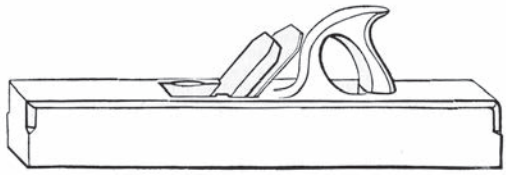
The Joiner and Cabinet Maker



The Joiner and Cabinet Maker

His Work And its Principles

"Whatever thy hand findeth to do, do it with thy might."
Ecclesiastes ix. 10.

ENLARGED EDITION WITH ILLUSTRATIONS

by Anon,
Christopher Schwarz &
Joel Moskowitz

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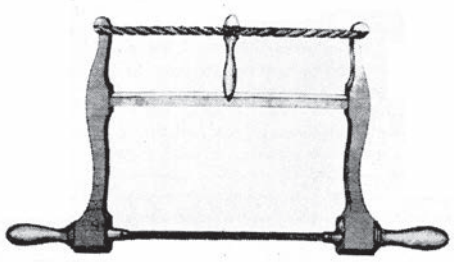


Acknowledgements

Research, writing, and working in wood are never done well in a vacuum. I need to thank some people for their help in getting this book to a wider audience.

Maurice Fraser, who taught me most of what I know about hand tools and also instilled a sense of history and tradition in my work.

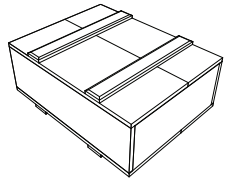
Christopher Schwarz, whose interest in hand tools and traditional work has revitalized the hand-tool market, and whose ability to write compulsively, engagingly and intelligently on woodworking enabled him to do the heavy lifting on this project, in addition to his full-time job as editor of two magazines

Most of all my wife, Sally Bernstein, who not only functions as my editor, but without her support I would still be just sweeping up shavings.

— Joel Moskowitz

I don't write books for a living, so writing books takes its toll on the people in my life. So to Lucy, Maddy and Katy: Thank you for nine months of patience at my absence from school events, the sledding hill, the pool and the couch. This book, and the rest of this year, are for you.

— Christopher Schwarz



Part I: History

Introduction

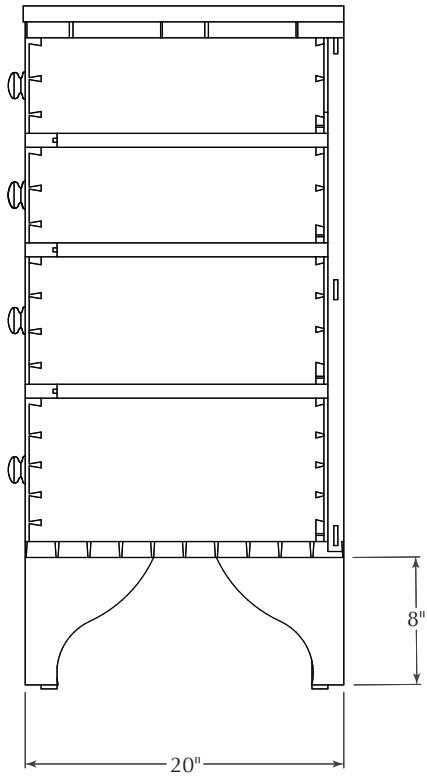
In 1839, an English publisher issued a small book on woodworking that has – until now – escaped detection by scholars, historians and woodworkers.

Titled "The Joiner and Cabinet Maker," this short book was written by an anonymous tradesman and tells the fictional tale of Thomas, a lad of 13 or 14 who is apprenticed to a rural shop that builds everything from built-ins to more elaborate veneered casework. The book was written to guide young people who might be considering a life in the joinery or cabinet making trades, and every page is filled with surprises.

Unlike other woodworking books at the time, "The Joiner and Cabinet Maker" focuses on how apprentices can obtain the basic skills needed to work in a hand-tool shop. It begins with Thomas tending the fire to keep the hide glue warm, and it details how he learns stock preparation, many forms of joinery and casework construction. It ends with Thomas building a veneered mahogany chest of drawers that is French polished.

Thanks to this book, we can stop guessing at how some operations were performed by hand and read first-hand how joints were cut and casework was assembled in one rural English shop.

Even more delightful is that Thomas builds three projects during the course of his journey in the book, and there is enough detail in the text and illustrations to re-create these three projects just as they were built in 1839.



Profile View (Section)

When we first read this book, we knew we had to republish it. Simply reprinting the book would have been the easy path, however. What we did was much more involved.

We have published "The Joiner and Cabinet Maker" with additional chapters that will help you understand why the book is important, plus details that will make you a better hand-tool woodworker. In this expanded edition, you'll find:

• A historical snapshot of early 19th-century England. Moskowitz, a book collector and avid history buff, explains what England was like at the time this book was written, including the state of the labor force and woodworking technology. This dip into the historical record will expand your enjoyment of Thomas's tale in "The Joiner and Cabinet Maker."

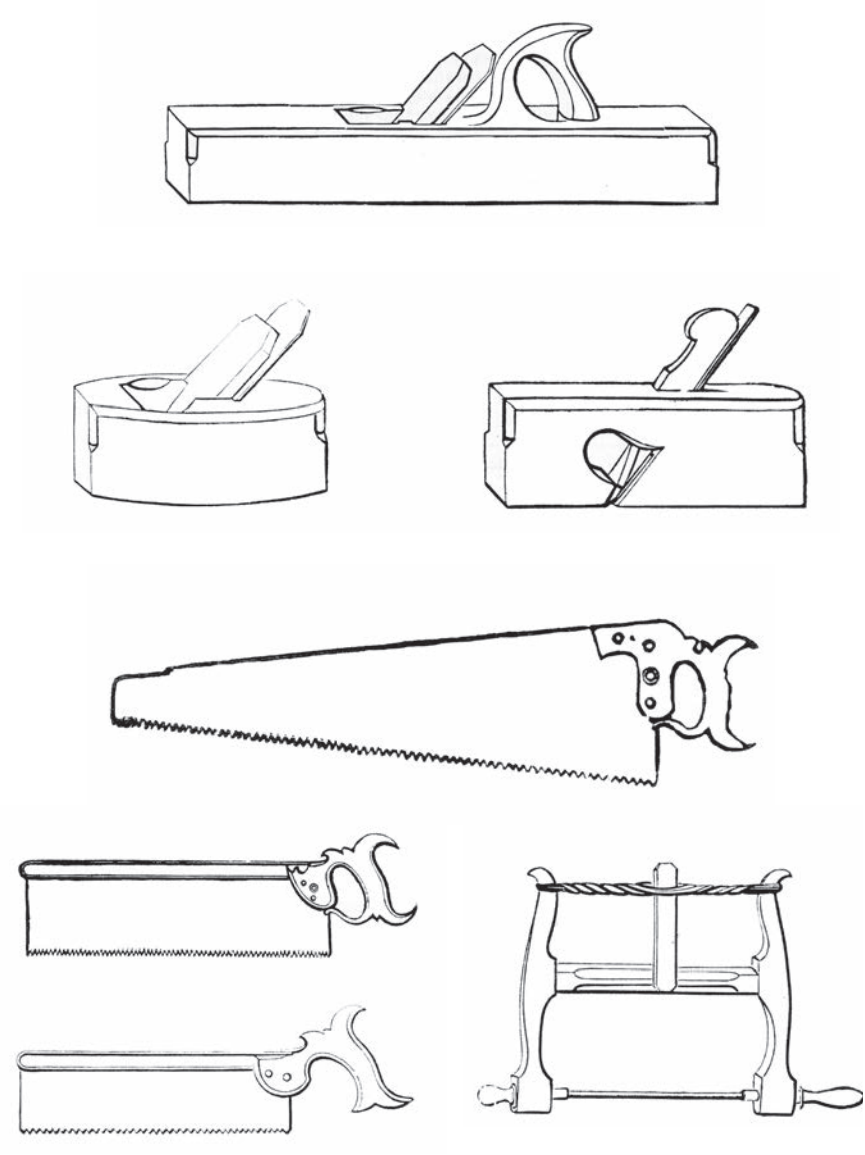
• The complete text of "The Joiner and Cabinet Maker," unabridged and unaltered. We present every word of the 1839 original (plus a chapter on so-called "modern tools" added in a later edition), with footnotes from Moskowitz that will help you understand the significance of the story.

• Chapters on the construction of the three projects from "The Joiner and Cabinet Maker." Schwarz built all three projects – a Packing Box, a dovetailed Schoolbox and a Chest of Drawers – using hand tools (confession time: he ripped the drawer stock on a table saw). His chapters in this new edition of "The Joiner and Cabinet Maker" show the operations in the book, explain details on construction and discuss the hand-tool methods that have arisen since this book was published.

• Complete construction drawings and cut lists for the modern woodworker. This will save you the hours we spent decoding the construction information offered in "The Joiner and Cabinet Maker."

We encourage you to read this entire book and attempt to build the three projects using hand tools. That is a tall order, we know. However, building the Packing Box, the Schoolbox and the Chest of Drawers will unlock the basic skills needed for all hand-tool woodworking, and it will offer insights into how traditional, high-quality casework was really built.

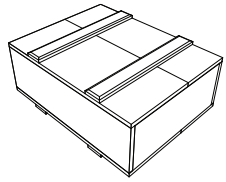
— Christopher Schwarz & Joel Moskowitz



These are some of the tools of the joiner shown in "Spons' Mechanics' Own Book" (1885).

"But 'it will do' is a very bad maxim, especially for a person learning a business; the right principle is to ask oneself, 'is it as good as it can be made?' or, at least, 'is it as good as I can make it?' "

— "The Joiner and Cabinet Maker"



Part III: Construction

The Packing Box

It's easy to dismiss the Packing Box built for Mr. Green as too simple a project for even a beginning joiner. It is, after all, a crude box made with a gross of nails.

However, I urge you to build the Packing Box. If you follow along with Thomas (as I did), there is remarkable stuff to learn here about hand work that is rarely discussed in modern texts.

Hand-tool woodworking is different than power-tool woodworking. With power tools it's simple to size your parts exactly then assemble them so every corner is flush and perfect when the clamps come off.

When working with hand tools, this is neither easily achieved nor is it a good idea. With hand tools, parts can (and should) be irregular widths and lengths. After the parts are assembled, the box is trued up with a plane afterward.

In the end, both approaches result in the same sturdy and good-looking box. However, you have to be careful about how you mix power tools and hand tools. While they can play nicely together, you also can make a lot of fussy work for yourself by sizing all your parts to within .001" in length on a shooting board with a plane before assembly. That's a waste of your effort.

Mr. Green's Packing Box also will teach you how to become adept with a full-size handsaw to break down your stock (something that most of us need practice with), which will prepare you for the backsaw work when building the next project, the dovetailed Schoolbox.

And lastly, you'll get an education in cut nails and clinching. This project requires a whole handful of cut headless brads that are installed in a variety of ways that will teach you how to avoid splits, how to work rapidly and how to clinch the buggers, which is immense fun.

So if you were thinking of skipping the Packing Box, please reconsider. Here's some bait: You get to buy a new tool, the two-foot rule. That's the tool that Thomas and Mr. Jackson use to pick the stock for the Packing Box. You also get to learn a good deal about deal, which is the wood used throughout "The Joiner and Cabinet Maker."

Rules, Deals and Chalk

The two-foot rule was the standard measuring device for woodworking for hundreds of years. The steel tape was likely invented in the 19th century. Its invention is sometimes credited to Alvin J. Fellows of New Haven, Conn., who patented his device in 1868, though the patent states that several kinds of tape measures were already on the market.

Tape measures didn't become ubiquitous, however, until the 1930s or so. The tool production of Stanley Works points this out nicely. The company had made folding rules almost since the company's inception in 1843. The company's production of tape measures appears to have cranked up in the late 1920s, according to John Walter's book "Stanley Tools" (Tool Merchant).

The disadvantage of steel tapes is also their prime advantage: They are flexible. So they sag and can be wildly inaccurate thanks to the sliding tab at the end, which is easily bent out of calibration.

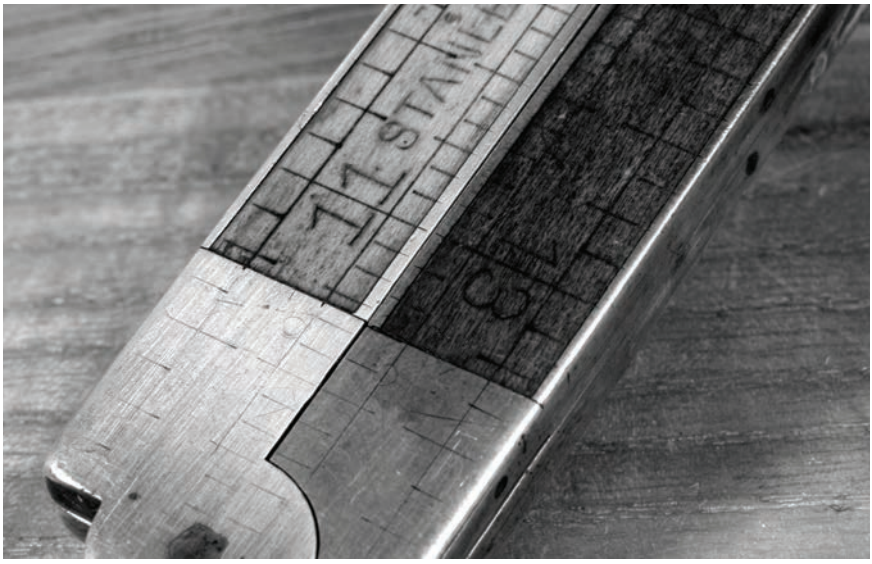
What's worse, steel tapes don't lay flat on your work. They curl across their width enough to function a bit like a gutter. So you're always pressing the tape flat to the work to make an accurate mark.

Folding two-foot rules are ideal for most cabinet-scale work. They are stiff. They lay flat. They fold up to take up little space. When you place them on edge on your work you can make an accurate mark.

They do have disadvantages. You have to switch to a different tool after you get to lengths that exceed 24", which is a common occurrence in woodworking. Or you have to switch techniques. When I lay out joinery on a 30"-long leg with a 24"-long rule I'll tick off most of the dimensions by aligning the rule to the top of the leg. Then – if I have to – I'll shift the rule to the bottom of the leg and align off that. This technique allows me to work with stock 48" long – which covers about 95 percent of the work.

Here I'm using a zig-zag rule and a carpenter's pencil to lay out the cuts on the pine stock for the Packing Box. I dislike zig-zags for this work because they don't lay flat. They have the precision of a hand grenade.

Other disadvantages: The good folding rules are vintage and typically need some restoration. When I fixed up my grandfather's folding rule, two of the rule's three joints were loose – they flopped around like when my youngest sister broke her arm. To fix this, I put the rule on my shop's concrete floor and tapped the pins in the ruler's hinges using a nail set



One leg of this scale has been cleaned with lanolin. The other has been wiped with wood bleach, which lightened the boxwood but didn't affect the markings.

and a hammer. About six taps peened the steel pins a bit, spreading them out to tighten up the hinge.

Another problem with vintage folding rules is that the scales have become grimy or dark after years of use. You can clean the rules with a lanolin-based cleaner such as Boraxo. This helps. Or you can go whole hog and lighten the boxwood using oxalic acid (a mild acidic solution sold as "wood bleach" at every hardware store).

Vintage folding rules are so common that there is no reason to purchase a bad one. Look for a folding rule where the wooden scales are entirely bound in brass. These, I have found, are less likely to have warped. A common version of this vintage rule is the Stanley No. 62, which shows up on eBay just about every day and typically sells for $20 or less.

The folding rule was Thomas's first tool purchase as soon as Mr. Jackson started paying him. I think that says a lot about how important these tools were to hand work.

When marking out his stock, Thomas uses chalk in conjunction with the rule. The author also notes that Thomas always has chalk in his pocket. What gives?

Chalk is ideal for marking out coarse measurements on boards

because it won't snap like a pencil lead on a rough-sawn wooden surface. It's also far easier to see than pencil lead. In my shop, I've always used chalk at every stage in construction. You can make very bold (but easily removed) marks on your parts to keep them organized. I also use chalk to mark all the areas of tear-out that need to be addressed on a nearly finished piece of work. (Does chalk dull your edge tools? I haven't had a problem.)

I also like how the chalk dust in my pocket absorbs excess moisture on my hands, which is a trick from the rock climbing and billiards set.

The third unfamiliar thing at this stage of the book is the way the author throws around the word "deal." It's easy to get the impression that deal is merely an English word for dimensional pine. But if you dig around, it can become confusing. "The Joiner and Cabinet Maker" instructs you to build one project using either "pine or deal."

Huh? Let's hit the books.

In my library, the accounts I dug up all agree that a "deal" is a plank of pine or spruce that is 9" wide. But they disagree on the thickness. According to Bernard E. Jones's "Practical Woodworker" (10 Speed Press), deal is 9" wide and no more than 4" thick. Charles H. Hayward's "Carpentry for Beginners" (Drake) agrees that deal is 9" wide, but says the thickness is between 2" and 4". And Paul N. Hasluck's "The Handyman's Book" (Senate) states that deal is 9" wide and 2-1/2" thick.

What is also helpful to know is that deal is just one word that English books use to describe standard sizes of wood. According to Hayward, a 20th-century author, here are some others:

Plank: A piece of wood that is 11" wide or wider and 2" to 4" thick.

Batten: A piece of wood that is 5" to 8" wide and 2" to 4" thick.

Board: Anything that is more than 4" wide and less than 2" thick. This term is usually used with floorboards and tongued-and-grooved boards.

Scantling: Small bits that are 2" to 4-1/2" wide and 2" to 4" thick.

Strip: Pieces that are less than 4" wide and less than 2" thick.

But that's not all. There are different kinds of deal. Deal that is Northern pine (*Pinus sylvestris*) can be called Baltic red deal, Dantzic deal or yellow deal. And Spruce (*Picea excelsa*) shows up as white deal. And Canadian spruce (*Picea nigra*) can be called New Brunswick spruce deal.

Sawbenches make this work much easier. These flat-topped shop appliances are about as high as your knee. They allow you to hold your work without any clamps. My left knee is holding the stock firmly to the sawbench. My right knee is braced firmly against the edge of the stock.

The author of "The Joiner and Cabinet Maker" uses the word deal to describe a piece of wood that is about 9" wide and that comes in a variety of thicknesses. The wood that Thomas uses is called "half-inch deal." That means it came into his hands already 1/2" thick, and he

didn't have to plane it down from 4/4 stock – an important detail to remember as you explore hand work. Don't thickness stock more than you have to.

One more detail: The master gives Thomas five hours to build the box. If you're still not sold on building the Packing Box yourself, you might consider timing yourself. What case work project can really be completed in five hours?

Laying Out and Sawing

When laying out the cuts on the deal, Thomas allows himself an extra 1/4" to account for the waste in sawing, which accounts for the kerf and any wandering off the line. This is less than the 1" typically allowed in machine work. If you abide by this guideline you need to be careful about looking for splits at the ends of the boards. If you don't abide by this 1/4" guideline, don't sweat it. The master gave Thomas an extra 1" at the end of his boards.

When Thomas goes to work at the bench, he finds that things are in disarray. Sam, the villain of this book (who we don't actually get to meet), has left the workbench a mess. The tools are everywhere and the bench is covered in shavings.

Thomas cleans the bench. It might seem that this is an episode of "The Anal Retentive Joiner," but it's not. Cleaning up your work area before you begin is good practice – you don't waste time looking for a tool buried under piles of tools. And, amongst good tradesmen, orderliness is prized.

I once judged a contest put on by the Robert Bosch Corp., a German company with deep roots in the country's apprentice system. In this contest, the best student woodworkers and trim carpenters had been brought together to compete for an impressive prize of money and tools. The students were given a plan and told to build the project in one day. The judges watched the entire construction process – we weren't there just to judge the resulting project.

The Bosch officials were interested in how the students conducted themselves. Did they use safe practices? Did they work in an orderly manner? How did they treat their tools? Was their working pace steady but deliberative? Did they clean their work area as they proceeded?

In other words, it wasn't a race to see who could finish first. Or who could make the most impressive wooden object. It was a race to be the best all-around tradesman.

It was a very unusual contest to hold in the United States.

In any case, Thomas goes about putting his work area in order before he begins. What is remarkable to me is that this occurs right after Mr. Jackson gives him a firm deadline for completing his work. Thomas knows that a little cleaning will save time at the end.

'So He Sets to Work With Good Heart to Make the Box'

The first step to making the Packing Box is to knock down your stock into manageable lengths. The best way to do this is with a pair of sawbenches and a handsaw. Every hand-tool shop needs a pair of sawbenches as handsaws are awkward to use at workbench height. Sawhorses will suffice in a pinch, but the wide top of a sawbench is superior.

Handsaws are also a constant companion in a hand-tool shop, and selecting one is an important task. For breaking down stock, I like a saw that has 7 or 8 points per inch (ppi). Typical handsaws have a 26"-long blade, though many cabinet makers like using panel saws in a shop environment, which have a blade that is more like 20" long.

Either saw length will work fine, though you will find it easier to find the more common 26" handsaw, so they are less expensive.

As to the shape of the teeth, there is some debate amongst woodworking historians as to what Thomas might have used circa 1839. Some woodworkers contend that saws during the 18th and early 19th centuries were likely all filed with a rip tooth, which is where the front cutting face of each tooth is filed at 90° to the sides of the tooth.

Others contend that woodworkers of this era would surely have heard of and used the "fleam" tooth, which is where the cutting face of each tooth is angled a bit, which makes for a cleaner crosscut.

Thomas uses all his saws for both ripping and crosscutting operations, so that is some support for the hypothesis that all the saws were filed with one (likely rip) configuration. But as someone who has hand-sharpened saws, let me offer another theory: These saws were filed with some fleam, and that fleam was the result of filing a saw by hand.

Yup, if you've ever tried to file a rip saw by hand, you've probably noticed that it's almost impossible to file the face of every tooth at 90° without introducing a little bit of fleam. And even a little fleam makes a saw cut more smoothly – especially when you have variable fleam, which is what you get when you sharpen a saw by hand.

So now you have a saw that will do the job. You've marked your

Shown is one common pattern for a sawbench. Note the flat top that is about 7" wide and the height of the bench, which is just below the worker's knee.

crosscut with a carpenter's pencil or with a striking knife. Your rips are marked with chalk. So how do you begin to saw?

Sawing is one of the most important woodworking skills. Learning to plane or nail is no big deal compared to learning to saw. So what do you need to know to become a good sawyer? There are several suggestions I can make that will immediately ensure you become a better sawyer. Here they are:

1. Use a three-fingered grip. Extend your index finger when sawing. Never use a four-fingered grip, even if a misshapen tool tote allows four digits inside. All sawing is supposed to be done with three fingers on the tote and your index finger extended out, which tells your body: "Do this operation so things are straight."

2. Never clutch the tote nor use more than a tad of downward pressure when sawing. Both of these muscular missteps will take you off your line in a hurry. A good saw wants to cut straight, and a good sawyer knows to get out of its way and let the tool do its job.

3. Take long, even strokes (fool yourself into thinking the sawplate is longer than it really is) and lift the saw slightly on the return stroke. This helps clear your line of sawdust and reduces the huffing you'll do.

Begin your cut with the saw pitched low (at top). This lower angle makes the tool easier to start. When you are sawing sweetly, raise the saw (45° for crosscut saws and 60° for rip saws). This makes the cut more aggressive.

Thomas used a brad awl to secure one end of the chalk line. A nail or a helper monkey are other good options (speaking as a former helper monkey).

4. Correcting a wayward sawcut is a subtle thing. If you drift off line, try to correct your cut by making a couple strokes while you slightly twist the tote toward the line. Then relax your grip and take a couple normal strokes. All saws lag a bit in responding to directions from the user. It's easy to over-compensate.

5. A shiny saw will help ensure that your cut is true as you progress. Observe the reflection of your work in the sawplate. When the reflection is a perfect mirror of your work, then the saw is straight and plumb.

6. Mark your cutline across the width and the thickness of your work and always work so you can see your lines. Never let the sawplate obscure your pencil or knife line. You might have to move your head to an awkward place to see your lines, but that's OK.

Learning to rip a long board is more difficult than learning to crosscut. Thomas has to rip a long board to improve the yield of his material and get all the Packing Box's cross-strengtheners he needs from the waste that will fall away.

Ripping can be tricky and tedious, so it's best to have a good line to work to. Thomas lays out a chalk line. I haven't used a chalk line since I left the farm in Arkansas, but I was happy to get reacquainted with the chalk-line tool (and buy a cool bottle of chalk dust).

If you don't have a five-hour stretch to devote to building the packing box, it's likely that you will have to leave your stock sitting out overnight. As recommended in the book, you want to keep the air circulating around the boards. I sticker my parts when I leave them overnight. This reduces cupping and winding.

Snapping a chalk line is a more reliable way to get a straight line on rough stock than using a panel gauge. And when your edges are unreliable as reference surfaces, chalk is the way to go.

When you rip a board, take your time at the outset. And raise the saw up high – a 60° angle is faster, and you won't get the same blow-out that you'd get by using this high angle in a crosscut. Eventually, you'll become a ripping machine (or you'll buy a band saw).

Onto the Planes

With the pieces sawn to length, it's time to dress the ends and faces of the boards with your planes. "The Joiner and Cabinet Maker" mentions three bench planes: a trying plane, a jack and a smoothing plane. The trying plane is the longest of the three planes and is used for shooting long edges straight and flattening large panels. In some shops, this is called the jointer plane.

The jack is used for coarse stock removal, shooting shorter edges and flattening smaller panels. It is sometimes called the fore plane, and is typically 14" to 18" long.

These three bench planes are the heart of the hand-tool workshop, though some woodworkers get by with only one or two of them. At top left is a trying plane (sometimes called a jointer). To the right is a smoothing plane. At the front is a typical jack plane.

The smoothing plane is a short plane, usually about 10" long or less (older wooden ones are typically shorter than modern metal ones). They are used for the final dressing of the stock.

Throughout this project Thomas makes do with a borrowed jack plane and a smoothing plane, and you can, too. The jack plane's iron should have a slight curve to its edge to prevent the corners from digging into the wood. The marks left by the corner of an iron can be called "tracks" or "gutters."

A wide range of curvatures will work with a jack plane, which typically has a 2"-wide iron. An 8"- or 10"-radius curve will serve well, though some woodworkers will use a flatter curve.

For the smoothing plane, you can sharpen its cutting edge with a slight curve that you create with a little extra finger pressure at the corners of the tool as you sharpen it. Or you can sharpen the iron straight and just feather back the corners with a fine file. In the end, what matters is that the plane leaves a surface that is free of gutters.

The jack plane sees a lot of use in "The Joiner and Cabinet Maker," and it is a workhorse in a hand-tool shop. I have both wooden- and metal-bodied planes and like them both. These are great planes for

Wooden-bodied planes all work the same. The most important thing to remember is to tap the back of the plane's wedge every time you make an adjustment to the iron. Tap the back of the iron to increase the cut. Then tap the wedge. Tap the side of the iron to adjust the cutter laterally. Tap the wedge. Rap the heel of the tool to reduce the cut. Tap the wedge.

Note the hand positioning here. The left hand is a fence to keep the tool square to the face of the board. The right hand pushes the tool forward (note the three-finger grip).

One of the biggest errors beginners make when planing by hand is they take too thin a shaving. Thin shavings are great for smoothing planes. The other planes should take thicker shavings. Here you can see the gnarly curlies my jack spits out.

beginners because they are common, inexpensive and forgiving when it comes to setting them up.

While a smoothing plane and a trying plane require a flat sole to work well, the jack gets by without this fussing because it usually takes a substantial shaving. It still needs to be fairly flat, but you don't have to get out the feeler gauges and machinist granite plates to get the job done.

Once you get your jack working well, you want to set it to take a substantial shaving, which should look like the ribbon on a birthday present as it curls out of the tool's mouth. That thick-ish shaving will get the job – cleaning up your hand-sawn edges – done in a jiff.

Once you have an edge that is straight, take the board out of the vise and use your panel gauge to mark the final width of the board. A panel gauge works like a typical marking gauge except the beam is longer and the head is wider. A panel gauge can have either a needle-like pin or a knife as a cutter. The pin is less likely to wander than a knife is, but a knife leaves a sharper line. The trick to using a knife in a panel gauge is to use several gentle passes to make your mark instead of one mighty stroke.

When I'm working with rough stock, I'll use a panel gauge that can

Here is a panel gauge with a pencil installed. You can alter any panel gauge to accept a pencil by drilling a hole and a slot near the end of the beam (be sure to drill in the end that doesn't have the pin or knife). Then use a screw to pinch the slot and hole around the pencil.

Check your work with a straightedge. Wooden straightedges are lighter, inexpensive and can be any length you please. Note the traditional shape: The beveled top exposes more end grain. I have found that this shape allows the tool to respond easily to changes in humidity.

Check your edge with a try square in at least three places as well. If your edge is true to the straightedge and the try square then it is tried and true.

accept a pencil because the pencil line is easier to see than a knife line or pin scratch.

Then work the edge of your board down to the line left by your panel gauge. If you pay attention to the shavings emerging from your plane, you'll actually see the shaving's edges become a little ragged as you hit your knife or pin line, especially if you left a nice, deep mark. When you see this raggedness, stop planing.

With the long edges planed, it's time to dress the ends of the two end pieces. A shooting board is one way to achieve a true end; however, in this instance Thomas does without. It might sound a bit nuts to dress a board's end with just a smoothing plane and a pencil line, but that's because you've never tried it.

You don't need a fancy shooting board or special plane to do this work. A sharp, fine-set plane and a good eye will get you by. In the future chapters, we'll discuss and use a shooting board, but for this project – a rough box – I encourage you to give it a go freehand.

You will be surprised how a trained eye can discern straight and square at a glance. You only have to see it and achieve it enough to get it in your blood. This is a good place to begin your training. When the ends are square, compare the pieces to one another, which will point out

Trim the ends of your two ends to length using a smoothing plane. The ends might not be square after your work on the edges, so keep a try square handy. Try working from each corner and into the middle to avoid splintering the grain on the outfeed side of your stroke (called "spelching").

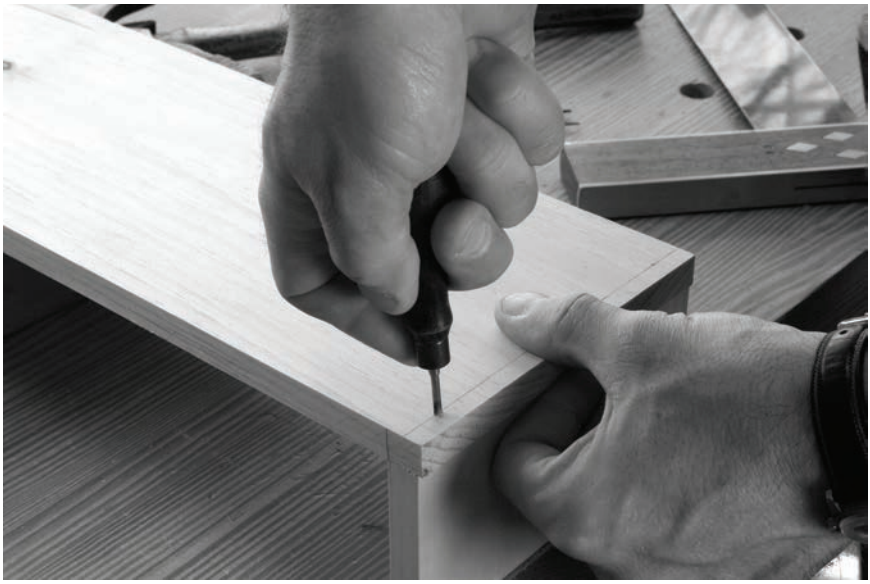
any high or low spots on the ends.

When the ends are square and identical at 14" long, switch your attention to the side pieces. You don't have to square the ends of these two longer pieces. You read that right. The ends of the two side pieces are dressed square after the box is assembled (it works brilliantly).

On your two long sides you need only to mark the inside dimension of the finished box (18-1/2") using a pencil and a square. Those lines will guide assembly and ensure you are making a rectangle and not an oddball rhombus.

"The Joiner and Cabinet Maker" recommends using clasp-head nails to fasten the sides to the ends. A clasp nail is basically a nail with a head, so a good modern choice for this job is a 4*d* fine finish standard nail. These nails have a pronounced wedge to them, so stay your hammer hand for a moment. Take a minute to prepare a sample corner joint using two pieces of 1/2"-thick deal in your shop.

When you do this, you'll see something ingenious immediately. One of the reasons the side pieces are left a bit long is to prevent the nails from splitting the work at the ends when the nails are driven home. The



*Thomas uses a brad awl to start his nails. If you have a brad awl, great. If you don't, a 3/32" drill bit is a second good option for 4*d *nails. Note: brad awls have a flat tip, like a screwdriver, which bores into the wood. The tools that look like an ice pick are scratch awls, which are used for marking joinery – not making pilot holes.*

extra meat at the ends makes a difference.

Even so, I don't think you want to drive your nails into the dead center of the end boards. Cheat them a little in toward the inside of the box. This reduces even more the chance of your work splitting.

Another detail on boring your pilot holes: The author of "The Joiner and Cabinet Maker" recommends that the pilot hole be about half the length of the nail. This works only in the lightest of softwoods. If the wood is even a little tenacious, you'll need to bore the pilot hole a little deeper. This is another great reason to make a sample corner joint to test out your nails and pilot holes to ensure that they play nice together.

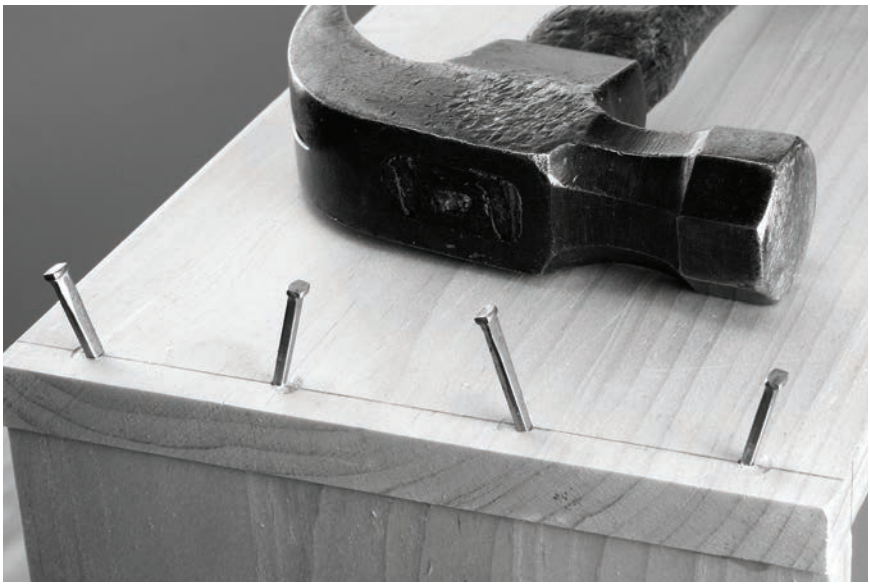
Once the ends and sides are nailed firmly, you can dress the sides flush to the ends. This is easy work for a smoothing plane.

Making Good Edges

The two pieces that make up the bottom are butted together then held close by the cross-strengthener pieces that cross the bottom. The two bottom boards aren't edge-glued (that's the next project).

However, that doesn't mean the joint shouldn't be airtight. As mentioned earlier, a jack plane has its cutting edge sharpened with a

Here you can see how the wedge shape of the nail is oriented to push against the end grain of the board, reducing the chance of a split. You also can see how the sides overlap the end pieces.



Angling the nails as shown helps to increase their holding power in the same way that a dovetail joint increases the holding power of that all-wood joint. The nails are trickier to drive at an angle like this, but it makes a significant difference in the strength of the end product.

Here, I'm driving up the center of the edge, trying to achieve an edge that is straight and square. The jack's curved iron appears basically flat to the wood, so you don't have to be worried about getting good wood-to-wood fit when you prepare edges this way.

slight curve. The curve serves to prevent the corners of the iron from digging into the face of a board. However, the curve also serves a second purpose when dressing edges of boards. You can alter the squareness of the edge to the faces of the board by shifting the plane left or right as you balance it on the edge. If you shift it right, the jack will remove more wood from the right edge and less from the left. Shift it left and the opposite happens. Run the plane down the middle of the board and your plane will basically make a photocopy of the edge.

Note that when you run the plane down the middle that you should pay attention to your body mechanics. Leaning to the right even a tad will encourage your plane to cut deeper on the right. And vice versa.

Work the edge until the straightedge and try square tell you that the edge is perfect. Then dress the mating edge of the other board using the same steps. Then test your joint by placing one jointed edge on top of the other.

Bracing the Bottom

The cross-strengtheners hold the two bottom pieces tightly together. They prevent the bottom from flexing, and they make the finished box

Testing an edge joint isn't difficult. Place the mates on top of one another and rotate the top board a bit. If the corners drag at both ends, the joint is a lead-pipe cinch. If the top board spins a bit, then there is a hump on one (or both) of the edges. Fetch your straightedge to determine which edge is the culprit.

easy to pick up. The cross-strengtheners (sometimes called battens) are made from the pieces that fell off after Thomas ripped the ends and sides to width. Their precise width isn't important.

Cut them to length, then dress their long edges so they are straight and parallel (if you like tidy work). Then chamfer the two long edges of each cross-strengthener. If you have a chamfer plane, this is a simple operation. If, however, you have only your trusty jack, you can still do a fine job. Mark out the chamfer you want (this one is 3/16" x 3/16") then plane down to those pencil lines with your jack.

With the chamfers cut, you're ready to nail the cross-strengtheners to the two bottom pieces. But here's the problem: How do you hold the two bottom pieces together tight as you nail the cross-strengtheners in place?

Nails to the rescue. You can nail the two bottom pieces to your workbench's top. If you use cut nails with a pronounced taper, you'll find the edge joint closes up with just a little pressure and stays put while you fasten the cross-strengtheners.

When you drive the nails into your workbench's top, apply the wedge

Nailing into your bench might seem like blasphemy, but once you've inspected a number of old workbenches, you'll probably get over that problem. People with pristine workbenches probably aren't building much on them. (Frank Klausz excepted. He has a furniture-grade workbench and a long list of completed commissions.)

against the edge of the top. This will seem to violate the rule on cut nails to apply the wedge this way. In a large benchtop, you are unlikely to ever split it with a simple nail. Plus, a few well-placed nails into your bench ensure that you won't need as many clamps for operations such as this.

The Rule for Placing Stuff

When it comes to placing the cross-strengtheners, it might seem suitable to use "Kentucky windage" and place them by eye. However, "The Joiner and Cabinet Maker" pauses here to offer a lesson in proportion.

The cross-strengtheners are placed using this scheme: Take the length of the top and divide it in half. That dimension should be the centerline between the two cross-strengtheners. In other words, the top is divided into four parts. And the spaces between the centerlines of the cross-strengtheners is 1:2:1.

This is important. Not only because it is a great way to position anything, but because you'll also use the same system to place the hinges on the Schoolbox. And, I might add, I think it looks "right."

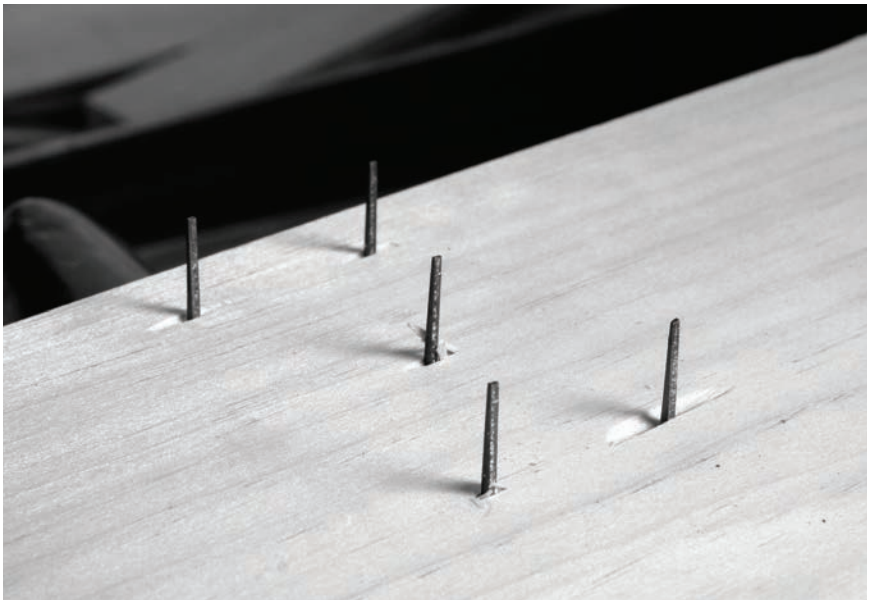
After wedging up the bottom on the benchtop, I use a holdfast to secure the cross-strengtheners in place. Then I drill my pilot holes for my nails and drive a few mostly home.

The book recommends using 3*d* nails. You can easily use 4*d* nails. In fact, I recommend that because you probably already have 4*d* nails on hand and they are easier to clinch. Drive all the nails mostly home. When all the nails are partway in, release the assembled bottom then drive the nails home while resting the assembly on top of some scrap so the tips of the nails don't burrow into your workbench.

Clinching Nails

Clinching (sometimes spelled "clenching") is when you drive a nail that passes through both thicknesses of wood you are fastening. The tip of this nail sticks out about 1/4" and is bent over and driven into the wood.

Clinching adds remarkable strength to a joint. A 1948 study by the U.S. Forest Products Laboratory concluded that clinching can increase the holding power of a nail between 45 percent and 464 percent – depending on a variety of factors, including the species of wood and its moisture content.



When your nails are driven home, you'll have a small forest of nail tips awaiting you on the inside of your bottom assembly. You'll be turning these over and back into the bottom boards using the power of clinching.

Also interesting: The study concluded that bending the tip across the grain increased the holding power by 20 percent compared to a nail clinched along the grain.

But how do you best clinch a nail? There are several methods.

Four Ways and a Trick

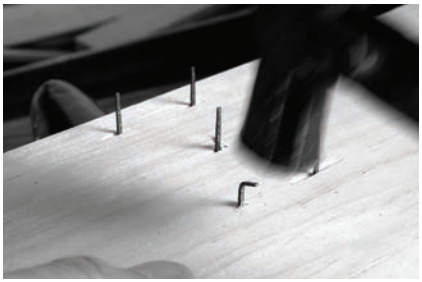
Here's how automated clinching machines do it: They fire a nail in at an angle, and there's a steel plate waiting for the nail's tip when it emerges. When the nail hits the steel it bends over into the wood – essentially it ricochets like a bullet or pool ball.

I've never tried this with a pneumatic nail gun, but it sounds like fun on a Friday afternoon.

For the hand clinchers, there are at least two common techniques. The first one is to first drive the nail through the work. Rest a steel plate, anvil or a second heavy hammerhead on the nail's head. Then tap the tip of the nail with your hammer. It will curl over. Then you can drive the drooping tip back into the wood.

The second technique is similar to the machine process. You drive

I have a steel plate behind the head of this nail as I clinch it. Here is the nail tip right before the first strike.



The head begins to bend after the first strike.

the nail through the work and against a waiting "bucking iron," which curls the tip and forces it back into the wood.

There's one more technique I'll sometimes use when I'm being really, ahem, retentive. I'll drive the nail through. Then I'll use needlenose pliers to bend the tip to the angle I want. Then I'll drive it into the work. This results in a tidy appearance. I admit it's a bit much.

When I have a lot of clinching to do, I've found that a cast iron table saw wing can be your best friend when clinching flat work – doors, lids and the like. Lay the cast wing on your bench and you have a nice big area to support your work as you merrily clinch away. And no, the clinching does not really mar, crack or otherwise defile the cast iron wing.

Fastening Your Bottom

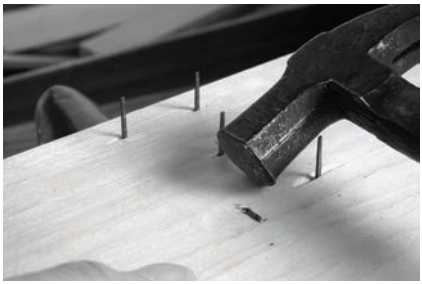
From this point on, things are downhill on this project (in a good way). Secure the bottom onto the case with glue and 4*d* nails. These nails should be driven in at opposing angles just as you did with the pieces into the ends – the angles help keep the bottom in place.

This bottom is oversized (aren't they all these days?). So as you lay out the lines for nailing and the like, you need to be aware that the bottom will overhang the case all around. This is a good thing. Just be aware of the position of your cross-strengtheners. You want these to end up flush to the sides. There might be a little finessing involved to shift the bottom around until everything lines up.

Once you glue and nail the bottom in place, trim the bottom flush to the sides and the ends using a jack plane or smoothing plane. This should complete the part of the Packing Box that holds stuff.

After two strikes the nail's tip is at a 90° angle to where it was originally.

Three strikes and you're down. (Note: Thomas does this in the book with one less strike. Precocious boy.)



One final strike drives the tip back into the wood. This is as dead as a doornail.

If you don't have clinching confidence, try bending the tip a bit with needlenose pliers – then drive the nail home.

A Similar Lid

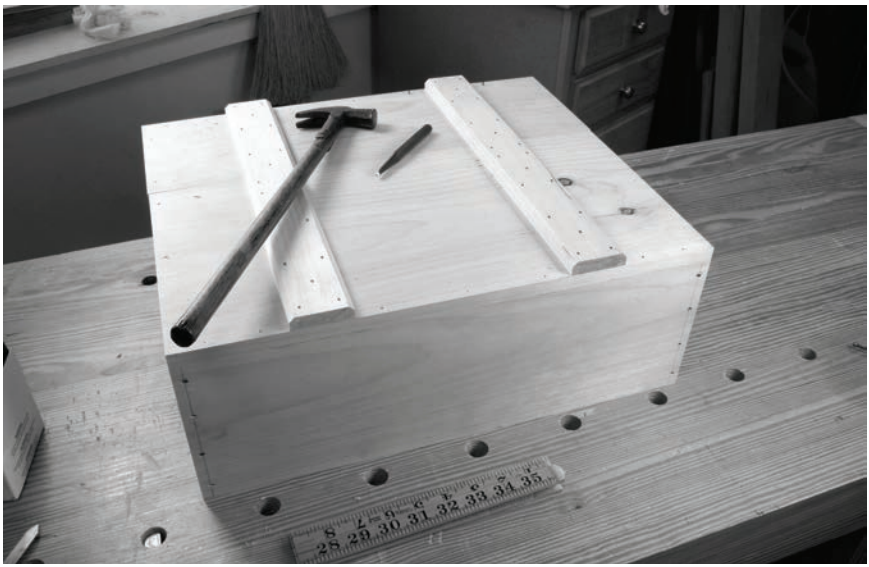
Now make the lid in the same manner as you made the bottom. All the measurements and techniques are the same. The only difference is that you will bore the pilot holes but not seal up the box.

Once the lid is finished, the final touch is to chamfer the ends of the cross-strengtheners on the lid and the bottom. This is more cosmetic than anything. You can do this freehand with a jack plane or a block plane. Or, if you own a chamfer plane, you can make these chamfers quite tidy. Just be sure to work from the ends and into the center. You don't want to spelch your corners at this late stage. Then you are ready to take the Packing Box to Mr. Green so he can be on his way. And you can move onto the next project and its significant challenges.

After I finished this Packing Box, I was a bit amazed at how handsome it was. I've never been so attached to something that was one evolutionary step above a U-Haul box.

I've been keeping this box in my office for the last six months. It's too

A thin bead of hide glue is a great adhesive for attaching the bottom. The nails will hold the bottom in place as the glue sets. Then, as the bottom moves with the seasons, the nails bend and keep everything together.



Drive all the nails through the bottom and into the carcase. Then set them. Note that my nail set has a square head, which matches that of the nails' heads. A round-headed nail set isn't ideal here. Where do you find an old nail set? Transform a round nail set by grinding or filing its edges. This is simple and quick work.

Preparing the lid is exactly like preparing the bottom. Wedge up the pieces that make the panel, then nail on the cross-strengtheners. Clinch the tips. Here, I'm using the cast iron wing from a table saw.

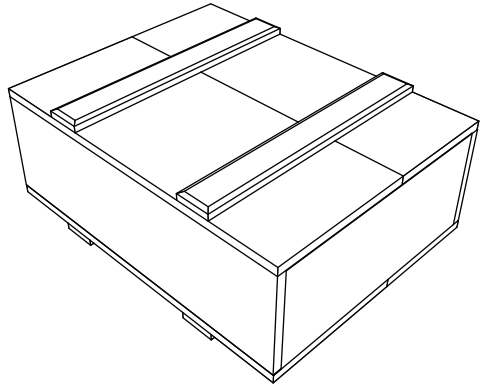
nice to simply set aside, yet it's too rough to allow it to go into the public (read: female-dominated) areas of our house.

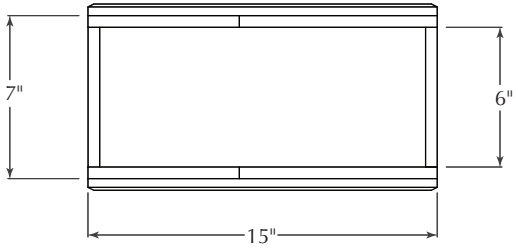
So I've filled it with fireworks and set it aside until I can put a set of strap hinges on it. Oh, and a hasp. Once we shoot off the fireworks in the Packing Box (thank you, Labor Day), I've decided that this will make a good first toolbox for my young apprentice.

The Packing Box

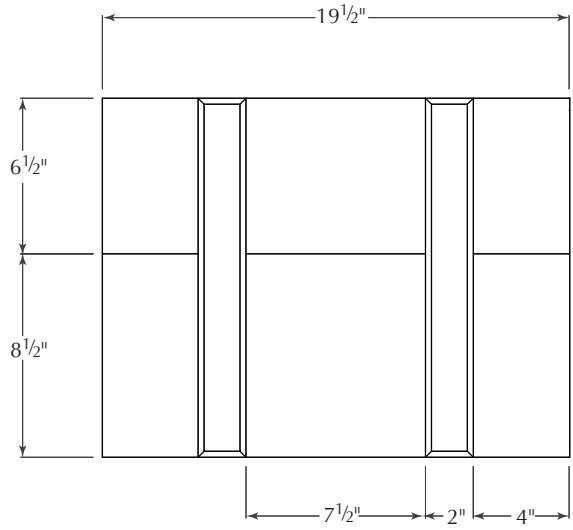
	NO.	PART	SIZES (INCHES)		
			T	W	L
❑	2	Ends	½	6	14
❑	2	Sides	½	6	19½
❑	2	Top/bott. wide piece	½	8½	19½
❑	2	Top/bott. narrow piece	½	6½	19½
❑	4	Cross-strengtheners	½	2	15

Construction Drawings: The Packing Box

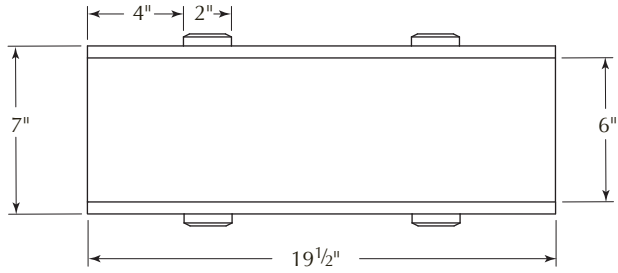




Profile View



Plan View



Elevation View