

Building Shaker Oval Boxes

by John Wilson (ShakerOvalBox.com)

There was a time when households had few belongings, when clutter from too much stuff was not an issue. Basics such as matches, glue powders and paint pigments, and sugar, coffee, tea, and spices needed containers. Before the age of canisters and Tupperware, the Shaker craftsmen made and marketed their oval boxes.

The place for boxes in the home has changed throughout time. Modern metal and plastic containers have displaced the traditional preeminence of wooden boxes in the pantry. Today they are more often seen on the coffee table in a more decorative setting. Along with the change in use has come a change in finish so that varnish rather than paint is preferred. Cherry is more common for bands than plain maple. Yet this is still a box for all occasions, utilitarian as well as decorative. Its charm and grace make a difference whatever role it plays.

These beautiful boxes were first made from hard maple and white pine. In an age before machines, thin wood strips were rived from a straight billet of wood and made ready for bending by hand planes and scrapers. Hot water soaking makes this sturdy wood pliable, and bending gives us a complete oval shape in a single motion. Tacked and made secure by oval shapers, this efficient process impresses me every time I do it.

John Wilson first saw oval boxes 25 years ago as a woodworking instructor at Lansing Community College in Michigan. Besides teaching and selling his boxes, Wilson founded The Home Shop to produce supplies for the oval box trade worldwide. This article is reprinted with permission from Popular Woodworking, Issue #135 (August 2003), pp. 32-41. Updated April 2006.

Try this traditional bent wood craft for a project that is attractive, useful, and easier than you might think.

The Search to Find Wood That Bends

We are not likely to go to the wood lot for a straight grained section of log to split stock for bands. Few of us have a wood lot near by, and technology has separated us from skilled hand-tool use. But the need for bendable wood to flex around the box core remains the same. This capacity to flex is not always apparent in wood. While straight grained stock is the place to begin to look for bending material, brittleness can cause the best looking piece to snap. One condition that causes brittleness is drying out. It's a consequence of the fact that we live some distance from the wood lot. Green wood, which bends best, isn't readily available.

In your search for materials for bending wood you will find hard maple a good species. Cherry, while it makes as fine a box, is prone to changes in growth direction and unexpected brittleness. I sometimes imagine Shaker craftsmen watching my frustration with ornery cherry boards and sighing, "Ah, the price of vanity. Stick to the utility of maple, and it would go well."

Strange as it seems, the same thing that make for suppleness in the human body (age and nutrition) apply to wood. Freshly cut boards do better than old dried ones. Also, the conditions of favorable growth will yield better results. Ample nutrients and sunlight make



Photo 2: Resaw Jig

Resawing on the band saw can handle stock of 6" or more depending on the capacity of your machine. The resaw jig guides the cut. Clean up the board's sawn edge between each cut to give one smooth side. A drum sander gives a finished face to the sawn side. The blade shown is a 1/4" Timber Wolf four-teeth-per-inch band that's used for general work in my shop. Others prefer a silicon-carbide hook-tooth 1/2" or 3/4" blade.

for faster growth as evidenced in wider annual rings. This is a favorable sign in selecting wood for bending. And, of course, straight growth, and not picturesque knarled figure, is ideal.

Cutting Band Stock

Where will you find such wood for your box bands? The wood you use may be recently cut for firewood, or you may have luck with an old board of unknown species. The real test is to try it. Dimension a piece and slab off thin bands on your table saw

or band saw. The photos #1 and #2 show it being done. The table saw needs a zero-clearance insert to reduce the gap next to the blade to prevent the thin band from disappearing down the slot. Avoid short stock. Small box bands 12" to 20" long cut more effectively and safely when sawn double length 24" to 40" long. The blade is the

key. I use thin kerf 10" 40-tooth blades with alternate top-bevel design. Try a new blade to see what factory sharp can do.

When the table saw, blade and wood are in sync, the result is a finished band ready to use with little or no sanding.

The band saw needs a steady rest as a guide for thickness. A sharp blade is important here as well. I use a 1/4" 4 tooth per inch Timber Wolf. Others prefer 1/2" or 3/4" carbide tipped blade for their band saw. A thickening drum sander will reliably finish the band to specifications given in the table on page 40. The planer may not work well for thickening because of the thinness of the bands. They can catch in the blades and shatter. When planing just a few bands, try sticking them on a shooting board with double-stick tape to stiffen them.

However you cut your wood, be patient and be prepared to try again. You can get a feel for flexibility in the wood as it comes off the saw. I heat my shop with what doesn't work.

Sliced Veneer Stock

Veneer is another source for bands. This is wood dimensioned by slicing at a veneer mill. It is an efficient use of the best grade of logs as there is no saw kerf waste. Successive



Photo 1: Table Saw

The table saw is my tool of choice for resawing bands up to 3" wide, although things slow down appreciably when nearing the capacity of the 10" blade. A sharp blade is a must. The zero-clearance wood insert shown here will prevent the thin wood from dropping through the table. When your setup is cutting effectively, there is little sanding required.

sheets of uniform thickness make it attractive. Great quantities are sliced for the furniture trade for high quality face veneers.

Most of this is cut to 1/42" (.024") thickness making it too thin for our use in boxes. The other common thickness is 1/16" which works for smaller boxes, and you can expect reasonable bending results from hard maple. (One commercial source is Constantines: 954-561-1716 or constantines.com.)

When the log is sliced, the knife leaves one side of the veneer with slight crack lines. This "open side" face needs to be inside the box when bent. Otherwise, the surface will be rough and could splinter. Gently flexing the veneer prior to preparation for soaking may reveal a side with these slight crack lines. Placing in water will always show this. What happens is the wood takes a slight curl across the grain when wet. The rule is this: The inside of the curl is the outside of the box.

I have built my business during the past 20 years on meeting the needs of the oval box trade (ShakerOvalBox.com). I use veneered band stock selected and dimensioned specifically for bending. While I welcome your business, I know that cutting bands in the manner described above can be both rewarding and of high quality. For instance, there is no bias side in sawn band stock. Many of you have the capacity to do your own cutting. It is worth the effort. Try widths of 2" and narrower that cut easily on the table saw. Wider stock has been known to be more difficult.

Top and Bottom Boards

The other materials needed for box making are the oval boards for the top and bottom. These are 1/4" to 7/32" thick and not bent. Unlike the stock for the bands, this material is readily available. The oval shape sets off some interesting figure and features. It is an opportunity to use small sections of boards that accumulate from other work.

The one factor you need to consider in tops and bottoms is wood expansion. If the oval board expands too much in humid weather, the band will crack. Breakage is serious stuff, and is ever present in a box. The larger the box size, the more likely it is to occur. The reverse of this is the board drying out after you make your box. That will result in gaps where it meets the band, spoiling your nice tight fit. Where possible you want quartersawn stock to minimize the future effects of humidity change.

One solution to wood movement in larger box sizes is to use plywood. The cross banding of alternative plys stabilizes the wood. For appearance sake, pick plywood without a joint in the veneer face, and be careful not to sand through the very thin face veneers.

It is also a fact that different tree species expand and contract differently. Softwoods are more stable than hardwoods. The Shakers used quartersawn eastern white pine because it is a very stable cut of wood. You can find a table listing wood behavior as moisture changes in R. Bruce Hoadley's "Understanding Wood" (Taunton). Based on variation in species movement, I opt for plywood when maple tops and bottoms reach 7" wide, cherry at 8" wide and pine at 12" wide.

Whatever your species and growth orientation, be sure the moisture content of tops and bottoms are similar to the inside environment of your home. If you are uncertain of that, and do not own a moisture meter, never fear. Boards 1/4" thick will adjust to your home's humidity level in a few days. Bring the top and bottom boards inside before you make your box and expose all surfaces equally for a few days to allow this to happen.

Setting Up Your Bench

To dimension bending stock and top and bottom boards as described above takes the resources of a full shop. Many craftsmen choose to purchase dimensioned materials and thus simplify their operation. The equipment and shop space to do the actual box making is quite modest. Even those without access to a wood shop can do it.



Photo 3: Finger Pattern

Profile the finger design to rough dimension before final trimming with a utility knife. The locations for copper tacks are drilled at this time, too.

I have always used a combination of hand and power tools. Standard floor-model sized machines are fine, but smaller ones work well. A 10" band saw and a 4" x 36" belt sander with 6" disc, both bench top machines, are suited to box making. An electric drill rounds out the power equipment. If you wish to do the cutting, shaping and drilling all by hand, that should not be too much of a challenge either. After all, original boxes predate these modern conveniences.

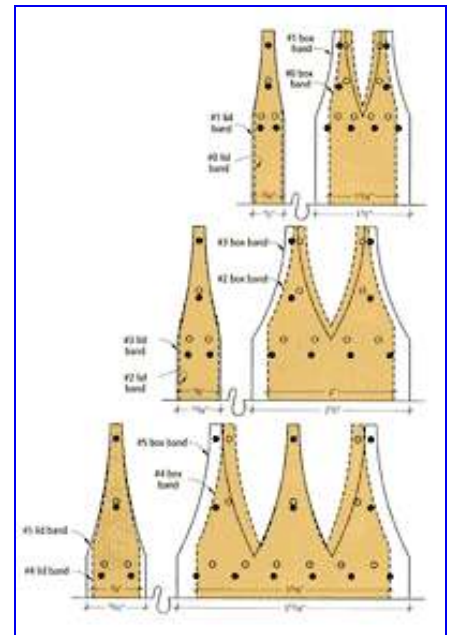
To set up your shop for this project you need a few jigs that are easy to make or find. You need a

tray for soaking the bands. Normally, it needs to be long enough to fully immerse the largest size, 32" for the #5 box.

However, alternating ends for soaking can allow you to get by with something shorter. Box makers traditionally use hot water for this process. The alternatives to hot water are cool water and steam. All three methods work, but there are some differences in technique that go with each.

If you are already set up for steam bending, then by all means use it. If you can obtain a metal tray at least 4" x 32", then you are ideally set for hot water soaking. Set the tray on a stove or electric hot plate with stabilizer blocks under each end (photo 7). A length of steel gutter (the modern flat bottom style) with end caps attached together with a 3/4" plywood cover will serve for this.

When hot water is used, soaking takes 15 minutes. The wrap itself goes quickly with a few motions round the core.



Full-size patterns of fingers on box and lid bands



Photo 4: Trim to Finished Shape

My preference for trimming is a utility knife with a fixed, not retractable, blade. This gives the necessary control. Use heavy-duty blades, not the lighter ones that come with a new knife.



Photo 5: Feathering Band Back

The inside end of a band is feathered back 1" to 1 1/2" depending on its thickness. This will provide a fair curve to the inside of the box.

Cool water will be the option when neither the above are available, as you can co-opt the bathtub. Understand that flexibility comes from both soaking and heat, and when only one condition is involved, as in cool water soaking, you must allow 12 to 24 hours of soaking and use more finesse when bending. A forward then back motion to bending in small increments as you go around the tight end of the oval will flex the wood under circumstances such as this.

When tacking the lap, you will need an anvil for clinching the points of the tacks. This can be made from an 8" length of 1" or 1 1/4" galvanized pipe bolted to a wood cradle and clamped to your bench (photo 9).

Cores and Shapers

In addition to a soaking tray you need a set of cores and a set of shapers. The core is a wood plug the size of the inside of a box. The hot, wet band is bent around it (photo 8). Made from soft wood (2" foam board can be used), they are created using the oval patterns at right.

The shapers are the key to Shakers box production (photo 10). You will need a pair for each box made at one

soaking. If you wish to make five of one sized box, then 10 shapers are needed. The alternative is to bend on five successive occasions, which is a lot more work than making a few extra shapers. They are made to the same oval pattern as the cores, only they have a 10° beveled edge to act as corks in the oval opening. Cut them slightly oversized by cutting 1/16" outside your pattern line. Drill holes for ventilation and to allow you to grab them for removal after the band is dry. The wood for shapers can be solid or ply, and the thickness varies. The smallest ellipse is 1/2" thick, mid-sized 5/8" thick, and



Photo 6: Bench Sander Tapering

The 4" x 36" bench sander sees a lot of use when I make a nesting set of five boxes. Here feathering the end of the band is controlled by a wood block to ensure a gradual taper.



Photo 7: Hot Water Tray

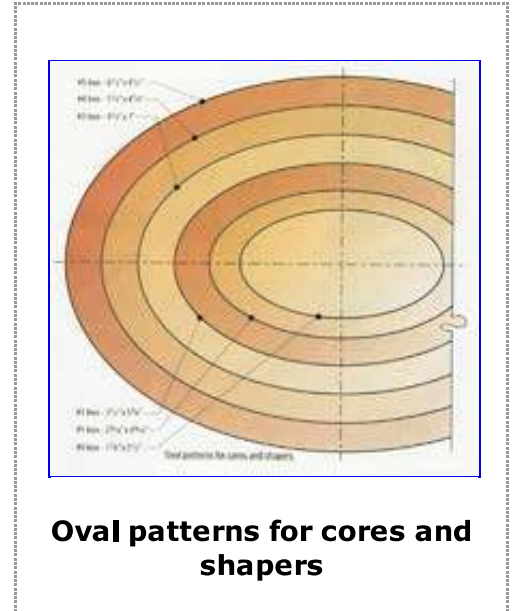
The band has been feathered on one end and the fingers are trimmed and drilled on the other. The hot water tray has an electric hot plate with wood blocks under

each end for stability. While a full boil is not necessary, water more than 180° will effect a softening of the lignin.

sizes #5 and larger use 3/4" stock.

Preparing the Box Band

Now you can begin the box-making process. Cut and drill the bands for the fingers. Photo 3 shows the band marked according to the finger pattern for shape and location of the tack holes. The locations of the copper tacks are drilled with a 3/64" or 1/16" drill. The swallow tails, as the Shakers sometimes referred to the fingers, are cut on a band saw, or this can be accomplished completely with a knife. The rough shape is trimmed (photo 4) to the graceful proportions of the finished box. There are three elements to this shape: narrow width, slight bevel to the edges, and a curved, gothic shape. I mention these because almost everyone starts by making the fingertips too blunt and too beveled—losing the graceful curve of the pattern in the process of trimming. The fingertip needs to be only slightly wider than the diameter for the copper tack head. This will make wrapping, tacking and drying go well, and achieve a more Shaker look. The beveled edges are trimmed to a slight 10°, not approaching the 45° commonly cut by novices.



Oval patterns for cores and shapers



Photo 8: Bending Oval Band

The wet band is wrapped around a core the size of the box. Here the wrapped band is being given a pencil mark so that the core can be removed and the band returned to the proper size. Note that both fingers are held to prevent splitting between them. The mismatch of the band is common at this stage and will be made even when tacking.

Now you should feather back the inside end of the band 1" to 1½" depending on the thickness of the band stock (photo 5). The sander with a block of wood to hold the veneer evenly is used to taper the end (photo 6).

When the band is trimmed and feathered, place it in hot water to soak (photo 7). Water hotter than 180° F will soften the lignin in wood fiber that allows it to be bent. Upon drying it will hold the new shape. Soaking for 15 minutes is sufficient for ordinary bands. However, double that time for very small box sizes with a tight curve, and for troublesome bending stock.

Bending the Oval Band

Your soaked band will cool quickly once it is taken from the tray. When this operation goes in a smooth even motion, band breakage is minimized. Your core will need a pencil mark where to start the feathered end of the band in bending. This is how you find that mark: the major tack line is centered in the front of the oval. The start mark is left of center. How far left? It's the same distance as the measurement between the main tack line and the tips of the fingers.

Copper tacks clinch the band. No glue is needed for this efficient fastening. The tacks are 1/16" longer than two layers of veneer. So two or three sizes of tack are used

for this set of boxes, which has thicker veneer for the larger sizes. Have your tacks, anvil, hammer, a pair of shapers and a core ready when the band is taken from the hot water.

The central operation of all box construction takes but a few seconds. In one smooth sweep, hold the feathered end at the start mark and bend half way around. Change hands, hold and complete the wrap. Pencil a mark across the veneer lap to register the circumference. Photo 8 shows this step completed. Hold both fingers securely at all times to avoid splitting the wood between them. Do not worry about having the edges exactly even or main tack line centered at this stage. Both of these come next.

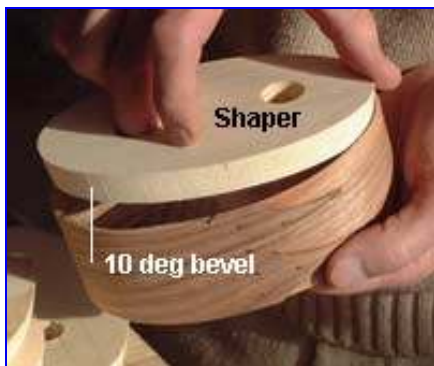


Photo 10. Shapers Hold Oval Box

Once tacked, wood corks called shapers are put in both sides to hold the box shape for one to two days of drying. The 10° edge bevel and the holes for ventilation are a hallmark of this piece of bench equipment that is key to the Shaker system of production.

the bands.

The lid band, which went in to soak along with the bottom band, is next. It is bent on the box itself, which acts as the core (photo 11). Size, alignment and centering are observed for this band as well. When tacked, the lid band goes in place with the fingers pointing the same way as the bottom fingers (photo 12). The first half of box construction will be complete when these two bands have thoroughly dried, in one to two days. Allow for normal air flow around the box. Avoid using extra heat, direct sun, or fan blowing. Drying too quickly can result in the veneer warping.

Open the band slightly to remove the core. Bring the band together to meet the pencil mark. Here is where you align the edges of the lapping band. Then tack the lap (photo 9).

The last step is to place a shaper in both sides of the oval band. These can be rotated if needed to bring the main tack line into the center of the oval. The band is pliable while wet, so you can rotate the shaper. Match the second shaper with the position of the first to avoid a skewed band. Be gentle in entering the shaper and do not push too hard because this will flare the edges of



Photo 9. Clinching Lap with Copper Tacks

Small copper tacks 1/16" longer than the two thicknesses of veneer are used to clinch the lap. No glue is used. The wood cradle secures the pipe anvil to the bench.



Photo 11. Lid Bent to Box

The top band is wrapped on the box itself. It will be tacked and then returned to the box for drying. Note that the direction of the finger matches the bottom band fingers.

Fitting Oval Tops and Bottoms

The oval boards to complete the box are 1/4" thick for mid-sized boxes, and 3/16" and 7/32" for the two smallest boxes.

Draw the oval by using the dry box band as the pattern. Remove the shapers and give the inside a light sanding. Use



Photo 12. Drying Oval Box Half

The construction of an oval box is half completed when it is set aside to dry for one to two days.

to be traced out, it is in the opposite position from where it is in place on the box. Check it out in position on the box to make sure that you have the right finger direction to match the bottom.



Photo 14. Disc Sanding to Pattern Line

The disc sander finishes the edge

Fixing Mistakes

You might find two kinds of repairs helpful in your work, each using their own kind of glue. Wet bands that split can be repaired with cyanoacrylate (like Hot Stuff Original) two-part glue because it works on wet wood. The advantage of this is that any repair will hold the pliable wood before it dries. Minor gaps found around the edges of the oval board can be repaired with carpenter's glue. Wipe glue into the gap and sand immediately. The sander dust loads the wet glue, giving a matching glue line. Unlike cyanoacrylate that remains clear under varnish, carpenter's glue must be removed from the surface before finishing.

a mechanical pencil for an accurate line around the inside of the oval band. Now determine the direction of the fingers. It's up to you. Historically most boxes were pointing right, but significant numbers were lefties. In either case, both top and bottom bands should match.

Getting the top band finger direction to match that of the bottom band can be troublesome. The reason is this: When the lid is laying on the bench



Photo 13. Tracing Oval Top

Here I'm tracing the oval on the 1/4" boards used for tops and bottoms. A mechanical pencil will ensure accuracy of this line.

After band sawing the oval, sand the board up to the line on the disc sander (photo 14). This is not a right angle, but has a slight bevel to give it a cork effect. To get this, adjust the disc table up 4°. Most sanding machines aren't designed to do this out of the box, but you can easily file the slide that adjusts the table to allow it to tilt up the 4°. Insert the oval board against the front edge first (photo 15), then press in the back. This avoids catching the feathered end of the band, which can be damaged. Press the board into the oval band until it is even or slightly below the band all the way around. Sand this joint line flush. Now repeat these steps for the lid section.

Wood Pegs Hold the Boards

up to the pattern line. The sander table is elevated to 4° to provide a slight cork effect to this ellipse for a tight fit. To make this adjustment, you may need to file out the slide slot so it no longer stops at 0°, or you can remove the thumb screw and use a small C-clamp.

Once the oval boards are in place and the joint sanded flush, it is time to drill for wood pegs. These holes center on the ¼" top and bottom boards, and are placed 2" to 3" apart around the edge. They keep the oval boards in place. It takes a 5/64" hole

drilled ½" deep. Two jigs are shown for insuring that you do not miss the edge of the boards.

Photo 16 is a small drill held down with a wood yoke to create a horizontal drilling jig. Photo 17 shows an adaptation for a drill press using a right angle clamped to the work surface. It drills in the vertical mode.

The wood pegs can be split off a thin cutting of wood. However, in my shop, hardwood toothpicks made by the World's Fair Brand Co. serve for pegs. Cut the box in half on the band saw to double your count of pieces at just



Photo 15. Inserting Oval Board

The oval board is fitted into the bottom by setting it against the front lap and then working the back into place. This will ensure that the feathered end will not be damaged in the process of pushing the oval.



Photo 16. Drilling Perimeter for Wood Pegs

After the oval board is in place and sanded flush, drill the perimeter every 2" to 3" for wood pegs. This drill jig locks a spare drill to a board with a front table the right height to center the hole on the ¼" board inside.

the right length. Tap the pegs in securely (no glue needed) and snip off with wire cutters (photo 18).

With the pegs in place, sand the surfaces of the box (photo 19). The finger lap is one area I do by hand to insure that the curved finger design retains its full relief.

Finishing the Oval Box: Paint vs. Varnish

Boxes need a finish coat on the outside for protection, but remain plain wood on the inside. The reason for this is the neutral nature of wood. Just like the insides of bureau drawers, you do not want the odors from oil or paint finishes to affect food or cloth.

Historically, boxes were painted before the mid-1800s, and clear finished after that. Paint was made locally from lime, clay, milk and pigments. Recipes for finishes were a shop tradition. Interestingly, craftsmen of old did not remove the lid when painting the box, so

that original boxes show a narrow band of plain wood around the top edge. This may be due to the possibility of a lid sticking to the home made paint.



Photo 18. Inserting Wood Pegs

Wood pegs are made from cutting in half the box of World's Fair Brand toothpicks. The tapered end to these match the 5/64" hole for a secure fit when tapped in place.

What do I recommend? First, if you do paint, take the lid off and save yourself the trouble of having to explain "incomplete" outside painting. Second, leave the inside plain. Third, use whatever finish you like, have on hand and are familiar with. There is nothing that is all that special about a box finish that should keep you from getting it done.

The little #1 box with red paint (shown on the cover) was finished with one coat of latex flat paint, followed by sanding with 220 grit sandpaper. This will accent the edges of the

oval and finger area, and reveal the copper tacks. The new paint is finished with Kiwi brown shoe polish! That's right, I call it old-time patina in a can. Rub it on and brush it off. Note of caution: Try a sample of whatever wax finish you use before doing the box to insure that the solvents in your wax do not "pucker" the surface of the paint.

Clear finishes come in a variety of forms: shellac, varnish, lacquer, oil and blends of several of these. Some are brushed, some wiped on. Each has fans. All work. Your choice. For myself, I prefer a quick dry polyurethane for durability in areas where water spatter is likely, such as in the kitchen. This can be brushed on from the can, or mixed 50/50 with painter's naphtha (a form of paint thinner) to make a wipe-on finish that avoids the nasty habit of varnishes getting runs or drips. Sand between coats.

Conclude with a rub on brown paper sack. This is an old painter's trick that has been known to really work - simple, available, quick, and effective. Open a grocery sack - the kind the bag boy used to put your groceries into, remember? - so the inside is lying flat open. You want to avoid rubbing on the ink printing on the outside lest it transfer to your fine finish. I have a piece of 1/4" foam (used for carpet underlayment) under the paper to avoid encounters with grit on the bench that pokes through the paper. Then rub top, bottom and sides. Takes



Photo 17. Alternative Drilling Method

An alternative drilling method makes use of a drill press. The jig, which I call a bookend, creates a vertical drilling station.



Photo 19. Final Sanding

Final sanding is done with a 120-grit belt replacing the 80-grit one used for shaping wood before.

less time to do it than reading about it, and it gives your box a smooth, burnished feel.



Photo 20. Signing Your Work

In this industrial age, craft work is highly valued. Sign your box with pride.

Sign and Date Your Creation

When the finish is done, you want to sign and date your handiwork. Did the Shakers sign their boxes? Yes and no. There was a feeling at times that the community was paramount and individual expressions of ownership inappropriate.

But there are many examples of boxes that were signed, and many of these were given as gifts, just like yours may be. I think it is a nice touch in this age of mass production to have your individual creation labeled with your own signature and date.

Having finished your first project, be aware that you will receive both compliments and

longing eyes directed to the oval boxes. There is no project in my experience that has such universal appeal as a Shaker oval box. Watch out, you may find yourself joining the ranks of box makers! **PW**

Supplies

One of the nice things about making Shaker boxes is that woodworkers of any skill level (even non-woodworkers) can complete a nest of boxes with a few tools.

The author of this article, John Wilson, purchased tack-making machines from the W. W. Cross Nail Co. when it ceased production in 1991. Their production in his shop ensures that oval box makers will continue to be supplied with the signature tacks. A "Tac Pac," which includes a variety of common tack sizes, makes 130 boxes and costs \$12 (\$15 postage paid).

You also can purchase presliced boards in cherry or maple, and tops and bottoms in cherry, pine, lacewood (quarter-sawn-sycamore) and bird's eye maple. A set of five box bands (enough to make a #0, #1, #2, #3, and #4) are \$16 for cherry or maple. The five tops and bottoms in either species cost \$16.

To make your setup even easier, Wilson also sells cores, shapers, patterns for the fingers, copper trays for the hot water and videos.

Wilson also teaches classes on Shaker boxes and other woodworking topics.

To see a full selection along with a class schedule, you can download his catalog at shakerovalbox.com. You can contact him at:

The Home Shop
 406 E. Broadway
 Charlotte, MI 48813
 517-543-5325
 (8:30 a.m. to 5 p.m. Monday through Friday, EST)

Readers wishing to pursue this further will be interested in Wilson's forthcoming book "Shaker Oval Boxes" to be published by Home Shop Books and Videos.

Shaker Oval Box Specifications

Box Size	Copper Tack Size *Notes 1 & 2	Band Thickness *Note 3	Bottom Band Width X Length	Top Band Width X Length	Ellipse Width X Length	Top & Bottom Thickness	No. of Fingers & Length to Tack Line
0	1	.062"	1 1/16" x 11 7/8"	7/16" X 12 1/4"	1 7/8" X 3 1/2"	.195-.210"	2 - 1 3/8"
1	1	.065"	1 1/2" X 15"	1/2" X 15 1/2"	2 9/16" X 4 9/16"	.210-.220"	2 - 1 9/16"
2	1 1/2	.070"	2" X 19"	5/8" X 19 3/4"	3 1/2" X 5 3/4"	.235 - .250"	2 - 1 13/16"
3	1 1/2	.075"	2 1/2" X 23"	11/16" X 24"	4 1/2" X 7"	1/4"	2 or 3 - 2 1/16"
4	2	.080"	3 1/16" X 27"	3/4" X 28"	5 1/2" X 8 1/4"	1/4"	3 - 2 1/4"
5	2	.085"	3 11/16" x 31"	15/16" X 32"	6 1/2" X 9 1/2"	1/4" X 5/16"	3 - 2 7/16"

***NOTES: (1)** Leave 1/16" exposed end of tack inside, tap to clinch. The #1 tack = 3/16" long, #1 1/2 = 7/32" long, #2 = 1/4" long. **(2)** Use 3/64" or 1/16" pilot hole for #1, #1 1/2 and #2 copper tacks. **(3)** Band thickness is in thousandths because these small differences are impossible to read with a tape measure and a difference of as little as .006" will change the wood's bending properties; larger changes (0.15") can require you to use longer tacks. Purchase an inexpensive steel dial caliper (Grizzly sells a 4" caliper for \$11.95; item # G9808; call 800-523-4777 or visit grizzly.com to order).