

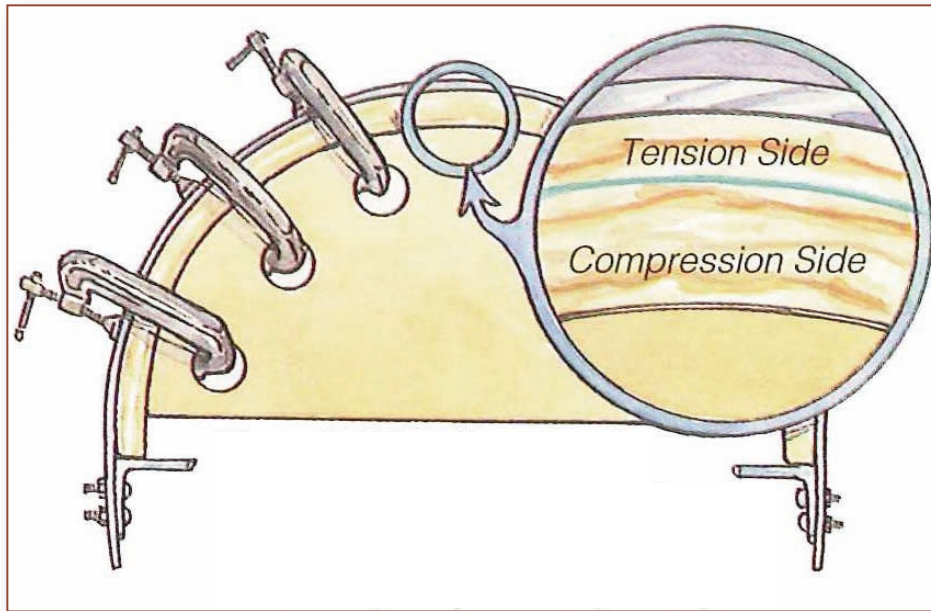
WOODWORKER'S JOURNAL

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Woodworking Technique

Steam Bending Basics



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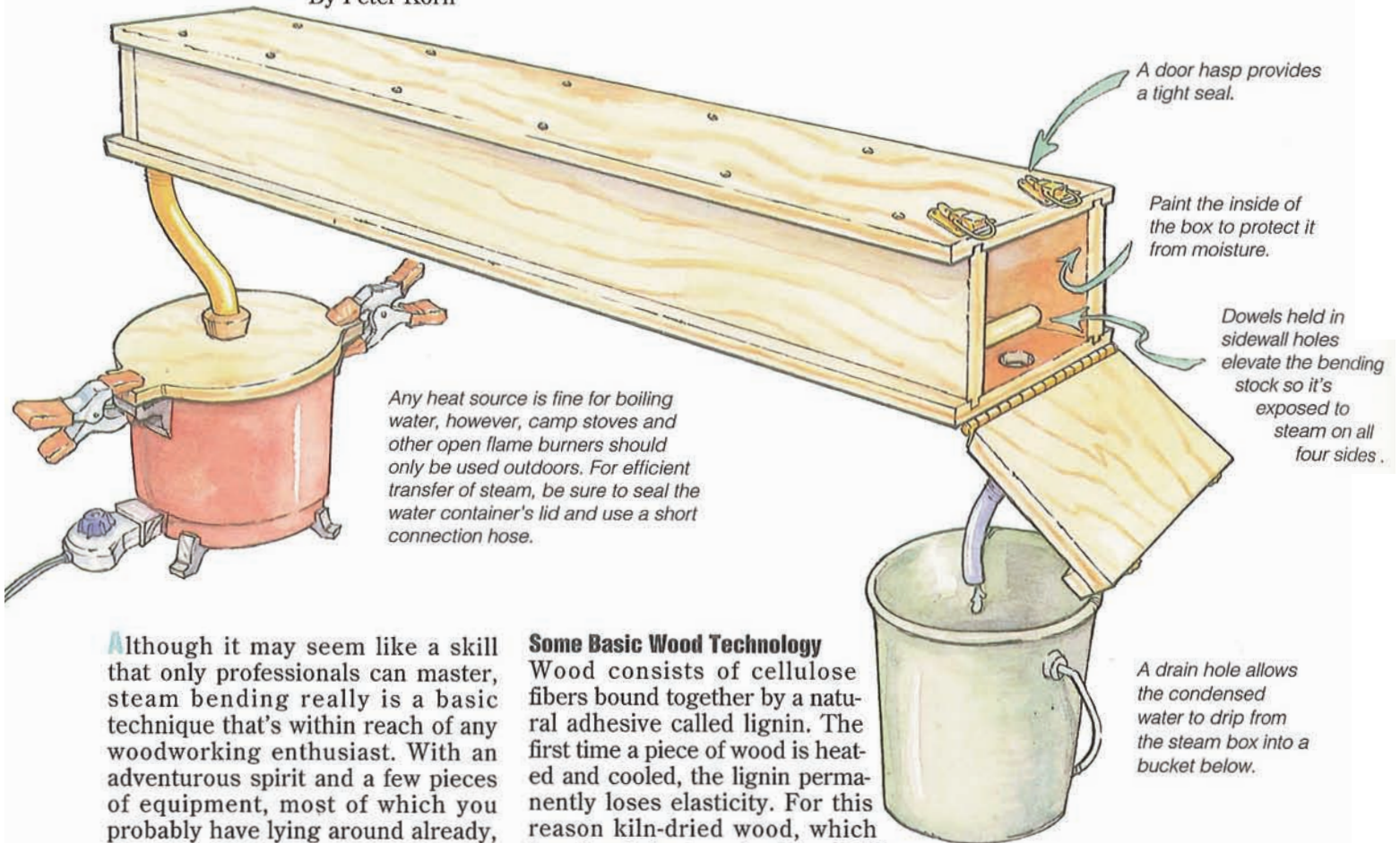


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Steam Bending Basics

By Peter Korn



Any heat source is fine for boiling water, however, camp stoves and other open flame burners should only be used outdoors. For efficient transfer of steam, be sure to seal the water container's lid and use a short connection hose.

Although it may seem like a skill that only professionals can master, steam bending really is a basic technique that's within reach of any woodworking enthusiast. With an adventurous spirit and a few pieces of equipment, most of which you probably have lying around already, you can get started.

Wood bent after using steam to make it pliable is generally strong since its grain follows the length of the curve. By comparison, curved components cut out of solid planks tend to contain weak sections of short grain (See **Figure 1**). Look out for lumber with severe grain runout, however, for even with steaming methods this wood is likely to crack.



Figure 1: A curve hand-sawn from solid wood (left) usually has significant grain runout, which weakens the piece. The grain lines on a steam bent piece (right), on the other hand, are continuous, making it the stronger alternative.

Some Basic Wood Technology

Wood consists of cellulose fibers bound together by a natural adhesive called lignin. The first time a piece of wood is heated and cooled, the lignin permanently loses elasticity. For this reason kiln-dried wood, which has already lost much of its pliability in the kiln, is not your best choice for steam bending. Air-dried wood is the ticket: when it's steamed and bent, the lignin helps lock the new curve in place. Green wood is also bendable, but has two disadvantages. First, it can take months to dry and second, the wood cells are often so full of water that hydraulic pressure bursts them open as they compress.

Wood subjected to steam in an enclosed container heats up and absorbs moisture, dramatically increasing the flexibility of its fibers. When it reaches sufficient pliability, the wood should be rapidly bent onto a form. After cooling and drying the wood will retain its new shape, although varying degrees of spring-back can occur, depending on the character of the wood, the amount of steaming, and the rapidity with which the hot wood was bent to the form.

Some species of wood lend themselves to bending more readily than others. For example, white oak, red oak and hackberry are particularly good (see **box at right**), while mahogany and hard maple are unsuitable. Whichever wood you choose, select straight grained pieces to reduce the likelihood of fracturing.

Building a Steam Box

Making your own steam box is easy, as shown in the illustration above. A typical design incorporates a plywood box, a heat source, and a water container connected to the box by some sort of hose. When building a box, consider the size of wood you'll be bending. An efficient box shouldn't be too big, yet it must allow enough room for steam to circulate freely. For most bending needs, an exterior dimension of about 7" x 7" x 60" will

Steam bending results depend in part on the woods you choose. Selecting species with a better record of success will improve your chances.

Ash.....	67%
Beech	75%
Birch	72%
Elm (soft)	74%
Hackberry	94%
Hickory	76%
Maple (hard)	57%
Red Oak.....	86%
White Oak	91%
Pecan	78%
Walnut.....	78%

From The U.S. Forest Products Laboratory *Wood Handbook*

be more than sufficient. If you decide to give it a try, be sure to incorporate the following guidelines:

- Use exterior grade plywood for the box since its waterproof glue won't degrade from the steam.
- Apply paint to the box's interior to protect the plywood.
- Space a line of dowels across the box's width to elevate the wood above the condensation runoff and to promote the flow of steam.
- Seal one end of the box, and hinge the other end for easy access.
- Drill a small hole through the bottom at one end to drain condensed steam.
- Drill a second hole, at the other end, for the steam hose entrance.

The heat source for your steamer can be an electric burner, a wood fire, a camp stove, or whatever you have that will boil water. For safety's sake, remember to use your equipment outside if it generates a flame or has exposed hot coils.

The water container should hold several gallons and have an access hole small enough to be plugged with a large cork or rubber stopper. If the container is made of iron, make sure it's galvanized or enameled, otherwise the steam will probably stain your wood. By drilling a hole through the stopper you can hold the connecting hose in place. The hose should be made of rubber, plastic, or copper of at least 1/2" in interior diameter. Thin walled plastic tubing is not recommended as it collapses when the steam runs through. In use, be sure

to set the steam box at a slight incline so that condensation flows out the drip hole.

Steaming Your Wood

The first step in steaming your wood is to fire up the burner and boil the water. Once steam begins filling the chamber, put the wood in the box and close the lid. Steam the wood until it's pliable, then, wearing gloves for protection, remove the hot wood and rapidly bend it to the form.

How long should wood be steamed? There is no precise answer, so it's a good idea to include a couple of test pieces in the box for experimentation. Species, moisture content, and the intensity of the steam environment are all factors. Here are three rules of thumb for steaming air-dried lumber as laid out by Michael Fortune, a master woodworker and experienced steam bender from Toronto, Canada:

- Keep wood with a moisture content below 20% in the steam box for about an hour and a quarter per inch of thickness.
- Steam wood with 20 - 30% moisture content for 45 minutes per inch of thickness.
- Wood with a moisture content in excess of 30% needs only about 1/2 hour of steaming per inch of thickness.

When pulling hot wood from the box, work rapidly to place it in the bending form. The wood begins to cool instantly, and it's amazing how quickly flexibility diminishes. If possible, leave the wood clamped in the form for several days. If you need to store the bent wood for a while or reuse the bending form, clamp the stock to a jig to prevent the bends from straightening.

There are a variety of designs for bending forms. The most common is a one piece form, usually built with layers of plywood, to which the

Figure 2: Make a banding strap using metal between 1/16" and 3/32" thick, and bolt angle irons to its ends so the steamed wood fits tightly between them.

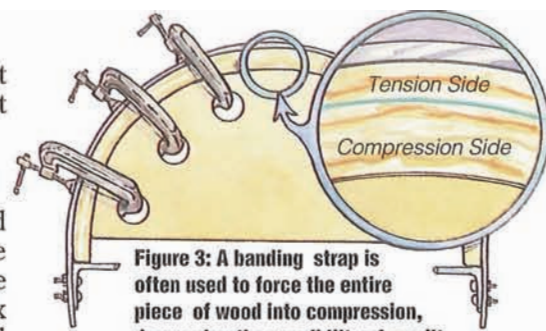
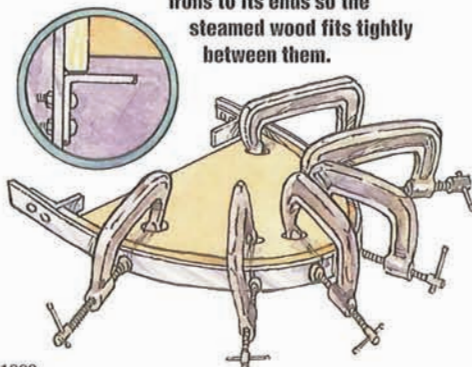


Figure 3: A banding strap is often used to force the entire piece of wood into compression, decreasing the possibility of a split on the tension side of the bend.

steamed wood is clamped (See Figure 2). Another type of form consists of two mating parts between which the work is sandwiched. I've also bent wood simply by wrapping it around and through pegs protruding from a board. Since steamed wood almost always has some springback, I often cut the form to a slightly more severe bend than I want to end up with. However, springback is unpredictable, so until actual test bends are made, the exact amount of over-bend required is anyone's guess.

When you bend a piece of wood, an imaginary line up the center stays constant in length (See Figure 3), while the outside of the curve gets longer (tension) and the inside becomes shorter (compression). Wood is fairly good at compressing, but splits apart readily under tension. It's the tension factor that limits the degree of curvature in a simple bend. Many woodworkers reduce the chance of splitting on the tension side of the wood by using a bending strap—a flexible steel strap about 1/16" thick and as wide as the bending stock, with end stops spaced to enclose the exact length of the work-piece. As soon as the wood is pulled from the steam box, the strap is fitted to the tension side of the stock. With the outside curve unable to expand, the entire piece of wood is forced into compression, minimizing the chance of splitting.

Steam bending is an accessible, low-tech process which broadens the range of design options available to a woodworker. Once you master the basics by following these simple steps, you'll find all sorts of uses for your new skill.

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