

MAKING WOOD TOOLS

with John Wilson

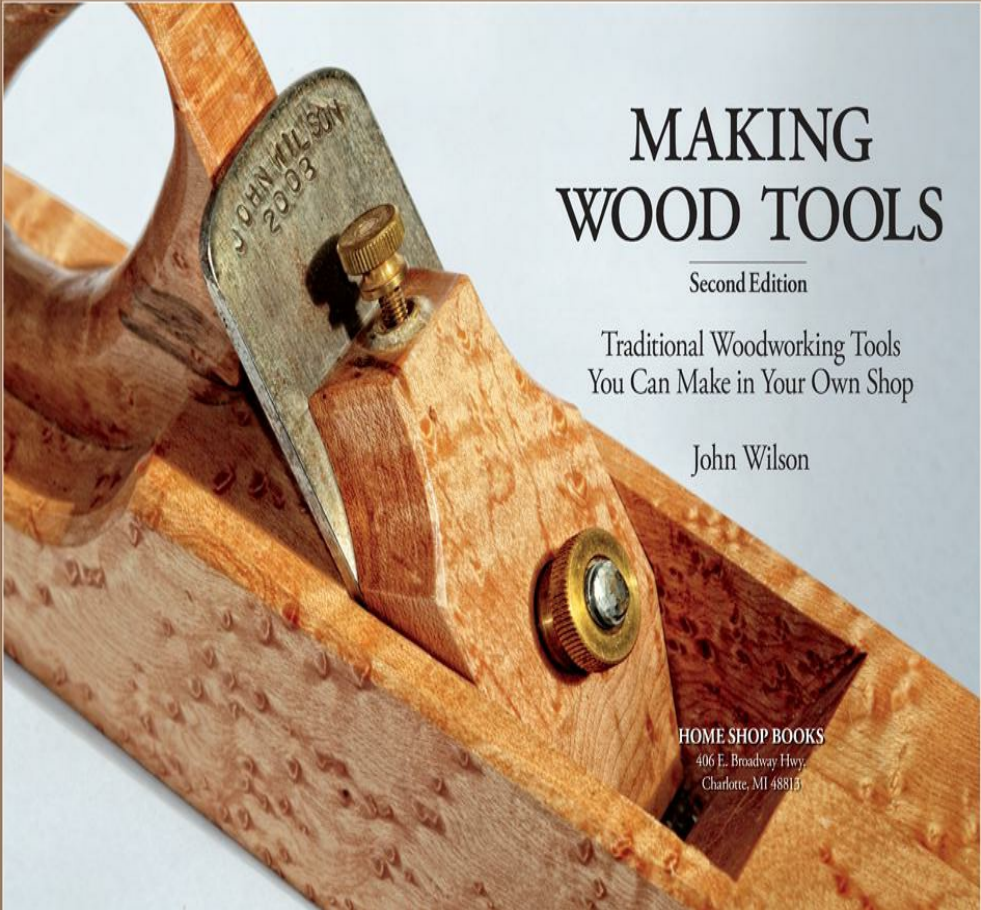
Second Edition

Traditional Woodworking Tools
You Can Make in Your Own Shop

MAKING WOOD TOOLS

Second Edition

JOHN WILSON



MAKING WOOD TOOLS

Second Edition

Traditional Woodworking Tools
You Can Make in Your Own Shop

John Wilson

HOME SHOP BOOKS

406 E. Broadway Hwy.
Charlotte, MI 48813



Contents



[Preface](#)

[Introduction](#)

[1 Making Planes & Other Tools](#)

[Block Plane](#)

[Chisel Plane](#)

[Compass Plane](#)

[Jack Plane](#)

[Shoulder Plane](#)

[Molding Plane](#)

[Scrub Plane](#)

[Large Compass Plane](#)

[Smoothing Plane](#)

[Spokeshave](#)

[Router Plane](#)

[Travisher](#)

[Hand Adze](#)

[Shop Drawknife](#)

[Scrapers](#)

[Cabinetmaker's Bow Saw](#)

[Carving & Layout Knife](#)

[2 Blade Making Methods & Materials](#)

[Tool Steel & Blade Making](#)

[Making Band Saw Blades](#)

[Sharpening Tools](#)

[3 Keeping Tools, Holding Work](#)

[The Home Shop Workbench](#)

[Saw Bench & Shop Stool](#)

[Work Horse for Dovetailing](#)

[Portable Dovetail Vise](#)

[Chisel Holder](#)

[Japanese Tool Box](#)

[Tool Tote](#)

[Carpenter's Tote](#)

[Boat Tote](#)

[4 Design, Layout & Construction](#)

[Design Elements of Wood Planes](#)

[Construction Steps](#)

[My Sources of Supply](#)

[The Home Shop](#)

[About the Author](#)

[Acknowledgements](#)

[Copyright](#)

Preface



Restoring our tool making heritage involves both design and construction of the tool body as well as the making of the blade. This book takes the mystery out of both. Those familiar with the First Edition will find modification to several tools as well as the addition of new ones. The hand adze is improved with added head weight and the spokeshave with a sole plate to protect from wear.

The new shoulder plane lends itself to a mortising plane for hinge gains, a rabbeting plane, and molding hollows and rounds. The simplicity of construction commends it as an undertaking early in your tool making venture into these specialty activities. The large compass plane builds on the scrub plane platform to give you the ability to hollow a Windsor chair seat or similar indent. And if you want a first project in using dimensional tool steel look no farther than the carving and layout knife.

Using O1 dimensional tool steel is new ground for many woodworkers. The availability of a variety of dimensions at reasonable cost is the beginning. Knowing about heat treating is what makes it useful. It is reassuring to learn that O1 tool steel remains as fine a steel as any available for the woodworker. The following is a conversation with a knife maker:

In SEM monographs comparing the grain structure of popular knife steels, O1 had the finest grain structure by far. In practical terms it means the O1 can be made sharper than other steels. Other steels have larger carbides and can make an edge that lasts longer in terms of wear, but can never be as sharp. Another attribute of O1 is that heat treating has more latitude and is easier to get good performance out of low tech processing.

The path to a fine tool can take many routes. What you will find here is my encounter with shop made tools:

- Using means of construction readily available in the wood shop
- Breaking down the construction into understandable steps
- Simplifying each step to ensure success
- Having the journey give you ownership in the fullest sense of a tool you can use.

JOHN WILSON

The Home Shop

P.S. Besides new projects like the Carving & Layout Knife shown below (see [page 142](#)), check out using table salt to “sand” the glue line to prevent clamping slippage on [page 11](#).



Introduction



The projects in this book represent tools you can make. These are not the electric stationary or portable tools prominent in most shops in the 21st century. They are the legacy of the 18th- and 19th-century craftsmen that are being rediscovered by woodworkers today. While the majority of my day is spent with a fractional horsepower electric motor in my hand or turned on before me at a saw, my life in wood is immeasurably enriched by knowing about these tools and knowing where to reach for them when the task calls for it.

Tools represent a state of mind. Their use and range of application depend on the skill of the hands that reach for them and put them to use. Whenever you see an application for another tool, that is the time to make or buy it. This is more than collecting. It is using the tools of the trade.

Don't balk at the price of a hand tool. For some reason we think they should be cheaper than their power equivalent and yet hand tools last immeasurably longer. My grandfather's hand tools are as good and useful today as they were in the 1860s when he learned to use them.

By the 1960s much of this legacy had been lost to Americans, both the mindset to use hand tools and the sources of supply where they could be found. It is one of the success stories of woodworking in our lifetime that this trend was reversed. Forums for good information were started and two of the first were *Fine Woodworking* (1975) and *WoodenBoat* (1974). I remember the first time I received the Garrett Wade catalog. What a feast for the eye and an invitation to explore. Two catalog sources from hand tool designers and manufacturers are very much alive today and come out of this revival: Lie-Nielsen Toolworks (lie-nielsen.com) and Lee Valley Tools/Veritas (leevalley.com). One of the individuals responsible for teaching Americans about their heritage, Tage Frid, is found in "The Home Shop Workbench" on [page 176](#).

Magazines, books, film, schools, and wood shows have proliferated in the period since the beginning of this tool revival. It is said that wood working ranks along with gardening, cooking, and reading as America's favorite pastimes. Magazines like *Popular Woodworking Magazine*, *American Woodworker* and *Wood* serve their interests and serve them well. Ernie Conover, Marc Adams, and Kelly Mehler come to mind as individuals whose knowledge and passion for fine woodworking and tools have led to opening schools. The Home Shop, my own business for supplying craftsmen with oval box supplies, holds classes where all of the tools featured here have been taught, and whose students served as proving ground for what you read.

So why make your own tools? Some do it to save money. Others for the challenge to learn how. I would add that a tool is more than itself, it is a mindset. This makes tool

making an enlightening experience, and a legacy to give your grandchildren.



Making Planes & Other Tools

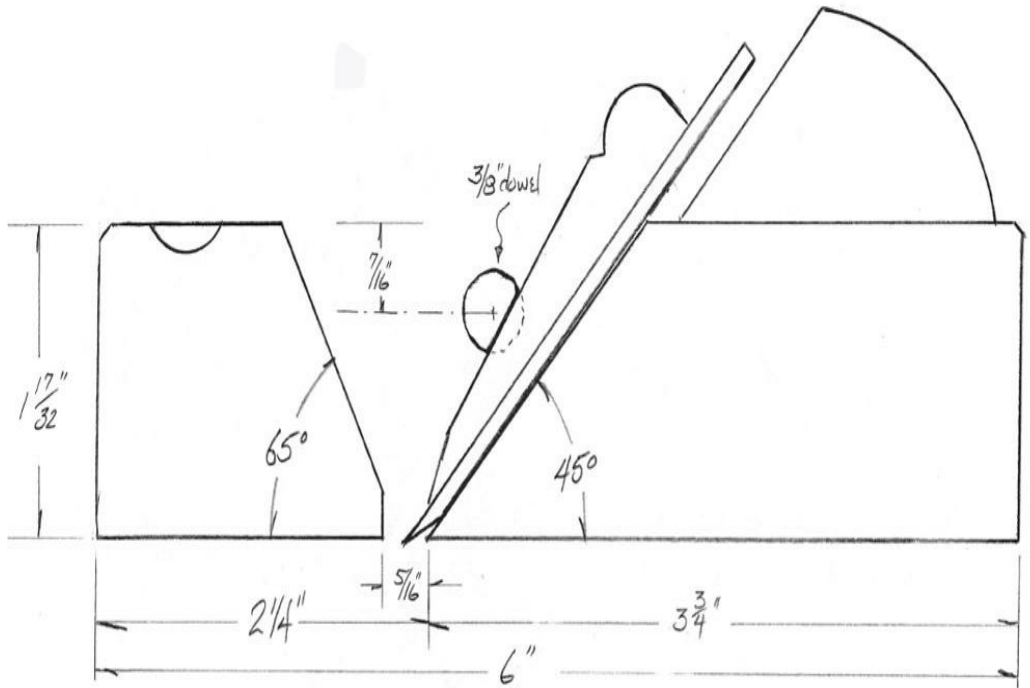
- ☐ [Block Plane](#)
- ☐ [Chisel Plane](#)
- ☐ [Compass Plane](#)
- ☐ [Jack Plane](#)
- ☐ [Shoulder Plane](#)
- ☐ [Molding Plane](#)
- ☐ [Scrub Plane](#)
- ☐ [Large Compass Plane](#)
- ☐ [Smoothing Plane](#)
- ☐ [Spokeshave](#)
- ☐ [Router Plane](#)
- ☐ [Travisher](#)
- ☐ [Hand Adze](#)
- ☐ [Shop Drawknife](#)
- ☐ [Scrapers](#)
- ☐ [Cabinetmaker's Bow Saw](#)
- ☐ [Carving & Layout Knife](#)

Block Plane



The block plane is a good place to start. It is the first woodworking tool for which I can claim ownership. I don't mean ownership in laying out money, but tool ownership of acquired proficiency. After leaving high school I hired on as a carpenter. The uniform was a baggy white coverall with bib and suspender front, ample pockets including a ruler slot at the hip, and a nail apron across the waist. The tools of the trade were a 20 oz. Estwing curved claw hammer slung in a canvas loop in the coverall, an 8" Stanley square which we called a handy-dandy tucked into the ruler slot and used for a myriad of tasks that would make a tool purist flinch, a Lufkin 6' folding rule with sliding brass extension for inside measurements, and a block plane. It resided in the nail apron and was employed for everything from chamfering a shelf board to making a door fit. If a tool is an object to solve a problem, and a wood tool is a way to work wood, then the block plane became my introduction to the world of hand tools.





SIDE VIEW
WOOD BLOCK PLANE

MATERIALS

Core block	^{1,2}	$1\frac{17}{32}'' \times 1\frac{17}{32}'' \times 6''$ walnut
Sides (2)		$\frac{1}{4}'' \times 1\frac{17}{32}'' \times 6''$ maple
Wedge		$\frac{1}{2}'' \times 1\frac{1}{2}''$ walnut stock
Blade		$\frac{1}{8}'' \times 1\frac{1}{2}'' \times 3\frac{1}{2}''$ O1 tool steel
Retainer bar		$\frac{3}{8}''$ hardwood dowel
Alignment		$\frac{1}{4}'' \times 1\frac{7}{8}'' \times 6''$ board and $\frac{3}{16}''$ dowel for 4 – $\frac{1}{2}''$ pins

¹ Plane body wood can be made from a variety of hard, smooth grained species.

² The width of the core block is the blade width plus $\frac{1}{32}''$ to $\frac{1}{16}''$ clearance. The height need not be so precise. However, when I made the core blocks $1\frac{17}{32}'' \times 1\frac{1}{2}''$ instead of $1\frac{17}{32}'' \times 1\frac{17}{32}''$ students sometimes cut and glued the wrong surface ending up with a plane with no blade clearance.

Block Plane Design

A plane is a frame, wooden or metal, for holding a blade much like a chisel. It fits comfortably in hand at a fixed angle for removing shavings from wood. Wood grain runs differently along the side and across the end of a board. The block plane is spoken of as being the tool of choice for working, or blocking, end grain. It does that, and so much more. Being the right size for single handed operation, it gets employed for chamfering edges either side or end grain. For ease of long strokes the length of a board its big brother planes come into play, but the block plane is handy, and kept sharp will serve the craftsman well.

There are several types of block planes sold today. Stanley has two versions of a metal block plane: the standard, No. 9½, and the low angle No. 60½. The low angle block plane is ¼" narrower as well as having a blade bedded to cut at a lower angle of attack as its name implies. The standard angle of a plane blade is 45° which experience has shown to be best for general work. Two attributes of blade angle are ease of operation and smoothness of cut. The first relates to the effort needed to do the planing, the second to the presence of any tear-out of wood fiber on the surface. As a blade is lowered it gets easier to push; as it gets steeper it does a smoother job. Hence, smoothing planes will have a blade angle of 52° or 55° or more rather than the standard 45°.

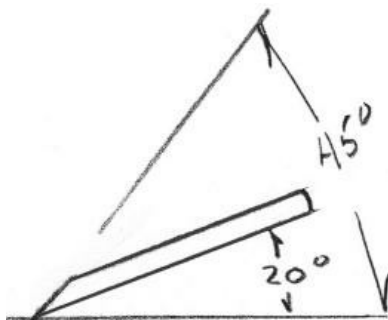
Bezel Up or Down

At first glance, the metal-bodied block planes, either standard or low angle, will appear to be much lower than a bench plane. This is deceptive due to the change in how the blade is placed. The blade's bezel, or bevel angle, in a metal-bodied block plane is up, while other planes have theirs turned down. It is the angle of approach rather than the angle of the whole blade that counts. It is the metal frame of the plane that allows the manufacturer to turn over the blade giving it a lower, and handier profile whether standard or low angle. In the illustrations on [page 6](#), the blade is sharpened at a 25° bevel.

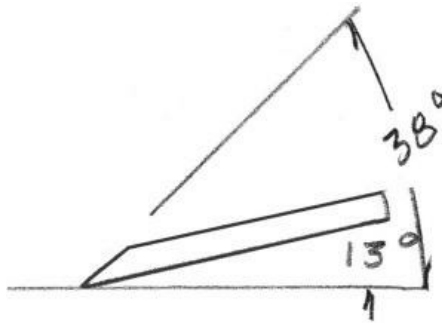
The wood-bodied plane, whether a bench plane or a small block plane, has the blade bezel down. This is because the wood frame can not be shimmed down in the bedding angle as is possible in a metal casting. It is still a small handy tool, but not as much as the low angle Stanley No. 60½ which remains in a class by itself.



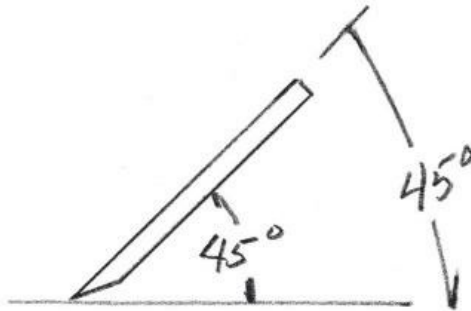
FOUR BLOCK PLANES. Stanley Model No. 9½ (middle) with standard blade angle and No. 60½ (bottom) low angle version. The wood-bodied E. C. Emmerich Co. (top right) and the shop-made model (top left) both have standard 45° angle of blade with the blade bevel down rather than up as the metal-bodied block planes do.



STANLEY NO. 9½ Blade angle 20° plus bezel 25° = 45° Angle of Approach



STANLEY NO. 60½ Blade angle 13° plus bevel 25° = 38° Angle of Approach



WOOD-BODIED BLOCK PLANE Blade angle 45° = 45° Angle of Approach

Teaching Block Plane Making

Not only was the block plane the first tool for which I could claim ownership, but it was the first plane I saw being made in a class. I credit Adolph Peschke for showing me this project. The father of *Woodsmith* editor Don Peschke taught classes in plane making at their family store in St. Louis. I was there to teach oval box making and learned from Adolph. The class has been the flagship event in plane making at the Home Shop since 1987. It set the pattern for every project to follow where students do both the plane construction as well as blade making. Being able to make your own blade gives versatility to project design as well as being a great learning experience.

A wood-bodied plane uses materials and methods you can do in the shop. In this regard it echoes the experience of apprentices for generations in learning their trade, and acquiring the tools needed to be a journeyman. The proportions of the block plane design are similar to the beautifully crafted Primus plane made in Germany and sold by the ECE Company. It also is based on a three-piece body which allows for accurate cutting of blade rest and fore angles that otherwise require difficult chiseling operations in a solid block. The use of a walnut core block and contrasting Birdseye maple cheek pieces introduces a striking appearance. From a durability standpoint, an all-maple body would be more serviceable, as wood-bodied planes do wear on the sole and require periodic

resurfacing if given extended use.

Making the Blade

The blade is made from an O1 tool steel blank $\frac{1}{8} \times 1\frac{1}{2} \times 3\frac{1}{2}$ ". This steel is very serviceable, easily worked in shop conditions (meaning the heat treatment tolerances are forgiving of the imprecise methods we have available) and produces a finished blade as good as any. While other alloys are touted in the market, one well-known producer of plane blades said in conversation that O1 would be his preference for a plane iron intended for this project. The steel is sold in 18" and 36" lengths at a reasonable cost of \$3 per blade. It comes annealed, meaning softer than what results from heat treatment, so shaping and beveling can be accomplished, as well as drilling blades used in the chisel plane described next.

Grinding the blade blank begins with rounding the top end to be comfortable in your hand. I call this style a tombstone end. The bezel or bevel cutting end is ground to an angle of 25°. Leave off grinding while a small flat remains ($\frac{1}{64}$ ") so that the feathered edge will not become carbon starved in heat treatment. Use the belt sander with 80-grit belt to level the bezel. The advantage is the flat surface and control possible with this tool. CAUTION: Sparks can ignite wood dust so clean your work area first. The sander is also used to ease the edges of the sides and tombstone end.

Everyone is fascinated with fire. The bezel end of the blade needs to be heated to 1,450° F to 1,600° F which renders the steel a glowing cherry red. This is a color as seen in the dim interior of the old blacksmith's forge, so be cautious in bright sunlight where it might be overdone. Only a band a half-inch wide at the end need be brought to this temperature. The use of a double tin can used as a heat shield, or elemental furnace, can help get an even glow to the blade end when using a propane or MAPP gas torch which may be more accessible than the intense heat of an acetylene torch used by welders. In either case, the blade when hot is quenched in oil, the whole of the blade immediately submerged in one stroke to avoid warping the blade if dipped slowly, also flame will surround the hot steel at the surface where oxygen can ignite the oil. (Read the section on "Tool Steel & Blade Making," [pages 150-157.](#))

The realignment of the molecular structure produces a blade very hard, yet brittle. Drop a blade at this stage and it is likely to chip. I have had one flake similar to that seen at the edge of glass. To achieve a useful balance between hardness and toughness, the blade is tempered. This involves heating the blade in an oven and holding it for 20 minutes at 350° F to 400° F. This results in an edge with a Rockwell hardness of 60-62 (in contrast to the brittle hard 65 to 70 or the annealed 45) which can hold an edge without chipping.

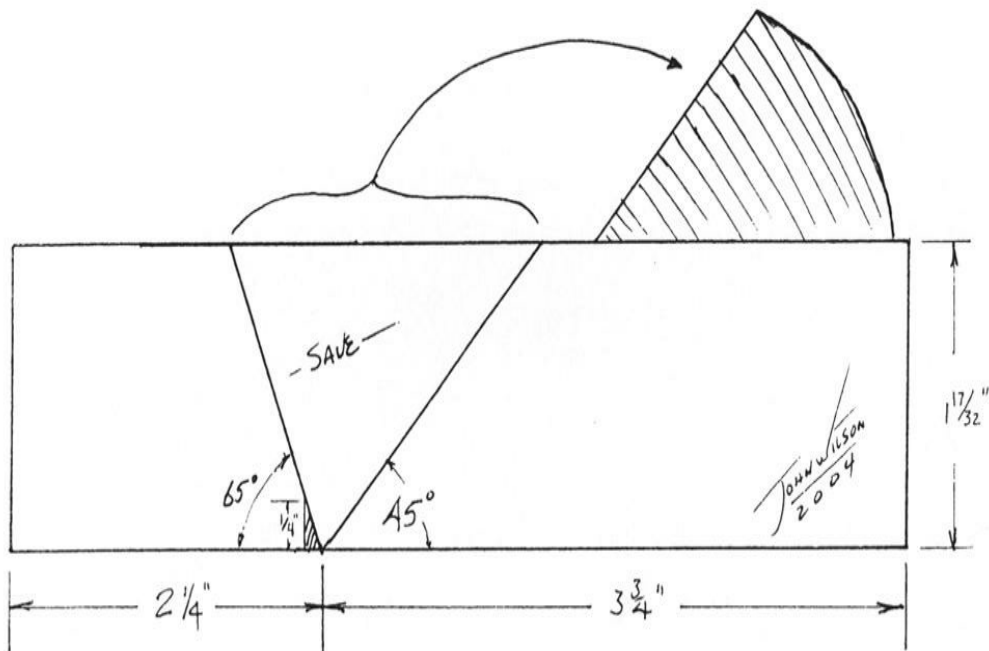
The final sharpening will bring your blade making to an end. Lap the back to ensure it is straight and smooth at the cutting edge. The entire blade can be polished, or left with heat treating colors and slight roughness that can help secure the blade when wedged. Imprint name and date on your creation.



TOOL STEEL IS HEATED to cherry red using a torch and tin can “furnace” to focus heat. Quench in oil to make it hard and brittle. **CAUTION:** Tin can gets hot. Keep away from flammable surfaces.



TEMPERING IN OVEN and holding at 400° F for 20 minutes and cooling slowly will restore needed toughness. Polish and sharpen cutter, but leave reverse side rough to help hold securely in plane.

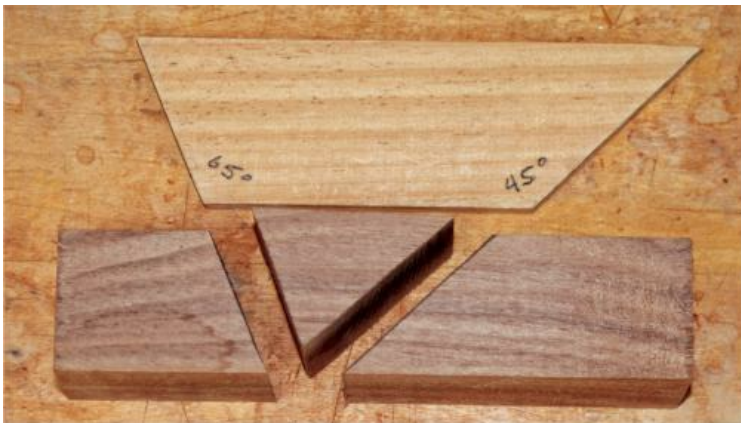


CORE BLOCK

Wood Plane Body

While all this working with fire and grinding, sharpening and heat treatment is going on, the class I teach is also working on the wood plane body. The three-piece body is the key to success for the new toolmaker. Making an inside square hole with a variety of angles is not for beginners, or anyone with the time constraint of a one day tool class. Follow the plan for cutting the core block. Draw the bedding angle 45° and fore angle 65° from a point $2\frac{1}{4}"$ from the front end. This is cut and sanded being sure that the bedding surface especially is flat and square. Save the triangle scrap which will become the heel of the body later. The fore block receives a $\frac{1}{4}"$ wide flat at 90° on the disc sander.

Glue-up of the plane body is accomplished using a thin board $\frac{1}{4}" \times 1\frac{7}{8}" \times 6"$ to keep all pieces aligned. Draw two lines across this board at $2"$ and $2\frac{7}{16}"$ to show where the throat opening comes. The appropriate size of the opening of the mouth is a factor of two opposing conditions. Having the sole close to the blade helps prevent tear-out, while having a mouth too small creates a jamb. The trade-off of these two factors results in an opening that varies from plane maker to plane maker. I believe that the evidence for a very tight mouth being significant in smoothness of cut is unclear. At the same time I know for a fact that a jamb of shavings is a pain.



THE CORE BLOCK IS CUT for the throat opening: 65° forward and 45° for blade angle. The intersect of angles is $\frac{1}{4}$ " from front of the core block. The salvage cut from the throat gives you the piece for the heel block.



THE THREE-PIECE BODY allows for accuracy. The bedding angle shown here is being sanded flat and square to the sides.

Wax the alignment board to prevent glue from adhering. Clamp the fore and bed blocks to the board. Set the cheek pieces alongside the core blocks and lightly pencil the throat opening so you can avoid spreading glue here. Holding the sides in position with a small clamp, drill $\frac{3}{16}$ " holes $\frac{1}{2}$ " deep through sides into middle of both core blocks. [See photo](#) showing this operation for accurately drilling these small pins. When all is ready, glue all surfaces (avoiding throat opening) and drive pins.



AN **ALIGNMENT BOARD** ensures that core blocks are in the right place. Mark $\frac{5}{16}$ " throat opening, then wax the board to prevent glue from sticking.

Clamp pressure can be in your bench vise or you can use four clamps. If you use a bench vise, be sure alignment board and dowel pins do not interfere with clamping pressure. Before glue sets hard, clear out any glue beads from the throat.

The sole and top surfaces are sanded flat and square to the sides. The ends are sanded on a slight arc. Next, sand a chamfer around the top surface and all four corners as shown in the photo of the plane body on [page 10](#). A nice touch is a finger indent in the fore block made with a router core bit chucked into the drill press. Finally, the heel block is made from the throat salvage piece and glued to the bed block leaving $\frac{1}{4}$ " space behind the opening so a hammer can tap the blade.

The wedge is cut at an 8° to 10° angle, any steeper and it pops out under pressure. Bevel the lower end for shavings and carve a crease near the top for ease in removing. The $\frac{3}{8}$ " dowel used for retaining the wedge has a flat filed one-third into the surface

touching the wedge that will increase retention.



SIDES ARE HELD IN PLACE with two $\frac{3}{16}$ " dowel pins each. Drill is marked with masking tape to give $\frac{1}{2}$ "-depth hole. Be sure no slippage happens when drilling the second hole. Here the first pin is set partially without glue to ensure accuracy. Draw a faint pencil line in the throat so that when you spread glue on all surfaces, you can avoid it there.



SQUEEZE IN BENCH VISE. Be sure alignment board and dowel pins do not interfere with pressure to sides. A chisel will clear glue beads from throat when glue skins over.



SHAPING BODY SEQUENCE I – all sides, top and sole flat and square.



SHAPING BODY SEQUENCE II – finish both ends. Give slight arc to end on disc sander.



SHAPING BODY SEQUENCE III – round over where sides meet ends, then chamfer edges as seen in this and other photos.



DIMPLE FORE BLOCK FOR FINGER HOLD using a router core bit chucked into the drill press. Note edge

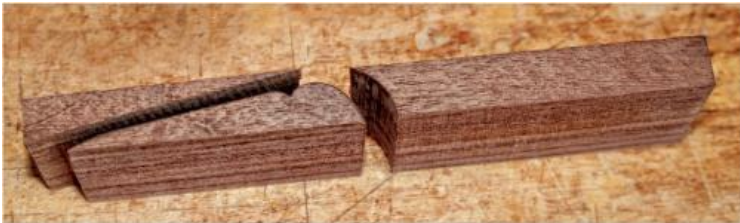
chamfering and corners rounded.

Locating the retainer pin is key to making the wedge work. The center point of the hole for the pin is $\frac{1}{8}$ " ahead of the wedge. The drawing shows the blade in position along with the wedge. Draw a line along the front of the wedge. Then draw a line parallel to and $\frac{7}{16}$ " down from the top edge of the side. The $\frac{3}{8}$ " hole is centered $\frac{1}{8}$ " ahead of the intersect of these lines.

Transfer the points from the inside of the throat to the outside of the plane. Draw a $\frac{7}{16}$ " parallel line outside and carefully eye the wedge position. You can make a simple transferring tool as shown. Drilling both holes independently will ensure location and leave any tear-out inconspicuous on the inside.



HEEL BLOCK IS CUT FROM THROAT SCRAP. Here you see the remainder behind it on the bench. Round over edges. Leave $\frac{1}{4}$ " space between bedding angle and heel block for hammer tapping the blade.



CUT WEDGE from $\frac{1}{2}$ " $\times$ IV2" stock. A 9° wedge is cut from end corner back 3". Sand micro bevel on lower end. Notch top. Sand true.

Final adjustment of wedge position is made by the amount of filing of the flat on the dowel, or by remaking the wedge. After putting blade, wedge, and cross bar together, sand the outside flush. Note that the retainer bar has no glue.

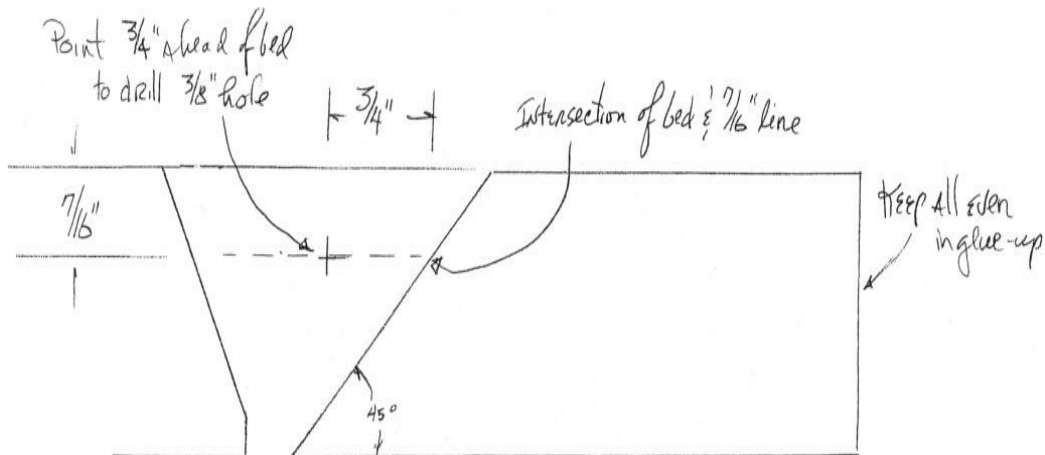
Final adjustments and sharpening will give you ownership of your very own plane. Working with a wedged blade is discussed in the section “Adjusting a Wedged Blade” on [page 13](#).

GLUE-UP LESSONS FOR THE SECOND EDITION

The three-piece plane body takes the mystery out of the various angles of the throat opening. One change in doing the glue-up involves the use of common table salt. How do you prevent these pieces from sliding when clamped? Using more clamps is one way to prevent slippage, and using pegs in each core block is another.

Now you can try a sprinkle of table salt to “sand” the glue line. I learned this from a participant who said it was used in assembling marquetry. A tool collector confirmed this when he told me of two instances where he purchased patternmakers’ tool chests, and pondered over the presence of a small salt cellar amongst the tools. His initial surmise that it was part of the toolmakers’ lunch kit now seems more reasonably explained: They both knew about salting the glue line.

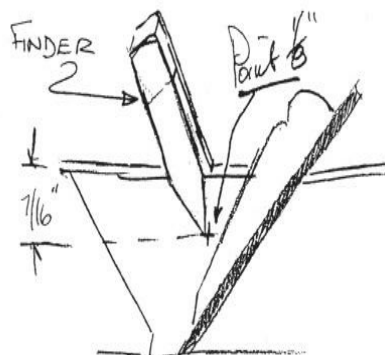
This is the place to add a further suggestion about gluing: Use half as much glue when wetting both surfaces, and start with light pressure. Only after four clamps are in place do you increase pressure all around. And just as with using half the amount of glue, use half as much final pressure. While talking about minimal amounts, use only a few grains of salt to sand the glue line. They will do the job and dissolve in the glue.



LOCATING CROSSBAR HOLES



FINDER





LOCATING THE $\frac{3}{8}$ " DOWEL HOLDING PIN. With blade and wedge in place, mark point $\frac{7}{16}$ " down from the edge and $\frac{1}{8}$ " ahead of the wedge, as shown in the drawing above right. Transfer this point to the outside. A simple toast tong tool is used here.



DRILL $\frac{3}{8}$ " HOLES for dowel pin.



RETAINER PIN IS IN PLACE with wedge tapped snug. Cut pin remainder, then sand both sides flush. Note there is no glue used with this pin.

ADJUSTING A WEDGED BLADE

Tapping a blade and wedge to adjust the shaving size is not part of modern plane culture. The Bailey and Stanley inventions of the last quarter of the 1800s made screw adjustment standard. Planes in this book employ both old and new ways. Looking ahead, the jack plane, chisel plane, and spokeshave have screw mechanisms, while the block plane, compass plane, scrub plane, and smoothing plane rely on a wedge. From a construction standpoint, the wedge is easier to make in shop-built tools. So for this reason alone, becoming familiar with adjusting the wedged blade is worth it. Additionally all those old planes collecting dust in the flea market, or maybe some you already own, can become part of your tool kit.

Advancing the blade is always easier than retracting it, or at least it is more obvious. Just tap the blade and it goes down. Alignment is accomplished the same way with sidewise taps to the blade. But how to reduce shaving size is mysterious. Tapping the sharp end of the blade is not an option. What is done is tapping the plane body, either on the back end or the top surface, to jar loose the wedge, or slightly move the blade back in the throat.

The plane body is first placed on a hardwood surface, and the blade is inserted and wedge engaged to give blade placement resting squarely on the flat surface. Tap the wedge with a light blow. Over-tightening the wedge will complicate adjusting. Sight down the sole and adjust the blade by tapping the blade to extend it. To retract the blade, tap the surface immediately ahead or behind the blade. Tapping the heel of the stock to retract the

blade will provide finer adjustment. Hold the wedge and blade with one hand while tapping both to retain control of a loose blade as well as provide pressure to retract.

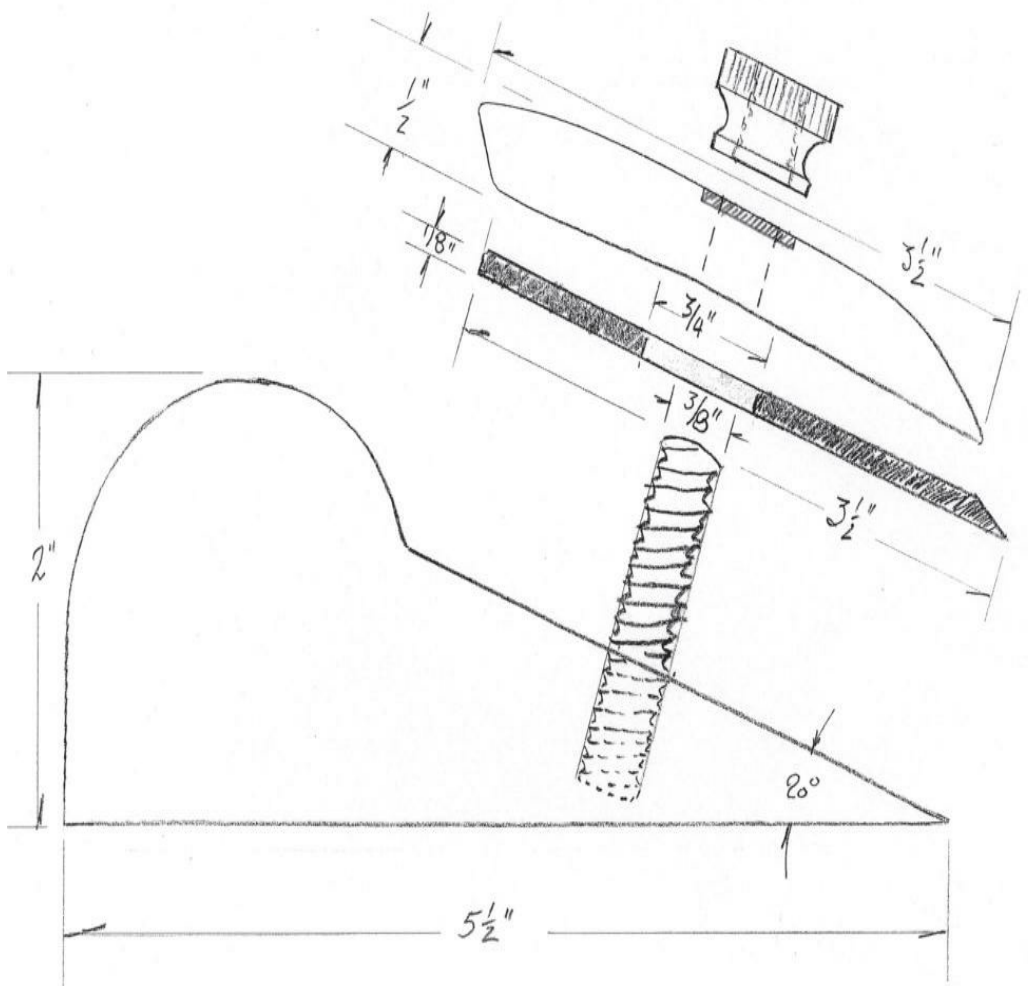
Chisel Plane



A plane is basically a holder for a chisel, keeping the blade at a uniform angle, providing a sole to the board, and affording a handhold to work effectively. A chisel plane is a cut away low angle block plane. The blade is exposed to the plane end making it the most obvious chisel holder. The plane can cut right up to an inside corner, much as one uses a bench chisel, only with more control.



Inspiration for this plane comes from “Wooden Chisel Plane” by Norm Pollack, Fine Woodworking, March/April 2001.



SIDE VIEW
CHISEL PLANE

MATERIALS

Maple plane body	$1\frac{1}{2}" \times 2" \times 5\frac{1}{2}"$	
Maple cap	$\frac{1}{2}" \times 1\frac{1}{2}" \times 3\frac{1}{2}"$	
01 Tool steel blade	$\frac{1}{8}" \times 1\frac{1}{2}" \times 3\frac{1}{2}"$	Reid Supply, 18", #SFS-54006, \$13.42
Steel threaded rod	$\frac{3}{8}" \times 16$	Reid Supply, 36" length, #TR-90, \$3.98

Brass thumb nut $\frac{1}{8}$ "-16

Copper washer

Rotary file (optional)

Reid Supply, #AJ-727, \$3.12

NAPA, #26442, \$.69

Reid Supply, #GAR-60020, \$7.04

The elements of the plane follow directly from the block plane. The blade uses the same 01 tool steel blank $\frac{1}{8}$ " $\times$ $1\frac{1}{2}$ " $\times$ $3\frac{1}{2}$ ". The grinding of the bezel (cutting angle) together with its hardening, tempering, and sharpening is the same. The one difference is the $\frac{3}{8}$ " $\times$ $\frac{3}{4}$ " hole for the screw rod. This is accomplished by drilling two $\frac{3}{8}$ " holes in the annealed steel, and filing away the bridge between the two holes.

The maple plane blank is $1\frac{1}{2}$ " $\times$ 2" $\times$ $5\frac{1}{2}$ ". The hand rest and bedding angle are cut in one piece. Take particular care of the flatness of the blade bed. The blade must rest firmly at both ends. The threaded post is anchored directly into the hard maple block. The hole is the minor dimension of the threads using a $\frac{5}{16}$ " or $\frac{21}{64}$ " drill bit. The $\frac{3}{8}$ " steel rod is clamped in a vise grip plier so that you can turn it into the hole. The threaded rod self-taps itself. Hard maple is a wonderful wood in this regard, anchoring the threaded rod as surely as if a metal insert were used. Once in place, the post is cut off with 1" exposed.



PARTS OF THE CHISEL PLANE. Cut the body from a maple blank $1\frac{1}{2}$ " $\times$ 2" $\times$ $5\frac{1}{2}$ ".



SAND THE BLADE SURFACE FLAT and square to the side. Shape palm end for comfortable grip.

The cap, also of maple, is shaped to hold the blade firmly at both ends. The center is slightly relieved to ensure the pressure is applied along the whole length of the blade. The $\frac{3}{8}$ " hole can be given a wear washer as used in the Jack Plane ([page 43](#)) made from a copper $\frac{5}{8}$ " o.d. $\times$ $\frac{3}{8}$ " i.d. auto part. A $\frac{5}{8}$ " Forstner bit is used to recess a $\frac{1}{16}$ "-deep hole prior to drilling through with the $\frac{3}{8}$ " drill. The washer is a press fit. To be sure, this is an embellishment more than maple needs to do its job for a lifetime. The knurled brass nut completes the cap. To aid in preventing the blade slipping during use, you can glue a piece of emery paper to the bed. This will provide some "tooth" to the surface to help grip the blade firmly. The back surface of the blade should be left rough from the heat treating.

Simple, yet effective, the chisel plane lives up to its name being ready to reach those hard to get to places in the manner of a chisel with control.



THE BLADE IS SIMILAR to that in a block plane, only an elongated hole $\frac{3}{8}" \times \frac{3}{4}"$ is drilled and filed in the annealed steel before hardening. The bridge between holes is being filed. Also useful is a rotary file with burrs on the side of a $\frac{1}{4}"$ shank that chucks into your drill press.



THE THREADED $\frac{3}{4}$ POST is self-tapping with vise grip to turn it. Drill the hole to the minor dimension of the threads, $\frac{5}{16}$ " or $\frac{21}{64}$ ".



THE THREADED ROD is cut 1" long and end filed smooth.



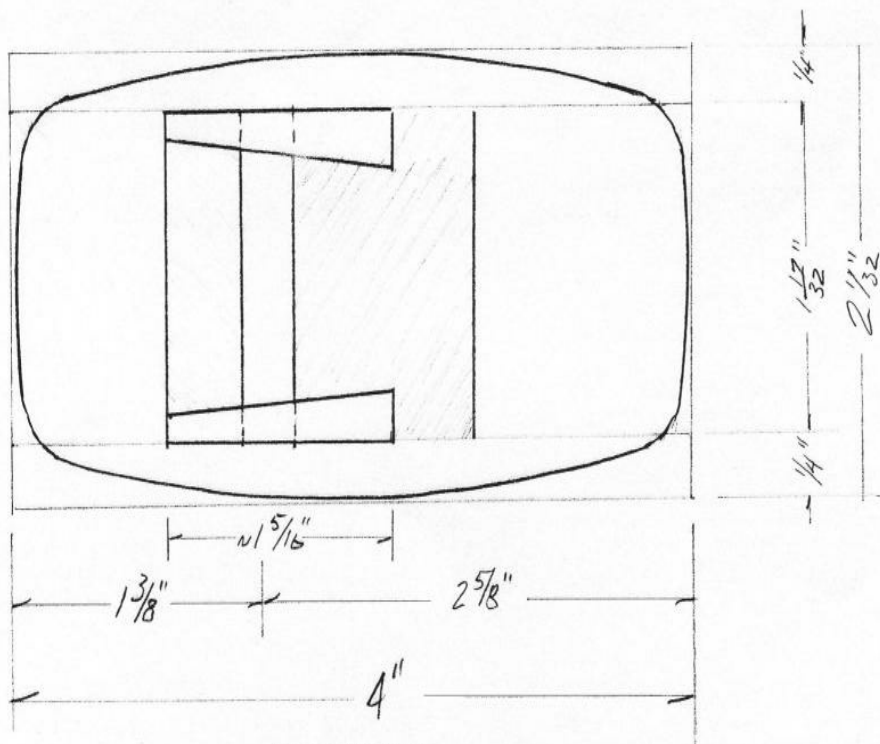
THE CAP is $\frac{1}{2}'' \times 1\frac{1}{2}'' \times 3\frac{1}{4}''$ with a $\frac{3}{8}''$ hole for the post. A nice touch is the copper ware washer shown here being drilled with a $\frac{3}{8}''$ Forstner bit. The washer is in the foreground.

Compass Plane

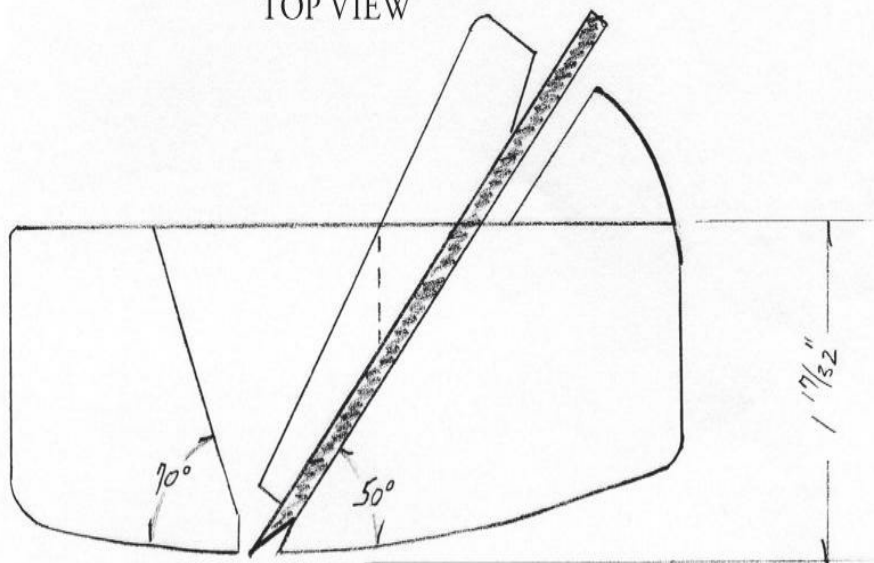


This plane came about in 1986 when I was teaching a class alongside Mike Dunbar's Windsor chair class at Ernie Conover's School. From time to time I would check on progress, or listen in on Mike's directions. Making the characteristic Windsor seat occupied a good deal of students' time, and involved hand tools unique to the trade. One such tool was this compass plane. I happened to have an extra block plane made by the German ECE Company with me, so I borrowed Mike's little compass plane as a model for this cut down block plane.





TOP VIEW



SIDE VIEW

COMPASS PLANE

MATERIALS

Core block	$1\frac{17}{32}'' \times 1\frac{17}{32}'' \times 4''$ maple or similar hardwood
Sides (2)	$\frac{1}{4}'' \times 1\frac{17}{32}'' \times 4''$ maple
Wedge	$\frac{1}{2} \times 1\frac{1}{2}$ maple stock
Abutments	$\frac{1}{4} \times 1\frac{1}{4}''$ tapered maple stock
Alignment & pins	$\frac{1}{4}'' \times 1\frac{7}{8}'' \times 4''$ board, and $\frac{3}{16}''$ dowel pins
Blade	$\frac{1}{8}'' \times 1\frac{1}{2}'' \times 3\frac{1}{4}''$ O1 tool steel

Beyond the Straight Surface

Various tools are used to shape curved surfaces. The straight chisel is curved side to side in the gouge, or bent up in the hollow. The draw knife is curved round to make the inshave or scorp. The plane has three variations to allow the blade to follow a depression. Two of these have short soles with handles to both sides, the spokeshave and the travisher are shown as projects later in this book. The third is the compass plane which modifies the straight soled block plane. Curve the sole front to back and create a hollow used by wheelwrights and coopers. Curve the sole side to side and make a round as in molding planes, or the boat wright's spar plane. Combine both front and back and side to side curves in the sole and you have a compass plane.

Materials for the Compass Plane

This plane's body parts are hardwood and you have several choices. The German plane I first modified had a body of hornbeam with a laminated sole of lignum vitae which is hard and self lubricating. My choice is hard maple. The parts include a core block, two cheek boards, tapered strip for abutments, and wedge. Cut the sides and core to 4" length, but leave abutment and wedge stock longer both for safe cutting of these parts and for spare parts for recutting if needed.

In addition, other wood parts are a $\frac{3}{16}''$ dowel from which to cut four $\frac{1}{2}''$ dowel pins (or see [page 11](#) for salting the glue line), and a piece of $\frac{1}{4}''$ wood $1\frac{7}{8}''$ wide $\times$ 4" long to use as a sole plate to align the two pieces of the core block in gluing.



TWO COMPASS PLANES, one adapted from the German ECE block plane in the background, and parts for making one from scratch. The angles of 70° and 50° are drawn on the core block, which has been cut.

The Blade

The blade is O1 tool steel $\frac{1}{8}'' \times 2'' \times 3\frac{1}{4}''$. We will start by shaping and hardening the blade. You can purchase tool steel at a mill supply in lengths 18" and 36". In its annealed state as it comes to you, it can be cut with a sharp hack saw to length.

The top of the blade is rounded and edges eased for a comfortable grip as this small plane will fit in the palm of your hand. The cutter is curved to a $2\frac{1}{2}''$ arc with a 25° bevel. A grinding wheel will do the major shaping, while my favorite tool for finishing the shape is the belt sander. The surface is flat and the operation is not so prone to overheating as the grinder. Use #80 grit belts that may have a little wear left before being thrown away.

Tool steel has about 1 percent carbon. The molecular structure of the carbon controls the qualities of hardness and ductility. The use of heat and rate of cooling control carbon

grains. Once the blade is shaped, the blade end is heated by a torch to cherry red 1,500° F, then quenched in oil. The heat and rapid cooling will make the blade very hard and brittle. To reduce the hardness somewhat and restore needed toughness to prevent possible chipping, the blade is tempered in an oven to 400° F for 15-30 minutes and allowed to air cool slowly.



HARDENING TOOL STEEL requires heating the blade to cherry red (1,500° F) using a propane torch and double can “furnace” to conserve heat, and quenching in oil.



THE BLADE AS MADE FOR A BLOCK PLANE is given an arc of 2½" radius and a cutting angle of 25°. The belt sander is the tool of choice to achieve an accurate shape without overheating the steel. One partially used 80-grit belt will do the work before it gets thrown away.

Final sharpening is done now. The unhardened top of the blade can be stamped with your name and date as the maker. Leave the surface that will touch the bedding block unpolished as the rough surface from the torch will help keep the blade from slipping.



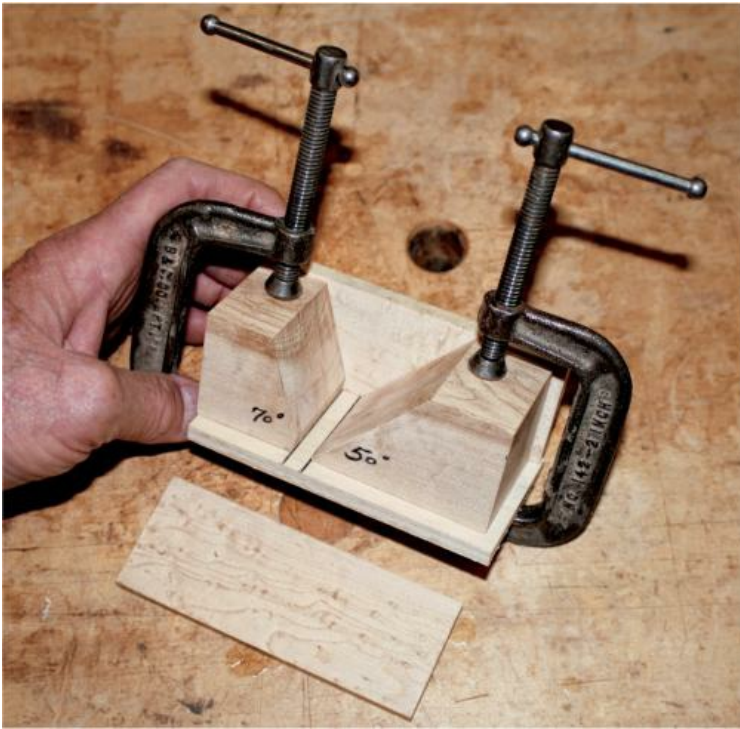
TEMPERING THE BLADE to restore toughness requires oven heating to 400° F. Air cooled slowly.

Angles, Blocks, and Cheeks

Making the wood plane body from a single hardwood block was a task mastered by an apprentice during his four years learning to be a journeyman woodworker. Carving the throat angles are difficult and unforgiving work. The solution to this showstopper task is to divide it into the various parts and reconstitute the parts into a plane.

The core block is 4" long by the width of the tool steel blade plus $\frac{1}{32}$ " adjustment clearance. The blade needs from $\frac{1}{32}$ " to $\frac{1}{16}$ " clearance for lateral adjustment. The two cheek boards are $\frac{1}{4}$ " thick and match the core for width and length. The bedding angle of 50° and the fore angle of 70° are laid out and cut. Sand these surfaces square and flat. The bedding angle especially needs to be flat to hold the blade.

The two blocks are clamped to the sole plate. This plate is marked with the $\frac{1}{4}$ " throat opening and waxed to prevent it from being stuck during glue-up. The two sides are placed in position and drilled for $\frac{3}{16}$ " dowel pins. These pins hold the sides during gluing to prevent slipping under pressure. See that the pins and sole plate do not interfere with the squeezing pressure. Now spread glue on core and sides, and clamp either with several more C-clamps or use the bench vise. Remove any glue beads from the throat, and sand all outside surfaces, keeping them square.



ARRANGING THE PARTS FOR GLUE-UP is aided by the use of a sole plate on which the $\frac{1}{4}$ " gap for the throat is drawn. This will ensure that the opening is correct and the sole flat. The $\frac{1}{4}$ " board is waxed to prevent it from getting stuck in the gluing.

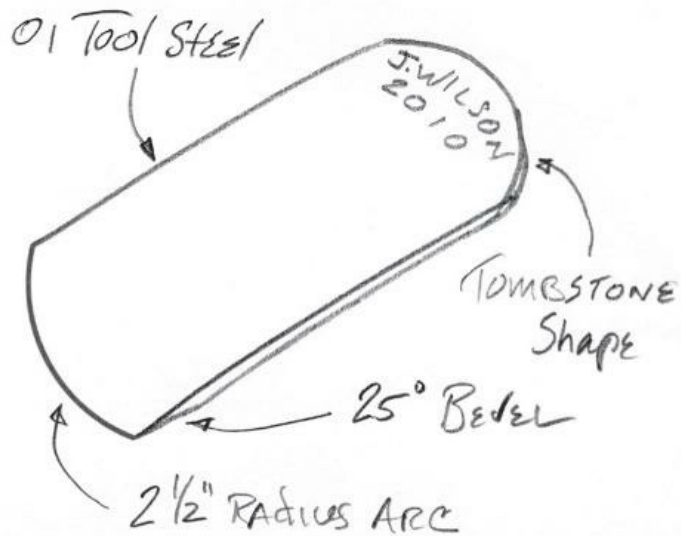
SEQUENCE FOR MAKING BLADE

Shape Blade:

1. Blank $\frac{1}{8}$ " $\times$ $1\frac{1}{2}$ " $\times$ $3\frac{1}{4}$ " .
2. Grind top to shape.
3. Grind 25° bevel with $2\frac{1}{2}$ " radius arc.
4. Use belt sander to finish cutter and fair and ease all edges.

Heat Treating:

1. Harden at 1,500° F, oil quench.
2. Temper 400°, air cool.
3. Stamp name and date.
4. Sharpen and lap cutter.



AS A MEANS OF KEEPING THE SIDE PIECES ALIGNED, small dowel pins anchor the cheek to front and

back core blocks. Two $\frac{3}{16}$ " dowels $\frac{1}{2}$ " long are used for each side. See [page 11](#) for alternative of salting the glue line.



THE SMALL COMPASS PLANE FITS WELL into the bench vise. Be sure that neither the sole plate nor the dowel pins will get in the way of good squeeze pressure.



YELLOW CARPENTER GLUE is removed from the throat opening. Then the plane is sanded square on all outside surfaces.

Curves, Templates, and Compasses

The shape of the plane derives from curves of a compass arc. The several arcs inscribed by a radius of $2\frac{1}{2}$ ", 5" and $7\frac{1}{2}$ " compass will serve to give the curve in the blade, side-to-side, and end-to-end hollow of the sole. Lay out this end-to-end curve first. Note that the center of the template arc is located at the throat opening giving the heel of the sole a bit more up-sweep than the front end. Cut out and sand.

The sides are profiled using the same $7\frac{1}{2}$ " arc template. Mark the arc on each side, and cut and sand. The ends are sanded to shape as you round the corners. Giving the ends a slight arc completes the little boat appearance of this demure plane.

Wedges and Abutments

Here is the key element of the plane: holding the blade. The wedge holds the blade, and the abutments hold the wedge. Elsewhere in the book are other means of doing this such as a dowel pin piercing the cheeks from side to side (block plane) and screw mechanisms anchoring a cap to give pressure (chisel and jack plane). Following the German model made by ECE Company, this plane has abutments to hold both edges of the wedge.



TEMPLATES OF DIFFERENT RADIUS ARCS will guide the shape of the plane and blade. The $7\frac{1}{2}$ " radius arc centered on the throat opening is the first to be drawn, cut, and sanded.



REPEAT THE 7½" ARC layout for the side profile.



THE BELT SANDER FIRST SMOOTHS THE ARC cut on the band saw. Then is used as shown here to round the corners and give a slight arc to the ends.



LIKE A LITTLE BOAT, the plane awaits the addition of the wedge (below) and its abutments (above).

To chisel the throat accurately in one piece presents a challenge that most of us admire but do not want to emulate. However, following the method of the three piece body with its core block and cheek pieces, the abutments can be added as small wedges on either side of the throat.

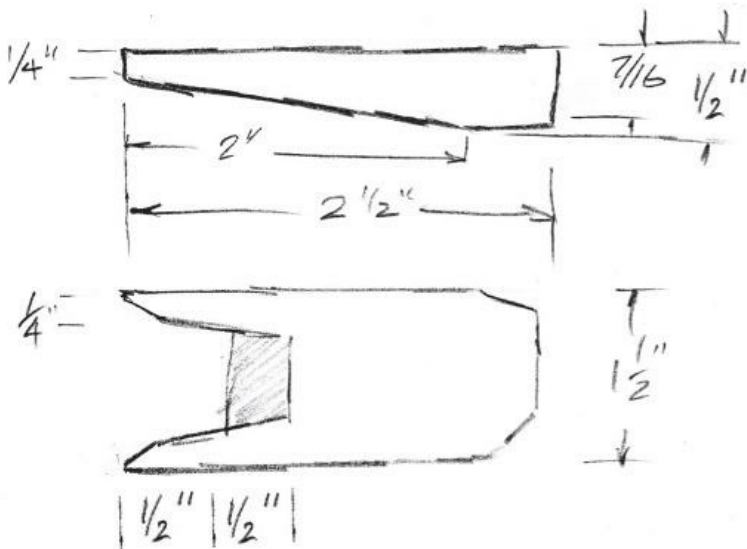
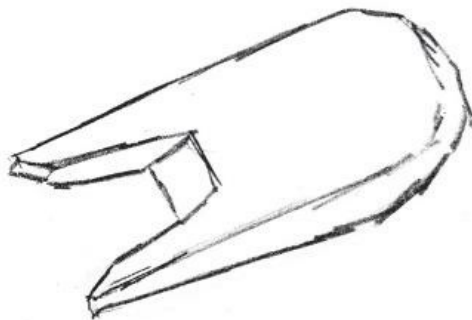
Start by making the wedge. Take a piece of hard maple $\frac{1}{2}'' \times 1\frac{1}{2}''$ long enough to hold safely while shaping, or about 10". The wedge is only $2\frac{1}{2}''$ long, but this gives you a spare in case the first turns out to be a practice piece. Cut a wedge $\frac{1}{4}'' \times 2''$ from the end (see drawing below) and sand smooth and flat. Save the scrap and use it to support the wood for the next step when the wedge is chiseled to give more openness to shavings passing the throat ([see photo](#)).

First make two small saw cuts defining the opening to be chiseled in the end of the wedge. Then C-clamp to bench using the scrap wedge and a protective board to do the chiseling. The top end of the wedge is shaped by a small cut in each corner, the edges rounded on the sander and a small bit of relief sanded on the underside as shown in the drawing below.

The abutment strip is $1\frac{1}{4}''$ wide by a tapering thickness of $\frac{1}{4}''$ on one side and $\frac{1}{8}''$ on the other. On your table saw this is a 5° bevel cut. Again, make it long enough (10-12") to cut safely and provide additional abutments if needed. With the blade and wedge in place, mark the length needed to fill the space ahead of the wedge. The angle at the fore block is 70° .

SEQUENCE FOR MAKING PRIMUS-STYLE WEDGE

1. Stock: $\frac{1}{2}'' \times 1\frac{1}{2}''$, final length $2\frac{1}{2}''$.
2. Cut taper on underside $\frac{1}{4}''$ thick back 2''. Save wedge.
3. Cut both sides of opening back $\frac{1}{2}''$.
4. Chisel slope, use scrap wedge when clamping.
5. Cut wedge to $2\frac{1}{2}''$ length.
6. Cut top profile and sand.
7. Bevel underside of top end $\frac{1}{16}''$ back $\frac{1}{2}''$.





AFTER CUTTING THE WEDGE, the center is chiseled to keep it from being in the way of shavings. Use the scrap cut away in the first angled cut to help support the stock while chisel work goes on. Then cut to length, and make the final shape.

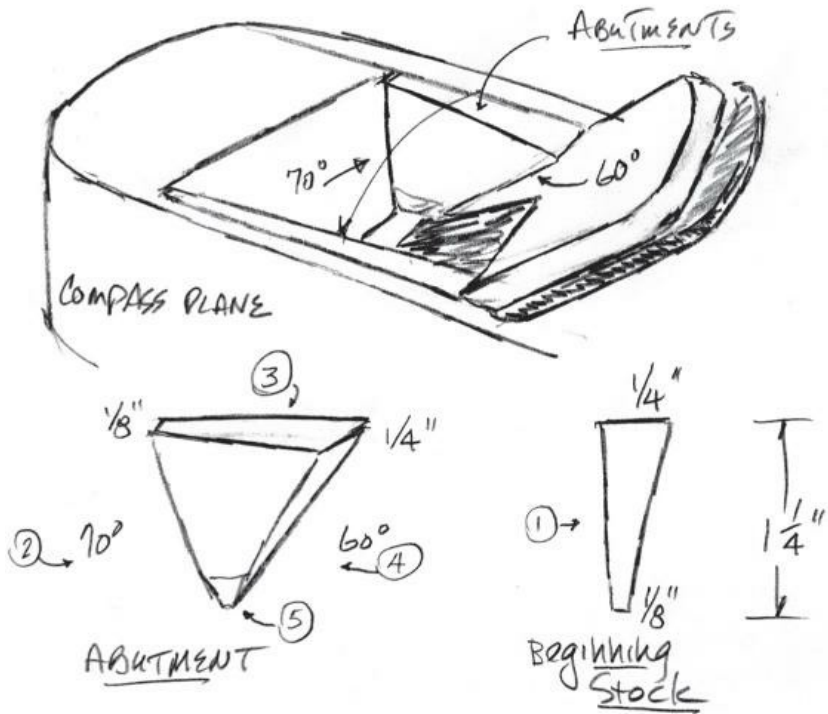


THE WEDGE IS DONE, and in position with the blade. Mark where the abutment comes for length. The angle of 70° will match the fore block. The wedge angle is a combination of the bedding block 50° plus the wedge angle, or about 60° .

SEQUENCE FOR ABUTMENTS

Abutments hold wedges without limiting the throat opening. Complicated in shape, they can be readily made when sequenced in the way shown here. Follow 1 through 5 on drawing. Also see [page 246](#). Shaping both ends will provide you with two mirror image abutments.

1. Beginning stock $1\frac{1}{2}" \times$ approx. 12", tapered thickness $\frac{1}{4}"$ to $\frac{1}{8}"$.
2. Cut both ends 70° .
3. Starting $1\frac{1}{4}"$ from end, sand $\frac{1}{4}"$ thickness to $\frac{1}{8}"$.
4. Cut 60° line for abutment $\frac{1}{8}"$ longer than opening in plane.
5. Sand bottom point taper.



The abutments are graced with tapers forward and down to make the throat opening. The small wedges of wood are hard to hold while sanding, so do this shaping while still attached to the stick. First, cut the 70° end. Next taper the end $\frac{1}{8}"$ thick back $1\frac{1}{4}"$. Then take the measurement for the length of the abutment and add $\frac{1}{8}"$, draw a 60° line and cut it off. Repeat for the second abutment remembering that the two are mirror images of each other, rather than identical. Making an abutment at each end of your stick will give a mirror image.



GETTING THE ABUTMENTS CUT JUST RIGHT may take some trial and error, so have enough of the wedged strip from which they are cut. Besides being wedged from top to bottom, the abutments are tapered forward, and a small feathered end at the bottom. Look at the following photos.

The extra $\frac{1}{8}$ " length will give you room to sand the angles to an exact fit. Any surplus will be above the top of the plane which is sanded flush after gluing. The last move is a touch of sanding to the lower point of the abutment to feather where no shavings can hit.

Once both abutments are made, add glue, place blade and wedge in place, and hand hold in position for a few minutes until the glue achieves some tack, then add thin strips of wood as wedges across the throat opening to press the glue line. When dry, sand the top face flush.



ONCE THE THROAT IS COMPLETE, cut and attach the palm block. It is cut out of the salvage material from the initial core block cut. Glue in place leaving a small space of an $\frac{1}{8}$ " between blade and the block so it won't interfere with hammer tapping adjustments.

Heel Block and Rocker Sanding

The last addition to the body is a small heel block made from the salvage core wood taken out of the throat opening. See the photo on the facing page showing this cut. The heel block glues in place $\frac{1}{8}$ " behind the blade which can be clearly seen in the photo where final sanding is done. Final shaping is done on the sander after glue-up.

The final dimensional shape is to rocker the sole to a 5" arc side-to-side. I find making a preliminary chamfer $\frac{1}{4}$ " wide along both sides of the sole will guide an equal and symmetric amount of sanding. Use a 5" arc template to check progress of the final curve. When that is done, give all hard edges a rounding to make the plane comfortable to your palm.



THE SIDE-TO-SIDE RADIUS OF 5" ARC is given to the sole. Also, all edges are chamfered to make it comfortable to hold.



COMPASS PLANE doing its job.

Jack Plane



The story of this plane goes back 20 years to a chance encounter I had with a Cecil Pierce jack plane. Pierce was a plane maker in Maine who made beautiful planes in his shop for more than 50 years. Just a one-man operation, an avocation really, for the love of the craft. I saw it while on the road in a shop where I was teaching and its shape captivated me. I drew its plan. I was to the point of asking if I might buy it. I was smitten.

That experience stayed in my memory, to surface recently when a group of friends with whom I conduct a tool making session asked for something different. How about a jack plane? I thought of Cecil Pierce's plane.



This project first appeared in Popular Woodworking Magazine #189, April 2011.

Threaded rod 10 – 32
Brass thumb nut $\frac{3}{8}$ " – 16
Brass thumb nuts (2) 10 – 32
Copper washer

Reid Supply, TR-57 (36", \$8.83)
Reid Supply, AJ-727 (\$3.12)
Reid Supply, AJ-718 (\$1.68)
NAPA United, #26442 (\$.69)

OPTIONAL PARTS

Wedge, hardwood $\frac{9}{16}$ " $\times$ 2" $\times$ 4 $\frac{1}{4}$ "

Wedge for 52° pitch $\frac{3}{8}$ " $\times$ 2" $\times$ 3"

Additional $\frac{3}{8}$ " knurled nut for making beveled washer

The Design

There are three basic parts to this plane: the wood body, the cutter, and the adjustment mechanism. The Pierce plane body was what started the venture, and was easiest for a woodworker like myself to make. The design copies his work which is gratefully acknowledged (*Fifty Years a Plane Maker and User*, by Cecil E. Pierce with drawings by Sam Manning, Monmouth Press, Monmouth, Maine, 1992). What is different is the method of construction and the blade holding cap. Instead of starting with a single wood block, I start with three, one core and two side boards.

The blade is made from O1 tool steel available from mill supply catalogs in an 18" length for about \$20, enough for three blades. Two reasons exist for doing your own. One is being able to make exactly the kind of blade needed for the plane. The second is finding out how blades are made. I incorporate blade making in all my tool workshops. I have heard from students that the blade forming and hardening is an epiphany.

The third element is the blade adjustment mechanism. For hundreds of years, shop-made planes, the kind that apprentices made for themselves in the course of becoming a journeyman, had a wedge for holding the blade. Then in the period 1875 to 1900 a series of developments occurred resulting in the modern plane. The ability to advance and retract the blade by screw mechanism rather than tapping a wedge, won over the market and made us unfamiliar with working any wedged plane.



THE ELEMENTS OF A JACK PLANE WITH DOUBLE SCREW ADJUSTMENT: Razee plane body, cap with holding and adjustment screws, blade with rest button, and 52° wedge for optional smoothing plane pitch.



PARTS OF THE JACK PLANE: Handle with $\frac{3}{4}$ " holes prior to cutting, blade, cap parts, core block and sides, angle pattern, lead screw and thumb nut.

What follows is a description of the three parts of the plane: the blade, the body, and the adjustable pressure cap. See for yourself if a shop-made plane that looks good, adjusts easily, and cuts well is something you can make.

The Plane Iron

The plane iron $\frac{1}{8}" \times 2" \times 5\frac{1}{2}"$ is cut from O1 tool steel. It makes a fine blade that has parameters for hardening and tempering well suited to conditions in the wood shop. An 18" length will yield three blanks which might encourage you to plan on making several planes. Come to think of it, threaded rod comes in 36" lengths, and it's easier to buy the brass knurled nuts and studs in quantity at one time, which saves on shipping.

Tool steel comes in an annealed state softer than it will be later after heat treating. You can saw, drill, and file it as it has a Rockwell 45 hardness. Above Rockwell 55 such tools cannot cut steel. However, it is not as soft as mild steel, so get a new blade for your hack saw before attempting it.



MAKING THE BLADE BEGINS with a $\frac{1}{4}$ " slot and hole for rest button. The 25° angle is ground and the top rounded.

The main screw is a $\frac{3}{8}$ " threaded post with a brass knurled nut. You need to drill a slot in your blade by drilling two $\frac{25}{64}$ " holes, not quite touching, joined with files to complete the slot. Another tool for enlarging a hole is called a rotary file (Reid Supply #GAR-60020, \$7.04) a $\frac{1}{4}$ " bit with carbide burrs along its side to enlarge a hole. The hole for the stud, called a rest button, is drilled into the blade using a $\frac{3}{16}$ " drill.

The tombstone style of the top end is filed after grinding to smooth and ease its edges. The cutting end is ground to 25° . Do not be alarmed by producing some blueing indicative of overheating the steel in ordinary sharpening activities, as the whole cutting end will be heat treated.

One of my favorite tools for sharpening blades is the woodworkers' $4" \times 36"$ belt sander. This is a benchtop version of the $6" \times 48"$ floor model which can work just as well. I save my belts after working wood to use for steel. A new belt works best, but you can get one blade sharpening from a used belt. Use the belt sander after using a grinding wheel as it will give a perfectly flat surface. The belt is much less likely to blue the blade than grinding. Safety point: clean out wood dust before doing this to avoid sparks setting fire.

Heat treating a tool steel blade is a mysterious venture for the uninitiated, so take this opportunity to lift the veil. First, it is helpful to know some hardness/brittleness characteristics of the O1 steel. Soft and workable is what the annealed state is at Rockwell 45. The crystalline structure of the steel is changed by heating above $1,450^\circ \text{F}$ followed by an oil quench. The heating is done by either a welder's torch or a handy propane torch whose flame is large enough to heat a $2"$ wide blade. (BenzOmatic torches series JT, BT and TS all have a brass regulator valve with a side mounted burner tube that deliver enough flame to do the job. A "pencil point" torch does not deliver enough heat. MAPP gas delivers a hotter flame than propane.)

How do you know you have heated the steel to the right temperature? The end should glow with a medium red appearance when viewed in shaded light, not full sunlight. The quench is a full immersion, rapidly dipped to avoid warping the steel. The oil can be motor oil, new or used. However, soy oil is better, as it does not smoke. Outside this doesn't matter, but in the shop motor oil quench leaves a blue haze every time you use it.



HARDEN THE CUTTER using torch and furnace made of nested tin cans. Quench when red hot. The 2" × 2" sheet metal with hole slid over the end of the torch protects the plastic from reflected heat.

The blade has a gray appearance where it is heated, and the steel is hard to Rockwell 75. If you have any concern about whether or not you have the heat and quench right, run a file lightly along the edge. Where it is still annealed, the file will bite into the steel. Where it is hard, it will glide over it.

Along with hardness goes brittleness. Rockwell 75 steel will actually shatter when struck by a hammer. Tempering a blade will reduce hardness and restore the necessary toughness. The hardness range for a plane iron is around 62. A second operation, called tempering, to moderately heat and slowly cool the steel will accomplish this.

When you purchase tool steel, the wrapper often gives you information on tempering temperature with resulting hardness. The Starrett brand O1 steel indicates that for their product heating to 350° F - 400° F for 30 minutes to an hour will result in 62–64 hardness; 400° F - 450° F results in 58–60 hardness. Anything over that will be too soft to hold an edge. (A kitchen toaster oven works, so does your stove oven.) If you have any doubt on the accuracy of the toaster or oven thermostat, purchase an oven thermometer (under \$5) to be sure. Set the blade in the oven for one hour and allow to

air cool.

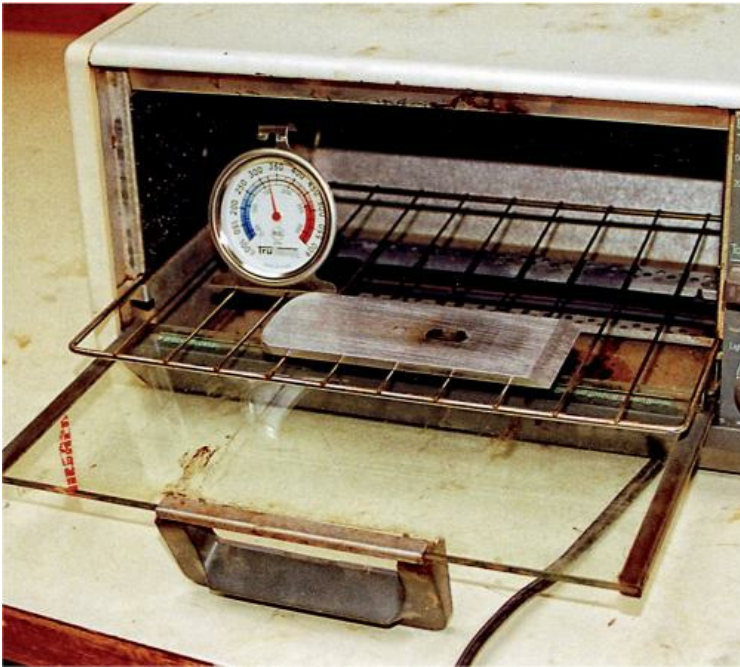
Now that the blade is heat treated you can finish sharpening the bevel and lapping the back. The rest button is ground at a 15° angle to provide a landing for the adjustment rod. It is ground flush with the back of the blade. A drop of CA glue will set it permanently in place.

The Wood Plane Body

The wood for this plane can be selected from a range of hardwoods. Beech was traditionally used in Europe, but I suspect that hard maple would have been used as much as red beech if they had it. Hard maple is the same as sugar maple of maple syrup fame, and is an American tree. Other woods like white oak, walnut, and hickory would do, but hard maple is my first choice.

The challenge for any plane maker is accurately forming the throat or plane pocket. The two elements are the angle of the iron, and the opening of the sole which determines the gap ahead of the blade. Achieving compound angles within the pocket, and doing so without going beyond any of the respective surfaces is the challenge. Besides cutting into a single block of wood, two-piece and three-piece plane body methods are possible.

You can follow Cecil Pierce as he writes about cutting the throat in a single piece plane body. Accurate layout, drilling preliminary holes, chipping and paring with chisels, the use of rasps, and an ingenious range of scrapers, mostly homemade, are his arsenal in this task. Oh, and patience. He takes two or three evenings absorbed in the task. As he begins cutting, listen to his words:



TEMPER IN TOASTER OVEN for 30 minutes at 350° - 400° F. This restores necessary toughness to the tool steel while resulting in 62 Rockwell hardness.

After a few days away from the project, I am back at work. Even though this will be my umpteenth plane, I have the enthusiasm of a boy for the job. The wood is so beautiful, the tools so adaptable, the knowledge of pitfalls by now so infinite, and the product so rare in this high-tech age, that there could be no more fertile seed for enthusiasm.

While my own plane body takes another path, I cannot but embrace the moment that goes on at his bench. Find your own voice, too. The three-piece plane body design has the advantage of speeding up the process and reducing the skill level necessary for a successful result. Both of these are important to my goal of teaching plane making in weekend workshops where time and experience are limited. One has to respect a man of Pierce's experience when he speaks of "the knowledge of pitfalls by now so infinite," so let me describe to you an alternative.

The two-piece or three-piece plane body eliminates the inside-square-hole challenge. Making a two-piece plane is described by Bud McIntosh (*WoodenBoat*, March 1986). The three-piece plane is described by James Krenov in *The Fine Art of Cabinet Making* (1979) [pp. 80-100](#). In both cases, the plane pocket is exposed, rendered into its needed form, and reconstituted with glue.

The drawing on [page 34](#) shows you the basics. The bedding angle is 45°, the foreward

face is 60° . The width of the pocket is the blade width plus small amount for lateral adjustment. Accurate dimensioning the core block provides the $\frac{1}{32}$ " used by Pierce.

Assemble The Three-Piece Body

Starting with a core block $2\frac{1}{32}" \times 2\frac{1}{32}" \times 12\frac{1}{2}"$ draw a line $3\frac{5}{8}"$ from the end. Ahead of this line mark and cut a 60° angle, after it a 45° sloped block. These surfaces must be square and flat. A small flat is made on the 60° block $\frac{3}{16}"$ back from the sharp edge. The two side pieces are $\frac{5}{16}" \times 2\frac{1}{32}" \times 12\frac{1}{2}"$.

An alignment board will aid in glue-up. A scrap of $\frac{1}{4}"$ plywood $2\frac{1}{2}" \times 12\frac{1}{2}"$ is waxed. Mark on this a line square across at $3\frac{3}{4}"$ from one end. A second line $\frac{5}{16}"$ apart defines the opening of the throat. Prepare for glue-up by clamping the two core blocks to the alignment board. Spread glue on all surfaces avoiding the throat opening on each side board. The alignment board allows you to keep the right throat opening and the even alignment of core and sides.

Two $\frac{3}{16}" \times \frac{1}{2}"$ -long dowel pins are drilled in each side, and driven into the plane. Cut off flush. Squeeze the plane in a bench vise or use clamps. Check that all parts touch the alignment board, and all glue lines are tight.

When the glue is dry, sand the top and bottom of the plane box. Keep this sanding minimal to avoid getting the box thinner or out of square. Remove any glue beads from the throat. File the 45° blade block slightly to remove the sharp edge. Check the fitting of the blade for throat opening and lying well supported and flat to the block surface. Correct any irregularities now.



THREE-PIECE BODY: By dividing the plane box into three, the angles of the blade pocket can be easily and accurately made: 45° bedding angle, 60° fore angle, and one small 90° cut in the fore block.



DOWEL PIN BOTH SIDES. Two $\frac{3}{16}$ " pins on both sides will prevent movement under pressure. While two clamps hold the core blocks to the alignment board, drill $\frac{1}{2}$ "-deep holes for the pins which are cut off flush. (See [page 11](#) for alternative of salting glue line instead of pins.) Clamping can be done in the bench vise like the one here which is 12" wide, or with clamps.

Blade Adjustment Methods

You can choose one of two ways to hold the blade. The time honored wedge is still effective and the simplest to construct. A wedge $4\frac{1}{4}$ " long, cut on a 10° angle, engages a $\frac{3}{8}$ " dowel pin. This pin has a flat one-third of its thickness where it touches the wedge, and is free to rotate because no glue is used. The photo at right shows a strike button placed on the fore block. This is one inch of $\frac{3}{4}$ " hardwood dowel. Glue this piece in a hole to prevent marking the plane when tapping the blade free.

The alternative to a wedge for setting the blade is the double screw mechanism. The main screw is a $\frac{3}{8}$ " threaded post and brass knurled thumb nut. The second screw is set into the cap and bears on a rest button set in the blade. This secondary screw is both for adjustment and for holding the blade in use to prevent it slipping out of adjustment. Using flat milled blade stock has replaced the traditional forged blades of more than a century ago. Those old blades were wedge-shaped themselves, being thicker at the cutting end. The opposition of two wedges gives positive blade holding now missing from single piece blades. The rest button and screw rod provide this holding.



JACK PLANE WITH WEDGE AND RETAINER DOWEL PIN. This is a simple, yet effective, jack plane mechanism. Note also the wood strike button in the fore block.



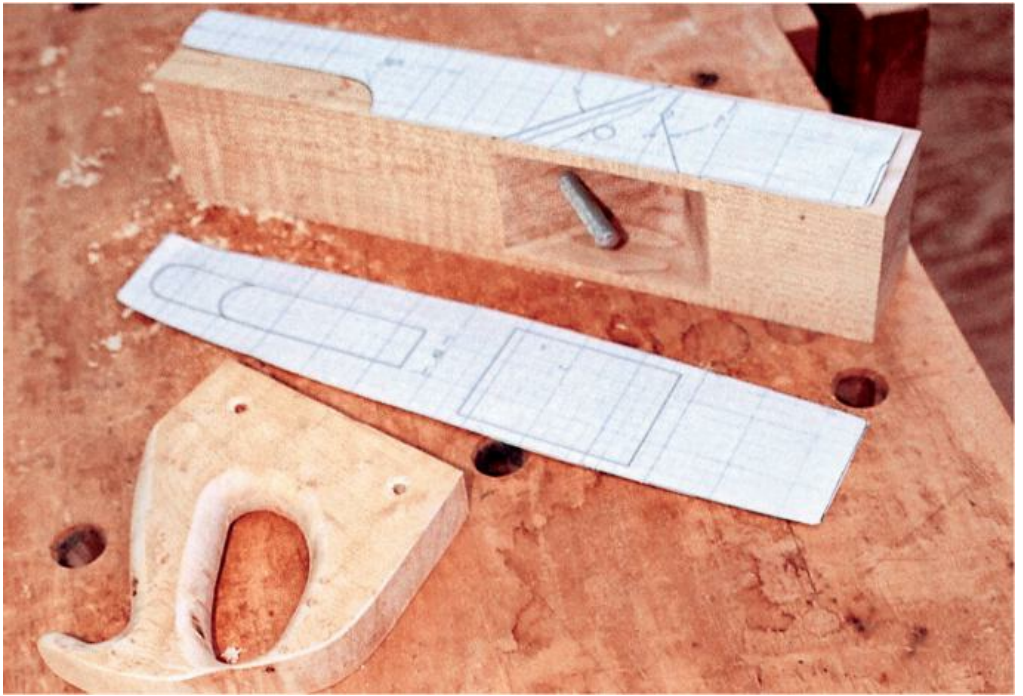
DRILL FOR $\frac{3}{8}$ " THREADED ROD. Use of jig helps hold plane body at 45° . A pre-drilled $\frac{3}{16}$ " hole keeps the $\frac{21}{64}$ " drill on line.



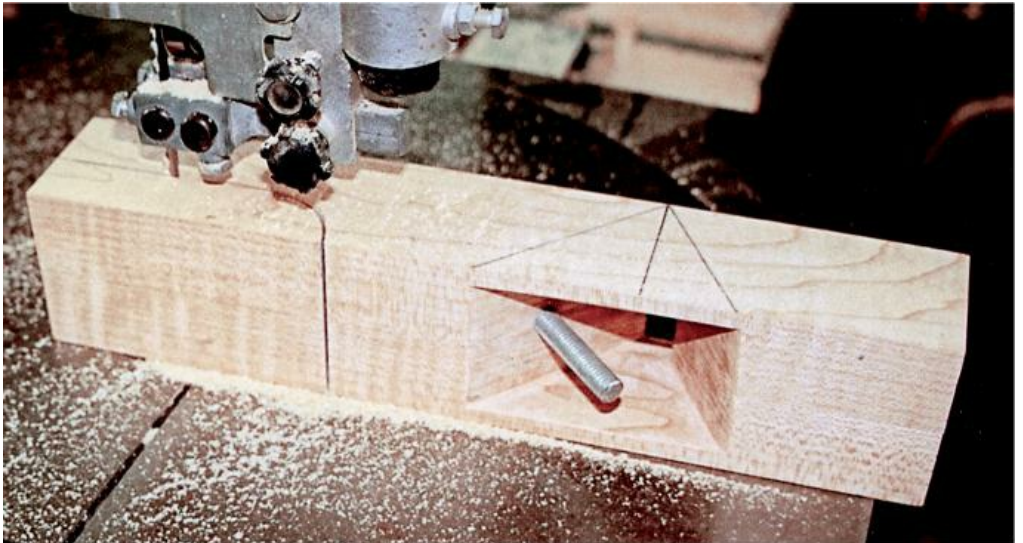
ADVANCE THE $\frac{3}{4}$ " THREADED ROD that taps itself into an undersized hole. Tape indicates how far to go.

Set up some way to hold your plane body at a 45° angle for drilling the screw post. Mark the location of the hole $1\frac{7}{8}$ " up from the sole in the center of the blade block. Pre-drill a pilot $\frac{3}{16}$ " hole to guide the larger $\frac{21}{64}$ " drill going $\frac{3}{4}$ " deep. File the end of your rod slightly to help in entering the hole. Spot a mark $\frac{3}{4}$ " from the end. The rod is held by vise grips while turning. You will feel the rod bottom the hole. Cut off leaving $1\frac{1}{2}$ " of threaded post or $1\frac{7}{8}$ " if using the 52° pitch adapter. If the post is not square to the block, make it so using a wood block and hammer. If you need to remove the post, use a hack saw to make a slot for a screw driver used to withdraw it.

There are two shapes in this plane different from a normal plane body. The coffin shape and the step, or razee section, where the handle is bedded defines the Pierce plane. Draw out the shapes, and cut on your band saw starting with the razee. The upswept end of this cut fits the radius of the $4" \times 36"$ belt sander nicely. The coffin sides are also cut on the band saw followed by sanding a fair curve to the whole body. The edges are chamfered all around for hand comfort. The amount of chamfer along the bottom edge is small, while the top edge has a $\frac{1}{8}"$ flat to the chamfer increasing where it turns around the nose of the plane.



SHAPES AND CURVES. The profiles are copied from the plans. The coffin shape and handle step define the Pierce plane.



SHAPE THE PLANE. Cut the razee step and coffin sides on the band saw.



SAND BOTH SIDES and chamfer edges.



CAP IS SAWN AND DRILLED for screw assembly.

Blade Cap

Next make the adjustable pressure cap. A production company would have this made as a special bronze casting. What is made here is in keeping with a shop-resourceful project. A piece of hard maple $\frac{3}{4}'' \times 2\frac{1}{32}'' \times 4''$ is cut to the profile shown in the drawing: the long bottom bevel, the 15° top angle, and the side scallops giving it a touch of grace. This cap will be sanded for side-to-side clearance later, the side sanded determined by how it fits best on the threaded post.

The pressure screw lands on a copper washer set into the cap. This is a brake gasket available from an auto store (NAPA #26442). A $\frac{5}{8}''$ recess holds it in place. Start your

drilling with a Forstner bit of this size going only $\frac{1}{16}$ " deep. Next drill the hole slightly oversize at $\frac{25}{64}$ ". In order to slip on or off the threaded post, this hole must be enlarged. Angle the first hole 30° for post clearance. Follow this with a hole straight into the cap. Finish filing out the hole before setting the copper washer as the last step in setting up your plane.

In the back of the cap, drill a recess for the stud on the blade using a $\frac{1}{2}$ " Forstner bit going $\frac{5}{16}$ " deep. Check the drawing for location.

The adjustment screw is made from 10–32 steel or brass threaded rod and two brass knurled nuts. One nut is glued to the end of the threaded rod with thread locker or CA glue. The other nut is set into the cap to act as threads in the hole. Hold the cap at a 15° angle to the drill in your press. Start with a $\frac{1}{2}$ " Forstner bit and drill $\frac{5}{16}$ " deep. Drill the remainder of the hole with a $\frac{15}{64}$ " drill. Press a nut, knurled side first, into the hole. To ensure that you have things lined up properly, thread the rod into the nut before gluing. Use a small amount of epoxy or thick CA glue to fill the recess around the nut.



TWO-SCREW MECHANISM: Drilling top screw at 15° will hold inverted thumb nut that threads the hole. Back of cap has space for rest button and $\frac{3}{8}$ " lead screw hole. Front of cap has wear washer and adjustment rod.

The Handle

The shape of this plane has a long heritage among boatbuilders on the Maine coast. Cecil Pierce had a formative experience as a young man that set him on a vocation as a plane maker with a bent for this style of jack plane. Listen to him tell it:

It was about sixty-five years ago that I had a chance meeting with my uncle somewhere in town, probably at the general store. "Cecil," he said, "Let's you and me go to East Boothbay and visit the shipyards tomorrow." Uncle was not fooling me about his intentions; his motive was not to show me around but to get there himself. He had no auto and he knew that I had an old Model T that would take us the fifteen miles very well, even though it was spring and the roads were muddy and riddled with frost and ruts.

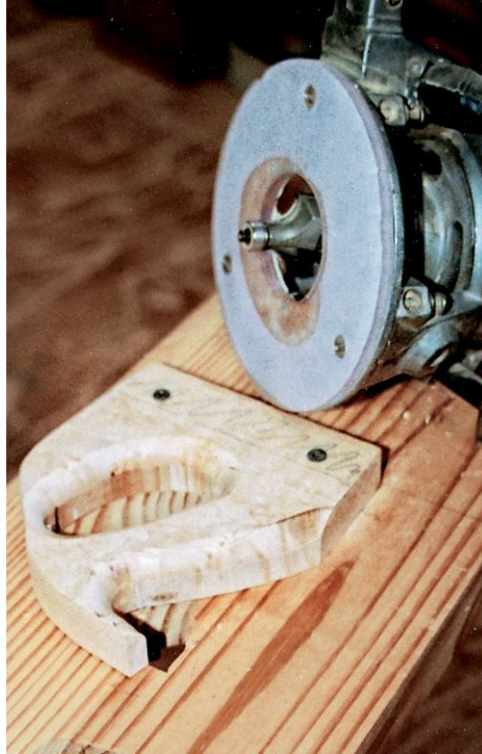
Like the ship that sailed with the tide in the morning, we set out and we arrived in due time without incident. Uncle Fred opened the little door in the big door and stepped inside with me close at his heels. There before our eyes was a schooner yacht newly planked up. High on a staging on her side were two men.

These were the days of the entrepreneurial outboard jointers. One was taking long sweeps with a wooden plane and was sending to the floor shavings as long and unbroken as his step-back and lunge-ahead allowed I cannot tell you of anything else that I saw that day, although we visited two other yards; nothing else mattered. Although the period of gestation was to be a long one, I was determined to master the plane. Thus, that chance meeting was to influence me for the rest of my life.

The handle completes the razeeed and coffin shaped plane box. The shape of the handle is personal, and relates to your hand size and how you grip the plane. Comparison of the vintage jointer plane used by my grandfather made by the Auburn Tool Co. in the 1870s and a modern ACE jointer shows the handle holes have grown by one finger width. The same is true comparing hand saw handles. Is the enlargement of the handle hole due to the increase size of the average person's hand in 140 years, or to the change in custom in how to hold the tool? Handsaws for sure work best when the forefinger is not in the hole, but pointing forward. The photo of Cecil Pierce on the cover of his book shows him holding the jack plane the same way, three fingers in the handle hole and the forefinger pointing forward.

The razee stepped down handle improves the feel and control of the plane over the style where the handle is mounted higher on the square plane box. The handle itself is cut from $\frac{1}{8}$ " or $\frac{15}{16}$ " maple. The latter dimension is what hardwood boards are dimensioned when milled "hit or miss" for furniture work. It is sold this way as a more uniform dimension than 4/4 rough stock. Whatever you have, cut the profile and hole as shown in the photo below. The top faces are left flat, while the hand grip surfaces need to be rounded over. Rasps and sandpaper can do it, or use a router with a $\frac{3}{4}$ " half round bit

with a ball bearing center, set shy of full depth. That way the pilot has a small flat when guiding the second pass, and the edges of your roundings have a slight defining edge.



HANDLE IS CUT OUT and routed for curves. The two screws holding the handle for this operation are in the bottom edge that will be cut off.

The handle is bedded $\frac{3}{8}$ " deep into a rectangular slot. Begin this with a series of holes made with a $\frac{7}{8}$ " Forstner bit. Drill the hole at each end before removing the center material. The sides and end of the slot are cleaned up with chisel and scraper. When done the handle will be glued and any irregularities covered up. However, it gives you a taste for what the throat cutting operation entails, and may encourage you to try it, or confirm the wisdom of a three-piece plane body.



DRILL RECESS with Forstner bit for bedding the handle with Forstner bit.



ONE STEP TO GO in fitting the handle. The body is glued and shaped. The threaded post and finished blade and rest

button are in place. The cap is made. The handle is formed with recess drilled and needing a chisel to clear the slot. Also, the bottom $\frac{3}{4}$ " of the handle needs to be cut off.

Final Details

A cluster of chores remain to finish your plane. With the blade adjustment mechanism done, check the throat opening. The side of the cap is sanded to give needed clearance. The hole for the post likewise is filed to allow taking on or off. The copper washer is pressed into place. The blade itself is given a final edge. The back is lapped, if not done before. Seeing that everything works properly will take some fine tuning.

The makers mark goes on the top of the iron and the nose of the plane. I like to date it as well. The plane body is protected with a thin sealer of varnish. The brass adjustment screw may need to be slightly stiffened with a swipe of candle wax or beeswax to prevent it from inadvertently moving, and not doing its job as a stop for holding the blade.

It is possible to adjust the angle of the blade to the 52° pitch of a smoothing plane. Cut a wedge 2" wide and 3" long with the thickness $\frac{3}{8}$ " at the top to a sharp edge where it meets the throat opening. A $\frac{3}{8}$ " hole corresponding to the position of the $\frac{3}{8}$ " threaded post will allow the wedge to go between the blade and the block. The length of the post needs to be longer by $\frac{3}{8}$ ". Also, the brass knurled nut meets the cap at a new angle. A wedged brass washer is made from the small side of a $\frac{3}{8}$ " knurled nut. First file out the threads, then saw off the small milled section on an angle and file to proper size to make a landing for the nut.

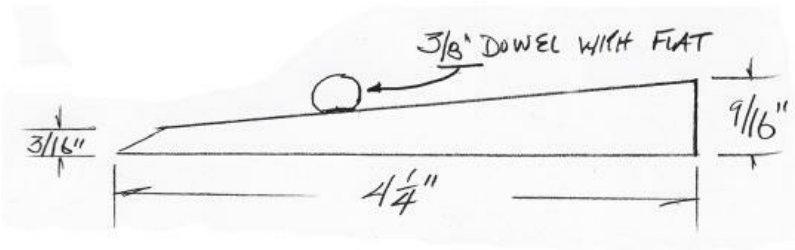


IT WORKS! But not without tuning up. Sharpen blade, make blade square to sole, and adjust the cap.

Remember those other lengths of material, the O1 steel and threaded rod along with the extra knurled nuts and studs ordered at the beginning? Making planes could be catching.



SMOOTHING PLANE OPTION: Cap assembly with added 52° wedge to allow standard 45° pitch to be changed to smoothing plane.



WEDGE USED FOR ALTERNATIVE BLADE-HOLDING MECHANISM



BRASS WASHER MADE FROM
 $\frac{3}{8}$ " knurled nut. Remove
 threads, file to angle for
 landing of main screw.



WOOD WEDGE 2" x 3",
 ANGLED from thin at
 bottom to $\frac{3}{8}$ " at top.
 Drill $\frac{3}{8}$ " hole for post.

52° PITCH OF JACK PLANE BLADE

Shoulder Plane

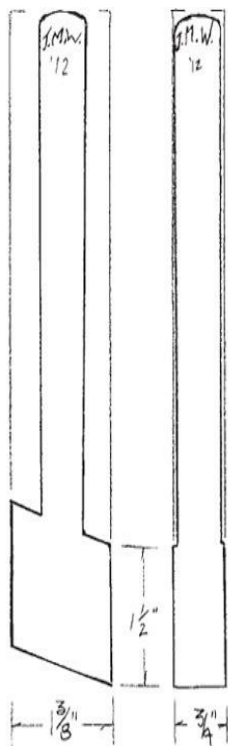


The three planes described here are based on similar assembly. The key element is using the top of the plane for alignment of the core blocks, and doing this glue-up in two stages. The plane body is kept open for fitting the wedge before the second side is attached.

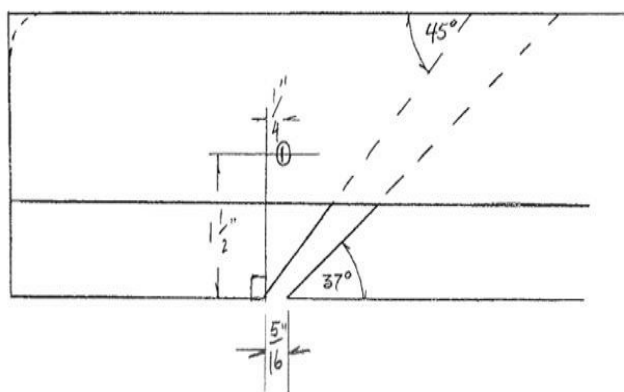
A mortising plane for leveling hinge gains whose opening is without side flair is shown at the top of the photo at right. A simplified shoulder plane, 37° bedding angle and side shaving exit for planing edge joints is in the middle. And at the bottom, a full shoulder plane with skewed blade is shown with the 19th-century Ohio Tool Co. example behind it.

The shoulder plane is a good choice for beginning plane making — good-looking, functional, and hard to mess up. Give it a try.

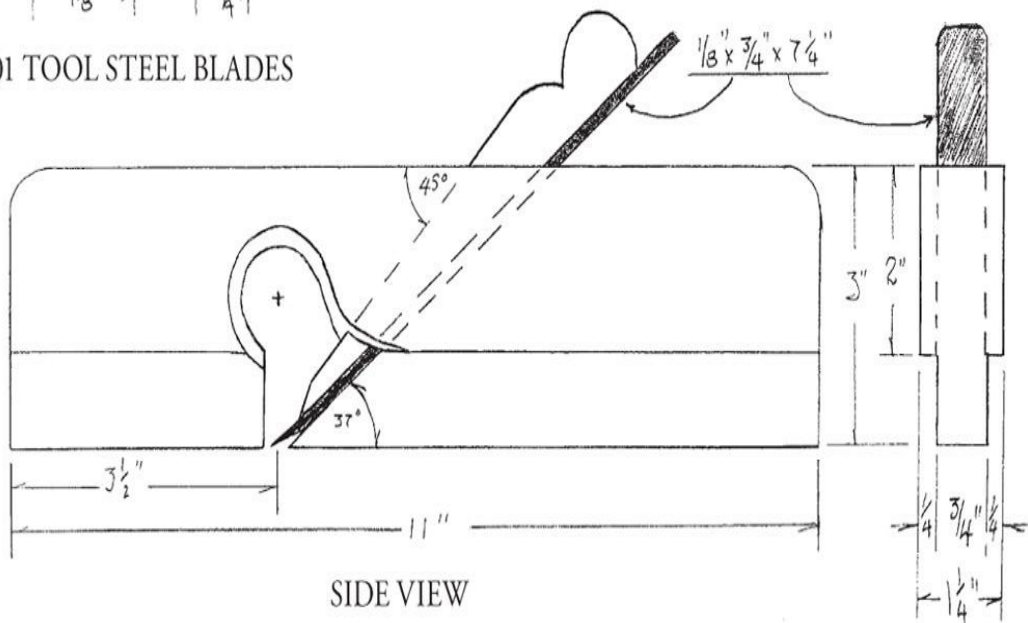




31 TOOL STEEL BLADES



LOCATING CENTER FOR 1" HOLE



SIDE VIEW

SHOULDER PLANE

END VIEW

MATERIALS

01 Tool blank	$\frac{1}{8}'' \times \frac{3}{4}'' \times 7\frac{1}{4}''$
Core block	$\frac{3}{4}'' \times 3'' \times 11''$
Sides (2)	$\frac{1}{4}'' \times 2'' \times 11\frac{1}{4}''$
Wedge	$\frac{3}{4}'' \times \frac{7}{8}'' \times 6\frac{1}{4}''$ (as part of a longer stick)

Raboter, Rebate, Rabbet?

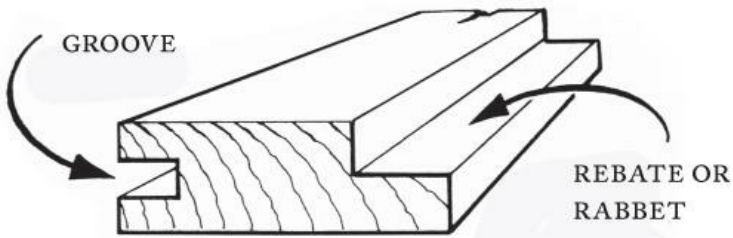
The name shoulder plane refers to the feature of the blade edge and the plane edge being the same. This enables the work of planing a rabbet in the edge of a board as shown in the drawing, as well as clearing out a groove to receive shelf boards.

The origin of the word is presumed to be from the French *raboter*, meaning “to plane” which was taken into English as *rebate* but pronounced *rabbet* until the beginning of the 1700’s. It was brought to America in pronunciation and spelling as *rabbet*, while in England the old spelling of *rebate* was retained and the pronunciation changed to *reebate*, which it is to this day, both for the joint and the plane.

The purpose of the rabbet joint is to join boards so the gap between them is covered and the boards are free to move with humidity changes while still remaining weatherproof. It was a simple and effective joint before milling machines and the more familiar tongue and groove joint.

The use of the rabbet plane for shelf construction brings us to another piece of wood history. Uprights in shelf units need a series of grooves for boards to fit into. These shelf grooves need not be very deep, $\frac{1}{8}''$ to $\frac{1}{4}''$ is sufficient, but the width of the groove needs to match the milled board. Several old rabbet planes I examined were $\frac{7}{8}''$ wide, which seemed unusual until remembering that our current milled lumber of $\frac{3}{4}''$ thick came into standard practice in the early 1900s, and before that it was $\frac{7}{8}''$ thick.

The use of a rabbet plane in making shelving can be used in this way. A series of marks for the shelf intervals are made in the uprights. A board is clamped across the upright at one of these intervals, and a knife scores the wood. A batten the width of the groove is laid down and a second score made to define the other side of the groove. The plane is now used to swipe the end of the groove to prevent tear-out at the far end, and the main groove planed out. The depth of the groove will be determined by the thickness of the cross board and the step in the side of the simplified shoulder plane: A $\frac{3}{4}''$ cross board will stop the groove at $\frac{1}{4}''$ deep, a $\frac{1}{8}''$ cross board will produce a groove $\frac{1}{8}''$ deep, and so forth.



Why were historic rabbet planes made with blades skewed at a 20° angle? Obviously because they work better. But why do they work better? I can think of three ways. First, the shoulder plane itself cannot be cocked at an angle during the planing of the board as we often do with other surfacing tasks, so the skewed blade does it. (The simplified shoulder plane does not have a skewed blade, but the bedding angle is 37° instead of the traditional 45° to make it a more effective cut.) Second, the shavings need a boost in sidewise exiting the throat. Third, and perhaps the most important reason why historic rabbet planes were made with skewed blades is that it keeps the cut tight to the shoulder of the joint.



SHOULDER PLANE whose cutter will plane into the recessed edge of a rabbet or can be used to recess hinge gains.

Looking ahead to these plane projects, three variations on a theme shown in the photo on [page 49](#), there is the mortising plane, the simplified shoulder plane, and the rabbet plane either with straight blade or skewed blade. The task of the mortising plane is to level the recess, or gain, for hinge leaves so they fit flush to the field. The blade can be

of various dimension from $\frac{1}{4}'' \times \frac{1}{2}''$ to $\frac{1}{8}'' \times \frac{3}{4}''$ depending on what you have, and adjusting the core block thickness to match. The bedding is 45° . The circular throat opening is simply a 1" dia. hole. This is adequate for the small chip removal this plane is set to do. To make the plane efficient in exiting the shavings over the length of a board, the throat opening is enlarged with a sidewise flair, and the $\frac{1}{8}'' \times \frac{3}{4}''$ blade is set at 37° . The third project is the traditional rabbet plane with its "T" shaped blade, sides extending to fully cover to the sole, and skewed blade, throat and wedge. This is more complicated throughout. However, all share the same assembly method as variations on a theme so that what I regard as the most useful of them all, the simplified shoulder plane, will be shown in detail, leaving you to modify it for the others.

Simplified Shoulder Plane

The blade used in this plane is $\frac{1}{8}'' \times \frac{3}{4}'' \times 7\frac{1}{4}''$ of O1 carbon tool steel. The width of the blade, and likewise the core block of the sole and the cutting region of the plane matches the standard milled one inch board. As mentioned above, the size of rabbet planes of a century ago were often $\frac{7}{8}''$ to match milled boards of the earlier standard. The blade's top end is rounded to relieve sharp edges, and the cutter ground to a 25° bevel. The blade needs clearance to slide easily. If it does not, then file or sand the stem to provide relief once the plane body is made. This will allow clearance along the wedged slot. Once shaped and stamped with your maker's mark, the blade's cutter is heated cherry red ($1,500^\circ$ F) and quenched in oil. This hard, but brittle steel is tempered in an oven at $350\text{--}400^\circ$ F, held at that temperature to soak for 20 minutes and allowed to air cool. Sharpen and polish or leave heat treating colors as you prefer.

Plane Body Parts and Layout

Start by milling the core block the width of blade. In contrast to other plane core blocks, the width of both are the same which gives the shoulder plane the unique ability to cut up to the side of the joint.

Layout of the core block starts at a point $3\frac{1}{2}''$ from the front with a bedding angle of 37° and the wedge angle of 45° (see drawing). Saw and sand these pieces. Keeping these surfaces straight and square is imperative. It starts with having the band saw table square. Any sanding should retain "witness marks" from saw kerf lines showing you sanded only the minimum and kept a square face.



CORE BLOCK FOR SHOULDER PLANE has bedding angle of 37° and fore angle 45° , giving an 8° wedge.

Glue-Up Assembly

The layout of these parts and the sequence of gluing them results in a remarkably straightforward assembly. First, glue the two core blocks to one side of the plane. The top edge affords alignment of these two core parts, leaving you to ensure that the $\frac{5}{16}$ " throat opening exists when gluing the second block. Spread glue on both surfaces, do not overdo the amount, and avoid the throat opening. The shop tip of using a few grains of table salt on the glue line will prevent parts from slipping under pressure. Four clamps are needed for each, starting with one with light pressure. An L-shaped guide with $\frac{5}{16}$ " throat opening marks can be clamped to the sole to help accurate alignment. Cut this from a $\frac{3}{8}$ " $\times$ 1" $\times$ 10" stick with rabbetted recess to guide the sole (see [page 59](#)).

Here you will appreciate the two part sequence of glue-up. With the blade in place, the wedge is cut and fitted into the opening with perfect accuracy as you can see all surfaces. When satisfied with the wedge, the second side is glued, again avoiding glue on the throat surface. Remove clamps, clear glue beads from the throat, sand top and trim ends. The body is rounded at the ends, and the top edges chamfered.



OPENING THE THROAT BEGINS with drilling a 1" hole. A cut vertically from the fore block opening will complete the mortising plane shown top left. To allow for shaving removal proceed to flair the hole shown next.



ASSEMBLY BEGINS with gluing core block to one side panel which provides alignment along the top edge. The second side is glued after fitting the wedge.

Cutting the Throat

Locating the center of the 1" hole is shown in the plan: A line at right angles up from the throat opening, a line parallel to the sole and $\frac{1}{2}$ " above the side piece edge, then $\frac{1}{4}$ " back toward the blade for the hole center. Before drilling, draw a larger $1\frac{1}{2}$ " circle from this point to guide sawing the flair around the hole. Now drill the 1" hole.



TO ALLOW SHAVINGS TO EXIT rather than ball up inside is accomplished by removing $\frac{1}{4}$ " enlargement to flair the hole to the side. Finish the opening with a round wood rasp.

COMPARING THE TWO PLANES

Simplified Shoulder Plane

Sides stepped

Plane length 11"

Blade/plane sole $\frac{3}{4}$ " wide

Blade bedding angle 37°

Blade stem reduced $\frac{1}{64}$ "

Blade straight across

Skewed Rabbet Plane

Full width sides

Plane length 10"

Blade $1\frac{3}{8}$ " wide, plane width $1\frac{1}{4}$ "

Blade bedding angle 45°

Blade stem "T" shaped

Blade skewed 20°

The sexy throat opening makes this plane operational by providing side exit for shavings. First cut up from the sole following the vertical line drawn on the fore block. Then using a coping saw or scroll saw, make an angled cut following the $1\frac{1}{2}$ " circle penciled around the hole. The far edge of this cut should leave some of the hole untouched. A wood rasp will finish this off. The ending of the cutout takes an ogee turn to the throat.

Gracefully done, surprisingly simple.

Mortising Plane

The tool that caught my attention in the first place was a mortising plane by Keith Cole shown in the background of the photo on [page 52](#). The job it does is level the gain for a

hinge by removing the waste after defining the edge of the opening and striking a series of chisel cuts across the mortise.

You can use various blade sizes for this including the $\frac{1}{4}'' \times \frac{1}{2}''$ in the original, or $\frac{1}{8}'' \times \frac{5}{8}''$ which I had at hand from making spokeshaves. The opening does not need to pass out long shavings, as the mortising waste comes up in smaller chips, so the hole drilled at the throat does not have the side directing flair characteristic of the shoulder plane. Also the blade does not need to meet the edge of the core block. Hence, mill the core block $\frac{1}{64}''$ wider than the blade width, and skip any side grinding chore.

For all these reasons, the mortising plane can use various materials at hand in the shop, and eliminate steps in construction. That said, the shoulder plane with its $\frac{3}{4}''$ blade would serve in most instances the job of setting a hinge.

Skewed Rabbet Plane

We discussed at the beginning the purpose and advantage of the skewed rabbet plane. Briefly, rabbetting boards made a weather tight joint that was easier than tongue and grooved, or match board jointed as the English say. The skewed blade kept the planing tight to the shoulder of the joint. Both the simplified shoulder plane and an example of an old rabbet plane are shown in the middle of the photo on [page 49](#). The differences between the two are shown in the chart above.

As you become conversant with the shoulder plane design you can incorporate whatever features you wish in your model. I might say that using the 37° blade angle follows the Ron Hock shoulder plane (Kit K5075, www.hocktools.com), and similar cutting ease comes from the skewed 45° blade.

Making the Traditional Skewed Rabbet Plane

What is nice about the design of the shoulder plane shown here is the open assembly feature which is even more important when attempting the skewed plane. No two ways about it, making compound angles in the throat and the wedge is a challenge, and having the throat open for all the complicated fitting is a big help. The angle in most historic planes I saw is 20° , so set your band saw to that angle when cutting the core block. CAUTION: When sanding these surfaces leave “witness” marks from the band saw to ensure that you do not sand away your accurate cut. Fit your wedge with a piece of blade material in place as shown in the photo at left.



THE SKEWED FULL SHOULDER PLANE has a blade angle of 45° at a 20° skew. The open assembly method used for these planes is essential for getting these compound shapes to fit.



A HOT DAY IN JUNE TO BE HACKSAWING for an hour to shape the blade shown here near the end of removing the reduced tang shape. Patience and several saw blades paid off to get the job done. A drop of oil or swipe of paraffin on the hacksaw blade helps.

The outline of the blade is shown in the plan. Decide on the width for your plane, then cut the cutter to its angle, grind the one edge of the blade to its 20° angle, and finally hack saw or grind the stem to create the characteristic “T” shape of this blade.

The throat opening is flaired like the simplified shoulder plane, only the hole size is ½” dia. instead of 1” dia. Locate the hole 1” up from the sole in a place that makes the hole just touch the bedding block surface. [See photo](#) for final flair and ending ogee. Overall this plane has a more traditional look and feel than the simplified shoulder plane, although I believe that both would find place in the tool box of a joiner, or as the English call them a fitter, of the past as well as the present.

Graceful in look, efficient in use, but definitely more complicated in making.



THE SKEWED RABBET PLANE THROAT OPENING starts with a ½” hole that just touches the bedding block surface, is flaired and ended in the ogee curve.

Molding Plane



“There are three broad categories into which planes may be classified – smoothing, molding, and rabbetting. The second and most numerous group consists of molding planes which do not create a plane at all but carve, alone or in combination, beautiful moldings for decorative effect. It is the molding planes which provide the woodworker with the source for artistic achievement that sometimes approaches sculpture.”

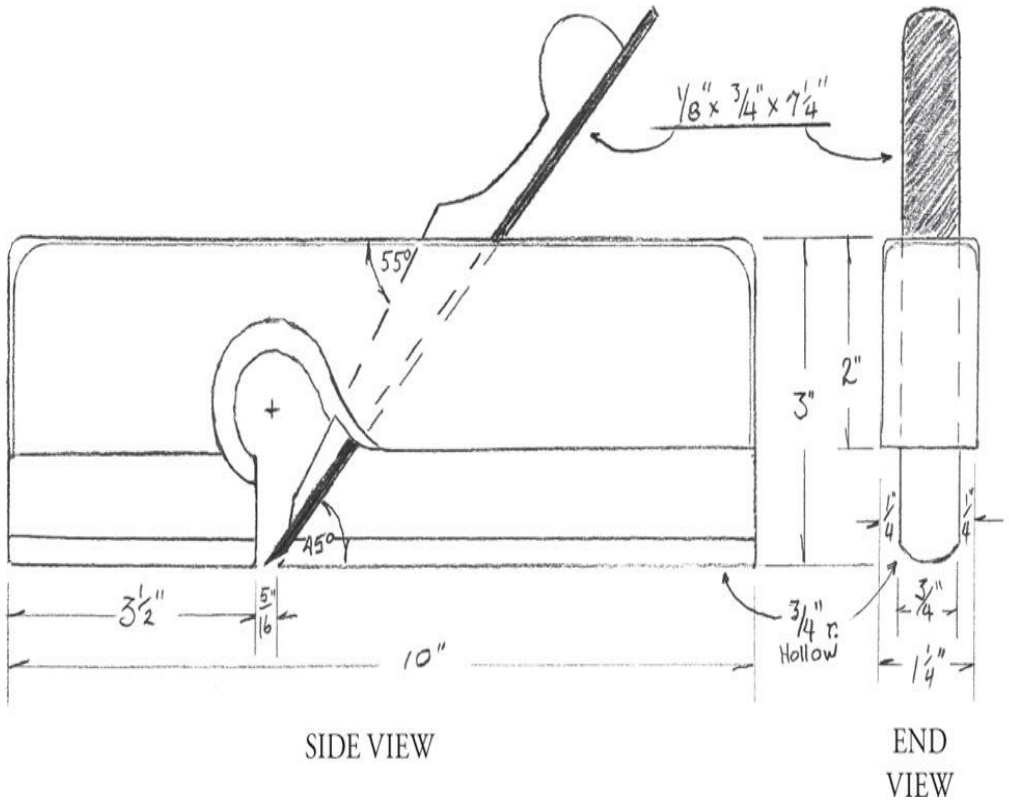
— Alex W. Bealer

“Old Ways of Working Wood” (adapted)



Molding planes are unique in the shapes they can furrow in wood. While other plane soles are flat, they are curved, and the blades follow this pattern at a 45° angle. Molding planes share with shoulder planes the ability to cut to the edge since the blade and the sole are the same width. The traditional molding plane is a thing of complicated angles, slots and curves, that rather intimidates the would be plane maker.

An elegant solution is one that simplifies, and this design qualifies for that definition of elegant. The blade is a single piece of O1 tool steel without elaborate shaping save for the cutting bevel. The body is a core the width of the blade with two $\frac{1}{4}$ " sides. The wedge is fitted while the body is half made and its inner recesses observed.



NO. 12 HOLLOW MOLDING PLANE

MATERIALS

O1 Tool blank	$\frac{1}{8}" \times \frac{3}{4}" \times 7\frac{1}{4}"$
Core block	$\frac{3}{4}" \times 3" \times 10"$
Sides (2)	$\frac{1}{4}" \times 2" \times 10\frac{1}{4}"$
Wedge	$\frac{3}{4}" \times \frac{7}{8}" \times 6\frac{1}{4}"$ (as part of a longer stick)

In the rabbetting plane we have a plane that satisfies all the requirements of such a molding plane save for the sole shape. Building on this design platform we can

accomplish the shapely furrow by contouring the sole and matching the required blade profile. The example is a No. 12 hollow which cuts a curved trough, or hollow, $\frac{3}{4}$ " wide. The No. 12, like other numbers in the series, refers to the width of the plane in sixteenths. The planes were made in matched pairs of hollows and rounds. Making such a matched pair starts with the hollow which can then be used to form the round's sole.



ASSEMBLYJIG aligns core blocks to one side. Open assembly makes possible the fitting of wedge and blade. Bedding angle of 45° and fore block angle of 55° are clamped temporarily to the jig which has marks for the $\frac{5}{16}$ " throat opening. Salt cellar provides a few grains to "sand" the glue line to avoid slippage under pressure.



FITTING WEDGE, curving sole and finding blade profile proceed with this open assembly. The sole radius is a portion of a $\frac{3}{4}$ " radius circle that is being cut on a pattern of stiff paper or thin aluminum. The blade profile will be traced from the curved sole once it is shaped.

The plan view of the No. 12 hollow shows a plane in most aspects the same as the $\frac{3}{4}$ " rabbetting plane to which you can refer for instructions. However, molding planes are traditionally set at 45° or higher to achieve a smooth cut, so do not copy the 37° angle given in the rabbetting plane. The sequence of gluing the core block to one side only helps in fitting the parts of your molding plane. The plane body when its curved sole is done will be used to make the pattern used in shaping the curve of the blade.

Shaping Sole and Blade

The sole of the hollows and rounds are not a half circle, but a portion of a circle whose radius is the blade width, or for the No. 12 a $\frac{3}{4}$ " radius. To make a pattern, draw a $1\frac{1}{2}$ " circle ($\frac{3}{4}$ " radius) and draw two lines $\frac{3}{4}$ " apart through the middle of the circle using the tool steel blank as seen in the layout photo below. This defines the arc used in making the sole.



THE SOLE SHAPE begins by sanding or planing a 60° flat along both edges. Do this by drawing a line $\frac{1}{8}$ " up the side and $\frac{1}{4}$ " over the sole as seen in the previous photo. A 60° gauge made from scrap wood is held in my left hand to aid in positioning the plane.



THE BLADE PROFILE is beveled at 25° and arced to match the sole shape, but at slightly different radius due to its bedding angle in the plane. Here a quarter, at $\frac{15}{16}$ " diameter, is used for the preliminary profile for a No. 12 molding hollow. An accurate pattern comes from tracing the sole at the bedding angle as seen in the center photo, next page.

To shape the sole note that the arc meets the two defining lines just drawn at a 60° angle. We can achieve the beginning of the curve on both sides of the sole by sanding a flat defined by a line $\frac{1}{8}$ " up and $\frac{1}{4}$ " over from the sole's edge as you see drawn on the core blocks in the layout photo. To help you in holding the plane for sanding, cut a 60° angle on a scrap of wood which you can hold preliminary to sanding this flat. Once both flats are sanded, proceed to blend the curve, always respecting the three reference points of the edge, the center, and the other edge. The curved sole can be seen in the photo on [page 61](#) where the throat is being sawn on the band saw.

Now that the sole shape is defined, the blade profile pattern can be made. Take a stiff piece of white paper cut to $\frac{3}{4}$ " width. Lay it in the throat on the bedding block and trace the shape where it meets the sole. The resulting pattern will be similar to, but not the same as, the sole pattern due to the angle of approach of the blade. Mathematically, the shape is an arc of an ellipse which is what happens when a circle is viewed at an angle, but at 45° the difference is not great. The method given here of defining the plane sole by circles and arcs, then shaping the sole and using the intersect of the bedding angle and the sole to make the blade cutter pattern will achieve results simpler than a mathematical formula.

You may wonder at the coin in my hand in the photo where the curved bevel is being ground on the tool steel blade. In making a prototype, there are times to "just do it," and worry over formulas and general guidelines later. So I used a quarter, which is a $\frac{15}{16}$ " circle to begin my blade, not knowing yet about using the bedding-angle-to-sole for a pattern. I lucked out in achieving an almost perfect fit for my No. 12 hollow. I recommend making a pattern, but, as my friend Keith Cole often reminds me, if you have to choose between being lucky or smart, pick lucky every time.



THE O1 TOOL STEEL is heated cherry red then quenched in oil to harden the cutting end. The next step will be to temper the steel to restore needed toughness by heating in an oven to 350°-400° F followed by air cooling.



ONCE THE blade, wedge, and sole arc are done, glue the second side. The throat begins with a 1" hole centered 1½" up from the throat opening and ¼" toward the blade, followed by cutting the opening on the band saw. The flaired hole is cut by tilting your band saw table at 15°, or using a coping saw to follow a 1½" circle line. Cut so the flair stops short of the far side piece.

The blade with its 25° bevel and patterned profile is heated in the tin can furnace and quenched in oil to harden the carbon tool steel. Tempering is done in an oven at 350-400° F for 20 minutes and air cooled to achieve the right balance of hardness and toughness.

Cutting the throat starts with locating the center for the 1" hole. Square up from the fore edge of the opening to a point 1½" from the sole, then ¼" toward blade block. Before drilling, draw a 1½" circle to guide the flare to be added after the hole is drilled. The band saw cut follows this squared line into the hole, then completes the ogee curve up to the bedding block. Flare the hole by either setting your band saw at 15°, or using a coping saw, to remove the rim around the hole. This cut will exit ¼" short of the far side of the hole leaving the back side to be smoothed with a round file.

This method of achieving a molding plane will work for various shapes. The plane body has the simplicity of the three piece design. The core block can be made to match whatever blade width you choose. The shape of the sole of your plane will give you the compound profile needed for the blade. Hollows and rounds, flutes and reeds, hand rail and spar planes can all be achieved.

Scrub Plane

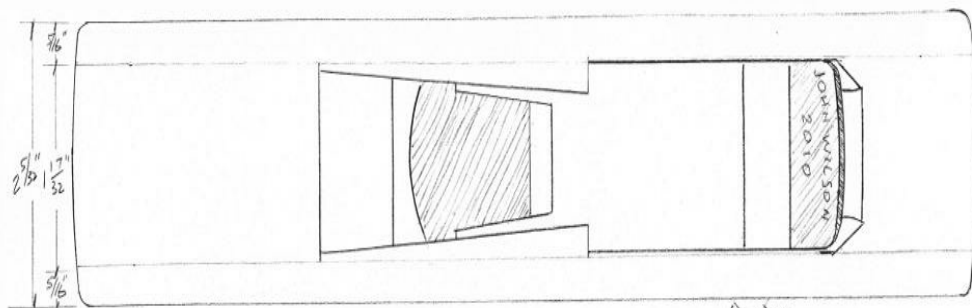


To scrub, or clean up. That is this plane's work. It is hard for us in the modern age of thickness planers to imagine having to dress a board to finished dimensions as a first step in building something in wood. I can remember when Ryobi manufactured the first portable thicknessing planer 30 years ago. It scaled down the big machine so that the small shops had a planer powered by 110 volt current. My father could recall electrification itself which brought electric everything into the local shop. Before that the invention of the original square head planer run off a stationary power source in the early 1800s made possible the planing mill at the Shaker Village at Mt. Lebanon, NY, in 1832.

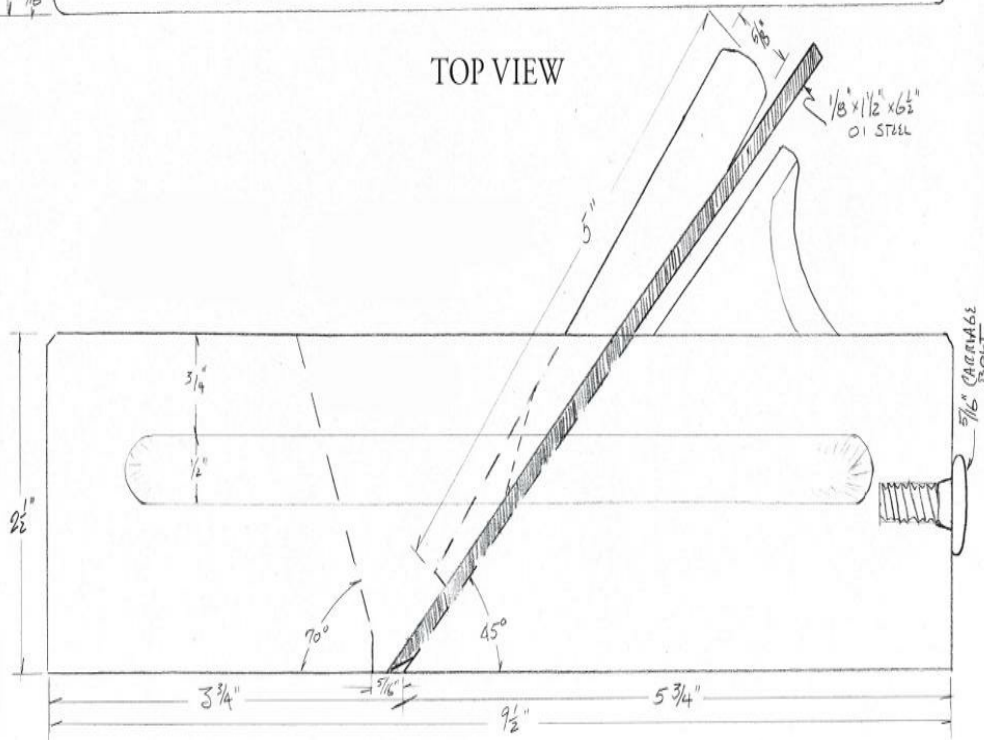
Before that, it took two men in a pit sawing logs. Wood frame buildings in the 17th century had hand hewn beams with bays filled in with bricks or plastered over woven saplings which the English called coppice. Siding boards were too expensive.

Our memory is short, but history tells of a lot of hard labor for those who worked wood.





TOP VIEW



SIDE SECTION VIEW

SCRUB PLANE

MATERIALS

Core block	$1\frac{17}{32}" \times 2\frac{1}{2}" \times 9\frac{1}{2}"$
Sides (2)	$\frac{5}{16}" \times 2\frac{1}{2}" \times 9\frac{1}{2}"$
Wedge	$\frac{5}{8}" \times 1\frac{1}{2}" \times 5"$ (stick 8")

Abutments (2)	$\frac{5}{16}$ " taper to $\frac{1}{8}$ " $\times$ $2\frac{1}{4}$ " $\times$ 10" stick
Dowel pins (4)	$\frac{3}{16}$ " dowel
Alignment board	$\frac{1}{4}$ " $\times$ $1\frac{7}{8}$ " $\times$ $9\frac{1}{2}$ "
Strike button	$\frac{5}{16}$ " carriage bolt, all threads $\frac{3}{4}$ " long
Blade	$\frac{1}{8}$ " $\times$ $1\frac{1}{2}$ " $\times$ $6\frac{1}{2}$ " O1 tool steel

Hand tools were adapted to meet these needs. The scrub plane is just such a tool. It is designed to “make the rough places plain.” The cutter is narrower than the bench plane so that thick shavings from a flat surface do not overpower the power source, once referred to as “potato power” by John Gardner, the wooden boat revivalist. The shape of the cutter is interesting in its curved edge, again for preliminary facing of a rough board. The result is a series of furrows, or waves, across the board. This is what a Windsor chair seat feels like on its underside. It reminds the modern woodworker of an earlier day before mechanical power whenever he pulls his chair up to the table.

Blade

A narrow blade, as mentioned before, will serve best for facing a rough board. I use the $\frac{1}{8}$ " $\times$ $1\frac{1}{2}$ " O1 tool steel as in the block, chisel and compass planes. The model for this particular scrub plane is made in Germany by the E. C. Emmerich Co. Their blade is a metric equivalent of $1\frac{5}{16}$ " wide. Using the $1\frac{1}{2}$ " steel is handy, but you may wish to purchase the narrower size and adjust the width of the plane body accordingly.



GRINDING THE TOMBSTONE top to the blade, and the curve to the cutter end. The 25° bevel to the cutter comes last.



PARTS OF A SCRUB PLANE, with ECE Primus plane used as model in background.

The shape of the blade is ground first in the tombstone shape top end, then the curved cutter end using a $2\frac{1}{2}$ " radius compass arc. Profile the arc, then grind the 25° bevel. When shaping is done, use the belt sander to finish both ends, and to ease the sharp sides to be more user friendly.



THE BELT SANDER PROVIDES CONTROL and cool finishing to bevel surfaces plus smoothing sharp edges in sides and top.



AFTER SHAPING THE BLADE, the tool steel is heated using a MAPP gas torch (right) and nesting tin can furnace to conserve heat. In the background is the pot of oil for quenching the hot metal to make it hard.



SCRUB PLANE PARTS with core block divided into fore (70°) and bedding (45°) blocks. The scrap piece will be used later for the hand block. Note the lines $\frac{5}{16}$ " apart on the alignment board to ensure the proper throat opening.



HARD BUT BRITTLE is tempered in an oven at 400° F to restore toughness yet keep a 60-62 Rockwell hardness cutting edge. The rainbow of colors is the border of heat from the torch.

Harden the cutter by heating to cherry red (1,500° F) with a propane or MAPP gas torch (large volume flame, not pencil point type) in a tin can furnace as shown in the photos. Quench immediately by full immersion in oil. When cleaning the surface, leave the side that rests on the wood plane body unpolished to enhance friction by the wedge. Temper the hard and brittle steel in an oven to 400° F and heat soaking it 20 minutes, then allow to slowly air cool. Sharpen the cutter, and stamp your name and date.

Plane Body

The plane body consists of a core block cut into three pieces to give the 70° fore block, the throat scrap used later for the hand hold, and the 45° bedding block. The two sides are glued once these angles are cut and dressed for accuracy. The glue-up involves a waxed alignment board to which the face and blade blocks are clamped ensuring that the sole is straight. Draw two lines $\frac{5}{16}$ " apart to achieve an accurate throat opening. The sides are positioned with the use of $\frac{3}{16}$ " $\times$ $\frac{1}{2}$ " dowel pins to prevent movement when clamped. All these steps are illustrated in the accompanying photos.

The sequence for shaping the plane starts with smoothing all sides and rounding the corners with an arched sanding of the ends. The finger hold in both sides is cut $\frac{1}{2}$ " wide, $\frac{1}{8}$ " deep, down 1" (centered) from the top edge. How you do it is a matter of preference and available equipment. Chiseling with a gouge is one way. A router or shaper using a $\frac{1}{2}$ " core bit is another. The photo shows using the core bit in the drill press with a guide clamped to the table to achieve a straight slot that stops 1" from each end.



USE OF ALIGNMENT BOARD AND DOWEL PINS will ensure that everything in the glue up is correct.



GLUING ALL SURFACES. Note the pencil line on the side showing where to avoid glue in throat area. When glue is spread, sides are pinned with dowel pegs. Alternatively, salt the glue line.



SQUEEZE in bench vise, or use C-clamps. Check that all joint lines are tight.

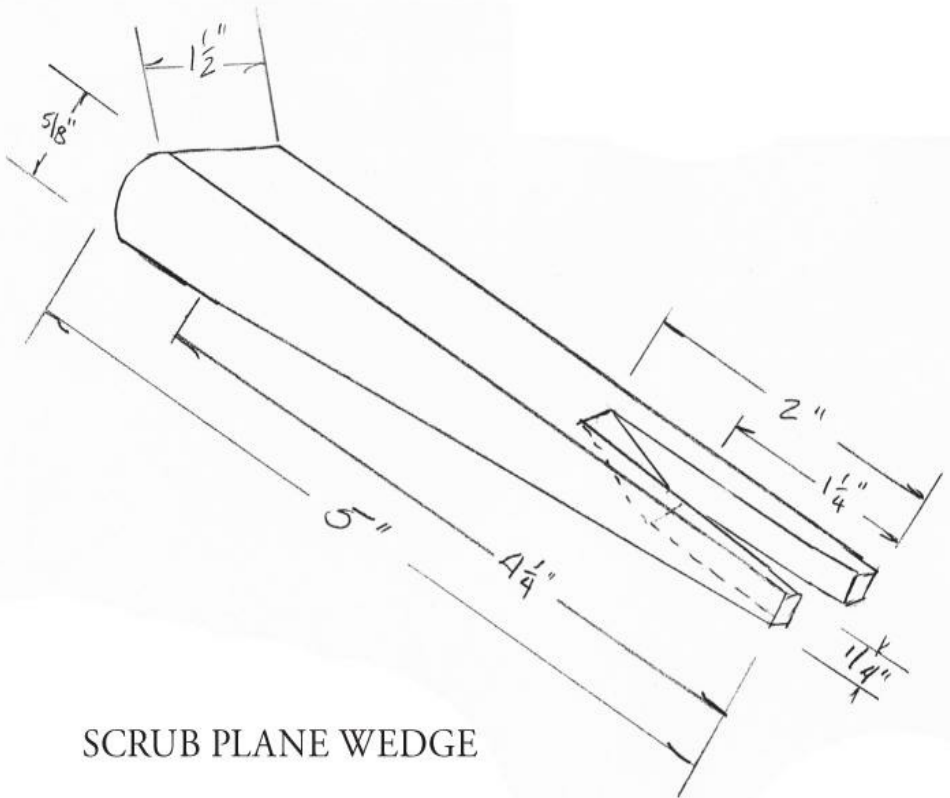


AFTER THE GLUE DRIES, beads are removed from throat and all sides sanded flat and square. Here the end is given a slight radius.

Wedge and Abutments

The wedge is cut from wood $\frac{5}{8}'' \times 1\frac{1}{2}''$. Draw a line up $\frac{1}{4}''$ from the end edge, and back $4\frac{1}{4}''$ to cut the angle which is about 5° . Sand this surface flat. The end is cut away as shown in the photo. Define the opening on the band saw, then cut the ramp edges with a saw, and chisel the slope. Note the use of the scrap wedge under the clamped wood

when secured to the bench. When done, cut the wedge 5" long and sand a rounded end as well as easing all edges.



SCRUB PLANE WEDGE



WITH PLANE BODY AND BLADE DONE, the wedge is next. The angle is sawn and sanded on the reverse side, and now the cut out for chip clearance is made.



DEFINING THE SLOPE OPENING in the wedge.



FINISHING THE CHIP CLEARANCE OPENING. The wedge is clamped to the bench using the scrap cut from the wedge and plywood under it to protect the bench. Save the scrap for gluing the abutments later.

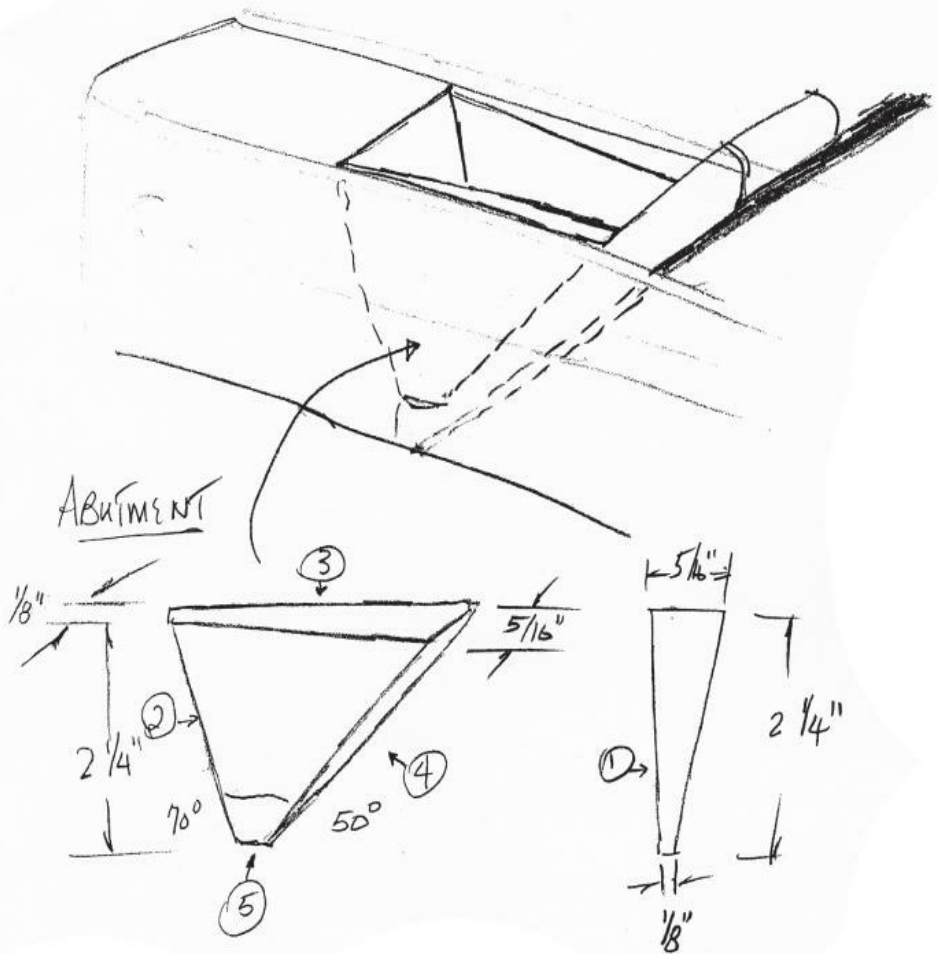


A CORE BIT IS USED to plough the finger hold in both sides. Here the drill press and edge guide are used. A router or shaper is also an option.

The wedge is held by abutments. (See drawing of this sequence below.) These are cut from a piece $2\frac{1}{4}$ " wide and cut on a bevel so that one edge is $\frac{5}{16}$ ", the other $\frac{1}{8}$ ". Cut a 70° angle in each end. Note that this will give two mirror image pieces needed for both sides of the throat. (See also [page 246](#).) Next sand the ends so that they taper from full thickness where they will hold the wedge down to $\frac{1}{8}$ " at the fore block. Now determine the length of the abutments by putting blade and wedge in place and marking the opening. Add $\frac{1}{8}$ " to this measurement and lay a line 50° , the 45° blade angle plus the 5° wedge. Cut the abutments and sand the edges straight. The bottom point is tapered on the sander. Fit in the throat opening, sanding any adjustments. When ready, glue in place holding with wedge and fingers. Additional holding comes from wedging small cross pieces.

SEQUENCE FOR ABUTMENTS

1. Stock $\frac{5}{16}$ " to $\frac{1}{8}$ " taper, $\frac{2}{4}$ " wide.
2. Cut 70° end.
3. Sand taper on end of stock from $\frac{5}{16}$ " to $\frac{1}{8}$ ".
4. Cut 50° angle.
5. Sand bottom point.





ABUTMENTS ARE CUT from tapered 2 1/4" wide stock. Here the end angle of 70° is cut and the taper to the end is sanded while still attached to the stick.



ABUTMENTS ARE GLUED using pressure from the wedge and sidewise finger holding.

Final Arrangements

When this assembly dries, sand the top of the plane body flat. Now is the time to sand the top corners and edges for comfortable holding. The chamfer is $\frac{1}{8}"$ to $\frac{3}{16}"$ wide, increasing as the ends are rounded.

Next shape and glue the small holding block behind the blade. It is made from the throat cut out. This is where your hand will rest in planing, so check out what is comfortable. When gluing this block leave a $\frac{1}{8}"$ space behind the blade.



REMOVE THE WEDGE before glue sets. Final holding is made by several thin scraps of wood wedged into place.

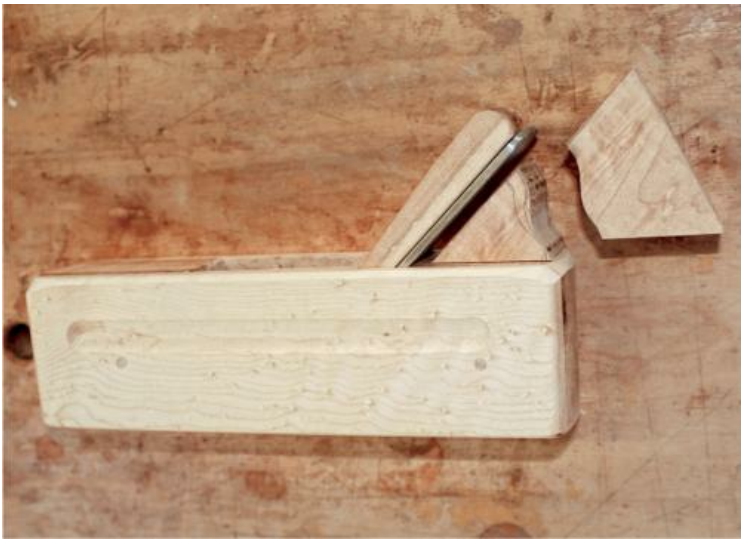


THE SURFACES ARE SANDED flat and edges chamfered with special emphasis on corners.

Finally, a strike button is inserted into the end of the plane. This is cut from a $\frac{5}{16}$ " carriage bolt that has threads all the way to the square under the head. Cut it $\frac{3}{4}$ " long and file the rough burr. Drill a $\frac{19}{64}$ " hole in the center of the end, slightly deeper than $\frac{3}{4}$ ". Square the hole opening with a chisel. Drive the bolt into the plane end.

When everything is done, give it a test to confirm that your plane is in working order. The finish is one coat of varnish except the two surfaces facing the blade. Rub out on brown paper sack for a smooth finish.

The following project, a large compass plane, is made on the scrub plane platform. Wait until later to drill and insert the carriage bolt strike button. Everything else is added to what has gone before.



THE HAND BLOCK IS CUT from throat scrap. Here the initial cut is made showing its position.



SANDING THE HAND BLOCK can be round or faceted as shown here. When glued, an $\frac{1}{8}$ " space is left behind the blade.



A STRIKE BUTTON is made from a $\frac{5}{16}$ " carriage bolt. The slightly undersized hole ($\frac{19}{64}$ ") makes for a permanent fit.

Large Compass Plane

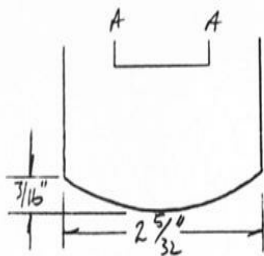


This compass plane is resting on a Windsor chair seat whose grooves show where the tool made its mark. Comparing this to the photo of the scrub plane on [pages 63](#) and [71](#) shows where its design began and where this adaptation took it.

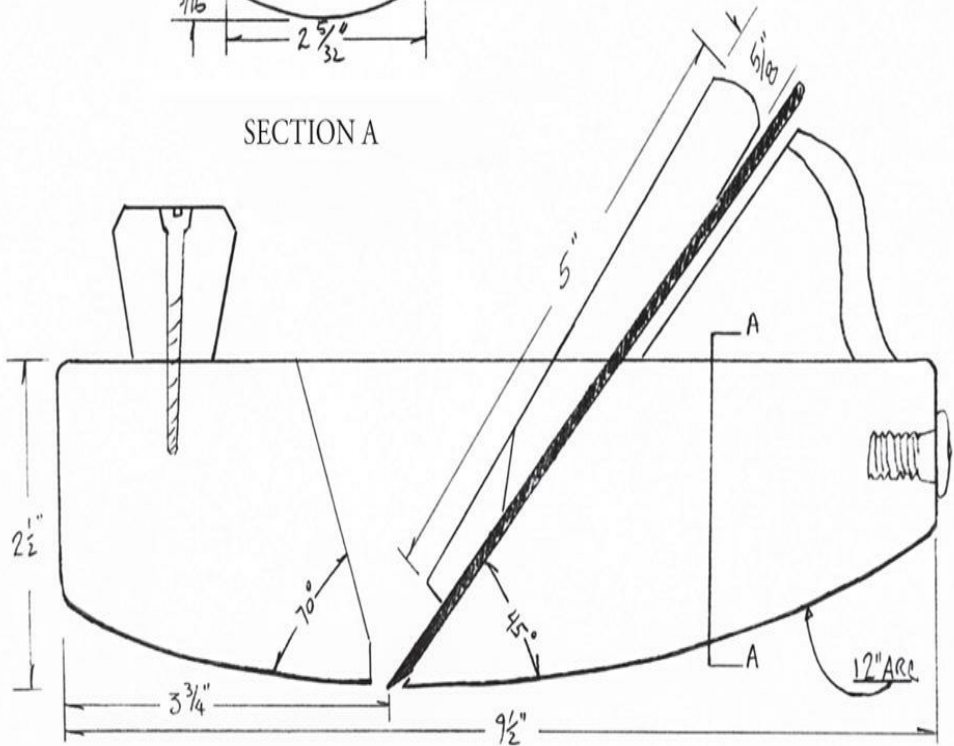
Tool marks can be a design feature in the finished piece. The Arts and Crafts movement was a reaction to the Victorian ideal of a polished and elaborate surface decor. There is a place for artfully embossed surfaces that are an honest expression of tools in the hands of a competent craftsman.

Explore your own tool surfacing techniques and get beyond uniform, smooth and plain surfaces as the only standard.





SECTION A



SIDE VIEW
LARGE COMPASS PLANE

MATERIALS

Core block	$1\frac{17}{32}'' \times 2\frac{1}{2}'' \times 9\frac{1}{2}''$
Sides (2)	$\frac{5}{16}'' \times 2\frac{1}{2}'' \times 9\frac{1}{2}''$
Wedge	$\frac{5}{8}'' \times 1\frac{1}{2}'' \times 5''$ (stick 8")
Abutments (2)	$\frac{5}{16}''$ taper to $\frac{1}{8}'' \times 2\frac{1}{4}'' \times 10''$ stick
Knob	$1\frac{3}{8}'' \times 1\frac{3}{8}'' \times 1\frac{1}{4}''$
Alignment board	$\frac{1}{4}'' \times 1\frac{7}{8}'' \times 9\frac{1}{2}''$

Strike button $\frac{5}{16}$ " carriage bolt, all threads $\frac{3}{4}$ " long
Blade $\frac{1}{8}$ " $\times$ $1\frac{1}{2}$ " $\times$ $6\frac{1}{2}$ " 01 tool steel

Curved excavated surfaces require a plane with curved sole and blade. The small compass plane shown on [pages 20-31](#) is a diminutive tool that fits the palm of your hand much like a block plane, and like that straight run tool, the small compass plane is surprisingly effective at hollowing inside curves. The plane shown here extends the size and range for this kind of work. Refer to [pages 62-73](#) for construction of the plane body up to the final shaping of the plane's sole. The last step is the addition of a knob.

Start by drawing a 12" arc centered on the throat opening. Cut a pattern for this by scribing a line using trammel point and pencil (a stick with a small nail pivot at one end and a notch for your pencil 12" away) to draw a template. The strike button shown in the scrub plane needs to be left out until later as it may interfere with sawing this curve.

After the fore and aft curve is band sawn and smoothed, the sidewise radius is made in the following way. Scribe a line $\frac{3}{16}$ " up from the sole from end to end on both sides. Next sand a 45° chamfered edge up to this scribed line. Finally sand across the sole to blend a fair curve from side to side. The $2\frac{1}{2}$ " radius arc curve of the blade in the scrub plane is fine for the work of this compass plane. The final step is to make and attach a knob at the front end of the plane with a $2\frac{1}{2}$ " wood screw as shown in the photo on [page 75](#).



SOLE ARC OF 12" is drawn on a pattern and marked and sawn on the plane body. The center of the 12" radius is at the throat $3\frac{3}{4}$ " from the toe rather than the middle of the plane.



MAKING THE SIDE-TO-SIDE ARC starts with drawing lines $\frac{3}{16}$ " from both edges of the sole. Sand up to the lines as shown on the top right where the chamfer has just begun. It will be sanded the full length on both sides of the sole. Finish by sanding the arc across to blend a fair curve.

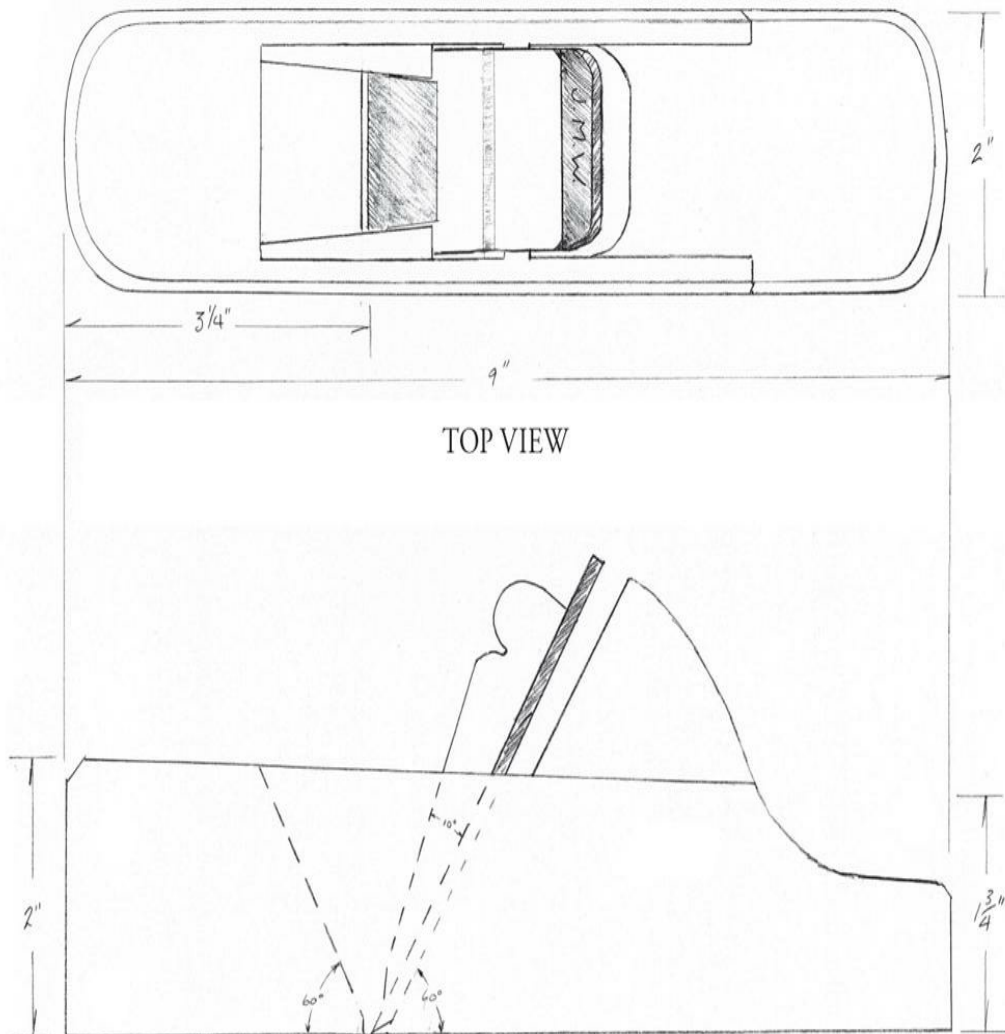
Smoothing Plane



The angle of approach in a plane changes the effort needed to cut and the likelihood of tear-out from the surface. These are cross purpose factors, meaning that reduced effort and increased tear-out results from lowering the angle of approach and increased effort and smoother cut from a steeper blade angle. Like other twin factors, and tool steel hardness and toughness comes to mind, the trade off between them results in a compromise of acceptable levels in each. Tool steel accomplishes this by tempering the excessive brittleness by reducing hardness a bit. Planes change the angle of approach.

When maximum shaving to quickly reduce stock size is desired, a plane with lower angle of approach and a somewhat larger throat opening to prevent clogging is employed as in the scrub plane. The smoothing plane has a steeper blade angle and tighter throat.





SIDE VIEW

SMOOTHING PLANE

MATERIALS

Core block	$1\frac{17}{32}$ " $\times$ 2" $\times$ 9" hard maple
Sides (2)	$\frac{1}{4}$ " $\times$ 2" $\times$ 9" hard maple
Wedge	$\frac{5}{8}$ " $\times$ 1 1/2" $\times$ 3 1/4" hard maple

Abutments (2)	$\frac{1}{4}"$ to $\frac{1}{8}"$ taper $\times$ $1\frac{1}{2}"$ $\times$ $10"$ hard maple
Blade	$\frac{1}{8}"$ $\times$ $1\frac{1}{2}"$ $\times$ $4"$ 01 steel
Alignment board	$\frac{1}{4}"$ $\times$ $1\frac{7}{8}"$ $\times$ $9"$
Dowel pins (4)	$\frac{3}{16}"$ $\times$ $\frac{1}{2}"$

The trade-off in ease of cut and surface finish has resulted in the general approach angle of 45° . When greater control over surface finish and avoiding tear-out are primary, a smoothing plane with the blade at a steeper angle is employed. Some have 52° , some 55° , some 60° . This little plane employs the possibility of a 60° approach for fine work, and a 90° option when even that would tear the surface in some wild grain wood. How could that be? The change is effected by turning the blade around so the bezel, or ground surface, faces forward. The 60° bed plus a 30° bezel gives a 90° approach. It is now a scraper plane.



MATERIALS FOR MAKING YOUR SMOOTHING PLANE include (from bottom to top) two sides, a core block, strips for abutments and wedge, plus tool steel blank.



FIRST MAKE 60° ANGLES 3/4" from front. Save cutout for palm rest later.

Scrapers are considered elsewhere (see [page 130](#)), but they are an option that has been eclipsed by the range of mechanical sanders in today's shop. Just as I would be reluctant to give up my thickness planer, so I feel the same attachment to my 3" × 21" belt sander. However, you can have the best of both modern and traditional. This little plane can introduce you to tradition. One added suggestion, scrapers work best when held on an angle in moving forward. This adds a slicing action to cutting while still at 90° to the work. Try about a 30° diagonal forward motion and vary it until you find the sweet spot that works.

The following description builds upon the basic shape of the block plane. It has grace and function in being held by both hands even though small. The angle of 60° is cut in both fore and bed blocks. The opening lines drawn on the glue-up boards used for the block plane are reduced from $\frac{5}{16}$ " to $\frac{1}{4}$ " , because the steeper bed angle results in the blade being not so far forward. Abutments for holding the wedge replace the dowel pin in the block plane.

Design

This plane is similar to other planes, yet with significant differences. In size it is halfway between the block plane at 6" length, and the jack at 12". In blade angle it is an extreme 60° for minimum tear-out, though it could be made at 55° which is more common for smoothing planes.

In shape, the plane has the palm block made from the throat cut out like the block plane, and a razee step aft like the jack. The width is the same as the block plane using

1½ blade steel, and 2" high like the jack plane body. To relieve this height a bit, and add a slightly jaunty look, a ¼" wedge is cut away along the top surface. It reminds me of a rum runner speed boat. The razee cut away gives a lower hand hold.



SAND ANGLE FACES flat and square.

One interesting feature is the use of abutments, or slivers of wood for holding the blade wedge. Examination of old planes shows the ways for wedge retention carved into the body. A nice piece of work appreciated by anyone who has tried it. This plane adds thin pieces of wood to the sides which simulate the traditional carved ways. These pieces can be made from the wood used for the sides and are added after the body, blade and wedge are available to test their size and angles. The pieces are ¼" thick at their top and feathered at the lower end for maximum chip clearance.

There you have it, a plane incorporating features of both block and jack, while introducing a further option for holding the wedge. If you were to turn the blade around, the angle of approach is 90° making this into a scraper plane.

Construction

Starting at a point 3¼" from the front, cut the core block ($1\frac{17}{32}$ " × 2" × 9") into fore block

with a 60° face, and blade block at 60° , or 55° if you wish. Sand these faces flat and square. Make a small flat $\frac{1}{8}$ " wide at the sole opening end of the fore block. Glue up with the sides ($\frac{1}{4}$ " $\times$ 2" $\times$ 9") uses an alignment board ($\frac{1}{4}$ " $\times$ $1\frac{7}{8}$ " $\times$ 9") on which the $\frac{1}{4}$ " opening is drawn for the throat.



A SMALL FLAT is sanded in the fore block.

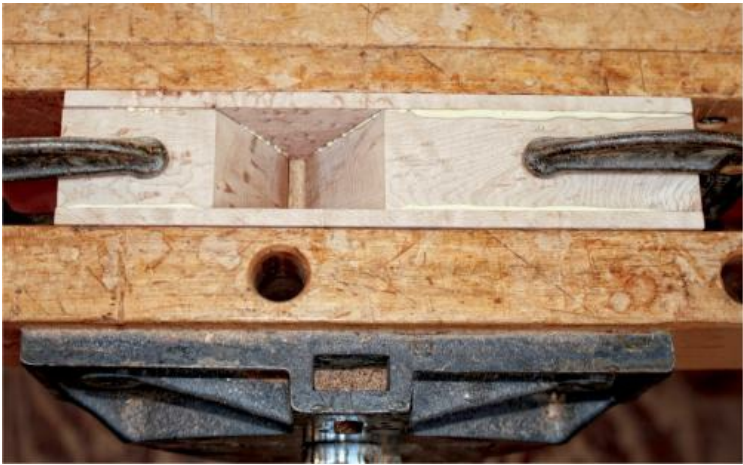


HERE WE SEE THE CORE BLOCKS clamped to the alignment board which has a $\frac{1}{4}$ " throat opening drawn for

reference. Pencil mark throat area so glue can be avoided.



ONE SMALL CLAMP holds sides in place while drilling for $\frac{3}{16}$ " $\times$ $\frac{1}{4}$ " dowel pins. An alternative of salting the glue line is described on [page 11](#).



CLAMP IN THE BENCH VISE when dry, remove glue beads from throat.

Wax this board to prevent glue sticking. Gluing core blocks and sides makes use of $\frac{3}{16}$ " dowel pins to insure the side boards do not slip under clamping pressure. First clamp the core blocks into position on the alignment board. Put the sides in place and use one clamp to hold them while drilling for two dowel pins per side. Mark a light pencil line in the throat to show where not to spread glue. Take sides off and glue all surfaces and reassemble. Dowel pins $\frac{1}{2}$ " long are driven into place with glue already in the holes from spreading the sides.

Clamping goes well in the bench vise, or you can use four clamps. In either case check

that all glue lines are tight. When dry, clear glue beads from the throat.



DRAW A LINE from the front top to a point $\frac{1}{4}$ " below the rear corner. Bandsaw and sand flat and square both top and sole.



ENDS ARE FINISHED with rounded corners and slightly curved face.



EDGES ARE CHAMFERED holding plane body at 45° and rolling the edge around the end.



THE CUTAWAY END, called a razee, is drawn following the plan. Also the palm block drawn as part of the ogee design characteristic of this plane.



THE PALM BLOCK given a 45° bevel followed by a slight rounding of its top edge. It will be glued after abutments are installed.



HERE WE SEE ALL THE PARTS cut away to form the body. The cutaway at the top of the photo came from the first cut on the plane box. The palm block is the waste from cutting the throat opening. The razee is what we call the cutaway at the back.

Cut the body by removing a $\frac{1}{4}$ " wedge of material from the top so that the front is 2" and the back $1\frac{3}{4}$ " tall. Sand top and sole flat, being careful to keep these faces square to the sides. Round the ends slightly.

Shape the scrap of wood from the throat into the palm block as shown in the drawing. This block is located $\frac{1}{4}$ " behind the blade. Holding it in place, draw the curve for the razee in the back end. Cut the razee and sand on the roller end of the belt sander. Before gluing the palm block, chamfer the edges of the plane, and add the flats to both edges of the palm block as seen in the photos. The palm block is glued later after the abutments are in place and sanded.

The wedge of 10° is made from a piece $\frac{5}{8}" \times 1\frac{1}{2}" \times 10"$. Draw a line from the corner back $3\frac{1}{4}"$, cut and sand flat. Cut out the middle area as shown on the drawing. Clamp the wedge to your bench using the salvage from the first cut to support the work. Protect your bench with a $\frac{1}{4}"$ ply buffer board. Chisel the center opening. The top of the wedge is cut and sanded.

The blade is made following instructions for the block plane. The abutments are cut from stock $1\frac{1}{2}"$ wide whose thickness tapers from $\frac{1}{4}"$ to $\frac{1}{8}"$. (See [pages 70](#) and [246](#).) Draw a 60° angle on both ends, cut and sand straight. Taper these on a sander so that the 60° edge is $\frac{1}{8}"$ thick and the taper is $1\frac{1}{2}"$ back from the end.

The wedge angle is 70° (the sum of the blade angle of 60° plus the 10° wedge) which is drawn so that the abutments are $1\frac{7}{8}"$ long. This should be a bit long to allow for sanding to fit. When abutments are cut and sanded straight, the lower point is feathered back $\frac{1}{4}"$ on the sander so no flat exists to catch shavings. When final fit is finished, glue in place holding them with wedge pressure and two fingers. Sand the top surface flush when dry.



THE WEDGE $3\frac{1}{4}"$ long is cut giving it a 10° angle. Pencil lines show where the top will be cut after shaping the throat end.



CUT THE WEDGE OPENING starting with saw cuts to define the opening and remove the waste.



CLAMP TO THE BENCH using wedge cut off for support. Chisel the bevel approach to the opening.



WITH WEDGE AND BLADE IN PLACE, mark the point where the abutment will end. This point to the front of the throat (plus $\frac{1}{8}$ ") is the length of the abutments in the next step.

The palm block is now glued. The final shape of the ogee is shaped over the roller end of the belt sander.

Once all final sanding is done finish with a thin wipe on coat of varnish. When dry rub on brown paper sack for a perfect smooth surface.



USING AN ANGLE FINDER, first draw a 60° line at both ends and cut off. Sand the end bevels so that each abutment tapers from $\frac{1}{4}$ " to $\frac{1}{8}$ ". Then cut off on the 70° line. Sand edges to fit wedge and body. Give bottom point a

feathered end.



GLUE THE ABUTMENTS IN PLACE held by the wedge and two fingers. (See the top photo on [page 72](#) for using thin scraps of wood for holding.) The palm block is the final glue step, followed by sanding the ogee shape.



MAKING SHAVINGS. With the jaunty good looks of a rum runner launch, this plane invites you to find it a place

among your bench tools.

Spokeshave

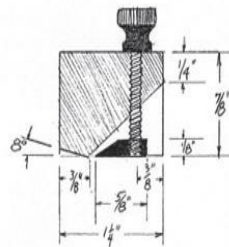
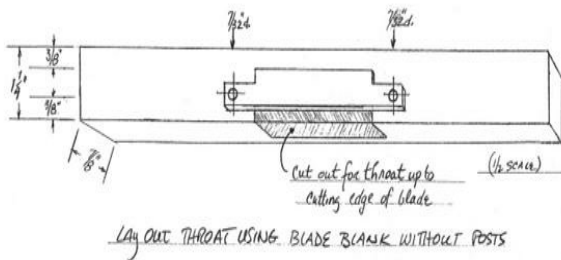
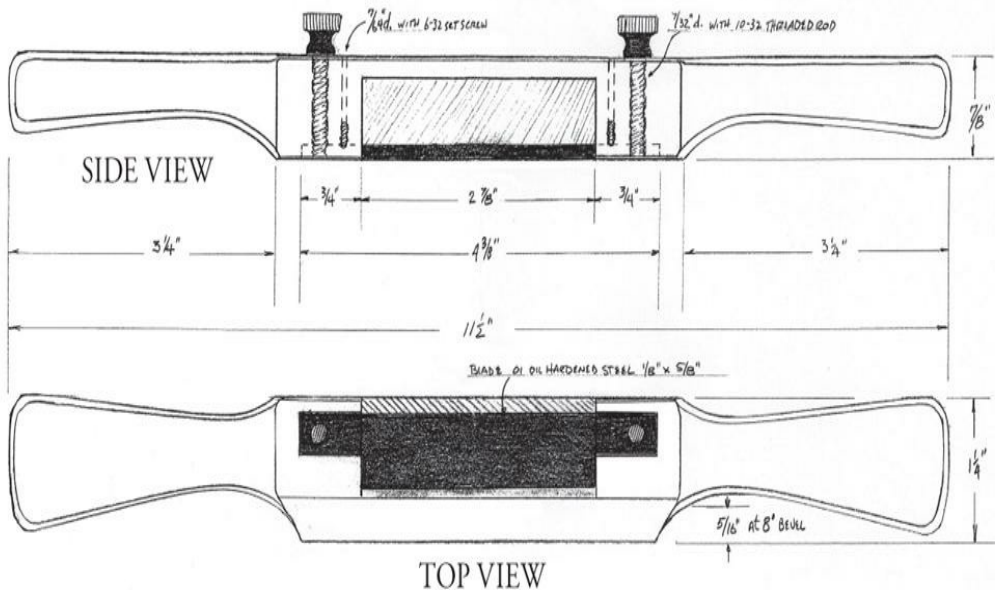


The shop-made spokeshave is a fine addition to your tool kit. The wood bodied 'shave has the blade positioned flat to the sole, rather than angled as in its steel-bodied counterpart. Sometimes referred to as razor type spokeshave, these are the ultimate of a low angle blade.

Gil Chesbro developed the spokeshave as a class project. He and I have teamed up for classes at the Home Shop since 2001. Every student has to demonstrate that his newfound tool can work before he leaves class. Having students make the blade as well as the wood body has been added to the original class. Compared to the block plane blade, it is complicated with the addition of threaded rod posts that serve to hold the blade. Leveling screws give precise adjustment that makes this tool a joy to use.



This project first appeared in Popular Woodworking #164, October 2007.



THROAT LAYOUT

SPOKESHAVE

MATERIALS

The blade and parts can be purchased locally at a mill supply, or by mail. The following items are available from Reid Supply Co., 800-253-0421 or reidtool.com. The minimum length of tool steel flat stock is 18", or enough for four blades. Therefore, you may wish to order enough parts to do four shaves.

Flat stock 01 steel	$\frac{1}{8}'' \times \frac{5}{8}'' \times 18''$	#SFS-5400, \$6.01
Brass knurled 10-32 nuts (2)		#AJ-718, \$1.68 each
Threaded rod 10-32 $\times$ 36"		#TR-57, \$8.83
Flat head wood screws $\frac{1}{4}''$ (2)	$\#6 \times \frac{1}{2}''$	

Or

Set screws (2)	6-32 × 3/8"	\$.08 each
1/16" Hex key		#10903, \$.99
You will need both a 6-32 tap and a 10-32 tap for the blade		\$3.54, \$3.58

1 *Order from general hardware, not mill supply.*

History of the Spokeshave

The traditional wood-bodied spokeshave has a blade that lays flat to the work surface, or sole, of the plane. It cuts in fine, smooth strokes that rival or surpass its cousin, the angled blade of the metal-bodied shave.

The spokeshave receives its name from wood wheel making where it is indispensable to the wheelright in planing the transition from the square hub end of a spoke to the round. And you can fit the wood sole to plane in tight recesses if needed. Just increase the angle of wood in front of the blade. I suggest ordering parts for several shaves while you are at it.

How Tool Steel Works

The project starts with making your blade which will become the template for carving the wood body. Tool steel for the blade is an alloy that changes properties when subjected to heat. The 01 (oil-hardened) stock is a good steel for general applications, and has rather forgiving parameters when heat treating.

There are three stages through which you take the steel. It is manufactured in lengths 1/8" × 5/8" × 18", enough for four blades. The cost is less than \$10. Tool steel is annealed when manufactured, meaning that it is soft enough at Rockwell 45 that it can be cut with a hacksaw and drilled.

The second stage is where the steel is hardened. Here you play blacksmith and heat the blade red hot in your shop-made furnace. The temperature of steel when it glows red is between 1,450° F and 1,700° F. The duller color of cherry red is the desired temperature range of 1,450° to 1,500° F for 01 tool steel. It is now subject to abrupt cooling by quenching in oil. The 01 steel gets its name from being formulated to require the shock that happens when it is immersed in oil that boils at 325° F. Some other steels are designed for a water quench that is a more severe temperature drop to 212° F. The blade is now super hard at Rockwell 75, but it is also very brittle, and will shatter if struck with a hammer.

To restore the desired toughness, or ductility, the blade is tempered in an oven that heats to 400° F, and then slowly cooled. This will be done in your own heat treat oven, aka toaster oven. The shiny surface of the steel at this temperature has a light straw color which is the first of a rainbow of surface patina from yellow to bronze to blue as the

steel is heated to 625°F. The final hardness is determined by the amount of heating. Light straw heating will result in a blade of Rockwell 60 hardness that possesses adequate toughness for durability.

Making the Blade

The steps for blade making are:

1. Lay out the shape and holes on the 01 steel.
2. Hacksaw the blade to length and notch the ends.



BLANKS. Cut individual blanks to length, and notch the ends. (Save the scrap piece for later.)

3. Center punch the location for holes and drill with a #21 or $\frac{5}{32}$ " drill, and tap the 10-32 threads.
4. Cut two pieces of 10-32 threaded rod $1\frac{1}{4}$ " long which serve as handles while grinding. Grind the bevel, leaving small flat on the leading edge.
5. Harden the blade by heating the sharpened edge to cherry red (1,450° - 1,500° F) and quench in oil.
6. Temper to light straw (400° F) in toaster oven.
7. Sharpen edge and flatten the back of the blade on the belt sander.

8. Use the new blade as the template for making the wood body.

9. Super glue the threaded rod permanently to the blade.

You can follow these steps as illustrated in drawings and photos. While 01 annealed steel is soft, that is relative to its hardened state. You will find that starting with a new 24-tooth blade in your hacksaw is helpful. If you have not used a tap before, they are brittle and easily broken. As you start cutting threads, retract a quarter turn for every half turn advance. That technique plus a drop of oil will prevent breaking flutes on scrap buildup.

When grinding the bevel, use two 1¼" pieces of threaded rod as handles. You will find it fairly easy going and there is no need to keep from bluing the annealed blade with heat. However, it is good practice to leave a 1/64" blunt edge to protect from carbon loss in the heat treatment.

Heating Furnace

To harden the tool steel, it needs to be heated until it glows cherry red. That puts it in the temperature range of 1,450° F to 1,500° F. If you have access to an acetylene torch this is easily done. What is helpful for those who don't is to be able to heat treat using an ordinary soldering torch and MAPP gas which is 200° F hotter than LP. Used alone there is not sufficient heat to fully turn the blade cherry red. What is needed is your own furnace.



TAP FIRST. An 18" length of 01 tool steel 1/8" x 5/8" will make four spokeshave blades. Black magic marker is used to highlight layout lines to locate holes for 10-32 threaded rod posts. Here a tap and tap wrench are used in a setup on the

drill press using a spring-loaded center (taken out of the drill chuck for viewing purposes) to keep the tap straight while threading.



GRIND THE BLADE EDGE using the threaded rod posts to aid holding. Note that the posts are attached opposite of the finished blade for this purpose. After the edge is ground to rough shape, the belt sander is my favorite means of achieving a perfectly shaped edge.

Refractory brick can be stacked as seen in the photo below to shield the blade to conserve heat. Fire brick at \$2 apiece can be purchased where pottery kiln supplies are sold, or a potter may have pieces you can have. (Do not use common brick as heat can cause them to explode.) My favorite furnace is made from two tin cans pop riveted together as in the photo at right. Here the insulating layer of air between the two cans will preserve the heat. The heavier steel used in diet drink cans such as Slim Fast® served as the inside, and an evaporated milk can for the outside. One pop rivet in the bottom held the two together.

The trick is to get the entire length of the blade heated to cherry red ready for the oil quench. That is the reason for the furnace. Your existing torch and gas may work fine. If not, try switching to hotter MAPP gas and another torch that delivers a larger flame. Wear protective gloves and safety glasses while holding the blade in the furnace with pliers. Fire is always dangerous in a wood shop, so do this somewhere where you are safe.

Have a metal container with sufficient oil in it to plunge the blade completely beneath the surface in one quick motion. Doing so will evenly quench the steel and prevent warpage. You can use motor oil, either new or used, or household vegetable oil. A red hot blade will burn the oil if held at the surface where there is oxygen.

Once the blade is hardened be careful not to drop it as it can chip in this brittle hard state. Use a belt sander to true up all surfaces. Use the threaded rod pieces to hold on to it. The final feathering of the cutting edge is done now. The belt sander will give flat surfaces with good control and low heat. Keep a water quench handy to dip into. Any belt will be used up on steel, so I use partially worn 80-grit belts no longer useable for wood.



BLADES CAN BE HEATED in several ways. Making a simple furnace will conserve heat and allow a small torch to do the job. The two tin cans are held with a pop rivet through the bottom providing a $\frac{1}{4}$ " space all around the sides. The "pencil point" torch shown here just barely delivers enough flame for heating the blade, and not enough for larger plane irons.



THE INEXPENSIVE FURNACE HERE is made of stacked -up insulating refractory brick available as pottery kiln bricks. (Do not use common brick for heating.) The plastic igniter on this torch can melt from heat reflected back from the furnace. Buy a different model, or shield it with a 2" square of sheet metal with a ½" hole in the center through which to pass the flame tube.

Tempering the Blade

The 01 tool steel is formulated to reduce the super hardness in it to a moderate Rockwell 60 with toughness restored for durability when it is heated to 400° F. You have your own heat treatment oven in the form of a toaster oven. Set the dial at 400° F and heat your blade for 20 minutes. The shiny surface will provide the heat gauge for tempering. Check for light straw color. This will be just a hint of a surface blush of color. The patina is delayed in appearance, so do not overdo it.

The blade can now be sharpened to a fine finish. Avoid any bluing of the edge, as that will mean the steel was heated to 600° F and made softer than desired at the point it is needed most — on the cutting edge.



HEAT TREATING consists of hardening by heating tool steel to about 1,450° F - 1,500° F (cherry red) and quenching it in oil. The unwanted brittleness from this step is removed, or tempered, by reheating to 400° F in a toaster oven. The blade is polished after the oil quench, and heated until the surface color is light straw. Allow it to cool slowly.



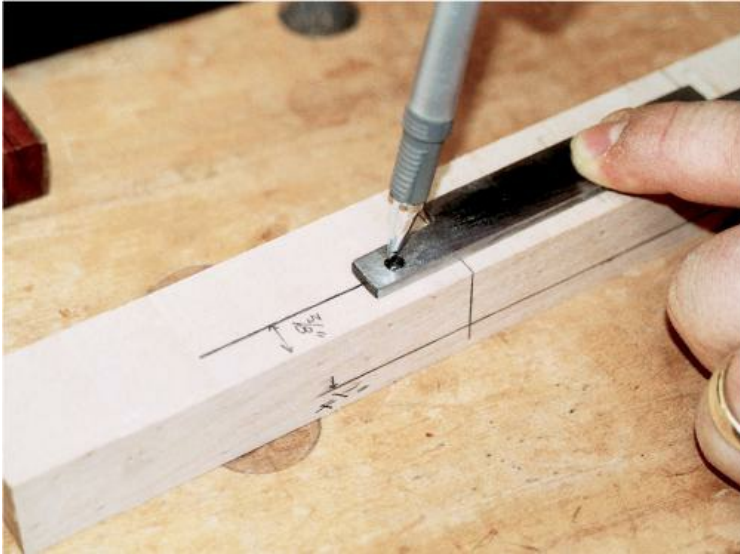
FINAL SHARPENING is done now before securing the threaded posts. Lap the back as well.

Making the Wood Body

Using a piece of hardwood, like hard maple, cut a blank $\frac{7}{8}" \times 1\frac{1}{4}" \times 11\frac{1}{2}"$. Study the plan to identify which sides of the body the blade is to be recessed and where the throat is cut out. The photo below illustrates the layout of the blade for locating the holes for the threaded posts. Using the drill press make the $\frac{7}{32}"$ holes.

Thread the posts into the correct side of the blade (opposite what is used when grinding and sharpening the blade) and insert it into your wood blank. Mark the location of the ends of the cutter which can now be extended using a square to define the throat. Cutting this with a fine saw is made easier by a wedge and V-block made from scrap wood and shown below. Remove the waste with a chisel.

The tangs of the blade are recessed using a $\frac{1}{4}"$ chisel. Use a scrap of tool steel to check for depth while chiseling. Be careful not to split out the narrow edge of the recess while using a chisel to define the tang slot. My suggestion is to use a knife for this cut line instead.



LAYING OUT THE WOOD BODY. The position of the throat and rod holes are marked, with the blade used to center the hole. Use a $\frac{7}{32}"$ bit in drill press for accuracy. (Follow plans for all layout dimensions.)



CUTTING THE THROAT IS MADE EASIER with a holding block and wedge, as shown. The wedge goes under the body, and a block with 90° cut out serves as a holder. First cut the ends of the throat with a fine handsaw, then chop the waste with a chisel.



NOW CLAMP THE BODY FLAT on your bench to chop recesses for the tang end of the blade. Here, a piece of scrap steel bit is used as a gauge for how deep to chisel.

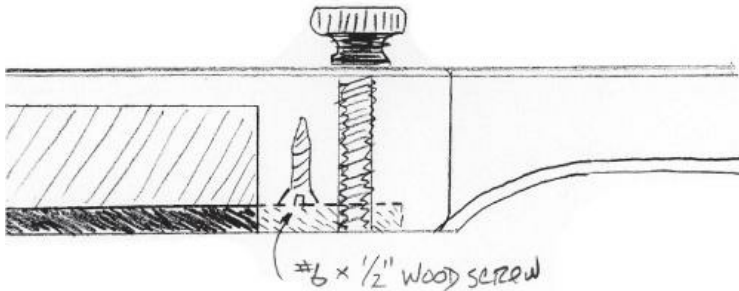
Micro Adjustment

Adjustment for blade exposure is accomplished by leveling screws under the blade. Two

methods are possible. One uses #6 $\times \frac{1}{2}$ " flat head wood screws as shown in the photo below. Adjustment is made by removing the blade and changing the screw depth with a Philips screwdriver (see photo on [page 89](#) and the drawing below). The other uses a 6-32 set screw adjusted with a small hex key as shown in the drawing on [page 90](#). Drill a $\frac{7}{64}$ " hole through the body of the shave and thread the hole with a 6-32 tap. The advantage of this arrangement is that adjustment can be made without removing the blade, only a loosening turn of the knurled nut. The disadvantage is that a small hex key may not always be at hand when needed. A Philips screwdriver is more likely. You can store the $\frac{1}{16}$ " Allen wrench in a .070" hole drilled into the handle end, and kept from falling out by adding beeswax to the hole.

Plane the approach to the throat to an angle of 8° for a good general angle for the sole. For use in tighter inshaves, the back of the blade will need to be rounded as well as the sole planed to a greater angle.

The final step in the cutting section of your shave is to install the blade and file the posts to length. They should be flush with the top of the knurled nuts. Allow the extra length to protrude through the bottom of the blade, and grind off on the belt sander. This will give you the desired flush surface to the blade and sole. A drop of CA glue will anchor the threaded rod in the blade.



ALTERNATE LEVELING METHOD



LEVELING SCREWS are put into the tang recess to control blade exposure. The flathead #6 $\times \frac{1}{2}$ " screws need the holes beveled for the flat head. A $\frac{3}{8}$ " drill bit, hand twisted into the shank hole already drilled, will achieve the necessary bevel.



THE APPROACH TO THE BLADE is beveled to allow for the curvature of the wood to be shaved. A general

angle of 8° is planed here using a block plane. With that, the cutting part of the spokeshave is done.



THE HANDLES ARE ROUGHED OUT on the band saw or with a coping saw. The shape is individual. I use the roller end of a belt sander for smoothing and chamfering the edges, preferring handles that have some “edge” rather than smoothly rounded ones.

Handles & Finish

The patterns for the handles provide the shape of the shave in my project. However, handles appear in many shapes according to personal preference. Band saw the rough outlines, and use rasps and sandpaper to smooth. You will notice that my templates provide for curves that sand conveniently over the roller end of a 4" × 36" belt sander making for a quick job. This slightly formal production look may not appeal as your personal expression. So make it your own way.

The final step is to apply two coats of varnish, which here is a wipe-on urethane thinned with naptha. Sign and date your new spokeshave. Use it with pride.



WITH THE WOOD BODY FINISHED, and the blade ground to final sharpness, the threaded posts are set using CA glue or thread locker (in the package).



A WORN SPOKESHAVE, or one made new, can have a sole plate attached and let into the narrow approach to the throat opening. Thin brass strip $\frac{5}{16}$ " or $\frac{3}{8}$ " wide and brass screws are a hardware or hobby store item.

Router Plane

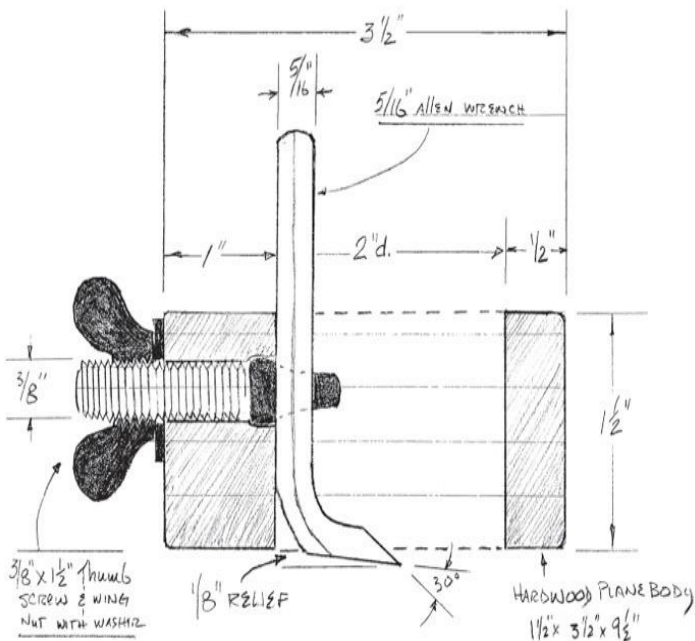


This was originally published as the “\$5 Router Plane,” but don’t let that catchy title imply that it is inferior, because reasonable price and useful can go hand in hand. The photo at right shows what this plane can do, and that is cut a slot across the grain of a board. The slot is first defined by a knife, chisel, or back saw, then ploughed out with a router plane taking off successive deeper layers if the depth is more than an 1/8” deep.

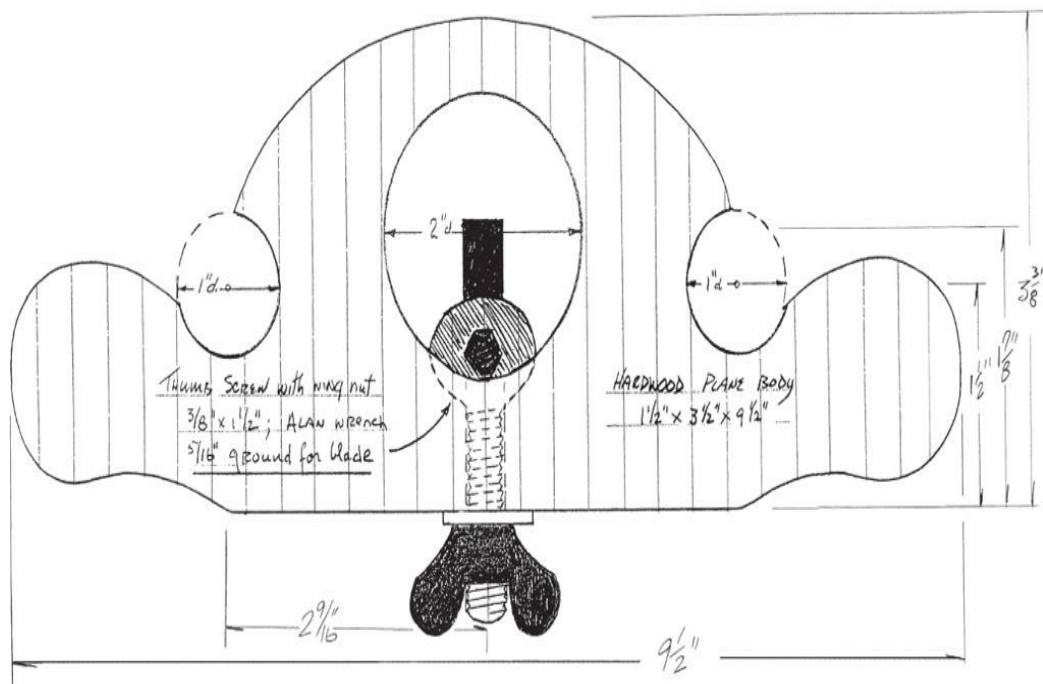
The prototype is a plane sold by E.C. Emmerich Co. of Germany. Their body is a full 2” thick and the custom cutter and holder are specially made for the plane. Looking at this useful tool, I was struck by the possibility of doing this as a shop-made project. The wood body was no problem, but what to do with the blade and holder was. The chapter to follow shows what I found.



This project first appeared in Popular Woodworking #149, August 2005.



SECTION VIEW



ROUTER PLANE

MATERIALS

$\frac{5}{16}$ " hex key (Allen wrench)	#AHK-28, \$0.90
$\frac{3}{8}$ " malleable iron thumbscrew, 1½" long	#MIT-23, \$2.76
$\frac{3}{8}$ " malleable iron thumb (wing) nut	#MIN-4, \$1.50
$\frac{5}{16}$ " flat washer	\$0.07
4" square file, $\frac{5}{32}$ "	#GRO-32-414, \$3.32

These may be purchased at the Reid Tool Supply Co., reidtool.com or 800-253-0421.

Here is a real life shop problem: The project calls for a shallow slot, or dado, in the middle of a board. Defining the edges using a wide chisel is a first step. But how best to remove the waste is a challenge. The chisel could do it, although gauging the depth accurately would take patience. Using my electric router would solve that problem, yet experience tells me that free hand use of this power tool can lead to stray excursions into surrounding margins. So fence guides would need to be set.

This situation calls for a router plane. An uncommon plane that looks different, it most often elicits the question “What does it do?” Now you know — it levels dados and hinge gains. Its right angle blade will allow you to make a flat cut of accurate depth.

Router Plane History & Use

Router planes have been made with metal bodies by Stanley and other manufacturers for more than 100 years. You can find examples in tool catalogs today. Like other planes, earlier router planes were made with a wood body to hold the right angle cutter. I happened to use a modern example of a wood router plane made by the ECE Company of Germany, the same firm who makes the line of Primus planes. ([See photo](#) showing all these planes.) It is this plane that inspired my shop-built model.

The colloquial name for this tool is “Granny Tooth” plane. It is not at all hard to use. Adjust it to depth and use it in a series of short, choppy push strokes. Just as with power routers, your application may call for more than one setting to achieve the desired depth. In any event, define the edges of the dado with a wide chisel. I find it helps to use the chisel to remove a little waste at the end of the slot so that my final strokes with the router do not split out wood beyond the desired end. Use it once and you will be convinced of the utility of this odd looking plane. Make your own and you have the added satisfaction of tool making as well as tool use, something that was very much of becoming a woodworker in times past.



SHOWN HERE are three router planes: my shop-made version (left), an E. C. Emmerich plane (top right) and a Record No. 71, each with their cutter.

Collecting Your Materials

When I set out to make my version of the ECE plane, the challenge was to make the right angle cutter and the specialty holder to attach it to the wood body. Both these parts were special forg-ings and castings, something not familiar to me. The solution to the right angle cutter is adapting a $\frac{5}{16}$ " Allen wrench. The holder is made from a $\frac{3}{8}$ " malleable iron thumbscrew with washer and wing nut. The beauty of this is that they are available from Reid Tool Supply by mail and the parts cost less than five dollars.

Start by ordering the hardware. I suggest buying two sets to make the most of shipping cost, plus giving you a backup in case making a mistake, or a second plane if you don't. Also, order a slim file for the hexagonal hole.

The wood for the plane body is made from any of a variety of hardwood. You need a piece $1\frac{1}{2}" \times 3\frac{1}{2}" \times 9\frac{1}{2}"$. The toolmakers at ECE use red beech, hornbeam, pear or lignum vitae. In Japan toolmakers often use a dense oak. My preference for wood available locally is white oak or hard maple. You may find something already on hand in your shop.

The wood body is dimensioned and the pattern drawn on the surface. Three hole sizes are required: $\frac{3}{8}"$ diameter, 1" diameter and 2" diameter. If you do not have a 2" drill, this can be cut using a scroll saw or a hand coping saw. The two 1" holes are merely to give a smooth curved hand hold, and can easily be sawn instead. The $\frac{3}{8}"$ hole for the

thumbscrew is drilled $\frac{1}{2}$ " from the top surface, centering on the 2" hole opening.



DRILL THE $\frac{3}{8}$ " HOLE for the thumbscrew. The larger 1"-diameter and 2"-diameter holes can be either drilled or sawn depending on your woodshop's drilling capabilities.



THE PLANE BODY is sawn on the band saw.



SAND the plane body.

Now cut the profile of the plane. Once the edges are sanded, round over all edges using a wood rasp, or a $\frac{1}{8}$ " rounding over bit in a router as shown in the photo below. Enlarging the $\frac{3}{8}$ " hole to receive the thumbscrew is best done after making the hexagonal hole for the Allen wrench. At this time the thumbscrew will not quite fit into the middle hole, but will later.

The thumbscrew now is drilled and filed to make a hexagonal hole for the Allen wrench. Start by drilling a $\frac{5}{16}$ " hole in the malleable iron thumbscrew head. This hole wants to be $\frac{1}{8}$ " closer to the threaded stem than the actual center. Do your drilling with the thumbscrew firmly clamped to avoid accident. I find that starting the $\frac{5}{16}$ " hole by slightly angling the drill can achieve the desired location. However, once started drill straight across so the Allen wrench will be held at right angles to the holder.



ROUND THE EDGES with a trim router. The template for the layout of the body is on the bench.



DRILL THE THUMBSCREW with a $\frac{5}{16}$ " drill, as shown here. Note that the position is $\frac{1}{8}$ " closer to the thread side of the head.



USE A SLIM TRIANGULAR FILE to make the hexagonal hole for the Allen wrench.

The hexagonal shape is achieved using a slim file similar to a small triangular file for sharpening hand saws. Orient the hex shape so that the cutter will face forward. The malleable iron files relatively easily. You want a tight fit, so keep testing for size as you file.

Now the holder and cutter (aka thumbscrew and Allen wrench) are ready to be fitted to the plane body. A $\frac{1}{4}$ " chisel will serve to enlarge the place where the $\frac{3}{8}$ " hole comes into the center opening. You want the holder to recess sufficiently so the center is held firmly against the wall of the center opening.

You are now ready to grind the cutter. The Allen wrench is already hardened suitable for the plane blade. By having a small container of water handy to the grinding wheel you can keep the temperature from spoiling the tip of the blade. Both legs of the wrench need to be shortened somewhat. Because this is hard steel, a hack saw will not work. Grind a V-groove from all sides until the end drops off.



HERE THE BLADE AND HOLDER are ready to be fitted into the plane body.



CARVE THE RECESS for the head of the thumbscrew as shown here.

Before grinding the cutter itself, study the drawing on [page 100](#) showing the angles

needed for an effective blade. Specifically, note the need for relief. In the words of the ad for stomach acid medicine, “How do you spell relief?” In cutting tools relief is spelled out as: “Nothing touches the work surface behind the leading edge.” To achieve this, the Allen wrench is ground flat on the bottom, with the angle rising steadily from the cutting edge to the back with about $\frac{1}{8}$ ” of rise. This will ensure that it will avoid skating off without being able to cut.

The top surface is ground last to give an approach angle of 30° . Both top and bottom grinding need to result in a cutting edge that lays flat to the work surface. This is a trial and error process that will take some fussing to get right. My grinding tool of preference is a belt sander. It is an opportunity to use up a partially worn belt. The advantage of the belt sander for finish grinding is achieving a flat surface, good control, and a cool working surface while using water to dip the blade.

A tool is a problem solving device. The most important part of any tool is your eye for knowing when and where to use it, and your hands to guide it to the solution. So put your new router plane to use right now. Clamp a scrap of 2×4 a foot long in your bench vise. Draw a slot an inch wide and six inches long. Now use a chisel to define the edges, and chip out a little waste at the stop end of the slot. Set your plane for $\frac{1}{8}$ ” deep, and go for it.

A wood plane with its special cutter and holder is in your hands to make it work. A valuable new tool for less than five dollars.



GRIND THE CUTTER to a 30° angle. Grinding wheel manufacturers do not recommend side grinding. Use the front for rough-in, and the side only for light finishing.



BE SURE TO GIVE YOUR ROUTER PLANE a trial run as soon as you're done sharpening the iron.

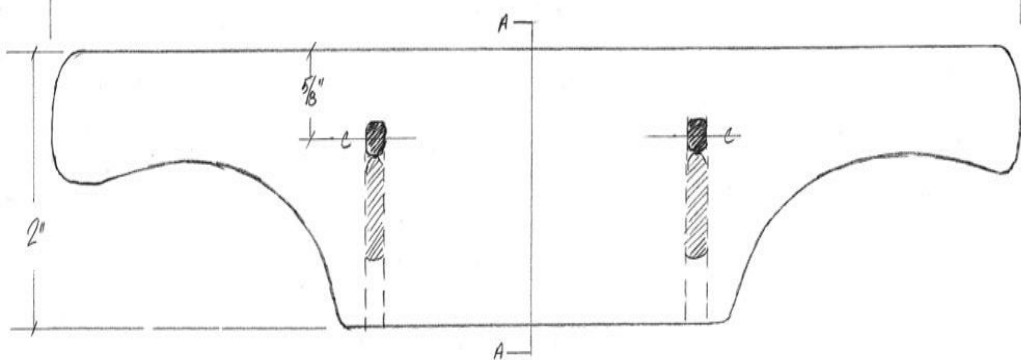
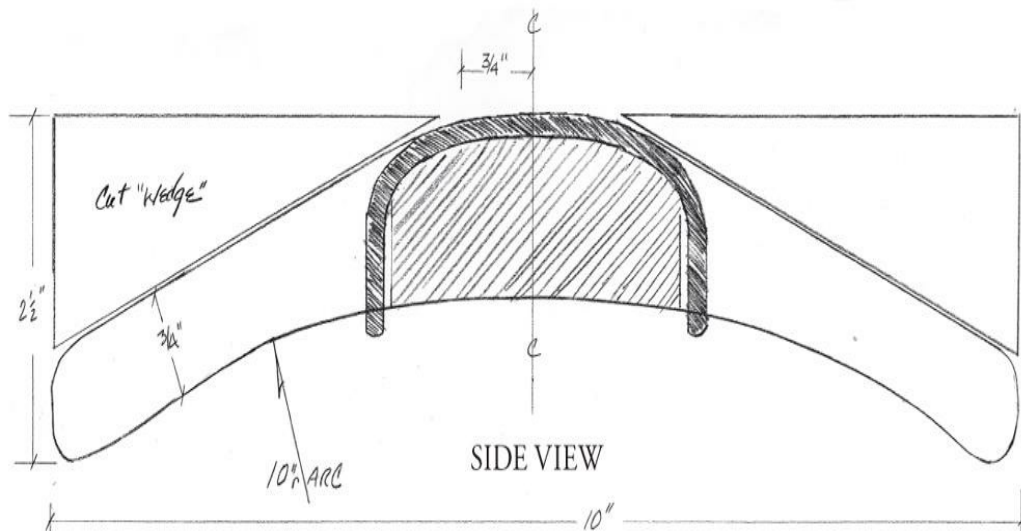
Travisher Plane



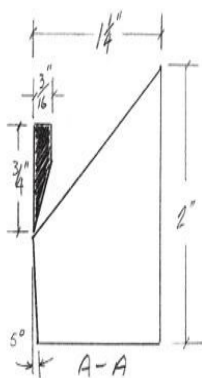
Perhaps best known to chairmakers for hollowing seat bottoms, the travisher plane is one of those specialty tools that will get in where other tools fail to go. The concave blade and rounded body allows for scooping out recesses. The appearance and the handling of the travisher is similar to the spokeshave. Where the spokeshave allows for hollowing a dip in one direction, as in the transition from a square to a round on wood wheel spokes, the travisher will hollow where the recess sets into surrounding surface as in a chair seat.



This project owes much to Gil Chesbro's creative work, as does the spokeshave and cabinetmaker's bow saw.



TRAVISHER



MATERIALS

Hardwood block	$2'' \times 2\frac{1}{2}'' \times 10''$
01 Tool blank	$\frac{3}{16}'' \times \frac{3}{4}'' \times 6''$
Set screws (2)	$\frac{1}{4}'' \times 28'' \times 1''$
Hex key	$\frac{1}{8}''$

Every trade has its quirky tools, and this one comes from chairmaking. Sit in a sculpted chair seat and you benefit from the ability of this plane to hollow out the shape to fit your bottom. Before Gil Chesbro and I teamed up to teach specialty planes, I had never seen a travisher or even heard the name. So this project owes much to Gil's creative work, as does the spokeshave and cabinetmaker's bow saw.

The travisher plane is one of those specialty tools that will get in where other tools fail to go. The concave blade and rounded body allows for scooping out recesses. The handling of the travisher is similar to the spokeshave. Where the spokeshave allows for hollowing a dip in one direction, the travisher will hollow where the recess sets into the surrounding surface as in a chair seat. As is fitting of a curved chair seat, this plane has no straight lines in either wood body or the blade. Both represent a conceptual challenge that if taken one step at a time will yield a working tool. When viewing the hard maple blank next to the finished plane body, I am reminded of the comment attributed to Michelangelo that the block of marble contains the classic statue waiting for the removal of unwanted chips. But before sculpting your classic, you must make the blade which is your pattern for locating the tang holes as well as particulars of the throat opening.



TO MAKE THE TRAVISHER (on right) you need a block of hardwood $2'' \times 2\frac{1}{2}'' \times 10''$ (above), a tool steel blade $\frac{3}{16}'' \times \frac{3}{4}'' \times 6''$ (below shown with ends cut out and beveled), and two set screws. The die for cold bending the curved shape is shown on left, and is used after the blade is cut and beveled.

Making the Blade

Like the blades used for other planes, the travisher blade is made from 01 tool steel. A blank 6" long is cut from stock $\frac{3}{16}'' \times \frac{3}{4}''$. Next the tangs are cut in each end by hack sawing a notch leaving a $\frac{1}{4}''$ tang $1\frac{1}{2}''$ long. The 25° cutting angle is ground, and the angle is achieved by making the width of the bezel surface $\frac{1}{2}''$ wide. The belt sander is used to complete the grinding of the cutter, resulting in an accurate flat face in a safe and reliable manner.

The curved blade is made cold. A 3" radius is drawn on a hardwood block which will squeeze the blade into shape. In making this wood die, note that the two surfaces facing the $\frac{3}{16}''$ steel blade are not quite the same curve. Draw a 3" radius line, then draw

a second line parallel to that $\frac{3}{16}$ " away, and cut both lines. A friend who is a tool and die maker once had the job of making a die for a Volkswagen fender. Only the plans mistakenly did not allow for the thickness of the sheet metal so another two months work went into a new die. Fortunately, the consequences of not allowing for our blade are not so dire.

The blade is squeezed in this die using a mechanic's vise. We tried bending the tangs cold as well, hammering them around while being held in the die. This is at the threshold of $\frac{3}{16}$ " 01 steel's ability to take a bend, and some blades broke. The solution is to remove the blade from the die, and heat the tang before bending. Do not quench this bend but allow it to cool slowly to prevent a brittle outcome that will snap the tang when making the final alignment adjustments to make the two tangs parallel and equal in angle.



THE CURVED BLADE IS SHAPED COLD in this hardwood die. The first squeeze is followed by several lesser ones shifting the blade from left to right to even the curve.



THE SHARPER BEND OF THE TANGS need heat. Here a $\frac{3}{8}$ " i.d. length of pipe is used to bend the tang. Do not quench. Final adjustments are made to have tangs parallel and even. The hardening and tempering of the steel follows instruction given for other planes.

Heat treating proceeds in the same fashion as other 01 steel blades. Heat to $1,450^{\circ}$ F to $1,600^{\circ}$ F range as seen in a cherry red glow with a torch. Refractory brick or tin can furnace will conserve heat to allow for even heating. Quench in oil. Temper the steel in an oven at 400° F for 20 minutes and allow to cool slowly. Curved blades are harder to grind and polish than straight ones. A small drum sander chucked into the drill press works. Curve a baton of wood to hold successively fine sandpaper to give a final edge.

Sculpting the Travisher Body

The wood for your plane body needs to be a smooth dense hardwood such as hard maple. The blank is $2" \times 2\frac{1}{2}" \times 10"$. Start by drawing the location for the tangs. Draw a line $\frac{5}{8}"$ from the edge on the $2"$ face. Lay your blade on this line to locate where to drill $\frac{9}{32}"$ holes. Use a small chisel to make the holes square to fit the tangs. Refer to layout and cutting diagrams for this work.



THE FIRST SERIES OF CUTS to sculpt the body start with drawing the curve of the blade and extending these lines to the edge. A second cut on a 10" radius arc cuts away the other side.



HOLES ARE DRILLED for the tangs which are squared with a chisel. The blade used to locate the holes and the cut away pieces are shown on the bench.

The first cut is to shape the sole. Draw an arc where the cutting edge will go. Extend these lines straight to the ends of the block. After band sawing the wedge from each end, smooth this surface on the belt or disc sander. The other side is cut on a 10" radius arc.

Next lay out the lines for the throat. This is a curved recess removing wood from where the cutter will be making shavings. Draw two lines 3" apart back from the ends of the cutter where it meets the wood body and extend them 1" down the back face. These are cut with a trim saw, and the throat opening chiseled. The throat mimics the curve of the blade as you can see in the photos. Holding the wood on an angle for sawing and chiseling will go easier with a notched block and clamp as shown in the photo below.



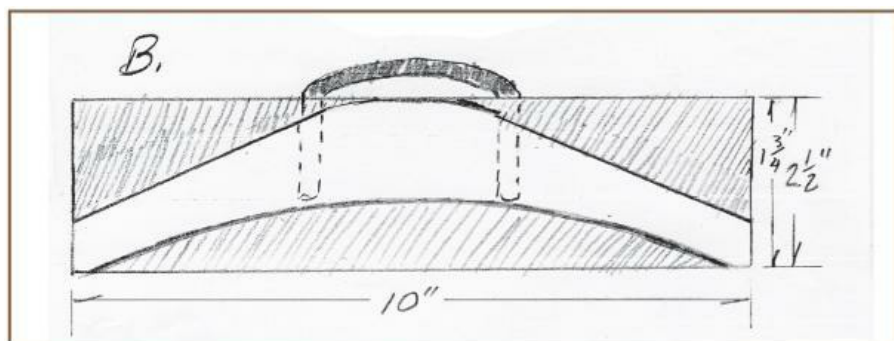
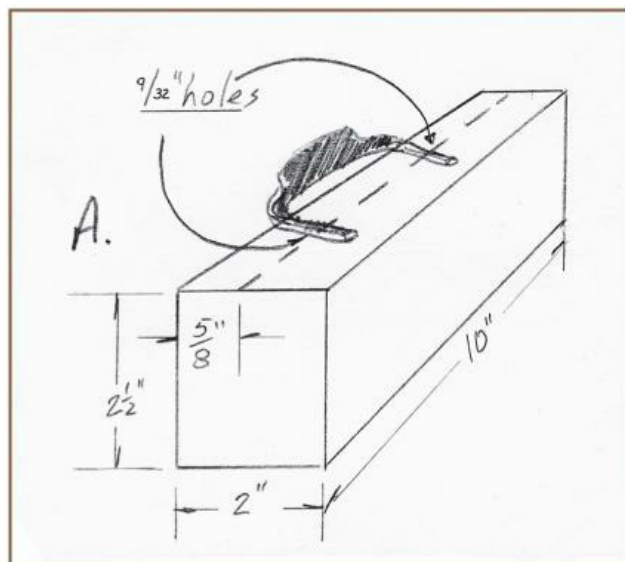
THE THROAT IS DEFINED by saw cuts. The curved shape is held by a block made for holding it while sawing and chiseling the opening.

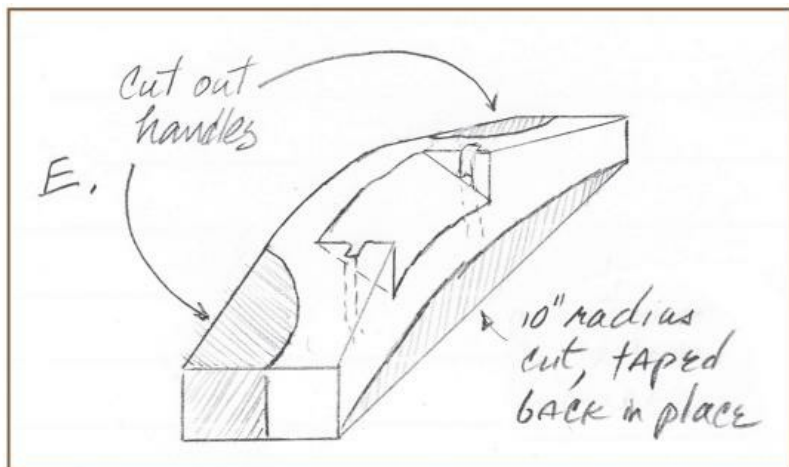
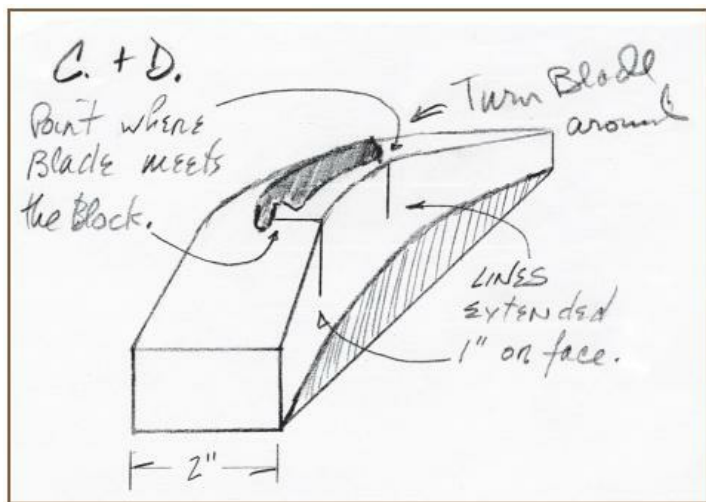


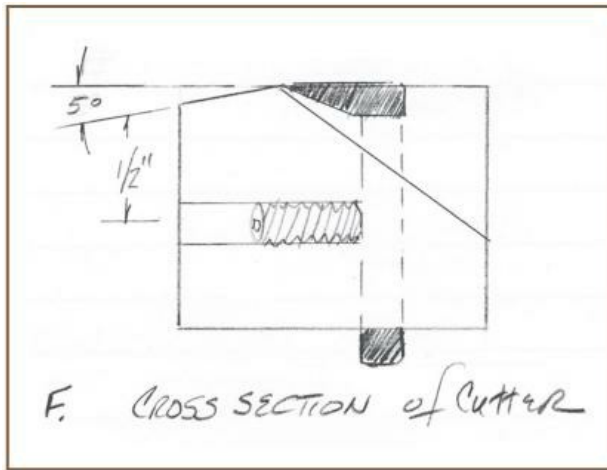
CHISELING THE CURVED THROAT OPENING uses both the angle block and a bench stop.

LAYOUT & CUTTING

- A. Draw line $\frac{5}{8}$ " from edge of 2" face of block. Lay blade on this face, and drill $\frac{9}{32}$ " holes where tangs intersect the $\frac{5}{8}$ " line.
- B. On the $\frac{1}{2}$ " face, draw the arc of the blade, and extend the lines to each end $1\frac{1}{4}$ " from the edge of block. Cut the wedges, and sand the arc to a fair curve. Cut the 10" radius arc from the other side. Square the tang holes.
- C. Start the layout of the throat from the point where the blade meets the block. Extend the two lines to the edges of the block. Extend these 1" on the other face. Use a notched block and clamp to hold back on a 45° angle while sawing and chiseling throat.
- D. Drill and tap for set screws to hold blade tangs.
- E. Tape the 10" arc cut away back in place. Draw hand holds on 2" face and saw. Smooth and chamfer on sander.
- F. Sole is extended to an 5° bevel as an approach to the cutter.







Insert the blade to make final adjustments. The sole ahead of the cutter has an 8° bevel which is sanded on the disc. The blade is held in place with set screws. The location of these holes will intersect the tang holes using a $\frac{7}{32}$ " drill. The hole is tapped with $\frac{1}{4}" \times 28$ threads to receive a set screw. The cutaway from the arc cut into the side opposite the sole is then taped back in place while the handles are cut to the profile shown on the drawing. The edges are chamfered to give a comfortable hold.



THE FINAL CUT creates the handles. The scrap block is taped to the underside to give a level base to the work.



THE $\frac{7}{32}$ " TANG HOLES are threaded to receive the $\frac{1}{4}$ " $\times$ 28 set screws. Again the back is supported with the cutaway block.



THE FINAL SHAPING is the 5° approach to the blade sanded on the sole.



SANDING ALL AROUND seems to fit well with the 4" × 36" belt sander. When surfaces are smooth and fair, chamfer all edges to make for comfortable holding.



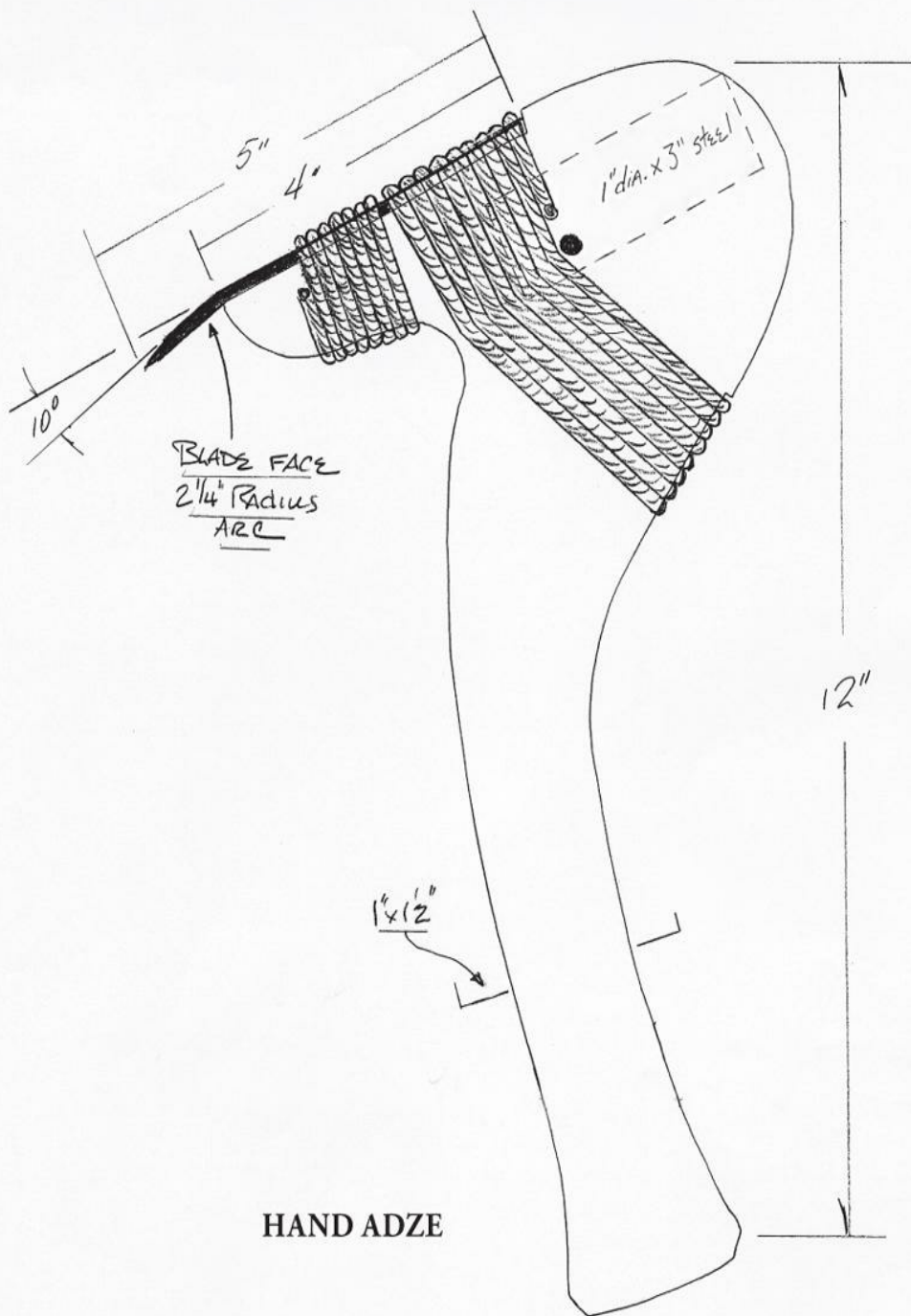
HARD TO BELIEVE all these pieces come from one $2'' \times 2\frac{1}{2}''$ block. Like sculpture, there resides a travisher waiting to be released from the block of wood.

Hand Adze



I first saw a hand adze used by craftsmen at the Kamba Carvers' Union in Mombasa, Kenya in 1969. They were sitting on the ground with a couple of dozen billets of wood in a basket on one hand, and a saw and hand adze with which they applied one cutting and chiseling operation to each billet as it was transferred to a basket on their other side. In short order operations were made in each as the work lot was passed back and forth until final sanding was done by an apprentice nearby. Kamba figures of African animals were sold by street vendors and stores throughout the region, what we referred to as "Airport Art" made for tourists. Items were cheap. What I did not appreciate until my visit to the Kamba carvers' association was how efficient and elemental were the tools of the trade in skilled hands. The combination of tool and skill earned them a living on a par with school teachers in Kenya.





HAND ADZE

MATERIALS

Hardwood	$1\frac{3}{4}" - 2" \times 6\frac{1}{2}" \times 12"$
Wood pins (2)	$\frac{3}{16}"$
Nylon cord	$\frac{1}{8}" \times 15'$
Epoxy	
01 Tool steel	$\frac{1}{8}" \times 1\frac{1}{2}" \times 5"$
Steel rod	$1" \text{ dia.} \times 3"$

Three different folk traditions have their influence in my hand adze. Besides the Kamba carvers are the Indians of the northwest coast and the Portuguese boatbuilders. Both these later examples are shown alongside this adze. It would be interesting to go back in time and acquire a Kamba adze. If memory serves me right, they were a medium sized chisel with a narrow tang that pierced the knot end of a small wooden club used as a handle. What I don't remember is the angle of the blade to the handle, and my adze required some experimenting to make it have an effective bite in hollowing chair seats. The means of attachment follows the Northwest Indian tool.

Handle

The thickness of the blade steel defines the thickness of the handle, which is $1\frac{1}{2}"$. Ideally, a natural fork is used to ensure strength. The one shown below came from a locust crotch that was destined for the fireplace before rescuing for a higher use. The adze as drawn would be amply strong using white oak, hard maple, or hickory from a $\frac{8}{4}$ flat sawn plank readily available from a furniture wood supply. The head of the handle is bulky for more than strength, as it gives heft to the tool which otherwise has a blade that is lightweight by adze standards. See [page 123](#) for the addition of a 3" slug of 1"-dia. steel for better head weight.



A **HAND ADZE** in the Northwest American Indian tradition (left) and a Portuguese boatbuilder's adze (right) give influence to the project shown here. The former shows how to attach the blade. Following the Portuguese adze angle was not suitable for chair seats, and my final version abandoned this acute angle.

The angle of the blade to the handle is of some importance, and is determined by personal preference and the intended use. My adze is needed to hollow chair seats. The angle of the northwest Indian adze would suit carving a totem pole or hollowing a log canoe. As the blade becomes more parallel to the handle, the action of the adze changes from chopping to a draw knife stroke. The ability to select for yourself the proper angle is what tool making is all about.

One thing I like about the Portuguese adze is the rough texture of the wood handle. The

ability to get a good grip and maintain it for long use depends on handle shape and surface friction. Tool marks from chisel and spokeshave are left to texture the surface, and unvarnished wood is the best finish. For size, the 1½" square blank is pared down a bit, leaving a slight enlargement at the end to give a good hold.



THE ADZE BLANK leaves ample wood in the head to give heft to the tool which will finish out at 24 oz. The blade fits the small notch seen on the left face. The 1¼" to 2" thick maple is having the grip thinned to 1".



SHAPING THE HANDLE with a spokeshave will leave tool marks that improves the grip. The roller end of a belt sander is another method. Again leaving some hard edges rather than smooth rounds will make the adze easier to use. The pommel or flair at the handle end also improves the grip.

The blade holding face is cut down so the blade has a stop to hold its end. The $\frac{1}{8}$ " nylon cord will need two things to hold it in place. Two small wood studs, either cut from $\frac{3}{16}$ " dowel or whittled from a splinter off the handle, are set in holes $\frac{1}{4}$ " deep close to the blade and just before its end stop. The other side is notched and both hold the cord from slipping.

Blade

The blade is a 6" length of $\frac{1}{8}$ " $\times$ $1\frac{1}{2}$ " O1 tool steel. This versatile steel is adaptable to forming cold the curve of the cutter and the angle of the blade. A blank $\frac{3}{16}$ " thick would serve, too, but requires heat to form the curves. The blade face is a $2\frac{1}{4}$ " radius arc and the angle is 10° . Secure $\frac{1}{4}$ " of the end in a vise and hammer the blade until it matches the 10° angle scribed on a scrap of wood.



HAMMER A 10° BEND in the blade 1" back from the end, then form the 2/4" arc by peening the cold steel. Gauges of 10° and the arc made from scrap wood will measure your progress.



GRINDING THE OUTSIDE of the blade. The final edge is a combination of major bevel outside, and smaller bevel inside to give a resulting 25°. Inside shaping is done with a small drum sander in a drill press.

The inside curve of a railroad iron served as the recess in which to peen the curve of the blade. Heating the steel and forming it over an outside curve, such as an anvil or closed jaws of a metal vise, may be your solution. Make a gauge from a scrap of wood with the 2¼" arc to test the shape.

Once the shape is made, grind the cutter. Final sharpening is done on a belt sander and sharpening stones. The inside of the curve is lapped using a curved wood paddle and fine wet or dry sandpaper.

The blade is hardened and tempered in the same fashion as other planes: torch heat in a tin can furnace to cherry red, then quenched in oil. The tempering is oven heating to 400° F for 20 minutes, then slowly air cooled.



HONING THE INSIDE CURVE is done using a curved wood paddle wrapped with fine wet-or-dry sandpaper.



HARDENING THE BLADE heats the end to cherry red, then it's quenched in oil. Follow this with tempering in a toaster oven or kitchen oven at 400° for 20 minutes. Let cool slowly.

Attachment of the Blade

The handle is already prepared to receive the blade. The face is recessed $\frac{1}{8}$ " to provide a stop 2" from the head of the handle. The wrapping could be various strong cord. What I used comes from boatbuilding where oar looms are wrapped with $\frac{1}{8}$ " nylon cord impregnated with epoxy. Lighter line would work as well. It's the epoxy that impregnates everything together. If the head loosens in later use, another dose of epoxy will make it tight. The wrap of line starts and ends in a $\frac{1}{4}$ " -deep hole into the handle. This can be sealed with CA glue as you start the wrap, and tucked into another hole and sealed when finished.



BLADE AND HANDLE ARE JOINED with nylon cord. Here the end is placed in a hole, and sealed with CA glue. A similar glued hole finishes the wrap. A $\frac{3}{16}$ " pin is inserted in both sides to guide the cord wrap. The handle can be notched to receive the cord, in this photo just beneath the cord.



CLEAR EPOXY BONDS cord, handle and blade. Any future tightening is accomplished with another dose of epoxy.



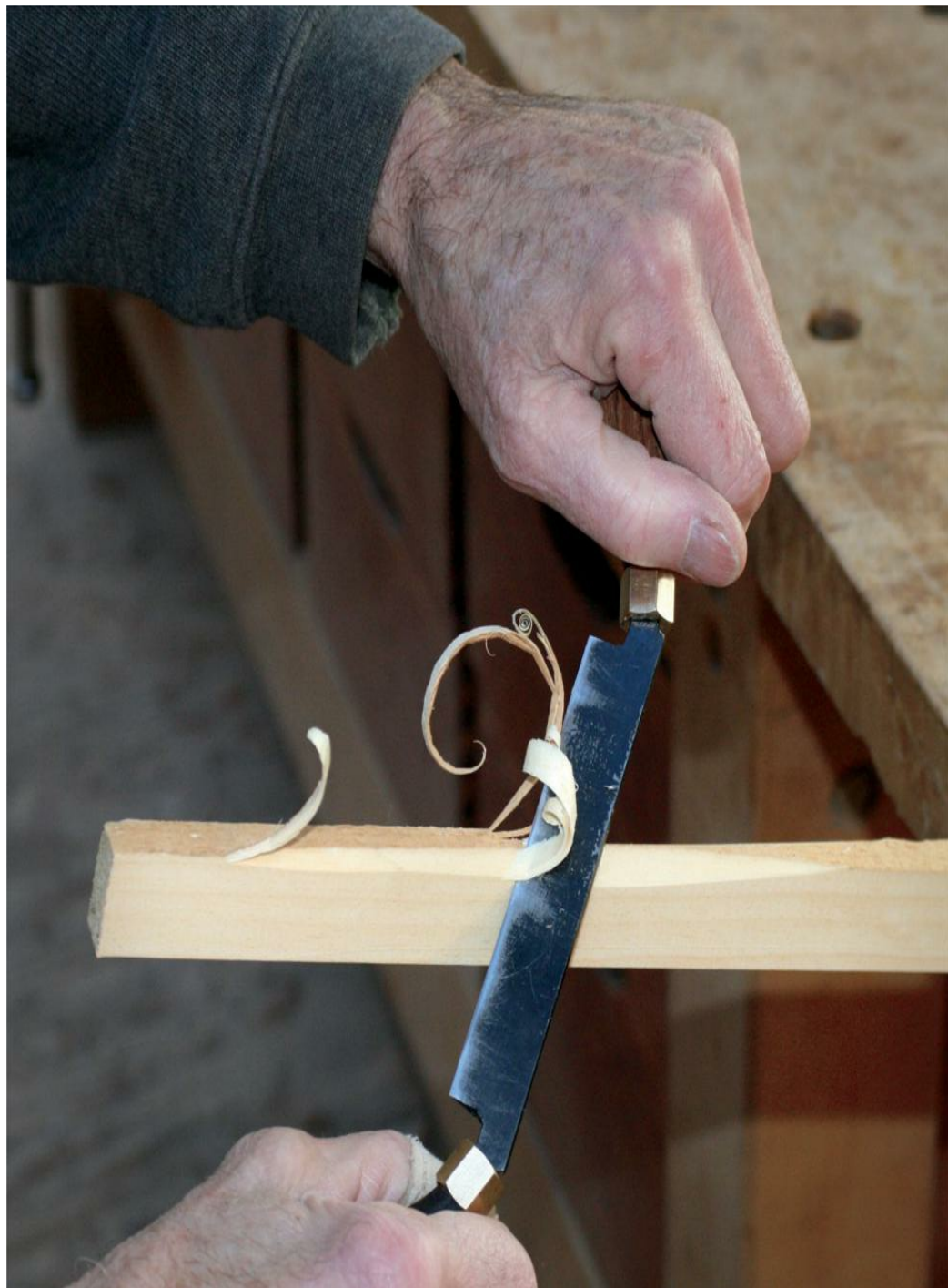
THE HAND ADZE is improved with the added weight of a 3" long slug of 1"-diameter steel epoxied into the large wood head. This will add 10 ounces of momentum to each stroke. Drill a 1" dia. $\times$ 3" hole into the wood head, and a $\frac{1}{8}$ " dia. hole into the bottom of this hole for glue escape. (See also [page 258](#).) You may also extend the handle to 34" and make a full adze.

Shop Drawknife

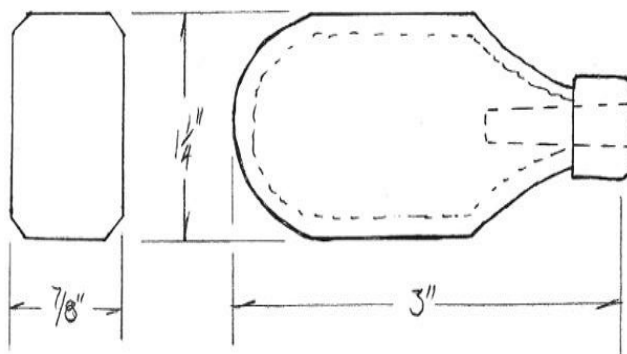


A tool by definition solves a problem. It gets something done in the hands of one who knows how to use it. Make it a part of your tool kit, and you reach for it automatically when something needs doing. That is ownership. The drawknife is often seen as an interesting artifact in the flea market or museum more than being a useful part of your tool kit. That was my experience throughout my school and teaching career. It hung in the tool cabinet, never taken down, nor do I recall ever seeing others use it.

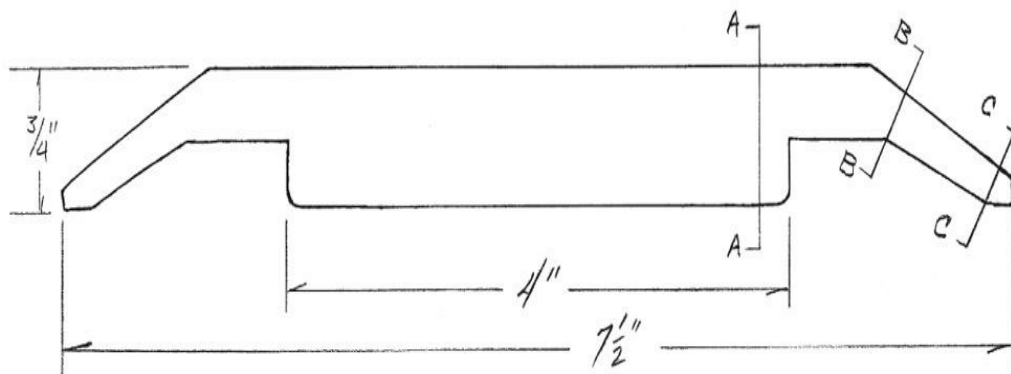
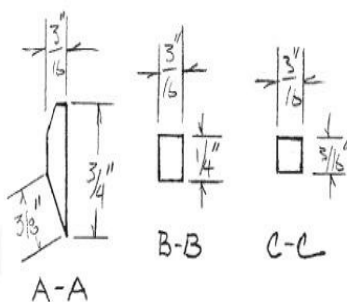
Find out how this handy-size drawknife with side-mounted handles can earn a place in your shop.



This project owes much to David Abeel's creative work in chair making at the Home Shop.



HANDLE WITH BRASS FERRULE



3/16" X 3/4" 01 TOOL STEEL BLADE

MATERIALS

- 01 Tool blank $\frac{3}{16}'' \times \frac{3}{4}'' \times 7\frac{1}{2}''$
 Ferrules (2) $\frac{1}{4}''$ compression nuts
 Handles (2) $\frac{7}{8}'' \times 1\frac{1}{4}'' \times 10''$ hardwood

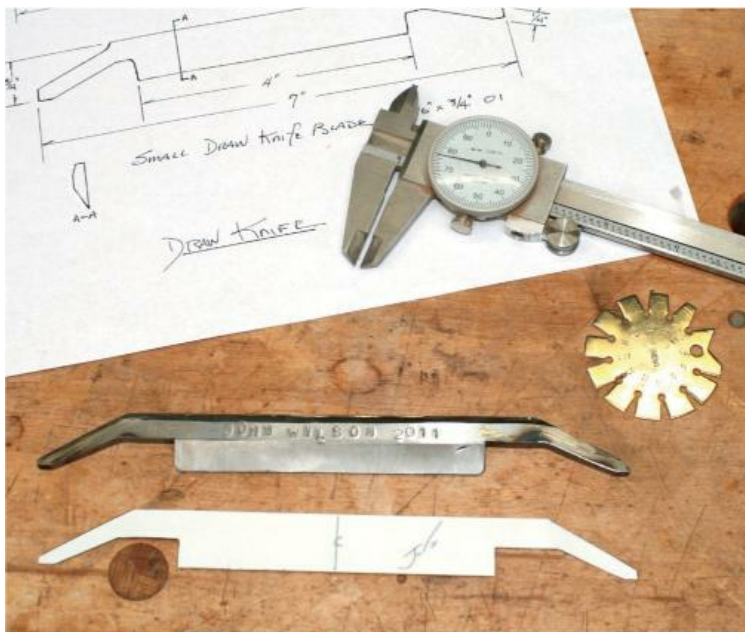
Three situations recently have made me come to appreciate this tool. One was watching a canoe paddle being made where the blade was taken down from $1\frac{1}{2}''$ -triick pine blank to the finished $\frac{3}{8}''$ thickness and then shaping the handle grip with a drawknife. (“Canoe Paddle”, *Popular Woodworking* #142, August 2004.) The second is timber framers who peg their frames, and the pegs are made by whacking off splits of wood and using a drawknife at the shaving horse to make strong, coarse pegs to pin mortise and tenon joints in beams. Finally, chairmakers make use of many spindles and rungs and posts. The most familiar way is to use a lathe to turn the square to a round and add embellishments for style or strength. Less familiar is to use a drawknife to rough out the shape and finish with a spokeshave.

In each case the drawknife in the hands of the craftsman is an efficient way to rough out a shape for use as is or to trim using a finer tool. As such the drawknife is in a class by itself. You have to watch someone skilled in its use to appreciate its ease and efficiency. It gives you a new approach to working wood.

Drawknives come in a variety of sizes. The one made here with a 4" blade is smaller than most, and is the favorite of David Abeel, who comes to the Home Shop to teach Windsor tall stools and side chairs. David likes it because your arms are close to your body when using it. Control and ease of use results from that. Take a billet of wood for a chair leg or stretcher, clamp it in your bench vise, and render it from square to tapered round in a matter of a few strokes. Amazing. A tool as a problem solver.

Making the Drawknife

The blade is a blank of O1 tool steel $\frac{3}{16}'' \times \frac{3}{4}'' \times 7\frac{1}{2}''$ notched at both ends to define the tangs for the handles. The 4" blade is ground to a 25° bevel, the trailing edge relieved an $\frac{1}{8}''$ to allow for a tighter curve. See the drawing for details and the blade profile. The use of $\frac{3}{16}''$ -thick steel follows the original knife. An option is to use $\frac{1}{8}''$ steel which is used by Veritas Tools in their 4" drawknife. When using the thinner steel, the cutting and grinding is less tedious and the back edge of relief can be skipped. However, the feel of the heavier tool is more to my liking.



CUT THE BLADE and grind and file to final shape. Here a brass bevel gauge helps achieve a 25° bezel. The dial indicator is useful in getting accurate tang size. The aluminum pattern was used in drawing the layout.

The size of the tang determines good retention without splitting the wood handle. A $\frac{3}{16}$ " $\times$ $\frac{3}{16}$ " size tang has a diagonal dimension slightly more than the $\frac{1}{4}$ " hole size. In this situation add a slight taper so that the end is $\frac{3}{16}$ " and the hilt $\frac{1}{4}$ ". The strong brass ferrule used here reinforces the wood handle to ensure a secure fit.

Heat the blade to cherry red (1,450° F - 1,600° F) as shown in the photo on [page 128](#) using a simple tin can furnace to focus the heat from a propane or MAPP gas torch, or use an acetylene torch if available. Quench in oil to harden. The tempering is 350° F - 400° F for 20 minutes in an oven followed by allowing the steel to slowly air cool.

The handles are cut from $\frac{7}{8}$ " $\times$ $1\frac{1}{4}$ " hardwood. Hard maple is traditional, but in this instance rosewood handles give a nice contrast to the brass ferrules. You can cut ferrules from copper tubing, but I found a brass part in the plumbing section that adapted well to the knife. They are screw caps for $\frac{1}{4}$ " soft copper flair fittings. The caps were sold separately for 50 cents each, but the entire fitting is reasonable enough to buy one and remove the caps. The $\frac{1}{4}$ " hole in the cap needs to be filed square with a slim triangular saw file to fit the square tang.

The handles are 3" long with the ferrule end shaped before cutting to length. This end needs to fit snugly into the ferrule so use a rasp to finish the fit. Cut to length, round the end, and chamfer the edges. The feel of a cut and shaped handle like this is different than a turned knob. It is your preference whether you turn a traditional knob or cut one like this.

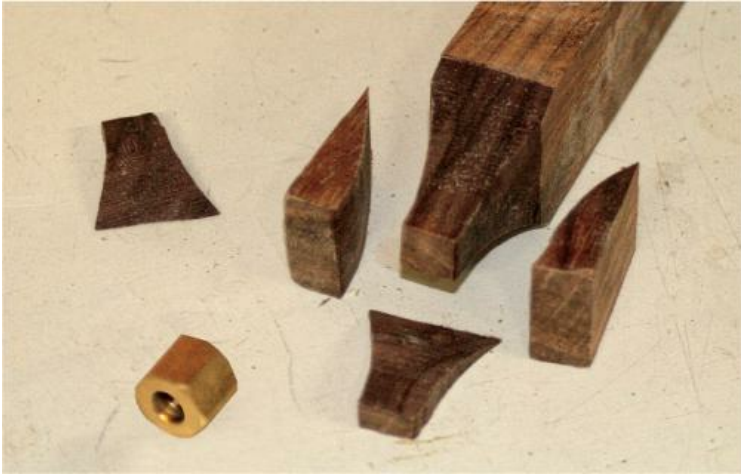
The ferrule is tapped securely on to the handle. Then a 1/4" hole is drilled through the ferrule into the handle. Driving the handles is shown at the bench vise with the lower end resting on the vise ways and the upper end held at the proper angle with an auxiliary board clamped to the vise.



HARDENING THE BLADE is done using a torch that delivers sufficient volume of flame. Such torches have a valve screwed on the end and delivery tube side mounted. The heat is focused in a furnace made of nesting tin cans. The pot holds soy oil for a quench. Keep all surfaces clear of wood and sawdust to avoid fire.



TEMPERING THE BLADE to restore necessary toughness following the cherry red heating and oil quench. It is done by heating to 350° F - 400° F in an oven and allowing to cool slowly.



THE FIRST CUTS to make the ferrule end of the handle. A piece of hard maple or rosewood $\frac{7}{8}" \times 1\frac{1}{4}"$ is used. The brass ferrule is a compression fitting for $\frac{1}{4}"$ soft copper plumbing.

While smaller than its cousins used in timber framing or paddle making, this knife deserves a place at your bench to effectively cut down a spindle or rough out a board. It will shave in the manner of a chisel or plane in skilled hands that appreciate a sharp tool of the right size.

NOTES ON DRAWKNIFE USE

Bevel Up or Bevel Down? The rule is simple: Whichever works in a given situation, do it. That said, bevel down affords more control to avoid going too deep. The next steps add to this debate.

Dub the Blade. This means giving a 5° sharpening angle to the flat side of the blade, something generally avoided in sharpening chisels. Dubbing makes it possible to lift the direction of the cut slightly when it wants to go too deep when using the knife with flat side down.

Ride the Bevel. As wood turners know in holding a chisel on a lathe, steady depth of cut comes from getting the feel for the bevel angle of the tool to control how deep to cut when using the knife with the bevel side down.



THE BELT SANDER shapes and chamfers the handle. To achieve a tight fit on the ferrule, use a rasp for the final sizing. The pencil line for the 3" handle will be cut on the band saw and finished on the sander.



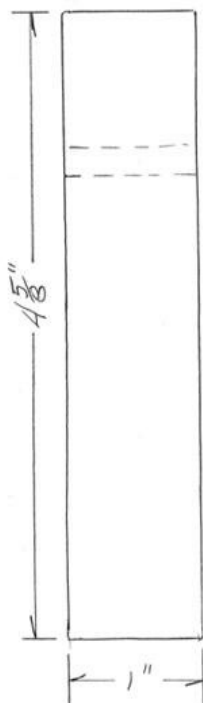
THE HANDLE IS DRILLED to receive the blade tang.



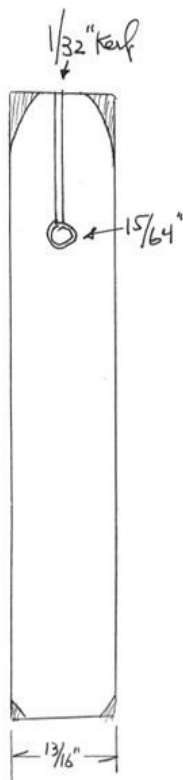
HELD IN THE VISE with the lower end resting on the bed ways, the handle is tapped in place.

I have several of these scrapers around the shop along with an 8" smooth file. Hardly a day goes by without taking them in hand to remove a rough place or erase a pencil line.





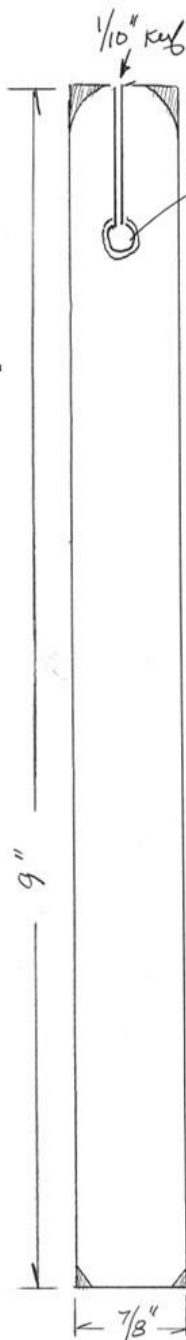
TOP
VIEW



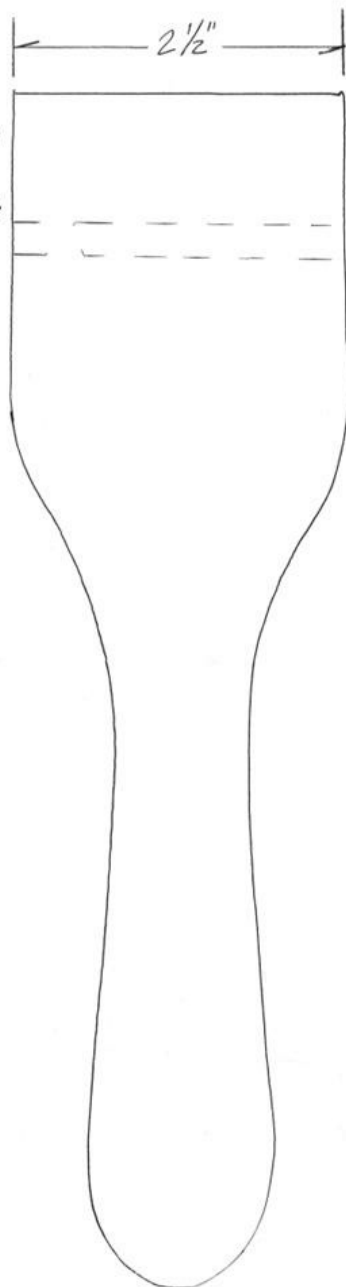
SIDE
VIEW

HANDLES FOR
1" & 2 1/2" RED DEVIL
REPLACEMENT BLADES

SCRAPER



SIDE VIEW



TOP VIEW

MATERIALS

Hardwood	$\frac{7}{8}'' \times 2\frac{1}{2}'' \times 9''$	
	$\frac{13}{16}'' \times 1'' \times 4\frac{5}{8}''$	
Replacement blade	1''	Red Devil, #3061
Replacement blade	2½''	Red Devil, #3063

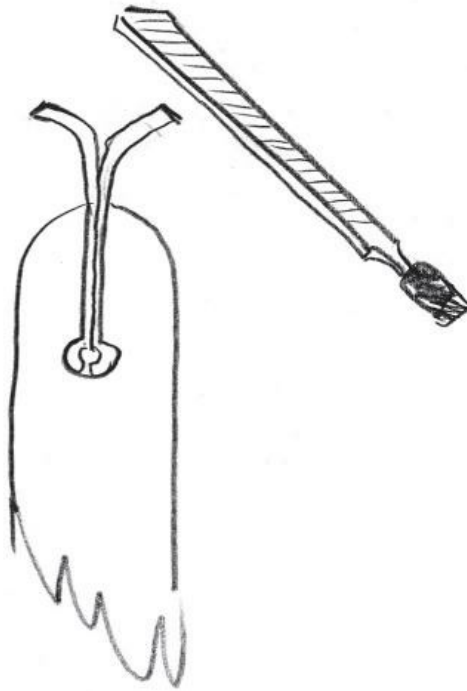
Scrapers come in a number of styles. The traditional card scraper is about the size of a 3×5 card of steel $\frac{1}{16}''$ thick that can be filed. You need to be initiated into how to sharpen the card scraper. The cutting edge is a hook applied to the filed edge with a burnishing tool in such a way that the edges are pushed down and out so as to turn a hook along the edge. This does the cutting.

Perhaps because of the mystique of card scrapers, it seems almost common to use the 2½'' Red Devil. Don't be fooled. The hook is already incorporated in the turned ends of the scraper blades. They are mounted in a handle 9'' long. Red Devil sells both the complete scraper (product #3050) and replacement blades (product #3063). The replacement blades are used to make up your own scraper. It is an exercise I have my sharpening class do because a sense of ownership of the tool is enhanced. The hardwood blank is cut out and the end is drilled and a slot cut to receive the replacement blades.



A FAVORITE PAINTING that I have had pinned above my bench shows how it was to scrape a ballroom floor before the advent of the electric floor sander. The workman to the left is reaching for his file to sharpen the blade. The man to the right uses a plane. The bottle of wine is not misplaced for this task either. Note the shavings accomplished with scrapers used by skilled hands. The year is 1875.

Credit: Raboteurs de Parquet, 1875 (oil on canvas) by Gustave Caillebotte (1848-94); Musee d'Orsay, Paris, France/The Bridgeman Art Library; Nationality/copyright status: French/out of copyright



FILE STROKE at 30° to blade.

The gap between the turned end of the blade and the end of the handle is not quite large enough, so it has a tendency to jamb up shavings. The solution to this comes in two ways. The first is to cut off $\frac{1}{4}$ " of the handle to provide a larger gap. The second is to develop a stroke that holds the tool at a 30° angle to the direction of scraping. This makes for efficient cutting and achieves the curling out of wood shavings that won your heart over when first demonstrated. It takes a little practice to develop this angled stroke, but the effectiveness of the scraper depends on it.



SHARP AND DRAWN WITH ANGLED STROKE produces curled shavings thought only possible with a plane. The blade slices when 30° to the line of pull. Less angle and the shavings pile up jamming the opening behind the blade. Counter to what you might think, scrapers work best on hardwood like cherry and maple and less on softer woods like pine and basswood.

New blades need filing. As they come from the factory the edge is not only dull, it is at too steep an angle. It looks to be more than 45° to the blade which will cut fast, but not hold an edge as well as a bezel at 30° . The smooth 8" flat file is used to sharpen the edge. As mentioned in the section on sharpening, filing is done so that the dull edge which reflects a glint of light can be watched as each stroke of the file lessens it until you can stop as a fresh edge is made right across the bezel.

Besides changing the bezel from over 45° to about 30° , the edge is given a slight curve

to prevent the ends from leaving a cut mark sometimes referred to as a gutter on your work. This is achieved by bearing down a bit with the file at the beginning and end of its stroke until the slight crown is established. You can also grind and file a profile in the scraper for special needs.

There are situations that call for a narrower scraper, and Red Devil makes smaller scrapers and narrower blades. The 1" scraper is product #3010, and the replacement blade package #3061.

The most important advantage of this style of scraper is its ease of use. Because of the handle arrangement, you have a strong grip on it to enable you to effectively remove surface wood without undue straining of your hands. Master the angled stroke of a sharp scraper, and you will be amazed at the efficiency with which it can be used.

One footnote on the effectiveness of a scraper on different species of wood. Contrary to what you might think, the harder the wood the better they work. It seems soft wood fibers crush ahead of scrapers rather than holding their shape and allowing the scraper to slice. Pick a cherry or maple board for testing your new found tool in order to give it a proper workout.

Cabinetmaker's Bow Saw

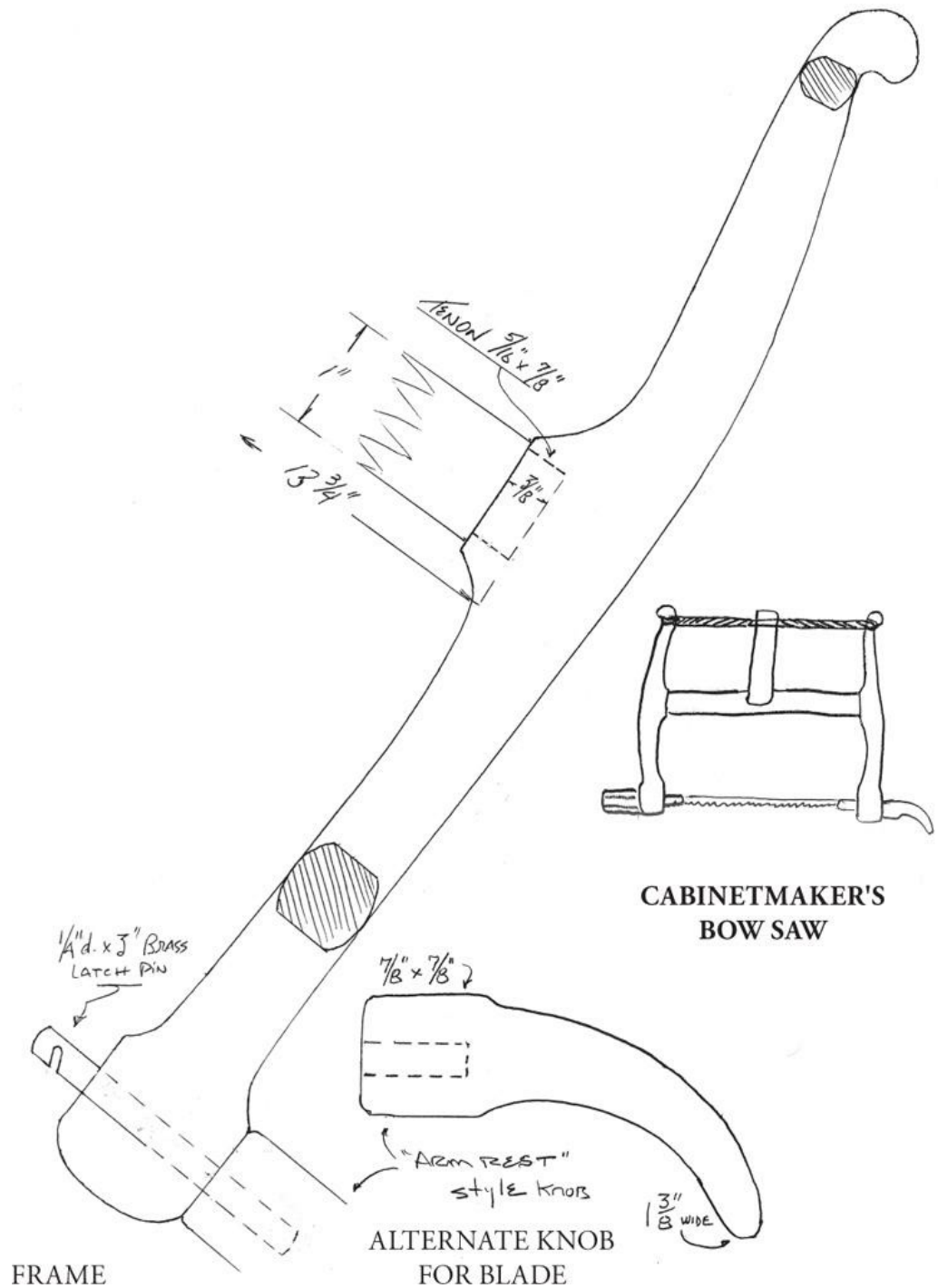


This is a story of two tools, a block plane and a coping saw. It is a story of ownership and appreciation. In June after my freshman year at college I was walking a subdivision looking for a building job. The first builder was a subcontractor siding with wood shingles. Since he was working alone he needed a helper. He directed me to buy a few basic tools for shingling — hammer and apron, ruler, square, saw and block plane — and come back tomorrow morning. The next morning was spent waiting for him, looking at the job in progress. My man “no-showed,” so after eating my lunch I went on to where a crew was working. That house, too, was being shingled. The foreman said they needed a carpenter, but no laborer, only carpenters on their crew. “Can you shingle?” Saying yes was a stretch based only on studying the first job in progress. “Do you have your tools?” “Yes,” again, only this time I did indeed have tools, new and limited, but enough to get me a trial. That was the first of many days I was sure would be my last throughout that summer as I learned how to use and took ownership of the tools of the trade.



MATERIALS

Frames (2)	$\frac{3}{4}'' \times 1\frac{1}{4}'' \times 12''$
Stretcher	$\frac{3}{4}'' \times 1'' \times 13\frac{3}{4}''$
Knob	$1\frac{1}{4}'' \times 1\frac{1}{4}'' \times 4''$
Knob	$2\frac{1}{2}''$
Toggle	$\frac{5}{16}'' \times 1'' \times 5\frac{1}{2}''$
Brass rod latch pins	$\frac{1}{4}''$ d. $\times 3''$
Jute string	8'
Blades, 12" (3)	10, 16 and 24 tpi



Fitting wood shingles I used the block plane a lot. It became a permanent part of my nail apron. The saws were not used so much, probably because the other men soon realized my limited experience and took the fitting work themselves. The panel saw and coping saw were tools I came to appreciate when running base trim. It is not generally known outside the trade that two kinds of corners require different joints. Outside corners are mitered and will tighten when nailed. Inside corners if mitered will gap. I didn't know, and my first one was torn out. Inside corners may look mitered, but one piece is run square to the corner. The other is cut to the profile of the baseboard and will stay tight when nailed. The straight part of the cut is made with a panel saw, but the fancy milled part uses a turning saw with a thin blade called a coping saw. Ownership again.

The coping saw looks like a bow. The U-shaped frame of steel rod has a latch pin at both ends for holding a thin blade with cross pins. Spring the bow slightly to engage the blade and it has tension. Orthodoxy says to install the blade reversed to cut on the pull stroke. Being untutored I installed mine like other saws and found it worked. In fact, the possibility of springing the bow and slacking the blade made me learn to "let the saw do the work." Good advice for any saw. Moral: Use the bow saw however it works best for you.

The big brother to the coping saw is the cabinetmaker's bow saw. The blade is longer and tensioning is the result of twisted cord in the levered frame. It does not look like a bow at all, more of a frame saw. But tradition prevails in naming it. What they do have in common is the ability to make curves. They both have latch pins that swivel, and thin blades that cut a tight radius.



THE PARTS OF THE BOW SAW include the three frame pieces, the toggle and jute string, two handles and blade, brass latch pins and escutcheon cross pins.

The frame makes a nice shop project. The shape allows for giving expression to the curves and fitting the tenoned center bar. The key to an effective saw is the blade. In my early attempts at making bow saws, the blade was a length of band saw blade. They worked, but not well enough to give that sense of ownership deserving of a new found traditional tool.

The solution to this was found in a kit made by Gramercy Tools. It was reviewed in the December 2006 issue of *Popular Woodworking* magazine by Christopher Schwarz, editor. Let him tell his experience:

My problem with the modern manufactured bow saws was they were difficult to steer, they cut slowly and were unbalanced. The new 12" bow saw from Gramercy Tools, however, is another animal entirely. The first time I used it was

like the first time I used a premium hand plane — it was almost a religious experience. Thanks to the saw's sharp and narrow blade, its featherweight frame and its remarkable balance, the saw absolutely flies through your work, tracks a line and is so balanced that you use it one-handed.

The price tag on the saw is \$140, but Gramercy sells blades separately. This solves the problem of sourcing the non-wood parts, and gives you proper blades to be effective. (Call 800-426-4613 or go to toolsforworkingwood.com. Product #GT-BOWS. Also see woodjoytools.com.)

Their web site, gramercytools.com/bowsaw, gives measured drawings of the saw. They say “our saw looks conspicuously like a 200-year-old saw, confirming that 18th-century craftsmen knew what they were doing.” The blades are a 12” version of the 6” coping saw blades and work as well. The $\frac{1}{8}$ ” blade width, number of teeth 10, 18 and 24 tpi, and the small amount of set all add to making this a fine turning saw. The latch pins can be made from $\frac{1}{4}$ ” brass rod in shop, or purchased in the 3 blade and brass pin kit for \$26. The Gramercy saw uses fish line for tensioning whereas the saw shown here has jute string waxed with canning paraffin.



AT THE TOP OF THE PHOTO are purchased latch pins and blades (10, 18, 24 tpi) with cross pins set into the blade. Below them are shop made parts. The octagon knob is at the far side of the saw while the curved handle fits one's arm.



A MORTISE-AND-TENON JOINT fits stretcher to frame. It is fitted without glue to allow for flexing when tightened and for storage.

Returning to my shop-made version, the $\frac{1}{4}$ " brass rod is sourced locally or online along with brass coated steel escutcheon pins cut to $\frac{5}{16}$ ". Hack saw a slot and drill $\frac{5}{64}$ " for the pin. The blade end is likewise drilled for the pin. They make a punch like an old-fashioned conductor's punch, but simply using a $\frac{5}{64}$ " drill worked even if it was hard on the drill. Changing blades means slipping two pins. If you use blades with cross pins press fit into the ends, then saw a diagonal slot to catch the pin.



USE OF READILY AVAILABLE band saw blades requires that the strong set of the teeth be flattened in the jaws of a vise with aluminum or brass plates. Behind is an oil stone for finishing the set reduction.

Sourcing your own blade stock has two challenges — where to get it and making the blade work. The simplest source for a 12" length of blade is to buy a made up band saw blade and cut it up giving you a half dozen blades for the price of one band saw blade. For this small bow saw a 10, 16 or 24 tpi blade $\frac{3}{16}$ " or $\frac{1}{4}$ " wide is used. The finer toothed blades work easiest.

However, frustration comes from poor blade performance. They do not saw easily. They stick in the kerf. Solution: Remove excess saw set. These blades are made for power saws not hand saws. By pinching the blade between two aluminum or brass plates you can squeeze half the set out. A few swipes on a fine oil sharpening stone will also help tame the overly aggressive saw blade.

I found a comparison between the Gramercy Tools blade and an Olson band saw blade to be different in just this way. (See chart below.) Also when teaching dovetailing, some student shows up with a new saw. But it does not work like they saw mine do in demonstration. It jams in mid-stroke. While it seems like sacrilege to take a stone to the new blade, that is just the solution.

The knobs at both ends can be turned or champhered, the handle being 1¼" × 1¼" × 4" and the shorter end knob 2". Our historic example had an arm rest style handle, a nice touch giving added control. The brass rods cement into ¼" holes in the handles using thick CA glue, which in this situation goes off without accelerator.

The saw frame is made of hard maple, beech, or hickory. The stretcher is mortised into the frame and left without glue allowing the saw flex in tightening, and to be taken apart into a neat package. The toggle is made from 5⁄16" × 1" stock. With the proper blades you will find the bow saw, like the coping saw from my carpentry days, works in many places where band saws fail to go.

COMPARISON OF TEETH SET: REDUCING SET FOR EFFECTIVE BOW SAW BLADES

MFR	WIDTH	TPI	BLADE THICKNESS	THICKNESS WITH SET	AMOUNT OF SET	SET AFTER SQUEEZING	AFTER SQUEEZING AND HONING
Olson	3⁄16"	10	.025"	.048"	.023"	.012"	.010"
Gramercy	1⁄8"	10	.019"	.026"	.007"	n/a	n/a

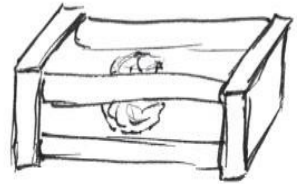
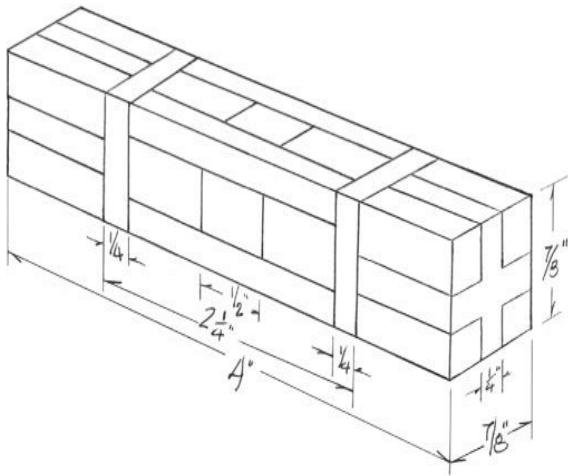
Carving & Layout Knife



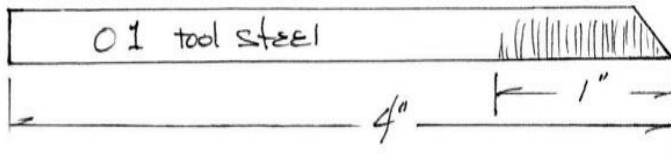
This is what I consider a “starter” project in tool making. Starter can refer both to a first tool project and to a tool suitable for a beginner. Here is a knife for carving as well as a layout knife useful in the shop. It will introduce you to using dimensional O1 tool steel, and require no more equipment than available in the most modest workshop.

Recently I gave a talk to my son Will’s boy scout troop on whittling a neckerchief slide. The boys had observed me carving a ball-in-cage slide at a campout. It is a project I first made as a scout sixty years ago, and with the right sharp knife and soft pine blank can be made between camp chores. It always engages their interest to see how the ball gets inside the cage, which of course was in there all the time.

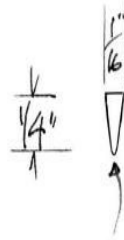




BALL-IN-CAGE WITH STAPLE & RING (SCOUT SLIDE)



SIDE VIEW



leave $\frac{1}{64}$ " flat
on bevel edge to
protect carbon
in heat treating.

END VIEW



CARVING & LAYOUT KNIFE

MATERIALS

O1 Tool steel	$\frac{1}{16}'' \times \frac{1}{4}'' \times 4''$	Amtek Tool & Supply \$15.75 for a 36" length 800-334-1660 or amtektool.com
Clear tube	$\frac{1}{4}'' \frac{3}{8}'' \times 3''$	Available locally
Clear tube	$\frac{5}{8}''$ i.d. $\times 2''$	Available locally
Tube coupler	$\frac{1}{2}''$	Available locally
Cement or adhesive		Available locally

During the scout demonstration, I showed them samples of different carving wood and gave each a pine blank to carve their own slide. It became apparent that their pocket knives, besides being unusably dull had no proper whittling blade. Next time I will include a sharpening demonstration with my talk, but what to do about getting the right sharp blade was more of a challenge. This project is the answer both for scout whittling and for a host of shop uses as well.

The blade shape is copied from my pocket knife, and is called a coping blade, or more prosaically a sheep foot blade. It is $\frac{1}{4}''$ wide and 1" long, straight edged with a 45° slope behind the point. This is made from O1 tool steel $\frac{1}{16}'' \times \frac{1}{4}'' \times 4''$ cut from 18" or 36" lengths sold by mill supply companies. That will allow you to make several knives to have around the shop or give as gifts. The knife itself rests easily in the palm of your hand and its handle is stationary rather than hinged. It is a combination of $\frac{1}{4}''$ clear plastic tube and a $\frac{1}{2}''$ insert coupling.

Start by hacksawing a 4" length of tool steel, and file the angled back point and straight beveled edge. File on both sides so the bevel face extends almost to the back edge and leaves a very slight flat on the cutting edge. This slight flat will help protect the carbon content in heat treating, and will be the micro bevel sharpened after hardening.

A regular propane or MAPP gas torch will do the heat treating if you make a heat shield from two nesting tin cans fastened with a sheet metal screw or pop rivet in the bottom. Heat the blade plus one inch of the stem to cherry red (1,500° F). Quench in oil to harden. Any oil will do, although I prefer cooking over motor oil which smokes. The next step is to temper in an oven at 375° F for 20 minutes allowing it to slowly cool. This tempering results in the proper balance of hardness at 60 RC and toughness to overcome the brittle hard first stage. Polish the blade with fine sandpaper or steel wool.



CARVING AND LAYOUT KNIFE. A 4" length of carbon tool steel, a 3" length of $\frac{1}{4}$ " clear tube, a 2" section of $\frac{5}{8}$ " tube for guard, and a $\frac{1}{2}$ " tube coupler for the handle all combine for a knife of many talents.



THE ORIGINAL SCOUT SLIDE had a staple and ring carved into the ends of the ball in cage. More time consuming than the center piece, I left them off after doing it once.

You may wish to customize your knife with a wood handle. However, a few items from the plumbing section of the hardware store shown here are quick and effective. A 3" length of $\frac{1}{4}$ " clear tube receives the blade stem, and both sleeve inside a $\frac{1}{2}$ " plastic tube coupling.



O1 TOOL STEEL IS SOLD in 18" and 36" lengths at mill supply companies. The size for this knife is $\frac{1}{16}" \times \frac{1}{4}" \times 4"$, leaving you ample to make several knives.



HEAT TREATING BEGINS with a torch and tin can heat shield to turn it cherry red 1,500° F. The can in the background contains cooking oil for quenching the hot steel. This makes it extra hard and brittle. Temper in an oven at 375° F for 20 minutes and air cool to restore toughness.



THE SMALL DIMENSION OF THE BLADE makes shaping the 45° end return and the straight cutting edge bevel easy with a hand file.

Three types of cement were tested: tube products (clear silicone caulk and construction adhesive), epoxy glues, and water mixed cement, like Durham's Water Putty and Durabond Drywall Compound. Each worked, but with some reservations. Tube products air dry so the center of the handle takes days or even weeks to set. Boatbuilders are familiar with epoxy stiffened with fillers which work well, but may be less accessible for others and do not clean up with water. While all these products do not bond well to the poly-based ½" tube coupler, they all are adequate to fill and hold the inner tube and blade inside the handle.

Have fun shaping and hardening the tool steel and joining parts to complete your knife. And while at the hardware store, get 2" of ⅝" clear tube for a blade guard which is slightly heated for a tight fit.



PUTTING IT ALL TOGETHER with cement to bond the blade, inner tube, and handle. Shown on bench (left) are several options including tube caulk, epoxy, and water-mixed cement. Will Wilson is using Durham's Water Putty to complete the carving knife.



Blade Making Methods & Materials

- ☐ [Tool Steel & Blade Making](#)
- ☐ [Making Band Saw Blades](#)
- ☐ [Sharpening Tools](#)

Tool Steel & Blade Making



The tool projects in this book make use of tool steel readily available at a reasonable price in dimensions and composition suitable for blade making. It is one way among many to make blades. The ancient art of blacksmithing is a fascinating craft in itself. Anyone wishing an introduction to it would do no better than to pick up any of Alexander Weyger's books, *The Making of Tools*, *The Modern Blacksmith*, and *The Recycling, Use and Repair of Tools* (Van Nostrand Reinhold Co., New York).

What is presented here is more modest. The O1 tool steel in prepared dimension is ready for a specific blade project. It is rather like buying a milled 1×12 board that can enable you to begin a woodworking project. Logging, sawing green lumber, the art of drying boards, and milling smooth dimensioned stock have all gone before. It helps to know a little of that world to appreciate the finished board. Likewise, tool steel characteristics give understanding to blade making.



Three Stages of Tool Steel

Steel that has carbon in it can be shaped and hardened. The carbon is only around one percent, but its effects are many. Steel without carbon is soft and is called mild steel, and can not be hardened and tempered for blades. High carbon steel goes through three stages in blade making. Initially, it needs to be soft enough that hacksaws, drills and files can shape it. This is called annealed steel. It is still hard compared to mild steel, and a new hacksaw blade will help avoid a prolonged job of cutting the blank. To be annealed, the steel is heated 50° F to 75° F above its transformational point of 1,350° F to 1,400° F and cooled slowly. The blacksmith at his forge heats the steel and buries it in hot ash to cool. The O1 steel as it comes to you is in this annealed state.

The standard measure of hardness that describes tool steel is the Rockwell “C” scale. It is measured by imprinting a hard stylus in the surface of the steel and measuring the indent. Annealed tool steel has a Rockwell number around 45, mild steel around 25. The steel of files and hacksaw blades is around 55. Hardened blades will be 58 to 62, or too hard for shaping with anything besides abrasive stones and grinding.

The three stages are annealed, hardened and tempered. Hardness and ductility are two properties that go hand-in-hand with changes from one stage to another. Hardness can be appreciated as the ability to hold an edge and is measured by the Rockwell scale. Being ductile means that it is tough, that it can take shock, and can be bent to a degree without breaking. We want a blade to hold an edge, but tough enough to take the shocks of usage without chipping or breaking. As in many twin qualities, these properties are in opposition, as hardness increases ductility decreases until we have steel that can shatter. You can demonstrate this by taking a small scrap of high carbon steel and putting it through the heating and quenching of hardening. Strike it a hammer blow on an anvil and it will shatter. The Rockwell hardness of such steel is 70 to 75 or more. To modify this hardness, the third stage of blade making will temper the steel to restore the needed toughness without softening it back to the annealed stage, which is too soft to hold an edge. This will be in the Rockwell range of 58 to 62.

The way tool steel grain structure is changed is by heating it to specific temperatures followed by either quick or slow cooling. Annealing is heating to the transformational point and slowly cooling it. Hardening is heating to the transformational point and quenching it. There are different quenches with different boiling points determining the dropping point, including tallow (425° F), oil (375° F), and water (212° F). Tempering is accomplished by heating to between 350° and 500° F, and slowly cooling in air, with the heat level determining the hardness. Starrett brand O1 tool steel that I have used prints this information on their packaging: 350° F to 400° F gives 60 to 62 Rockwell, 400° F to 450° F Rockwell 58 to 60, and 450° F to 500° F Rockwell 56 to 58.

Measuring Heat

How do you know how hot the steel is in heating? The blacksmith watches the color. Steel begins to glow dark red at 1,125° F, and the color and brightness changes until it is

white hot at 2,250° F. These are viewed in the semi-darkness of the old forge and not in broad sunlight. It is well to learn the range so you can match it with the desired temperature in hardening. The second color change is on the surface of polished steel as it goes through the tempering heat range. These are surface patina colors rather than incandescence. There is a rainbow of colors from light straw at 400° F through orange, bronze, peacock, purple to blue and pale blue at 600° F and finally gray when color disappears. Each of these heat points produces a successively softer but more ductile blade.

File Check for Hardness

Judging the hardness of your blade once treated can be confirmed by testing with a file. As you run the file along the edge of the blade, you will feel it first bite the softer upper end, then skate over the harder cutter end, which is now harder than file metal.

In a recent class, one batch of O1 did not harden unless we held it cherry red for a full 30 seconds. A student detected the problem by using the file test after going through hardening and tempering. Reheating with extended cherry exposure solved it. The supply company metallurgist was unable to solve the mystery, but the moral is the usefulness of file checking for hardness in the shop.

The steel itself is referred to as O1 tool steel, which is a formulation of high carbon steel whose grain structure is properly hardened by quenching in oil. It is a good, general-purpose tool steel with critical heat points tolerant of the imprecise methods of the shop. There are other steels available. In conversation, one of the leading blade manufacturers allowed that for plane irons, O1 is as good as any including the steel which his company uses. Fancier is not necessarily better.

THE TWO COLOR SPECTRUMS OF TOOL STEEL

Tempering colors are a patina on polished steel that give an oxidation spectrum indicating a temperature range from 400° F to 625° F.

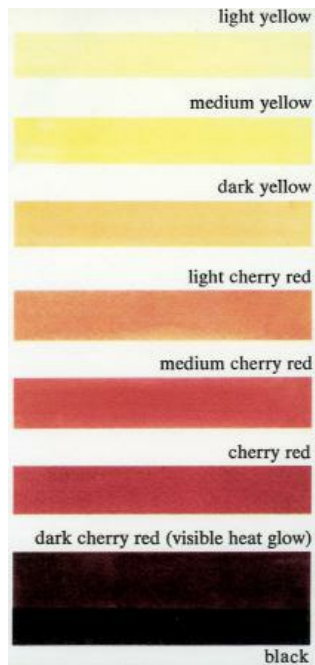
Tempering Temperatures



TEMP.	OXIDE COLOR ON POLISHED SURFACE
625° F	grey
600° F	pale blue
575° F	medium blue
550° F	full blue
525° F	purple
500° F	bronze
475° F	light orange
450° F	straw
425° F	light straw
400° F	faint straw

Hardening colors are heat-glow colors of steel as seen in a semi-dark shop. The smith can judge malleability during forging, and hardness at moment of quenching. Range from 1,125° F dark red to 2,250° F white hot.

Hardening Temperatures (in semi-darkness)



TEMP.	COLORS
2,250° F	white
2,100° F	yellow
1,750° F	orange
1,650° F	bright red
1,550° F	full red
1,500° F	bright cherry red
1,450° F	cherry red
1,400° F	medium cherry red
1,350° F	low cherry red
1,300° F	blood red
1,125° F	dark red

Adapted from Alexander G. Weygers The Modern Blacksmith, Van Nostrand Reinhold.

The other choice to make is thickness. A thicker blade is regarded as better. But how thick is enough? Various dimensions of O1 are available from mill supply, so this is something you can play with. The issue is chatter, and thickness is related to stiffness to

resist chatter. Look at blades in Stanley planes and you will see a blade $\frac{1}{16}$ " thick. However, this blade does not stand alone, but is coupled with a cap iron that both stiffens the blade and is incorporated in the adjustment mechanism. At the other extreme are some Japanese planes, which have a unitary blade such as used here and are about $\frac{3}{16}$ " thick. The $\frac{1}{8}$ " thickness used in my planes works well. Here is a historical footnote to the thickness of blades made for planes years ago with wedged holders: Close examination shows these blades are forged to be heavier at the cutter end. What is going on here is the creation of a wedged blade in opposition to a holder wedge making a more effective lock.

Heat Source

Once you have your O1 tool steel, the first step will be cutting, drilling and filing that can be done in annealed steel. When grinding the bezel, or cutting angle, you will notice that it works easily and the sparks are yellow. Sparks from hardened steel are white. It is not so critical that "bluing" the edges of the blade be avoided as it would be in sharpening a finished blade. However, having a can of water handy when shaping your blade will keep it from becoming too hot to handle, and introduce you to using a water dip. The boiling point of water being 212° F will help you learn when temperatures are nearing the critical tempering range above 300° F. To be blue means it reached 550° F, and while it may only be a small portion of the blade that is blue it is the critical thin blade edge that is compromised by careless grinding. The hardening and tempering procedures used for any of the blades in these plane projects will also restore a blade once made soft.



SETUP FOR HARDENING TOOL STEEL: MAPP gas torch (there are various models all with side tube delivery to provide ample flame), double tin can furnace to focus heat, metal pot with soy oil for quench. **SAFETY FIRST:** Refractory brick to hold furnace, metal surfaces and pot, and use of welder's glove all to protect from fire damage.

It is only the $\frac{1}{2}$ " to 1" end of the blade that needs hardening. This is accomplished in the shop by heating the steel with a torch. Several torches are available, with larger blades requiring a hotter flame. If you have an acetylene/oxygen torch used in welding available, this can deliver a hot flame with ample spread for any blade. Other torches, however, can work. The most common torch used in plumbing and other chores is the cheap and handy propane torch. This will work for some tasks such as silver brazing band saw blades discussed in the next section, but is insufficient for all but the smallest blades. Larger blades are too great a heat sink and you will find yourself moving a cherry red spot back and forth across the blade.

There are three things you can do. First, the hotter alternative to propane is MAPP gas. It comes in the same handy cylinders as propane and uses the same torch heads. The

second is to conserve heat by using a furnace thereby overcoming the heat sink of the blade and air dissipation effects of heating in open space. My favorite furnace is made by taking two tin cans that nest inside each other, and combining them with a pop rivet in the center of the bottom. This furnace is supported on metal or stone as it will get red hot in use. Using fire in the shop takes common sense at all times to prevent accidents. The third alternative is a different torch head. The common torch delivers a pencil point of flame. However, there are those with larger capacity that are recognizable by having the delivery tube attached to the side rather than the end of the brass valve chamber (see photo on [page 154](#)).

Oil Quench

Once the tool steel is heated cherry red across the entire end, it is quenched in oil. The container of oil needs to be large enough to completely submerge the blade in one quick stroke. A partial submersion will possibly warp the blade, and will ignite the oil at the surface. Also, having a small volume of oil may cause the heat in the blade to raise the oil's temperature above the flash point. Motor oil, either new or used, is a readily available and cheap source. However, when used inside the shop, a blue haze will fill the room. Vegetable oil avoids this nuisance. At the food store a gallon of soybean oil has good manners and a higher flash point (550° F), and is cheaper than peanut or safflower oil. Be sure to use a metal container for the oil.



HEAT TREATING makes tool steel brittle hard. Tempering reduces some hardness in order to restore necessary toughness. Here a toaster oven is used to heat the brittle hard blade to 400° F for 20 minutes followed by slow air cooling. In contrast to kitchen ovens, toaster ovens can have faulty settings, so checking with an oven thermometer is useful.



SHAPING THE O1 TOOL STEEL BLANK starts at the grinding wheel rounding the top and beveling 25° for the cutter. The belt sander will give good results for a flat surface and it runs cool. Here the wood shop sander is used. CAUTION: Clean out sanding dust before generating metal sparks. Worn 80-grit belts will get one final use surfacing a blade. Throughout the book I will use tools common to the wood shop, understanding that a metal shop and elsewhere will have other tools for you to use if available.

Tempering the hardness to restore necessary toughness is done in an oven. Take care not to drop the blade at this point or a chip like glass can break off. The tempering temperature is within the range of a toaster oven or the kitchen oven. Once cleaned of the quenching oil the blade will not impart any objectionable odors that would make it unwelcome in the house. Follow instructions for the steel you have purchased and the hardness you desire, but 350° F to 400° F for 20 minutes should result in a blade of 60-62 Rockwell.

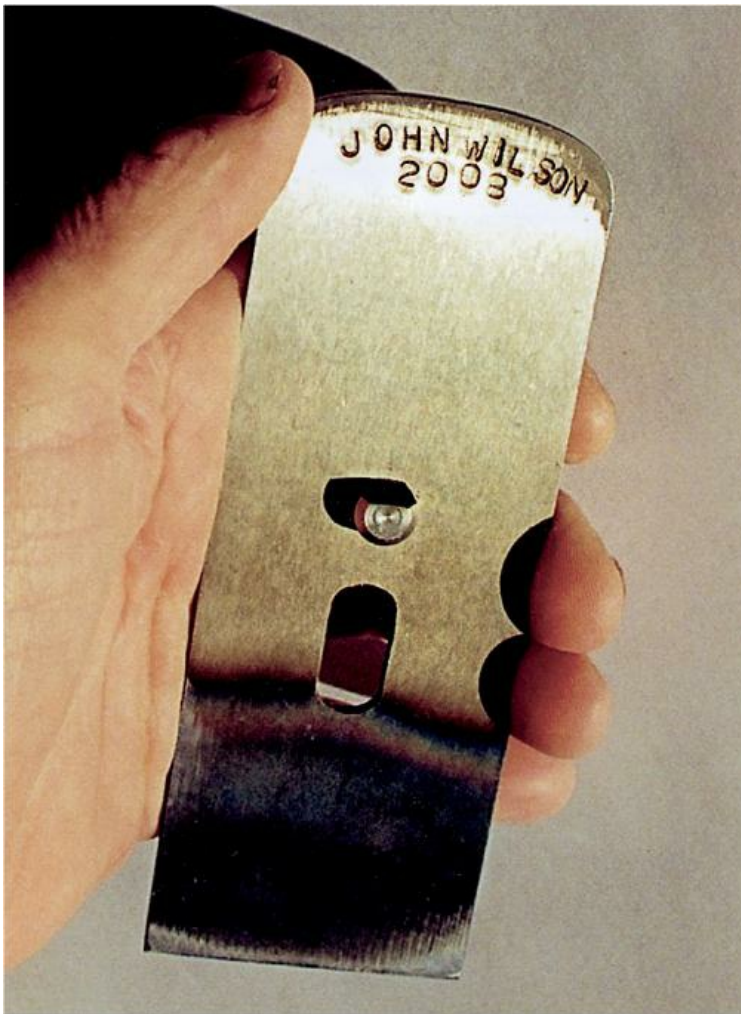
Shaping and Sharpening

When annealed, all work goes faster. A bench grinder with water quench handy is the first step. The bezel, or cutter bevel, is ground at a 25° angle. Rough this on the grinder. However, a flat and accurate angle is easier to finish on a belt sander. A new belt is best, but being frugal I save my old 80-grit belts and get another use doing blades. The advantage of a belt sander is that the surface is flat, works with less heat, and is easier to control than a grinding wheel. Some tout the advantages of a hollow ground bezel

possible on a wheel, but the results are debatable. Certainly the control, cool working surface, and availability of the belt sander are undeniable.

When finishing the bezel before hardening, it is suggested, with some merit, that the very edge be left flat ($\frac{1}{64}$ " is sufficient) to avoid becoming carbon starved in the heat process. I can attest to the advantage of such a practice for assuring that the blade remain square to the end. Once grinding or belt sanding removes the square cut end of the blade, it is a fussy business to restore the square end.

Because we are not depending on the surface patina to judge the tempering temperature in the oven, the final polishing and sharpening of the bezel need not be done until after all heat treatment. The blade needs not only the 25° angle sharpened, but also the back surface lapped to remove any warp in the steel and polish the surface which intersects the bezel. Polishing the entire surface is personal preference whether uniformly bright, or leaving the rainbow colors of heat treatment, and providing some roughness to enhance holding by the wedge.



A **FINISHED JACK PLANE BLADE** shows the rainbow of hardening heat colors and the straw patina of tempering to 400° F.

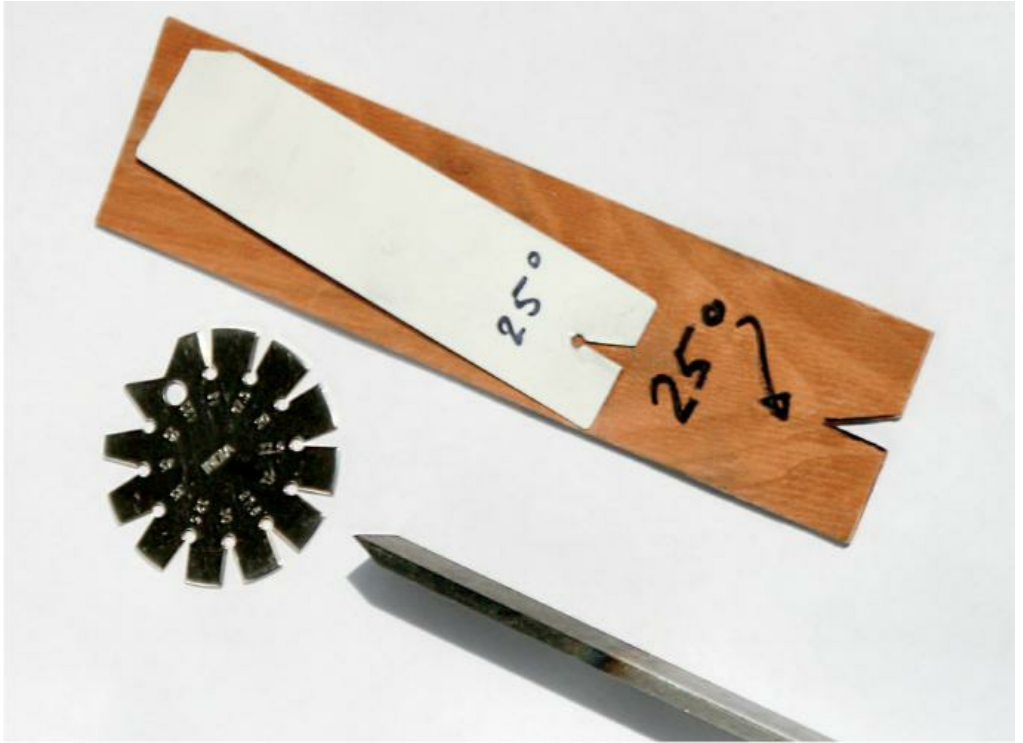
Bevel Gauge for Blades

Take the guesswork out of what angle to grind your blade by making your own 25° slot gauge. The material can be any thin wood or sheet metal. Shown here is white aluminum trim stock .019" thick. Ask at any place that sells siding for them to cut off a foot of "white aluminum coil stock." It is great for all sorts of patterns.

Make a 25° slot about $\frac{3}{8}$ " deep in the end of a piece of 1" × 4" coil stock. The $\frac{3}{32}$ " hole at the point is optional. Use a magic marker to label.

Coil stock is not the same as aluminum flashing. Besides being painted white, it is

stiffer than flashing making cutting it different: Score the surface with a sharp knife, flex it up and down once, and snap! You have a clean, fast edge.



BEVEL GAUGES FOR BLADES come in various shapes and materials. Commercial circular brass gauges allow for checking various angles. However, the most common angle for tool making is 25° . The circular gauge requires checking for the right slot every time you pick it up. The shop-made gauge is right there every time.

Making Band Saw Blades



Band saw blades are replaced rather than sharpened. There is a tendency to incorporate this in all sorts of situations, which has led to the label “throw-away society.” This is not a compliment in my estimation. It is too often a commercial contrivance appealing to ease. Planer blades have gone this way in the benchtop 12” models, which is too bad. But band saw blades seem to be an exception. Sharpening them would be impractical. But more importantly, the matter of metal fatigue from the flexing on each revolution limits the life of the blade itself.

What is possible is to break the dependence on made-up blades, and become independent with a simple method for silver brazing band saw stock in your shop.



I was on the road teaching a woodworking course recently when my band saw blade broke. Not carrying a spare meant buying a replacement locally.

It had been 20 years since I began silver brazing my own band saw blades, and I had forgotten what a broken band saw blade means for woodworkers who don't. First, there is the inconvenience of stopping operations while shopping for the blade. Second is the cost. Third is the disappointment in the poor quality of the weld on the band.

My store-bought blade got me through my immediate need, but it soon broke. All these factors are improved by making your own band saw blades.

What must be the best-kept secret in the band saw market is worth your time to learn. Dependence on pre-dimensioned blades can be a thing of the past. What you need to know and the tools you use and the materials to make your own are all readily available. No special machinery, no elaborate instruction, no obscure source of supply.

You can make up your own band saw blades in 10 minutes using nothing more than a propane torch and a holding jig. Buy the same band blade material you are currently using from the same supplier and you'll save 50 to 70 percent. And you'll get back to work doing what you came to do in the first place — working wood in your shop.

Silver Brazing vs. Resistance Welding

There are two methods for splicing band saw blades: resistance welding and silver brazing. In welded blades, the ends to be joined are cut square and electric current supplies the heat to arc weld the butt joint. Silver brazing joins using a fill material of silver alloy. The surface area of the joint is increased by scarfing the ends back about $\frac{3}{16}$ ". The heat for joining the ends is from a common propane torch.

Silver brazing is not the same as soft soldering used in copper plumbing fittings. While both processes use solder, flux and torch heat, brazing is done at a higher temperature, and there is more strength in the band when the filler material is silver alloy. It is, in fact, as strong as the metal itself.

Silver alloys such as N50 or Easy-Flo 3 are examples available today that contain cadmium. Used for decades, we now know that the cadmium in them creates a health risk. Cadmium-free alloy such as BRAZE 505 (visit LucasMilhaupt.com for a brazing book you can download) contains 50 percent silver, 20 percent copper, 28 percent zinc and 2 percent nickel.

Just as with soft soldering, a suitable paste flux is needed to ensure joint surfaces that are free from oxidation. Both silver alloy and flux are available in convenient quantities from catalog stores. While the conventional propane torch is used for both soldering and brazing, the temperature range for silver brazing is much higher: 1,200° F to 1,600° F.

Band Saw Blade Stock in the Coil

If the ingredients for brazing are simple and easily obtained, what about the band saw blade material itself?

Olson Saw Co., a major supplier of band saw blades, will sell blade stock in the coil directly to you. Most common types of blades are available, and at significant savings. You also can find other sources for band saw blades in coil form on the Internet (even at the auction site eBay.com) or through other suppliers. Other major blade manufacturers, such as Starrett, Lenox and Sandvik, provide blades in coil form. Recently Timberwolf brand by Suffolk Machinery Corp discontinued direct sales of coil band stock as part of their distributor agreement with companies who sell pre-sized bands. However, a large and user-friendly source is MSC Industrial Supply Co. (mscdirect.com), which carries Starrett and Morse brands. (Keyword search on the site for a list and price of different types.)

For example, Olson sells $.014" \times \frac{1}{4}" \times 6$ -tooth blades for fine work in a 100' coil for about 50 cents a foot. Coils of $.025" \times \frac{1}{4}" \times 6$ -tooth blade is about 70 cents a foot. Olson doesn't mention the availability or price of the coils on its web site or in its catalogs; you need to call them.

In researching the article I asked folks in the band saw blade industry about this. Their answer was that their customers had been dissatisfied with the results of their shop-made blades. The solution, I suggest, is better information.

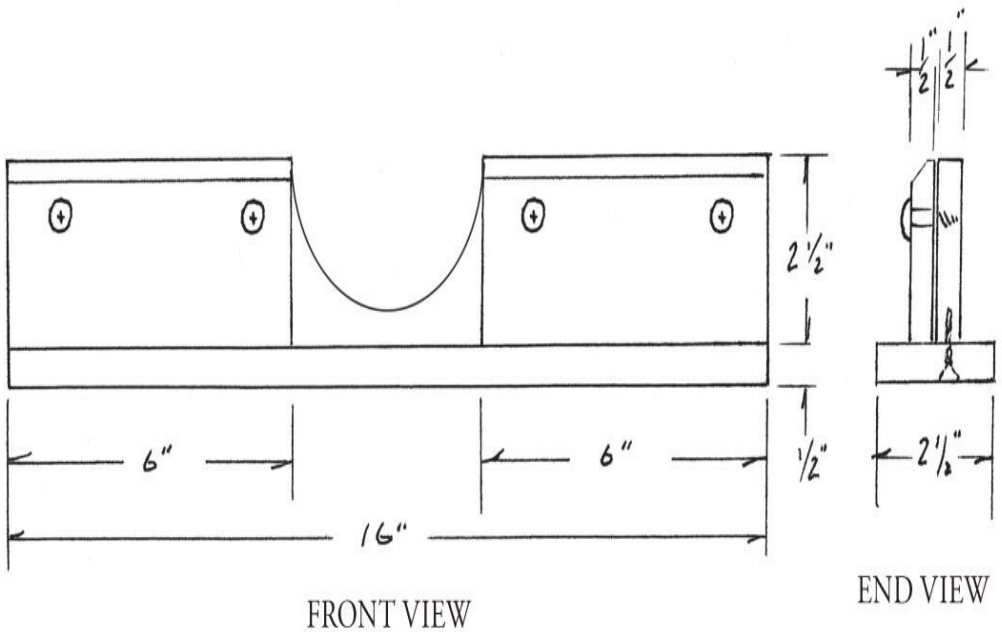
Steps in Making Up Blades

Here is how you go about saving money and gaining independence by making your own band saw blades.

1. Buy a coil of your favorite band saw blade from a supplier.
2. Obtain a "refill kit" for splicing your blade that contains silver alloy and flux from a catalog store.
3. Make a jig for holding the ends of the blade as shown below, or buy one.
4. Cut your band to length (add $\frac{1}{4}"$ for the scarf joint).
5. Scarf both ends of the band on a belt sander to prepare them for joining.
6. Align the blade in the jig, add flux and a premeasured wafer of silver alloy into the scarf joint.
7. Heat the joint cherry red with a propane torch.
8. Anneal the blade with several passes of the torch to remove brittleness on either side of the joint.
9. File the joint smooth.

Let's take these steps one at a time. The sources of supply at the end of this article will help you locate the blades and materials you need. Silver alloy sells for \$25 to \$40 per ounce, and flux is \$6 in a 4-ounce jar. Both quantities are more than you will need, so it makes sense to buy a "refill kit" from a catalog store. What is significant to getting good results is knowing about what is called "ribbon solder." This is $.003"$ thick by $\frac{1}{4}"$ or $\frac{1}{2}"$ wide. A page of this book is $.003"$ thick to give you an idea of how thin this is. Cut it with paper scissors and make confetti-sized squares as a pre-measured unit for use. For a $\frac{1}{4}"$ blade a piece that is $\frac{1}{4}" \times \frac{3}{16}"$ is plenty. Cut a dozen such pieces and place

them in the flux jar where they are ready for use along with the flux. NOTE: Flux contains zinc chloride and needs to be used with caution.



HOLDING JIG

Use a scrap of wood to pick out the pre-measured silver alloy square along with a dab of flux. This is a more convenient and accurate way than using wire solder common in plumbing work. The refill kits differ in this regard. Woodcraft sells its joint kit for \$34.99 with a 10" length of wire silver solder and the refill kit for \$9.99 with the same length of wire. Lee Valley Tool's splice kit sells for \$33.50 and has a 7 1/2" length of 1/4" ribbon solder, while the refill kit at \$22.50 gives you a larger jar of flux and 38" of ribbon silver solder. This will do 150 splices. I rate this a good buy.

The holder for the band joint is easily made from 1/2"-thick hardwood. It will hold the two ends for brazing and gives you the opportunity to accurately align the blade by sighting along the top. This wood jig is intended for small blades and torches as shown here. A metal holder is used with larger torches and heavier blades requiring more heat.

Jointing the Blade; Playing with Fire

After cutting the band stock to length (plus 1/4" for the scarf lap), the ends need to be ground to a bevel angle back about 3/16" to 1/4". Rather than do this at a grinder, I touch them on the belt sander. Visual inspection will guide you to making them even on both

ends. Hold the blade so that the bevels are on opposite sides and mate when aligned in the jig.

The beauty of the ribbon solder will be appreciated as soon as you line up the band joint and have the ends touching each other. The wafer of solder and the small dab of flux are held in place by the blade ends.

It is now time to turn on your torch. Silver alloy flows at about 1,200° F, and the joint will be heated cherry red in the 1,600° F range.

When it is fully hot the joint appears to have a molten shimmer to it. It takes less than a minute to heat. The joint is now brazed, but an important step remains: annealing. Heat makes the blade brittle. If you skip the annealing step, your blade will soon break near the joint where the brittle joint area meets the non-heated steel.

In annealing, the torch is used to accomplish a series of heatings to restore the needed toughness to the blade. Back the torch away from the blade an inch and apply a few seconds of heat across the joint area. Allow it to cool for about 10 seconds, and repeat four or five times more, backing away a bit more each time you swipe the joint. You want to heat the blade into the 400° F to 450° F range to temper out the hard brittle steel.



CUT BAND SAW BLADE ¼" longer to allow for overlap of the joint, here using sander to grind bevel.

How do you know you have it right? Look carefully at the blade the next time it breaks. If the joint fails, then you have missed with the flux or given insufficient heat to

the joint. If it breaks just beyond the joint, you have not properly annealed the blade. If it breaks elsewhere, then you have a stress fracture from the blade repeatedly flexing over the wheels of the saw.

Annealing in the Literature

If the instructions with the two splice kits are what people follow, it is not surprising that the technical support people at band saw blade companies report poor results from woodworkers making their own blades. Nowhere is there any mention of annealing the joint in either kit.



ALIGN SAW BLADE. Sighting allows accurate alignment using screwdriver to tap ends into position.



RIBBON SILVER SOLDER with nickel alloy is cut into small pieces (see container top). Silver solder flux and one measured piece of solder is put into the joint.



PROPANE TORCH heats joint to cherry red.



TAKING THE BRITTLE HARDNESS (introduced by red hot heating) out of the band is accomplished by successive passes of the torch using less and less heat by backing up the torch further each pass.

So I turned to the standard reference, Mark Duginske's *Band Saw Handbook* (Sterling). Both methods of making up a band are discussed. Here is what he says about resistance welding: "Before it can be used, you must anneal it to restore the weld joint to the same metallurgical hardness and strength as the rest of the band. This is done by reheating it to an annealing temperature and then cooling it slowly." When discussing silver brazing, however, there is no mention of annealing after heating the joint with the torch to flow the solder.

One band saw blade manufacturer spent \$60,000 on the annealing machine for its blades. They guarantee the results. What you can do is the finesse of the blacksmith. It starts with knowing what needs to be done and how to do it. Then look at your failures and try it again.



FINAL STEP is to file burrs and remove the glass-like residue of the flux.

The final step is to file the joint smooth. Surplus flux forms a glass-like bead on the metal that scratches off with the end of your file. You will appreciate the premeasured flake of ribbon silver solder at this step, because there will be very little surplus metal to be filed away as a result.

You can achieve consistently good results doing your own silver brazing. Moreover, you can make up a new band the moment you have a need for it in a matter of 10 minutes. In my book, quality and convenience rank every bit as high as the savings in cost.

Finally, you will come to appreciate that silver brazing is not just for repairing a broken blade. Don't believe the catalog descriptions. In fact, you may find that by the time your blades break there is little or no useful life left in them, which is testimony to your newfound skill.

AUTHOR'S NOTE: Thanks to Dave Hout for showing me this practical method for making up band saw blades. As shown, it works best on ½" and smaller blades rather than larger resaw and band mill blades.

SUPPLIES

For silver brazing kit and refill:

Lee Valley Tools

leevalley.com or 800-871-8158

Woodcraft Supply Corp.

woodcraft.com or 800-225-1153

For band saw blade stock by the coil:

Olson Saw Co.

olsonsaw.com or 203-792-8622

■ blade stock in 100' coils

MSC Industrial Supply Co.

mscdirect.com or 800-645-7270

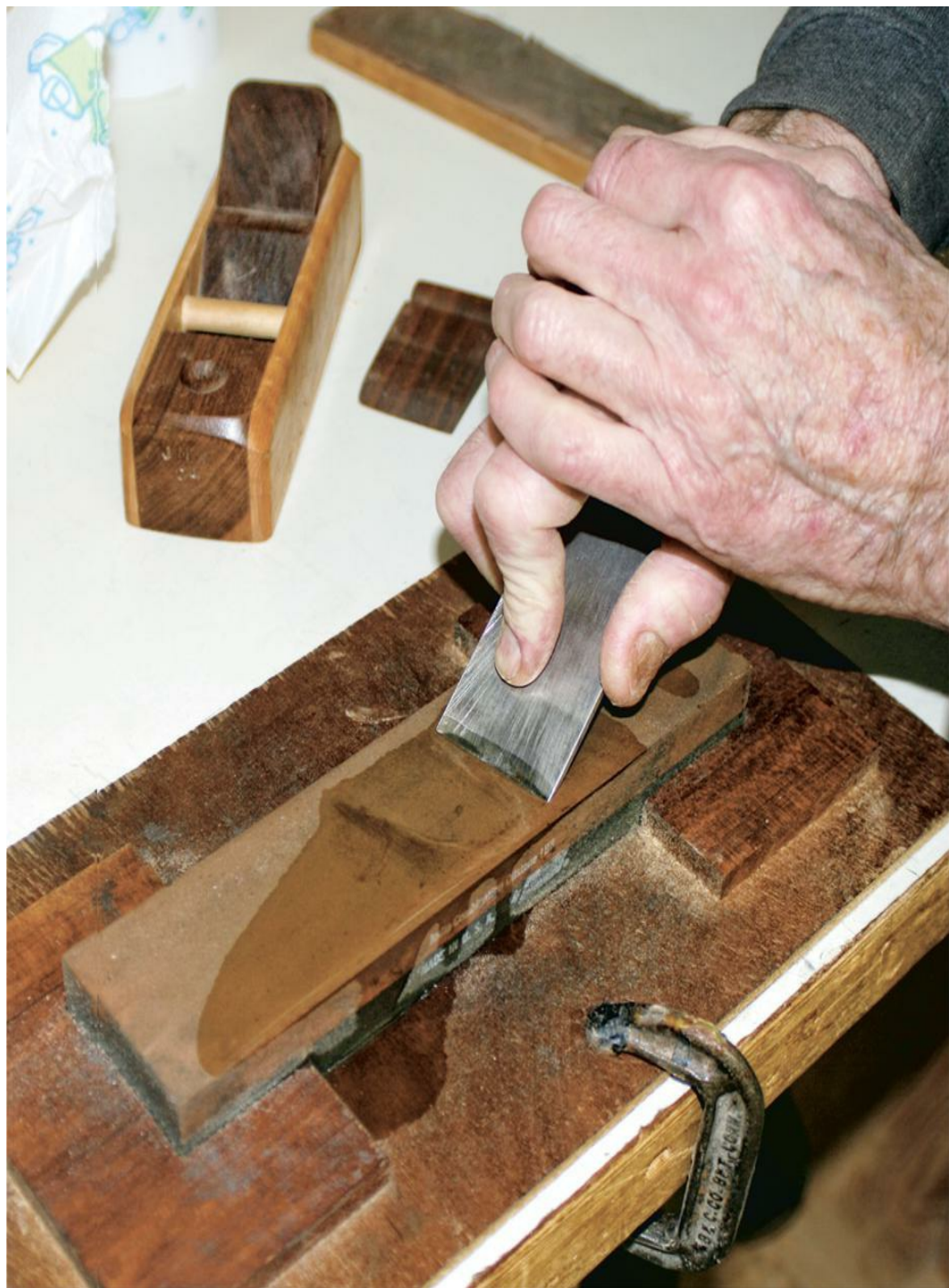
■ Starrett and Morse blades in 100' coils

Sharpening Tools



Aside from finishing, no area of woodworking these days abounds with variety as does sharpening. The notion of sharp is the common denominator. In that there is agreement: Know what sharp is, and do it.

Perhaps the advent of fractional horsepower electric motors have been responsible for the loss of the notion of sharp more than anything since the demise of the apprentice system. Think about it. If working with dull tools entails little more than pushing into an electric saw or planer, the incentive for understanding sharp and doing something about it loses its imperative. John Gardner, father of the revival in teaching how to build small wooden boats, said “when potato power gets things done, your hand tools need to work.” The imperative is fatigue and pride is the guide.



Mentors in Being Sharp

Two incidents stick in my mind from watching my father work: filing a scraper and using it effectively scraping porches when refinishing, and using an oil stone followed by a spit stone to sharpen a tool. Nothing is particularly grand about either, but I appreciate today the importance of files and stones to make tools effective and getting the job done.

Seeing someone work with hand tools is an important ingredient in the awakening of craftsmanship. The close connection to wood is inescapable with a hand tool. Let's not go romantic about this. There is nothing desirable about dimensioning boards from a log using a hand saw by two men, one above, the other in a pit below. Twenty boards a day was a good rate. I suspect the day was long and the men tired. I for one would not volunteer for this service. Planing boards for use is the same. So the Shakers embraced power and were inventive of new ways expressly to spare the drudgery of such tasks. How could you be sensitive to life's spiritual journey if you were worn out?

However, what happened in the embrace of power in the mid-twentieth century was the eclipse of an entire hand tool tradition that had emerged in the previous three centuries. It went far beyond alleviation of drudgery. The speed and precision of the millwork factory was appropriated as a model for the wood shop as soon as the small electric motor made it possible. In the 19th century, power was delivered by a line shaft from water or steam power. Then electric motors and the power grid freed wood machines from such stationary locations. The pendulum swung. The ideal was finding ways to do all the tasks of the shop using power tools. Hand tools were often regarded as relics. Recovering the lost tradition of hand tool use entails understanding what tools can do and making them work, specifically the notion of sharp.

There are many good systems for sharpening hand tools. Whatever works for you, use it. Proponents will teach you and manufacturers will sell you the wares, but you need to appropriate it at a handy location so it is practical to turn to when needed. Learn the feel of a sharp hand tool so you can accomplish the potential that resides in it.

Which Steel is Harder:

File Steel or Blade Steel?

Some tools are sharpened by file. Some are sharpened by grinding and polishing. All the tools which are sharpened by a file have steel, which is softer than file steel (about Rockwell 55). Trying to sharpen harder steel will ruin your file. It's a rock-paper-scissors game. The tools that use a file for sharpening are scrapers, hand saws and chain saws.

Glint or Burr?

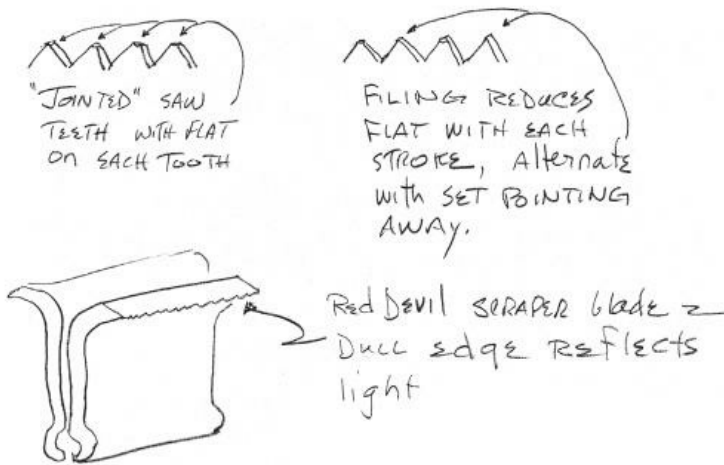
Is it a glint or a burr you use to indicate when sharpening is done? It is a challenge not only to know how to begin to sharpen a cutting surface, but also to know when to end. In filing you see the surface being sharpened (the bezel), while in grinding or polishing it is away from you on the underside of the tool. A dull edge will reflect light, a sharp one

won't. If you get your tool positioned to a light source to reflect off the dull edge you see a thin band of light showing where it is dull. You can watch with each stroke of the file as that dull edge gets smaller until you can stop as it disappears. Any more strokes will be a waste of effort, time and tool steel. The telltale sign of enough use of a sharpening stone is the feel of a burr along the surface away from the stone.

Files come in as many shapes as there are tools to be sharpened. Round files of various diameters sharpen chain saws of various tooth size. Large and small triangular files sharpen coarse and fine hand saws. Flat files sharpen scrapers and just about anything else where the blade steel is not harder than the file. The three degrees of fineness in file surface are designated mill bastard, second and smooth, with each being a successively finer cut. The 8" second or smooth flat file is the most useful for scrapers. Buying a quality file by a name brand such as Nicholson rather than a generic is worth the few dollars more as there can be a considerable difference in the quality of the cut. Files can be dulled, too, when carelessly dropped into a drawer with other files.

Hand Saw Jointing, Filing, and Setting

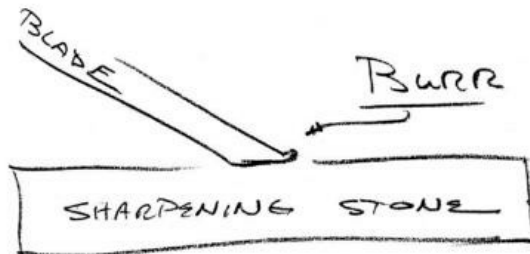
Jointing a hand saw is using a file down the length of the teeth to create a flat at the tip of the point of the teeth. Jointing accomplishes two things: the teeth are now all the same height, and the glint off the flat tip will guide you in how many strokes to take to make it sharp. You use an appropriate size of triangular file in the gullet of alternative teeth to file one side, then turn the saw around and file the other teeth, the difference being the direction the teeth are set. You want to file with the set away from you rather than file into the set. A light positioned so you can see the reflection off the flat tip is essential to knowing how many file strokes it takes to make it sharp and get all the teeth the same length.



SHARPENING BY FILE

WATCH FOR GLINT on dull edge. With each stroke, this thin band of light narrows until gone = sharp.

The last step is to set the teeth. This is bending the teeth to opposite sides so the saw will cut a kerf that is wide enough to allow the blade to cut without binding up. This is done with a setting tool. It looks like a muscle building device for hand strength, only the resistance is where a point pushes on the tooth to give the needed deflection called set. The amount of set is different for hardwood and softwood, with softwood saw set being greater in order to achieve a non-binding kerf. This is due to the tendency of softwood fibers to crush and close up the kerf while hardwood fibers cut cleaner and less allowance need be made for close up. Saws come from manufacturers with more set than is needed for most cutting you do in the shop. The first few filings without setting will reduce this and you will find an improvement if you refrain from resetting the saw until you use it a few strokes to see if it is needed.



SHARPENING WITH OIL OR WATER STONE

AS THE BLADE FACE is made flat right through the dull edge, a fine burr is raised on the back side.

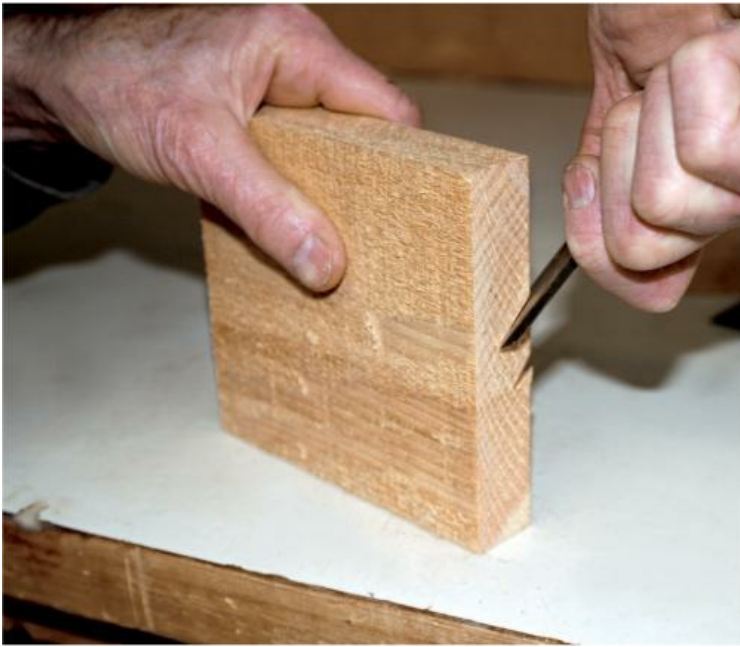
New dovetail saws seem to suffer the same over-setting. This is a fine tooth saw of 14 or 16 teeth per inch. When there is a too severe bend in the teeth, the saw will hang up in the cut and not have the smooth action you expect. I have seen students in the dovetail class despair over this when the brand new saw they bought would not work. Their assumption is improper technique, and it is relief to know that improvement is immediate when the saw is tamed. The solution appears as sacrilege, but do not be faint hearted. Take a fine sharpening stone and run a swipe or two down both sides of the saw. This will accomplish the reduction in aggressive set so it will perform well.

Hand saw sharpening by hand is superior to commercial sharpening services. Their machine files all teeth from one side. Filing into the tooth set leaves a different edge than filing away from the set. When hand filing, every other tooth with set pointing away is filed; then the saw is turned around for the rest. This results in an even saw.

Oil Stones, Water Stones

My father used an oil stone and a spit stone. A drop of oil on one and a drop of spittle on the other. Not hygienic, I suppose, and certainly not genteel, but effective and pretty much always available in the correct amount when needed. I didn't know it then, but these two stones represented two types: oil and water. It was a practical and effective demonstration to watch him, and perhaps receive an admonition to take care in using the whetstone so as not to furrow it with a careless jab of the blade because the surface was soft and could be damaged. The sequence was always oil stone first, finished on the fine whetstone.

Today there are a variety of Japanese water stones, large bricks of porous stone that soak up water in a bucket between usage. There are natural oil stones quarried from the only noviculite source in the world along the Arkansas River in the state of Missouri. The industrial diamond technology of recent years has produced diamond faced surfaces. Each type of sharpening stone has its proponents and the fact that they still compete for attention attests to the fact that they all work. In each case, set the stone so that it doesn't slide so you can use both hands to hold the blade to get effective pressure and angle when sharpening.



TESTING SHARPNESS by pushing plane blade into end grain of a block of wood. The first time I was shown this was by Adolph Peschke in St. Louis when he wanted me to find out how using a leather strop with honing compound would add to any sharpening method. It made me a believer by comparing how far it would push after honing.

My own preference is for an 8" combination stone made by Norton (product #85565-8) with carborundum on one side (coarse) and India stone on the other (medium/fine). For the final polish, I use a hard Arkansas oil stone. The cutting oil should be thin so it cleans the surface without causing the blade to glide off the grit. A quart of 30W oil and two quarts of K1 kerosene mixed in a gallon jug will last a lifetime and is easy and cheap. A two-ounce squeeze bottle holds oil at the sharpening station along with paper towels. Fill the squeeze bottle only half full. That way when it tips over as they do the oil won't run out. Label the jug and the squeeze bottles with black magic marker "cutting oil."

A Strop to Polish the Edge

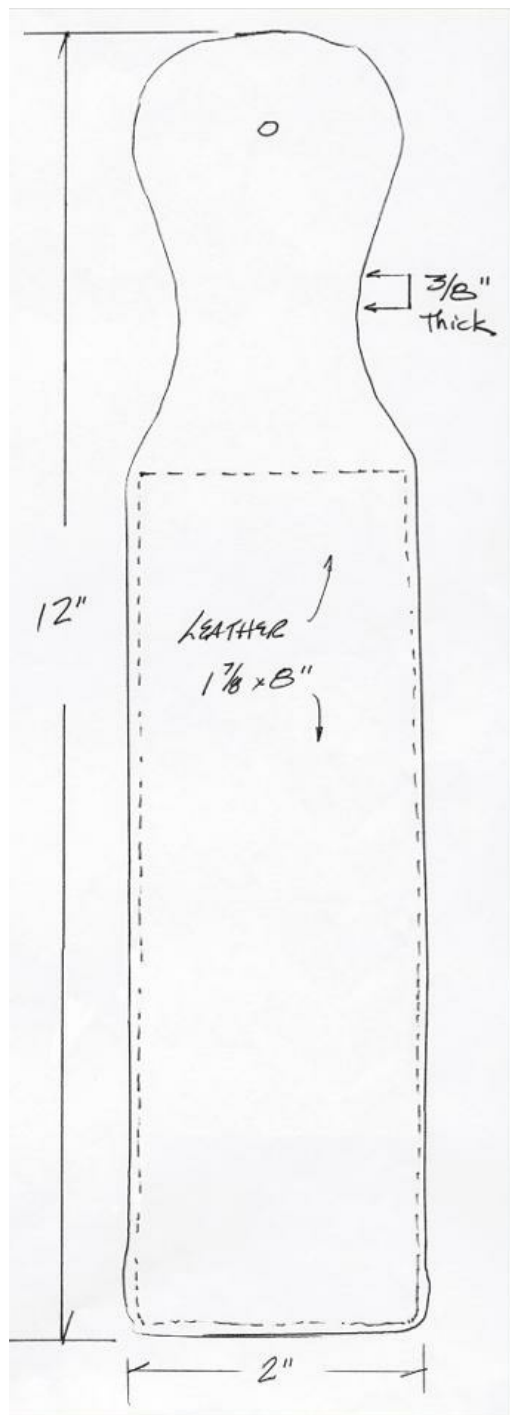
I was teaching in St. Louis 20 years ago and met Adolph Peschke at the family store run by *Woodsmith* magazine. His son Don is editor of the magazine. Adolph taught a class in plane making, so I bought one of his kits, which became the prototype of the one I teach in my plane making class. Another project he had students make was a strop. It was a wood paddle on which was glued leather (rough side out) on one side and emery cloth on the other. The emery is to touch off a rough edge and the leather is charged with honing compound for polishing the edge. (Lee Valley product #05M08.01, Chromium Oxide, 6-ounce stick, \$11.95.)

Adolph made me a believer by this demonstration. He said for me to sharpen my plane iron and then try pushing it by hand into the end grain of a block of wood. Next he gave me the strop on which to take a half dozen strokes. “Now,” he said, “see how far you can push that blade.” Wow! He made me a believer.

The beauty of the strop is that it makes no mess and rests right along with your chisels where you need it. The strop always enhances tool ownership. When charging the leather, use cutting oil to wet the leather and then rub with the rouge stick to work up a slurry to fill the rough porous surface of the leather and need not be replenished for months and years. The use of a strop is similar to using a buffing wheel to polish the edge. However, it is not so aggressive, so you can strop many times before needing to resharpen.

STROP FOR POLISHING YOUR SHARP TOOLS

1. Cut the wood paddle.
2. Sand edges for comfortable holding.
3. Glue leather to paddle rough side out.
4. Charge with oil and jeweler's rouge.



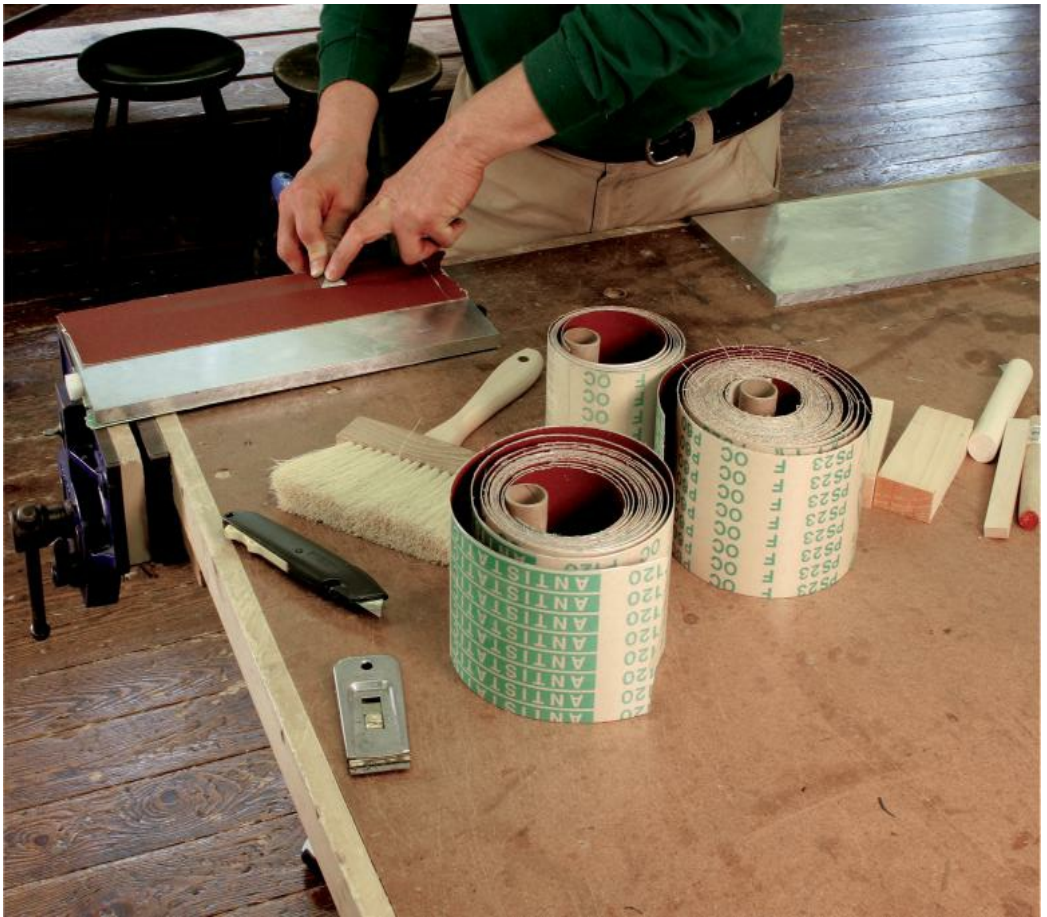
Sandpaper Sharpening

For years I have known about a sure-fire, cheap, no mess, and readily available system for sharpening that uses sandpaper. Sand is passé these days, with aluminum oxide the material of choice. Perhaps it all looked too simple, or maybe my oil stones were too ingrained, but it took my colleague Keith Cole several years to win me over. He would bring a collection of grits in a baggie and set up a sharpening station on the outfeed table of my saw. Simple and effective, the grits start with #80 for really dull stuff and end at #1,000 wet or dry (used dry) paper. He has #1,500, but I suspect that is showing off.

Another friend of mine in the teaching game is Mike Dunbar, the Windsor chair expert who started the Windsor Institute in Hampton, NH. He shows you his sandpaper system in “Sharpening for the Sensible,” *Popular Woodworking*, April 2007. At home or on the road, he needed a portable, easily set up, and cheap system. He writes:

My classrooms were full of unusable tools [brought by students] and I could not spend a lot of time on each one. A lot of chair making tools have curved blades, and also use both chisel- and knife-edge profiles. So, my eventual solution would have to be versatile. Finally, I would need supplies that were easy to find and provide. Hosts were not going to buy expensive equipment just for me. The answer: sandpaper.

Below you see Mike demonstrate his system. The sandpaper is glued with spray contact adhesive. The surface is a ½" aluminum plate. You might use ¾" MDF board, or scrap sink cutouts faced with Formica were you not able to find metal plate.



YOU DON'T NEED EXPENSIVE EQUIPMENT to get a sharp edge. Here you can see Mike Dunbar's aluminum plates, sandpaper and small scraps of wood that allow him to sharpen all of his tools. The razor blades, utility knife and brush round out the equipment needs.

Begin with a Bench Sander, End with a Strop

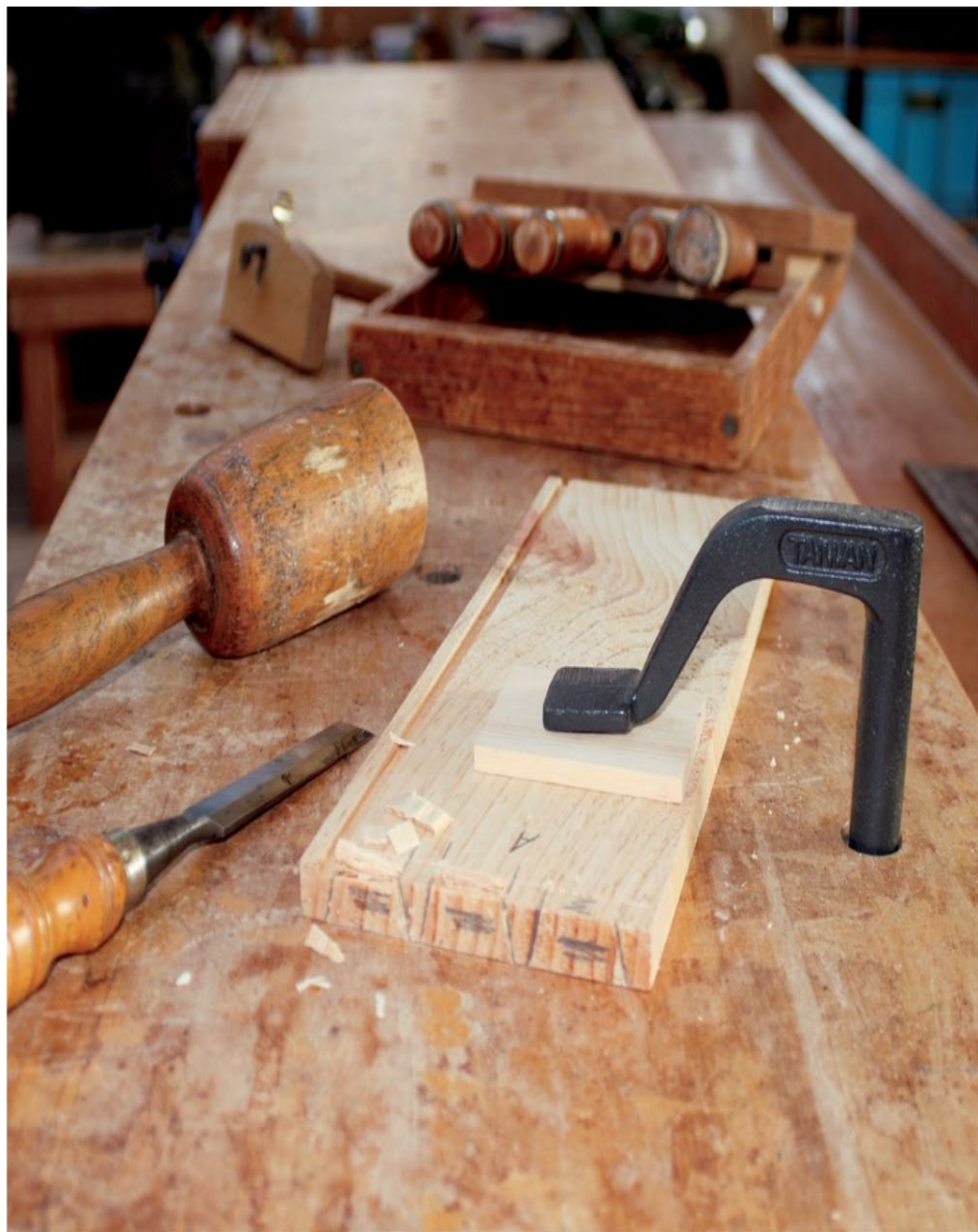
To whatever sharpening system you use, I would add a preliminary sander and an ending strop. For shaping the blade when new or abused, a bench top sander with 80-grit sanding belt does a great job. It is in place of a grinding wheel, which can easily damage a tool edge with heat (the blue mark). The sander does a good job establishing flat surfaces on both sides of your blade. Use belts that may be too worn for effective use on wood, and sharpen a tool or two before throwing them away. A water quench will keep the tool in the comfort range for holding on to it. It is really user friendly in the regard to preventing heat damage. We use this sander for getting the 25° bevel needed for plane blades after initial grinding the tool steel blank.

At the end of the sharpening process make use of the strop. Use it several times before

any need for resharpener. To make your own, follow the pattern on [page 171](#). Attach the leather, rough side out with yellow carpenter glue. Charge the leather with oil and honing compound. Keep one at your sharpening station, another with your chisels.



THE LEATHER STROP with abrasive compound will provide the final sharp edge after any system you use. It is also handy to use several times between sharpenings.



Keeping Tools, Holding Work

- ☐ [The Home Shop Workbench](#)
- ☐ [Saw Bench & Shop Stool](#)
- ☐ [Workhorse for Dovetailing](#)
- ☐ [Portable Dovetail Vise](#)
- ☐ [Chisel Holder](#)
- ☐ [Japanese Toolbox](#)
- ☐ [Tool Tote](#)
- ☐ [Traditional Carpenter's Tote](#)
- ☐ [Boat Tote](#)

The Home Shop Workbench



Building your workbench is a practical exercise as well as a personal expression of your craft. It is the outcome of what work you want to hold, what space your shop affords, what budget constraints and resources are at your disposal, coupled with your time, energy and skills.

The coming of John Brown to teach his Welsh stick chairs in 1997 necessitated making six workbenches in short order. This design is hand tool friendly, which means it is taller, longer and narrower than the work tables with a vise attached that many of us work at. Time and cash limits led to a design that could be made from green wood as well as the more costly kiln-dried lumber. Mill your lumber this week; make your bench the next.

Success is measured by the 15 years of faithful service these benches have given, plus the 25 more built by craftsmen who came to the Home Shop to make their own.



Four Different Benches

My experience over a lifetime of working wood can be divided into four periods. First, as a boy in my father's basement shop, I used a bench belonging to my grandfather with an old-fashioned leg vise, long, narrow and at a proper height, and a chest of drawers built in for tools. Second, my junior and senior high school shop experience in the 1950s, and later the Lansing Community College (LCC) shop, where I taught for 27 years, both

had work areas best described as assembly tables with small wood vises attached.

Third, with the revival of traditional woodworking skills marked by the advent of *Fine Woodworking* magazine in 1975, a window on a lost world was opened, and I read of Tage Frid and the workbench he used and taught. I conducted a class at LCC myself where students made their own Frid bench. Finally, the need for outfitting a teaching shop of my own resulted in a design where green wood could be used not unlike the design and construction of woodworkers 200 years ago. Each of these experiences combine to give the basis for evaluating workbenches both from the standpoint of function, and from cost and practicality of construction.

A story about the college shop where I taught for 27 years is instructive of what not to do. The large shop was ringed with tables whose base was a double tier of gym lockers topped with a 2" slab of hard maple about 30" table height. In each corner was attached a small wood vise. However, the shop supervisor couldn't bear to see the new maple tops scarred in any way, so sheets of masonite were glued to the maple. Over time the glue came loose. So any semblance of a firm, or "dead" work surface was lost. All in all, they were adequate assembly tables only.

Such tables were standard for shop classes in public school as well as college. They went along with the woodworking culture of the time which represented the love affair with the electric fractional horsepower tools that swept the hand tool traditions of earlier times into little used and poorly maintained storage.

Advent of the European Tradition of Workbenches

The year I started teaching woodworking in such a shop, 1977, was at the beginning of a revival of the old tool tradition, largely lost for 50 years in America but alive and well in Europe. A young Dane by the name of Tage Frid came to teach at Rochester Polytechnic Institute (RPI) in New York State in 1948. He relates his consternation upon viewing the state of affairs in the school's shop, and set about making benches that would serve the way he felt school shop should be taught. Frid influenced a new generation of woodworkers both at RPI and at the Rhode Island School of Design (RISD) that led to the watershed entry of *Fine Woodworking* magazine. It opened a new world to me just as I was entering upon a vocation as a woodworker/teacher after years as a carpenter in home construction.

I found Frid's article in a 1977 issue of *Fine Woodworking* (see [chapter 4](#) in Scott Landis' *The Workbench Book*, Taunton Press) inspiring. I wanted to learn more, so I held a class at LCC one summer for seven students to each make the Frid bench, a first for me as well as the students. We all learned a lot, not the least of which was the complexity of the project. It is rightly a statement of competence for the woodworking student which, in fact, is how Frid used the exercise for his graduate students.

I would like to say that the Frid bench became the center focus of a new era of hand tool adventure in my own shop, but no. Time ran out and while students finished their benches, I did not. Mine remained a pile of milled parts on a shelf until 25 years later I

gave it to an aspiring young cabinetmaker to encourage his dreams. What I used was a makeshift bench incorporating my grandfather's leg vise, the only piece of my boyhood shop to make it from New York to Michigan.

The Home Shop Bench

Started in 1985, the Home Shop in Charlotte, Michigan, is a place where Shaker oval box supplies are produced and sold, and instructional events conducted. I invited John Brown to come teach his distinctive design of Welsh stick chairs in 1997. He wrote to say that each student must work at his own bench for him to come. The letter arrived four months before the event. Time, cost, and construction concerns all converged to result in a workbench design. The success of this design was born out both in its use at the Home Shop, and in the classes offered for many years for students to make their own bench. The 27-page construction manual is still in print and available from myself for \$14 postpaid (406 E. Broadway Hwy., Charlotte, MI 48813).

I was fortunate to have as a resource, Scott Landis' *The Workbench Book*. Landis gives an overview of benches, including how he was involved in producing designs by Michael Fortune. Chapter 5 discusses the design process, which is most helpful in understanding what goes into bench design. Fortune points to the need for a bench to be taller, narrower and longer than the assembly tables of public school shop. Bench vises need to be placed at the end as well as front. And the structure needs to provide a firm surface so important for effective chiseling, as well as rack free for sawing and planing.

Building Green

In my case, constraints of time and cost and construction resulted in a bench made from green, or high moisture content wood. It may seem counterproductive to do this when all of cabinetry preaches the need for wood dry to interior home conditions. In fact, I find the belief in the necessity for only using dry wood so ingrained that woodworkers completely shut down at the suggestion of using green wood, like the devil running from holy water. Yet there are many examples of green wood construction, though most are peripheral to the cabinet shop. Such examples as boat building, coopering, timber frame construction and chair making to say nothing of bent wood boxes. All incorporate high moisture content wood either as an essential component of the construction process, or at least tolerant of the usage of wood not yet dry.



THE BOLTED TENON JOINTS OF THE BASE provide not only the assembly today, but the means for tightening the joint when wood dries and shrinks, as well as portability next time you move your shop.

Workbenches use a lot of heavy dimension stock which is expensive in cabinet-grade lumber dried to furniture standards. However, there is an abundance of trees in much of the United States outside the high plains capable of providing bench making lumber. Rendering logs into boards is now something of a cult revival with the advent of the band mill as represented by the Wood Miser Company's line of saws. Such backyard enthusiasts are eager to meet the needs of a workbench project.

But how do you get the wood dry? Not easily, because it takes a long time to do so in air drying — about one year per inch thick is the norm. And commercial kiln operators are few and far between who will custom dry small lots of lumber. One solution is to design a bench where shrinkage occurs within the bench itself following construction.

That way a woodworker can decide on the design for his bench, cut the stock at a band mill, build the bench in a few weekends, and get right to work, or in my case be ready for John Brown's class. In the months to come as the bench dries and shrinks any slack in joints is taken up with a turn of a bolt. An added advantage of such construction is the portability of the bench by unbolting joints, so it no longer gets left behind as my grandfather's bench did in New York.

So the bench I designed combined an available resource in hardwood logs, with the custom milling work of small band mill operators, and side-stepped the hurdle of drying thick dimension lumber by building green. The design works just as well if dry lumber is available. Some species of hardwood are better suited to the project than others. Avoid a wood such as elm that is prone to warping. Smooth grained wood is most desirable in the finished bench, making hard maple a perennial choice. One unexpected complication arose from using red oak. The tannic acid corroded the cadmium coating on the bolts used to join the frame so they froze in place and could not be tightened when later shrinkage occurred.

How Wood Shrinks

Understanding how wood shrinks will avoid some complications in building with green lumber. Wood cells shrink most along the annual growth ring, less across the annual growth ring, and least in length. Oak, for example, shrinks 10 percent along the growth ring, 5 percent across the growth ring, and 0.1 percent in length. The goal is to avoid distorting the shape of the workbench pieces when they dry. Bench legs will serve to illustrate what we want to avoid, shrinkage that can cause a green square to become diamond shape when dry.

Both [Figures A-1](#) and [B-1](#) (at right) are actually 4" square as cut green. [A-2](#) dries out of square as a diamond shape, while [B-2](#) remains square to its surfaces as it shrinks with one face losing $\frac{1}{4}$ " and the other $\frac{1}{8}$ ". In the bench plans, the bolted mortise-and-tenon joints allow for keeping joints tight while they shrink.

A second difference between them is the avoidance of the heart of the tree. Whenever the heart is part of the board, you can expect trouble with drying. The second log cutting plan allows for scrapping an inch or two of the heart without having bark, or wane, showing up on the corners of the 4 × 4.

The most difficult part of the bench to go through the drying period without warping is the top. Here close attention to grain direction is essential if you are to have a successful project six months later. One consequence of the principle of major shrinkage occurring along the annual ring is that flat sawn boards will cup when they dry, and in the following manner. This is the opposite direction from what a casual observation would lead us to believe.

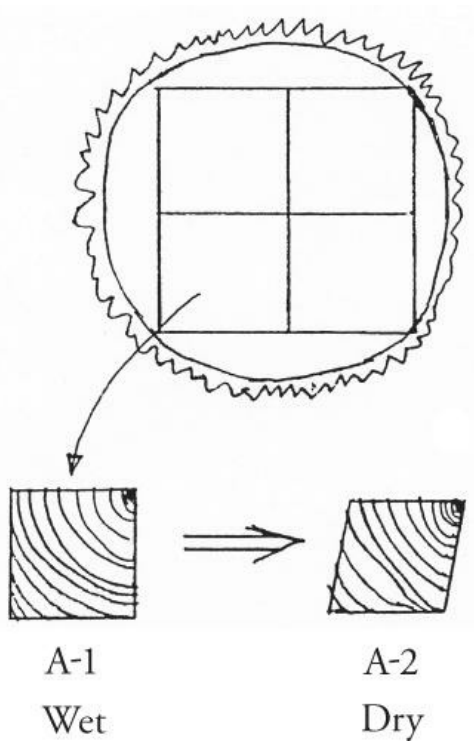


FIG. A:
POOR ORIENTATION OF 4 X 4

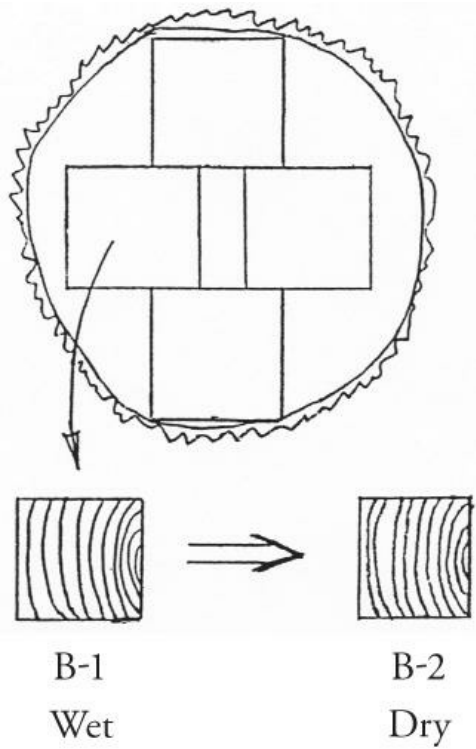


FIG. B:
BEST ORIENTATION OF 4 X 4

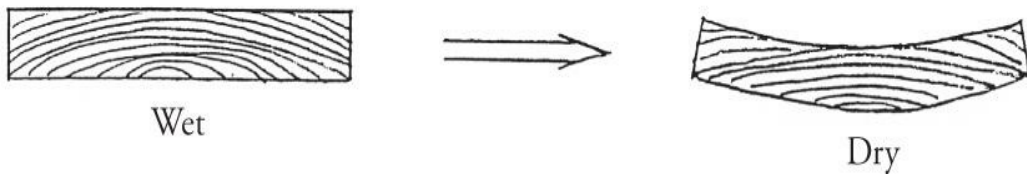


FIG. C:
SHRINKAGE

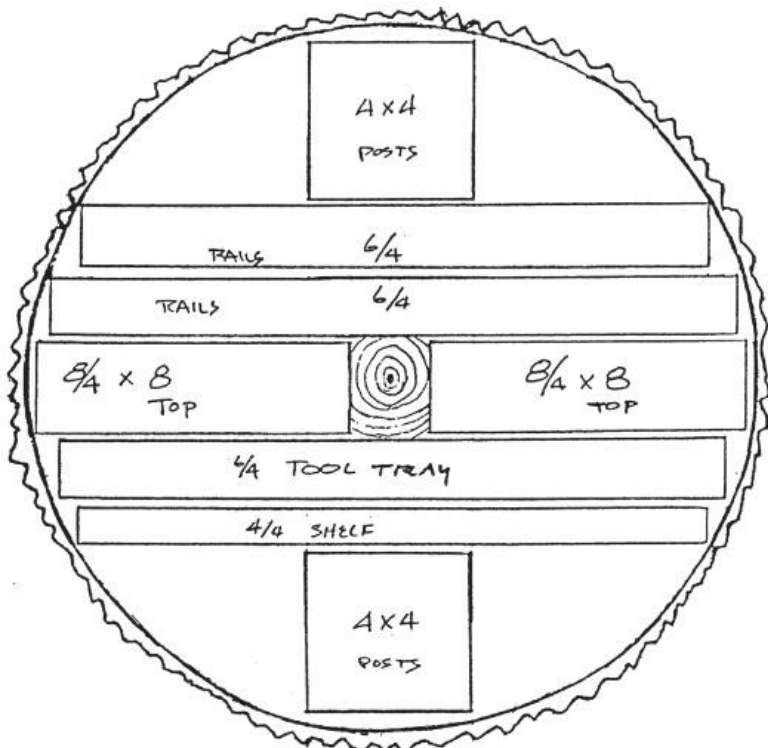


FIG. D:
LOG CUTTING DIAGRAM

The direction of grain is more important in some pieces than others. Posts and bench tops need close attention, while rails and shelf less so. Top boards are best quarter sawn, meaning the annual rings are perpendicular to the board surface, to minimize shrinkage and avoid cupping. The place of the top boards in the log cutting diagram ([Fig. D](#), at right) achieves this.

The log of 20" diameter or greater by $8\sqrt{2}^1$ long will yield the best results. This pattern will provide needed grain direction within each piece that will ensure warp-free drying during the dry-out phase of the bench.

To summarize, the wood for a workbench can be made from a variety of wood species to take advantage of what you can find. The diameter of the log is important to get the fairly robust dimensions of bench stock with the correct grain orientation. The importance of grain direction and absence of heart wood will ensure warp-free drying during the next six months.

The Design

Overall the bench follows the proportions of being taller, narrower, and longer than an

assembly table. The bolt-up leg and rail frame allows for tightening when wood shrinks as well as portability. The two part bench top incorporates a 14" work surface with holes for bench dogs and holdfasts with a 5"-6" tool tray allowing for any shrinkage in the top coupled with open ends on the tray for easy clean up. The tail and front vises are Record quick release type with extended cheek boards. Holes in these cheeks afford additional dogs to hold work, the dogs being shop turned hardwood. Built-in storage is a productive use of the middle space in the bench.

After making 10 benches myself, and conducting classes where many other craftsmen made their own bench in three days, I can attest to the straightforward milling and assembly of the design. The opportunity, unique in this design, of utilizing green lumber is an option lost since the Roubo bench in the eighteenth century. Savings in cost and drying time are significant, as well as appealing to resourcefulness. Green wood construction is a solution to time and cost factors. It also gives useful skills and a sense of connectedness to the larger world of trees.

In reading about Tage Frid and the workbenches his students made I am struck by several things. First, what an extraordinarily fine experience his students had!

We have been making these workbenches every two years so the students each have their own. This gives them the proper tool for holding their work. In addition, the process of building the benches is a good exercise in learning how to set up machines for mass production and how to work together as a production team. The last time, we made a run of 15 benches and it took us three days from rough lumber to having all the parts ready to fit or assemble, with the bench tops glued together.

Tage Frid Teaches Woodworking, Book 3
[p. 25](#), Taunton Press 1985

Second, one sees how widely the trestle style frame and sliding vise with bench dogs top design is followed among the present generation of woodworkers. It attests to the influence of this tradition. It is a bench that makes a statement of accomplishment as well as provision for holding wood.

Third, while an effective bench and a handsome accomplishment, the project is complicated. This in itself is no reason for not copying it for yourself, unless in so doing no bench gets finished. Frid states that in three days the milling and top glue-up was accomplished by his students. I had experience in conducting a class making the Frid design as mentioned above, and know that, like framing a house, the project is less than half done at this point. My own bench design was the basis for three day courses where from four to eight students made their bench complete. Finishing the project is important.

To suggest that one bench design is the standard for fine work is nonsense and elitist. Woodworkers should follow their passion for wood to make a workbench for themselves. Research could start at no better place than reading Scott Landis' *The*

Workbench Book (Taunton 1987) and Chris Schwarz' *Workbenches: Design, Construction and Use* and *The Workbench Design Book* (Popular Woodworking Books 2010). They afford an eclectic mix of shop solutions. Your bench will be the outcome of what work you want to hold, what space your shop affords, what budget constraints and resources are at your disposal, and your time, energy and skill. My design is the outcome of just such considerations. I offer it to expand the options. Look at the Roubo Bench detailed by Landis and Schwarz. It has a frame similar to mine. Understand the larger world of building green, which it represents. Add to that the use of bolted tenon joints for portability and tightening up future shrinkage. Go to a friendly band mill operator and pick a log for cutting. Then get it done.



TALL, LONG AND NARROW are the proportions of a traditional workbench. The variety of ways to hold wood make it much more than a solid platform.



THE WORKBENCH TOP comes apart in two sections, which shows that they are independent to allow wood movement without damaging the structure. Close inspection of the end of the tool tray shows duct tape over the end grain. This is a green wood project and end grain checking is avoided by covering both ends of the top boards.

Bench Construction

The photographs show steps in construction from cutting mortises and tenons through anchoring the top. See the bench plan on [pages 266-267](#). The following notes give information on joint design and construction.

When drilling the posts for the joint bolts, make use of a drill press to ensure drilling is square. This is done after cutting the mortises. Drilling for the $\frac{3}{8}$ " machine bolts with a $\frac{25}{64}$ " drill makes for easier assembly and disassembly later. Mark and center punch the outside of the leg. Drill a recess for the bolt and washer with a 1" Forstner bit. This operation is made accurate with a simple centering jig: Use $\frac{1}{4}$ " hardwood about 2" $\times$ 6" with a 1" hole in the center. Positioning over the $\frac{25}{64}$ " hole will allow visual centering, and prevent the drill from wandering. The jig is also the only way I know of drilling when using a hand-held power drill so the bit will not walk away. The jig is clamped down.

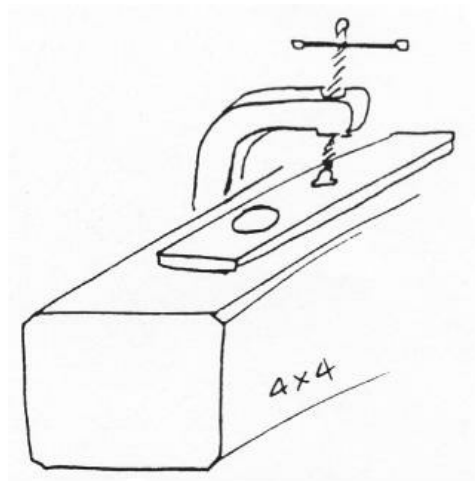
Rails are drilled for the nut and washer recess 2" back from the shoulder. Use a $1\frac{1}{2}$ " Forstner, and drill from the inside surface to within $\frac{1}{4}$ " of the outside surface. These

holes are given a flat landing for the nut and washer with a 1" chisel ([see photo](#)).

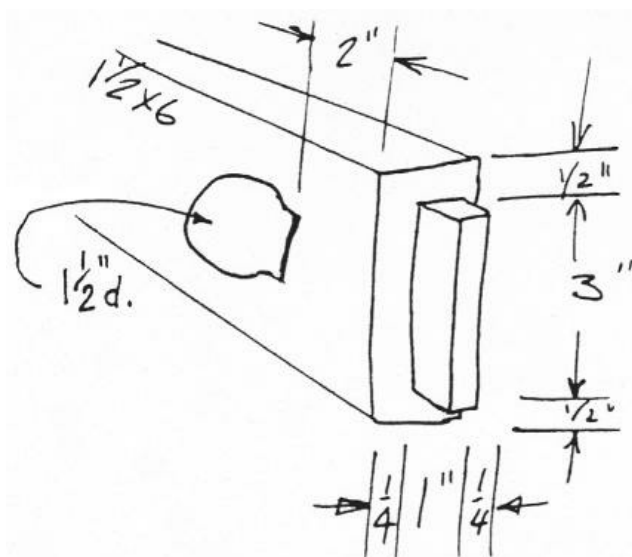


JOINT WORK ON THE BASE begins with mortising the legs, shown here being drilled out with a Forstner bit at the drill press. With multiple benches to build, and 16 mortises per bench, we used a plunge router and template guide to clean up.

Cut the cross supports so that the top and tool tray will be $\frac{3}{16}$ " above the top of the posts. This allows for shrinkage so the top will come down onto the posts as it dries. (If building with dry wood, this and other allowances for shrinkage can be ignored.) The supports will overhang the rails by $\frac{1}{2}$ " both front and back. The step in the middle allows for the difference in height of the top slab and the tool tray. However, the step should be $\frac{1}{16}$ " less than the tool tray bottom to allow for shrinkage. Drill $\frac{7}{16}$ " holes to coincide with similar holes in the top rails front and back. Next drill the slot for the center lag bolt that is two holes $\frac{7}{16}$ " drilled barely touching each other, and chiseled clean. This is going to allow for the major movement of the top slab.



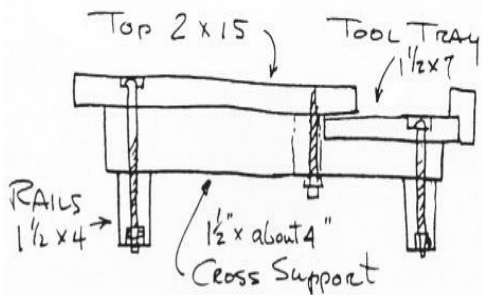
CENTERING JIG



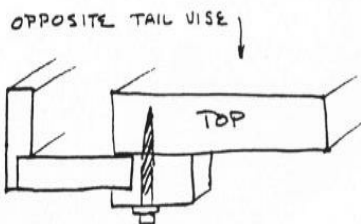
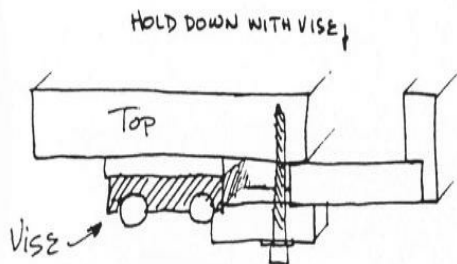
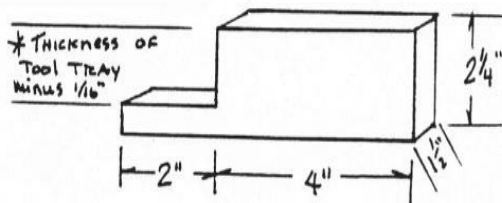
TENON & NUT
WASHER RECESS IN RAILS



THE MORTISE AND TENON is shown here where the bolt goes through a hole drilled in the leg. The rail (cut in two for demonstration) is drilled to receive the nut and washer. See the photo on [page 186](#) for the final drilling which will complete the joint.



CROSS SUPPORTS



END CLAMPS



ASSEMBLY BEGINS with end sections bolted together. Here they are connected to the four long rails.



LONG CLAMPS hold the bench together, with one laid diagonally to adjust as needed to square the base. Once in place, the long $\frac{3}{8}$ " drill completes the hole for the 6" bolts. My oldest son David is doing the work.



WITH THE BASE COMPLETE and the bottom shelf in place, the top holding cross pieces are predrilled for attaching to the rails. The rails are also drilled for the long bolts.

The photo below shows the top being attached. The carriage bolts are recessed to allow for a 1" dowel plug (not glued, pressure fit only) so no metal is exposed on the bench top. The three cross bars anchor the top to the base, and the tool tray to the top. Note again that this is a moveable joint allowing for shrinkage as wood dries. The ends of the bench top and tool tray are held together with end clamps that help squeeze this joint together.

The bench top grid of $\frac{3}{4}$ " holes for bench dogs and holdfasts is an important feature of any bench. Here are several suggestions:

- Green wood will shrink, closing the holes slightly. They can be redrilled later, or simply wait to drill when dry.



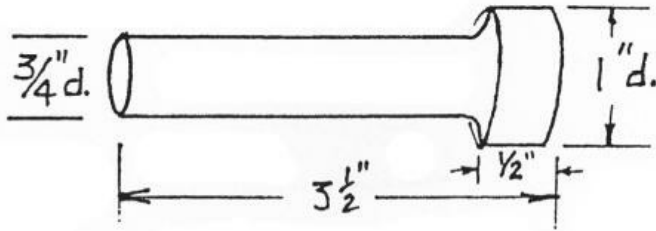
THE LOCATION OF THE HOLE through the top is found using a pointed bolt being hammered here. Drill through the top, then countersink for the head of the 8" carriage bolts. A dowel plug is used to cover the bolt head.

- Look carefully underneath so all holes have clear space avoiding cross rails and bench vise ways.

- Unless you already have a bench with dog holes and know what positions work best for you, wait until you find a need for a hole in a place before drilling it, or at least start with fewer holes than you will eventually drill.

- Holdfasts are great but their shanks vary from under $\frac{3}{4}$ " to exactly $\frac{3}{4}$ ". Because the

holes for them need to be oversized by $\frac{1}{16}$ " , check them first before drilling.



BENCH DOG

■ You can turn your own bench dogs from 1" hardwood dowel. See the illustration above.

Now you can enjoy the most important tool in your shop.



ONCE THE TOP, TOOL TRAY, AND BACK RAIL are done, the bench vises are bolted on. They require leveling blocks as shown in photos of the complete bench on [pages 189](#) and [264](#).



THE VISES HAVE BEEN FITTED with extender boards. These and the top are drilled for bench dogs and holdfasts. Before drilling, be sure the underneath area is free of cross bars and vise ways where you plan to drill.





TWO VIEWS OF THE COMPLETED BENCH show the detail of parts. The design allows for using green wood which will dry and shrink in place. Bolted mortise and tenon joints will tighten up as needed. The top and tool tray are lapped to allow for as much as one inch of shrinkage. Dry wood or green, seasonal changes, and portability are all part of this versatile design.





FOUR BENCHES WERE MADE in this batch. After construction, the ability to take it apart for transporting is shown as the tool tray with cross supports is being held by the proud maker in the photo at right.

STORAGE DRAWERS FOR CABINETMAKER'S BENCH



THE SPACE UNDER THE BENCH is a logical place for tool storage.



SHOWN IS A STANDARD DRAWER hung from guides, roughly $6'' \times 14'' \times 18''$. A shallow tool tray rests on a ledge inside the drawer, $2'' \times 12\frac{3}{4}''$ square. Drawers below the standard drawers rest on guides on the lower rail, $8'' \times 14'' \times 18''$. Center guides are attached with one 3" screw at each end. Space under the bench top receives a $\frac{1}{4}''$ plywood shelf for use as storage for square and level and patterns.

Saw Bench & Shop Stool



Holding wood for working is as important as the tool for cutting it. This project predates all others in this book as it was originally used when I started as a carpenter in residential construction. The stool was standard issue for carpenters working for Means and Nix in Cazenovia, NY, where I became a journeyman carpenter during four summers, 1959 to 1962, of my college years. As the article from *Popular Woodworking* relates, it was at the beginning of my second year that Will Means invited me to his shop to make my first stool. As something of a badge of acceptance as a workman worthy of his own stool, this project is associated with my graduation into the trade.

As testimony of a long and useful life, the photograph on [page 268](#) shows that stool 50 years later.



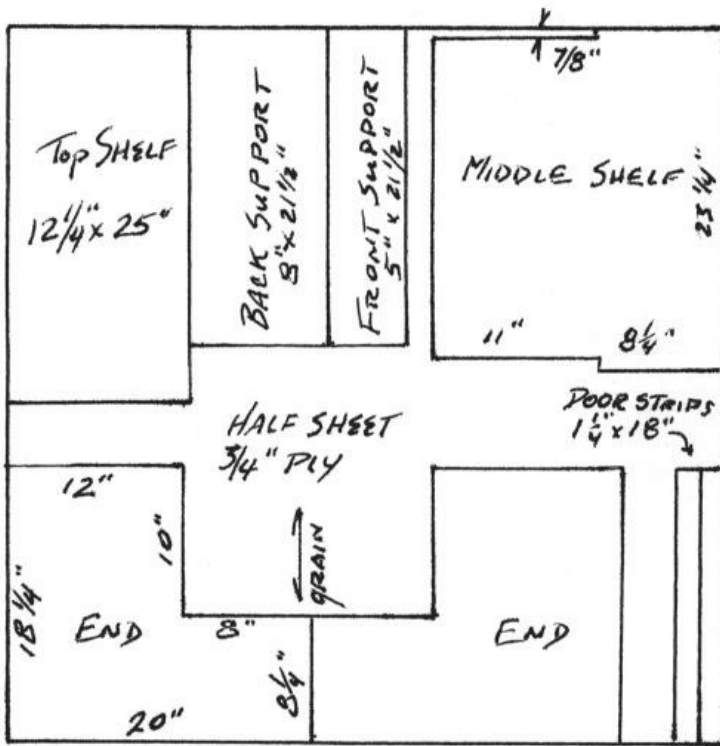
I have used this stool at various times since, both professionally and in all the multitude of homeowner chores. For 10 years I held a contractors license and had my own remodeling business in Charlotte, MI, where the original stool pretty well got worn out,

Just before its end, I took measurements for a new generation of stool. It is made from a half sheet of $\frac{3}{4}$ " plywood. Pick a sheet carefully. The yellow pine sub-flooring used here will stand up well. Make two of them while you are at it. The second stool which came from the sheet of plywood I bought was sent to the magazine along with instructions on how to make it. Editor Christopher Schwarz took it with him on woodworking show demonstrations. He found considerable interest when he used it while showing hand saw use. In fact, there were more questions on where he got the stool than on hand saws. So he realized reader interest warranted publishing the article which he titled "Saw Bench," which it certainly is. More than that, it is saw horse and work stool, tool organizer and lunch seat.

Rescuing the Spirit of the Old Work Stool

My simple plywood two-step in the old tool shed had reached the end of the road. Looking at it you could see a pile of old wood ready for the burn pile. I saw in it a project that recalled 50 years of working life. It was more than just memories that came to mind. If it was time to recycle the old stool then it was important to document what had been a most useful object, and perhaps make a successor to it before its last rites.

My time in home building and remodeling went back to four summers during college. I learned the trade of carpentering before the modern era of specialization, the days when a small carpenter crew did everything from the first framing to a completed house ready for painters. It was a good education. The shop stool represented a sort of rite of passage into the world of construction.



CUTTING PLAN

HALF-SHEET 3/4" BC YELLOW PINE PLYWOOD

That first summer I was too busy learning the ropes as the new kid to understand the significance of a shop stool. I borrowed someone else's when a task was at ceiling height. The second summer I was more confident of what was required on the job. After all, they had hired me back.

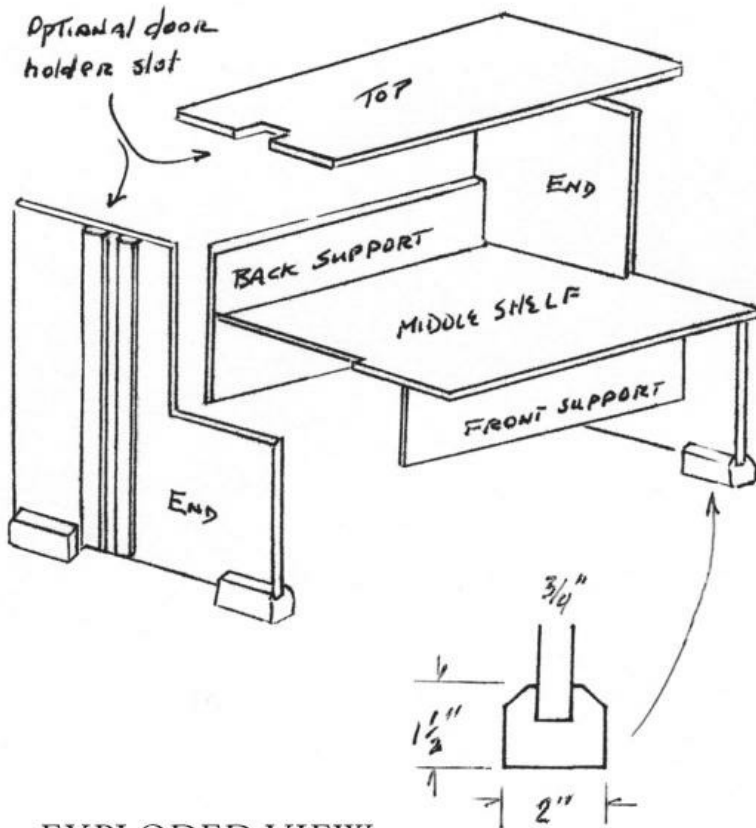
One day the boss suggested I stop by his shop to make a shop stool. It sounded helpful to me, but looking back on it from the perspective of years later I can see its significance. It marked my acceptance as a man who could use an on-site bench to do his work. From now on along with my growing box of tools, the back of my car held my very own work stool, something some newer member of the crew would ask to borrow. That pile of old plywood ready for the burn pile was to me a badge of rank, hard won during months of work on the job.

So what was so special about the shop stool on the job? The place at which you work is an important extension of the tools you use. This is as true of home building and remodeling as it is in the workshop. In fact this shop stool is an asset in either your shop

or on the building site.

- It serves as a stable two-step work platform.
- It's a mobile work surface for cutting and assembly.
- It holds doors on edge for planing tasks.
- Two stools will replace the need for sawhorses.
- It keeps tools in one place where they are easier to find and transport to a new work site.

All of this is from a half sheet of $\frac{3}{4}$ " plywood and some deck screws. Recalling all the ways the shop stool gives good service made me realize how important it was to record its dimensions. I inherited mine from men of experience on the job. There is no better school of design than experience. So here it is for you, too.



EXPLODED VIEW
WITH FOOT DETAIL

While plywood is a stock construction item, I found that its quality varied considerably and that taking time to shop for a sheet with reasonable finish, free from major voids, and not warped, paid off. Some of the best plywood these days comes from yellow pine and is the BC grade with one good face. Pick the best you can.

The illustrations and cutting plan give you direction. Start by screwing the 8" back support to the middle shelf, and then screw the 5" front support under the middle shelf leaving it centered with $\frac{7}{8}$ " exposed at each end. With these in place, the sides will screw to the middle shelf more easily. The top step goes on and you are done. It's that simple.

The door holder slot, if desired, is added to one side. And there is one more addition that will add years of life to your shop stool. I found that the plywood feet abraded away with use. As that happens, the stool loses stability as well. So I made some simple hardwood blocks. The blocks are made from a piece of $1\frac{1}{2}" \times 2"$ with a groove $\frac{3}{4}"$ wide by $\frac{1}{2}"$ deep routed into the wider face. Cut these into four pieces 4" long and glue them onto the sides.

One further use of the stool comes at noon – all the guys sitting around the work site with their lunch pails open!

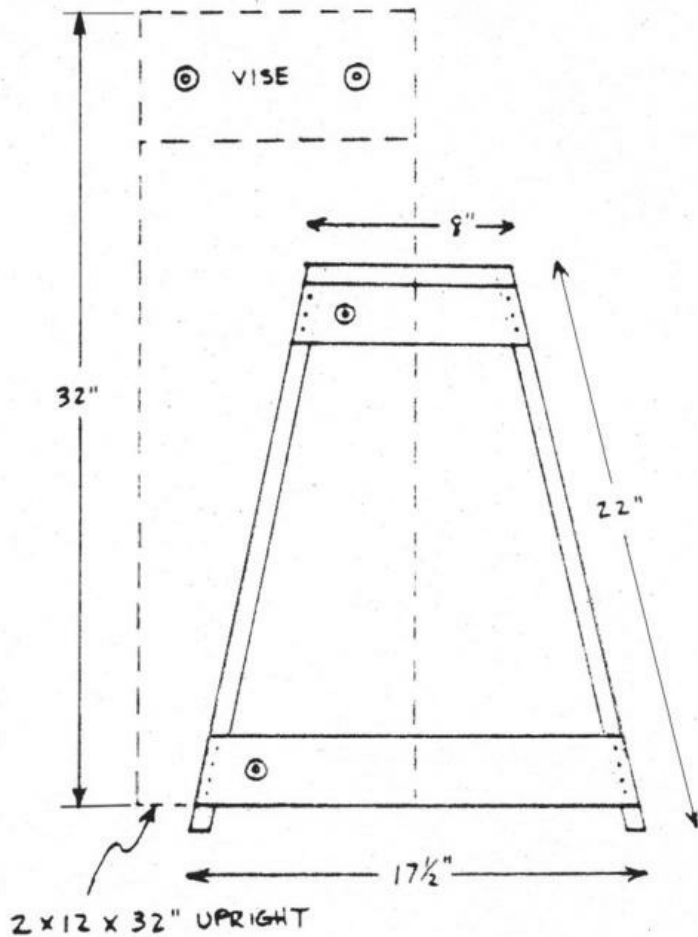
Work Horse for Dovetailing



When I took my teaching on the road, the need for student work places presented a problem. At the college wood shop, there were student benches with woodworker's vises for everyone. The first thought was to go to wood shops to teach. However, two things made this impractical. School wood shops were often not located where sponsors wanted me to come teach, and school shops did not welcome outsiders. If my freelance workshop plans were to happen, I had to make student work stations portable.



This project first appeared in Highland Hardware's Wood News, #23, Spring-Summer 1989. Highland Hardware is a woodworkers' supply in Atlanta that has had many famous presenters and attendees. An example of each are Sam Maloof, chairmaker to presidents, and Jimmy Carter, a woodworker who was president. After bringing my road show to Highland Hardware, they included this work horse in their publication.



END VIEW

WORK HORSE

MATERIALS

1" x 5" x 22" hardwood

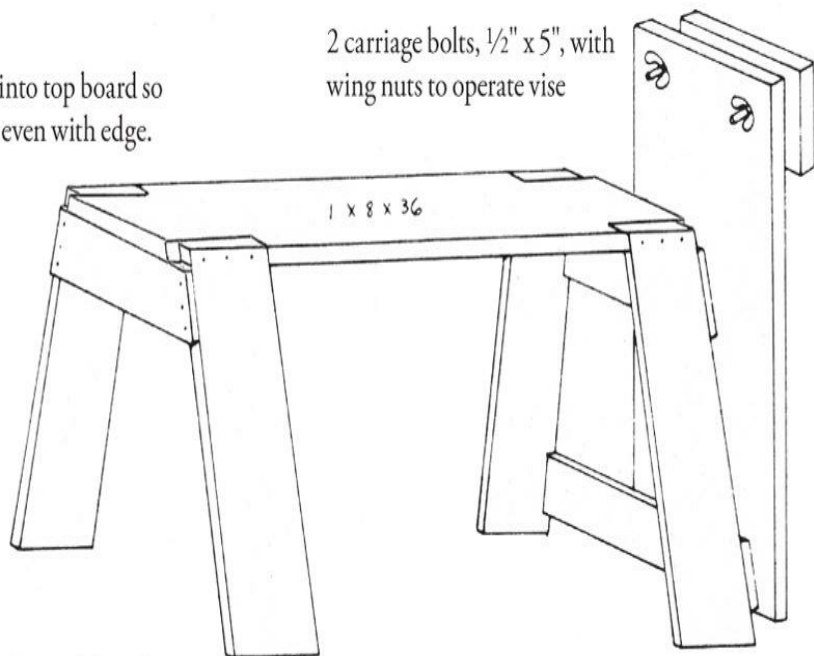
Legs (4)	or $1\frac{1}{2}" \times 5\frac{1}{2}"$ Douglas fir
Top	$1" \times 8" \times 36"$
End braces (2)	$1" \times 3\frac{1}{2}" \times \text{about } 10\frac{1}{2}"$
End brace	$1" \times 5" \times \text{about } 17"$
Face board	$1\frac{1}{2}" \times 11\frac{1}{4}" \times 32"$
Vise board	$1\frac{1}{2}" \times 5\frac{1}{2}" \times 11\frac{1}{4}"$
Drywall screws (30)	2" or $2\frac{1}{2}"$ long
Carriage bolts (2)	$\frac{5}{16}" \times 3"$, with washers & nuts
Carriage bolts (2)	$\frac{1}{2}" \times 5"$, with washers & wing nuts

Teaching oval box making is easier than many wood projects to equip. You do not need a separate work station for each student, because students rotate among several locations. I bring two work tables on which to set benchtop sanders and drilling jigs. All that is needed beyond that are standard folding tables. However, a project such as the Shaker dovetailed dining tray is different. Here students will work on their own for hours at their bench to accomplish the cutting and chiseling required of dovetail joints. The solution was to elaborate on the common saw horse and add a vise. The need for portability was accomplished by detaching the vise panel and stacking the horses so that a dozen would fit into the back of my pickup for the next road trip. Attachment of the vise panel was offset left or right to accommodate the handedness of students.

By making the back of the horse 8" wide from either 4/4 maple or 2×8 construction grade fir or yellow pine, there was a platform to straddle that when 22" high served both a seat and a work space to chop tails and pins. A panel 32" high attaches with two wing nuts and carriage bolts to the end of the horse. At the top was a vise made of hardwood with two large wing nuts on $\frac{1}{2}"$ bolts, which held a board in a vertical position. The beauty of this will not be lost on anyone who has tried dovetailing at a standard woodworker's vise. Holding wood securely for sawing requires being a few inches away from the jaws of the vise, otherwise wood vibrates and sawing is difficult. Standard wood vises have bed rods and acme threads preventing holding a board this way without side extensions. In this work horse, the boards are held right when you want them.

Let legs into top board so they are even with edge.

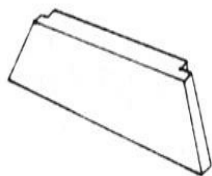
2 carriage bolts, $\frac{1}{2}$ " x 5", with wing nuts to operate vise



Upright face board must be of rigid stock, or you can double up $\frac{3}{4}$ " plywood.

2 carriage bolts $\frac{5}{16}$ " x 3" to fasten face board to horse

Joints are best rabbeted.



Fasten with glue and 2" or $2\frac{1}{2}$ " drywall screws.

For wood, use $\frac{4}{4}$ maple planed hit or miss to leave as nearly 1" of stock as possible; $1\frac{1}{2}$ " softwood, e.g. Douglas fir or yellow pine can be substituted.

NOTE: Face board is offset to right or left of center to accommodate the worker's handedness.

WORK HORSE

I prefer to use 1"-thick hard maple. You can buy $\frac{5}{4}$ stock, but that may be more expensive than necessary. $\frac{4}{4}$ No. 1 common hard maple is readily available at a reasonable cost. If you just skim the rough milling off (called planing hit or miss) to leave the maximum stock, you can arrive at the size which gives the thickest board. Actually, most any hardwood will do. Even $1\frac{1}{2}$ " framing lumber can work, in which case use 3" drywall screws. There is a big difference in the density of framing lumber. Try to pick a piece of slow growth wood with tight annual rings.



THE VISE UPRIGHT should be more rigid than shown here. Although these worked they allowed vibration when sawing. Glue together two pieces of $\frac{3}{4}$ " plywood as uprights. The cross piece is reinforced with steel to which bolt heads are brazed. Three inches of $\frac{1}{4}$ "-steel rod is brazed to the nut for a handle.

The legs are let into the top board to give a smooth edge to the top. Unlike many saw horse plans, the legs are not splayed front to back so that the front vise can be vertical. Joints are glued and screwed using 2" or 2½" drywall screws. The cross pieces on the legs are rabbeted for added strength.

Making the legs all even to the floor can be done after assembly. With the horse set on

a level surface, scribe a line around the long leg using a scribe setting equal to the amount of gap between the short leg and the floor.

The front upright needs to be especially rigid. I first used $\frac{3}{4}$ " yellow pine plywood but it vibrated too much when sawing. Your choice depends on what's on hand. Doubled up $\frac{3}{4}$ " plywood glued together, hardwood more than an inch thick, or a good dense 2×12 of Douglas fir or yellow pine all would work. The upright is offset to the right of center for right handed riders. Mine are drilled to be reversible for either right or left handers. Attach the vise to the head board with two $\frac{1}{2}$ " $\times$ 5" carriage bolts with washers and wing nuts. For improved leverage in working the vise, braze a 3" piece of steel rod on the nut for a handle.

Now you are ready to mount up for work. The capacity of the vise is limited to the distance between the carriage bolts. This is 8" on mine. The work is held vertically with the kind of support needed for cutting dovetails. To chop the waste, slide back to the end and work on the middle surface of the horse.

"Happy trails" to you, or maybe it should be "Happy 'tails" to you.



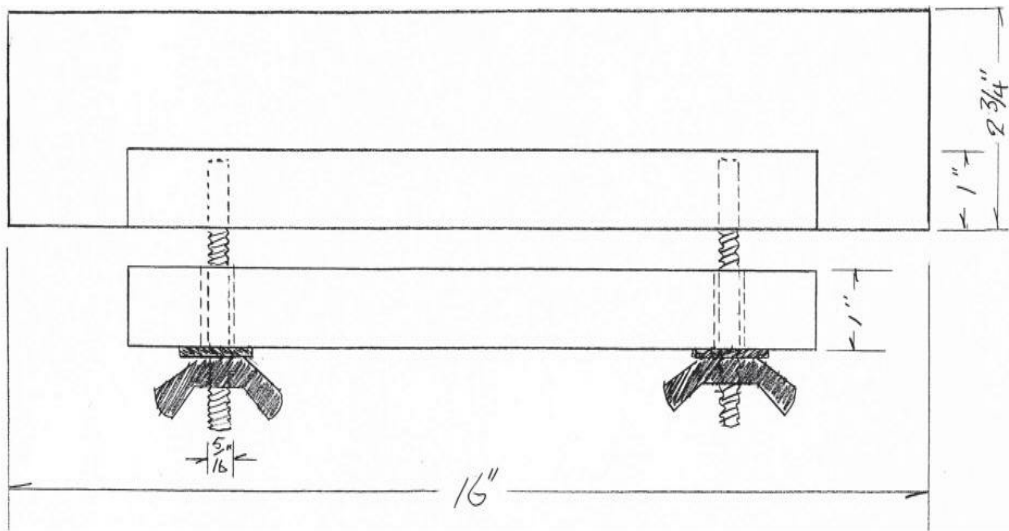
THE WORK HORSE was made as a station for sawing dovetails. I needed portable work stations for students in a hands-on class where ten or more would attend. Here you see 12 work horses: 11 stacked, one assembled using two carriage bolts. The vise holds boards for sawing, while the 8" seat is long enough for one to slide back providing space to chisel waste.

Portable Dovetail Vise

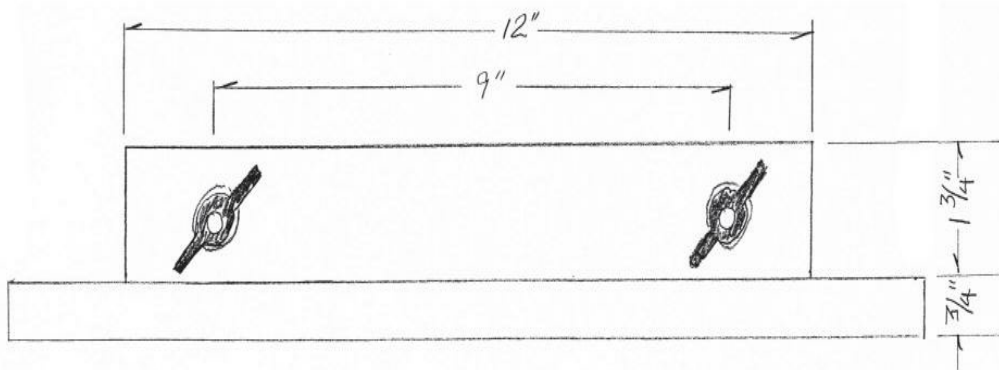


Holding boards for hand-cut dovetails is a problem. It is one of the few times where one is sawing various angled cuts on the end of a board. Boards saw best when securely held. The usual wood vises of the cast iron sort that most of us use these days have two bed ways and an acme threaded rod to operate the jaw. This arrangement interferes with holding a piece of work vertically. If you do stand up the board in such a vise, the vibration occurring from not clamping close to the end makes sawing ineffectual. It is interesting to note that bench vises used before our modern cast iron type allowed for vertical board holding, in concert with the practice of hand-cut dovetail construction.





TOP VIEW



FRONT VIEW

PORTABLE DOVETAIL VISE

MATERIALS

Base $\frac{3}{4}" \times 2\frac{3}{4}" \times 16"$ hard maple

Anchor block $1" \times 1\frac{3}{4}" \times 12"$ hard maple

Jaw 1" × 1¾" × 12" hard maple
Threaded rod ⅜", cut for two posts with wing nuts and washers, total 10"

Dealing with the College Wood Shop

The following project for vertically holding boards came from my experience teaching woodworking at Lansing Community College. The shop tables had plenty of cast-iron vises, but nothing to serve student needs when making hand-cut dovetails. I was not in a position to remake the wood jaw piece that is bolted to the iron plate which, if sufficiently extended beyond the vise itself, can afford the means of clamping vertically. Equipping the shop was done long before my tenure with wood jaw plates the same size as the metal vise.

The solution for drawer construction, or similar dovetailing projects, was to use a router and jig. I have no quarrel with what has become standard in the cabinet trade since the advent of the portable electric router. I own one and use it myself. For strength, utility, and speed it deserves a place in the wood shop. This is not the place to debate hand-cut vs. power-cut dovetails, except to help understand why those who made the community college shop did not provide a means for holding boards vertically at the shop tables. They did not know.



ANY BENCH OR TABLE can serve as a dovetail station with this portable vise. It holds boards vertically so the angled cuts in the end can be made with minimum vibration.

The Solution

A simple device of three maple boards and $\frac{5}{16}$ " threaded rod using nuts and washers provides the solution. It clamps to the edge of any table or bench. If there is one element of mystery about its construction, it is that maple can anchor threaded rod by simply drilling a hole of the minor thread dimension and turning the threaded rod with vise grip pliers until it bottoms the hole, then cutting the rod to required length. This project taught me how to do this, and both the chisel plane and the jack plane projects incorporate this method in their construction.

The free movement of the front board depends on accurate placement of the holes, which are slightly oversized to ensure smooth operation. The capacity of this holder is a board 1" thick by $8\frac{1}{2}$ " wide, but it can be made to fit your needs. In fact, it is simple enough to make that were you to have a project such as a blanket chest, you could in an hour make a holder of sufficient width to accommodate the widest boards.



THE THREADED $\frac{5}{16}$ ROD with wing nuts is anchored into the hard maple block. This vise can hold up to 1"-thick boards, but you can make the threaded rod as long or short as you wish.

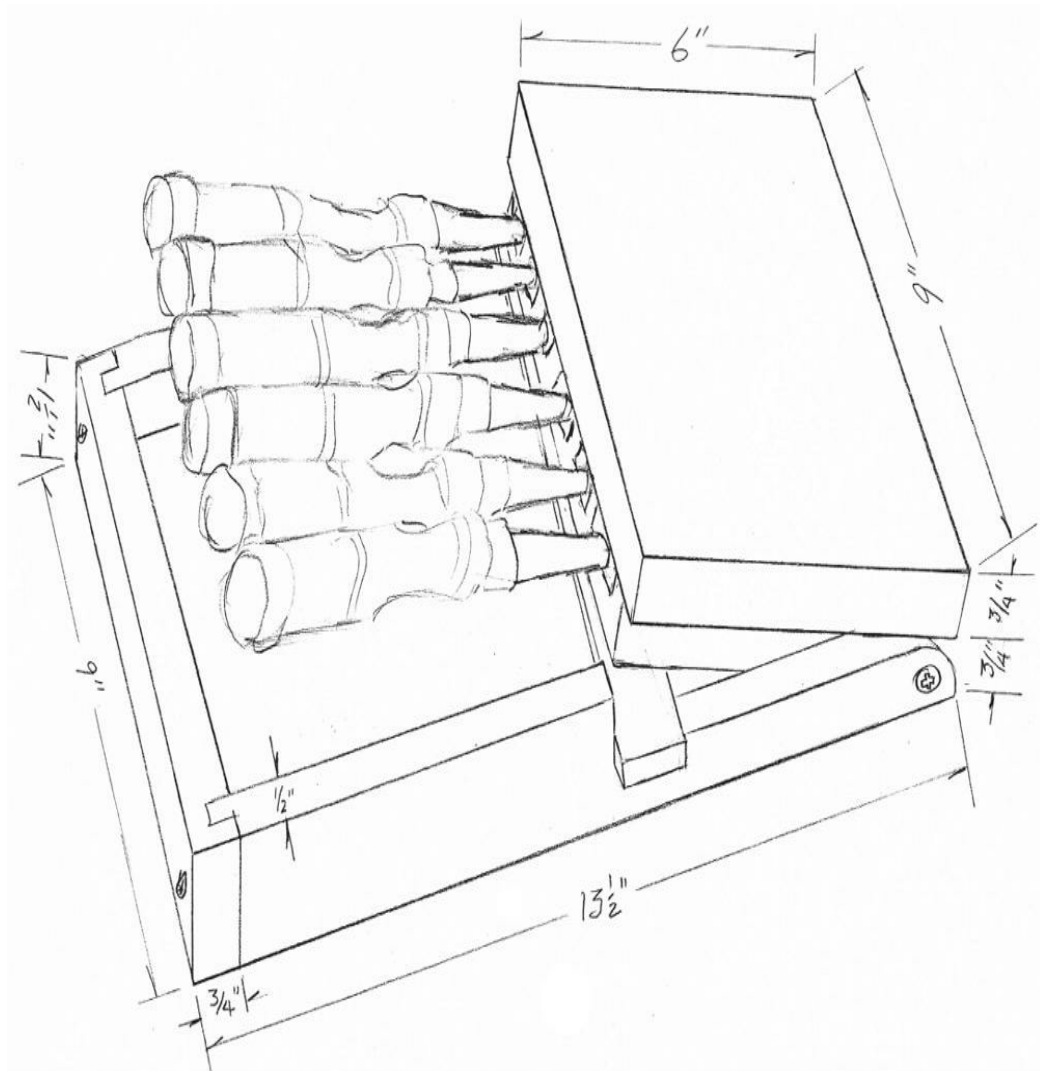
Chisel Holder



Being able to store a set of chisels, and then have the holder be the bench organizer while using them is helpful. Not only does this mean that the chisel is right at hand when you reach for it, but no more having the chisel roll onto the floor in the shuffle for other tools.

One of the benefits of teaching is learning from students. Fairly early in my years of teaching college wood shop, a student, Thad Vance by name, came up with this idea for holding chisels. Thad made one for both of us, and I've been using mine ever since.





CHISEL HOLDER

MATERIALS

Slotted chisel holder	$\frac{3}{4}" \times 6" \times 8"$
Board to box the slots	$\frac{3}{4}" \times 6" \times 9"$
Handle	$\frac{3}{4}" \times 1\frac{1}{2}" \times 9"$

Handle sides (2)	$\frac{1}{2}'' \times 1\frac{1}{2}'' \times 13\frac{1}{2}''$ hardwood
Wood screws (4)	1 $\frac{1}{2}''$

Authors and Publishers

I approached *Woodworkers Journal* about publishing this project. Publishers and authors do not always see eye to eye when it comes to contracts. The few dollars involved never match the satisfaction in finding your idea worthy of print, which is huge. However, the language of that contract somehow took the edge off the exchange. The project was to be their right to use in any way they wished, and I was never to use it in print again myself.

Any project idea large or small is a creative endeavor. It is what I do for fun, and as it has turned out it is what I do professionally. To lock up a project idea seemed excessive, and I told them so. Thirty years has blurred the details of how it was resolved. I think they decided to drop their request for exclusive rights, and accepted the project on my terms. What I do know is that it never got in print, so they had the last word on our exchange back then. It is the privilege of independently publishing a book that this postscript is printed.

Now for the chisel holder project.



THIS HOLDER SERVES to present you with just the right chisel when you need it. The prop stick is used to hold the chisels at ready position; removed, it lays flat for storage.

The Project

The project is cut from 3 feet of 1 × 6 board. The one element requiring strength is the handle, which has holes at the end allowing for the hinge screw. For this reason pick a wood of strength such as maple or oak for the sides of the handle. The chisels rest in

slots $\frac{9}{32}$ " deep and various widths corresponding to your chisel sizes. These are routed into one $\frac{3}{4}$ " board, while a second $\frac{3}{4}$ " board is glued on to it. These two boards differ in length allowing the hinged handle holder to articulate.

Up to this point there is little difference between this holder and the usual hinged box with slotted tray positions. What makes this more than a holder is the prop stick that holds the chisels at a handy "at ready" position for use. The holder has become a stand. Not only is this accessibility to your chisels handy on the top of your bench, but I keep it that way in the drawer under my bench so that this convenience is part of opening the drawer whenever a chisel is needed.



GLUING UP THE HOLDER with $\frac{1}{2}$ " overlap fits the notch in the hinged handle. The top of the handle is jointed with a rabbet/dado combination visible in this photo.

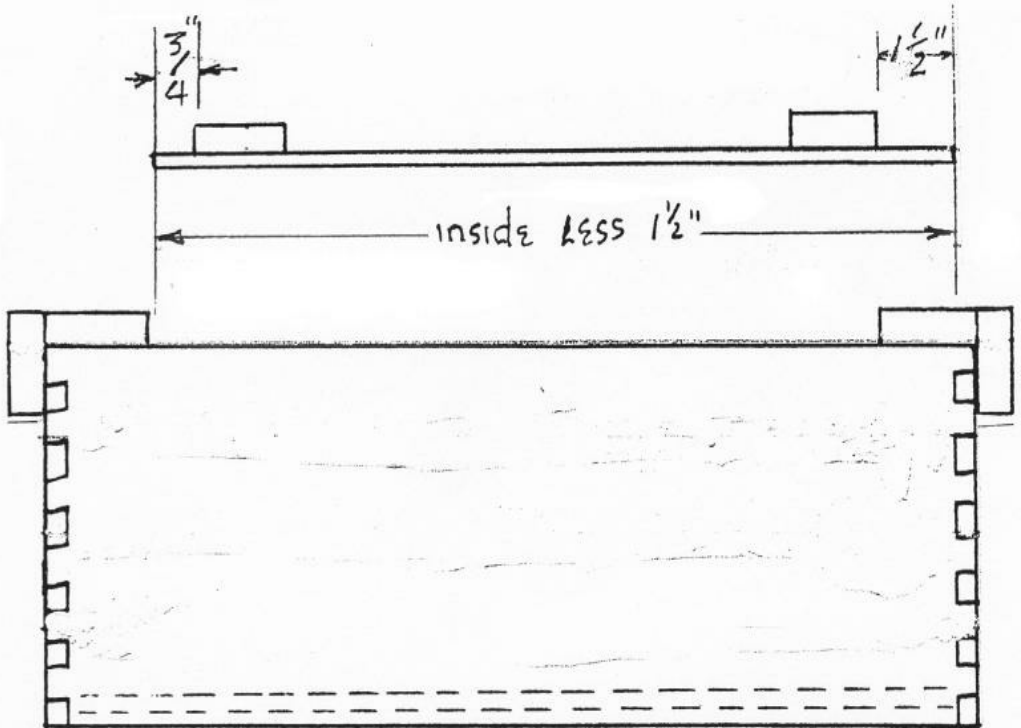
Japanese Tool Box



The 6" Makita Power Planer is one of these specialized tools that is a step larger than you think is good for you to handle. It is the scale of tool that fits timber framing, which is itself woodworking on a scale larger than life. In the tradition of the Japanese, mine came in an attractive wood box, one that can be used for many tools. The photo on [page 213](#) shows you both the original with rope handles at both ends, and mine with wood cleats for lifting the box. The key to both is the sliding lid in all its ingenious simplicity.



The way the lid works ~
use it for any size box.



FRONT VIEW

JAPANESE TOOL BOX

MATERIALS

Sides (2)	$\frac{1}{2}" \times 7\frac{1}{2}" \times 25"$
Ends (2)	$\frac{1}{2}" \times 7\frac{1}{2}" \times 12"$
Cleats	$\frac{1}{2}" \times 2" \times 12"$

Bottom	$6\text{ mm} \times 11\frac{5}{8}" \times 24\frac{5}{8}"$	
Lid	$6\text{ mm} \times 11" \times 22\frac{1}{2}"$	
Clinch nails (28)	$1\frac{1}{2}"$ copper	#NCRS13
	Jamestown Distributors (800-497-0010)	

Design

The lid is simplicity itself. The top is made of 5-ply, 6 mm birch plywood with cross cleats at each end that enable it to engage corresponding cleats in the box. Enter the lid into one end and slide back an inch and it's done. No need for hinges or other hardware. The original box came fitted with rope loops in each end for handles. This version has a double cleat at each end to provide the hand holds for lifting.

The cleats on the original box were glued and fastened with clinch nails. Decorative copper clinch nails are used here. The forged heads give an attractive touch. They are available from Jamestown Distributors (800-497-0010).

The finger-jointed corners are readily recognized and were known to an earlier generation as a cigar box joint. Together with the dovetail joint, it is the way to build strong boxes. The machine-like precision of the pins makes this joint reserved for machine cutting, whereas the dovetail makes an attractive and doable hand cut joint. The corners can be butt jointed and still make a box utilizing the sliding lid feature unique to this tool box. The sides are made of $\frac{1}{2}"$ stock with box joint pins on $\frac{1}{2}"$ intervals and 5-ply, 6 mm birch plywood top and bottom.



THIS TOOL BOX IS MODELED on the Makita Power Planer case shown in the background. Key to its operation is the sliding lid. Handles can be rope or end cleats. Joints are either box or dovetails. Bottom can be set in a groove or attached directly.



THE KEY TO THE JAPANESE TOOL BOX is the sliding lid. Once you grasp the design and its proportions, it can be used on any size box. Cross cleats are all $\frac{1}{2}'' \times 2'' \times$ (width of box). Lid cleats are clinch nailed to the birch plywood top board.

Construction

The sides of the tool box are cut from $\frac{1}{2}''$ stock. The dado for the bottom ply is ploughed $\frac{3}{16}''$ deep and 6 mm wide for the Baltic birch 5 ply. The cleats for both ends and the lid are $\frac{1}{2}'' \times 2''$. The box shown is 8" deep, 12" wide, and 26" long overall. You decide what will fit your tool storage needs.

A sliding sled arrangement makes cutting the box joint on the table saw possible. Lon Schleining describes this in "Box Joints on the Table Saw" (*Fine Woodworking*, March/April 2001, [pages 60-63](#)) and Bill Hylton in "Box Joints" (*Popular Woodworking*, June 2005), two recent examples of articles giving you guidance. While the use of the table saw or router table may appear to make this box joint a snap, beware. Sequencing opposing sides and accurate replication of pins are both a challenge. Which is to say it takes care to set up a full sequence of cuts to get good results, and confusion in matching sides is an easy mistake. The other concern is tear out as the dado passes out of the cut. Pay attention to suggestions that help minimize this unattractive defect. The clamping up of two joints for cutting at one pass avoided most tear-out and misalignment mistakes. In rereading my shop notes for sequencing the stock of boards for cutting seems very complicated, but it actually went easier than that in shop (see construction steps on [pages 271-272](#)).

The cleats are glued and nailed. The lid cleats are clinch nailed. A No. 4 box nail will clinch nicely (box nails have a common nail head with a finish nail wire shank). Drill a pilot hole the size of the shank and clip off excess length before bucking the point with an iron while hammering the head. The forged-style head gives a finished touch. Alternatively, use copper rose headed nails from Jamestown Distributors.

If you wish to avoid the box joint set up, the tool box can be made with simple nailed corners. Again, box nails are used, this time No. 6. The ends would best be made $\frac{5}{8}''$ or $\frac{3}{4}''$ thick. The cleats as shown will add reinforcement to the corners so that a serviceable box will result and should give a good long life. Looking at the traditional carpenter's tool tote ([page 227](#)) shows that utility can last.

Tool Tote

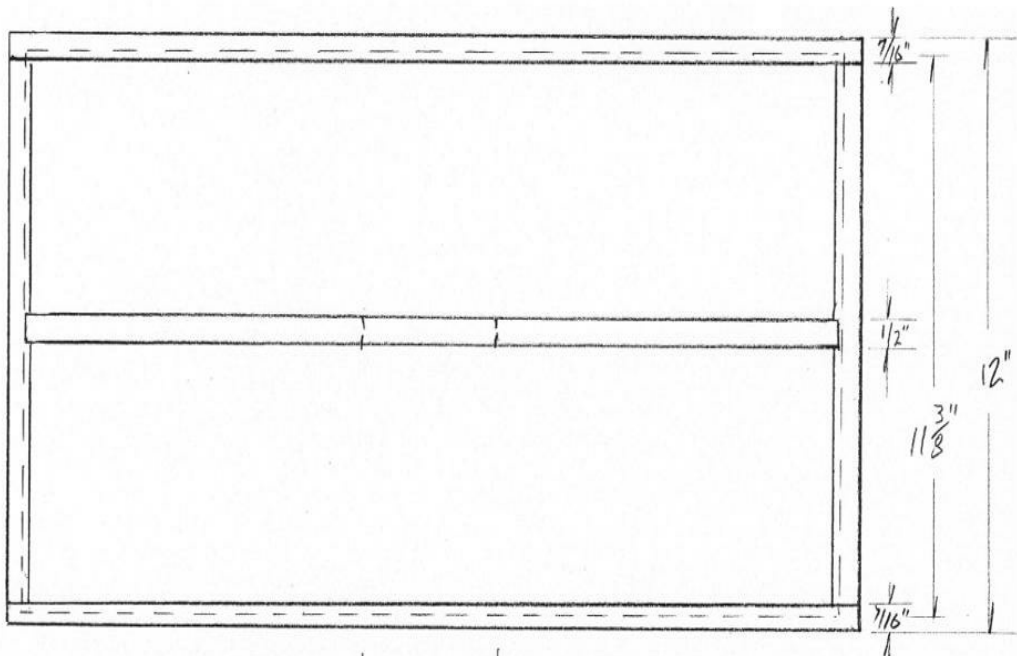


Tote: (U.S. colloquial)—v.t. To carry or bear, as on your person, to tote a gun—n. that which is toted.

There you have it. Tote. Something to have along with you when needed. Origin uncertain, but the use is clear. In the arsenal of the woodworker, it's to have your tools when and where you need them. The tool tote is not a storage box. It is not a tool box or a cabinet. It is smaller, lighter and handy to the job. It helps both to carry tools to the job and to give a place where they won't be lost.

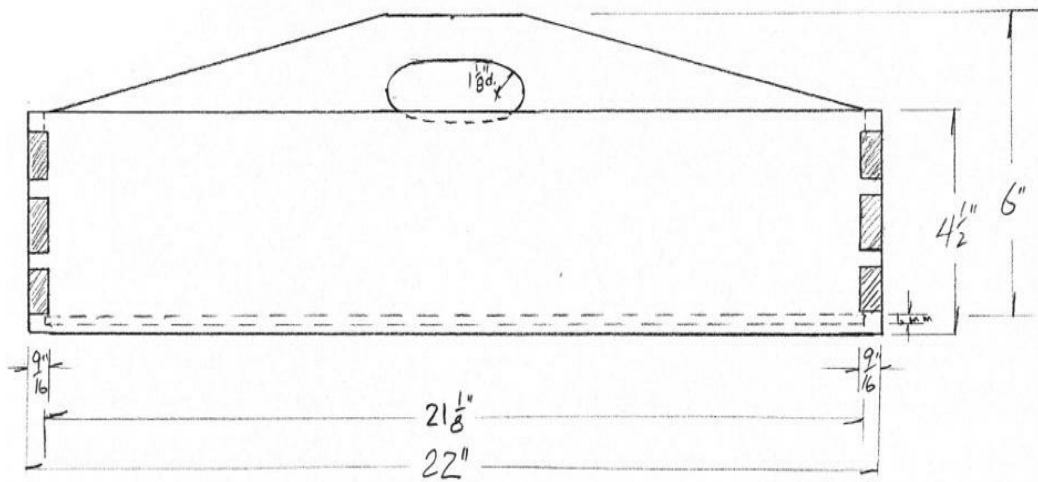
This tote also serves as a sampler of quality workmanship. With its hand-cut dovetailed corners it gives you satisfaction every time you carry it. It makes a statement of proficiency even before you tackle the job.





TOP VIEW

3 1/2"



FRONT VIEW

TOOL TOTE

MATERIALS

Sides (2) $\frac{7}{16}'' \times 4\frac{1}{2}'' \times 22''$

Ends (2) $\frac{9}{16}'' \times 4\frac{1}{2}'' \times 12''$

Center $\frac{1}{2}'' \times 6'' \times 21\frac{1}{8}''$

Bottom $\frac{1}{4}''$ (or 6 mm ply) $\times 11\frac{3}{8}'' \times 21\frac{1}{8}''$

Size and Materials

By choosing a softwood such as pine or yellow poplar (I know this is a deciduous tree and, therefore, technically a hardwood, but it is soft compared to oak or maple) your tote will be lightweight. If you haven't already had experience in hand-cut dovetails, softwood is easier to work and more forgiving in fitting tails and pins. The bottom is plywood for dimensional stability. This means that it won't expand and break your tote when humid or moist conditions are encountered. Five-ply 6 mm birch plywood, sometimes called Baltic birch ply, looks good, has the right thickness, and is very good quality.

Don't make your tote too large. You could lengthen it to hold a full size hand saw and framing square, but in so doing defeat its handiness. I recall a carpenter building himself a new tool box large enough to hold every tool he needed for framing and trim. It held them all right, but he didn't reckon on how much they would weigh. Pride prevented him from admitting his mistake, so every day he staggered under the load. Morning wasn't so bad as toting it at day's end. Lesson: Keep your tote handy by restraining its size.

Start by dimensioning the sides and center board. The project could be made with $\frac{1}{2}''$ lumber all around. But looking at the drawing shows long sides $\frac{7}{16}''$, the ends $\frac{9}{16}''$ and the center board $\frac{1}{2}''$. It is a matter of proportion. Grace comes from attention to detail in proportions.

The first job is to plough the slot $6\text{ mm} \times \frac{1}{8}''$ for the ply. 6 mm is slightly less than $\frac{1}{4}''$ at .230", but use the edge of the ply itself to get it right. The dado for receiving the center board is $\frac{1}{2}'' \times \frac{1}{8}''$ in the center of both ends. If possible end the dado without cutting the narrow bottom edge below the slot. The router plane in the tool projects is the right tool for this job.



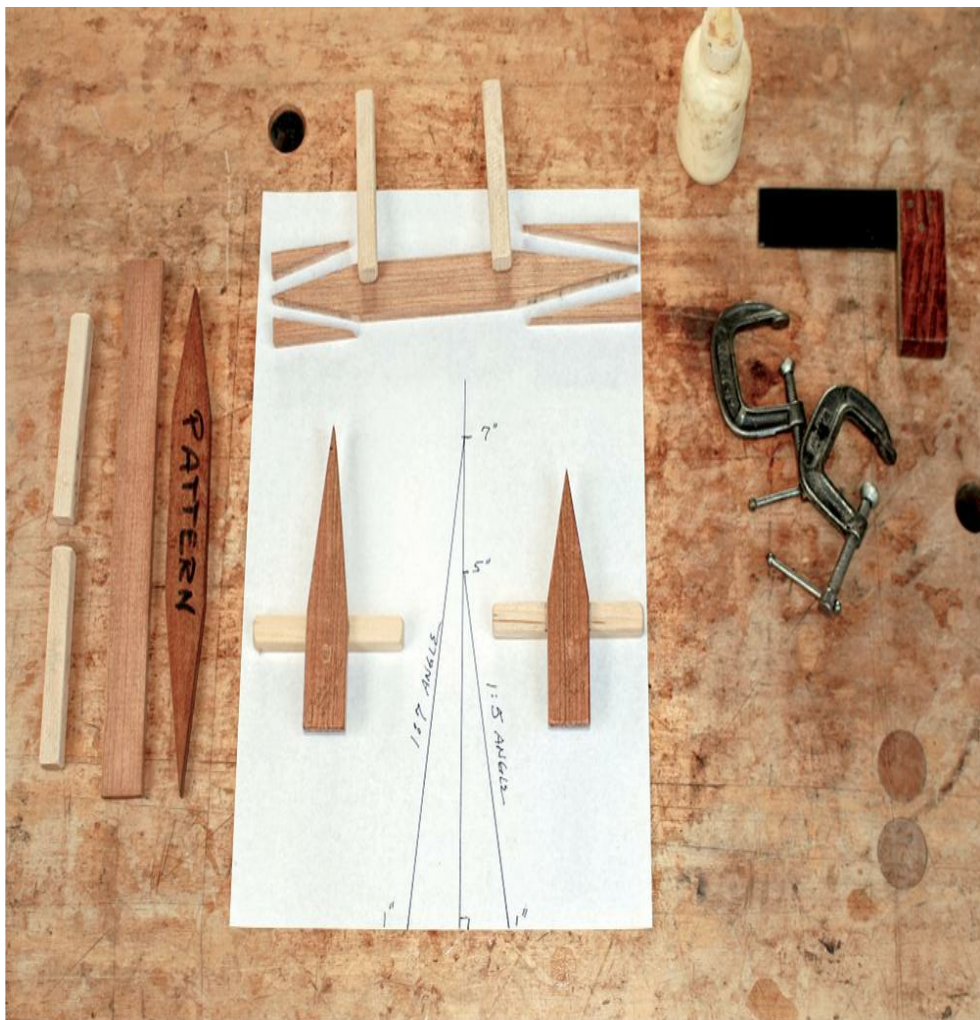
PINE IS A GOOD CHOICE both for a lightweight tote and ease of dovetailing. Here the sides, ends and center are cut to size, grooved for the bottom, and the birch ply bottom under them.

MARKING GAUGE

Experience can replace the need for marking gauges for dovetail layout, but we need help getting to that point. The gauges shown here come in two sizes: one with a 1:5 angle for use in softwood, and 1:7 for hardwood.

Why this difference? The short answer is tradition. Tradition embodies what works, even if the explanation as to why it is so is not known. The longer answer is that retention comes from the slope of the tails, and that's good. Splitting of the sloped wood is possible, and that's not good. Like so many things that come in pairs, the solution is a balance between the two. But why the difference? Well, softwood fibers crush more easily than hardwood, hence they get a bit more slope for retention.

The combination of a beveled end and a square end to the gauge acknowledges that every pin and tail has one angled and one square line. The bevel itself comes from run and rise layout familiar to carpentry. Draw a line 5" long or 7" long square to the edge of your bench and measure over 1" over from the end. The connection of the end points is a slope of 1:5 or 1:7.



MARKING GAUGES FOR DOVETAILS in two pitch: 1:5 for softwood, and 1:7 for hardwood. Making a pair is a good start in hand cutting your dovetails. On the left are blade ($\frac{1}{4}'' \times \frac{7}{8}'' \times 8''$) and cross bars ($\frac{7}{16}'' \times \frac{7}{16}'' \times 3''$) and template. Both the angle side and the square are used in dovetail layout.

Dovetail Rules, Scribing and Layout

Next comes the fun stuff — hand-cut dovetails in all four corners. Do not be deterred if this is your first go at this classic joint. What follows is my summary of what to keep in mind as you go through layout and cutting dovetails.

1. Scribe gauge lines the thickness of adjoining pieces.
2. Start and stop with a half pin.

3. Tails are twice the width of pins.
4. Pitch or bevel of tails is 1:5 for softwood, 1:7 for hardwood.
5. Label all parts to keep from mixing up which ones go together.
6. Use pin section as template for tail layout.
7. Cut on salvage side of the line when cutting tails.

The scribe line is part of the joint in layout, sawing, chiseling, and final appearance. It is not a pencil line. It is still there when the project is finished. It is scored with a knife or scribed with a scratch cutter. As rule No. 1 reminds you, set your scribe to the thickness of the adjoining board. The pins are on the 22" long sides that will fit into tails in boards $\frac{9}{16}$ " thick. So set your scribe to $\frac{9}{16}$ " and score both sides of the board at both ends. The end boards will get scored with the scribe set to $\frac{7}{16}$ " and you need to score all around the four surfaces of the tails, edges as well as main surface.

Layout of dovetails is done by eye. If you don't have experience to guide you, refer to rules No. 2, 3, and 4 for guidance. Start with a half pin. A half pin is actually the width of any other pin, only it is beveled on one side only, the other side is square to the edge of the project. There are exceptions to rule No. 2, but generally start and stop with a half pin rather than a half tail.

Working from the inside surface, mark with a pencil a line $\frac{1}{4}$ " from both sides. Then mark two more $\frac{1}{4}$ " wide sets of lines that are equally spaced between the half pins. Extend the lines across the end of the boards on an angle that is a 1:5 pitch. Use an adjustable T-bevel or make a layout gauge as shown in the side bar. There is both a bevel angle and a square needed to complete each layout. CAUTION: Each pin must get thinner on the outside surface of the board! Saw the lines drawn for your pins. The waste is chiseled out.



SCRIBE LINE the width ($\frac{9}{16}$ ") of the other boards' thickness. Layout of pins uses both the 1:5 pitch and the square. Half pins (only one side beveled) start and end the pattern.



CUT DOWN TO THE SCRIBE LINE with a fine tooth (14 or 16 tpi) saw. Keep work well supported near jaws of vice which has wood jaw extenders to hold vertical work like this.

Cutting Dovetails

Next come the tails. To avoid confusion over which are pins and which are tails, look at both from the board's face. The pins have straight lines, the tails are beveled like you expect dovetails to be. You use the pin section as a template for layout of tails, rule No. 6. Because slight variation will occur, you must label all joints to keep layout and assembly in correct order, rule No. 5.

Use a sharp pencil to transfer the lines from the ends of your pin section to the tails. What you have here is what you use. Do not be tempted to "improve" your bevel lines with the layout gauge. The goal here is a perfect match to whatever you cut in the pins. Use the square end of your gauge to extend the lines across the ends of the board.

A tight fit depends on following rule No. 7. Saw on the salvage side of the line. What is the salvage side? It is the waste side that will be chiseled out. You should still see the very edge of the pencil lines from the layout when you are done cutting the tails.



CHOPPING WASTE FROM PINS. Note scribble marks on area to be removed. This reminds you what to cut and what to remove. The letter “A” corresponds to the joint. Each one identified A-A, B-B, etc. to remind you which goes to which. Sounds simple, but believe me, screw-ups happen.

The first material to be cut away is the space for the half pins at both sides of the board. Use the dovetail saw and follow the scribed lines in the edge. Then chisel the waste for the two full pins. A knife is used for final cleanup.

Experience give awareness of three pitfalls to avoid when cutting dovetails. So remember pins are smaller on the outside surface; cut on the salvage side of the line for tails; and keep all joint pairs together in layout and assembly. There’s good fun in mastering this classic joint. Become proficient so you can use it often.



ONCE THE PIN SECTION is cut use it as the template for the tails. This ensures a perfect match. When you saw the tails, cut on the salvage side of the line. In other words, leave the pencil line on the tail to ensure a tight fit, and use a sharp pencil.

Putting it All Together

Assembly of the box includes fitting the bottom in its slot. Well-cut dovetails go together without any clamping, merely by tapping with mullet and block of wood with the pin-tail fit giving all the retention needed. For those of us not so accomplished some clamp help is needed.

The center board hand hold is made by drilling holes in both ends. The waste between

is removed with a jig saw and smoothed with rasp and sandpaper. Next shape the top edge even with the sides when fit into the dado.



BEFORE ASSEMBLING THE TOTE, cut the dado for the handle in both ends. Here the router plane was used to cut the groove after defining the slot with a straight edge and knife.

Before gluing the center board, ease the edges of the box and the top edge of the center board as well as hand hold. The tool options are several including rounding over bit in a trim router, block plane, and sandpaper over a wood block. The amount of rounding over should be a matter of both appearance and function: the hand hold and top of center

board receiving more than the edges of the box. The center board is glued both with a bead of glue along the bottom as well as the dado.



THE TOTE is **ASSEMBLED** dry fit to be sure all parts are accurate. The bottom slides into the groove with no glue needed.



THE CENTER BOARD is glued and nailed. Set the board in place, draw a faint pencil line, and use that line to guide the pilot holes for three nails through the bottom plus two nails in both ends.



THIS TOOL TOTE has dovetailed corners, a ply bottom set into a rabbeted groove, and a center handle board. The pine is lightweight, strong and works well for joints. The result is an attractive and useful carrier and organizer of tools for any job.

POSTSCRIPT: SIMPLIFYING THE TOOL TOTE

The tool tote is a handy project, and not just for tools. The following steps eliminate parts of the project as drawn to make it easier – an “I can do it” project for those exploring what woodworking is, as well as folks focused on getting it done. Without changing the final dimensions of the tote, here are my suggestions ranked in order from fewest compromises in strength and beauty to most plain and simple.

First, make the sides and ends both ½”-thick stock, thereby eliminating separate steps in preparation. This makes hand-cut dovetails with same size boards a simpler step also. So, cut a piece of pine 4½” wide about 60” long, plane to ½”, and groove for the bottom board before cutting out sides and ends.

Second, the hand-cut dovetails stop more people from going beyond reading and viewing pictures than anything else. They are strong, good looking and fun, but leave your epiphany for hand-cut dovetails for another day and choose one of the following joints:

- Router cut dovetails, either full or halfblind depending on how elaborate your dovetail jig is. Half-blind dovetails require the ends to be ¼” shorter.

- Rabbeted joints cut on table or radial arm saw, or hand cut with panel saw and rabbetting plane. The rabbet is a ¼” step in the ends of the side boards. Glue and nail using 4d finish or box nails. Ends are cut ½” shorter.

- Butt joints are the obvious simple construction choice, and one used by a woodworker a century ago for the carpenter’s tote featured next. This joint is also glued and nailed, with the ends 1” shorter than drawn.

Looking at the center divider and the bottom, I was going to suggest butt joints here as well. However there is little or no time savings or avoidance of higher skill level in doing so, and much to be gained by cutting the groove for both like good looks, strength, and an automatic squaring up of the project when assembled. These joints stand as drawn, already simple and effective.

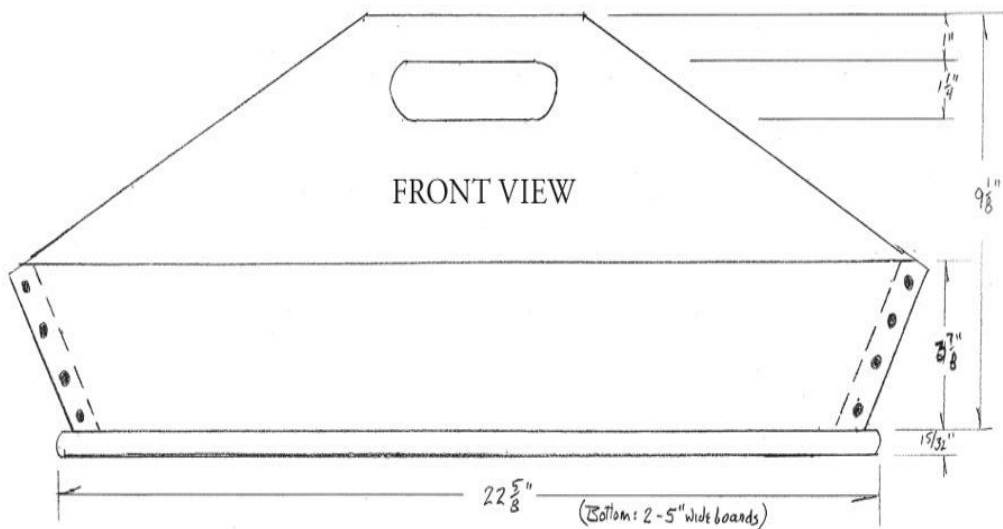
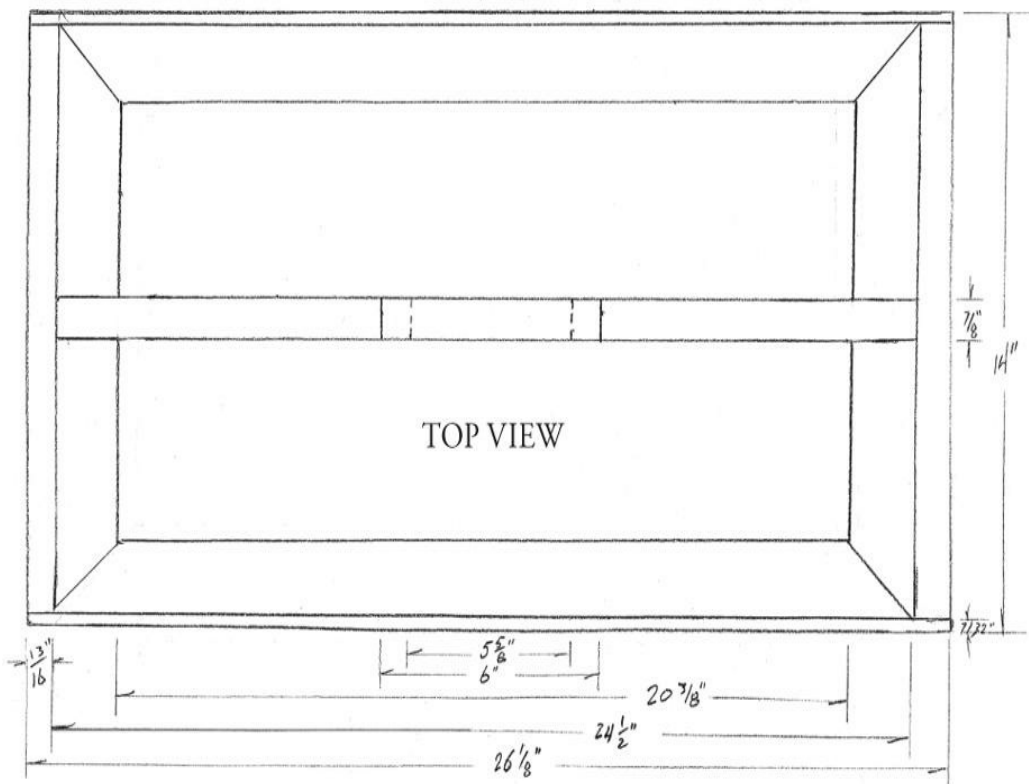
A tool tote, simple or fancy, is useful. Make two.

Traditional Carpenter's Tote



Here is an historical example of a tote. I acquired this at an auction where the object of my bidding was a tool amidst the odds and ends it contained, and as auctions go the tote and all its contents were on the block for one money. I never owned it in the sense of making use of it myself. That was around 1960 when I carpentered in home construction during the summers between my college years. My father gave it to the rector of our family's church. There it was used to hold books and magazines beside his easy chair. Not a bad adaptation, and one that gave it a meaningful existence for many years. Fifty years later when preparing material for this book, I wrote the family of the now deceased minister, and to my delight the tote showed up in a shipping box on the door step. It seems to want to reinvent itself again as a project from the past.





TRADITIONAL CARPENTER'S TOTE

MATERIALS

Center	$\frac{7}{8}" \times 9\frac{1}{8}" \times 24\frac{1}{2}"$
Top edge	6" centered with $9\frac{1}{4}"$ to each end; long point is $3\frac{7}{8}"$ up from bottom
Sides (2)	$\frac{7}{32}" \times 4\frac{1}{2}" \times 26\frac{1}{8}"$ (overall); $22\frac{1}{4}"$ (at bottom)
Ends (2)	$\frac{13}{16}" \times 4\frac{1}{2}" \times 13\frac{1}{16}"$ (overall); $9\frac{1}{8}"$ (at bottom)
Bottom	$\frac{15}{32}" \times 10" \times 22\frac{5}{8}"$ (made of two boards)

Time has a way of sifting the better from the not so good, with the less worthwhile culled out. I have seen this type of tote used by masons, but this one was clearly used by a carpenter. The saw blade holder at the end indicates a place for several trim saws, which was added after the tote was first made. The diminutive thickness of the side wood is another indication that it was not intended for the rougher conditions of the stone mason. At first glance the wood would seem too light, but the years would argue otherwise. I appreciate the ability of a past craftsman to get it right when dimensioning parts of such a project, and pay attention to his guidance. The sides are $\frac{7}{32}"$ and bottom $\frac{15}{32}"$, one oak the other chestnut, while the ends are $\frac{13}{16}"$ and center $\frac{7}{8}"$, both of softer wood, perhaps sweet gum. The result is strong enough, yet not unnecessarily heavy. While 6 mm Baltic birch ply would do for sides and 12 mm bottom, the sides predating plywood, are quartersawn oak, which enhances its appeal.

How do you date such a project? Both fasteners and dimension of wood can help place it in time. The sides and bottom are nailed using modern wire nails. This means that it was made sometime after 1885 when wire nail technology changed nails from square cut to round. The center board is $\frac{7}{8}"$ thick. While it is evident from the different thicknesses of sides and bottom that the maker had use of a thickness planer, the $\frac{7}{8}"$ dimension is suggestive of commercially milled board size prior to 1904. That date marks the change from $\frac{7}{8}"$ to $\frac{3}{4}"$ in milling smooth boards for sale in lumber yards. We speak of a 1×12 board, but that is the rough size which when milled smooth becomes $\frac{3}{4}" \times 11\frac{1}{4}"$ today, but $\frac{7}{8}" \times 11\frac{1}{2}"$ back then. So it is possible that $\frac{7}{8}"$ -thick milled boards were commonly available when this was made indicating a date of manufacture between 1885 and 1904. If my guess as to chestnut and sweet gum are right, that would place it in that time, as both have long since disappeared as commercially available species.



ATTENTION TO THE VARYING THICKNESS of parts is what makes this project work. Center $\frac{7}{8}$ ", ends $\frac{3}{4}$ ", bottom $\frac{1}{2}$ ", and sides $\frac{1}{4}$ " will add interest, strength, and light weight.

The construction, as I said, seems light for durability, but time shows it works. Also, the fasteners are common nails and I doubt if glue was used. The sides and ends are nailed with 6d or 8d box nails, while the bottom is fastened to the ends and middle board with 3d or 4d size. Note that no fastening is used on the long side joint. This is surprising until close inspection shows the manner in which the sides are held in place by the bevel angle joint. This again is a lightweight, quick solution to putting sides together. However, time shows that it is under-engineered for durability, as both sides have bowed slightly allowing a gap along the joint. The only compound cuts are the 30° for the bottom edge of sides and end, and the 15° cut where ends join the sides.

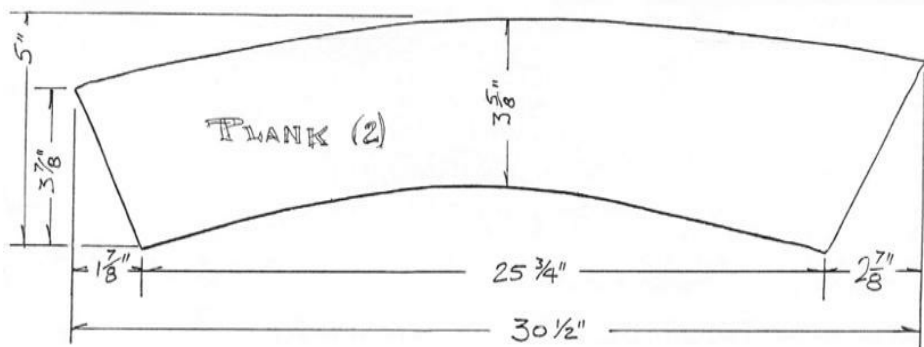
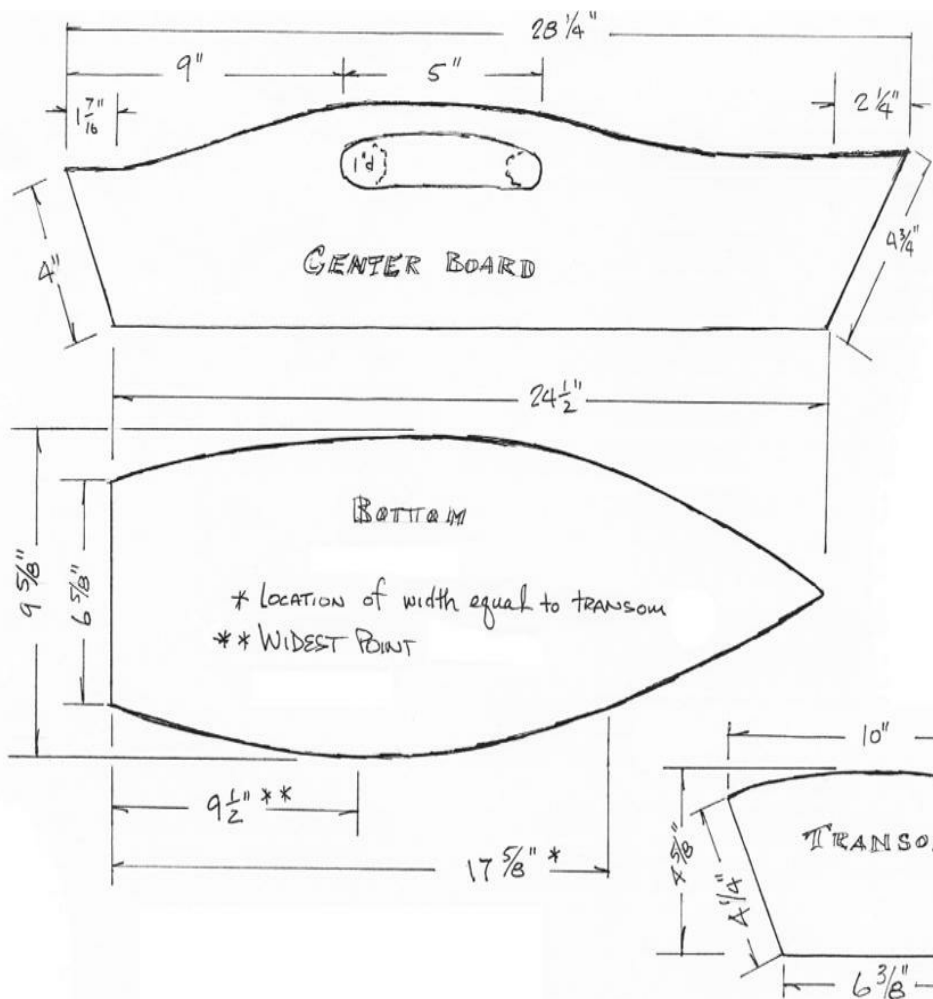
I remember a book I read to my children about a boy who built a toy boat and lost it. In a touching finale, he finds his treasure in a store and buys it back. The title of the book is "The Little Boat Twice Owned." I will title this tool carrier "The Twice Owned Tote." Through the generosity of my friends it came home.

Boat Tote



The trilogy of totes is concluded with the boat builder's tool holder. No question what trade is represented. Seeing how this is designed may give you an idea for representing other trade interests. I remember when I first saw Steve Stier's boat tote. Steve is a timber framer, preservation consultant, and fellow teacher in a class on half-hull models. It was at such a team teaching event that Steve showed up with his tools in a pram. (See the photo of my version on [page 233](#).) It was head turning as well as a conversation starter. 'Seems Steve worked in boat yards down east in Maine.





BOAT TOTE

MATERIALS

Center board	$\frac{1}{2}" \times 5\frac{1}{2}" \times 28\frac{1}{4}"$
Bottom	$\frac{1}{2}" \times 9\frac{5}{8}" \times 24\frac{1}{2}"$
Transom	$\frac{1}{2}" \times 4\frac{5}{8}" \times 10"$
Side planks (2)	$\frac{1}{8}" \times 5" \times 30\frac{1}{2}"$
Gunwales (2)	$\frac{1}{4}" \times \frac{3}{8}" \times 30"$
Rub rails (2)	$\frac{1}{8}" \times \frac{1}{4}" \times 30"$



PRAM OR SHARPIE? Two boat designs rigged out as tool totes. I like the pram with its squared-off bow giving more tool room. However, its three-board sides are much more difficult to make.

There is nothing so effective as doing one for yourself to appreciate the skill of someone else. The pram tote is not easily planked. The compound curves of multiple planks are a challenge. And getting them to stay together while the glue dries is something else. The simpler version shown here is of a flat bottomed, slab sided boat. It follows the lines of a 12' sharpie sailboat I designed and taught for many years called *Sailor Girl* (*Popular Woodworking* "Build a Sailor Girl On Your Own," February 2005; *WoodenBoat* "Design Contest Winners — Boats for Family Boat Building," May/June 2007; and *Sailor Girl Manual* by John Wilson (\$30, plus postage). While it may not have the elaborate lines of Steve's pram, it is a clear statement of boat work in a more easily worked version. It may open a conversation or two while serving to organize your

tools for the next project event.

Boat builders are familiar with epoxy and its gap filling version mixed with thickeners. That makes an excellent glue for such a project as this. Holding the planks while glue sets up is a challenge. The solution used here was to use instant CA glue at the stem and transom. This “goes off” in less than a minute while the glue line of epoxy takes hours. My one reservation about CA glue is its brittle nature. I would reinforce the important joints with standard glue. One way is to use a spot or two of CA with regular glue between spots. The best of both worlds. Unlike the real boat, your tote need not hold out water, so carpenter glue can substitute for boat builders’ epoxy glue.



UNLIKE MOST BOATS with some curve, or rocker, to their bottoms, totes have flat bottoms. Ends, bottom and

center board are made of $\frac{1}{4}$ " pine. Sides need to be flexible enough to bend, yet strong. Edges are reinforced by $\frac{1}{4}$ " $\times$ $\frac{3}{8}$ " gunwales glued to the shear (top edge).



Design, Layout & Construction

☐ [Design Elements for Wood Planes](#)

CONSTRUCTION STEPS

- ☐ [Block Plane](#)
- ☐ [Chisel Plane](#)
- ☐ [Compass Plane](#)
- ☐ [Jack Plane](#)
- ☐ [Shoulder Plane](#)
- ☐ [Molding Plane](#)
- ☐ [Scrub Plane](#)
- ☐ [Large Compass Plane](#)
- ☐ [Smoothing Plane](#)
- ☐ [Spokeshave](#)
- ☐ [Router Plane](#)
- ☐ [Travisher Plane](#)
- ☐ [Hand Adze](#)
- ☐ [Shop Drawknife](#)
- ☐ [Scrapers](#)
- ☐ [Cabinetmaker's Bow Saw](#)
- ☐ [Carving & Layout Knife](#)
- ☐ [Strop](#)
- ☐ [The Home Shop Workbench](#)
- ☐ [Saw Bench & Shop Stool](#)
- ☐ [Work Horse for Dovetailing](#)
- ☐ [Portable Dovetail Vise](#)
- ☐ [Chisel Holder](#)
- ☐ [Japanese Tool Box](#)
- ☐ [Tool Tote](#)
- ☐ [Carpenter's Tote](#)

☐ [Boat Tote](#)

ADDITIONAL INFORMATION

☐ [My Sources of Supply](#)

☐ [The Home Shop](#)

Design Elements & Construction Steps



When I teach, summary sheets are given to students to direct their work. It serves as a checklist progressing through construction. Experience has shown where hidden traps await, and these are noted. The checklists are intended as a reminder rather than instruction, so read not only about the project but also the section on “Tool Steel & Blade Making” on [pages 150-157](#). Planes share techniques, and reading up on other tools besides the one you plan to make can alert you to shop tips that are not repeated.

First, a summary of the important design features used on shop-made tools. These 14 elements emphasize how the various planes are similar and how they differ. It will provide a checklist about basic design, and suggest possible alternative construction. For example, a plane may use one of several wedge-holding methods, or a screw post.

Look again at the class picture on [page 234](#) for inspiration.



DESIGN ELEMENTS OF WOOD PLANES

Three-piece Plane Body

A simple throat opening is the hole in the router plane. However, most planes have inside square holes with complicated angles. Divide the body to open surfaces for accurate shaping. By this method, the blade bedding angle is accurate and the surface made flat. The throat opening is defined by the layout lines on the alignment board shown here with fore and aft blocks clamped to it prior to gluing. The final plane body can be a display of contrasting woods, or cut from one block so the assembled parts look all of one piece.



Use of Dimensional O1 Tool Steel

Reasonable in cost, available in small quantities and dimensioned for specific use are all features of this product available from mill supply sources. The O1 tool steel is a traditional standard of annealed, or soft state, steel that is workable with a hacksaw, files, drill and grinder. When heated, oil quenched, and tempered, it gives a blade with properties needed for cutting wood. By understanding how to make blades, you have the ability to make it fit your plane design rather than having to adapt to a purchased blade.



The Wedge

This time-honored method is simple and direct. It was what apprentices learned to use in their basic tools of the trade. They learned how to make them, too. What they did not do was make their own blades, which was the guarded province of the metal trades. The wedge itself can be simple, as shown here in the block plane, or cut in a way to leave open the pathway for shavings as in the compass and scrub planes.



Wedge and Dowel

If the wedge holds the blade, what is to hold the wedge? The dowel used in the block plane is the simplest way. The rod is shown here after the holes have been drilled in the sides. The wedge is in place ready for the surplus end to be cut off and the sides sanded smooth. The rod itself has a flat in the middle to increase surface contact with the wedge. It is not glued, but allowed to rotate to the pressure of the wedge.



Wedge and Abutments

Abutments are thin wood wedges glued to both sides of the throat to create ways that hold the wedge. This is a further application of the principle of dividing a complicated throat opening into its constituent parts. This is not to say that abutments are simple. They have multifacets that are sanded and cut in steps at each end of a piece of stock specially made for this. Making an abutment at each end of the stick will ensure that you have two mirror images to glue to the two sides of the throat. The result ensures more free passage for shavings.



Threaded Post

The next attachment methods all make use of a threaded rod and knurled brass thumb nuts. In the chisel plane, this is the only way to hold the blade as there is no forward block. Hard maple is capable of holding threaded rod without brass inserts. Drill a hole the minor dimension of the thread, and turn it into place using vise grip pliers as a handle. The rod can be removed if necessary by sawing a slot on the end for a straight screwdriver. The wood cap will provide holding pressure along the blade.



Adjustable Screw Cap

As versatile and simple as wedges are, woodworkers today are not familiar with their use. I developed the screw cap in the jack plane as a means for a shop-made alternative. To the screw post is added an adjustable screw cap. It makes use of a rest button embedded in the blade. It also serves as a positive stop holding the blade in use.



Screw Posts Attached to the Blade

The spokeshave uses two threaded rods tapped into the blade itself. These hold the blade with knurled nuts. Adjustment is provided by leveling screws, or set screws tapped into the wood frame. The former requires taking the blade out for adjustment, which is no difficulty really as spokeshaves seldom need adjustment. Plus you can set them for a

heavier cut at one end if you wish. The set screws need a small Allen wrench.



Tangs with Set Screws

The travisher seems different in most all ways from other planes. The holding method incorporates a blade with tangs bent at the ends reminiscent of blades in old spokeshaves. Here the tangs go into squared holes with set screws. These are tapped into the wood frame using a standard thread tap.



Strike Buttons – Wood

The wedge is freed by hitting the plane body to jar loose the blade. How not to mar your wood plane takes thought. Learning not to over-tighten the wedge is a start. Making a strike button provides a buffer from the blow. The jack plane in its wedged version has a $\frac{3}{4}$ " dowel set into the fore part.



Strike Buttons – Metal

The German wood body planes often have a metal strike button. Like so many parts of commercially made tools, it is a challenge to find a locally available piece to replace them. In this case, a $\frac{5}{16}$ " carriage bolt is a perfect fit. Drill a hole slightly undersized to the threads, and use a chisel to enlarge the hole for the square portion of the shank under the head.



Epoxied Cord Wrap

Some blades do not require adjustment, only holding. The hand adze illustrates a time-honored American Indian way to integrate the blade into the handle in our case using nylon cord saturated with clear epoxy.



Adapting Hardware

The router plane shows the adaptation of a commonly available part, in this case a thumb screw, drilled and filed to receive the Allen key blade in place of a custom part. I mulled this problem over for more than a year before a simple solution was found. Talking it over with colleagues was an important avenue to success.



Specialty Hardware

With the growing market for traditional tools, you may find parts available for your project. The bow saw was made in the shop using brass rod and escutcheon pins. The blades were adapted from band saw blades. However, the rods as well as proper hand saw blades are available from Gramercy Tools.



CONSTRUCTION STEPS FOR BLOCK PLANE

Select Materials

1. Plane body of smooth grained hardwood. Core block $1\frac{9}{16}$ " or $1\frac{17}{32}$ " $\times$ $1\frac{9}{16}$ " or $1\frac{17}{32}$ " $\times$ 6", 2 sides $\frac{1}{4}$ " $\times$ $1\frac{9}{16}$ " $\times$ 6".
2. Wedge $\frac{7}{16}$ " $\times$ $1\frac{1}{2}$ " $\times$ $2\frac{5}{8}$ ", but leave part of longer stick to give safe holding when cutting and sanding.
3. Retainer bar of $\frac{3}{8}$ " hardwood dowel.
4. Blade $\frac{1}{8}$ " $\times$ $1\frac{1}{2}$ " $\times$ $3\frac{1}{2}$ " O1 tool steel.
5. Four $\frac{3}{16}$ " $\times$ $\frac{1}{2}$ " dowel pins.
6. Alignment board $\frac{1}{4}$ " $\times$ $1\frac{7}{8}$ " $\times$ 6".

Plane Body

A three-piece wood plane body will enable you, as a beginner, to easily create the throat angles. The key to accurate assembly is having a board on the bottom to ensure the correct throat opening, and that all the parts are aligned.

1. Cut the throat angles of the core blank ($1\frac{17}{32}$ " $\times$ $1\frac{17}{32}$ " $\times$ 6"). Draw lines 65° and 45° from a point $\frac{2}{4}$ " from the front end.
2. Band saw, cutting on the salvage side of the line, leaving the pencil line for reference when sanding. Save the salvage block for later as a palm rest.
3. Sand surfaces smooth and true. Sand to layout lines, and check for square.
4. Sand front block secondary angle. This is $\frac{1}{4}$ " wide, and at right angle to the base.



5. On a board $\frac{1}{4}" \times 1\frac{7}{8}" \times 6"$, draw two lines across at 2" and $2\frac{5}{16}"$ to show where the throat opening comes. Wax the board. Clamp both core blocks in place using the two lines to make the $\frac{5}{16}"$ opening at the throat.

6. Lay the sides in place and drill $\frac{3}{16}"$ holes $\frac{1}{2}"$ deep through the sides into the middle of both core blocks. Glue $\frac{1}{4}"$ side pieces to core blocks. Use yellow carpenter glue, avoid spreading in throat areas of the sides. Drive $\frac{3}{16}"$ dowels into holes to prevent movement when squeezing. Alternatively, use a few grains of table salt to prevent glue line slippage.

7. Clamp the sides to the core blocks using bench vise or four clamps. Check that all joints are tight and the sides are resting on the bottom alignment board.

8. When glue skins over, use a chisel to remove the glue beads in the throat. Sand all outside surfaces flat and square.

Blade

A piece of O1 oil hardened tool steel $\frac{1}{8}" \times 1\frac{1}{2}" \times 3\frac{1}{2}"$ is used for a blade. In its annealed (soft) condition, it can be cut with a hack saw, and ground to shape. Hardening and tempering are both accomplished by heating the steel and watching for color change. Hardening is 1,450° to 1,600° F at which point steel is cherry red. This is a glow. Tempering is at 400° F which is light straw yellow. Set oven temperature between 350° F - 400° F.

1. Grind the top end rounded over like a tombstone. File to remove sharp edges. Grind

the bezel, or cutting angle, at 25°. Use a bench sander to finish the accurate bevel. Leave a $\frac{1}{64}$ " flat on blade edge.

2. Stamp your name and date.

3. Harden the cutting edge cherry red with a torch or charcoal fire (1,450° F - 1,600° F).

4. Quench the red hot blade immediately in oil. Plunge the whole blade below the surface of the oil in one motion. Test for hardness by passing a file from top to bottom along an edge. Hardened steel will feel like passing the file on glass.

5. Temper the hard edge to restore toughness. Place in toaster oven at 400° F. It takes 20 minutes to soak the steel. Look for a light straw color on the surface of the polished steel. Cool slowly.

6. Sharpen the edge. Lap the back to ensure it is straight and smooth at the cutting edge. The back of the blade is left with heat treating colors and slight roughness to help secure blade when wedged.



Assembly of the Plane

The shape of the wood body is a matter of individual expression. The goal is to have the plane comfortable in hand and pleasing to the eye.

1. Once the wood body is sanded smooth and square, ease the edges to be comfortable.

2. Glue the block cut from the throat for a palm rest. There needs to be a $\frac{1}{4}$ " space between the blade and this block to allow for the hammer tapping the blade.
3. Drill a finger hold by using a core bit in the drill press to make a dimple in the center of the front block.
4. Cut the wedge. Its angle is 8° to 10° (steeper and it pops out under pressure). Micro bevel the lead edge back $\frac{1}{4}$ " .
5. Pin the throat with a $\frac{3}{8}$ " hardwood dowel by drilling a $\frac{3}{8}$ " hole down $\frac{7}{16}$ " from the edge of the body and $\frac{1}{8}$ " forward of the wedge in position.
6. File the pin flat where it touches the wedge. Remove one-third of the pin thickness. The pin is free to rotate in the hole.

CONSTRUCTION STEPS FOR CHISEL PLANE

Blade

1. Follow the steps in blade making for block planes.
2. Drill two $\frac{3}{8}$ " holes in the center of the blade before heat treating. These holes should just miss overlapping and the bridge filed away to make a hole $\frac{3}{8}$ " $\times$ $\frac{3}{4}$ ".



Plane Body

1. Cut the profile of the body from hardwood blank $1\frac{1}{2}$ " $\times$ 2" $\times$ $5\frac{1}{2}$ ".
2. The 20° bedding angle is sanded flat and square.
3. Round the palm rest for comfort.
4. Drill $\frac{21}{64}$ " hole for $\frac{3}{8}$ " threaded rod. Use vise grips to turn the rod which self-taps into plane. Cut the rod off at 1" and file the end.

Cap and Assembly

1. Cut cap from blank $\frac{1}{2}$ " $1\frac{1}{2}$ " $\times$ $3\frac{1}{2}$ ". To ensure good blade holding pressure, relieve center to ensure pressure at ends of cap.

- 2.** Drill first with $\frac{5}{8}$ " Forstner bit going only $\frac{1}{16}$ " deep to create recess for copper wear washer. Then finish drilling $\frac{3}{8}$ " hole for threaded post.
- 3.** If additional holding grip on blade is needed, glue emery paper to bedding angle.

CONSTRUCTION STEPS FOR COMPASS PLANE

Select Materials

1. Plane body from hard maple or similar wood. Core block $1\frac{17}{32}" \times 1\frac{17}{32}" \times 4"$, two sides $\frac{1}{4}" \times 1\frac{17}{32}" \times 4"$
2. Wedge $\frac{1}{2}" \times 1\frac{1}{2}"$ from stick about 10"
3. Abutments $\frac{1}{4}"$ taper to $\frac{1}{8}" \times 1\frac{1}{4}"$ from stick about 10"
4. Four dowel pins $\frac{3}{16}"$ hardwood, $\frac{1}{2}"$ long
5. Alignment board $\frac{1}{4}" \times 1\frac{7}{8}" \times 4"$
6. Blade $\frac{1}{8}" \times 1\frac{1}{2}" \times 3\frac{1}{4}"$ O1 tool steel



Blade

Follow instructions for block plane blade. Curve cutter to a $2\frac{1}{2}"$ radius arc.

Plane Body

1. Lay out 50° and 70° angles for throat opening. This is $1\frac{3}{8}"$ from front end. Cut to create fore and bedding blocks. Save salvage for later. Sand surfaces square and flat, especially bedding block. Sand $\frac{1}{4}"$ vertical face on fore block.
2. Clamp core blocks to alignment board matching $\frac{1}{4}"$ opening lines for throat. Wax board.

3. Position sides and drill $\frac{3}{16}$ " holes for four dowel pins. Be sure holes are slightly deeper than $\frac{1}{2}$ ".

4. Spread glue on all faces avoiding throat area of sides. Set pins. Squeeze in bench vise or use C-clamps. Clear glue beads from throat. Sand all surfaces flat and square.

5. Draw $7\frac{1}{2}$ " radius arc on side, centering arc on throat opening giving more up sweep to back end. Cut and sand the curved sole.

6. Profile the body using $7\frac{1}{2}$ " arc on both sides. Cut and sand. Complete shape by sanding corners and ends.

7. Cut wedge by removing $\frac{1}{8}$ " $\times$ 2" taper from stick end. Sand square and flat. Layout middle opening and saw two cuts defining edges of opening. Clamp to bench using end taper scrap, C-clamp, and protective board. Chisel opening. Now cut wedge ($2\frac{1}{2}$ ") from stick. Saw corners and sand edges of top end. (See [pages 26-28](#).)

8. Abutments are cut from tapered stick $\frac{1}{4}$ to $\frac{1}{8}$ " $\times$ $1\frac{1}{4}$. Fore angle is 70° . Taper the end of the stick back $1\frac{1}{8}$ " leaving the end $\frac{1}{8}$ ". Mark length and add $\frac{1}{8}$ ". Cut on 60° angle. Sand angle edges to achieve tight fit. Give pointed end a finishing taper. Glue and hand hold. Sand top surface flush.

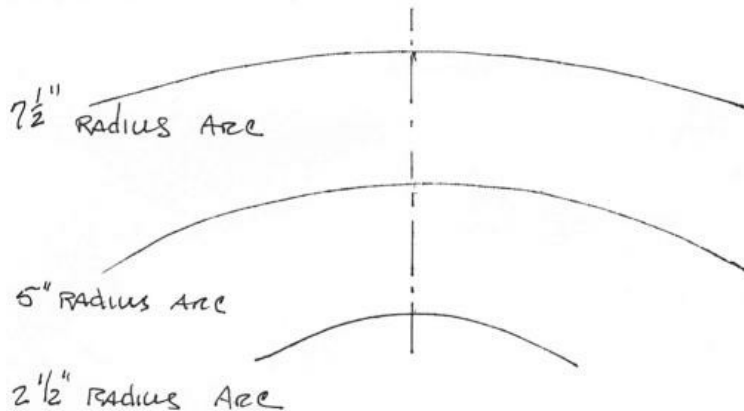
9. Cut heel block from throat salvage. Glue in place, and sand to final shape.

10. Side-to-side radius of 5" arc is started by a chamfer $\frac{1}{4}$ " wide along both sides. Round across the sole and cheek with template. Ease all edges for comfortable handling.



Template Arcs

Draw arc on card stock, cut out, and use to shape sole front-to-back ($7\frac{1}{2}$ " radius), profile ($7\frac{1}{2}$ " radius), sole side-to-side (5" radius), and blade ($2\frac{1}{2}$ " radius).



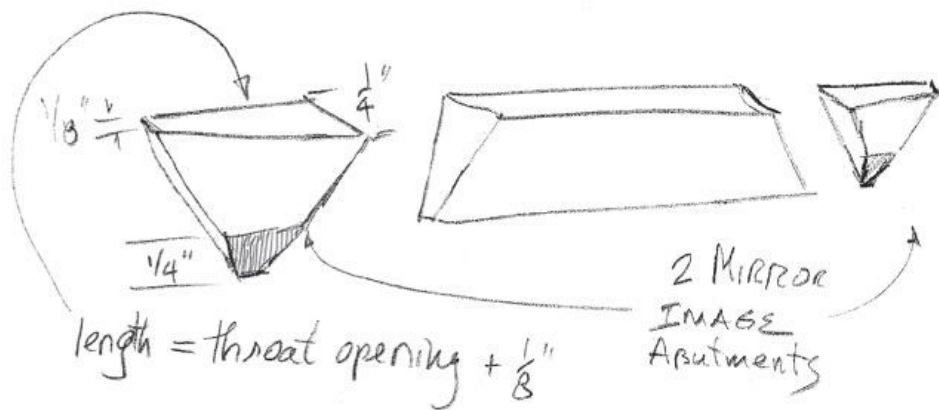
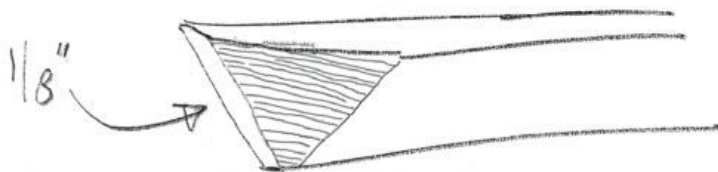
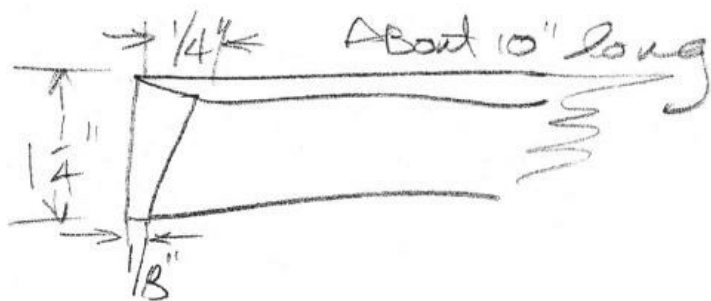
Using 5" and $7\frac{1}{2}$ " radius arc as templates for shaping compass plane. Start with the rocker to the sole, then the sides. The final side-to-side curve is sanded using the 5" arc as a guide.



ABUTMENTS FOR COMPASS PLANE

1. Cut tapered strip on 5° table saw angle.
2. Cut 70° angle at each end for two mirror image abutments.
3. Sand both ends to leave 1/8" thickness along 70° end.

4. Cut off both ends at 60° and feather lower point.



CONSTRUCTION STEPS FOR JACK PLANE

Select Materials

1. Plane body of smooth grained hardwood. Core block $2\frac{1}{32}" \times 2\frac{1}{32}" \times 12\frac{1}{2}"$, 2 sides $\frac{5}{16}" \times \frac{1}{32}" \times 12\frac{1}{2}"$.
2. Cap, hardwood $\frac{3}{4}" \times 2\frac{1}{32}" \times 4"$, but leave part of longer stick for safe holding while cutting bevel. Copper wear washer $\frac{5}{8}"$ o.d., $\frac{3}{8}"$ i.d.
3. Handle, hardwood $\frac{15}{16}" \times 5" \times 5"$, lower edge will be cut off, but left for holding while shaping.
4. Blade of O1 tool steel $\frac{1}{8}" \times 2" \times 5\frac{1}{2}"$. Rest button $\frac{1}{2}" \times \frac{3}{8}"$.
5. Screw mechanism: $\frac{3}{8}" \times 16$ steel threaded rod, 10 – 32 brass or steel threaded rod, brass thumb nut $\frac{3}{8}"$ and 2 brass thumb nuts 10 – 32.

Plane Box

1. Core $2\frac{1}{32}" \times 2\frac{1}{32}" \times 12\frac{1}{2}"$; sides $\frac{5}{16}" \times 2\frac{1}{32}" \times 12\frac{1}{2}"$.
2. Locate throat $3\frac{5}{8}"$ from front of core block: blade angle 45° , fore block 60° .
3. Saw blocks, sand: must be square and flat. Cut and sand fore block edge back $\frac{3}{16}"$ at 90° .
4. Alignment board $\frac{1}{4}" \times 2\frac{1}{2}" \times 12\frac{1}{2}"$ with 2 lines $\frac{5}{16}"$ apart for opening and wax.
 - Mark throat position on sides to avoid gluing
 - Spread glue on all surfaces
 - Clamp core blocks to alignment board
5. With sides glued and in place, drill $\frac{3}{16}"$ holes $\frac{1}{2}"$ deep through the sides into the center of both core blocks. Drive glued dowel pins.
6. Apply pressure in bench vise, or 4-6 clamps. Check to see that all parts touch alignment board, and glue lines are tight.
7. Remove clamps and clear any glue squeeze-out from throat.



Shape Plane

1. Sand plane box top and bottom (do not over sand, keep square).
2. File edge of blade block slightly.
3. Lay out and cut razee shape, sand smooth; lay out and cut profile, sand smooth.
4. Chamfer around upper edges.
5. Drill post hole $1\frac{7}{8}$ " up from sole using $\frac{21}{64}$ " bit, $\frac{3}{4}$ " deep.
6. Insert $\frac{3}{8}$ " threaded rod:
 - File lead end of rod
 - Mark $\frac{3}{4}$ " with black marker on rod
 - Vise grips to turn into hole
 - Cut off $1\frac{1}{2}$ " long, or $1\frac{7}{8}$ " long for 52° smooth plane option, and file smooth.

Handle

1. Lay out handle shape on $\frac{15}{16}$ " $\times$ 5" $\times$ 5" blank. Drill two 1" holes in grip opening to aid in cutting out. Cut outside profile.

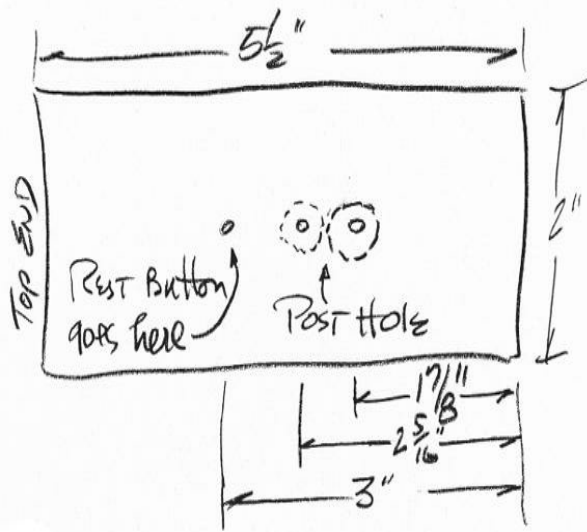
2. Round over grip using router $\frac{3}{4}$ " bit, or rasps and sandpaper.
3. Mark center line on razee, starting $\frac{5}{16}$ " from back end, drill $\frac{7}{8}$ " holes, $\frac{3}{8}$ " deep, the length of handle.
4. Chisel slot, square front end, and before gluing, check blade clearance.

Blade

1. Drill two $\frac{25}{64}$ " holes, filed apart makes $\frac{25}{64}$ " $\times$ $\frac{3}{4}$ " slot as shown on layout. Pilot holes with $\frac{3}{16}$ " drill first.
2. Drill $\frac{3}{16}$ " hole for rest button 3" up from bezel.
3. Grind bezel (25°); finish on belt sander leaving $\frac{1}{64}$ " flat on edge; crown the top and remove sharp edges.
4. Stamp name and date.
5. Heat to cherry red (1,450° F - 1,600° F), quench in oil.
6. Clean all surfaces on belt sander or leave heat treatment color as you wish.
7. Temper in oven 350° F - 400° F for 20 minutes for 60 – 62 RC, air cool.

Cap

1. Cut cap $\frac{3}{4}$ " $\times$ $2\frac{1}{32}$ " $\times$ 4"; bevel cut top 15°; slope chip end 1½" back; micro bevel sharp end back $\frac{1}{8}$ ".
2. Drill for post centered 1⅞" from sole end:
 - Recess $\frac{5}{8}$ " Forstner bit $\frac{1}{16}$ " deep for wear washer.
 - Angle $\frac{25}{64}$ " hole 30°.
 - Drill straight $\frac{25}{64}$ " hole.
3. Drill rest button recess $\frac{5}{16}$ " deep with $\frac{1}{2}$ " Forstner bit centered $\frac{1}{16}$ " and $1\frac{7}{16}$ " from top.
4. Adjustment screw hole centered in top:
 - Recess $\frac{1}{2}$ " Forstner bit $\frac{5}{16}$ " deep for knurled nut.
 - Complete hole with $\frac{15}{64}$ " drill into rest button recess.



Drill BLADE

- $\frac{3}{16}"$ holes, 1 for Rest Button
2 for piloting $2\frac{5}{64}"$ drill
- Drill $2\frac{5}{64}"$ holes
- File away bridge =
 $2\frac{5}{64}" \times \frac{3}{4}"$ hole

5. Band saw scalloped edges on 15° bevel.

6. Sand all surfaces and chamfer.

7. Press knurled nut for adjustment screw, knurled end first, into recess. Test for proper angle with threaded rod, and fill around nut with epoxy.

Adjusting Plane Mechanism

1. Post can be straightened if need be with block of wood and hammer.

2. The cap needs sanding for clearance. Do this on the side that will match threaded rod location.

3. Rest button is ground 15° for landing of top screw. Sand back side even with blade. Glue in place with CA glue.

4. Make final adjustments to main screw to allow smooth on and off action by filing hole in back of cap. Insert copper wear washer when done.



CONSTRUCTION STEPS FOR SHOULDER PLANE

Select Materials

1. Maple core block $\frac{3}{4}" \times 3" \times 11"$
2. Two walnut sides $\frac{1}{4} \times 2" \times 11\frac{1}{4}"$
3. Wedge $\frac{3}{4}" \times \frac{7}{8}" \times 6\frac{1}{4}"$
4. O1 tool steel $\frac{1}{8}" \times \frac{3}{4}" \times 7\frac{1}{4}"$



Blade

1. Cut to $7\frac{1}{4}"$ length.
2. Curve tombstone top end, 25° bevel cutter end, leaving slight flat to protect the carbon to be sharpened later.
3. Harden to cherry red ($1,500^\circ \text{ F}$) and oil quench.
4. Temper in oven 375° F 20 minutes, air cool slowly.
5. Stamp initials and date.

Plane Body

1. Cut fore block 45° and bedding block 37° . Sand flat and square.
2. Glue core blocks to one side; see alignment strip shown in molding plane assembly to aid in this.
3. Clear glue beads from throat and fit wedge with blade in place.
4. Glue second side.
5. Locate center for 1" throat opening hole and draw a $1\frac{1}{2}$ " circle. Drill 1" hole.
6. Cut vertically from fore block throat edge and around to bedding block.
7. Flair the throat opening following the $1\frac{1}{2}$ " circle line.
8. Smooth the throat opening, round over the top ends, and chamfer edges of the plane.

CONSTRUCTION STEPS FOR MOLDING PLANE

Select Materials

1. Maple core block $\frac{3}{4}" \times 3" \times 10"$
2. Two walnut sides $\frac{1}{4}" \times 2" \times 10\frac{1}{4}"$
3. Wedge $\frac{3}{4}" \times \frac{7}{8}" \times 6\frac{1}{4}"$
4. O1 tool steel $\frac{1}{8}" \times \frac{3}{4}" \times 7\frac{1}{4}"$

Blade

1. Follow steps for Shoulder Plane whose straight cutter makes a rabbetting plane.
2. Before hardening, the shape of the hollow or round blade follows the profile of the bedding block where it intersects the shaped sole.





Plane Body

1. Follow the construction steps for the shoulder plane, only cut the fore block 55° and the bedding block 45° .
2. Glue core blocks to one side, then contour the sole for hollow or round. Use this to profile the blade.
3. Complete the plane as outlined in the Shoulder Plane.

CONSTRUCTION STEPS FOR SCRUB PLANE

Select Materials

1. Plane body of hard maple or similar wood. Core $1\frac{17}{32}'' \times 2\frac{1}{2}'' \times 9\frac{1}{2}''$, 2 sides $\frac{5}{16}'' \times 2\frac{1}{2}'' \times 9\frac{1}{2}''$
2. Wedge $\frac{5}{8}'' \times 1\frac{1}{2}'' \times 5''$ (stick 8")
3. Abutments $\frac{5}{16}''$ taper to $\frac{1}{8}'' \times 2\frac{1}{4}'' \times$ stick 10" long
4. Dowel pins (4), $\frac{3}{16}'' \times \frac{1}{2}''$ long
5. Alignment board, $\frac{1}{4}'' \times 1\frac{7}{8}'' \times 9\frac{1}{2}''$
6. Blade of O1 tool steel $\frac{1}{8}'' \times 1\frac{1}{2}'' \times 6\frac{1}{2}''$
7. Carriage bolt, $\frac{5}{16}'' \times \frac{3}{4}''$, with threads all the way to the head

Blade

1. Cut to $6\frac{1}{2}''$ length. Shape tombstone top end and curved ($2\frac{1}{2}''$ radius arc) cutter beveled to 25° .
2. Harden to cherry red ($1,500^\circ$ F), quench in oil.
3. Temper in oven 350° F with heat soak for 20 minutes. Air cool slowly.
4. Polish front, back rough, sharpen cutter.
5. Stamp name and date.

Plane Body

1. Cut core block fore angle 70° , bedding 45° , from a point $3\frac{3}{4}''$ from front. Sand square and flat.
2. Sand $\frac{1}{4}''$ flat 90° to sole on fore block.
3. Clamp core blocks to waxed alignment board leaving $\frac{5}{16}''$ throat opening.



4. Hold sides to core assembly with clamp while drilling $\frac{3}{16}$ " holes for four $\frac{1}{2}$ " dowel pins. Alternatively, use a few grains of table salt.
5. Spread glue on all surfaces, avoiding throat opening. Drive dowel pins.
6. Clamp in bench vise or use C-clamps.
7. Clear glue beads from throat.
8. Sand sides flat and square to each other and ends slightly curved with corners rounded.

Abutments and Wedge

1. Cut wedge by sawing on line $\frac{1}{4}$ " up from the end edge to a point $4\frac{1}{4}$ " back. Sand flat and square.

2. Cut opening first on band saw to remove main salvage, then hand saw to define edges of "ramp" which is chiseled. This work is done on the side opposite from the wedge cut in No. 1.
3. Cut wedge 5" long, round over top end, sand corners.
4. Cut 70° angle on both ends of abutment stick. Sand straight.
5. Sand taper in both ends to 1/8" thick at end.
6. Measure length of abutments with wedge and blade in place. Add 1/8" to measurement for trial fitting.
7. Cut on 50°. Sand straight. Make adjustments to fit. Sand small taper on lower end.
8. Glue abutments with C-clamps on top side, and scrap wedge from No. 1 on the sole side. Remove plane wedge before glue sets.
9. Sand top surface of plane box flat.

Final Finishes

1. Plough finger hold 1/2" wide, 1/8" deep, on line centered 1" down from edge.
2. Sand chamfer around top edge.
3. Cut hand hold block and glue in place 1/8" behind blade.



LAYOUT OF ABUTMENTS with scrub plane in progress behind and the German-made scrub plane in background.

4. Metal strike button made from $\frac{5}{16}$ " carriage bolt, $\frac{3}{4}$ " long. Drill $\frac{19}{64}$ " hole in center of end. Chisel opening for square under bolt head. Drive in strike button.
5. One coat of varnish, leaving bedding angle and back of wedge plain wood.

CONSTRUCTION STEPS FOR LARGE COMPASS PLANE

1. Materials listed for scrub plane, only skip four $\frac{3}{16}$ " dowel pins if you choose to "sand" the glue line with table salt (See [page 11.](#))
2. Knob $1\frac{3}{8}" \times 1\frac{3}{8}" \times 1\frac{1}{4}"$ with a $2\frac{1}{2}"$ wood screw



Blade

1. Same blade as Scrub Plane

Plane Body, Abutments and Wedge

1. Follow Scrub Plane steps, except omit drilling and setting carriage bolt strike button until later.
2. Cut a 12" radius arc sole centered at the throat.
3. Side-to-side arc starts by drawing a line along both sides $\frac{3}{16}"$ above the curve.
4. Sand a 45° chamfered edge along the sole up to this line, then blend a fair curve from side-to-side.
5. Drill and set carriage bolt strike button.
6. Shape knobs and fasten to plane body.

CONSTRUCTION STEPS FOR SMOOTHING PLANE

Select Materials

1. Plane body of smooth grained hardwood. Core block $1\frac{17}{32}'' \times 2'' \times 9''$, 2 sides $\frac{1}{4}'' \times 2'' \times 9''$.
2. Wedge $\frac{5}{8}'' \times 1\frac{1}{2}'' \times 3\frac{1}{4}''$, but leave attached to 10'' stick to give safe holding when shaping bevel and grip.
3. Abutments made from tapered $\frac{1}{4}''$ to $\frac{1}{8}'' \times 1\frac{1}{2}'' \times 10''$ hardwood.
4. Blade $\frac{1}{8}'' \times 1\frac{1}{2}'' \times 4''$ O1 tool steel.
5. Alignment board $\frac{1}{4}'' \times 1\frac{7}{8}'' \times 9''$.
6. Four dowel pins, $\frac{3}{16}''$.

Blade

Follow instructions for Block Plane blade.

Plane Body

1. Cut fore and bed angles at 60° from a point $3\frac{1}{4}''$ from front.
2. Sand surfaces flat and square to core block.
3. $\frac{1}{8}''$ flat 90° to sole sanded on fore block.
4. Use alignment board (waxed) with throat opening lines $\frac{1}{4}''$ apart, $3\frac{1}{4}''$ from end. Clamp fore and bed blocks to board. Lay sides in position, mark opening.
5. Clamp sides in place to prevent slipping while drilling $\frac{3}{16}''$ holes $\frac{9}{16}''$ deep for dowel pins.



6. Spread glue on all surfaces avoiding throat openings. Place sides in position and drive dowel pins. Squeeze in bench vise or clamp.
7. Remove from vise or clamps and clear any glue beads from throat opening.
8. Cut wedge of material from top of plane body starting from 0" thickness at front and 1/4" thick at rear.
9. Sand top and sole flat and square to sides. Sand front in arc, and chamfer edges of sides and front.
10. Cut palm block from throat salvage. Leaving 1/4" space behind blade, draw ogee

curve for razee end.

11. Band saw ogee curve in both block and body, sand curve, and chamfer. The palm block gets 45° flats sanded to the edges. Hold gluing until after abutments are in place and sanded.

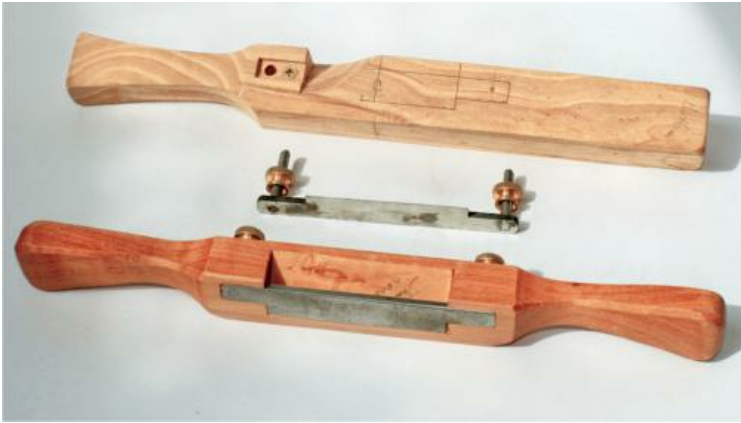
Wedge and Abutments

- 1.** Cut wedge on 10° angle from piece $\frac{5}{8}$ " thick and $1\frac{1}{2}$ " wide, saw from corner back $3\frac{1}{4}$ ". The center is band sawed out and finished with a chisel.
- 2.** Abutments are cut from tapered $\frac{1}{4}$ " to $\frac{1}{8}$ " maple $1\frac{1}{2}$ " wide. They are sanded thinner at the lower end and front. Do this sanding before cutting triangles off the main stick to provide safe holding. A final feather point $\frac{1}{4}$ " back goes on the bottom point.
- 3.** When cutting abutments, leave them larger so fitting can be done.
- 4.** Glue in place with wedge and blade holding abutments as well as fingers. Remove wedge before glue cures.
- 5.** Sand abutments flush with plane body.
- 6.** Glue palm rest block. When dry sand ogee smooth.

CONSTRUCTION STEPS FOR SPOKESHAVE

Select Materials

1. Plane body of smooth grained hardwood $\frac{7}{8}" \times 1\frac{1}{4}" \times 1\frac{1}{2}"$.
2. Blade O1 tool steel $\frac{1}{8}" \times \frac{5}{8}" \times 4\frac{3}{8}"$.
3. Two leveler screws brass #6 $\times \frac{1}{2}"$, or set screws 6 – 32 $\times \frac{3}{8}"$.
4. 2 brass 10 – 32 knurled thumb nuts with 10 – 32 brass or steel threaded rod.



Blade

1. Lay out shape and hole location on blade blank.
2. Hack saw notches at both ends of blade.
3. Drill holes with $\frac{5}{32}"$ bit and tap for 10 – 32 rod.
4. Grind bezel at 15° , leave slight flat at edge. Use threaded rod to help hold while at grinder and sander.
5. Heat blade to cherry red and oil quench to harden.
6. Temper in oven 20 minutes at 400° F for 60 – 62 RC.
7. Sharpen bezel and lap back. Polish or leave heat colors as you wish.

8. Fit $10 - 32 \times 1\frac{1}{4}$ " threaded rod and lock with CA glue. Check diagram for correct side, opposite to side when using rod as holder for grinding. Adjust posts upright to blade before CA glue goes off.

9. File flush the bottom surface of blade.

Spokeshave Body

1. Use blade without threaded rod (prior to step 8 above) to lay out the wood body on blank $\frac{7}{8}$ " $\times$ $1\frac{1}{4}$ " $\times$ $11\frac{1}{2}$ ", as shown in photo on [page 95](#).

2. Drill $\frac{7}{32}$ " holes for threaded rod.

3. Holding plane blank with clamp and angle block, saw ends of throat opening and chisel waste.

4. Remove wood for inset of tang ends.

5. Drill and install #6 $\times$ $\frac{1}{2}$ " leveling screws, or use 6 – 32 set screws.

6. Bevel blade approach of 8° .

7. Use patterns for handles to lay out and band saw. Sand smooth and chamfer edges.

8. Final assembly with blade, threaded rod, and brass knurled nuts. Sand and varnish.

CONSTRUCTION STEPS FOR ROUTER PLANE

1. Plane body hardwood blank $1\frac{1}{2}" \times 3\frac{3}{4}" \times 10"$.
2. Hardware: $\frac{5}{16}"$ Allen wrench, $\frac{3}{8}"$ malleable iron thumbscrew with washer and a wing nut.

Plane Body

1. Lay out shape on hardwood blank. Drill out 2" center, or cut with coping, bow, or scroll saw.
2. Drill $\frac{3}{8}"$ hole for thumbscrew.
3. Handles begin with 1" holes as shown, band saw remaining shape, sand fair and smooth.
4. Radius all edges with $\frac{1}{8}"$ rounding over bit in router, or rasp and sandpaper.



5. Enlarge recess for head of thumbscrew with $\frac{1}{4}$ " chisel.

Cutter

1. Grind the Allen wrench to shape at 30° . Note the $\frac{1}{8}$ " relief behind the cutting edge.

2. Cut down length of key by grinding "V" notch from both sides, snapping off, and rounding over.

3. Hex hole in thumbscrew starts with drilling $\frac{5}{16}$ " hole in head centered $\frac{1}{8}$ " toward threads from where bit naturally slides in curvature.

4. Use small triangular file to make hex opening.

CONSTRUCTION STEPS FOR TRAVISHER PLANE

Select Materials

1. Plane body of smooth grained hardwood $2'' \times 2\frac{1}{2}'' \times 10''$.
2. Blade of O1 tool steel $\frac{3}{16}'' \times \frac{3}{4}'' \times 6''$.
3. Two $\frac{1}{4}'' \times 28'' \times 1''$ set screws using $\frac{1}{8}''$ hex key.

Blade

1. Lay out for tangs $\frac{1}{4}'' \times 1\frac{1}{4}''$ at each end and hacksaw.
2. Grind bevel 25° , finish on 80-grit belt sander. (Leave $\frac{1}{64}''$ flat at edge to protect carbon.)
3. Stamp name and date.
4. Cold bend blade arc 3" in vise with wood die.
5. Bend tangs by heating in vise and bend with crescent wrench. Do not quench. Adjust angle of tangs true to face of blade and parallel to each other.
6. Harden by heating cherry red and oil quench. Polish with fine sandpaper, or leave heating colors.
7. Temper at 400° F for 20 minutes for a light straw patina on blade surface.
8. Sharpen bevel on small drum sander. Finish with stones or curved paddle and sandpaper for inside arc.

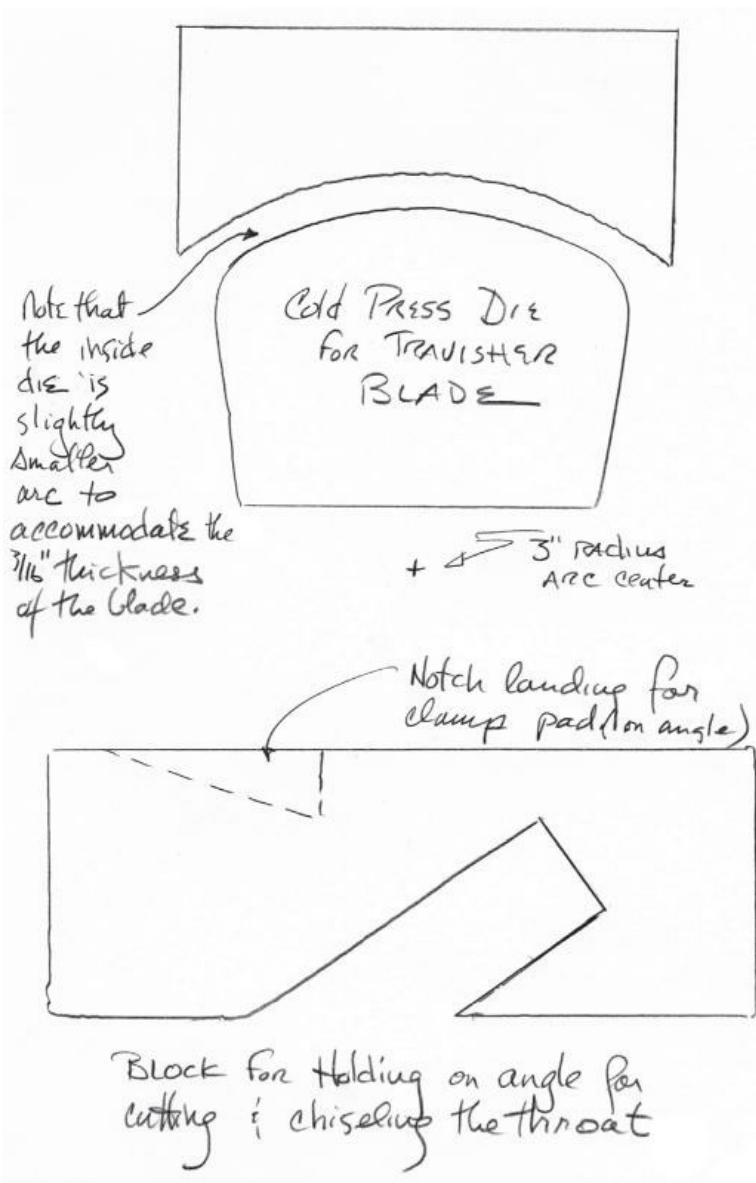




Body

1. Locate blade with center line, marking tang $\frac{5}{8}$ " from back edge of body. Drill $\frac{1}{4}$ " holes for tangs. A slightly larger drill size will make squaring this hole easier.
2. Lay out inside 10" arc and "wedges" to create sole that leaves handles $\frac{3}{4}$ " thick and $\frac{3}{4}$ " away from center line. Cut wedges only.
3. Fit blade by squaring the holes for tangs and sanding arc to match blade arc.
4. Open throat by marking blade edge and end point, then saw from there to the 10" arc line. Chisel from blade edge line to 10" arc line.
5. Bevel sole ahead of blade 5° .
6. Drill $\frac{7}{32}$ " holes for $\frac{1}{4}$ " $\times$ 28 set screws. Tap holes.
7. Cut 10" arc leaving handles $\frac{3}{4}$ " thick and following throat opening. Save scrap and tape back in place to support next cut.
8. Cut "wings" for handle shape staying $\frac{1}{4}$ " away from set screw holes.
9. Chamfer handle edges on roller end of belt sander.

10. Sand and varnish.



CONSTRUCTION STEPS FOR THE HAND ADZE

Select Materials

1. The handle needs the strength and heft that a hardwood like white oak, hard maple or hickory provides. A flat sawn 8/4 plank $6\frac{1}{2}" \times 12"$ will do.
2. A 5" blank of $\frac{1}{8}" \times 1\frac{1}{2}"$ O1 tool steel.
3. A 3" length of 1" dia. steel rod.
4. 15' of $\frac{1}{8}"$ nylon cord or its equivalent plus epoxy glue.

Making the Handle

1. The handle is rounded from $1" \times 1\frac{1}{2}"$ profile cut out of the plank. The end is left slightly larger than the shaft to give a good hold, and the texture of the knife and chisel marks is left for friction grip.
2. Drill a 1" hole 3" deep into the wood head to receive the steel slug. Drill a $\frac{1}{8}"$ hole into the bottom to relieve pressure when epoxying.
3. Two small wood studs ($\frac{3}{16}"$ dowel or whittled equivalent) are set in $\frac{1}{4}"$ -deep holds to keep the cord from slipping. The back edge is notched $\frac{1}{8}"$ deep to hold the cord there.

Making the Blade

1. The 10° angle of the blade and forming the $2\frac{1}{4}"$ radius arc of the cutter face are done cold. The angle is hammered while the blade is set 1" into a vise. The cutter curve is peened into a recessed anvil. (See [page 121](#).)
2. Grind the cutter face, and finish on a belt sander and sharpening stone. A wood paddle rounded to match the radius arc of the cutter face is used with wet-or-dry sandpaper over it to lap the inside surface.



BENDING THE BLADE on a 10° angle, the gauge on a scrap of wood is used as a guide. $1\frac{1}{4}$ " of the blade is set in the vise.

3. Harden the blade with a torch to cherry red, and quench in oil.
4. Temper to 350° F - 400° F for 20 minutes and air cool.

Attachment

1. Start the cord wrap by drilling $\frac{1}{4}$ "-deep hole into which the end is set with CA glue. A drop of CA glue on the end of the nylon cord will tame its unraveling.
2. Once wrapped, finish off in a similar hole, and impregnate with epoxy.



ADDED HEAD WEIGHT with 3" of 1" dia. steel rod. Drill 1" hole with $\frac{1}{8}$ " relief hole at bottom for epoxy.

CONSTRUCTION STEPS FOR SHOP DRAWKNIFE

Select Materials

1. O1 tool steel $\frac{3}{16}'' \times \frac{3}{4}'' \times 7\frac{1}{2}''$
2. Ferrules (2) $\frac{1}{4}''$ compression nuts
3. Handles cut from $\frac{7}{8}'' \times 1\frac{1}{4}'' \times 10''$ hardwood

Blade

1. Cut blade $7\frac{1}{2}''$
2. Profile for handle tangs.
3. Bevel 25° cutter edge leaving slight flat to protect carbon to be sharpened later.
4. Stamp name and date.
5. Heat treat to cherry red ($1,500^\circ$ F) and oil quench.
6. Oven temper 375° F for 20 minutes and air cool slowly.
7. Polish and sharpen.

Handles

1. Turn or bevel two handles.
2. Fit ferrules.
3. Drill $\frac{1}{4}''$ holes to receive tangs.
4. Set handles into blade.



CONSTRUCTION STEPS FOR SCRAPERS

Select Materials

1. Hardwood handle blank $\frac{3}{4}" \times 2\frac{1}{2}" \times 9"$ for standard scraper, and $\frac{3}{4}" \times 1" \times 4\frac{1}{2}"$ for small.
2. Replacement blades for scrapers by Red Devil #3063 for $2\frac{1}{2}"$ size, and #3061 for the 1".

Making the Handle

1. Drill $\frac{17}{64}"$ hole for the blade 1" from the end for the $2\frac{1}{2}"$ size, and $\frac{15}{64}"$ hole for the small scraper.
2. Saw slot from end to $\frac{17}{64}"$ hole. Experiment with different size saw blades as this slot wants to match the double blades in the $2\frac{1}{2}"$ scraper, or $\frac{1}{10}"$, and be thinner for the single blade in the 1" size, or $\frac{1}{32}"$ kerf.
3. Cut profile of handle, chamfer edges, and round end approaching the blade.



Sharpen

1. File edge at 30° angle to the direction of scraping.
2. Special profiles can be ground and filed as needed.

CONSTRUCTION STEPS FOR CABINETMAKER'S BOW SAW

Stock Preparation

1. The wood for the frame is hard maple, beech, or hickory. Two frames are $\frac{3}{4}" \times 1\frac{1}{4}" \times 12"$, one stretcher $\frac{3}{4}" \times 1" \times 13\frac{3}{4}"$.
2. The knobs are turned or chamfered from $1\frac{1}{4}"$ stock, with the arm rest style cut from $1\frac{3}{8}"$ stock. The toggle is $\frac{5}{16}" \times 1" \times 5\frac{1}{2}"$.
3. Blades adapted from $\frac{3}{16}"$ band saw blades, or purchased.
4. Latch pins of $\frac{1}{4}"$ brass rod, or use Gramercy-made pins.



Cutting the Frame

1. Lay out the pattern for two frames, cut to shape, and thin the tensioning ends to $\frac{3}{8}"$.
2. Stretcher is cut, edges chamfered, ends tenoned $\frac{3}{8}"$ long, $\frac{5}{16}"$ thick and $\frac{7}{8}"$ wide.
3. Cut the mortise to fit.
4. Drill the $\frac{1}{4}"$ hole for the latch pin in the ends of both frames.



Cutting the Frame

1. Lay out the pattern for two frames, cut to shape, and thin the tensioning ends to $\frac{3}{8}$ ".
2. Stretcher is cut, edges chamfered, ends tenoned $\frac{3}{8}$ " long, $\frac{5}{16}$ " thick and $\frac{1}{4}$ " wide.
3. Cut the mortise to fit.
4. Drill the $\frac{1}{4}$ " hole for the latch pin in the ends of both frames.



Assemble the Saw

1. Use Gramercy latch pins, or cut from $\frac{1}{4}$ " brass rod 3" long, with slot and catch sawn to receive cross pins in the blades, or simply drill for removable pin.
2. The knobs are cut and joined to the brass rod with CA thick glue.
3. The tensioning string is an 8' length of jute string. Use paraffin to wax the string and use the toggle to tighten.
4. Choose your blade and saw curves.

CONSTRUCTION STEPS FOR CARVING & LAYOUT KNIFE

Select Materials

1. Handle $\frac{1}{2}$ " insert coupling and 3" of clear tube $\frac{1}{4}$ " i.d. $\times$ $\frac{3}{8}$ " o.d.
2. Blade of O1 tool steel $\frac{1}{16}$ " $\times$ $\frac{1}{4}$ " $\times$ 4"
3. Blade guard 2" of clear tube $\frac{5}{8}$ " i.d.

Blade Making

1. Hacksaw 4" length.
2. File 45° return point on end.
3. Bevel 1" cutting edge with file leaving $\frac{1}{64}$ " flat along edge.
4. Heat cherry red (1,500° F) for 2" of length. Quench in oil.
5. Set in oven at 375° F for 20 minutes. Slowly air cool.
6. Polish with fine sandpaper or steel wool.



Handle Construction

1. Fill $\frac{1}{4}$ " tube with clear silicone caulk and wipe caulk on blade while sliding into tube.
2. Spread caulk inside $\frac{1}{2}$ " coupling and outside blade/tube assembly and insert. Set to dry.
3. Sharpen blade.
4. Slide 2" of $\frac{5}{8}$ " tube as blade guard.



CONSTRUCTION STEPS FOR STROP FOR TOOL SHARPENING

Selecting Materials

1. Paddle of $\frac{3}{8}$ "-thick wood, any species.
2. Leather (with one rough side) from cobbler or craft supply.
3. Honing compound; green chromium oxide stick is best.
4. Thin oil as used for sharpening; a mix of 30 weight motor oil (1 part) and K1 kerosene (2 parts).

The Strop

1. Cut paddle.
2. Cut leather and use yellow carpenter glue to attach, rough side out, to paddle.
3. Charge leather with compound by squirting oil followed by rubbing compound to make a slurry to fill leather. Good for a year's charge.
4. OPTIONAL: Emery cloth glued to the back for more complete sharpening.



CONSTRUCTION STEPS FOR WORKBENCH

Selecting Materials

1. This bench is designed to make use of wood either wet or dry. Working green has a long tradition, but one not so familiar to us in an age of abundant kiln-dried lumber. So read about it first on [page 179](#).
2. The two aspects of the design making green wood construction possible are the bolted tenon leg joints, which tighten as wood dries, and the split top which allows the tool tray and the bench top to shrink without opening any seams.
3. Hard maple is my wood of choice, but any species you can get, except red oak, will work in this design, which rewards resourcefulness.
4. Building a bench is a bigger undertaking than other projects in this book so it does not readily condense, but the following is intended to be suggestive and encouraging.

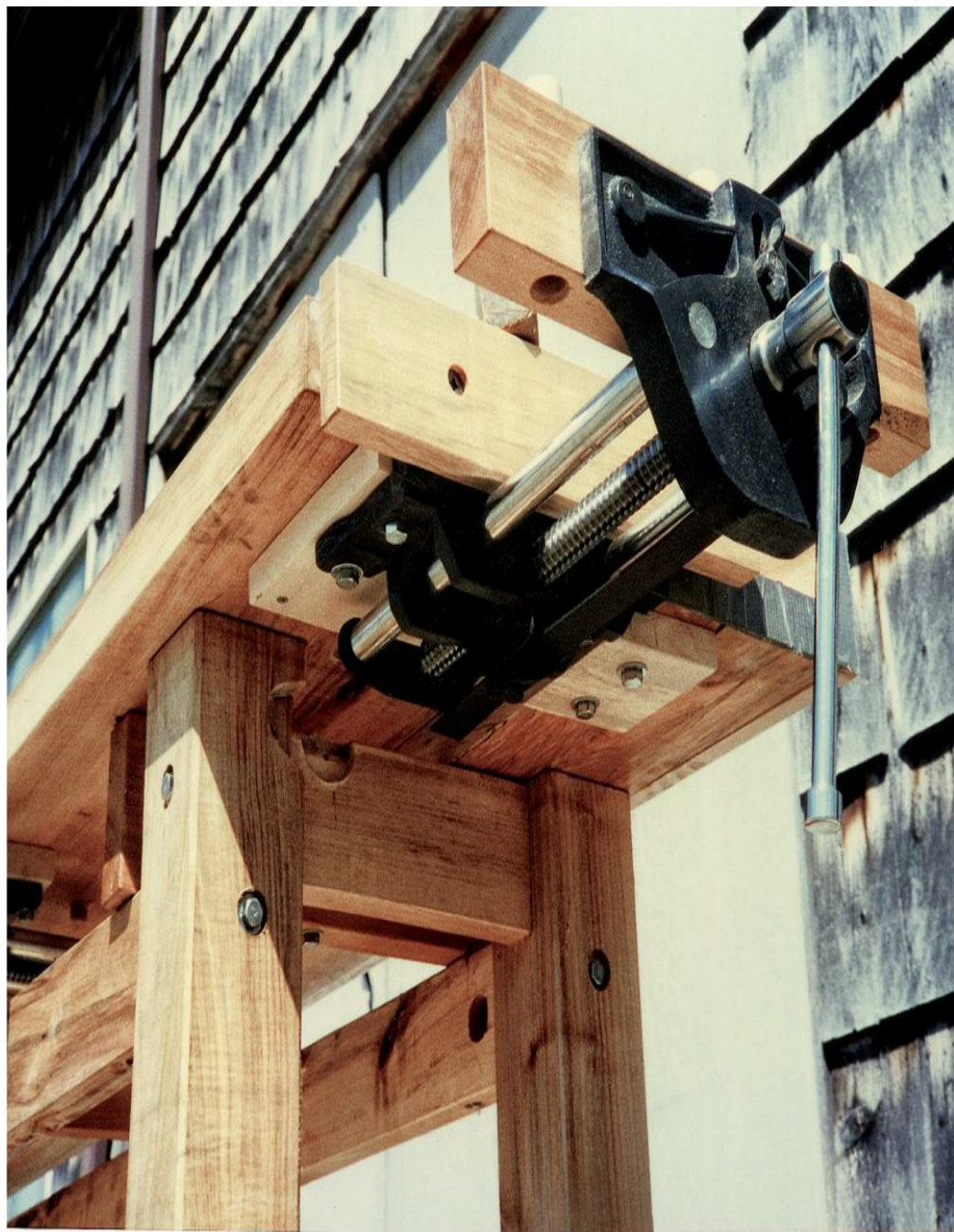


Overview of Building the Bench

1. Mill lumber from a 20" diameter $\times$ 8' 6" log, or alternative source.
2. Mortise legs and tenon rails.
3. Drill $1\frac{1}{2}$ " nut holes in rails and $\frac{25}{64}$ " holes in posts for $\frac{3}{8}$ " $\times$ 6" bolts. Assemble posts and rails.
4. Install shelf. Making drawers is a future project.



- 5.** Mill the top, tool tray, back rest, and cross supports.
- 6.** Bolt top to rails, countersink carriage bolts and plug 1" hole in bench top.
- 7.** Lay out vise and dog holes in top to avoid hitting posts, rails and bolts. Bolt up vises. End vise location depends on whether right or left handed; two front vises in 8' bench, one in 6' bench.
- 8.** Full construction notes available in manual, "Your Own Woodworker's Bench" by John Wilson (517-543-5325). \$15 postpaid.



CUTTING LIST FOR WORKBENCH¹

Posts (4)	$4 \times 4 \times 32''$ to $36''$	
Top	$8/4 \times 15 \times 8'$	Quartersawn, 2 or 3 pieces
Tool tray	$6/4 \times 7$ or $8 \times 8'$	
Back of tool tray	$6/4 \times 4$ or $5 \times 8'$	
Rails (2)	$6/4 \times 6 \times 6'$	
Rails (2)	$6/4 \times 6 \times 13''$	
Rails (2)	$6/4 \times 4 \times 6'$	
Rails (2)	$6/4 \times 4 \times 13''$	
Shelves (2)	$4/4 \times 8 \times 6'-6''$	
Cross supports (3)	$6/4 \times 6 \times 19\frac{1}{2}''$	
Vise jaws (3)	$6/4 \times 3''$ ² $\times 14''$	Dry maple
Vise jaws (3)	$\frac{3}{4} \times 3''$ ² $\times 14''$	Dry maple
Block	$6/4 \times 2\frac{1}{2}'' \times 6''$	To hold top & tray together
Shim blocks (2)	$\frac{3}{4}'' \times 4\frac{1}{2}'' \times 10''$	For vise mounting on $8/4$ top
Wood blocks	Misc.	For shelf & under top
Dowel	$1''$	For plugging carriage bolt head
Urethane or carpenter glue		Depending on moisture content of wood
Sealer for bench	WATCO oil or similar varnish/oil finish	

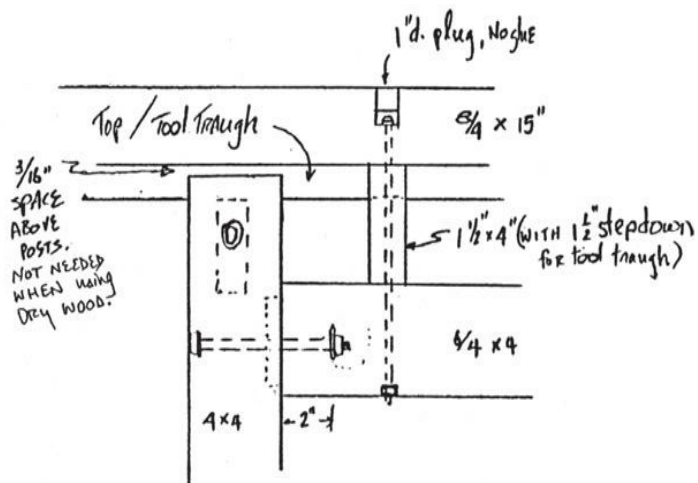
HARDWARE ³

Machine bolts, nuts, with $\frac{5}{16}''$ washers (16)	$\frac{3}{8}'' \times 6''$
Carriage bolts, nuts, with $\frac{5}{16}''$ washers (3)	$\frac{3}{8}'' \times 8''$
Carriage bolts, nuts, with $\frac{5}{16}''$ washers (3)	$\frac{3}{8}'' \times 10''$
Lag screws and $\frac{5}{16}''$ washers (3)	$\frac{3}{8}'' \times 6''$
Lag screws and $\frac{5}{16}''$ washers (2)	$\frac{3}{8}'' \times 4''$
Flat head wood screws (24)	$2''$
Flat head wood screws (5)	$3''$

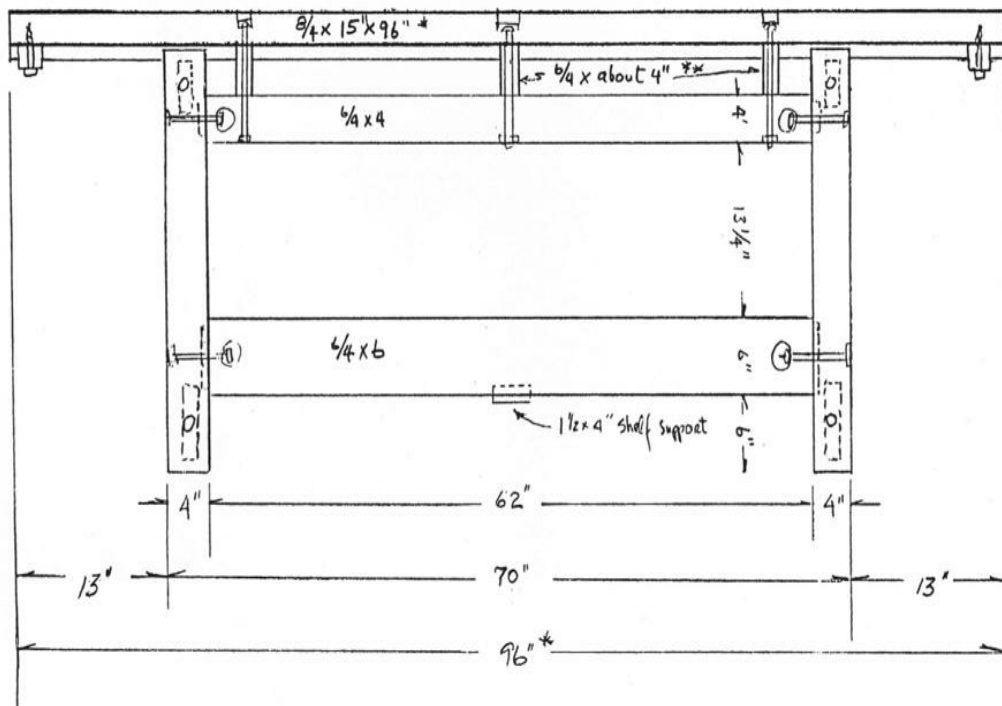
¹ Note on dimensions: Omission of the inch sign (") indicates size is approximate. For example $1\frac{1}{2} \times 4$ can mean $1\frac{3}{8}'' \times 3\frac{3}{4}''$ in dry wood. Likewise the use of $6/4$ or $8/4$ denotes rough dimension.

² Width needed to be flush with top.

³ Attaching three wood vises will take various lag screws, and screws, depending on the particular vise.



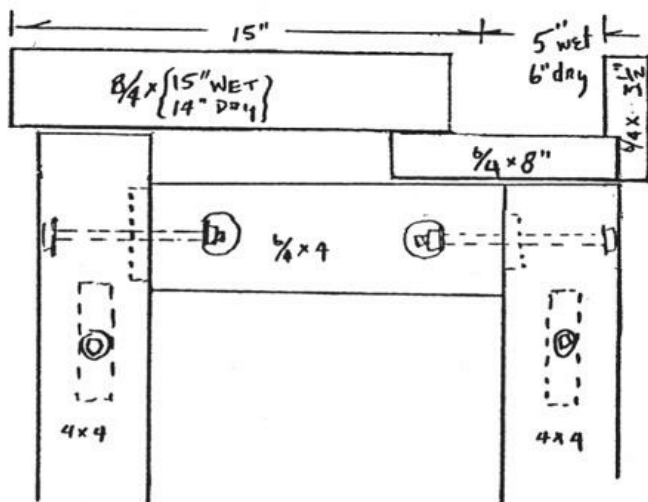
FRONT VIEW DETAIL



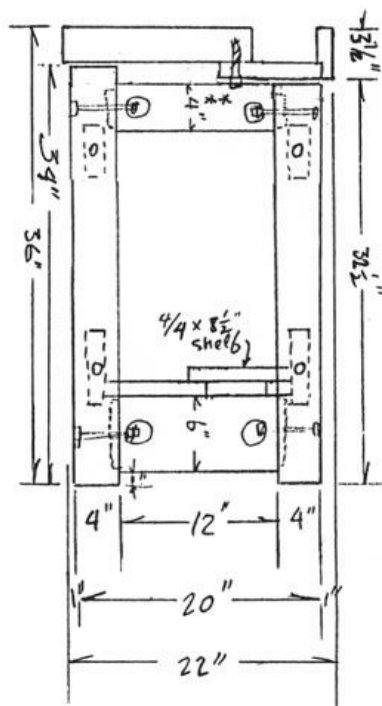
FRONT VIEW

HOME SHOP WORKBENCH

If building with green wood, review text on subject ([page 179](#)).



TOP END VIEW



END VIEW

HOME SHOP WORKBENCH

If building with green wood, review text on subject ([page 179](#)).

CONSTRUCTION STEPS FOR SAW BENCH & SHOP STOOL

Selecting Materials

1. Good grade of yellow pine $\frac{3}{4}$ " plywood, dense and with reasonable surface. One stool requires half a sheet.
2. Four hardwood feet cut from $1\frac{1}{2}$ " $\times$ 2" $\times$ 16".
3. $1\frac{5}{8}$ " deck screws and glue.



Assembly

1. Follow layout diagram on [page 194](#) for size of pieces and location on half sheet of plywood.
2. Screw the 8" back support to the middle shelf with glue and deck screws.
3. Attach the 5" front support under the middle shelf centering it with $\frac{7}{8}$ " overhang of shelf.
4. Screw sides to these supports; then screw down through the step into the sides.

5. Attach the top.
6. Door slot, if desired, goes at one end.
7. Hardwood shoes glue to the bottom for long life.



HERE IS THE OLD STOOL after a life of usefulness, now on the burn pile to be returned to basic elements of the

universe and to be recombined into a new generation of materials. Note the badly worn corners where the plywood feet gave out. The attachment of the hardwood “shoes” will extend the life of your stool.

CONSTRUCTION STEPS FOR WORK HORSE FOR DOVETAILING

Select Materials

1. Use hardwood such as 4/4 #2 maple planed “hit or miss” to leave as much as 1" actual thickness. Alternatively use yellow pine or Douglas fir 2 × construction stock at 1½" actual thickness.
2. Face board needs stiffness to counter sawing vibration. Use 1½" stock, or double up ¾" plywood.
3. Deck screws appropriate to thickness. Two carriage bolts ½" × 5" with wing nuts and washers for vise, and two carriage bolts $\frac{5}{16}$ " × 3" to fasten face board.

Build the Horse

1. Cut four legs 1" × 5" × 22" with 13° cut on ends. Top 1" × 8" × 36". Two braces 1" × 3½" × 10½" and one brace 5" × 17" rabbeted ends to fit.
2. Joint top 13° to receive legs, cut set 1" into top. Note top will extend ½" beyond legs to be flush with braces at each end.
3. Glue and screw legs to top.
4. Braces are rabbeted ½" inset on legs and flush under top. Bottom brace rabbeted also.
5. Glue and screw braces.



Vise and Face Board

1. Face board is $1\frac{1}{2}'' \times 11\frac{1}{4}'' \times 32''$ and vise $1'' \times 5'' \times 1\frac{1}{4}''$.
2. Bolt face board using $\frac{5}{16}'' \times 3''$ carriage bolts to cross braces. This board is easily reversed to offset either right or left on horse according to the handedness of the worker.
3. The vise operates with two $\frac{1}{2}'' \times 5''$ carriage bolts with wing nuts. Slightly oversize the holes for easy operation in the face board.
4. For class use, build one for each student. Horses stack when face board is removed.

CONSTRUCTION STEPS FOR PORTABLE DOVETAIL VISE

Select Materials

1. Hard maple is the only wood I have used for anchoring threaded rod. It seems reasonable that a range of fine grained hardwood would work if you want to try.
2. Base $\frac{3}{4}" \times 2\frac{3}{4}" \times 16"$; anchor block and jaw both $1" \times 1\frac{3}{4}" \times 12"$.
3. Length of $\frac{5}{16}"$ threaded rod, sold 36" long but 10" would be long enough for one vise, with two wing nuts and washers.



Assembly

1. Cut three hard maple pieces.
2. Drill anchor block for threaded rod using $\frac{9}{32}"$ drill and holes 9" apart.
3. Advance threaded rod into holes using vise grip pliers to serve as turning handle. When rod bottoms the hole, cut off to desired length for jaw opening. I left $2\frac{1}{2}"$ exposed which allowed for holding up to 1" thick boards.
4. Cut $\frac{3}{8}"$ holes in jaw piece. While rod is centered, these oversized holes need to be drilled slightly below center to have the top surface of both pieces level.

5. Glue anchor block to the base board.

CONSTRUCTION STEPS FOR CHISEL HOLDER

Select Materials

NOTE: This holder is designed for a six chisel set $\frac{1}{4}$ " to $1\frac{1}{2}$ ". Your chisels may vary in size and number. Adjust dimensions accordingly.

1. Three feet of 1×6 board. The one stress point requiring hardwood is the side bar end where the screw hinges the handle.
2. Cut the two holder blocks $\frac{3}{4}" \times 6" \times 8"$, and $\frac{3}{4}" \times 6" \times 9"$. The handle bar is $\frac{3}{4}" \times 1\frac{1}{2}" \times 9"$, and the two side bars $\frac{1}{2}" \times 1\frac{1}{2}" \times 13\frac{1}{2}"$.
3. Four $1\frac{1}{2}"$ wood screws.



Assembly

1. The slotted holder block is routed to hold the chisels in your set. Each slot is $\frac{9}{32}$ " deep, wider than the blade of each chisel by $\frac{1}{16}$ ", and 4" long. The space between each slot is determined by the size of the handle.
2. Glue the longer holder block on to it allowing $\frac{1}{2}"$ overlap at each end.

3. Cut the handle pieces. The side bars have a $\frac{3}{4}'' \times 6''$ notch for the longer holder block. The end is drilled and recessed for the screws to hinge the handle. Cut a small radius on the end to allow clearance for hinged opening.
4. The handle pieces are joined using a rabbet/dado joint, glued and reinforced with a $1\frac{1}{2}''$ wood screw.
5. A small bar $\frac{1}{4}'' \times \frac{3}{4}'' \times 10''$ is used to prop open the holder when in use.

CONSTRUCTION STEPS FOR JAPANESE TOOL BOX

Selecting Materials

1. Box joint project has $\frac{1}{2}$ " sides and ends, nailed butt joint box has $\frac{7}{16}$ " sides and $\frac{5}{8}$ " ends. Width and length of all parts adjusted to your tool needs.
2. Cherry or walnut look very nice with birch top and bottom for formal look, while pine or yellow poplar for utility piece. Likewise, $1\frac{1}{2}$ " copper rose head boat nails are a nice accent for cherry or walnut, with box nails for utility tool box.
3. The box as shown has two sides $\frac{1}{2}$ " $\times$ $7\frac{1}{2}$ " $\times$ 25", two ends $\frac{1}{2}$ " $\times$ $7\frac{1}{2}$ " $\times$ 12", 6 cleats $\frac{1}{2}$ " $\times$ 2" $\times$ 12", bottom 6 mm $\times$ $11\frac{5}{8}$ " $\times$ $24\frac{5}{8}$ ", lid 6 mm $\times$ 11" $\times$ $22\frac{1}{2}$ ", 24 clinch nails.



Box

1. Dado the slot for ply bottom 6 mm $\times$ $\frac{3}{16}$ " for sides and ends.
2. Cut to length both ends and sides. To butt joint and nail corners, shorten end boards 1". Mark box layout as joints A-A, B-B, C-C, D-D to avoid mixup.
3. Box joint construction on table saw following diagram for grouping parts for cutting. Beware of mismatching.
4. Cut fingers on one end of group. Loosen clamps, slide stock to align other end, and re-

clamp. Cut remaining joints.

5. Glue joints and engage bottom board in clamp-up. File or sand a slight chamfer on all edges of plywood to avoid failure of board to enter slot. Use wood strips to protect sides from clamp dents. Check for square.

6. Plug dado slot exposed at corner. Sand.

7. Nail and glue two cleats to each end.

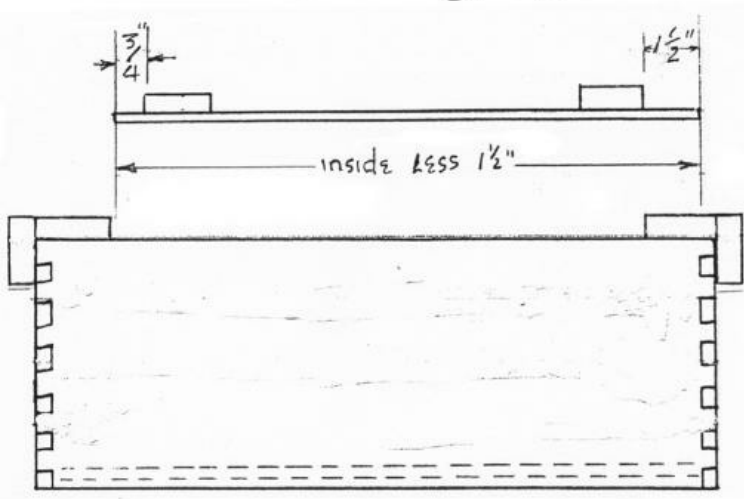
Lid

1. Check lid for size — clearance on sides and length to slide on ends.

2. Mark location for cross cleats. One goes $\frac{3}{4}$ " from end, the other $1\frac{1}{2}$ ".

3. Glue and clinch nail cross cleats.

*The way the lid works —
use it for any size box.*



CONSTRUCTION STEPS FOR TOOL TOTE

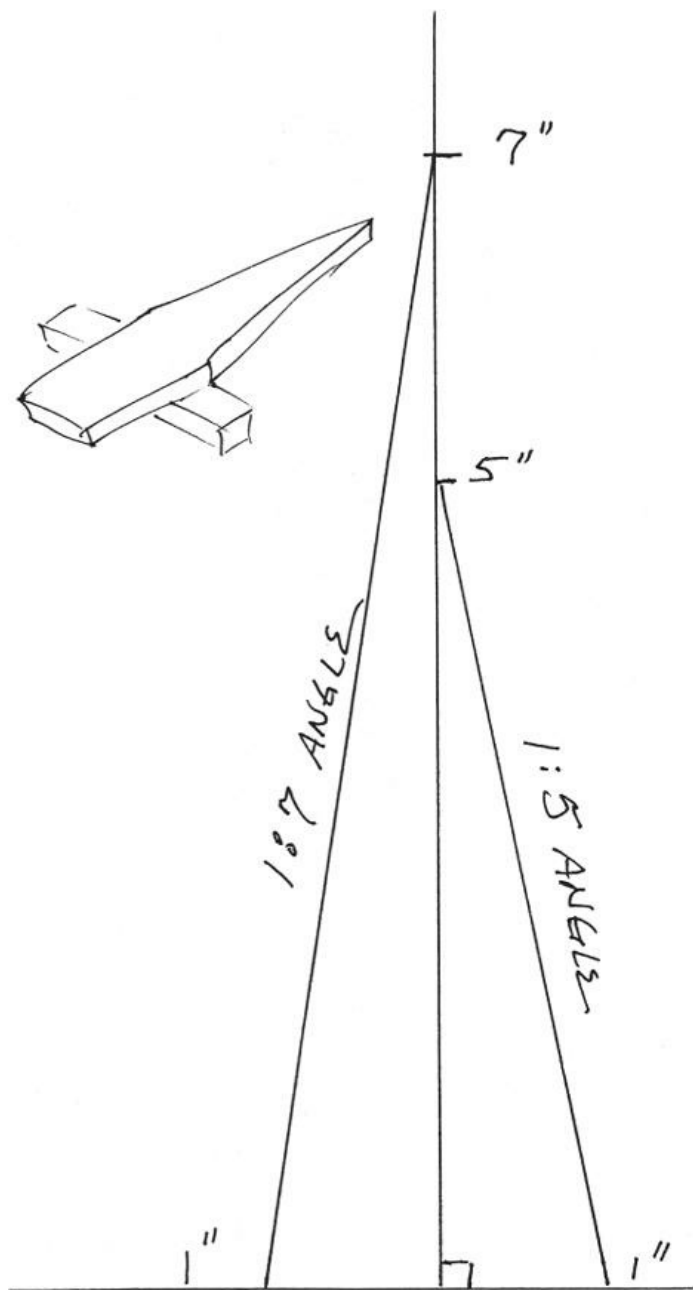
Stock Preparation

1. Either yellow poplar or quality pine is a good choice. Both are easily worked in dovetailing. All the pieces can be $\frac{1}{2}$ " stock, but the thinner sides and thicker ends are good details.
2. Prepare two sides $\frac{7}{16}$ " $\times$ $4\frac{1}{2}$ " $\times$ 22", two ends $\frac{9}{16}$ " $\times$ $4\frac{1}{2}$ " $\times$ $12\frac{1}{2}$ ", one center board $\frac{1}{2}$ " $\times$ 6" $\times$ $21\frac{1}{8}$ ", and a bottom of 5-ply Baltic birch 6 mm $\times$ $11\frac{3}{8}$ " $\times$ $21\frac{1}{8}$ ".
3. Plough a groove in sides and ends 6 mm wide and $\frac{1}{8}$ " deep.
4. The middle of both ends is slotted to receive the center board $\frac{1}{2}$ " wide by $\frac{1}{8}$ " deep. This slot should end before going through the lip below the bottom groove.
5. Cut the middle board to profile: Cut two $1\frac{1}{8}$ " holes with Forstner bit to define the hand hold and cut out between. Ease edges of handle.



Hand Cut Dovetails

1. Scribe all joints gauging opposite thickness. Tails are scribed all four surfaces, pins only two. Label adjoining joint pieces A–A, B–B, C–C, D–D.
2. Lay out pins (two half pins and two full pins). Use 1:5 gauge.
3. Saw and chisel pins.
4. Template pins onto tails for layout. Use sharp pencil.



HOW TO DRAW ANGLES
FOR MARKING GAUGE

5. Saw on salvage side of the line for tails. Remove end salvage by saw; chisel center pin salvage.

Assembly

1. Glue all dovetail joints after trial fit. Slide bottom into place before engaging second end. Clamp as needed.
2. Router hand hold with $\frac{1}{8}$ " roundover bit, top of center board, and top edges of box.
3. Glue and fit center board. Glue and nail with two finish nails in both ends and three into bottom edge. (Pilot $\frac{1}{16}$ " holes from inside before assembly.)

SIMPLIFIED TOOL TOTE CONSTRUCTION STEPS

1. Prepare sides and ends as one piece, $\frac{1}{2}$ " $\times$ $4\frac{1}{2}$ " $\times$ 6'.
2. Cut groove with several passes over table saw. Groove width matches ply bottom, $\frac{1}{8}$ " deep and $\frac{1}{8}$ " from edge of board.
3. Cut all parts to length. The ends will vary in length depending on choice of joint used. Full-cut dovetails use 12" end; half-blind dovetail $11\frac{7}{8}$ "; rabbeted joint $11\frac{1}{2}$ "; butt joint ends is 11".
4. Cut dado in ends for center board, and rabbeted side board ends if choosing that joint.
5. Cut center board $\frac{1}{2}$ " $\times$ 6" $\times$ $21\frac{1}{8}$ " or 21" if no end dado for center; hand hold drilled and cut; angle both ends to 4" wide where it meets ends. Sand or router edges.
6. Assemble box, sliding bottom ($\frac{1}{4}$ " or 6 mm $\times$ $11\frac{3}{8}$ " $\times$ $21\frac{1}{8}$ ") into groove before attaching second end.
7. Center board is glued with finish nails in ends and bottom (drill $\frac{1}{16}$ " holes through ply).

CONSTRUCTION STEPS FOR CARPENTER'S TOTE

Select Materials

1. The original tote looks good in quartersawn oak sides and sweet gum or yellow poplar handle board and ends, in the arts and crafts style. Increase the thickness of the sides if pine or yellow poplar is used for sides.
2. Use 4d and 6d box nails, or for decorative effect use the copper rose head boat nails listed for the Japanese Box project.

Making the Tote

1. The center board defines the shape. Follow the plans to cut the $\frac{7}{8}" \times 9\frac{1}{8}" \times 24\frac{1}{2}"$ board.
2. Drill $1\frac{1}{4}"$ holes at each end of the handle opening and remove the waste between.
3. Round over handle hole and top edges.
4. Cut ends $13\frac{1}{16}" \times 4\frac{1}{2}" \times 13\frac{1}{16}"$ (overall), $9\frac{1}{8}"$ (at bottom) and bevel edge meeting the bottom 30° and 15° compound angle where ends and sides meet. Nail ends to center.
5. Cut sides $\frac{7}{32}" \times 4\frac{1}{2}" \times 26\frac{1}{8}"$ with 30° bottom edge. Hold in place to mark length. Nail to ends.
6. Bottom is $\frac{15}{32}" \times 10\frac{15}{32}" \times 22\frac{5}{8}"$ (originally two boards) that is larger than sides by $\frac{1}{4}"$ all around. Cut and round over all edges. Nail to ends and center.



CONSTRUCTION STEPS FOR BOAT TOTE

Selecting Materials

1. The bottom, transom, and center board are pine $\frac{1}{2}$ " thick.
2. The planks are $\frac{1}{8}$ " cherry.
3. Glue is yellow carpenter or boat builder's epoxy. Use CA instant glue in spots to fix plank while other glue sets.

Building the Boat

Cut bottom ($\frac{1}{2}$ " $\times$ $9\frac{5}{8}$ " $\times$ $24\frac{1}{2}$ ") to shape as shown in plans, with 25° bevel cut at transom.



2. Cut center board ($\frac{1}{2}$ " $\times$ $5\frac{1}{2}$ " $\times$ $28\frac{1}{4}$ ") to shape, and drill two 1" holes at ends of hand hold; cut waste, and round edges. Glue and nail to bottom.
3. Cut transom ($\frac{1}{2}$ " $\times$ $4\frac{5}{8}$ " $\times$ 10") to shape, and fit. Glue and nail to center and bottom. Then plane even to bottom.

- 4.** Cut planks from $\frac{1}{8}'' \times 5'' \times 30\frac{1}{2}''$ cherry. Trial fit to establish bevel edge of bottom, which changes from bow (about 10°) to stern (about 30°).
- 5.** Glue planks using spots of CA glue in conjunction with regular glue to hold this hard to clamp shape.
- 6.** Once set on one side, sand bow end of plank to allow positioning of second plank to go on past it.
- 7.** Cut gunwale $\frac{1}{4}'' \times \frac{3}{8}'' \times 30''$ cherry, and rub rail $\frac{1}{8}'' \times \frac{1}{4}'' \times 30''$ cherry. Spring clamps can hold joint until glue dries.
- 8.** Finish with paint or varnish.

My Sources of Supply



■ The following sources are ones I used for these projects. Check the Internet for additional sources you might find helpful. Where prices are mentioned in the text, they were current when written.

- MSC, Atlanta, GA
800-645-7270, MSCdirect.com
- Reid Supply Company, Muskegon, MI
800-253-0421, ReidSupply.com
- Amtek Tool and Supply, Inc.,
Madison Heights, MI
800-334-1660, amtektool.com
- Jamestown Distributors, Bristol, RI
800-497-0010, JamestownDistributors.com

Focused on boats, I use them for epoxy and non-ferrous fasteners.

- Wood-Mizer, Indianapolis, IN
800-553-0182, wood-mizer.com

Local sawmills provide dimensioned green lumber used in workbenches. Call Wood-Mizer for the names of sawyers using their band mill in your locality.

- “Solar Drying Kiln,” PDF of my article in *Popular Woodworking*, December 2006, at ShakerOvalBox.com.

Shows you how to dry your own lumber.

These sources of hand tools provide catalogs that inspire:

- Lee Valley and Veritas, Ottawa, Canada, and in the USA
800-871-8158, leevalley.com
- Lie-Nielsen Toolworks, Warren, ME
800-327-2520, lie-nielsen.com
- Woodcraft, Parkersburg, WV
800-225-1153, woodcraft.com
- Garrett Wade, Cincinnati, OH

800-221-2942, garrettwade.com

■ Bridge City Tool Works, Portland, OR
800-253-3332, bridgecitytools.com

■ Japan Woodworker, Alameda, CA
800-537-7820, japanwoodworker.com

■ Highland Woodworking, Atlanta, GA
800-241-6748, highlandwoodworking.com

■ Traditional Woodworker, Richardson, TX
800-509-0081, traditionalwoodworker.com

■ Tools for Working Wood and Gramercy Tools, New York, NY
800-426-4613, toolsforwoodworking.com

The Home Shop



The Home Shop provides focus for projects, production, and sales in wood. Logs come in and lumber is dried in the unique solar kilns. Sheet copper is purchased and manufactured into tiny copper tacks needed for oval box making. Veneer is sliced and produced into bending stock for box bands. All in support of craftsmen worldwide who want to make historic Shaker oval boxes.

Friday afternoon often entails cleaning the shop and arranging equipment so that classes can be held on the weekend. That is when oval boxes, toolmaking and furniture projects are taught. This is no artificial environment, but a working shop with a staff willing to share their experience with others, and not just here in Charlotte, Michigan, but in a variety of venues around the country. See our web site, ShakerOvalBox.com, for more details on the production of the shop, the schedule of teaching events, and articles you can download from John Wilson's writing.

We welcome you to be a part of the Home Shop.





JOHN WILSON'S
MAKING WOOD TOOLS

John Wilson, a man whose work I admire very much.

Mike Dunbar, author

Make A Windsor Chair with Michael Dunbar

I enjoyed your workshop tremendously. It was one of the few woodworking workshops that I've come away from with the knowledge and confidence to complete projects on my own.

Frederick O. Quenzer, participant
Red Hook, NY

The travisher class was well thought out, and I came away with a tool I use all the time in my chair making. When it's time to make chair seats, I always reach past many manufactured shaves to grab this travisher first.

David Abeel, instructor
Windsor chair maker

John teaches on the road and at the Home Shop, a workshop and production facility in Charlotte, MI, that he founded to produce supplies for the oval box trade. An environmentalist (he built his own solar-powered kilns and shop), John always makes the most of materials at hand.

Christopher Schwarz, former editor
Popular Woodworking Magazine

John Wilson embodies the Shaker ideal of inspired woodworking. His thoughtful book of tool wisdom should be in every woodworker's library. He is one of the key leaders in woodworking today and this work shares valuable insight to better craftsmanship.

Scott Phillips, host of *The American Woodshop* on PBS



Hi John,

My name is Alexandra Wentzell.
I'm writing 4 him, 'cause he's
cooking dinner.

He wanted me to tell you he's
been a woodworker for many
years & has collected several
woodworking books. And is now
getting a good collection of
boat-building books. Yours -
by far - is on top of the list!
He also appreciates the old-fashioned
way of doing business.

Thank you!

Sincerely,
Alexandra Wentzell

Also by John Wilson

Making Shaker Oval Boxes, 1-hour Video 1989

Your Own Woodworker's Bench, Manual 1997

Building Sailor Girl with John Wilson 2004

Skaneateles Skiff No. 5, Plans 4 - 24" × 36" 2005

Making Wood Tools 2011

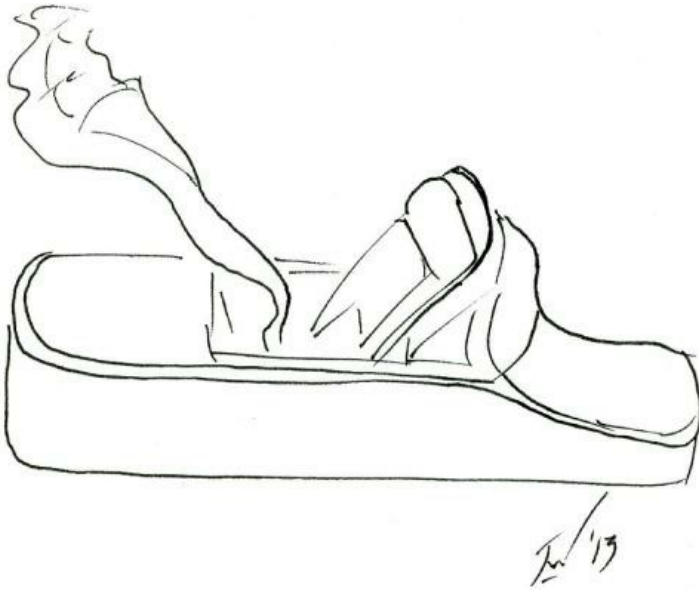
Dance Celebration: Alex (Tink) Wilson 2012

Making Wood Tools, Second Edition 2013

Oval Box Album, Vol. I 2014

Oval Box Making, Vol. II

Oval Box History, Vol. III



Home Shop Books

406 E. Broadway Hwy.

Charlotte, MI 48813

www.shakerovalbox.com

About the Author



Bits and pieces of my story are scattered throughout this book. For instance, telling about the shop stool as a badge of the journeyman carpenter as a 19-year-old in Cazenovia, New York. Seeing for the first time a wood block plane made by Adolph Peschke in St. Louis, which sparked interest in both making and teaching tools. Relating how the classroom at the Home Shop has been a proving ground in which to test the prototypes of wood tools and workbenches. All these are steps along the way to authoring this book on making wood tools.



My great grandfather, William Dexter Wilson, was an academic of some renown on the founding faculty of Cornell University (1867-1885) who authored some 16 books on Church history, philosophy, economics and jurisprudence. The lineage of teaching and writing goes back that far at least. Manual arts were not a part of his life, and presumably, he felt it a lack to rectify in his son. So he sent my grandfather as a Saturday learner to a cabinetmaker. My grandfather was rector of St. Mark's Episcopal Church, Syracuse, New York, and his carvings grace the altar and reredos to this day. His carving tools reside under my bench, though I have carved only two motifs: one in the headboard and one in the footboard of my bed in the little house next to the shop. I lived there for 12 years, and made oval boxes before the completion of the Home Shop. Still a

guest house for visitors, it is testimony to making shop space wherever you are. Teaching and writing, tools and wood, are all elements with a goodly heritage.

I was free to work in my father's basement work shop as it was a hand tool only environment, although I remember the purchase of his first electric drill. In this shop I was free to work as a child, presumably because my parents felt that pain would intervene before damage was done using hand tools. I learned from my father how to sharpen tools on an oil stone followed by a whetstone, and how to hand scrape a porch needing refinishing. I was provided with a good education concluding in a liberal arts degree from Carleton College (1962) and a graduate degree in social anthropology from the School of Oriental and African Studies, University of London (1964).

For a decade I taught anthropology at various colleges and universities, until the inability to complete the doctoral dissertation brought my college teaching career to an end. One door closed, another opened: residential construction, pretty much as a one-man business; teaching part-time as a woodworking instructor at Lansing Community College for 23 years; and the formation of the Home Shop in 1988. The mission of the Home Shop is to supply the Shaker oval box trade with all the materials and instruction needed to engage in this traditional craft.

Parallel to oval boxes are an array of projects and activities that spark my interest. Boatbuilding, furniture, and wood tools have all been on the agenda of workshops. Lacking dedicated teaching facility, all of these classes have been by necessity short in duration and focused in subject. Friday is a busy day finishing the backlog of orders for shipment, and this goes on until sweeping and rearranging the shop at the end of the day for the upcoming workshop. Constraints of time and space have served to distill class projects into focused entities. Many of these projects are the subject of *Making Wood Tools*.

The Home Shop

My commute through the drive gives me space to work. The Home Shop is represented at www.ShakerOvalBox.com.

The shop was completed May 8, 1988, in time for a celebration: the reception following Sally's and my wedding. The building was not yet a working wood shop with all the equipment that entails, so there was space to have a pot luck followed by a dance with piano and hammer dulcimer accompaniment. It was a celebration appropriate to the many good times people have joined together since, both as production facility and a classroom.



THE HOME SHOP exhibits the architectural lessons and quirks of a decade as a residential contractor.

Acknowledgements



To craftsmen past in whose footsteps we follow, whose skills we pass on.



To craftsmen today whom I have known and taught. These projects owe much to the inspiring proving ground of the classroom. With special thanks for teaching and project help from Keith Cole, Gil Chesbro, David Abeel, and Tod Herrli.



To the opportunity afforded by writing for publication, and especially to the editorial staff at *Popular Woodworking Magazine*, where some of these projects first appeared: Christopher Schwarz, Megan Fitzpatrick, Kara Gebhart Uhl, Linda Watts and Al Parrish.



To the Home Shop, my commute across the drive, which makes every day interesting, and to working with Eric Pintar, John Kellogg, Simon Porter, Dale Dodds, Pat Weston and all those others who make every day a pleasure.



To those who helped with this book: Lynn Fletcher interpreting my penned pages accurately, Jack Terry grooming my photos, Dusty Kuehner's gentle editorial suggestions, Kara Gebhart Uhl for proofreading, and Linda Watts, whose artistic templates pulled it all together.



To those at home where work and dreams are shared and find meaning: my children, David, Andrew, Molly and Will, and most of all, my wife, Sally.



Hand Adze: [Page 116](#)

Learn the process of making tools. This is more interesting than the tool itself. We can see and feel the tool, but process is the life that produces it. Focusing on process spares us from the tedium of material acquisition. It is the line between craftsmen and collectors.

— *John Wilson*

Making Wood Tools. Second Edition. Copyright © 2013 by John Wilson.

Print ISBN 0-9729947-5-0

eBook ISBN 0-9729947-9-3

This book is published as an outgrowth of the work and teaching at The Home Shop, Charlotte, Michigan.

Permission to use photographs from my articles published in *Popular Woodworking Magazine* is gratefully acknowledged. They are copyrighted by F+W Media Inc. Please note that these photos are not included in the Public Domain Statement below.

LIMITED PUBLIC DOMAIN STATEMENT: Permission is given to individuals to reproduce this book for their personal and their direct teaching endeavors by any means they wish. If any part of this book is used in a collected work, the statement “This material is in the public domain” must accompany it. The book or any major portion of it may not be reproduced for profit without the written consent of the author.

SOURCES OF SUPPLY AND PRICES are included even though they may be out of date by the time you read about the project. Magazine articles include such helpful information as a matter of course. Many publishers withhold such

information for reasons of timeliness and self-serving reluctance in offending sources not mentioned. However, I have included prices and sources to give some indication of what I had to work with in 2013. You can use it as a starting point for your search.

SAFETY NOTE: Besides the obvious cautions when using a torch to heat metal in the wood shop, there is one less obvious source of fire. Using a belt sander to sand tool steel blades gives off sparks that land in the sanding wood dust in the machine and on the bench/floor. The fine sanding dust is a place where such sparks can smolder and ignite. Keep all areas clear of wood dust.

The Home Shop
406 E. Broadway Hwy.
Charlotte, MI 48813

COVER: Cap and screw mechanism for adjusting jack plane. See page 43 for a description of how this is made in the wood shop.

BOOK DESIGN & LAYOUT: LINDA WATTS

Second Edition with More for You to Learn Making Wood Tools with John Wilson

"Veteran tool maker and teacher John Wilson brings us what may be both the most beautiful book of the year as well as the most useful. Interesting stories, innovative designs, and detailed plans."
— Chris Bagbee
Highland Woodworking News



PHOTO BY SCOTT PHILLIPS

Home Shop Books
406 E. Broadway Hwy.
Charlotte, MI 48813
www.ShakerOvalBox.com

Table of Contents

- [Making Wood Tools - 2nd Edition](#)
- [Title Page](#)
- [Contents](#)
- [Preface](#)
- [Introduction](#)
- [1 Making Planes & Other Tools](#)
 - [Block Plane](#)
 - [Chisel Plane](#)
 - [Compass Plane](#)
 - [Jack Plane](#)
 - [Shoulder Plane](#)
 - [Molding Plane](#)
 - [Scrub Plane](#)
 - [Large Compass Plane](#)
 - [Smoothing Plane](#)
 - [Spokeshave](#)
 - [Router Plane](#)
 - [Travisher](#)
 - [Hand Adze](#)
 - [Shop Drawknife](#)
 - [Scrapers](#)
 - [Cabinetmaker's Bow Saw](#)
 - [Carving & Layout Knife](#)
- [2 Blade Making Methods & Materials](#)
 - [Tool Steel & Blade Making](#)
 - [Making Band Saw Blades](#)
 - [Sharpening Tools](#)
- [3 Keeping Tools, Holding Work](#)
 - [The Home Shop Workbench](#)
 - [Saw Bench & Shop Stool](#)
 - [Work Horse for Dovetailing](#)
 - [Portable Dovetail Vise](#)
 - [Chisel Holder](#)
 - [Japanese Tool Box](#)
 - [Tool Tote](#)
 - [Carpenter's Tote](#)
 - [Boat Tote](#)
- [4 Design, Layout & Construction](#)

- [Design Elements of Wood Planes](#)
 - [Construction Steps](#)
- [My Sources of Supply](#)
- [The Home Shop](#)
- [About the Author](#)
- [Acknowledgements](#)
- [Copyright](#)

Table of Contents

[Making Wood Tools - 2nd Edition](#)

[Title Page](#)

[Contents](#)

[Preface](#)

[Introduction](#)

[1 Making Planes & Other Tools](#)

[Block Plane](#)

[Chisel Plane](#)

[Compass Plane](#)

[Jack Plane](#)

[Shoulder Plane](#)

[Molding Plane](#)

[Scrub Plane](#)

[Large Compass Plane](#)

[Smoothing Plane](#)

[Spokeshave](#)

[Router Plane](#)

[Travisher](#)

[Hand Adze](#)

[Shop Drawknife](#)

[Scrapers](#)

[Cabinetmaker's Bow Saw](#)

[Carving & Layout Knife](#)

[2 Blade Making Methods & Materials](#)

[Tool Steel & Blade Making](#)

[Making Band Saw Blades](#)

[Sharpening Tools](#)

[3 Keeping Tools, Holding Work](#)

[The Home Shop Workbench](#)

[Saw Bench & Shop Stool](#)

[Work Horse for Dovetailing](#)

[Portable Dovetail Vise](#)

[Chisel Holder](#)

[Japanese Tool Box](#)

[Tool Tote](#)

[Carpenter's Tote](#)

[Boat Tote](#)

[4 Design, Layout & Construction](#)

[Design Elements of Wood Planes](#)

[Construction Steps](#)

[My Sources of Supply](#)

[The Home Shop](#)

[About the Author](#)

[Acknowledgements](#)

[Copyright](#)