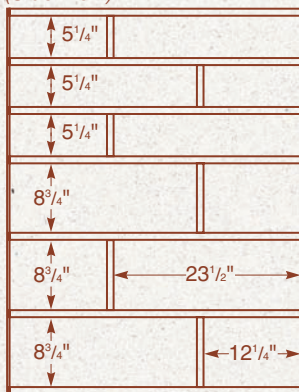


eliminate veneer chip-out by carefully knife-scoring the cut line, and using a very sharp plywood blade. I cut the dividers so the grain went from side to side on the horizontals, and from top to bottom on the verticals. Then, I glued all the edging on, using Titebond® glue and bar clamps.

Because I choose to leave them a little long for the glue-up, all of the ends of the edging needed to be trimmed, and the ones on the vertical dividers needed to be notched to fit over the horizontal edging's 1/16" lip. It's important to note that all of the vertical dividers don't get exactly the same size notch. The bottom divider is flush on the bottom because there isn't a 1/16" lip to clear, and the top divider gets a 1/2" x 2" notch for the top rails. All the others get the standard 1/16" notch on both edges.

Now I was ready to sort out the vertical and horizontal dividers and mark them for assembly. Using a long square, I marked a line for each side

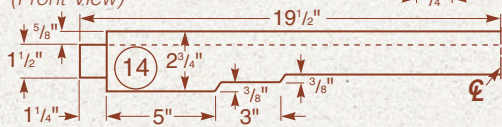
Divider Locations (Side View)



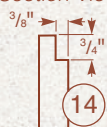
Top Vertical Divider (Side View)



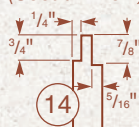
Front Bottom Rail (Front View)



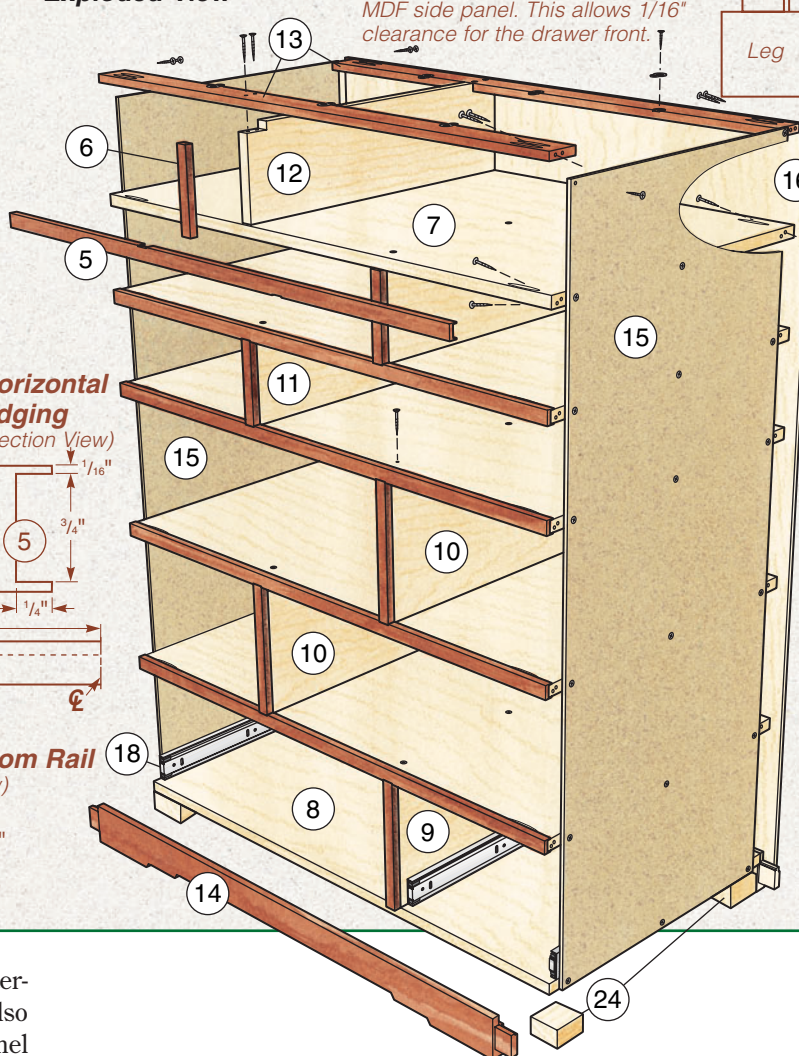
Front Bottom Rail (Section View)



Back Bottom Rail (Section View)



Center Section Exploded View



Drawer Clearance Detail

The drawer slide is mounted to the MDF side panel. This allows 1/16" clearance for the drawer front.

Side
Leg
Drawer front
1/8" Setback

1/16" Gap

Side to Center Assembly Detail
(Top View)

of the vertical panels, and the centerline onto the horizontal dividers. I also carried the centerline of each panel around to the opposite side. I then drilled three attachment holes for each vertical edge.

Before going any further, you must make and install two bottom rails into the bottom divider panel before the center section can be assembled. Each of these rails has its own details to take care of: rabbets, "cloud lifts," etc. Once the rails were detailed, I glued them to the bottom divider.

Rounding over the vertical edges was my last step prior to assembling the center section. I don't round over the horizontal edges until after the dividers have been joined.

I assembled the center section on a large, flat bench. This was very helpful, as it kept the back edges all lined up. It was also very useful — almost imperative — to have a right angle cordless drill/driver. I started at the top and worked my

way down, clamping each vertical in place, drilling pilot holes, and then attaching each vertical with glue and screws.

I had assembled the center section using an 1/8" roundover bit to break the horizontal edges.

The two top rails are the last parts of the center section. They are simply glued and screwed to the vertical divider.

With the dividers joined together in a single unit, I attached the MDF side panels that hold everything in

alignment and make a surface for the outside drawer slides to attach to. I used spacer blocks at the outboard ends of the horizontal dividers to hold them exactly the right distance apart. Once again, I attached the panels with glue and screws.

The center section was now complete and ready to be stained. My first step

Details such as the African blackwood splines and the ultra-detailed drawer pulls create a sense of elegance.



was to detail the intersections of the vertical and horizontal edges with 120 sandpaper. Then, I raised the grain and lightly sanded with 220-grit.

Staining this section was an exercise in being methodical and careful. It was simply not possible to stain the whole thing at the same time without a disaster taking place. So I stained one drawer bay at a time, wiped off the excess, and then moved on to the next section to avoid drying and blending problems. Once it was stained, I buffed it all as before.

With caution being the better part of valor, I assembled one side at a time to the center section. This was a pretty straightforward matter of gluing, clamping and pocket screwing. As I mentioned before, wear rubber gloves when handling the stained, but not finished, wood. I assembled the unit by attaching the horizontal dividers

to the ends with pocket holes — two per corner: one top and one bottom. After I had both sides attached, I made and attached large corner blocks to join the rails and legs on the bottom of the cabinet.

To prevent the stain from being marred at this point, I sprayed the assembled cabinet with a sealer.

A Classic Breadboard Top

The top is a classic Greene and Greene top: breadboard ends and exposed splines at the joints. I began by milling my board to thickness, then used my table saw to cut the top to size. Staying at the table saw, I formed the tenons with a vertical and horizontal cut.

I milled the breadboard ends to size and cut the groove in them on the table saw. This groove is not down the middle of these pieces, but is

instead offset due to the 1/8" thickness difference between it and the top. These pieces are flush with the underside of the top and proud on the top. Cutting the spline slot was best done by chopping it by hand with a sharp chisel.

Like the plug hole in the legs, I used a square mortising chisel in the drill press to cut the plug hole in the breadboard ends. After cutting the plug holes, I used the drill press to drill the attachment holes. I then slipped the ends into place, marked the screw holes, and drilled the pilot holes in the tenon.

Rounding over and detailing the top and ends is a bit tricky if you don't watch it. It was important to remember that the ends stand proud on the top and the front. I was very careful to keep the back and bottom edges square. Once again, I went through the prep steps and then stained the top and ends.

Once the stain was dry and buffed, I attached the ends to the top with 3" screws.

The Drawers and Pulls

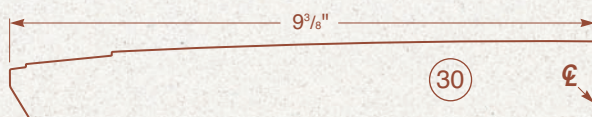
As I mentioned earlier, I selected the wood for the drawer fronts carefully so that the grain ran continuously across all of the pairs. I milled the boards to thickness and width, and then cut them up. I used my block plane to fine-tune the fit of each front so that I had an even, and parallel, gap all the way around. After fitting, I marked each front as to which opening it fit in. In a routine you're probably sick of by now, I rounded over the corners of the fronts, and went through the sanding and staining process.

I made the drawer boxes out of 1/2" Baltic birch plywood. I think this material makes a great drawer box. I cut the parts to size and machined their joints. When I had finished routing the rabbets, I sanded all the sides, fronts and backs to 120.



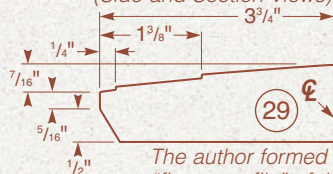
Forming the quartersawn mahogany drawer pulls is a time-consuming task. The author spent a significant number of hours detailing these pulls.

Large Drawer Pull (Side View)



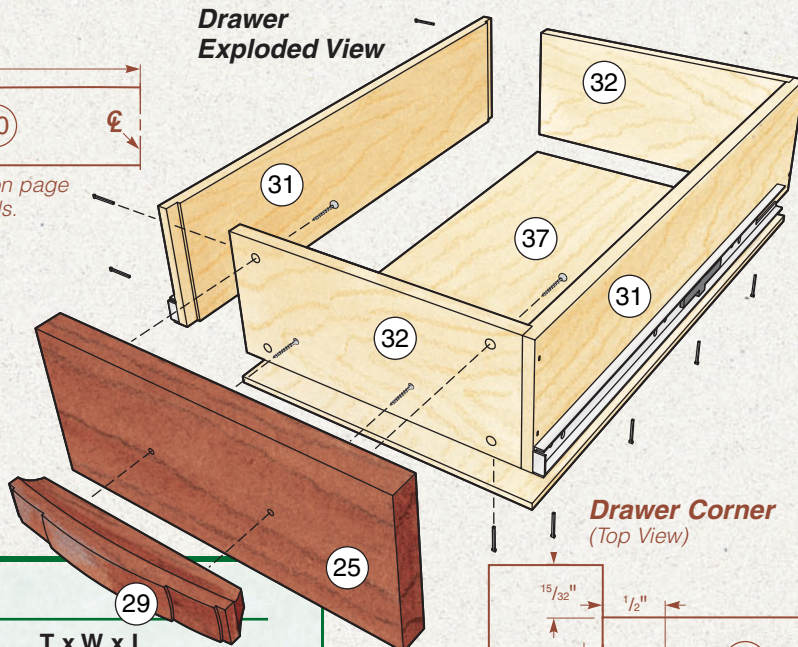
See inset photo on page 44 for more details.

Small Drawer Pull (Side and Section Views)

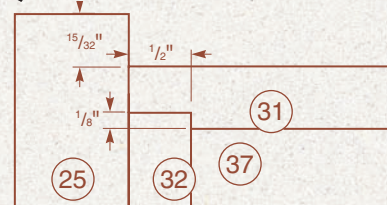


The author formed the "finger profile" of the pulls with a combination of a router and sharp gouges.

Drawer Exploded View



Drawer Corner (Top View)



MATERIAL LIST Drawers

	T x W x L
25 Upper Small Drawer Fronts (3)	7/8" x 5 1/8" x 12 3/16"
26 Upper Large Drawer Fronts (3)	7/8" x 5 1/8" x 23 3/8"
27 Lower Small Drawer Fronts (3)	7/8" x 8 5/8" x 12 3/16"
28 Lower Large Drawer Fronts (3)	7/8" x 8 5/8" x 23 3/8"
29 Small Drawer Pulls (6)	1 1/8" x 1 1/4" x 7 1/2"
30 Large Drawer Pulls (6)	1 1/8" x 1 1/4" x 18 3/4"
31 Upper Drawer Sides (12)	1/2" x 4 5/8" x 19 1/2"
32 Upper Sm. Dwr Fronts, Backs (6)	1/2" x 4 5/8" x 10 1/2"
33 Upper Lg. Dwr Fronts, Backs (6)	1/2" x 4 5/8" x 21 3/4"
34 Lower Drawer Sides (12)	1/2" x 8 1/16" x 19 1/2"
35 Lower Sm. Dwr Fronts, Backs (6)	1/2" x 8 1/16" x 10 1/2"
36 Lower Lg. Dwr Fronts, Backs (6)	1/2" x 8 1/16" x 21 3/4"
37 Small Drawer Bottoms (6)	1/4" x 11 1/4" x 19 1/2"
38 Large Drawer Bottoms (6)	1/4" x 22 1/2" x 19 1/2"

Using a brad nailer and Titebond, I assembled the drawer boxes. Before the glue had set, I laid each drawer box on my bench, measured it from corner to corner for squareness, and tweaked them if necessary.

While the boxes were drying, I cut the bottoms from the maple veneered 1/4" MDF. To prep for finishing, I sanded them to 120. I attached the bottoms with glue and brad nails.

One of the defining characteristics of Charles and Henry Greene's casework pieces is their drawer and door pulls. There are as many different variations of pulls as pieces they designed. The sculptural quality of these pulls is what ties them together. For this cabinet I designed pulls that were based upon an

amalgam of several different designs, the primary one being the chest of drawers from the Gamble house that I referred to earlier. I'll tell you from the start that these pulls take an inordinate amount of time. For a simpler pull that would look fine, check out my Greene and Greene desk in the Sept./Oct. 2000 issue of *Woodworkers Journal*.

In search of pleasing aesthetics, I tried to choose straight grain wood for these pulls. I milled all of the pieces to their rectangular dimensions and cut them to length.

To lay out the curved steps, I made a very accurate tagboard template and used it to mark out the steps. I marked the steps on the side of each pull with a black fine-line ballpoint pen (it's

easier to see). Using a 6 TPI x 1/4" blade, I very carefully hand sawed the steps. I was careful to cut just on the fat side of the line so I could clean up the saw marks without going past the layout line. Once the steps were sawed, I smoothed them to the line with a combination of a hard sanding block, files and my block plane.

I found a pleasing curve for the edge of the steps and, after experimenting a bit, I found that a pillar file, with its one smooth edge, was the best way to cut and smooth these curves.

Making the finger relief could probably all be done with a single, somewhat elaborate, router jig. I found it just as easy to do it with a combination of a pass on the router table and some hand work. I started by making a pass on the router table with a coving bit. This left me with a straight relief that needed to be modified into a curved one to match the curve of the pull face. I marked a line about 3/8" back from and parallel to the pull face. A few good swipes with a sharp gouge and a little cleaning up with sandpaper finished the job.

The final shaping to be done on the pulls is the undercutting of the ends.

“Staining this (center) section was an exercise in being methodical and careful. It was simply not possible to stain the whole thing at the same time without a disaster taking place.”

I did this freehand by judiciously grinding the ends on the end roller of my stationary belt sander.

There was a surprising amount of very painstaking sanding and detailing to be done before the pulls were ready for stain. I made quite an effort to get all of the pulls to look exactly the same. When all the detailing was done, I went through the staining process.

If this cabinet was always going to be up against a wall, I probably could have gotten away with making the back out of a piece of 1/4" MDF. Alas, that was not the case, so I opted for a piece of mahogany veneered 1/4" MDF. I veneered the back in a vacuum bag the same as I did the side panels. I only veneered one side of the back, but since it is screwed down with

about 20 screws, warpage won't be a problem. After cutting it to size, I sanded and stained the back in the usual method.

Mirror, Mirror

The mirror and its supports were the last things I needed to build before the cabinet could be finished and assembled. I started by milling all of the pieces to their rough, non-shaped

size. While still in this rectilinear shape, I cut the miter joints on the top and side pieces. After cutting the miters, I used a thin wood batten to lay out the curves and steps on both the top and sides. I cut the pieces to shape on the band saw and then smoothed them up with sandpaper and files.

The corners of the mirror are joined with face frame size biscuit joints, but you

can substitute dowels. Prior to gluing up the frame, I made sure to sand the inside edges, as this is much harder to do when the frame is assembled. I glued up the frame using Titebond, a bar clamp on the bottom and 3M packing tape on the miter joints. When the glue had set, I used a rabbeting bit in a router to cut most of the mirror rabbet.

I used a sharp paring chisel to finish off the rabbet.

Before moving on to staining the mirror frame, you'll have to follow the detailing steps I've used on other subassemblies, starting with rounding over all of the appropriate edges.

Moving to the mirror posts, I started by cutting the posts to length and then laying out their curves, using a band saw to shape them.

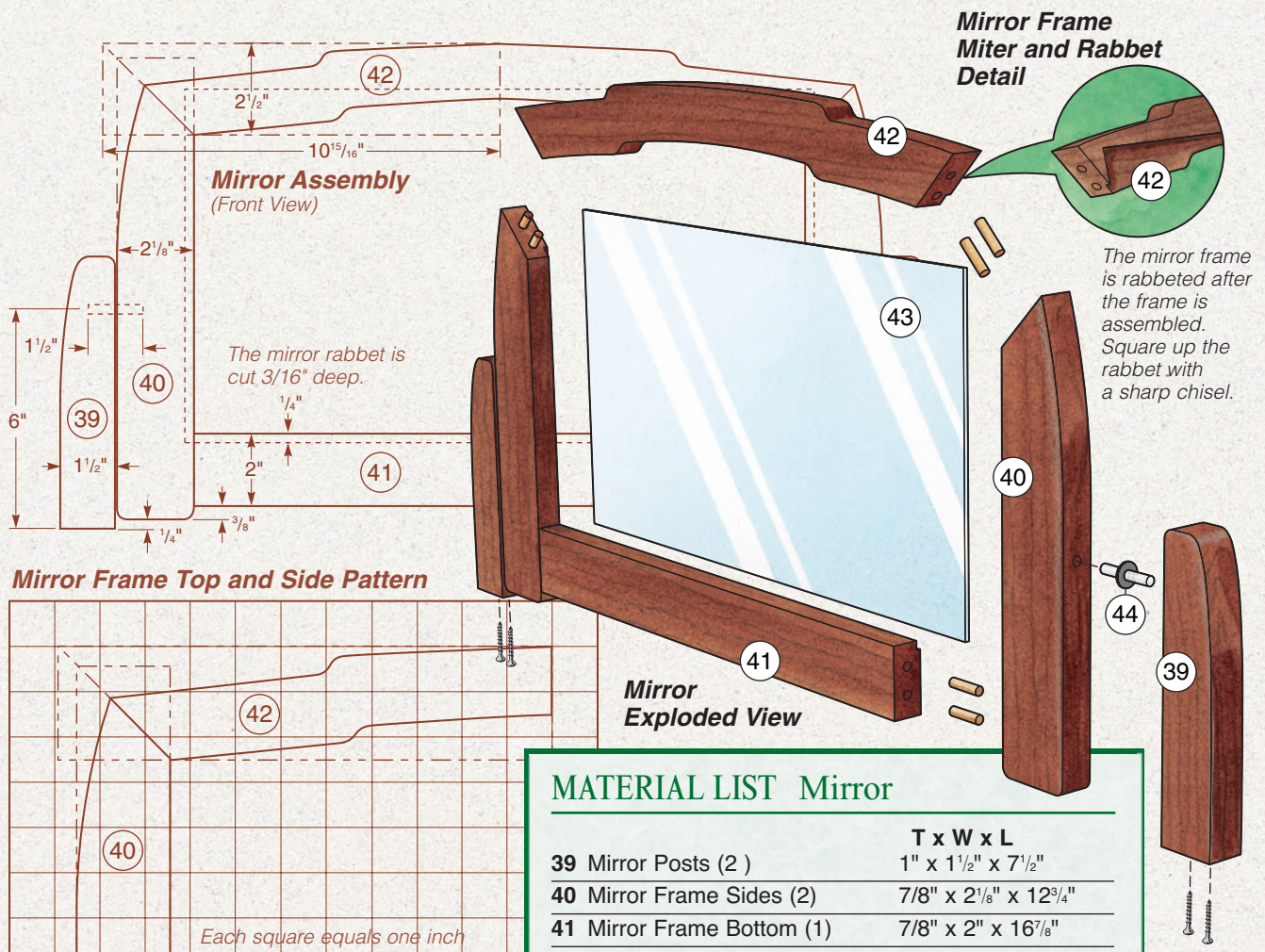
After looking at most of the available mirror pivot hardware — and finding it lacking — I decided to make my own, which, it turned out, was a lot simpler and a cleaner design. I ended up using 1" x 1/4" steel dowels and a 1/16" black nylon washer. This added up to a grand total of about \$2.00. The spacers serve to make the 1/8" gap so the assembled mirror has room to swing. With that done, I sanded and detailed all the parts and stained them.

The finishing process was quite straightforward. The first step was to go over everything with a good quality tack rag to remove any residual dust. For a finish, I sprayed three coats of catalyzed synthetic lacquer. (You can use the finish of your choice.) I usually buff with a fine Scotch-Brite or sand with 220 between coats, depending on how the surface feels.

Assembling a cabinet with this many drawers is rather time-consuming and needs to be done carefully. I started the assembly by attaching the mirror assembly to the top. The first thing I did was use clear silicone adhesive to glue a piece of 1/8" mirror into the



The posts of the mirror assembly are joined to the dresser top by screws driven up from the inside of the top. The top is attached to the carcass with tabletop fasteners.



mirror rabbet. While the silicone was drying, I marked and drilled attachment holes in the bottoms of the support posts. With the mirror assembly together, I carefully marked and drilled mounting holes in the top. I then mounted the mirror to the top. The top is attached to the carcass with tabletop fasteners and screws.

Installing the drawer slides was straightforward, although it required the use of a right angle drill/driver to install them, especially in those smaller compartments.

I attached the drawer pulls to the drawer fronts prior to installing the fronts on the drawer boxes. After the pulls were attached, I attached the fronts to the drawer boxes. My usual method for this is to drill four 3/8" holes in the front of the drawer boxes and then attach the fronts with drawer front attachment screws that have an oversize head. This allows for some minute adjusting to get the fronts perfectly aligned.

Once all the drawers were in place and the fronts attached and adjusted, I installed the back, using 1" screws and finishing washers.

Ebony-like Accents

The very last items to complete on the cabinet are the African blackwood splines and plugs. I made all of the plugs in my usual way: make a stick of the right dimension, dome the end with sandpaper, polish it on a buffer, cut it off on the band saw and repeat. I also cut the splines on the band saw and then sanded them to shape and polished them. I installed the plugs and splines using a small drop of clear silicone, tapping them in place. The silicone allows for a little movement and reduces the possibility of them falling out if the humidity changes. The cabinet was now complete.

I found this to be a very satisfying

project, but in a different way than many other projects I have done. There isn't any part of this cabinet that was particularly hard to construct, but it had engineering questions galore. I really love the process of thinking through how something is going to go together, and in what order. It was really satisfying to work through the challenges presented by this cabinet and have it come together so well. I would like to think that the Greene brothers, especially Henry (the engineering half) would have found this an interesting project. I hope you do and that it provides many years of service and pleasure.

Mike McGlynn is a professional furniture maker and contributing editor to the Woodworker's Journal. When not in his shop, you can find Mike on his mountain bike.



Band-sawn Bombé Jewelry Box

By Scott Phillips

Glue up a large block of wood, and then fire up your band saw. In short order, you will have a sophisticated “King of the Bombé Band-sawn Boxes.” As Scott Phillips would tell you, it’s all in the band saw blade.

Band-sawn boxes are perfect gift projects. First, they look great. Second, they’re easy to make. And third — they’re fun to make.

But before you get started, know that the true secret to successful band saw work is all about blade selection. Work safely — and keep in mind that higher priced band saw blades are worth every penny.

The French first inspired bombé (Bom-BAY) chests in the 1700s. This is a very demanding full-sized project, but a breeze to make as a miniature band-sawn box. Master period furniture maker George Reid has made both full-size and miniatures of period furniture styles for 60 years, and he challenged me to promote good period furniture forms. So I turned to my band saw with the eye-catching classic bombé form in my head. Here is how I make these boxes in four to five hours each.

Getting Started

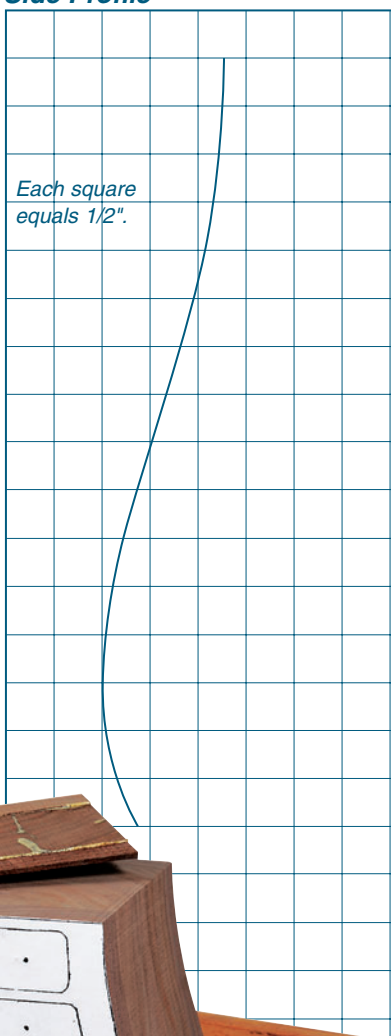
I use a Delta 14" band saw with riser block, 12" thickness capacity and 14" throat. I always upgrade my band saw with cool blocks. They give excellent support to the blade, and they are necessary when using the thin 3/16" scrolling style band saw blades. Metal blocks or side

roller bearings will quickly ruin the blade set on thin blades. (Tip: If you plan wisely and use some creativity, a band saw with a 6" thickness capacity can easily make this box by cutting the block into two halves along the middle drawer divider.)

To start this project, make several copies of the bombé patterns and use scissors to trim the patterns into usable forms. (You can also check out the details of this project at my American Woodshop show #1001 which will soon be featured at www.thewoodworkingchannel.com.)

Glue up a workpiece of dry wood so the finished glue-up nets a solid block 5" thick by 8" tall by 10" wide. (Use polyurethane glue and a plant-misting bottle filled with water to lightly moisten all glue surfaces first.) The wood grain of the “block” must run up and down the front of the finished box. This looks best, and having all the laminations run in the same direction will ensure the longevity of your glue-up. Otherwise, the glue-up will eventually fail.

Side Profile



Those lumber shorts in your shop that are “too good to throw away” just may become a mini bombé box. The author used short lengths of walnut.



Pick the Right Blade

A premium 3/16" band saw blade is essential to carve the serpentine shape on the front of the box. It must be paired with cool blocks, or you'll remove the set from the blade.



Once the glue-up is dry, use a 1/2" premium quality band saw blade to sculpt the outside shape of the bombé blank (piece 1). The table of the band saw must be absolutely square to the blade for every cut on this project (except for the serpentine sculpting). Use the patterns as labeled (see the *Drawings* on the next page) to create the curved profiles on the two sides and the bulging front. Notice that the front curve is identical to the side curves.

Time-saving Tips

A tip that will save you tons of time is to spray a light uniform coat of temporary bond spray adhesive on the back of the pattern and let it dry for 45 seconds before applying it to the wood. This way, the pattern will easily peel off in one full piece. Plus,

it can be repositioned again by repeating the process as before. If the adhesive is too wet when the pattern is applied, the bond will be permanent.

Another good tip is to re-attach the parts you cut off (drop) with

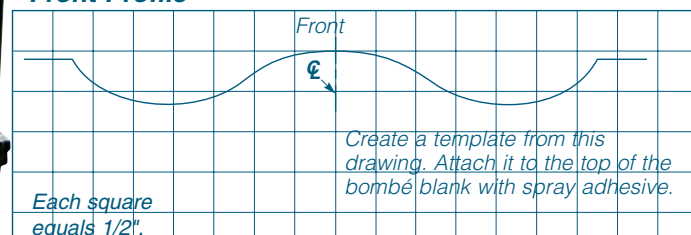
double-stick tape to stabilize the workpiece whenever a curved surface would otherwise be against the table. This puts a flat surface on the table, making the cut safer and more manageable.

Go ahead and use the 1/2" blade to cut off the back of the roughed-in bombé blank. It should be about 3/8" thick. Use a marking gauge to scribe in all straight cut lines for the back and for the drawers. A white marking pencil is perfect for making visible lines on dark woods like walnut.

The optional front bow profile that creates the serpentine shaped front requires a 3/16" premium quality band saw blade that is supported by cool blocks instead of the traditional metal guide blocks. (*Always* unplug your saw when changing blades.) The serpentine paper pattern is bonded to the top of the chest first. The two cut-in curves are made by tilting the table to 9° and locking it in place. This will sculpt a re-curved shape in the top two drawers. A good bit of sanding is required to refine this graceful serpentine shape, but it's really worth the effort.

Carving the serpentine shape onto the front of the box is the most technically difficult task in this project. The author suggests a couple of test cuts on scrap lumber before you shape your project.

Front Profile



Pattern for Bombé Box Cutouts

Entry Point

Use spray adhesive to attach an enlarged (full-size) paper pattern to the front of your blank. Be sure to allow the adhesive to dry for 45 seconds or a bit more before you place the pattern on the blank.

Each square equals one inch.

To use a copier to blow up the pattern above to actual size, first, set the copier to increase the drawing by 200%. Then increase that copied pattern by an additional 167%. (If your copier is capable, simply increase the drawing by 333%.)

Drawer
(Top View)

Drawer
(Section View)

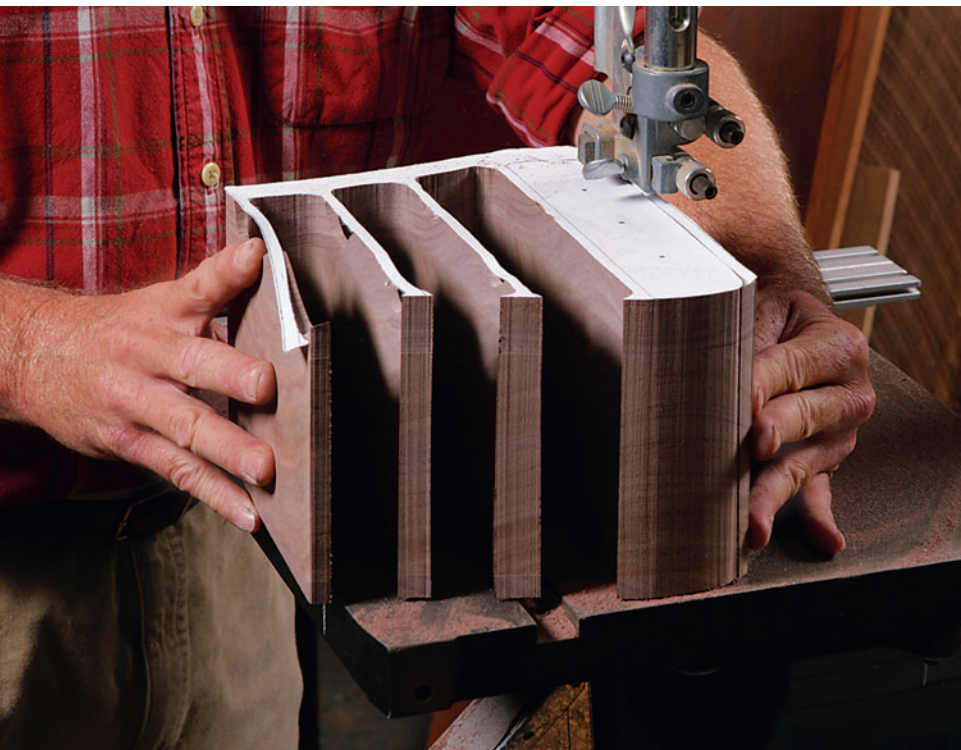
Note: the bombé blank is glued up to create the full dimension of piece one. The wood's grain must run top to bottom in all of the blank's laminated layers.

Turn to the sidebar on the next page for step-by-step instructions to complete the drawers.

Exploded View

MATERIAL LIST

	T x W x L
1 Bombé Blank (1)	5" x 10½" x 8"
2 Top (1)	¾" x 6" x 9"
3 Bottom (1)	¾" x 6" x 11"
4 Feet (4)	1/2" x 1" Bronze
5 Knobs (9)	5/8" Brass



After cutting off one side of the bombé chest, cut out one drawer at a time. Label the front top of each drawer — and don't cut the opposite side of the workpiece!

bombé workpiece. There will be a few voids under the pattern where the serpentine cuts were made in the previous steps. That's OK. Start at the arrow-marked entry cut and, using the 3/16" blade, carefully cut off one side of the bombé chest. The side should be of uniform thickness from top to bottom. Then begin to cut out one drawer at a time as shown in the *photo* above.

Use medium or thick viscosity cyanoacrylate (C.A.) glue and a curing accelerator to glue the side of the case back onto the chest. Carefully use the cut-out drawer workpieces to make certain that the drawer cavities are properly spaced. I put the glue on the smaller surface being bonded and the accelerator on the other half. Then I start a slow count to 15 as I adjust the drawer dividers for the perfect fit. At the 10 count the glue starts to set; by 15, it is solid — so you have to be on your game.

Next, apply the optional front serpentine profile pattern to the bottom of the front of the chest. The band saw table is still tilted and locked at 9° to shape the bottom drawer only. This cut requires freestyle sculpting techniques which may take a bit of practice to master. You might want to start on a practice piece before attempting the cut on your good workpiece. Work safely!

More sanding will be necessary. I use a microplane to shave away rough edges before I sand; it saves time and elbow grease.

Cutting the Drawer Dividers

To begin cutting out the drawers, adjust and lock the table so it is once again precisely square to the blade for all remaining cuts. Apply the full-size pattern onto the front of the

Four Steps to Making a Band-sawn Drawer



The first step in completing the drawers is to slice off the drawer front. Mark a line perpendicular to the front edge of the drawer, 3/4" back. Make the cut with your band saw as shown above.



Next, slice off a 1/4" thick drawer bottom by using an 8" wooden hand screw clamp to vertically stabilize the piece. Use the 3/16" saw blade for this cut. Turn off the saw before unclamping and removing the bottom.



Form the U-shaped sides of the drawers. The opening of the "U" always faces the drawer front. Scribe the cut-out shape by using a marking gauge set to 3/8" to form lines on the two sides and the back.

After the body is assembled (remember to attach the backer board), move on to complete the drawers.

The Drawers, Top and Bottom

Carefully cut the drawer blanks to form the hollowed-out drawers. There are no patterns for this, so use a marking gauge to lay out your cut lines. Mark the top side on all drawers, then follow the instructions in the *sidebar* below to finish the drawers.

The two final components are the 3/4" thick walnut top and bottom (pieces 2 and 3). The top measures 6" wide by 9" long. The bottom is 6" by 11". A graceful edge can be routed onto the fronts and sides of these finishing accents. I like the look of an ogee positioned to face the body of



For extra glue-up time, skip the accelerator and temporarily duct tape pieces together properly. Then, spray the exterior of each joint with accelerator, wait three minutes and remove the tape.

the bombé chest (facing up on the bottom and down on the top). These are mounted to the body with the same C.A. as above. I recommend using three beads of glue along the length on the boards. Be careful with the glue: it sets faster than you think, so have glue solvent handy. Better yet, learn how to apply just the right amount so it barely squeezes out during assembly.

change how the piece looks, so experiment. I chose eight 5/8" screwed-in brass pulls with four humidor 1/2" by 1" bronze feet.

In closing — remember, handmade gifts are always cherished more when given with jewelry! Enjoy!

Scott Phillips is the host of the nationally syndicated television programs The American Workshop® and The American HomeShop®. They are distributed by PBS.



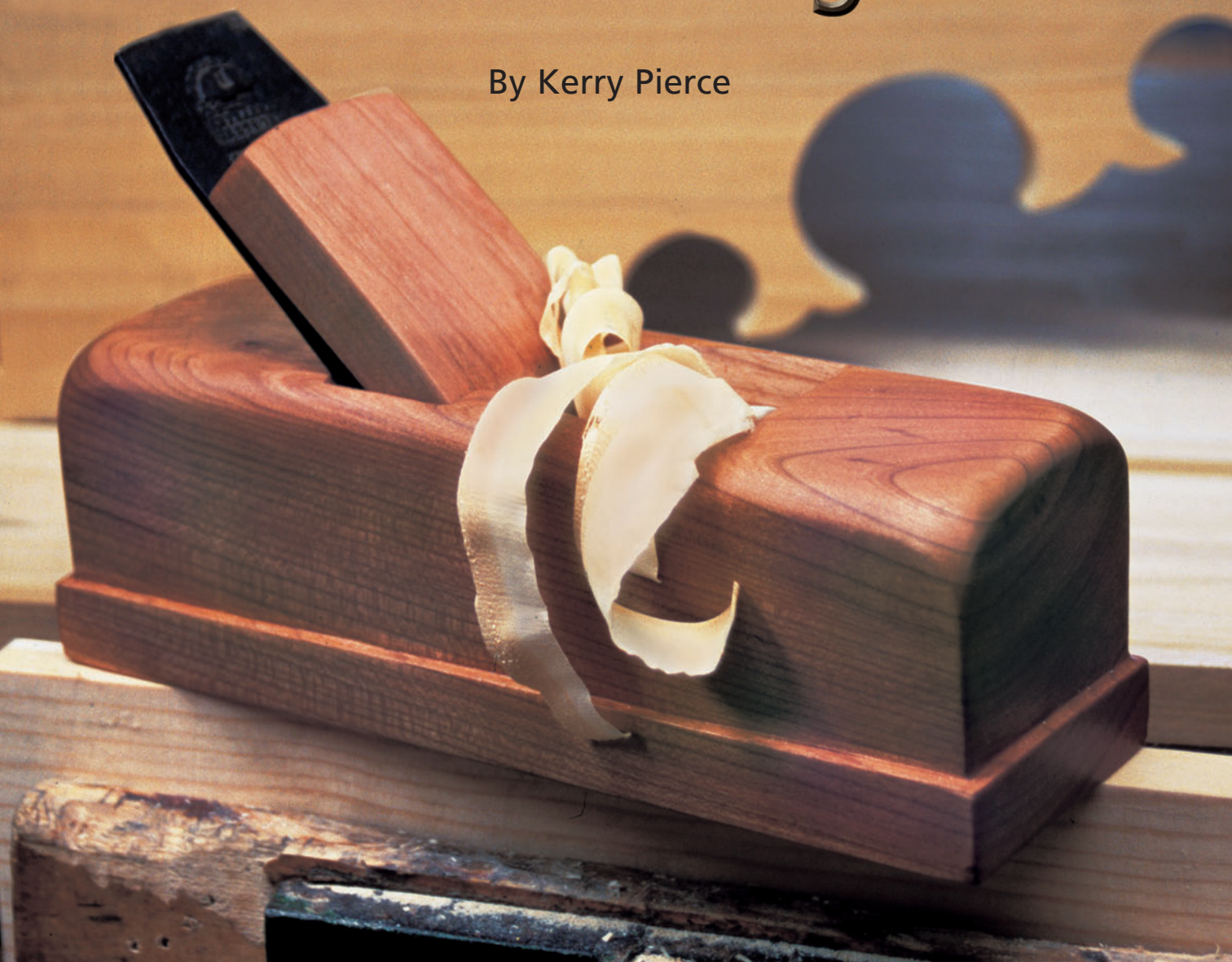
Glue the drawers together using the same glue you did previously (medium or thick viscosity C.A.). Sand the drawers smooth before finishing, but wait to mount the hardware until the box is done.

Your box will need a good bit of sanding before you apply the final finish. Brass pulls and bronze feet add a bit of sparkle to the rich dark hue of the walnut stock.



Plane Making 101

By Kerry Pierce



Despite the availability of good quality new planes at reasonable prices and good quality antique planes at even more reasonable prices, there are still compelling reasons to make your own.

First, the process of making, setting up and tuning your own plane will teach you things about planes you can't learn as quickly from a book or even from lessons taught by a first-rate instructor. But — at least for me — the very best reason for making a plane is the same as the very best reason for making the furniture I'll produce with that plane: The process gives me an opportunity to take material in my hands and, with it, fashion something that is both beautiful and useful.

Material

The irons in traditional wooden planes were tapered in thickness from approximately 3/16" at the business end to 1/16" at the other end. I have a supply of these irons because of my practice of buying junk antique wooden planes whenever I find them with good irons at cheap prices. Typically, I'll pay \$8 or \$9 for the plane, pull out the iron/cap iron assembly and toss the checked and beaten body in the trash. Modern irons only half the length of these antique irons typically sell for \$40 or more.

The tapered iron is reputed to be more resistant to slippage when wedged against a plane's bed than is an

Ian Kirby has called hand planes “woodworking’s wonder tool.” Double your woodworking satisfaction and build your own handmade wonder tool.

iron with parallel faces, like the irons in a Stanley bench plane, but Ron Hock at Hock Tools — who knows much more about plane irons than I do — told me this wasn’t so. To test the idea, I put a Stanley bench plane iron (a tapered iron) and cap iron into this little smoothing plane, and it worked just fine, although the mouth — opened for a $3/16$ " traditional iron — was a little too spacious.

Ron Hock offered to stock a supply of iron/cap iron assemblies and make them available to *Journal* readers at a very reasonable price (www.hocktools.com).

Making the Body

Begin by ripping, jointing, planing and cutting to length the plane blank (piece 1). It should finish out $2\frac{3}{4}$ " on a side with every face exactly 90° from every adjacent face, as shown in *Figure 1* at right.

I recommend a hollow-ground planer blade for making the finish cuts because these blades leave behind surfaces that require very little effort to smooth. Set up your table saw to take a 2" deep cut that removes $1/8$ " of material from the sides and ends of your blank, as shown in *Figure 2* at right. Form the shoulder at the top of the step by setting your table saw to take a $1/8$ " deep cut that is $3/4$ " from the fence. This will leave a step that is $1/8$ " thick and $3/4$ " high all around your plane blank, as shown in *Figure 3* at right.

Next, locate the mouth on the sole of the plane. The mouth is typically placed about a third of the way back from the toe of the plane, although the exact location is a matter of personal choice.

The line designating the back edge of the mouth will be the terminus of the bedding slope. For the time being, mark the front of the mouth $1/4$ " ahead of the back edge. Once you have an iron/cap iron installed, you’ll more precisely locate the front of the mouth. Remember that the opening in the sole includes not just the distance from the cutting edge of the iron to the front of the mouth but also enough room to accommodate the bevel on the end of the iron.

After you have located the mouth, use a bevel gauge as a guide to make lines on both sides of the plane blank that reach from the extended back edge of the mouth up



Figure 1: Prepare the plane blank by first cutting it to length. Use your jointer to mill the blank so that all six of its faces are 90° to their adjacent faces. A precision tool must be precisely made.



Figure 2: Use a smooth-cutting table saw blade, such as the author’s planer blade, to begin forming the plane’s distinctive step-out shoulder. A carbide-tipped 60- or 80-toothed blade is an acceptable alternative.



Figure 3: Complete the stylish and practical step-out with a $1/8$ " deep cut that is $3/4$ " from the table saw’s fence. In every step shown above, take note of the prudent use of push sticks and pads.



Figure 4: After laying out the plane's mortise, secure the blank in your vise. Carefully begin chopping out the waste, cutting only the portion of the bedding slope between the abutment cheeks.



Figure 5: To begin the mouth, the author drills two holes in the center of its width with a 3/16" bit. These act as references as he chops a hole on top of the blank which will become the mouth on the bottom of the plane.



Figure 6: Use a 3/16" chisel to form the mouth of the plane. The holes you drilled in the previous step serve as guides for this process.

Forming the mouth

to the top of the plane blank at a 45° angle. These lines mark the bedding slope you will cut on the inside of the plane. Then, follow the *Drawings* at right to lay out the rest of the plane's mortise. You will cut the groove for the cap iron screw head later on.

Secure the plane blank in your vise. Then, very carefully, begin chopping out the waste, as shown in *Figure 4*, at left. At this stage, you should cut only that portion of the bedding slope that falls between the abutment cheeks.

When you have reached a maximum depth of approximately 2", invert the blank and re-secure it with the sole facing up. It's time now to begin cutting the mouth.

Forming the Mouth

Although the mouth could be fully excavated with chisels, I begin the process by making a couple of holes with a 3/16" drill bit in the center of the mouth's width, as shown in *Figure 5* at left. These holes constitute the first connection between the opening I'm chopping on the top of the plane and the mouth on the bottom of the plane, serving as references to let me know if my work is on track. Once the connection is completed, turn to a 3/16" chisel and begin to actually form the mouth, as shown in *Figure 6* (below, left).

Once you've connected the excavation on the top of the plane and the mouth, clamp the plane blank in place so that the mouth just peeks over the edge of your bench top. The sole behind the mouth must be supported when you're chopping the bottom section of the throat or your chisel work will break out sections of the sole. Positioning the mouth just over the edge of the bench top (see *Figure 7* on page 62) provides the necessary support and allows chips to fall to the floor through the mouth, instead of clogging up your work.

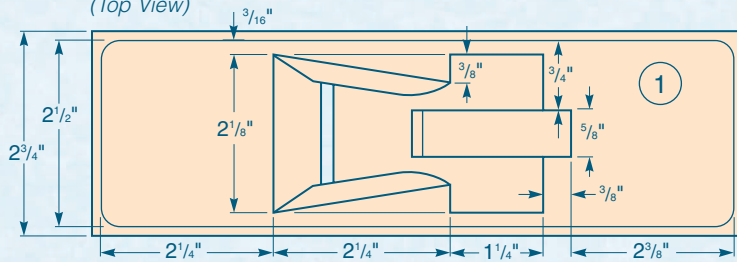
At this point in the process, you'll probably want to work back and forth, chopping away from the top for a while, then shifting to the bottom. When the bedding slope extends from the back of the mouth to the top of the plane, you're ready to cut the wedge slots.

Because the tops of the wedge slots are cut at a steeper angle than the bedding slope, the slots taper from the point at which they enter the plane's top surface to the bottom of the abutments. Tapping the wedge into this taper allows you to create the pressure that keeps the iron from chattering when it's used.

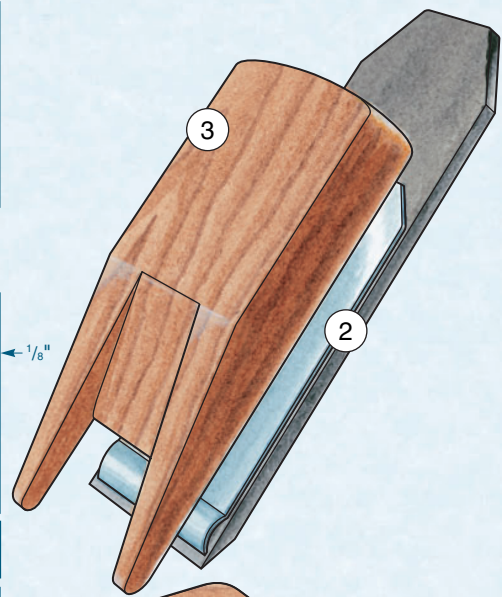
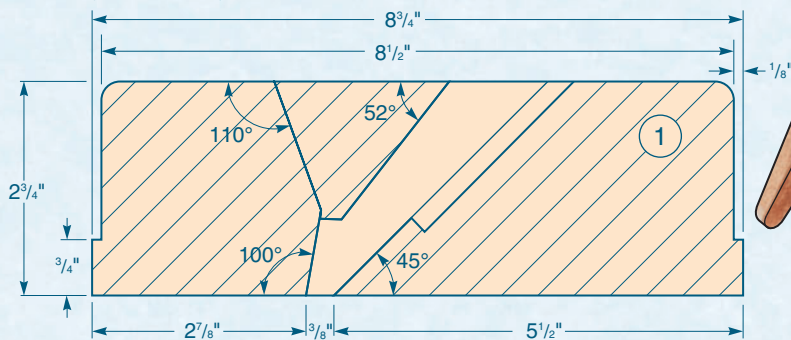
Two saw cuts are necessary to define the wedge slots. The first is simply an extension of the bedding slope that reaches all the way to the outside of the wedge slot. (*The*

Plane Blank

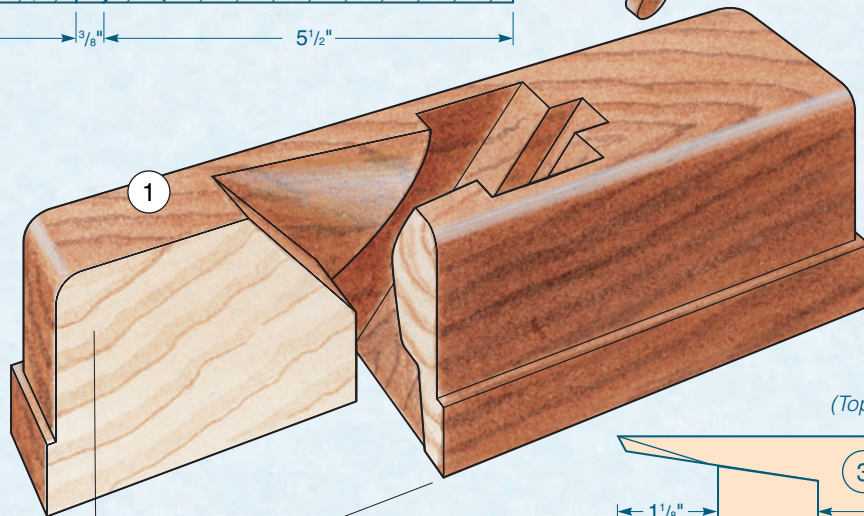
(Top View)



(Section View)

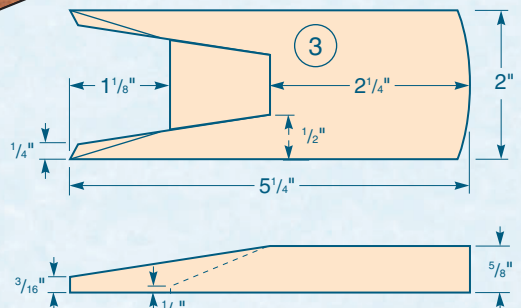


Cutaway
Exploded
View



Wedge

(Top and Side Views)



MATERIAL LIST

	T x W x L
1 Plane Blank (1)	2 3/4" x 2 3/4" x 8 3/4"
2 Iron/Cap Iron Assembly (1)	1/4" x 1 15/16" x 7 3/8"
3 Wedge (1)	5/8" x 2" x 5 1/4"

saw cut should actually be made a bit above the bedding slope. The surface is then pared down to the bedding slope.) The second cut should be made above the first cut at a distance great enough to accommodate the thickness of the iron, the cap iron and the wedge.

If you're working with an antique tapered iron (piece 2) like the one I'm using here, you can use my measurements and then make a wedge (piece 3) with a thickness that fits into the slots on your plane. If, however, you're using a parallel iron, like those made by Ron Hock, take some thickness measurements of the iron and cap iron assembly and then cut the wedge slots to fit. You can try conventional Stanley-type irons in planes made this way,

but I think they're a bit thin. In either event, you'll want to cut your wedge slots to a thickness that will accommodate the iron you're going to use in your plane. To cut the abutments, try a keyhole saw. Rockler Woodworking and Hardware carries one (item #49684 at 800-279-4441 or www.rockler.com).

Before you make the cuts marking the bottom of the wedge slots, do a little fine-tuning with a paring chisel to make sure the bedding slope is reasonably flat. You can check this by sighting down the throat and comparing the line at the back of the mouth and the line on the top of the plane that marks the upper end of the bedding slope.



Figure 7: Position the mouth just over the edge of the benchtop to support the sole behind it when you're chopping the bottom section of the throat. Otherwise, you risk chopping out sections of the sole.



Figure 8: The detail saw used here to cut the top of a wedge slot can also be used to cut the floor of each wedge. Be careful not to cut too deep and go through the 1/4" sidewall of the wedge: it's the only thing holding the plane body together at this point.



Figure 9: After getting the bedding slope as flat as you can with a wide paring chisel or a float, mark and cut the groove for the head of the machine screw which attaches the cap iron to the iron.

Shaping the wedge

Then cut the floor of each wedge slot with your little saw, as shown in *Figure 8* at left. (I'm actually cutting the top of a wedge slot in that *photo*.) Take care not to cut too deep, because the only thing holding the plane body together is the thin sidewall of each wedge slot, which is only 1/4" thick on the finished plane. Next, use a bevel square to mark the top of the wedge slot on the cheek of each abutment. Cut those with your small saw and clear out the waste from each wedge slot.

The next step in the process is one that traditional plane makers performed either with a wide paring chisel or with a special tool called a float. The wide paring chisel, in the hands of a master plane maker, could quickly create a flat bedding slope. A float — which looks a bit like a rasp with widely separated teeth that run across the full width of the tool — could also be used to remove any irregularities in a nearly finished bedding slope.

When the bedding slope is as flat as you can make it, mark and cut the groove that will accept the head of the machine screw holding the cap iron to the iron, as shown in *Figure 9* (below, left).

Fitting the Mouth and Wedge

I intended for this plane to be a smoother, so I cut a fairly tight mouth, one open a bit less than 1/16" from the cutting edge to the front of the mouth. Although you could theoretically mark the final limits of the mouth before you've bedded the iron, I prefer to finish the bedding slope, then load the iron and move the front edge of the mouth forward a bit at a time until I reach the final placement. If you look closely at *Figure 10* (top right), you can see scorings at either end of the mouth indicating tentative locations of the mouth's front edge.

The final step is to equip your plane with a wedge that will keep the iron/cap iron assembly pressed firmly against the bedding slope while — at the same time — offering no obstruction to the shavings that exit up through the throat and over the sides of the plane.

Begin by cutting out the distinctive two-pronged wedge shape from 5/8" material. Then stand the wedge on its side, and use the band saw to cut the slope that runs from the tips of the wedge's prongs to that part of the wedge that will enter the top of the wedge slots. Cut the wedge a bit heavy so you can later fit it with a plane.

When the wedge is very nearly planed to its final shape, I rub a little pencil lead onto the top of the wedge slots. I then tap the wedge into place atop the iron/cap iron assembly. When I remove the wedge, smudges of pencil lead will indicate where I need to do the final

paring to fit the wedge. If you look closely at *Figure 11* (at right), you'll see one of those smudges. A little later, as shown in *Figure 12* (bottom right), I'm paring away the smudged areas to achieve the final fit.

Take a Test Drive

To set the iron, place the plane — with the sole down — on a flat wood surface. Then insert the iron/cap iron assembly with the cutting iron's bevel down. Allow the iron to slide down the bedding slope until the cutting edge strikes the level surface on which the plane is resting. Then insert the wedge and press it snugly into the wedge slots. It should be tight enough so that you can lift the plane without the iron sliding out. Then hold the plane up to your eye with the toe facing you. Sight along the length of the sole. When the iron is properly set, the cutting edge will be just barely visible.

If no iron is visible, tap the toe of the plane with your plane mallet. This should cause the iron to slide just a bit farther down the bedding slope, despite the wedge you've pushed into place. Since I'm left-handed, I do this while I'm holding the plane in my right hand with two fingers wrapped around the wedge and the iron. Those two fingers will catch the iron in case the tapping knocks it loose.

Now sight along the length of the sole once again. If there is still not enough iron visible, tap the toe again. If there is too much iron showing, tap the heel of the plane with your mallet. Until you've applied the plane to your work, you won't really know if you've exposed the proper amount of cutting edge. The first few times you set your iron you'll be relying on guesswork.

As you work your way through this process, remember to confirm that the edge is exposed a consistent amount across the width of the plane. If it isn't, tap the sides of the iron to bring it into alignment. Once you've achieved what looks like the correct amount of exposure, give the top of the wedge one or two solid raps to set the wedge tightly enough so that you can use the plane without the iron coming loose.

Then apply the plane to a work surface.

If you're lucky, that first time out, your plane will produce a thin, translucent shaving. More likely, you'll have to reset the iron another time or two before it produces the kind of shaving you want.

Kerry Pierce is a master craftsman and well-known woodworking author. His latest book, Authentic Shaker Furniture, is widely available.



Figure 10: The scorings that can be seen in this photo mark possible locations of the mouth's front edge. The author adjusts the location after loading the iron, moving the front edge of the mouth forward a bit at a time until it's correctly placed.



Figure 11: The author cuts a 5/8", two-pronged wedge, creating its slope on the band saw. He rubs pencil lead on top of the wedge slots, taps the two-pronged wedge into place on the assembly, then removes it.



Figure 12: The pencil smudges from the previous step that you see in this photo indicate the location where final paring is required to fit the wedge into the assembly.

Band Saw Blade Anatomy

By Mark Duginske

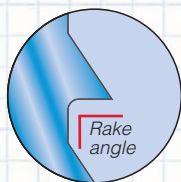
With the unique ability to make straight or curved cuts in wood of all thicknesses, the band saw offers more creative potential than any other woodworking machine, but exploiting its full potential requires picking and adjusting the best blade for a given task. Band saw blades all have the same basic design, but each has its own particular cutting characteristics. To get the best possible use out of a band saw, you have to use the blade that has the characteristics best suited for the given task.

Glossary of Band Saw Blade Terminology

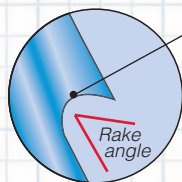
Teeth: Points on blade that do cutting. Teeth on some blades are hardened.

Tooth Point: Cutting or scraping edge; does most work and suffers most wear during sawing process.

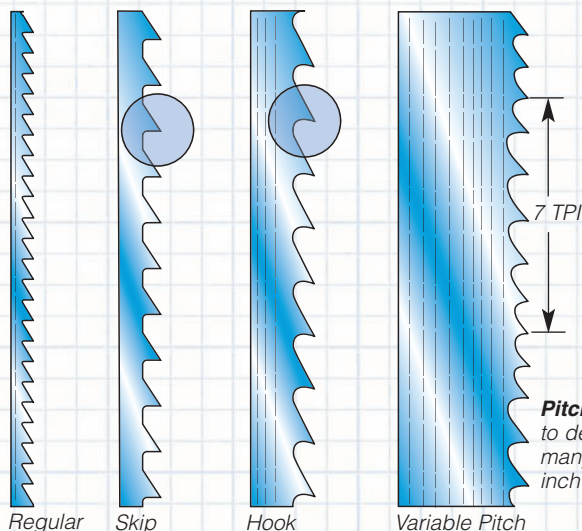
Tooth Spacing: How far apart teeth are. "Fine" refers to a blade with many teeth. "Coarse" refers to a blade with few teeth.



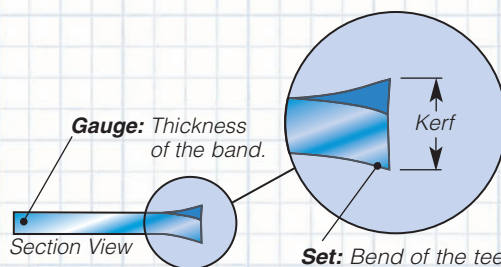
Rake Angle: Angle of tooth face in relationship to the tooth back.



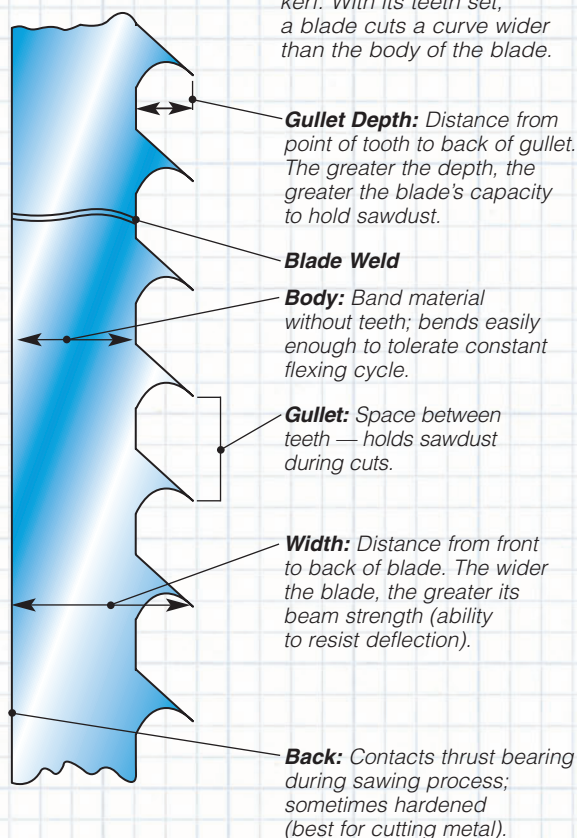
Gullet Corner: Corner of gullet. The sharper the corner, the greater likelihood blade will break prematurely. Gullet corners are usually rounded for this reason. Blades usually break at the gullet corner.



Common band saw blade tooth configurations



Set: Bend of the teeth, measured at widest point of blade. The more set a blade has, the wider the kerf. With its teeth set, a blade cuts a curve wider than the body of the blade.



Gullet Depth: Distance from point of tooth to back of gullet. The greater the depth, the greater the blade's capacity to hold sawdust.

Blade Weld

Body: Band material without teeth; bends easily enough to tolerate constant flexing cycle.

Gullet: Space between teeth — holds sawdust during cuts.

Width: Distance from front to back of blade. The wider the blade, the greater its beam strength (ability to resist deflection).

Back: Contacts thrust bearing during sawing process; sometimes hardened (best for cutting metal).

Review the *glossary* and *drawings* shown below. These are the terms and concepts you need to be familiar with if you're going to start improving your band saw's performance.

Selecting the Right Blade for the Right Reasons

The blade that you choose determines the type of work you can do. A very coarse blade will cut like a chainsaw. A narrow, fine blade will allow you to do intricate scroll work. Choosing the proper blade for

a particular job prolongs blade life and tooth sharpness; using a blade for the wrong application is the best way to abuse it. A number of key factors affect how a blade cuts, starting with the width and moving through pitch, teeth characteristics, set and the blade classification.

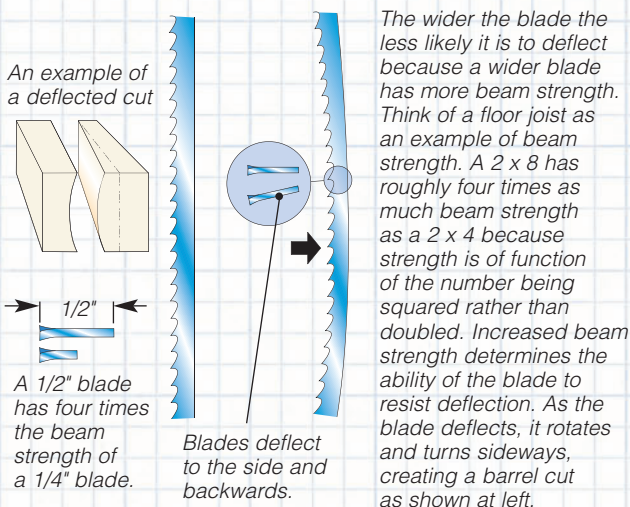
Width: Blades are usually classified according to width, which determines how tight a turn the blade can make. The narrower the blade, the tighter the turn. The wider the blade, the more likely it is to resist deflection.

A 1/2" wide blade .025" thick is the widest blade practical to use on a consumer-grade band saw. Some owners' manuals say you can use a 3/4" blade on a 14" wheel, but these thick blades usually suffer from metal fatigue from bending around too small a radius. Do not use a .032" or .035" blade on a saw that has wheels less than 18" in diameter. Also, the thick blades require more tension, which puts stress on the saw frame, bearings and shafts. A 1/4" blade is the most frequently used blade for general-purpose work.

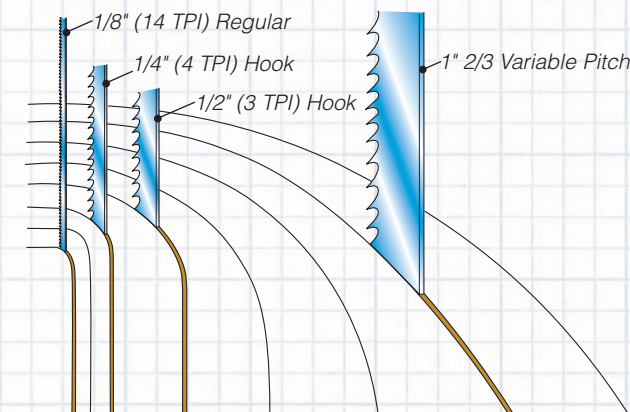
The number and size of the details in your pattern determine the blade width: you should choose as wide a blade as possible, yet one that will make the tightest curves with ease. The radius *chart* below will help you select the right blade for the job.

Today's Shop continues on page 62 ...

Defeating Blade Deflection



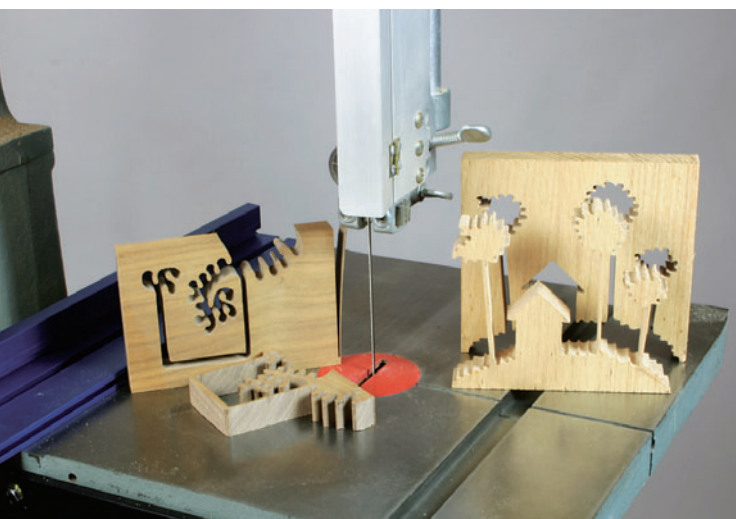
Blade Width Verses Cutting Radius



The factor that determines how tight a radius you can cut on your band saw is the width of the blade.



On my 20" Italian band saw I use a 1" wide carbide tipped blade with a variable tooth spacing pattern. I use it like a table saw for ripping. Resawing with this blade is a dream.



For years, the smallest blade that was available was 1/8", which will make a turn about the size of a pencil eraser, as shown in the top photo. A 1/16" blade had been developed but was discontinued. A new 3/32" blade is now available from Olson Saw. In this photo, you can see the work of a 1/16" blade in the oak piece on the right and a new 3/32" blade on the left. This very small blade requires special nonmetal guide blocks, called "Cool Blocks."

In practice, you'll develop tricks to decide the best blade for the job. For instance, to test if a 3/16" blade would work for a particular curve, place a dime (roughly 5/8") over the pattern. The 3/16" blade can cut a curve bigger than the dime, but not smaller. You can use other everyday items to determine which blade to use. A quarter is the size of the tightest cut that can be made with a 1/4" blade, and a pencil eraser is the size of the tightest turn that you can make with a 1/8" blade.

Pitch (Tooth Size): Pitch is usually given in a number that refers to how many teeth are in one inch of blade. A "coarse" blade has few teeth. A "fine" blade has many teeth. The coarser the blade, the faster the cut.

It is important to match the pitch of the blade to the material being cut. At least three teeth should be in the

material at any given time during the saw cut. A blade with more teeth will give a smoother cut, but one with too many teeth will create problems such as excessive heat and slow cutting. Feedback from the cutting process indicates if a blade has the proper pitch, too fine a pitch, or too coarse a pitch. When you've got the pitch right, your blade will cut quickly and smoothly. The right pitch results in a minimum amount of heat, required feeding pressure and utilized horsepower. Remember: the harder the material, the finer the pitch that is required.

Blade Teeth Characteristics (Form): The teeth are available in one of two shapes. The face of the tooth is either 90° to the body of the blade, called a 0° rake, or it has a slight positive angle, a hook tooth. A blade with 0° rake cuts with a scraping action. This makes a smooth cut, but increases heat caused by the cutting. A blade with hook teeth cuts more aggressively. It makes a rougher cut, but less heat is generated, which means that the blade can be used for a longer period of time. Blades can be broken down into four general groups according to the form of their teeth.

Standard Tooth: Teeth are spaced closely together; 0° rake. Offers a smooth cut especially useful for cutting small details and for cutting across the grain of the wood, because it doesn't tear as it cuts. It is the best blade to use when smoothness is a consideration. When cutting thick stock with a standard tooth blade, be sure to feed the stock slowly.

Skip Tooth: Teeth have a 0° rake, but every other tooth is removed. Because a skip tooth blade is coarse, it cuts much faster, especially when the blade is used to cut with the grain. This blade is best suited for cutting long, gentle curves.

Although it doesn't cut across the grain as well as the standard tooth blade or rip as well as the hook tooth blade, it is often the most widely used blade because it provides the best compromise.

Hook Tooth: The most aggressive blade, with a positive rake angle and the fewest number of teeth. It is particularly efficient at cutting thick stock with the grain. This makes it the best choice for ripping and resawing.

Variable Pitch: The variable pitch blade is the most recently developed blade for the metal cutting industry. The teeth progressively change in size from large to small and back to large again. The design dampens vibration and is often used in the meat cutting industry and for cutting thick stock or resawing.

Tooth Set: The teeth on the band saw are bent or "set" sideways: thus, the saw kerf is wider than the body. Set makes it easier to rotate the workpiece around the

Today's Shop continues on page 64 ...

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A 1/4" blade is the most frequently used blade for general-purpose work. It offers a good compromise between beam strength and the ability to make tight curves. Here, a 1/4" blade with six teeth per inch is used to form a cabriole leg.



blade when creating a curved cut. The side clearance of the blade created by the set of teeth also serves to decrease the friction between the blade and the workpiece on straight cuts. There are three basic set styles:

Alternate Set: Every other tooth is bent in the same direction. A blade with alternate set teeth gives the most cuts per inch, thus the smoothest cut. Standard tooth blades usually have teeth with alternate set, which is well suited to crosscutting.

Raker Set: Similar to alternate set except that some of the teeth, called rakers, are not set, or bent. Rakers clean the middle of the cut, and are used most often on skip and hook tooth blades. The design increases the efficiency of the cutting action but decreases the smoothness of the cut.

Wavy Set: Groups of teeth that are alternately set in opposite directions. This type of set is designed for cutting metal. The variable pitch blade also has a variable or wavy set, which helps to decrease harmonic vibration.

Blade Classifications: Band saw blades are usually classified in three different groups: small, medium, and large, as shown in the *chart* on page 66, but not every blade can be so neatly classified. Having at least one blade from each group on hand will prepare you for almost any situation.

Today's Shop continues on page 66 ...

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Blade Classification Chart

	SMALL	MEDIUM	LARGE
WIDTH	3/32" - 1/8"	3/16" - 3/8"	1/2" +
PITCH	14 - 24 TPI (fine)	4 - 12 TPI (medium)	2 - 4 TPI (coarse)
TOOTH	standard	skip	hook

Testing the Blade

The only real way to be sure that the saw will run correctly is to test it. Check the quality of the cut on scrap which is the same wood and size as your project. Don't be afraid to experiment. Figure out what the saw can do before you start planning what you can do with it.

To use the band saw efficiently, you must be able to tension in correctly. As with developing most types of skill, this takes time, patience and concentration.

Always pay attention to the performance of the blade. A well-adjusted blade will often change. As it heats up from hard use, it will expand. As it expands in length, it decreases in tension. When doing thick sawing for long periods of time, especially when cutting thick and dense wood, you may have to re-tension the blade to compensate for this expansion. If you do increase the tension to maintain performance, it is important that after you have finished sawing, you release the tension and allow the blade to cool and decrease to its original length. If you don't release the tension, you will have an overtensioned blade the next time you use your band saw.

Blade Metallurgy

The blade body and the tip of the tooth are the two parts that suffer the most from wear. When the tip becomes dull, the usable life of the blade is over.

Ideally, band saw teeth should be close to the end of their usable life cycle when the blade body breaks. The body has to be flexible to withstand the constant flexing-straightening cycle. If it is too hard, it will be brittle and break too easily.

The teeth, on the other hand, have to be hard. The harder they are, the more resistant they are to wear and heat. Destructive heat buildup is not usually a problem with the band saw unless it runs for a long period of time. Small blades such as 1/8" or 1/16" blades suffer

Cutting Priorities

To define your cutting priorities, analyze the situation and select a blade according to your requirements. One or two factors will be more important than others. Possible requirements include: speed, smoothness, accuracy, straightness, depth (thick or thin stock), tightness of curves, hardness or softness of material, orientation of grain (crosscutting, ripping or multigrain — both).

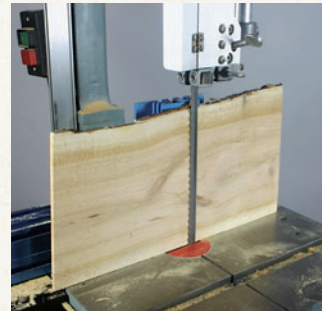
The best blade to use to crosscut, to cut diagonally, and for multigrain cutting is a standard tooth blade. A skip tooth blade also works well on long, gentle curves with the grain, and is often acceptable when making multigrain cuts. A 1/4"-wide skip tooth blade with four to six TPI is usually considered the best all-around blade. A hook tooth blade is good at long curves cut with the grain, and is especially good at straight cuts, such as ripping or resawing. In general, I recommend you select a blade according to the following priorities:

Width: If all of the cuts in your work are straight, use a wide blade for added beam strength. If there are curves, determine blade width by how many and how large they are.

Form: The second most important choice is the tooth form, determined by orientation of the grain. Choosing the tooth form also affects the pitch. The standard tooth form has twice as many teeth as other forms.

Pitch: The tooth spacing is the final consideration. After choosing the width and form, you may not have much say about the blade pitch, unless you have a large selection of blades on hand.

Today's Shop continues on page 68 ...



Heavy-duty jobs: The 1/2" blade has roughly four times as much beam strength as a 1/4" blade. In this sequence, the author uses a 1/2" bi-blade with three teeth per inch (TPI) to first cut a cherry log in half, then in half again, and then (using a high fence) to form small boards.

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Blade Metal Options



At right are the five metallurgical types of blades in 1/2" wide stock. The blades are shown in the order of their durability. From left to right are the carbide, bi-metal, carbon, spring steel hybrid and spring steel.

more from heat buildup because they don't dissipate heat as well as larger blades. The large blade body can absorb heat off of the tooth.

Metals are measured on the Rockwell Hardness Scale Subgroup C (usually abbreviated Rc), so this is the means used to indicate the hardness of band saw blades. The scale measures resistance to indentation. The higher the number, the harder the material. A tooth measuring one point greater than another tooth on the scale is 100% more abrasion-resistant.

The performance of all cutting tools can be measured by ability to cope with heat, shock, abrasion and flexing. Flex life is the ability of the blade to withstand repeated flexing around the band saw wheels without breaking. Resistance to shock is its ability to withstand impact blows caused by the vibrations inherent in cutting.

Abrasion resistance is an inherent characteristic of the material used to make the cutting tool, and the heat treatment to which it may be subjected. Red-heat hardness is a cutting tool's capacity to tolerate the heat generated in the cutting operation without destroying the tool's cutting ability. Abrasion resistance and red-heat hardness are very important in metal cutting and not as important in wood cutting.

Today's Shop continues on page 70 ...

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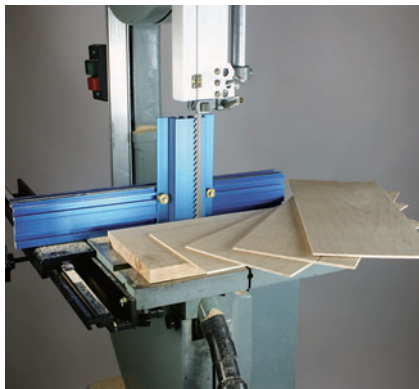
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So How do These Blades Compare?

Surprisingly, they're very similar. For most of my furniture and cabinet work, I use one of five different blades and switch to special-purpose blades only when necessary.

My two narrowest blades are a 3/32" with 24 TPI and a 1/8" with 14 TPI. The 3/32" blade yields an exceptionally smooth cut, and I find it much faster for sawing intricate patterns or open fretwork than a scroll saw. The only weakness is teeth too fine for resinous woods. The 1/8" blade also yields a fairly smooth cut, and saws through pine with less clogging. It's my blade of choice for crosscutting small pieces and sawing fine joinery. This size is also a good choice for fine cuts in harder woods like maple, hickory or exotics. I prefer the standard tooth design, but a 1/8" skip-tooth blade is also available for faster yet rougher cuts, such as for sawing out a curvaceous cabriole leg.

Among medium-width blades, my choices are a 1/4", 4-TPI skip or hook tooth and a 1/4", 6-TPI standard tooth. These two blades provide a wide range of cutting options, and either can be left on the saw as a general-



A 1/2 blade is a good choice for resawing. Coupled with a high fence, as shown here, you can create a flitch of matching pieces of stock.

purpose blade. The 6 TPI is better for a finer finish cut in harder woods, while the 4-TPI skip or hook tooth is better in thicker stock for quickly cutting out curved parts. The 4 TPI can even be used for resawing in a pinch, and it's also my choice for cutting basic joinery, such as tenons. For very hard woods, you might also want a 1/4", 8-TPI standard or skip tooth blade.

My favorite blade for making long, straight cuts and resawing on my 14" band saw is a 1/2", 3 TPI hook tooth. If you are cutting a lot of medium-thick (1 1/4" to 1 1/2") stock, or dense exotics, you may consider selecting

a 4-TPI or 5-TPI hook-tooth blade instead. For your most demanding resawing jobs, such as cutting a board into thin veneer, use a new blade or set aside a sharp 1/2" blade just for resawing. On my 20" Italian saw I use a 1" wide carbide tipped blade with a variable tooth spacing pattern. I use it like a table saw for ripping. Resawing with this blade is a dream — and should be. The price tag is higher than the very best table saw blade.

Mark Duginske is the author of numerous band saw books.

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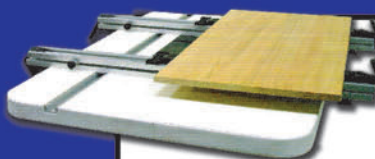
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The C12LSH has a 15-amp belt-driven motor and a 4^{11/16}" aluminum flip fence for cutting crown molding. It sells for about \$650. *For more info, call 800-829-4752 or visit hitachipowertools.com.*



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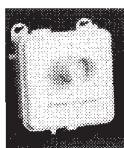
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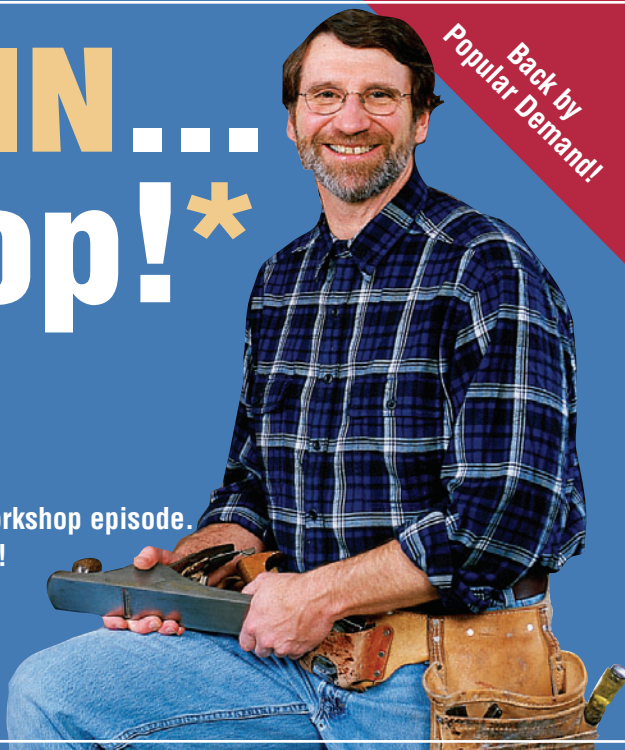
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THE EVER GROWING

By Charlie Self

A few years ago, 8" jointers for the home woodworking shop were fairly uncommon tools, but as the hobby woodworking tool market grows, so do the numbers, and sophistication, of the tools for home woodworkers. This time, there is more to the steak than the sizzle.

An 8" wide jointer allows you to face joint boards 8" wide, a third wider than with a 6" jointer. Fences are larger and sturdier, and the machines are much heavier (in the case of the Powermatic parallelogram 8" jointer, one heckuva lot heavier; it nearly ruins the scales at 630 pounds, unwrapped — the PJ-882 is not a jointer for basement shops with steep stairs).

Added to the larger width possibilities, and longer and

heavier fences, 8" jointers have more mass. Most 6" jointers weigh about 250 pounds, with the long bed models 40 or 50 pounds heavier. Woodtek's standard bed length 8" jointer ships at 458 pounds for both pieces, with at least 65 pounds of crate and carton. With one exception, all of the reviewed machines came in two boxes. The carton holds the base/motor

assembly; the beds are in a wooden crate.

Mass is a good thing with stationary woodworking tools. Mass reduces residual vibration (even after a tune-up). Mass keeps the machine from tipping when you're working with long stock.

When you pay extra for a long bed model 6" jointer, you get tables that are about 66" long (that's for the Powermatic 6" long bed). Woodtek's standard bed 8" jointer is about 66½" long, as is the JET. The longer bed 8" jointers reach 72" in a couple of cases. The monster with the mostest, the Powermatic parallelogram, length



WORLD OF 8" JOINTERS

is an astonishing 83 $\frac{3}{4}$ ". Craftsman offers 71" of bed, while the Delta DJ20/X5 8" jointer comes in at 76 $\frac{1}{2}$ ". Bed length as measured includes not only the two beds, but a space for the knives to rotate, which varies with the size of the cutterhead, and number of knives. Grizzly presents the G0500, with 75" long beds, and a weight of just about 400 pounds undressed.

Weight depends on many things, from the thickness of the tables to the length and thickness of the fence, plus the size of the motor, and the size of the stand in which that motor sits. No 8" jointer I've seen has an open stand as is sometimes the case with lower cost 6" jointers. Support is much better with an enclosed stand, but with the motor down low in the stand, for balance, and the back of the stand closed, it's essential that the motor be a totally enclosed fan cooled model (TEFC). With appropriate inner baffling, which all our reviewed machines have, little in the way of sawdust and chips should get into the motor compartment. Motor weight apart, 8" jointers



Craftsman's, JET's, Powermatic's, and Woodtek's depth of cut indicators. Most of these machines recommend a 1/8" maximum depth of cut. More material can be removed, but with a decreasing quality of cut resulting.



Sometimes, Bigger is Better

are often 2 HP, rather than the 1 HP of the 6" jointers. JET's JJ-8CS; Sears' Craftsman; Shop Fox's W1684 and Delta's DJ20/X5 versions are all 2 HP. Grizzly's G0500 is also 2 HP, while both Powermatic models and the Woodtek come in at 1½ HP.

Craftsman 21703

The Craftsman was the first arrival and was impressive coming out of the box. Compared to a nearby benchtop 6" jointer, it looked like an aircraft carrier, with lots of surface lightly cosmolined for protection during its travels. Milling appearance was excellent. The fence is very large, 40" x 5" tall, and is center-mounted (another universal feature) and flat. I quickly found that there are minor attachment and adjustment differences in these fences, but nothing wildly imaginative until I got to the monster Powermatic. The Craftsman is wired for 230 volts out of the box, and draws nine amperes. It comes with a plug. The motor is not listed as a changeover type. A shipping weight of 480 pounds shrinks down to an in-use weight of about 405 pounds. If movement around the shop is needed, add a good mobile base.

The cutterhead is 3" in diameter, and uses three high-speed-steel (HSS) knives. It is turned by two belts running from the motor to the cutterhead (many of the reviewed machines had dual belts, a good idea once the 1½ HP mark is passed, to increase the power delivered to the cutterhead). Pulleys raise the 3,450 rpm motor speed up to 5,000 rpm at the cutterhead, driving the three knives to 15,000 cuts per minute.

Nice touches: big handwheels for table adjustments; a soft grip handle on the fence to ease movements to precise positioning; positive stops on the fence at 45°

and 90° which speed many setups. The infeed table has a stop at 1/8" (depth of cut) which is the maximum recommended depth of cut for the machine for effective smoothing. Like most large jointers, this one will actually dig 1/2" into softer woods, but the finish will be execrable. Unless you're planing logs, cuts 1/8" deep reduce rough stock to smooth very rapidly.

There is a neat little shelf to hold push blocks, and a 4" dust collection chute (every 8" jointer had a 4" dust chute, but it could be adapted to a larger size). The switch has a large off button in easy position to hit it with a knee to shut down. It's out of the way enough so that accidental 'offs' should be rare.



Craftsman switch setup is excellent. The author likes the easily accessible stop switch.

Second impression, after the size, was the sound or, rather, the lack of sound. The last jointer used in my shop has a universal motor, and is a shrieker, so the much milder sound of this jointer is a solid relief to the ears (always wear hearing protection anyway). Instead of a screaming motor, though, you hear little until the knives start into the wood. At \$1,150, the Craftsman 921703 is a good buy for many woodworkers.

Craftsman
Model: 921703
Price: \$1,150.00
Phone: 800-549-4505
sears.com/craftsman



Table Length: 71"
Fence: 40" x 5"
HP: 2
Motor: 230V; 3,450 rpm
Convertible to 115V: No
Belt Drive: 2 Belts
Weight (approx): 405 lbs
Cutterhead: 3" Dia; 3 knives
CPM: 15,000

Delta
Model: DJ20/X5
Price: \$1,400.00
Phone: 800-438-2486
deltawoodworking.com



Table Length: 76½"
Fence: 35" x 5"
HP: 1½
Motor: 230V; 5,500 rpm
Convertible to 115V: Yes
Belt Drive: 1 Belt
Weight (approx): 394 lbs
Cutterhead: 3⅞" Dia; 3 knives
CPM: 16,500

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Insert Tooling: Simple and Sharp

Delta DJ20/X5

Delta's DJ20 has long been the standard for 8" parallelogram jointers. That standard has gotten a boost with the new Powermatic, largely because of the new fence and new layout of controls, though the DJ20 is still in there swinging — hard. Again, size is a major first impression, even with the shop becoming crowded with machinery. The Delta models are one of the 1½ HP exceptions to the 2 HP rating for the other machines reviewed. Parallelogram jointers offer the tightest clearance to the cutterhead. Levers adjust the tables quickly and accurately. The cutterhead is 3⅜" in diameter and carries three knives. Final rotation speed is 5,500 rpm, for 16,500 cpm. The motor is convertible, 115/230, and is sent,

without a plug, wired for 230 volts. The rabbeting ledge is large, 4" wide by 12" long, a real convenience for the few woodworkers who use this method of making rabbets. Overall table length is 76½", and machine height is a fairly low 32" (most jointers are low, which makes them OK for handling edge jointing of 6" to 8" boards, but a bit rough on a tall woodworker's back when actually face jointing). Delta provides a 5" x 35" fence, center-mounted with center-mount controls at the rear (standard positioning for all). The fence tilts in and out 45° to locked positions, with another positive stop at 90°. Weight is about 394 pounds uncrated and ready for use. Operation is smooth, no alignment was needed, the levers work



Insert tooling refers to small cutting blades attached to the cutterhead. All four edges of the insert are sharp, so you can loosen a screw head and spin the insert 1/4 turn to get a fresh cutting edge. The inserts align automatically.



smoothly, and all adjustments are easy to make, while all locks and stops operated easily, whether being locked or unlocked.

This is another quiet unit, at least until the wood touches the cutters.

The Delta DJ20 has been the 8" jointer of choice, for those who can afford it, for a great many years. It's fighting some stiff competition these days, but still offers quality and performance second only to more costly jointers. The DJ20 sells for very slightly under \$1,400 in a number of places now.



Grizzly

Model: G0500
Price: \$875.00
Phone: 800-523-4777
www.grizzly.com

Table Length: 75"
Fence: 38" x 4" x 1¼"
HP: 2
Motor: 230V; 5,500
Convertible to 115V: Yes
Belt Drive: 2 Belts
Weight (approx): 400 lbs
Cutterhead: 3" Dia; 4 knives
CPM: 22,500

Grizzly G0500

Grizzly presents exceptional value, and the largest choice of jointers in this class. The reviewed G0500 is a long bed that also can be had with a spiral head (tested in an earlier issue), the G0543. Its 75" bed length and low cost at first made the G0543 the lowest cost spiral head jointer on the market. It's still close to the lowest in price (\$1,295), but no longer the clear winner. Grizzly, however, offers six 8" wide jointers ranging from \$625 to \$2,495.

The G0500 is their middle of the line 8" jointer and has a load of fine features. The \$875 price brings a four-knife cutterhead, 3" in diameter, with a motor delivered ready for a plug for 230 volts. As it comes, ready to be set up for 230 volts, the amperage draw is 12. Switch the motor to 115, and the draw is very high, 24 amps. That's a lot of capacity for 115 volts, so 230 is better if at all possible.



JET JJ-8CS

Model:
Price: \$1,100.00
Phone: 800-274-6848
www.jettools.com

Table Length: 66½"
Fence: 38½" x 4"
HP: 2
Motor: 230V; 3,450 rpm
Convertible to 115V: No
Belt Drive: 2 Belts
Weight (approx): 398 lbs
Cutterhead: 3" Dia; 3 knives
CPM: 16,500



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Plug in our zoysia grass and you'll never have to spend money on grass seed again! Since you won't be buying seeds, you won't need to dig and rake – then hope the seeds take root before birds eat them or the next hard rain washes them away.

3 NO NEED TO DIG UP OLD GRASS

Plant Amazoy in old lawn, new ground, whatever. Set 1" square plugs into holes in the soil 1 foot apart, checkerboard style. Plugs spread to drive out old, unwanted growth, weeds included. Easy instructions with your order. If you can put a cork into a bottle, you can plug in Amazoy.

4 FOR SLOPES, PLAY AREAS, AND BARE SPOTS

You can't beat Amazoy as the low cost answer for hard-to-cover spots, play-worn areas, or to end erosion on slopes.

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5 IT STAYS GREEN IN SPITE OF HEAT AND DROUGHT

"The hotter it gets, the better it grows!" Plug-in zoysia thrives in blistering heat, yet it won't winter kill to 30° below zero. It just goes off its green color after killing frosts, begins regaining its green color as temps. in the spring are consistently warm. Of course, this varies with climate.



Thrives from part shade to full sun.

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6 CHOKES OUT CRABGRASS AND WEEDS ALL SUMMER

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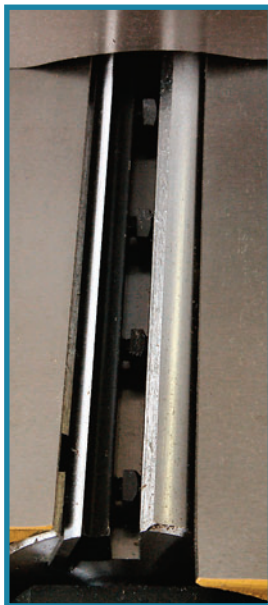
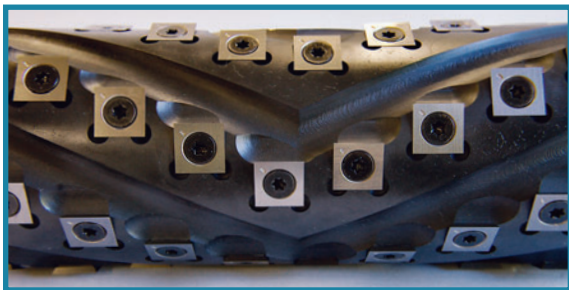
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Cutterheads ...



Insert tooling has come of age for the consumer in these 8" jointers. Woodtek placed their inserts in a unique V pattern (upper left), while Grizzly (lower left) and Shop Fox spiral the length of the cutting head. These insert cutting heads add value and price when compared to the tried and true straight knives (right).

The 489-pound shipping weight indicates an in-use weight of right around 400 pounds. The four-knife cutterhead provides 22,000 cuts per minute with dual belts running up from the motor. Cast wheels make bed movement smooth, easy and accurate. The fence is center-mounted, and large, with positive stops, and locks, at 45° and 90°. It is milled nicely and showed no appreciable deviation from flat on the model I had. Ways are dovetailed, and gibs allow adjustment for wear on the ways. The four HSS knives are 8" x 1/8" x 3/4".

A powder-coated base cabinet shows attention to detail, as well as indicating a desire to provide durability.

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the Heart of a Jointer

On a value basis, AKA bang for the buck, this Grizzly takes the prize. It is well-made, offers features to match most other 8" jointers, and is the lowest cost unit in our review sample. It is not the best jointer in all features, but is well set-up and serviceable.

JET 8" JJ-8CS

JET enters the fray with a model that is better than just OK, with capabilities close to those of the top machines, and quality right at the top level. JET's JJ-8CS ships at 470 pounds, with a fighting trim of 398 pounds. The overall table surface is 9" wide, with a cutterhead width of 8", and a listed depth of cut 1/2" deep.

The table is 66 1/2" long, the cutterhead carries three knives, and there are two belts to transfer power to the cutterhead from the 2 HP, 230-volt-only motor. Positive stops on the fence are at 45° and 90°, with the 45° working right and left. The 4" tall fence is 38 1/2" long.

Cutterhead speed of 5,500 rpm, off a 3,450 rpm motor, produces a 16,500 cpm action.

Handwheels for the table adjustments are heavy, well-made for easy use even with larger adjustments. A nice touch that JET has carried on with many tools for many years: a small can of touchup paint is included with the machine, making it easy to get rid of scratches and scrapes.

The JET uses wheels to adjust both tables; they do a good, quick job, working smoothly. The fence operates cleanly, moves back and forth easily, locks down quickly, and has adjustments very similar to the other fences. I dislike the location of the switch, around to the right end of the machine:

I prefer a switch where you can whack it with a knee to cut the machine off. With this one, you have to lean down and tap it with your right hand.

Priced at about \$1,100, the JET is absolutely a good deal.

Tool Review continues on page 86 ...

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Powermatic 60B

Another staple of the market, the 60B has been second runner to Delta's DJ20 for years, and, at a price of \$1,150, give or take a few bucks, has offered very good value for the money. When you look at the specs, it appears to be light — 263 pounds. Then you check again, and find out that's the weight of the bed: the motor and stand add another 113 pounds, putting the finished product right in there with the crowd (except for its big brother — see *sidebar* for a bit more on big bro). The 3" cutterhead is near the center of 6-foot long tables and has a speed of 7,000 rpm, considerably higher than that of the other tools in the review, for a cpm of 21,000. I like the height, 33", a bit better than that of the shorter units, but shorter woodworkers will likely not share my opinion.

The 60B mounts to its table with drop-through bolts, with nuts added underneath.

The fence is 4³/₄" tall by 38¹/₄" long. It was cleanly milled and flat, and adjusted quite easily.

The 60B uses a single V belt to transfer power from its 2HP, 230-volt motor, unusual among the group, but I had no problems, nor have I heard of any. Table adjustments are a bit different, with a lever doing the fine adjustment for the infeed table, and a handwheel locking that in place. The fine adjustments are made by snugging up the locking handle and then moving the lever against that snugness. When the right setting is reached, the locking handle is tightened securely, and the lock screw is tightened, too. A small handwheel adjusts the outfeed table.

The switch is placed to the lower right, with a protruding red off button that is easily knee-bumped to "off" if needed.

The tool shows some slightly old-fashioned features (very small handwheel on outfeed table, small lever and larger locking handle on infeed table), but remains tops in quality and easy to use. Price is about \$1,150 at discount houses.

Shop Fox W1705 (Spiral Head) and W1684 (HSS Knives)

Shop Fox offers a bright, shiny off-white machine, similar in color to the JET. It offers a 2HP motor, 230 volt only, two belts, and either a spiral cutterhead or a set of four HSS knives (there's an approximate \$400 difference with the spiral cutterhead in place).

Quality is excellent. Overall, the tables on the W1705 and W1684 are 70" long, set at a height of 31¹/₄" from the floor. Fence size is a large 39⁹/₁₆" x 4⁷/₈". Cutterhead speed is 5,500 rpm. That works out to 22,000 cpm for both the W1684 and the four-row spiral head, the W1705.

The center-mounted fence has positive stops at 45° left, 90° and

Shop Fox Model: W1705 W1684 Price: \$1,350.00 \$1,750.00 Phone: 800-840-8420 woodstockinternational.com		Table Length: 70" Fence: 39⁹/₁₆" x 4⁷/₈" HP: 2 Motor: 230V; 3,450 rpm Convertible to 115V: No Belt Drive: 2 Belts Weight (approx): 385 lbs Cutterhead: 3" Dia; 4 knives CPM: 22,000 Spiral Cutterhead: 3" Dia CPM: 22,000
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Powermatic Model: 60B Price: \$1,150.00 Phone: 800-274-6848 www.powermatic.com		Table Length: 72" Fence: 38¹/₄" x 4³/₄" HP: 2 Motor: 230V; 3,450 rpm Convertible to 115V: No Belt Drive: 1 Belt Weight (approx): 376 lbs Cutterhead: 3" Dia; 3 knives CPM: 21,000
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Woodtek® Model: Woodtek® Price: \$920.00 \$1,200.00 (with spiral cutterhead) Phone: 800-545-9663 www.woodworker.com		Table Length: 66¹/₂" Fence: 38" x 3⁷/₈" HP: 1¹/₂ Motor: 115V; 3,450 rpm Convertible to 115V: No Belt Drive: 2 belts Weight (approx): 375 lbs Cutterhead: 3¹/₁₆" Dia; 3 knives Spiral Cutterhead: 3³/₄₀" Dia; 54 cutters in 3 rows CPM: 13,500
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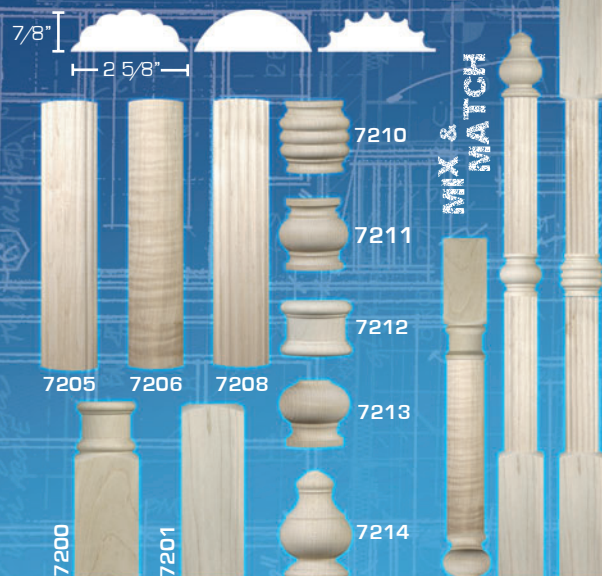
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Good Fences Make for Good ... Jointing

45° right. It moves smoothly on its guide system, and sets and locks in place fairly easily. This fence guide system varies very little from machine to machine, and has been around a good many years, so it is not a surprise to find it working well with all the jointers reviewed. The startups are smooth, and running is a low noise endeavor, as with the rest, until the wood hits the knives, when the din picks up considerably.

Table adjustments are made with 5" diameter handwheels that work smoothly and are sturdy enough to last a really long time. Weight packed bumps 465 pounds, so the final weight is probably in the 375-pound to 385-pound area.

This is one of two machines to have a post-mounted switch, above and behind the fence. I like the startup convenience of switches

mounted at just below eye level, but I'm a bit nervous about the need to remove a hand from the work to shut the machine down. I really prefer keeping my hands in place and bumping the machine off with a knee. But the stalk mount (post, if you prefer) is very preferable to a switch mounted at the end of the machine.

Selling price for the four-knife W1684 is about \$1,350. The spiral cutterhead W1705 will be within spittin' distance of \$400 more.

Woodtek® 8" Jointer

Woodtek® finishes out the list. It's one of three 1½ HP models (two Powermatics), comes wired for 115 volts and draws 20 amperes. The 8-foot power cord and plug are included, and overall table length is 66½", while working



Powermatic 60B

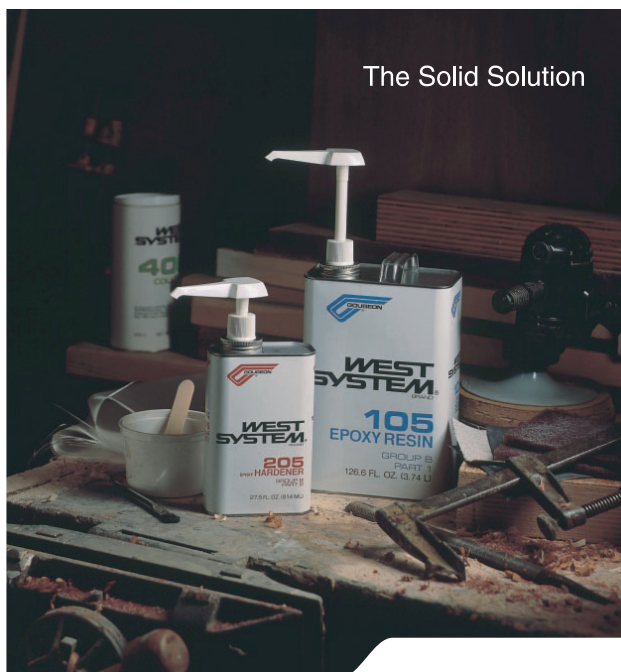


JET JJ-8CS



Woodtek

Not only are the fences for these jointers remarkably similar when it comes to their basic design, but their fence adjustment controls are also more alike than they are different. They bring to mind the old saying, "If it ain't broke, don't fix it."



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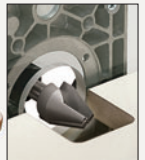
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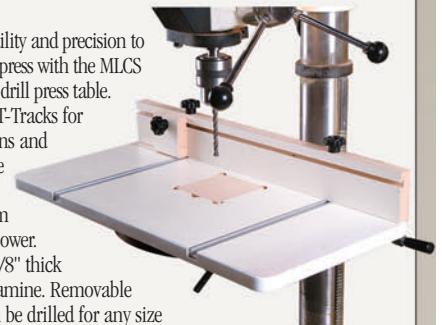
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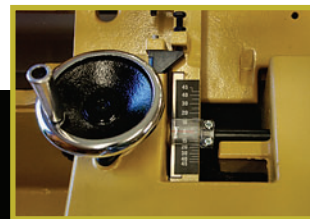
weight is about 375 pounds or a bit less. The Woodtek has a 38" x 3 7/8" fence with tiltability from 0° to 45° in fore and aft. The on/off switch is a standard mechanical type, located to the lower right and around the corner. It has a great paddle switch, large and easy to hit, but makes you bend over or lift your right foot off the ground for an emergency stop.

Adjustment is with heavy-duty 6" diameter handwheels for both tables. With the slightly shorter length of the tables, the wheels do a wonderfully smooth job.

The standard cutterhead, with three knives, runs at 4,500 rpm, giving 13,500 cuts per minute. The HSS knives are 8" x 1/8" x 3/4". The indexable cutterhead uses 54 carbide-tipped inserts, and



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Powermatic's PJ-882

Powermatic's PJ-882 is fairly new to the 8" market, featuring some evolutionary changes. Size is foremost (744 lbs) as well as its fence adjustment. Overall, this machine is a smooth operator.



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Stepping Up to the Big Boys

increases cost the least of any indexable type here, \$280. The cutterhead is designed with a V in the center, with the inserts splayed back from that. Insert changes are easy.

The motor drives two V belts. Base price for the Woodtek® 8" jointer is \$920; the indexable insert model is \$1,200. A box of inserts costs \$28 (10 in a box).

The manual is a problem, with the only clarity in the drawings for belt adjustment and knife replacement and adjustment. The actual exploded parts drawings are fair, but it would be nice to have some clear photos in the body of the manual, as well as fewer misspellings and odd usages of language.

In Conclusion

You can judge from the above that the tools were all — at the very least — satisfactory. Each has a strength or two, while some have many, usually driven by cost. If you want an entry-level 8" jointer, then you can't really beat the Grizzly G0500. The Woodtek spiral head 8" jointer is the lowest in cost for that style of machine. Craftsman's 8" jointer presents numerous good points: the switch, a 115-volt cord and plug as delivered, a rear motor guard panel with rubber sound cushioning and, for the patient, good odds of catching one of Sears' many tool sales.

JET is always a strong contender, while Shop Fox is looking to grab a bit of the upper-end market by

adding plenty of features and high quality. Powermatic — hey, it's still the gold standard, right alongside Delta's DJ20/X5 jointers. These machines are all hard to ignore.

While 8" jointers have been slow coming to the home shop, it's clear that they've finally arrived. Availability and price are now coming within a regular woodworker's price range. On a practical note, you can make much better use of your 12" planer if you can face-joint more than 6" wide stock. So, are you ready to step up to these big boys?



Charlie Self is an award-winning how-to writer and book author who is a regular contributor to the Woodworker's Journal.

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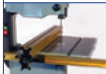
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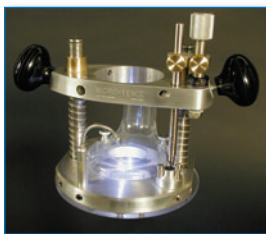
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Gilding: How to Apply Gold Leaf

By Michael Dresdner

Gilding is a term for affixing ultra-thin “leaves” of gold or other metal alloys onto a finished surface. The results can be quite stunning. You have probably seen it most often on picture frames, but it’s not limited to that purpose by any means. It’s not quite as difficult as it looks, but I do recommend practicing on scrap first.

Types of Leaf

Real gold, silver, and copper leaf are sold both in loose sheets and as “patent” leaf, which is affixed to tissue paper for easier handling. Imitation leaf, which is much cheaper, comes in books of loose sheets. All leaf except real gold must be sealed to prevent tarnishing. Synthetic leaf

is thicker and less prone to tear, but real gold moves and bends better. “It is like the difference between silk and cardboard,” says Jennifer Longworth of Sepp Leaf Products. “Real gold leaf almost seems to melt onto complex moldings and carvings.”

Ground

Preparation is critical. The surface must be sealed, perfectly smooth, and defect-free. I used high quality moldings from White River to make the job easier, then applied several coats of “ground,” a thick, pigmented primer that flows well

With a bit of practice and some basic supplies, you can add gilding to your grab bag of finishing techniques. Michael Dresdner walks you through the process.



Stir the ground thoroughly, then flow it on with a soft, natural bristle brush.



Double up sheets of leaf on carvings so the top piece will stick and provide coverage anywhere the bottom sheet breaks or gaps.



Again, when gilding carvings, brush the gilded surface with gold mica powder on a soft brush to hide any voids in the leaf.



Imitation or the Real Thing?

One book of imitation leaf costs \$7 and covers five square feet (\$1.50 per sq. ft.). One book of real gold leaf costs \$35 and covers less than two square feet (\$17 per sq. ft.).

and sands easily. Sand the ground with 600 grit (or P1200) paper and make sure the last coat is smooth. Avoid tack cloths; remove dust with a slightly damp cloth.

Ground comes in yellow, red and gray. Yellow helps hide voids under gold, as does gray under silver leaf. Red provides contrast for distressed, "rubbed through" antique effects.

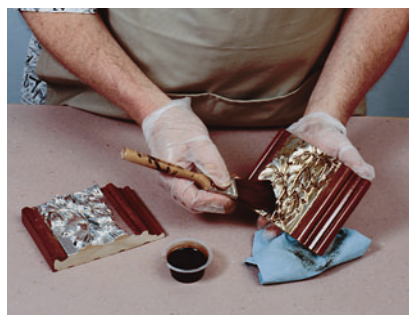
Size

Size is a self-leveling varnish used to glue the leaf onto the surface, and comes in quick and slow versions. Stir it gently, and brush it on smoothly and uniformly with

a soft, natural bristle brush. Absorb puddles in carvings by wiping the bristles on a cloth and re-brushing.

Unlike glue, size must be tacky, but not wet, to grab the leaf. It should feel dry. Quick size tacks in 1 - 3 hours, depending on temperature and humidity, and will stay open for gilding for another 1 - 3 hours. Slow size takes 6 - 8 hours, and stays open another 6 - 8 hours. You can tell when either is ready by dragging your knuckle across the surface. Nothing should come off, and you should hear a slight squeak.

continues on page 98 ...



One technique to enhance the look of gilding is to apply and blend colored glaze with a brush, then wipe off the highlights.



As shown in the examples above, adding a coat of glazing alters the color of leaf and intensifies the contrast of carvings.

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Katrina Camaraderie



I just returned from the town of Slidell, Louisiana, where I was doing volunteer hurricane disaster relief work. At one of the houses we cut down a huge sycamore tree, and as a memento, all the members of our crew signed a slice from the trunk. What is the best way to preserve this slice to prevent splitting and damage? We plan on displaying it in our church for all to see.

Jack Umphre
Nashville, Tennessee



Saturate the slab with Pentacryl, then dry it slowly. The one possible problem is that if it was signed with a water-soluble marker, the signatures may blur. If not, your odds are good that they'll be unaffected. The easiest way is to immerse the slab overnight in Pentacryl. However, if you must brush or mop it on, keep reapplying more until it comes all the way through to the other side. Cover the piece with plastic in between coats, and come back every hour to add more. Then, flip it over and brush more on the other side until it can't absorb any more. It will penetrate approximately one inch per minute in end grain.

Once the slab is saturated, dry it very slowly in a cool, damp room. Ideal drying conditions are 60° F and at least 60 percent relative humidity. Stand the disk on end so that the air gets to both sides equally. Don't have such a room? Get a large cardboard box, like something a washer or dryer might come in, and set it atop the drying slab. That will help keep the moisture in and slow down the drying. Expect it to take about three months per inch of slab thickness.

How much Pentacryl will you need for the job? Use the calculator at <http://www.preservation-solutions.com/woodcalc.php>.

— Michael Dresdner



The Red Cross has a special web page that allows you to direct your donations to specific relief efforts. If you'd like to give money to help Katrina, Rita or Wilma victims, please visit this web site:

<https://give.redcross.org/donation-form.asp?homepagespotlight>



An attractive option: add rub-through highlights. Expose the colored ground for distressed leaf. Use an oil-free 0000 steel wool, such as Liberon.

Gilding

Work in a draft-free area. Bits of gold will cling to anything in the vicinity. Wear cotton gloves; leaf sticks to plastic gloves and tarnishes as a result of skin contact. Roll back the cover paper and slide a leaf onto the surface, pressing it home with a cloth pad. Use doubled sheets on carvings. The top sheet will grab and cover where the bottom sheet's gaps occur. Once the entire piece is gilded, brush off any excess leaf using a soft, clean, natural bristle brush.

Touch up spots where no gold stuck by blowing on the size to warm it, then pressing in leaf scraps, or brush the surface with a soft, clean brush loaded with gold colored mica power. Mica sticks on voids, but brushes off gilded areas. Let the piece dry 24 hours before distressing, glazing or sealing the leaf. For the best results, be sure to seal the leaf with a coat or two of solvent-based finish. Waterbased coatings can dull the shine. (Gilding supplies are available from Rockler Woodworking and Hardware: 800-279-4441 or www.rockler.com)

While it is not for every occasion, gilding is a beautiful "finish" with many possibilities.

Contributing editor Michael Dresdner is the author of The New Wood Finishing Book.

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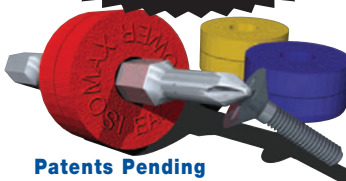
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