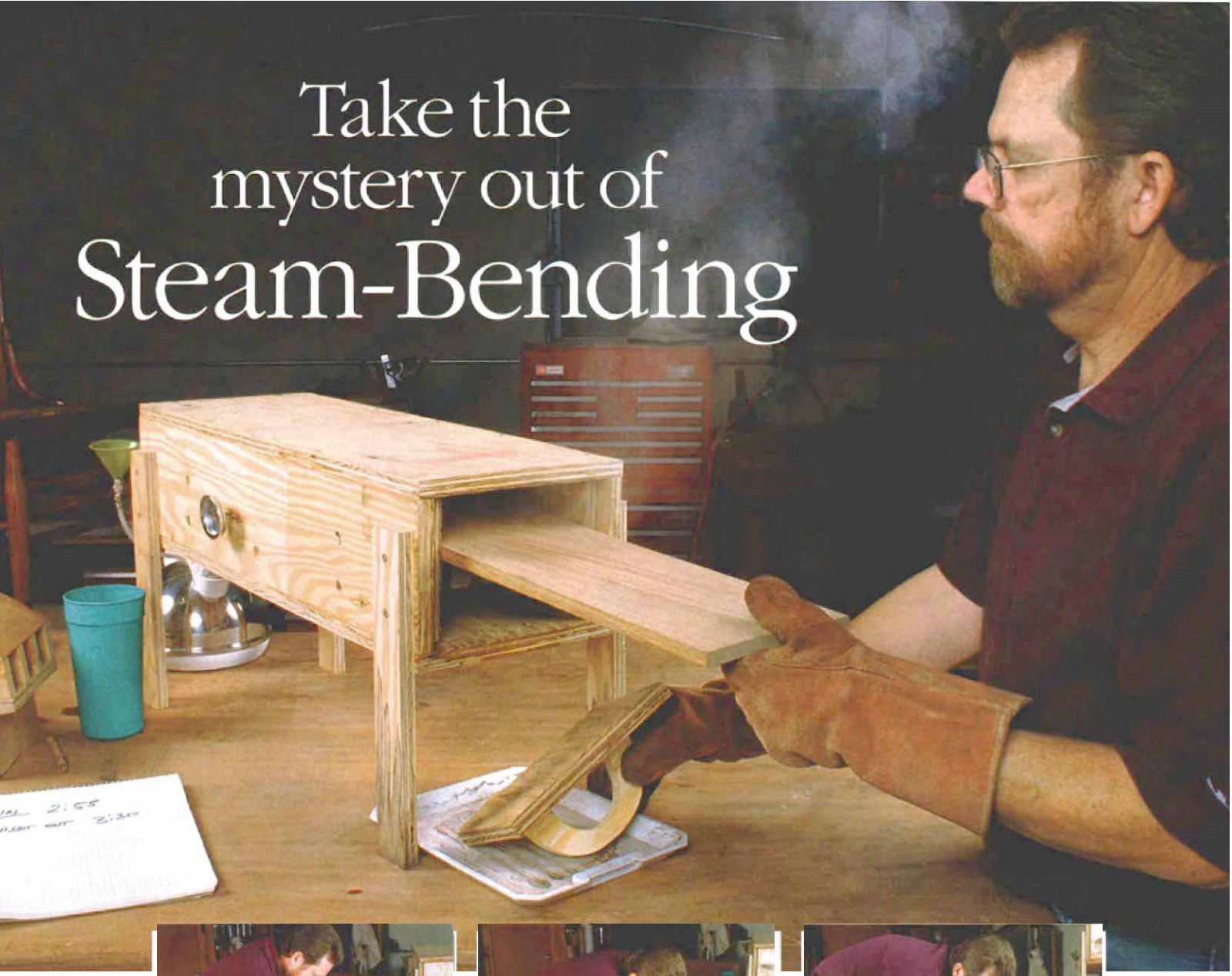
Take the mystery out of Steam-Bending



It's not magic—all you need is a source of steam, a box and a reliable bending form

BY LON SCHLEINING

Steam-bending is fast, strong and authentic. You'll never see a glueline nor have a piece break because of short-grain weakness. Steam-bending does not require green wood. Nor does it require a vast array of tools. What it does require, though, is lots of heat, a box to capture steam and a sturdy bending form.

Once you realize that each of the components works in conjunction with the others, the setup for bending is straightforward. There is almost no limit to the parts you can make by steam-bending—chair parts, table legs, curved drawer parts—except your imagination. I usually start with a drawing of the finished part, then design a form to bend it, allowing for a bit of springback (how much the part relaxes after it's been bent). The size of the bending blank determines the size of the steambox you'll need to use. The larger the box, the larger the steam generator it takes to heat it, so the box should be only as large as necessary for the parts you plan to bend.

The easiest way to understand the basics of bending is to see it done, so for this article I'll demonstrate by bending the back slat for a chair. The slat is made of ½-in.-thick material, and the radius is not very tight, which makes this is a good bend to warm up on.

The bending techniques illustrated here will work for simple bends of a slight radius as well as for more complex bends using compression straps (for more on compression straps, see the story on pp. 82-83). Whatever bending you design into your projects, what you learn here should lay the groundwork for success. As you gain experience, your confidence in bending will build, and your designs will grow bolder.

The best wood for steam-bending

Many experts claim that you must use green or air-dried lumber for steam-bending, but in the Los Angeles area where I live, air-dried stock is not a convenient option. I've had no choice but to bend kiln-dried material, and the results have been quite successful.

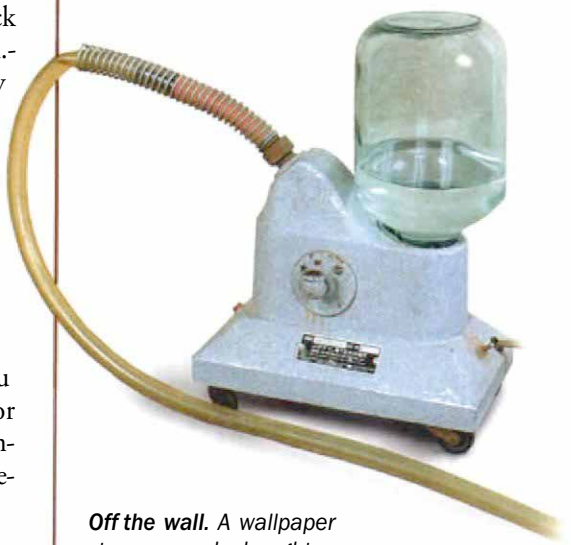
Kiln-dried wood is not only easily available, even if you live in the city, but it's also dimensionally stable, dry and ready to be milled as soon as bending is complete and the piece has had time to cool.

Any wood will bend somewhat, but long-grained woods such as hickory, ash

FIND A SOURCE OF STEAM

Off the shelf. *This kettle, available for $29.95 from Lee Valley Tools, comes with an extralong spout to accommodate a steambox.*

From the kitchen. *The author's electric deep fryer, on longtime loan from his mother, is outfitted with a frame to hold a steambox.*



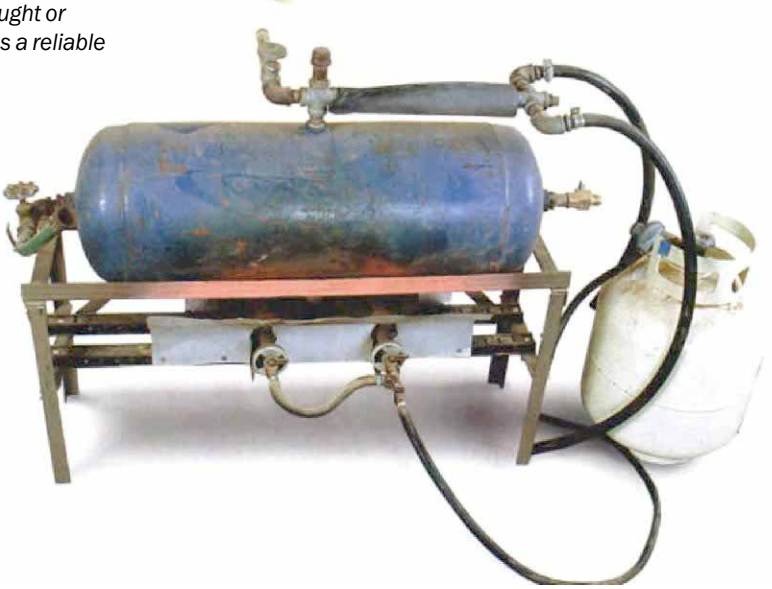
Off the wall. *A wallpaper steamer can be bought or rented and provides a reliable source of steam.*

The boiler's size must be proportionate to the size of the steambox. The larger the box, the larger the boiler because more steam is required to keep the box as hot as it needs to be: at least 200°F. No matter how big the heat source is, the steambox will never get any hotter than 212°F as long as there is a pressure release in the box, creating the perfect temperature control.

If the steambox doesn't reach 200°F within 20 minutes or so, chances are your boiler is too small for the size box you're trying to heat. Often it's a matter of simply using two kettles instead of one to get the box up to temperature.

Electric heating is probably safer than devices that have an open flame, but as long as you are careful, any sort of heat source works fine.

The electric kettle available from Lee Valley Tools (800-871-8158) puts out a lot of heat for its small size. It is possible to rent or buy a wallpaper steamer. But an electric deep fryer is cheap (look for one in a thrift store) and puts out a great deal more heat than an electric cooking pot or wallpaper steamer. A two-burner propane steamer will heat a very large steambox but must be used outside only. Whatever sort of boiler you use, there must be a convenient way to add water. Even the small kettle goes through 2 qt. of water an hour.



For the outdoors. *This shopmade propane burner will put out an exceptional amount of steam, but because of its open flame, it should be used only outdoors.*

Photos: Matthew Teague

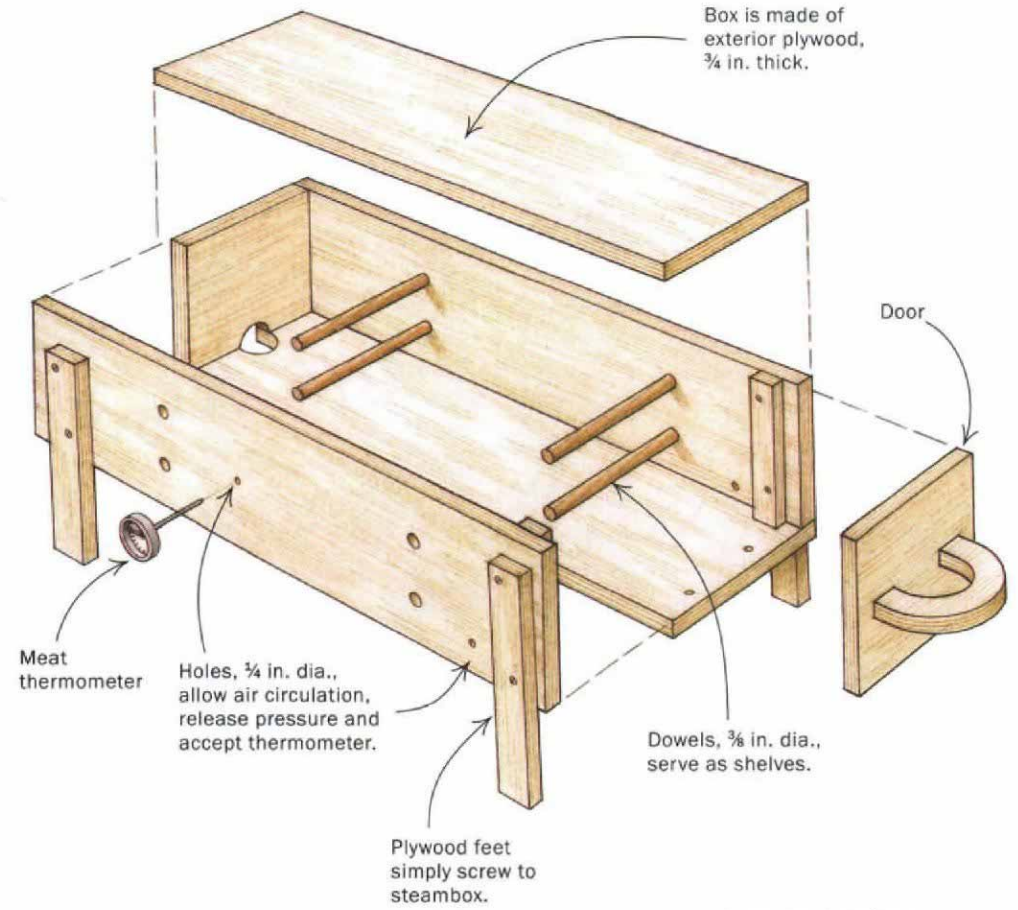
BUILD THE STEAMBOX

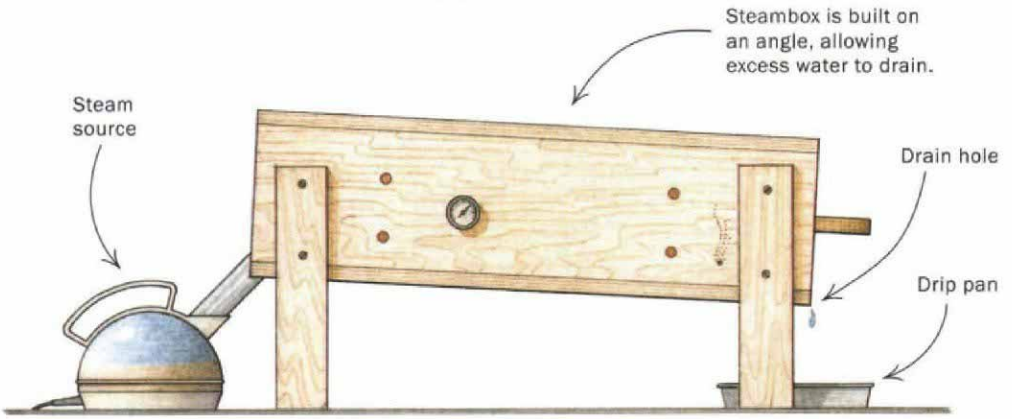
I typically use ¾-in. exterior plywood for the box itself. It's inexpensive and is fairly stable, even when it's steaming hot. Inside, dowels are used for racks, which allow the steam to circulate around all four sides of the blanks so that the heat will penetrate evenly.

Build the box only large enough for the number and sizes of parts you'll be bending at one time. I usually build a new box for every project.

The box should not be tightly sealed. Drill ¼-in. holes in several areas to provide access for a thermometer and to allow the steam to circulate. Use a common meat thermometer to measure the temperature in several places to make sure it's uniform. Resist the use of metal in steamboxes. Hot steam, hot wood and wet steel react in such a way as to turn the wood black.

Plastic pipe is a tempting material to use as a steambox. It works okay, but as it heats, it also softens. Unless its entire length is supported in a wooden V-trough, it will sag in the middle. It also lets heat easily escape, so you might need to insulate it. As with a wooden box, use dowels for racks to hold the pieces away from the sides and bottom of the pipe and to allow air to circulate.





Keep water in the pot. *When using this small electric kettle, the author adds water often, ensuring that there's plenty of steam to keep the temperature inside the box above 200°F.*

Take note of the the time. *Once the blanks are inside the steambox, monitor the temperature and note the time it reaches 200°F.*

Drawings: Vince Babak

and oak bend easiest. Dense woods, such as cherry, hard maple and most exotics, are certainly more challenging. Ideally, wood for steam-bending should have straight grain, which enables you to bend without stressing the areas already weakened by grain direction. I suggest starting with oak, because it is much easier to bend than most other species.

Predicting springback is not an exact science

If at all possible, use a full-sized drawing of the part to help design the bending form. Be sure to take into account that the shape will relax, or spring back, somewhat after it's been bent. Build some overbend into the form so that the part will relax to the shape you want.

Numerous factors affect springback, such as the radius, the thickness of the part, degree of bend, how quickly the part is bent, how long it was steamed, how long it stayed on the form to cool, the type of wood and its moisture content. The bad news is that if you're going to bend just a couple of parts, you'll have a difficult time predicting the amount of springback.

The rule of thumb is to allow for more—rather than less—springback than you expect. While a piece that has been overbent can be straightened out easily, it is nearly impossible to add more bend after your initial effort.

It's quite easy to straighten out the piece a little if it's bent too far. A wet rag placed on the concave part of the bend will straighten it out some. Heating the part with a hair dryer will accelerate the process. Do not try to bend the part just a little more once it's cooled—it will break almost every time.

Make a practice run before bending a piece

Begin by cutting several practice blanks out of oak. To determine grain runout, hold up the blanks so that light reflects along the surface of the edge that will be curved. The straighter the grain, the better. Oddly, it seems to make little difference how the end grain is oriented: whether vertically, flat or diagonally.

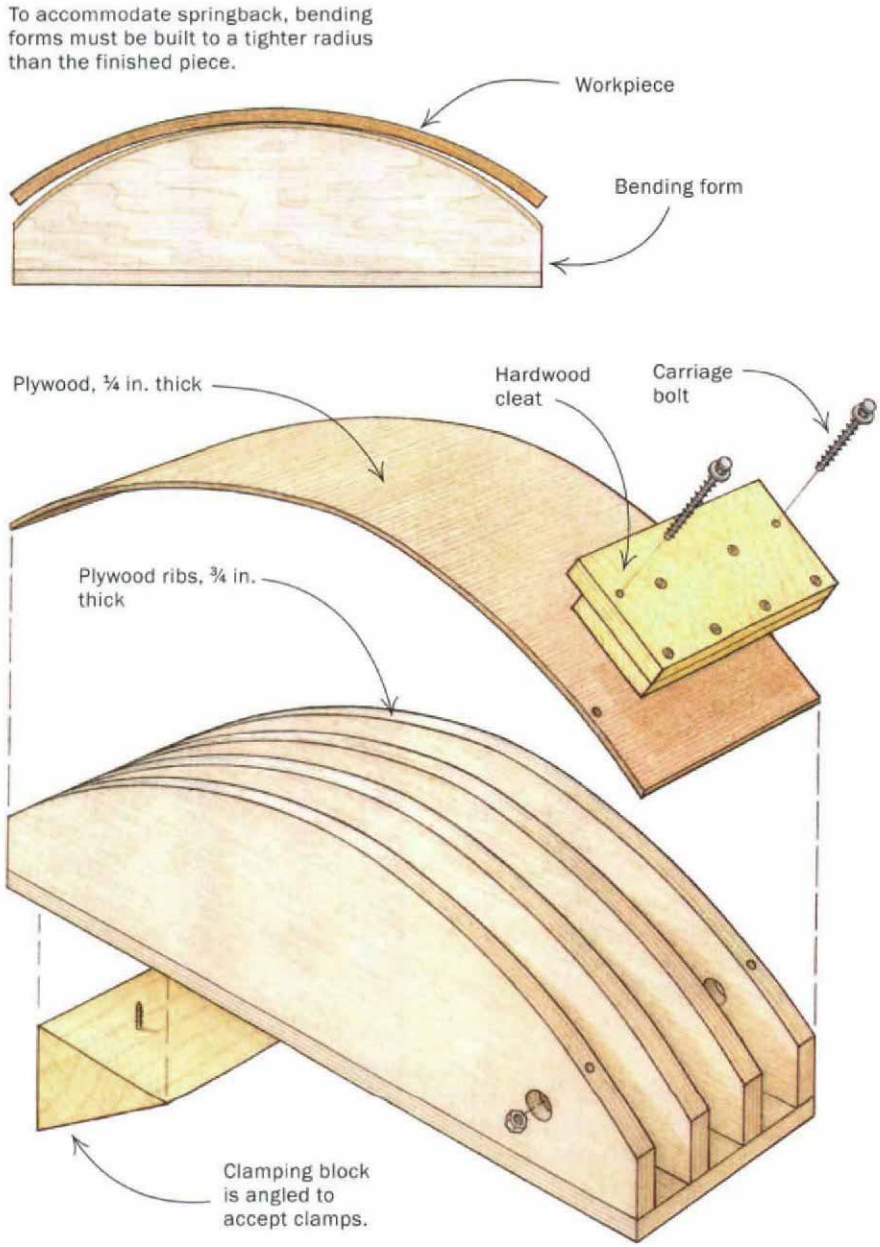
I usually load the blanks into the box while it's cool so that I don't have to work around the steam any more than necessary. Once the pieces are in place, close the lid, plug in the boiler and wait for the temper-

MAKE A STURDY BENDING FORM

The form serves as a mold for the shape of the part being bent. I usually draw the part full sized so that I can plan the form accordingly. The drawing shows both finished and rough sizes for the part and serves as a map for building the form. This is the time to build in overbend to allow for springback.

Use layers of plywood shaped like your drawing to build the form. Any flaw in the curvature here will telegraph into the final product, so shape carefully. Clamp pockets or a wedge system provide a means to clamp quickly. Speed is important because of the limited time the part will stay hot enough to bend.

Add a cleat of some kind so that the form can be held securely to a bench. Build the form stronger than you think it needs to be. It must absorb the stress of bending.



ature in the box to rise above 200°F. Check the temperature with a thermometer in several spots to make sure it's uniform. Note the time when the box reaches the correct temperature.

Because the heat must penetrate to the core of the material, monitor the temperature throughout steaming; add water as needed. Remember, it's heat, not moisture, that allows the piece to bend. Wood should be steamed for one hour per inch of thickness. For a ½-in.-thick chair back, leave the piece in the steam for a half-hour—or just a bit longer. If wood stays in the steamer too long, it begins to get dry and brittle and becomes harder to work.

When the blank conies out of the box, it will be very hot. When I work around steam, I wear gloves that cover my forearms. Once the piece is out of the steambox, it cools rapidly, so bending must be done immediately. It's important to work both quickly and deliberately—quickly to begin bending, deliberately to get the right shape. Don't force it. Give stock time to get used to the idea that its surfaces are changing length. After a few tries, you'll begin to develop a feel for the material and become a better judge of how quickly or how slowly you need to go.

Use clamps or wedges to hold the part on the form while it cools. You want to be sure that the piece has had time to dry completely before you remove it from the form. Whenever possible, let the piece cool for 24 hours.

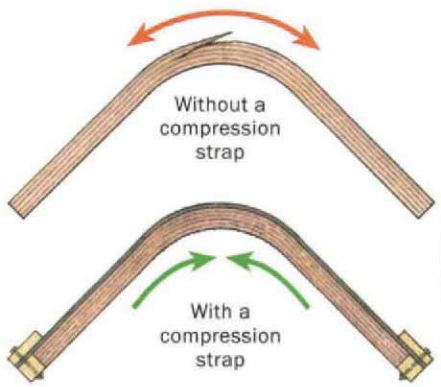
When the part comes off the form, it will spring back a bit. If the curve is correct, congratulations. If it's bent too much, use a hair dryer and a wet cloth as described on p. 81 If it's not bent far enough, start from scratch and make a new bending form with more curvature in it. Once the kinks have been worked out, make a series of cooling forms, which will enable you to bend a number of pieces in assembly line fashion.

Bending wood is not the answer to every woodworking application, but in certain situations, it's the only viable option. With careful setup, it's also a simple task. And no matter how many times I do it, I'm amazed when a blank comes out of a steambox so pliable that I can bend it into a knot. □

Lon Schleining is the author of "Treasure Chests,"a forthcoming book from The Taunton Press. His video, Steam Bending, *is also available from The Taunton Press,*

Compression straps aid tricky bends

HOW IT WORKS



When making dramatic bends without a compression strap, the outer surface stretches and often fails. But using a compression strap limits the stretching of the outside surface and forces the piece to compress on its inside surface.

Simply put, bending changes the lengths of the inside and outside surfaces of a piece, and does so quite significantly. Left to its own devices, wood will naturally try to stretch on the outside (convex surface) before it tries to compress on the inside (convex surface). If it stretches much beyond 10% of its total length, fibers begin to tear apart; the typical steam-bending failure. Enter the amazingly simple compression strap. Even the hardest bends, such as the hoop for a Windsor side chair, are simple when you use a compression strap.

It's fast and easy to make a basic compression strap, but commercially built straps are available as well (Lee Valley Tools-800-871-8158). You can gather the necessary materials—some nuts and bolts, some galvanized metal strapping—from a home center, and then you'll need only a drill press and *a* few scraps of oak. Use at least ¼-in.-dia. bolts to fasten the strapping to the blocks. Galvanized metal is a good choice for bracing material because it won't turn the oak black as uncoated steel can.

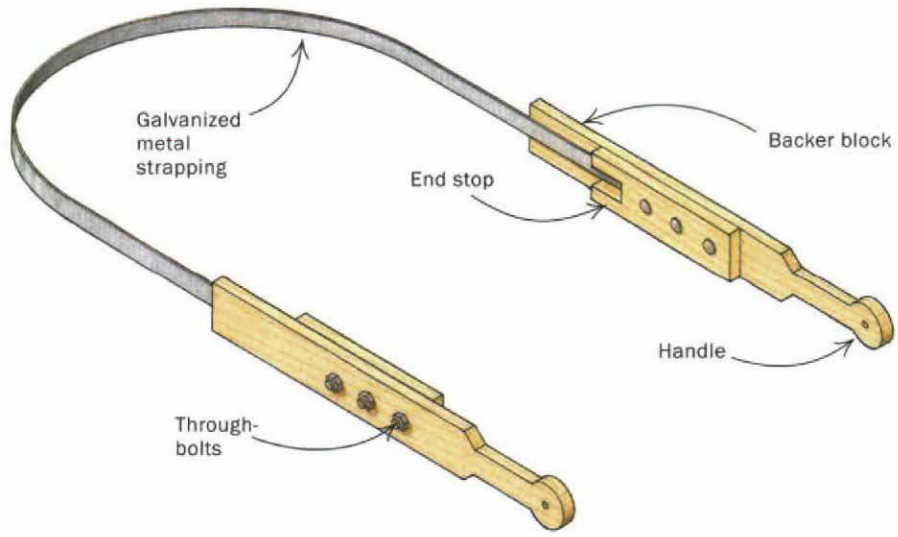
Using a 1-in.-square by 42-in.-long chair back as an example, start with a simple full-sized drawing. It makes cutting out and assembling the parts more straightforward.

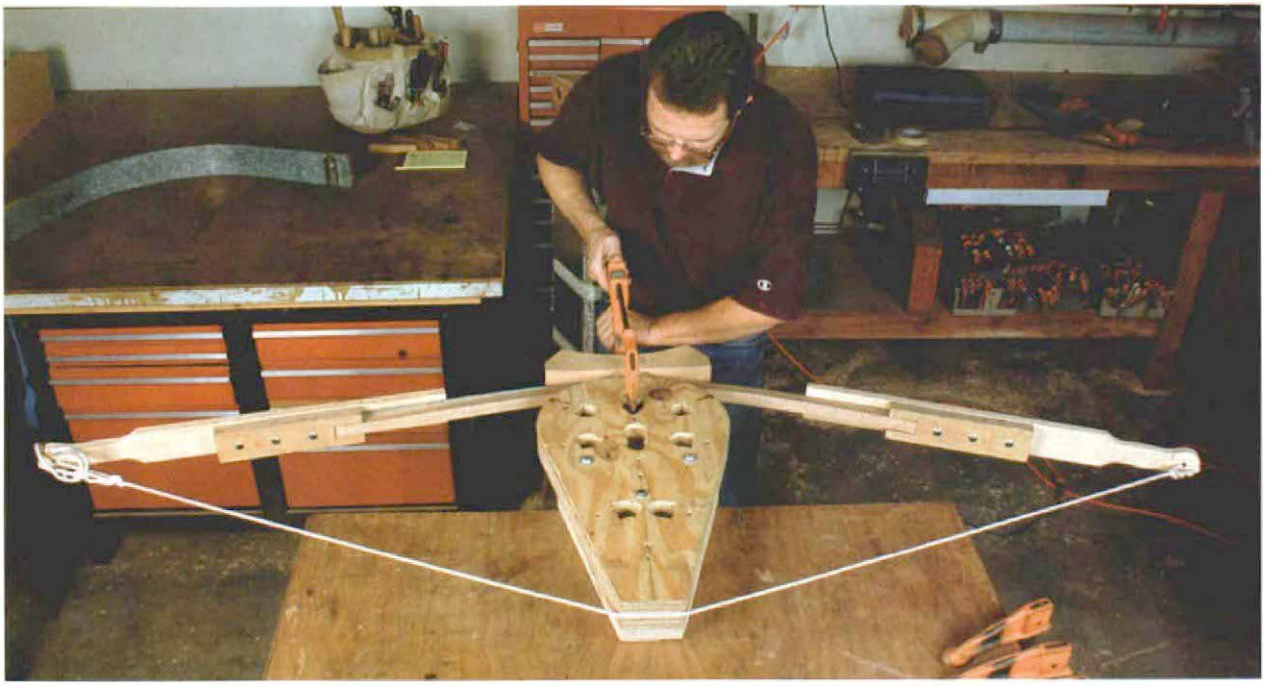
Build the strap as strong as you can manage and then some. It's easy to underestimate the tremendous end pressure you'll generate. Imagine shortening a 1-in.-square by 42-in.-long piece of oak by a couple of inches. Sound unrealistic? But this is exactly what must happen when the piece is bent 180°. Sometimes, just for fun, I place a coin in the strap between the part and the end stop. The coin imprints so deeply into the end grain that you can almost read the date.

Backer blocks will help keep the part from jumping out of the end stops as the end pressure builds during bending. By combining them with long handles for better leverage, you do two jobs at once.

Be sure to use a center punch to drill

COMPONENTS OF A STRAP





Beginning the bend. *With the form screwed to a work surface, load the blank into the compression strap and clamp it in place.*

***Pulley system* lends a hand.** Because *the author typically works alone, he gains leverage by using a pulley system, made from an inexpensive block and tackle bought from the hardware store.*

***Clamps ease the* bend.** As *the bend progresses, clamps help pull up the blank. Once the bend is complete, the assembly stays on the bending form for only a few minutes.*

Cooling forms save space. *Once the bend is complete, a cooling form, made of MDF, is a good way to store the piece for cooling overnight. Using cooling forms also enables you to bend other blanks almost immediately.*

the holes in the strapping metal. Otherwise, the drill will wander across the surface of the strap before it begins to take hold. Regular twist drills will go through the steel just fine.

Cut out the pieces, then round all of the sharp edges so you don't cut yourself. Drill holes for the bolts, tighten up everything, and that's all there is to it.

Using compression requires loading the blank into a compression strap before bending. Place the hot blank in the strap between the end blocks and add shims at the ends so that the piece is securely wedged into the strap. Then use the handles on the strap to bend the part.

COOLING FORMS REQUIRED

As soon as the bend is completed, take the part off the form and clamp it into a cooling form. A cooling form keeps the part in its final shape while it cools. The cooling form allows you to bend numerous blanks—one every few minutes—using a single bending form.

I build cooling forms out of plywood or particleboard, using more curvature than the final part needs but less than the bending form. Cooling forms are an easy way to achieve a greater degree of accuracy with the final shape.

It's likely the bends you commonly see in furniture were made with a compression strap, not just by bending the part unaided. Though it seems like a lot of trouble to build a strap, the process of bending even severe shapes goes from nearly impossible to very straightforward almost instantly.