MAKING A Spokeshave

BY JOHN WILSON

WITH PROJECT DEVELOPMENT BY GIL CHESBRO

Make this tool in your workshop using scrap wood and a piece of tool steel.

If you have been reading these pages during the past few years, you have been introduced to the traditional spokeshave. I'm going to show you how to make your own. This means making everything from a shaped, hardened and tempered steel blade, to making the tool's wooden body with a micro-adjustable mechanism, right in your own shop.

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 rivals or surpasses 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 wheelwright in planing the transition from the square hub end of a spoke to the round. And, you can fit the wood sole of the plane in tight recesses if needed – just increase the angle of wood in front of the blade.

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" x 5⁄8" x 18", enough for four blades. The cost is less than $10. (I suggest ordering parts for several shaves while you are at it.) Tool steel is annealed when manufactured, meaning that it is soft enough (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° Fahrenheit (F) and 1,700° F. The duller color of cherry red is the desired temperature range of 1,450°F 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 also very brittle; it will shatter if struck with a hammer.

To restore the desired toughness, or ductility, the blade is then tempered in an oven that heats to 425° F, and then it is 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 patinas 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 long edge life.

Making the Blade

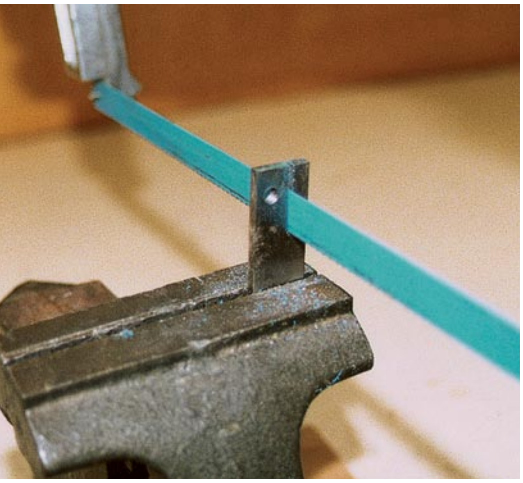
The steps for blade making are:

1. Lay out the shape and holes on the 01 steel.
2. Center punch the location for holes and drill with a #21 or 5⁄32" drill, and tap the 10-32 threads.
3. Hacksaw the blade to length and notch the ends.
4. Cut two pieces of 10-32 threaded rod to 1 1⁄4" long, which will serve as handles while grinding. Grind the bevel of the blade, leaving a small flat on the leading edge.
5. Harden the blade by heating the sharpened edge to cherry red (1,450° F - 1,500° F) and quench in oil.
6. Temper to light straw (425° F) in your 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. Attach the threaded rod permanently to the blade with cyanoacrylate (CA) glue.

You can follow these steps as illustrated in the drawings and photos. While 01 annealed steel is soft, that is relative to its hardened state. So you will find that starting with a new 24-tooth blade in your hacksaw is helpful. If you have not used a tap before, be careful; 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

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.*

LEAD PHOTO BY AL PARRISH; REMAINDER OF PHOTOS AND ILLUSTRATIONS BY THE AUTHOR



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

Shape the blade. *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.*

oil, will prevent breaking the flutes on scrap buildup.

When grinding the bevel, use two $1\frac{1}{4}$" pieces of threaded rod as handles, as shown at left. 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 $\frac{1}{32}$"-thick 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 (see "Heat Source for Making Blades," this page). Used alone there is not sufficient heat to fully turn the blade cherry red. What is needed is your own furnace.

Refractory brick can be stacked (as seen in the photo at far right on the next page) to shield the blade to conserve heat. Fire brick at $2 each 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. 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 is used for the outside. One pop rivet in the bottom holds 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

Heat Source for Making Blades

Hardening the 01 tool steel for a blade requires a heat source to make it cherry red, or 1,450° F to 1,500° F. Finding the right source involves safety, affordable cost, availability and effectiveness. Balancing these is what I want to share with you.

I have used a charcoal grill as a small forge with success, although to be effective you need to rig up a blower to intensify the heat. A hair dryer with a length of flexible steel tube can do this. For safety, and to avoid smoke nuisance, this needs to be done outside. Now you have to know how to gauge the color of hot steel. Cherry red indicates the right temperature when seen in the dim interior of the old forge, and not out in bright sunlight. Be cautious not to overheat the steel when outside. The requisite temperature of 01 tool steel means that heating above 1,500°F will not make it any harder; it will only create coarser crystalline grain structure and damage from loss of carbon.

Speaking of adding oxygen to fuel to intensify heat, bottled oxygen and either acetylene or propane are standard for farming, auto repair or machine-shop work. It is an excellent heat source for making blades as it gives abundant heat, is well focused and easily turned on and off. While the torch and regulators can cost as little as $100, you may be surprised to find each gas tank can cost $250 to buy, while refilling them after the initial charge is only $20 to $30 each. Propane is a viable alternative to acetylene by simply swapping the torch tip size, and avoids the cost of one tank charge by using the standard 25-pound propane tank sold for outdoor grills. Be sure to seek help to learn effective and safe usage for this.

The most accessible heat source these days is the small gas torch used for home repairs and plumbing. A 16-ounce bottle of fuel and torch are less than $50. No tank buying is involved as bottles are not refillable. However, buying the right torch to get enough heat to do the job is the problem. There are two kinds of fuel: standard propane and MAPP gas that burns 200° F hotter. We ran tests on this and found that burning temperature was only one factor; the other was quantity of flame. Many torches have a small output that will not heat a sufficient area to do the job, whether using propane or MAPP. Larger volume torches work when using a simple heat-conserving forge as described in the article (with either MAPP or propane), but the MAPP is faster and also could surpass the cherry-red stage advised for 01 tool steel.

BenzOmatic torches (series JT, BT and TS) all have a brass regulator valve with a side-mounted burner tube that delivers enough flame to do the job. In one case we used the BenzOmatic TS99 (Lenox also has a similar model, #LS10) which has a plastic handle with electronic strike in line of the burning tube (see photo at top right on the following page) and found the plastic melted from the intensity of heat in the furnace. A small metal shield with a $\frac{1}{2}$" hole for the burner tube to slip through served to save the plastic handle, but one of the company's other models without the plastic handle would be my first choice.

The right small torch to harden the tool steel and a toaster oven for tempering your blade will set you up to make woodworking tool blades. — JW 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 usable for wood. You can also use higher-grit belts.

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 425° 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. If there is nothing yet, turn up the heat to 425° F and watch it. When done, allow it to cool slowly.

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

Heat the blade. *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 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 (see "Heat Source for Making Blades" on the previous page).*

Inexpensive furnace. *The 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 1/2" hole in the center through which to pass the flame tube.*

Temper the blade. *Heat treating consists of hardening by heating tool steel to about 1,450°–1,500°F (cherry red) and quenching it in oil. The unwanted brittleness from this step is removed, or tempered, by reheating to 425°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.*

Sharpen and lap. *Final sharpening is done now before securing the threaded posts. Lap the back as well.*

and made softer than desired at the point hardness is needed most – on the cutting edge.

Making the Wood Body

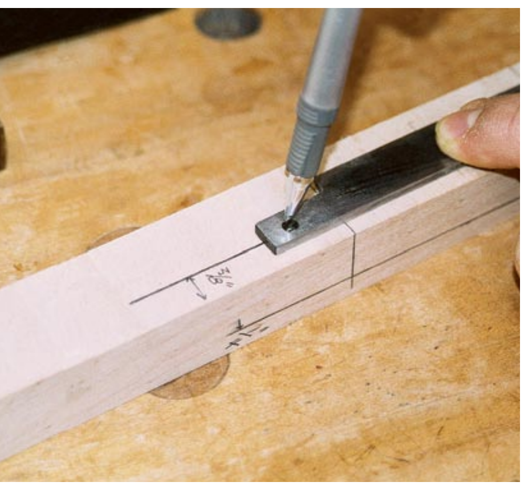
Using a piece of hardwood, such as hard maple, cut a blank 7/8" x 1 1/4" x 11 1/2". Study the plan to identify which sides of the body into which the blade is to be recessed and where the throat is cut out. The picture below illustrates the layout of the blade for locating the holes for the threaded posts. Use a drill press to make the 7/32" holes.

Thread the posts into the correct side of the blade (opposite what is used when grinding and shaping the blade) and insert the assembly into your wood blank. Mark the location of the ends of the cutter, then extend those lines 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. Remove the waste with a chisel.

The tangs of the blade are recessed using a 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.

Micro Adjustment

Adjustment for blade exposure is accomplished by leveling screws under the blade. Two methods are possible. One uses #6 x 1/2" flathead wood screws. Adjustment is made by removing the blade and changing the screw depth with a screwdriver. The other option uses a 6-32 set screw adjusted with a small hex key as shown in the drawing on the next page. Drill a 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 screwdriver is more likely. However, you can store the 1/16" Allen wrench in a 11/16" hole drilled into the handle end, and keep it from falling out by adding beeswax to the hole.



Body layout. *Laying out the wood body. The position of the throat and rod holes are marked, with the blade used to center the hole. Use 7/32" bit in drill press for accuracy. (Follow plans for all layout dimensions.)*

Clamp to cut. *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 chisel.*

Chop recess. *Now clamp the body flat on your bench to chop recesses for the tang end of blade. Here, a piece of scrap steel bit is used as a gauge for how deep to chisel.*

Bevel screw holes. *Leveling screws are put into the tang recess to control blade exposure. The flathead #6 x 1/2" screws need the holes beveled for the flat head. A 3/8" drill bit, hand twisted into the shank hole already drilled, will achieve the necessary bevel.*

Bevel blade approach. *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.*

Rough out the handles. *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.*

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, and 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 the excess 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.

Handles and 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 outline, 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" x 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.

Set the posts. *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).*

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. **PW**

John is the founder of The Home Shop (ShakerOvalBox.com), in Charlotte, Michigan, which produces and sells supplies for making Shaker oval boxes.

Supplies

Any Hardware Store

2 ■ flat head wood screws, #6 x 1/2"

or

2 ■ set screws 6-32 x 3/8"

1 ■ 1/16" hex key

1 ■ 6-32 tap

1 ■ 10-32 tap

Reid Supply Co.
800-253-0421 or reidtool.com

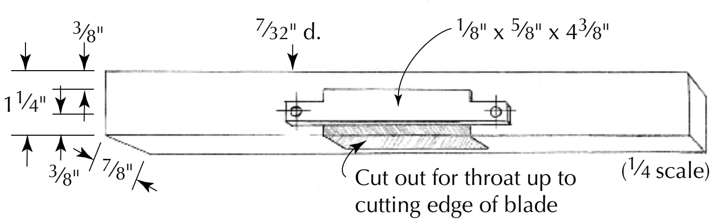
The minimum length of tool steel flat stock is 18", or enough for four blades. Therefore, you may wish to order enough parts to do four shaves.

1 ■ flat stock 01 steel, 1/8" x 5/8" x 18" #SFS-54000, $6.73

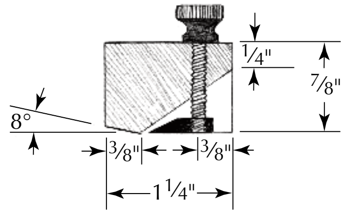
2 ■ brass knurled, 10-32 nuts #AJ-718, $1.68 each

1 ■ threaded rod, 10-32 x 36" #TR-57, $3.65

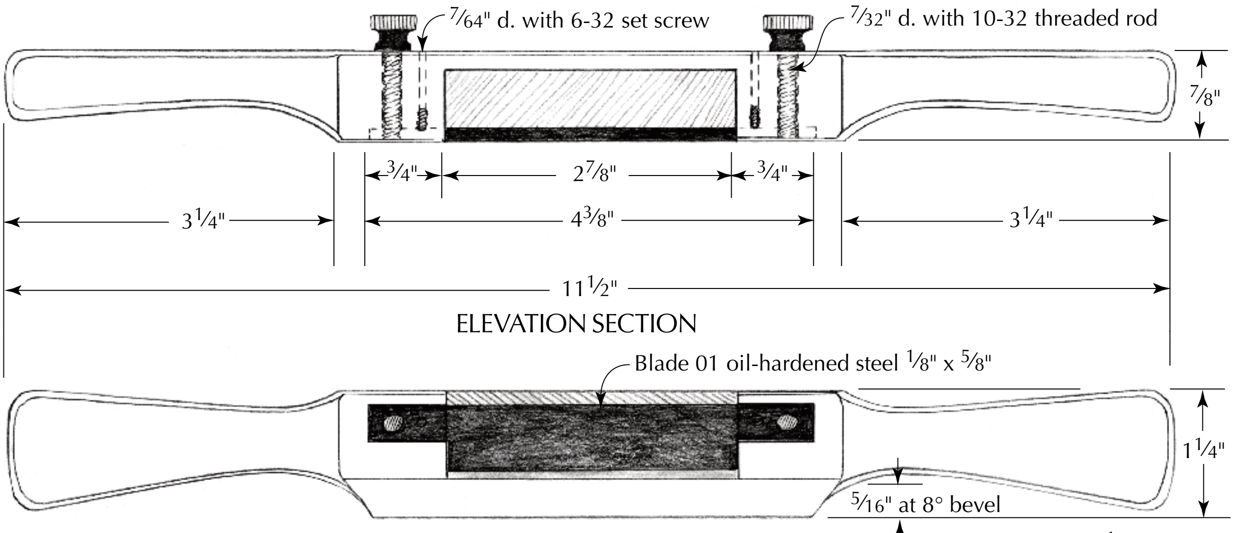
Prices correct at time of publication.



HOLE LAYOUT



PROFILE SECTION



PLAN

(1/2 scale)