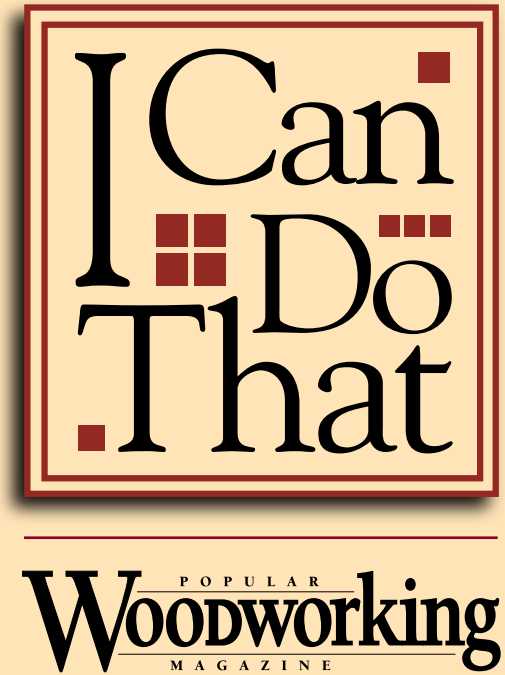

Manual

"More than hankering after the past, I am worried about the future. There seems no room left for Mr. Average; Mr. Expert has ousted him."

— John Brown
the Anarchist Woodworker,
Welsh chairmaker

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Introduction

When you get started in woodworking there are many paths to follow, forks in the road, dead-ends and shortcuts. It's a journey that our forebears would make with the help of a living, breathing guide: a master, a grandfather, a shop teacher.

Sadly, the guides are fewer in number today. And so you are left with people like me to help. Like the making of meat byproducts, it's not a pretty sight. Getting your woodworking instruction from books, magazines, television and the occasional class is a slow way to learn a complex task. In fact, many woodworkers spend a long time (years!) simply accumulating machines and tools before they ever build a single piece of furniture. And when they do begin to build, they inevitably discover that they actually need different machines and tools to make what they really want to make.

So they buy more tools and machines.

I want you to know something important that doesn't get said much: There is another way to begin building furniture. You don't need a table saw, a workbench or even a shop. You don't need to spend $1,000 to build your first birdhouse. You can go to the home center in the morning and start building something the same day.

I'm not talking about building junk, either. The difference between a nice-looking set of bookshelves and a rude assemblage of 2x4s isn't a table saw. The difference is cleverness, sound design and just a wee bit of patience.

To build nice furniture you need a handful of decent tools that you won't outgrow. This document will help you select the right tools that strike a balance between price and function. You need to use these tools correctly; we'll show you how to use them to build furniture (something

you rarely find in the instruction manual). You need a place to work; a driveway, garage or corner of the basement will do nicely. You need good materials; we'll show you how to get everything you need from the local home center. And you need plans and ideas for things to build that look nice and can be constructed with these tools, methods and materials.

The plans are in a column featured in every issue of *Popular Woodworking* magazine. We call the column "I Can Do That" because we want readers to say that (out loud or in their heads) when they open our magazine to that page. This document scrolling across your screen is the instruction manual for every single project featured in "I Can Do That." It's a living document; as we introduce new techniques or ideas, we'll update this manual and load it to the web site for you to retrieve.

Eventually, we think you'll outgrow this manual as your skills improve. I bet you will want a table saw someday. And a drill press. And a smoothing plane. When that day comes, however, you'll also have a house full of well-proportioned, well-built projects under your belt. You will be ready for those awesome tools, and the learning curve will be mercifully shorter.

If all this sounds like something that a bunch of idealists cooked up at a corporate strategy meeting, you're wrong. Though I had some carpentry training from my father and grandfather, I started building furniture on my back porch in Lexington, Ky., with a very similar set of tools. Probably the only major difference is that I had a circular saw instead of a miter saw (I didn't know those existed yet). I built a lot of stuff with my simple setup – some stuff we still have today and some stuff was long ago abandoned at the curb or given away.

So this, dear reader, is a valid path.

My only regret in following it is that I wish that I'd had this manual (or a master) to make the journey easier.

Christopher Schwarz
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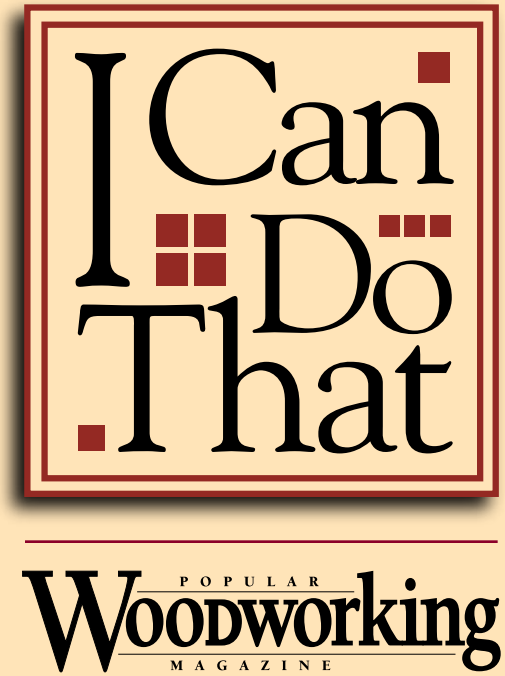
Editor, *Popular Woodworking Magazine*



I · Tools

"The pioneers cleared the forests from Jamestown to the Mississippi with fewer tools than are stored in the modern garage."

— unknown, attributed to Dwayne Laws

Rules for Tools

I'm not an emotional guy. I don't get nostalgic about high school, my first car or my first dog, Scampy. I don't much hug family members at holiday gatherings. But I do have the deepest respect and affection for my tools. The care you give tools will gush readily into the things you build with them. None of the tools in the following kit are disposable; if you take good care of them, they will be around for many years of service.

Stop Rust

Here are some basic tips for caring for all tools. Don't you dare let them rust. Rust spreads like a cancer in ferrous materials (iron and steel) and can make your measuring and cutting tools difficult to use. There are a lot of products out there to prevent and remove rust, but the best thing going cannot be found on the shelf: a small can of vigilance.

When you are done with a tool, wipe down the metal surfaces – especially the cutting surface – with a rag that has been soaked with WD-40. Always keep the rag nearby (mine is seven years old) and renew it with a squirt of WD-40 when it gets dry. Wiping your tool down does two things: First, it removes dust from the tool. Dust can carry salt. Salt attracts water. The combination of salt and moisture will start breaking down your iron and steel tools.

Second, the WD-40 helps prevent rust by forming a thin protective barrier, albeit one that must be constantly renewed to be effective. Other people will disparage WD-40 (I once did). Ignore them. We tested all the rust preventative products on the market one spring weekend. We applied the products to a cast-iron plate and left the plate outside in the dewy grass for a couple days. The area treated with WD-40 came out of the test looking the best. WD-40 is cheap. It's readily available. It won't stain your work. Spray some on a piece of wood and watch what happens. Once it dries, there's nothing to see.

Learn to See

All of your tools require tweaking and maintenance. They might work perfectly right out of the box; they might not. It all depends on who made the tool and what sort of day they were having when your tool came down the assembly line, whether the assembler was a robot or a person.

You need to learn to set up your tools so they do what they were intended to do – cut square, bore straight holes, measure accurately. Once you set them up, you need to check on them every once in a while. Trust, but verify. It's a fact: Tools lose their settings after regular use.

In fact, one of the biggest challenges in woodworking is training your eye to see the right things. You need to learn to see if the cut is square. You need to see if your square is square. Have you ever heard the old expression "tried and true?" It is an expression that applies to your tools as well as your work. When you make a cut you should test it to make sure it's the cut you wanted – this is called "trying" your work. If the cut is correct it is said to be "true." Likewise with your tools, you must try them to ensure they are cutting true. We're going to show you how to test all of your tools (and joints) so they are true. It's not hard, and it pays off big-time.

Buying Quality

You can spend a ridiculous sum on any tool – ridiculously huge and ridiculously small. Jigsaws can cost $35 to $500. Awls can cost $2 to $180. I wouldn't recommend you buy the tool on either extreme end of the spectrum. It would be easy for us to say simply: "Buy the best you can afford." But that's a cop-out. If money is tight, you shouldn't buy the $35 jigsaw. You should wait and save a bit more cash. If you're a wealthy heiress, you shouldn't buy the $180 scratch awl just because you can afford it (save your money for some real jewelry).

What's important is to buy tools that do what they are supposed to do. Tools that hold their settings. Tools that are easy to maintain and adjust. Tools that are reasonably durable. Tools that are safe. We are going to explain what is important about each tool, and what is not. We might not be able to offer brand-name advice or model numbers because those change from month to month and from city to city (no lie; ask me about that fact over a beer sometime). But we can help you narrow your choices considerably.

All of the tools on our list can be purchased from a home center or a hardware store. There is no specialty stuff on the list to search the world for.

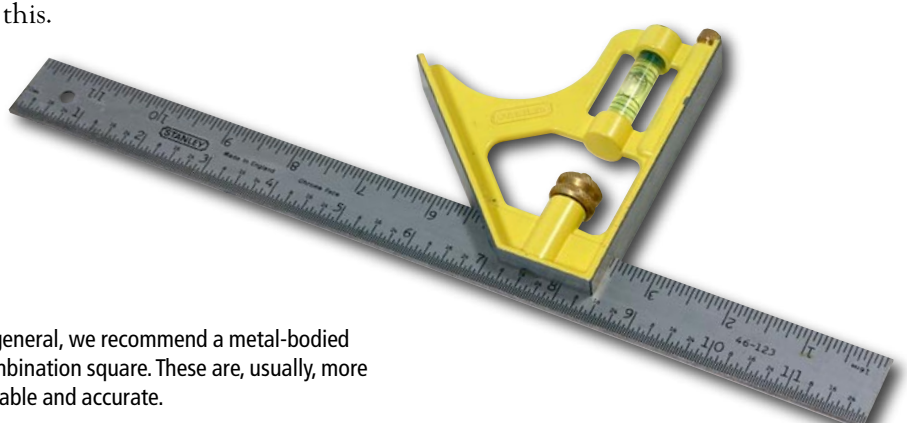
Measuring Tools – combination square, tape measure

You want to buy both of your measuring tools – a 12" combination square and a 16' tape measure – at the same time so you can check the scale on one to make sure it matches the other. They are unlikely to disagree, but if they do, you'll be chasing your tail for a long time before you figure out what the problem is. To buy these tools, take a mechanical pencil and scrap of wood with you to the store that is at least 6" wide, 6" long and has one straight edge.

12" Combination Square

This is the tool that will lay out your joints and cuts, and check all your work to ensure your cuts are accurate. The home center should have a few different brands available with some variance in price. Here's what's important:

First, the square must be square. The ruler and head must meet at 90° or the tool is worthless. There are ways to tweak a faulty square, but we don't recommend them. It's not something you should have to do. This is why you brought the wood and the pencil along with you – they will help you sort through the pile of combination squares to find the most accurate one in the bunch. Don't be embarrassed to do this in the store; they should be embarrassed that you have to do this.



In general, we recommend a metal-bodied combination square. These are, usually, more durable and accurate.

First, take the ruler and press one edge against the straight edge of your board to confirm that the edge is straight. Generally you don't want to see any light peeking out between the ruler and wood. If your wood is out of whack, wander over to the lumber section to look for an offcut to "borrow." Usually there's a barrel by the panel saw or radial arm saw where they cut down big stock into small stock for customers.

With the square reassembled, press the head of the combination square against the straight edge of the board and use your fingers to hold the ruler down and steady against the face of the board. With a pencil, scribe a thin line along the edge of the ruler. Make it as thin and consistent as possible. If the square moves or the line changes thickness, simply move the square and try again.

Now flip the square over so the other face of the ruler is flat against the face of your board and hold the head of the square against the edge. Push the square

The ruler from your combination square can confirm if the edge of the board is straight. Usually off-the-rack lumber will have at least one decent edge.

Accuracy is important here. Keep the square registered securely against the wood as you scribe the line. If anything feels like it shifted during scribing, make another line. Use a mechanical pencil to ensure your line is consistent in width.

up to your perfect line; this is called "showing the line to the square." If the edge of the ruler is perfectly parallel to your pencil line, you have found a square that is indeed square. Congratulations. If the line is slightly off, try the test again. If it's off in the same way, put the square back for another sucker, er – shopper.

Now look at the ruler itself. It must be readable. Look for fine dimension marks. Better-quality squares will have them engraved in the metal rather than printed on. Ideally, you want the ruler to have different scales on each edge. The best combination squares will have one scale in 8ths of an inch, another in 16ths, 32nds and 64ths. You can get away without the 64ths. The 32nds are helpful in most cases. The 16ths are non-negotiable and necessary.

Remove the square from its head by loosening the nut below the ruler. The ruler should be easy to remove and replace. You'll be doing this quite a bit. Now tighten up the nut and make sure the ruler locks firmly in place. It should stay put when you tug on it.

Check out the rest of the square. Is there a bubble level in the head? Yes? No? It doesn't much matter; it's mostly worthless in such a small tool. Is there a removable scribe/scratch awl in the head? Again, pretty worthless in my book. I seem to lose mine in the first week and never miss it. It's too small to use anyway.

Treat your combination square like it is a holy relic. If it gets knocked to the floor, curse yourself and then test it immediately for truth. If it's out, get in your car and head back to the hardware store. Throw away the old head but keep the ruler – it's still useful. Never slide the ruler needlessly through the head (I've seen some people who do this like it's a nervous tic). This activity wears the area where the head meets the ruler. I've had squares that went out of true after only a couple hundred full-length motions through the head. If that happens to you, buy a better brand of square next time.

Now flip the square over and show the ruler to the line. If your square is true and your line consistent, then the line and the ruler should be perfectly parallel. If the line and the ruler don't match up, try the operation again before you reject the square – it's easy to trip yourself up when checking your square.

16' Tape Measure

First, why not buy a 50' tape measure like all the contractors have on "This Old House?" My dad always mocks my 16' tape measure. "That," he says, "is for girls." Let me tell you, the big tape measures are a pain for furniture work. They curl up more and are hard to lay flat on the work. They weigh a lot. They are bulky. They rarely have the right scales on them.

A 16' tape measure is just the right size for furniture and cabinet work. I sometimes use a 12' tape, but it isn't appreciably smaller or cheaper than the 16' tapes, which are pretty easy to find. The first thing to do when buying a tape measure is to pull the tape out and look at the scale. It's nice to have 16ths on the entire length and 32nds along the first 12" or so.

A 12' or 16' tape measure is a good size for building furniture and dealing with household projects. When you start building houses, then you can step up to the big-boy tapes.

After comparing about 15 brands, I like the Lufkin scales. They have fine graduations and avoid the ridiculous gimmickry on some scales (some measure in 10ths of an inch!). Note the 32nds at the bottom and the 16ths at the top.

Now compare the scale on your combination square with the scale on the tape measure. They should match up. Line them up on the 1" mark and check the dimension lines between 1" and 2". The tape itself is important. You want the lines to be as fine as possible and you want the tape to lay as flat as possible on the work (this makes it easy to mark and measure accurately).

There also is a thing called "standout" with tape measures, which is how far out the tape will extend before it bends and droops. For building furniture, this is not a big deal – a mere 36" to 48" of standout is no problem in the shop. (Know, however, that you can never visit a home-building site with this wussy tool.)

Always check your tape measure against your combination square to ensure that the graduations are similarly fine and actually line up. Manufacturers of tape measures and combination squares swear that inaccurate scales cannot occur. I, however, have found occasional discrepancies.

Now check the tab, sometimes called the "hook," on the end of the tape measure. It should move a little bit. How much? Exactly as much as the thickness of the tip of the hook. If the hook is 1/32" thick, the hook should slide forward and back 1/32". Some people foolishly glue (or weld) the hook so it doesn't move. This prevents you from taking accurate measurements on either the inside or outside of your work. When you measure the inside of a box, the hook is pushed in so the outside face of the hook is "zero." When you measure the outside of a piece, the hook is pushed out so that the inside face of the hook is zero.

You can tweak the hook a bit with pliers back at home in order to make the tape measure accurate for inside and outside measurements. For now, find one where the hook looks like it moves enough to be accurate.

There are other features on a tape measure that are personal. A clip for the belt is necessary. The locking mechanism should be easy to activate and release – but not too easy. I've always fumbled with the tape measures that release by pressing a plate on the underside of the tool. I constantly retract the tape by mistake. Also – and this might sound funny – I like to have a brightly colored tape measure. The color makes it easy to find when you set it down.

The hook should move in and out. The distance it moves should be equal to the thickness of the hook itself. Tweak the hook with pliers until the tape consistently measures inside and outside measurements.

Saws – jigsaw, miter saw, circular saw

We had some long discussions about which kind of portable saws should be in this toolkit.

In the end, we settled on a jigsaw for curves, a 10" miter saw for crosscuts and miters and a 7¼" circular saw for ripping solid wood and cutting plywood down to a manageable size.

The jigsaw cuts curves beautifully and it is safe, powerful and inexpensive. (In fact, some professional cabinetmakers use their jigsaw for curves more than they use a stationary band saw.) Plus, with a little practice, you'll find that you need very little clean-up of your sawn edges. We'll show you how to achieve this (the trick is the blade you buy and your left thumb).

The miter saw is a great crosscutting tool for fine and rough work when it is properly tweaked. It will make airtight crosscuts, perfect miters and even break down stock into manageable lengths for you to work with your other tools. A simple 10" miter saw may be limited in capacity to cut only a 1x8, but when you're dealing with off-the-rack lumber from the home center, 1x8 is likely the largest lumber with which you'll be dealing.

The circular saw can be the last saw you add to you basic kit. You can make rips with a jigsaw if you have to. But when you tire of the clean-up, we recommend you buy a sidewinder circular saw. Once you build a simple jig for the circular saw you will be able to make perfect finished cuts that will allow you to even glue up several narrow boards into a wider panel – that's a task most people think you need a table saw and power jointer to do! Let's look at these tools in detail.

Jigsaw

This tool seems so simple, yet it is a subtle thing, capable of immense finesse in skilled hands. There are lots of features on these tools that are rarely discussed from a furniture-making perspective, but that's exactly what we're going to do here.

Here you can see what we're talking about. On the standard top-handle jigsaw, (at rear) your hands will be much higher – 3" to 4" higher. That said, I wouldn't reject either of these jigsaws – both cost more than my monthly truck payment.

First, there's the body style of the saw. There are two kinds of bodies: the common top-handle grip and the more European "barrel-grip" style. I absolutely hate to do this to you, but I encourage you to look for the barrel-grip saw. It bewilders me that the top-handle saw is the dominant style in this country. These tools are more tippy and harder to steer than the barrel-grip tools. This tippiness is not a big deal when you're just trying to notch some 2x4s on the job site, but it makes an appreciable difference in the shop. Keeping your hands and the tool lower to the work improves your control. This maxim is not just for beginners; this applies to everyone.

The next most important thing is the blade-release mechanism. This is something you're going to be doing quite a bit and so it should be simple. The best blade-release mechanisms are almost effortless: Pull a lever and the blade drops out or pops out. Lots of saws have sticky mechanisms – you don't want to have to grab the blade and wiggle it or tug it to remove it from the body. Eventually you will cut yourself.

This is a barrel-grip jigsaw – chic and European and hard to find in North America. Too bad; some of us really like the lower center of gravity. If you can find a jigsaw like this one at your home center, we recommend it. If you can't – don't worry about it.

Older saws need special screwdrivers or require you to twist a knob a good deal

to remove the blade. Avoid these if you can because there are less frustrating ways to work. Speaking of blade-holding mechanisms, there are two dominant styles of blade-holding mechanisms on the market: a T-style and a Universal style or U-style. The T-style blade has a (surprise) T-shaped shank on top. The Universal-style blade has a hole bored in the blade. I've used both. I don't really have a preference. In fact, my preference is to buy a jigsaw that can hold either style blade. The jigsaw gurus tell me that this compromise results in a blade-holding mechanism that is weak. But I have never – never – had a jigsaw blade come out of the tool while I was working.

Jigsaws have different "strokes" which is the amount that the blade travels up and down in the tool. A 1" stroke is typical and fine. Shorter-stroke saws are generally at the very low end of the price spectrum and should be avoided anyway. You'll also see a lot of hype about the "amperage" of a tool. By and large, this is not important for furniture work. By and large, it's an exaggeration or obfuscation anyway. I'd give up a couple amps of alleged power in exchange for a 12' power cord any day. And do check the length of the cord. A short cord gets hung up quickly on your work where the plug meets the extension cord.

Another feature that gets played up is the so-called "orbital setting." The orbital setting is the amount that the blade will travel forward and back in the cut. Usually, most saws have four settings: zero, one, two and three. "Zero" means no forward movement, which results in a slow cut but a clean one (generally). "Three" is when you need to cut plywood to cover your windows for an oncoming hurricane. It's fast and rough. Set your saw to "one" and you'll be fine until you move into the thick stuff.

How about a blower, do you need one? A blower puffs away dust from your cut line to make it easier to follow. I like a blower, otherwise I find myself doing all

Shown is a properly set jigsaw with the orbital on "1." When you work in thicker material (or need to saw really fast), switch up to "2" or "3."

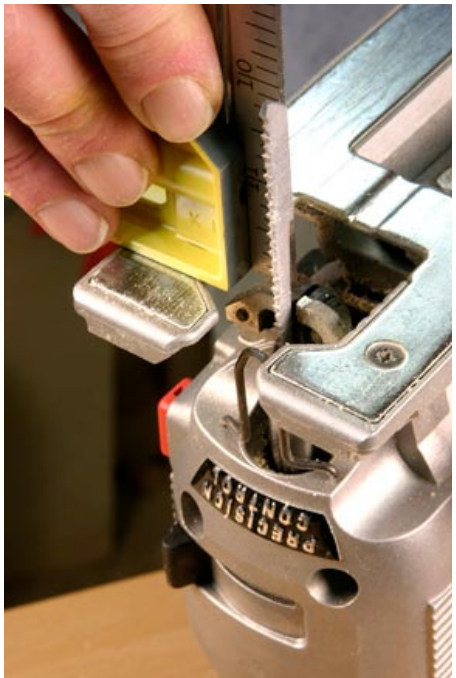
the puffing and turning blue. How about a worklight? I didn't think I'd ever advocate a worklight, but I wouldn't kick it out of bed for eating crackers. If your saw has one, you'll use it and like it. It can get dark down there by the blade.

Other features aren't so important. How you bevel the base of the saw is pretty irrelevant – some manufacturers

play up the fact that the saw requires no tools. I rarely find the need to bevel the base. Once a year maybe. So no big deal. Do make sure that your blade is cutting straight down. You can check this first with your combination square, but keep the ruler away from the teeth of the blade. The teeth can be bent, or set, to either side of the blade on some blades. Register the ruler against the steel behind the teeth.

Then make a careful and straight cut off the end of a board. No curves (these tend to deflect the blade). Now check the finished cut with your combination square. If the cut is square, you're good. If it's not, then tweak the base of the tool until the resulting cut is square. Then cut a curve at a comfortable pace and check the work. The edge should be square to the face. If the blade deflects, then slow down your cutting pace.

You do need variable speed at the trigger – the more you press the faster the blade goes. This is common on all but the cheapest tools.



Most people don't check the blade to ensure it's square to the baseplate, but it's a good idea. Even the best saws (such as this Bosch) will go out of alignment. If you don't check this occasionally, you'll be in for a rude shock when you try to do some precision work.

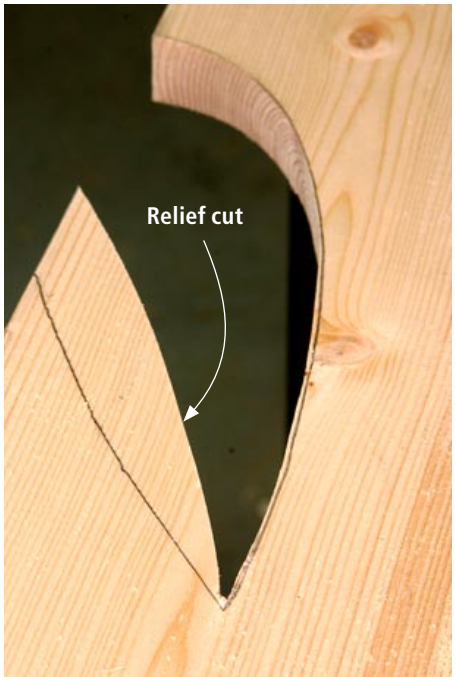
It's also good to test your results occasionally. If your blade is square to the baseplate but your work isn't square, there could be a couple problems. You could be cutting too fast, causing your blade to deflect. Or your blade is slightly bent. Either problem requires a remedy.

Jigsaw Use

Like any portable saw (hand or power) you want to have a pencil line that shows you where to cut. Always cut to one side of the line – the waste side. Cut as close as your skills allow. The less wood you leave, the less clean-up work will ensue, but the more disastrous the mistakes will become. I shoot for 1/32" of waste left or less.

The jigsaw is a two-handed tool. One-handed use is for hot dogs. One hand should grasp the tool's body and trigger. Keep the other hand with a thumb pressing down on top of the base against the work. I use both hands to steer the tool. My trigger hand supplies the forward motion and does the heavy steering. My other hand provides the small adjustments that are critical to tracking my line. The thumb also keeps the saw from jumping up and down in the cut. If you keep the saw's plastic guards in place, this is quite safe.

You also need to know about "relief cuts." These are the difference between



With a little practice you'll be able to cut very close to the line with your jigsaw. If you can leave just 1/32" of waste, then it's simple work to rasp (or sand) down to your line. If you cross the line while cutting, you'll have no line to rasp to. Make a relief cut into the corner before cutting the curve.

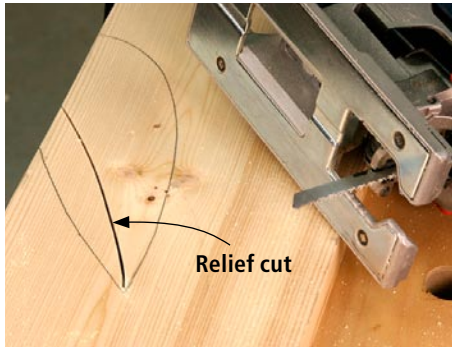
The jigsaw is a two-handed tool. A thumb on the baseplate will help steady the tool and will allow you great finesse as you round curves and track a line. We've removed the plastic guard on this saw (sorry, we shouldn't do that). With the guard in place, it's quite a feat to cut yourself.

success and disaster at times. Simply put, relief cuts are cuts you make into the waste that allow you to remove the waste one chunk at a time. They're sort of like waypoints for your tool. When your waste comes out in small chunks, it's less likely to droop and split and splinter, which can ruin your work. It also allows you to turn curves that are a bit tighter by freeing up space behind the blade, allowing it to turn.

I usually make a couple relief cuts where my cutline is heading into a turn or coming out of a heavy turn. Also, I'll make a relief cut when I see that the waste is going to be 6" long or so. This really depends on how big your waste piece is going to be and how droopy it will become during the cut.

We need to say a word about blades. Cheap blades will burn or leave a splintery mess in their wake. Buy nice blades and take care of them – wipe them clean with your WD-40 rag at the end of your shop time that day. After years of trying out different blades, we generally have two kinds of blades in our shop. I like the Bosch T234X Progressor blades, with 11 teeth per inch ("tpi" in shop lingo). Senior Editor Bob Lang likes the Progressor for straight cuts, but prefers the T101BR for curves where the Progessor is too "bitey" and "rough."

Both of these are T-style jigsaw blades, the most common style on the market. At bottom is the Bosch T234X (my favorite) and at the top in the T101BR (Bob's favorite). Note that mine is bigger.



Learning where to make a relief cut takes some practice. If you have a sharp corner, such as this, that's always a good place to put a relief cut. You'll also want a few relief cuts in a long cut to prevent your waste from sagging and possibly breaking off.

Miter Saw

These saws were once the provenance of the high-end finish carpenter. Then the rough carpenters started using them (where they're called "chop saws") as did the furniture makers. Each profession leans on a different feature of the tool to do their work. Finish carpenters like the combination of portability and accuracy. Carpenters like their speed and power. Furnituremakers like their accuracy and safety compared to a radial-arm saw (sometimes called the "radical-harm saw").

These tools are rarely perfect out of the box. They require tweaking for furniture work, plus they require a different way of working that we'll discuss later. But they are by and large incredible tools once you understand a few things.

Your basic 10" miter saw is accurate enough and durable enough for a lifetime of woodworking. Beware of low-priced saws, even from national brands. One of the ways they lower the price is by equipping the saw with a poor-quality blade. You'll have to replace that blade immediately, and that almost always negates the price savings.

Styles of Miter Saw

There are three major saws in the miter saw family:

- **Straight Miter Saw:** This saw makes miters at any angle, usually between 47° left and 47° right at minimum. The cut this saw makes will always be 90° to the face of the work.
- **Compound Miter Saw:** This saw does everything a straight miter saw does, plus the head tips left and right to make "compound" cuts. Compound cuts are when you make a cut that is angled in two directions, across the face of the board and across its thickness. This is mostly a feature used by trim carpenters for installing crown moulding. The heads can tilt one direction (right) or both (left and right).
- **Sliding Compound Miter Saw:** This saw does everything the above saws do, but it also runs on a sliding carriage, which allows you to cut wide boards – most of these saws will cut a 12"-wide board; some go as far up as 16". These saws are as expensive as a good entry-level table saw. And most of the features are little-used by a furniture-maker.

So which saw do you need? Really? Probably just a straight miter saw. These are getting harder to find these days, so you might have to step up to a compound miter saw. And even these are getting cheap. Thanks to overseas manufacturing, I've seen good 10" compound miter saws for about $100 or a little more. What about the blade size? The 12" saws are notably more expensive, though it's nice for the occasional cut where you really need the extra width. However, we honestly think you can get by just fine with a 10" saw.

Important Features

These saws can be loaded with extras, so let's cut through the clutter here. Two things are really important with this tool. First, it has to have a decent carbide-tooth blade that is capable of making clean finish cuts. Look for a blade with at least 40 teeth (and as many as 80). The

A carbide blade on top of a steel blade. Luckily, the steel blades are becoming more difficult to find, even on the cheaper saws. If you see a steel blade, don't buy it unless you need something to chew up your work in an unacceptable manner.

more teeth you have the smoother the cut, but having more teeth slows the cut and increases the chance you'll burn the work. And if you fall for a cheap saw that comes with a high-speed steel blade, you'll be upgrading it immediately and probably spending a good deal more money than you have to.

Second, you need a saw that is easy to adjust so the blade is 90° to the fence. Note that I'm not talking about the little handle up front that allows you to swing the head left and right. I'm talking about adjusting the tool so that when the head is locked at 90° it makes a perfect 90° cut. Sometimes you have to adjust the fence behind the blade, sometimes you adjust the points where the head locks down. We prefer this second method of adjusting the saw because it is faster and it doesn't ever result in you bending the fence. I've bent a couple, even while being careful. And when the fence is bent, you'll never get a square cut on both sides of the blade.

Follow the manufacturer's directions

The fences on these saws can be bent during assembly. When you get your saw out of the box, check the fence with your square to ensure it's straight. If it's not, take the saw back and exchange it. A bent fence is almost impossible to fix and will cause a lifetime of headaches.

A less-common problem is that the fence isn't square to the table. Check this along several points on the fence. A twisted fence will wreak havoc with your accuracy.

for squaring up the tool, and then make a sample cut and check it with your combination square. This brings us to another critical aspect of miter saws: How you make the cut. I've found that the No. 1 cause of errors in this tool is not that the fence is off, it's that the work has shifted slightly during the cut, spoiling your accuracy.

The problem is these tools have fences and tables that are make of machined aluminum, which is slippery. So it's quite difficult to hold your work perfectly during the cut. It's possible, of course, just difficult. Some manufacturers supply a hold-down clamp to secure the work against the table. These can be slow and can get in the way. The best solution I've found is to apply a layer of #120-grit peel-and-stick sandpaper to both sides of the fence. This works wonders.

The other way to spoil your accuracy is by taking too light of a cut and taking it too fast. For example, let's say you want to trim 1/32" off the end of a board. You line

Personally, I don't understand why they make the table and fence so smooth and slippery. Their job is to support and grip the work. Even after using these tools for 13 years, I still struggle with keeping the work immobilized as I cut it. If it shifts even a tiny bit during the cut, your cut won't be square. Adding a bit of self-stick sandpaper to the fence works wonders.

up the board as best you can and make your cut. It's not a lot of material so you make the cut quickly. Sometimes, not always, the blade can deflect out when you do this. This results in a cut that is not 90° to the face of the board. If you need to make a cut like this, take it a bit slower, which will keep the blade true.

The bottom line with this tool is it's always best to check your work, especially if you don't have some sort of stop to constrain it from slipping around. So cut each joint and try each joint. You'll be fine.

Other features of miter saws are less important. We haven't become fans of lasers on these saws yet. That may change, however, once they get them working just right. The raw amperage of these saws is mostly a non-issue. Almost all of them list their power as 15 amps, which is the maximum for a typical 120-volt household circuit and plug. All of the saws we've tested, even the cheapies, have enough power to cut standard material thicknesses with no complaint. The dust collection on all of them is quite poor – learn to live with it.

A few saws allow you to do stop cuts to make grooves or trenches across your work. You'll probably never use this feature. There are also high fences (best for crown moulding) and gizmos that allow you to micro-adjust your miter settings. These are not deal-breakers (or deal-makers).

Here's a common operation with a miter saw – trying to remove just a bit to sneak up on a cutline. If you make this cut too fast (especially in hardwoods or thick stock), then the blade can deflect. Though it seems like you're making a light cut, slow down and take this operation a little slower than usual and check the cut across the thickness to ensure everything's OK.

Circular Saw

When we decided on the list of power tools for our toolkit, we selected the jigsaw over the circular saw. But there are many instances where the circular saw would be the best choice; straight-line rips and cutting plywood are the most relevant. So we decided that the circular saw would have to be the first power tool added to that original list.

There is much to consider when selecting a circular saw, the first of which is the saw's size. The size of the saw is described in terms of blade diameter. You'll find saws that are from 4⅜" to 10¼" with a number of entries between.

So, how do you choose? To begin, take a look at the depth of cut that can be made with the saw set at 90° and at 45°. As you begin building projects from this series you'll find that your materials will be mostly ¾" or 1½" thick. So, the need to cut these materials should inform your purchase.

A 4⅜" circular saw will cut only 1¼" in thickness set at 90°, and ¾" when angled at 45°. So, it's obvious this saw is not the one for your shop. You'll find that a 6½" saw just clears a 1½" cut at 90° but because the size is a bit odd, you may have trouble locating blades.

The most popular size of circular saw is the 7¼". Any store that carries circular saws will have a complete line of 7¼" saws from which to choose, as well as a number of different blades designs (we'll discuss those in moment). The depth of cut with the 7¼" saw at both 90° and 45° is more than required. This saw meets or exceeds the requirements of most woodworking so there is no need to look into beefier models that are heavier and higher in cost – not to mention they can become unwieldy.

Saw Designs

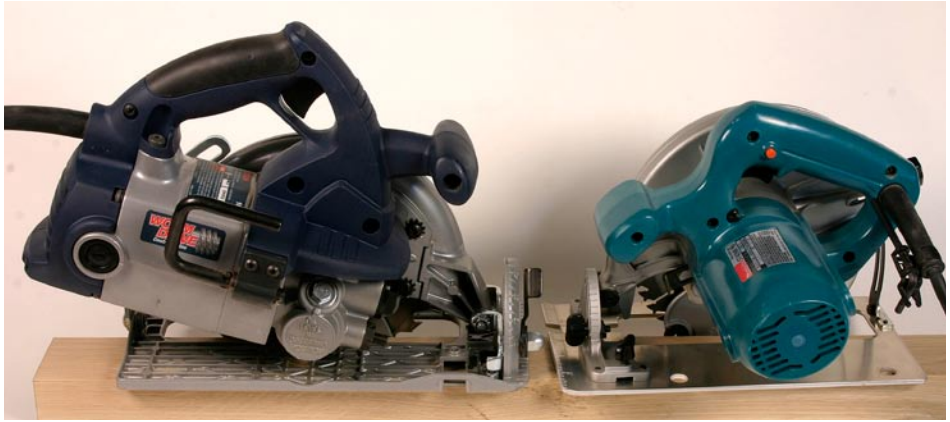
Circular saws are divided into two general categories – worm drives and in-line saws, also known as sidewinders.

Worm drives are easily recognizable due to their design. The motor sits behind the blade, which is driven by a "worm" gear (it looks like a curled worm.) These saws provide a good line of sight while cutting and will extend your reach across sheet goods, but they are more expensive than sidewinders. And, because the worm-drive saw is a much heavier saw – 14 to 16 pounds – they can be awkward to use because they tend to be front heavy.

Sidewinders, so named because the motor sits beside the blade, are the most common configuration. Sidewinders provide a better balance in your hand because the handle is directly above the motor. Bottom line: We recommend a 7¼" in-line saw.

What to Look For in a Saw

So where do you go from here? What about the power? Most saws boast of amps. The 7¼" saws generally have a 13- to 15-amp motor. Amps relate only the amount of electricity that the tools use, not the power sent to the blade. Is that



Not only can you see the difference between the worm drive saw (left) and the sidewinder (right), it is obvious that the sidewinder will be a lighter, more easily controlled saw.

good, or is horsepower better? Horsepower is generally measured when the saw is not in a real-world cutting situation. This too, is not an informative basis for comparison. The better way to select a saw is by price. A good sidewinder for woodworking will set you back around $100 to $150. Sure, there are saws that cost less, but they aren't going to last a lifetime nor be able to withstand the rigors of the woodworking shop. They would be great for a homeowner looking to use the saw occasionally.

Comparison Shopping

In side-by-side comparisons of saws, begin with an inspection of the saw's shoe – the bottom plate of the saw. You can find shoes that are aluminum or magnesium as well as plastic and other material. Our recommendation is to stay away from the plastic shoes and look for a metal base; cast metal would be best. A shoe with ribs will have added reinforcement in case (or when) you drop the saw to the floor – but that added strength adds weight to the tool.

The overall weight of the saw will affect comfort, and that is also an issue in choosing your saw. Also, check the handle positioning and the balance of the saw. Making sure that the saw fits your hands and feels comfortable while in use is key in the selection process.

Next you need to look at the adjustments of the saw. The two adjustments are depth of cut and angle. You'll find knobs, levers and wing nuts used to allow these adjustments. Large knobs and smartly placed levers will make the adjustment both quick and accurate. Small, out-of-the-way levers and wing nuts are less handy.

Large knobs can makes adjustments quick and easy when adjusting the depth or angle of cut.

The last issue to consider is how easy it is to change the blade. We've seen saws that require you to insert a nail through a hole in the blade to lock the blade. Or worse yet, to hold the blade as you try to release the arbor nut. These are not the best scenarios. A shaft-lock mechanism is the best option. This feature locks the shaft from rotating, allowing easy use of a wrench to remove the arbor nut.

About Battery Power

The battery-powered saws are new in design (because the battery technology has advanced) and look inviting. However, we suggest avoiding these for your woodworking toolkit. They might be fine for the homeowner but the cutting power and length of time you can use the tool are greatly reduced. What could be worse than having the piece ready to cut and finding out that the entire project needs to be put on hold because the battery on your saw is low? Corded saws are the way to go.

A Word About Blades

A sharp blade is very important when using a circular saw. Dull blades are one of the causes of kickback, which is when the blade catches the wood but instead of cutting the piece, the saw is propelled back toward the operator. This is dangerous.

There are many choices when selecting a blade for your circular saw. First, you should always use a blade that is sized for your saw – if you have a 7¼" saw, use a 7¼" blade. Installing a smaller-diameter blade will not allow the saw to develop the rim speed needed for the machine to work at its full potential.

Second, base your blade decision on the type of work the blade will perform. If you're rough-cutting lumber, a 24-tooth carbide blade would be right. But, using that blade to cut veneer-faced plywood would result in a massive amount of tear-out.

There are blades that have 16, 18, 24, 40 or 60 (teeth and some in between, I'm sure). There are blades for plywood as well as masonry. You have to decide how the saw will be used in order to select the correct blade. Our toolkit would have a 24-tooth carbide blade (carbide tips on the teeth will stay sharp longer) for rough-cutting stock and a 40-tooth carbide blade for the finish cuts.

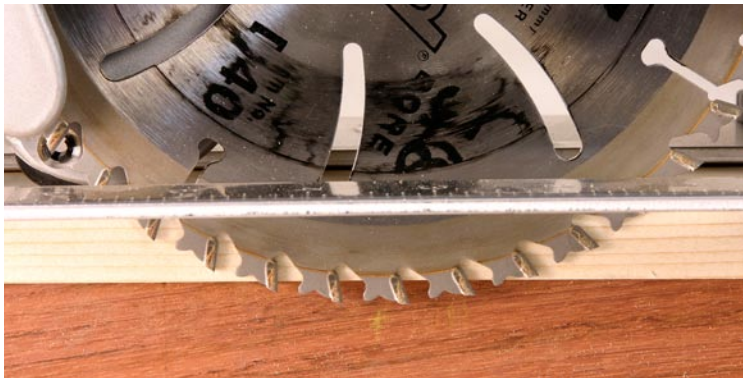
The cut made with a circular saw should not be considered the last step in the milling process. A hand plane should be used to fine-tune most of the edges for better-quality results.

Using the Circular Saw

There are a few basic guidelines for using a circular saw. Adjust the depth of cut prior to cutting any material. Loosen the knob or lever and raise or lower the shoe until the blade is between 1/8" – 1/4" beyond the lower edge of the material to be cut. Remember to tighten the depth knob before beginning the cut. Setting the depth of cut too deep could lead to binding and kickback.

Because the circular saw cuts with the blade coming up through the material, it is best to cut with the face side, or best side, down. Any tear-out would then be on the back side of the material and away from sight.

Always start the saw with the front of the shoe resting on the workpiece; don't let the blade make contact with the wood until the blade has reached full speed. Move through the cut with the motor/base resting on the "good" side of the workpiece, not the "waste" material side and do not remove the tool from the workpiece before the blade has come to a complete stop.



Properly setting the depth of cut will help extend the life of the blade and lessen the possibility of kickback.

Another good rule of thumb is to have your workpiece properly supported. This does not mean laying the workpiece across two sawhorses while cutting the middle of the board. This tool is designed to cut through material resulting in one piece – the waste – falling away.

To cut the end off of a board, make sure to have the waste material extended past any supporting surface. As the cut is finished the waste will fall away. In cutting sheet goods you may not want the waste to fall. In this case, support the work from below using several long lengths of scrap so the work is fully supported. Some people cut sheet goods on top of 4' x 8'

foam insulation board. Either way, set your cutting depth so you don't cut through your support below your work.

Making the Cuts Freehand

Many of the cuts made with the circular saw will be freehand cuts. This is where the saw is guided by hand and eye, not with guides or jigs. There are two methods for completing this type of cut while staying on your line and making straight cuts.

The first is to use your eye to watch the relationship of the blade to the cut line. With your safety glasses in place, tilt your head and watch the cut. The dynamics of the circular saw will enable to you to make straight cuts more accurately than you can with a jigsaw. The circular saw, because the cutting area of the blade is wider than a jigsaw blade, will help to guide you on a straight path. It is possible, however, to veer from the cut line so keep your attention focused.

The second method of cutting by hand and having the resulting cut straight is to use the "gun shot" to help guide the tool. The "gun shot" is a notch in the saw's shoe that aligns with the edge of the blade. Maneuvering the saw while keeping the notch at the line will provide a straight cut – as long as you started the cut at the line to begin with.

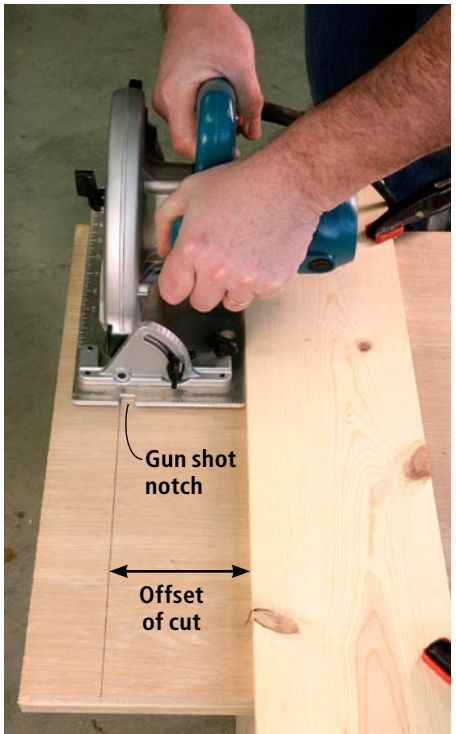
Cutting with Fences and Guides

Another much used method of making straight cuts with the circular saw is to use a fence or other type of guide. As long as the fence is straight, the saw will follow that fence and the result will be a straight cut.

One type of guide is a Speed Square or an aluminum carpenter's square. To use this setup, position the saw so the blade touches your cut line, then move the Speed Square tight to the saw's shoe on the opposite side from the blade. At the same time, hold the square tight to the edge of the board to allow the shoe to ride against the square. This technique is best suited for cuts across the grain (called crosscuts) no wider than the square itself.

Aligning the blade with the cut line and using a speed square provides a temporary fence for a square or straight cut.

Making wide crosscuts requires a different fence or guide. The best fence is plywood; the factory edge works great.



Clamping an auxiliary fence to the workpiece is an excellent way to achieve a straight cut, so long as the fence is also a straightedge. Notice the "gun shot" notch used for freehand cutting.

But, any scrap piece that has a straight edge will serve. Use the fence just as you would a Speed Square, but clamp this guide to the workpiece.

This arrangement is one of the best ways to accurately make cuts with the grain (called rip cuts), too. Place the plywood in relation to the cut line as before and repeat the process of running the saw shoe along the cut, ripping a straight line. Be sure to have the work supported correctly.

A Specialized Guide

If you plan to use your saw extensively we suggest making a fitted guide that is designed to work with your saw for crosscuts or rip cuts.

Why make a fitted guide? Without a fitted guide, you have to do more measuring to position your auxiliary fence on your work. You're always having to add in the width of the saw's shoe when positioning your fence. A fitted guide allows you to position the fence right on the cut line each time and the resulting cut will be perfect.

You'll need a piece of plywood and a straight piece of scrap stock (plywood will work here too) to build this fitted guide. The plywood needs to be about 5" wider than the shoe of the saw and the scrap should be about 4" in width, with a factory straightedge.

Attach the scrap to the left-hand side of the plywood keeping the straightedge to the right. Clamp the assembly to a bench or worktable making sure that the single-thickness edge is hanging off of the bench.

Next, adjust the saw for the thickness of the plywood and cut through the plywood as the shoe rides tight against the scrap. This is just like making a rip cut with a fence, but this time the fence is attached.

The freshly cut edge is now in line with the saw blade. Each time you make a cut, all you need to do is locate the jig exactly at the cut line and clamp it in place. Each

The jig has a wide fence to make clamping easy. Because this jig was created using the circular saw, whenever we clamp the jig exactly at the cut line, the result will be straight and on the layout line.

time you run the saw against that scrap, while the saw is resting on the plywood, the cut will be correct to your layout. One thing to remember is that you need to set the depth of cut to the material you are cutting and the thickness of the plywood. This will shorten the thickness of cut of the saw but you get accurate results each and every time. If you need the additional depth, resort to the hand-held cut methods described earlier in "Making the Cuts Freehand."

Boring Tools – power drill, awl

I'm going to guess that you already have some kind of drill. Maybe it's a corded drill; maybe it's a cordless drill. If I had to own only one drill it would probably be a cordless drill because these tend to have clutches and different speed ranges that make them ideal for driving screws in addition to drilling holes. However, nothing beats the raw and unlimited power of a corded drill. A handful of the corded drills have clutches and speed settings, and I don't know why there aren't more around. Probably because we love cordless drills – they're probably the hottest-selling tool on the market.

There are a lot of factors to consider when buying a drill because we use drills for so many different things. I'm going to tell you what's important for building furniture. First, you need a drill that is lightweight, balanced and will hold all the bits you need, from the tiniest wire bits up to 3/8"- or sometimes 1/2"-shanked bits. If you are buying a cordless drill, you probably should buy a 9.6-volt or 12-volt model. These tools generally satisfy all those requirements above – except they typically only hold bits up to 3/8" in diameter, which is OK. Heavy drills (such as 18-volt drills) are hard to wield with any finesse. And you are so rarely far away from your charger while you're in the shop that the run-time issue is moot.

I got by for years and years with a corded drill alone. Once I finally bought a cordless drill, I was glad I'd made the upgrade. Not only do you lose the cord, but you gain some features, such as control over your top speed and a clutch that prevents you from over-torquing your screws.

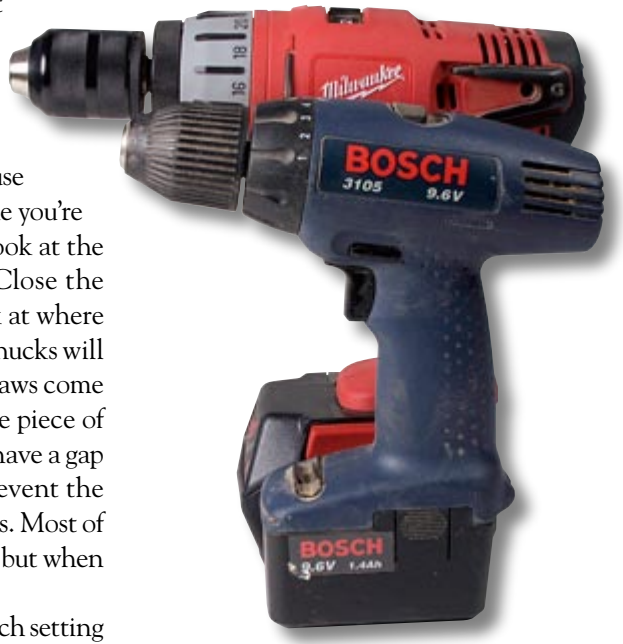
You need variable speed. This is found on all but the cheapest tools. Variable speed is where the more you pull the trigger, the more rpm you get. You want your drill to ramp up smoothly, though no drill is perfect in this department.

A keyless chuck is a desirable feature.

When you're in the store, close the chuck of the drill that you're considering and take a look at how closely the jaws close. The best chucks will close down to nothing. The lamest ones will allow you to get a toothpick in there. The tight jaws will let you grab the smaller bits that are occasionally important for woodworking.

Though the keyless chuck might not hold as tightly as a keyed one, this is almost never an issue. The keyless chucks hold plenty tight enough and are so much faster and easier to use than their keyed cousins. While you're examining the chuck, take a look at the three jaws that grab the bit. Close the chuck on itself and take a look at where the three jaws meet. The best chucks will have a seamless fit. When the jaws come together they will look like one piece of solid metal. Lesser chucks will have a gap at the center. This gap will prevent the chuck from closing on small bits. Most of the time, this is not important, but when you need a tiny hole …

Let's talk a minute about clutch setting and speed ranges. These are important "finesse" settings that you'll become more sensitive to the more you use your drill. Most drills (with a couple notable exceptions) have two speed settings, low and high. In general, the low setting is for



Maybe the big drill doesn't look so big to you here. Just wait until you have to heft this thing up for the hundredth time above your head. Then you'll want the wussy 9.6-volt drill. If you work far away from your battery charger (like on an oil derrick) then get the big drill; otherwise, smaller is generally better (and cheaper!).

driving screws and the high settings are for boring holes. That's simple enough. Then you have the clutch of the drill to consider. The clutch has more settings than any reasonable person needs. Perhaps manufacturers see it as a way to get the upper hand on competitors. I just wish I didn't have to do as much fiddling and clicking to get the right clutch setting.

What does the clutch setting do? It's for driving screws. When you reach a certain amount of torque, the clutch disengages the motor from the chuck to stop the spinning action. This disengagement can prevent you from making some critical mistakes, such as snapping or stripping a screw's head. Or driving it too deeply in softwoods – perhaps to the point where the screw won't hold.

How do you use the clutch? Here's how I do it: When I'm driving a bunch of screws into a cabinet back or the like, I'll set the clutch setting really low. When I drive the first screw I'm unlikely to fully seat it. So I click the clutch over a couple notches and try again. When the screw seats where I want it, I'll drive all the screws for that project.

One last detail on the clutch: I don't much use it in the high-speed range. Most drills have a setting on the clutch designed specifically for drilling bits. So I recommend you set your speed range to high, set your clutch to the drilling setting then go for it.

The list of things you don't need on a drill is quite long. Wrist strap? No. Bubble level? Nope. Work light? Not likely. Laser? Please! Focus on the attributes that are important and you won't go wrong when picking a drill.

Setting the clutch as shown will disengage the clutch, allowing you to drill at full power and speed. This is in the drill's instruction booklet that you threw away.

Another Type of Cordless Drill

Sometimes the easiest, fastest way to do a task is to use a hand tool instead of a power tool. Making small holes to get a screw started is an excellent example of this principle. One of the tools in your kit should be the simple, versatile awl.

You can use the pointed end of the awl for many things – marking lines that won't smudge or disappear, poking holes in the rim of a paint can so that the overflow from your brush doesn't spill over the side, marking holes to be drilled with a power drill, and making pilot holes for woodscrews.

You won't be faced with many choices when you go to buy an awl; there are basic ones at the local hardware store and fancy ones from mail-order woodworking suppliers. The steel should be straight and stiff, and it should be firmly attached to the handle. Start with an inexpensive awl. After using it for awhile, you'll find your personal likes and dislikes. You also may eventually find that you want two.

Machinists use awls for scratching lines, and awls intended for this purpose will have a handle like a screwdriver. For woodworking, you want a bulbous end so that you can push the point in to the wood with the palm of your hand.

The shorter awl has flats on the handle that prevent it from rolling around when put down.

The awls in the photo show a common variation in the handles of awls as well as many other woodworking tools. The awl in the bottom of the photo has two flat sides, while the other one has a round handle. The round handle is more comfortable, but it can roll away when put down on a flat surface.

The other difference is in the way that the very tip of the awl is shaped and sharpened – and this is the reason you'll likely want two. One shape works best for marking, and the other works best for drilling small holes.The most commonly seen point tapers like a pencil point. This is an advantage if you are using it to scratch a line on your work.

The other point style is faceted. I took a small mill file, and in a few minutes filed four facets on a round-point awl. These straight edges will provide a cutting action when making a pilot hole for a screw.

The faceted point on the left makes the awl an efficient tool for making a small hole.

To make a pilot hole with the round-tip awl, place it in the center of the opening and push down. You won't be able to go very deep because the wood fibers will crush and fill the hole. While using the faceted tip, twist the tip as you push down. The corners of the facets will cut the wood in the hole, letting you go deeper.

Finishing Tools – rasp, file, sander, block plane

After all your parts have been cut, you need to prepare the surfaces for finishing. And that's when you should turn to your files, rasps, sander and block plane.

Rasp and File

Rasps and files are freeform shaping tools. They can be used on their own to create shapes or they can clean up the work left by other tools, such as the jigsaw. The rasp is the coarser tool and you use it before you turn to the file.

There was a time in history when a discussion on rasps would be quite lengthy. There used to be hundreds of patterns and sizes available to the woodworker. Now you're going to be lucky if you find more than one kind to choose from at the store.

Files are a little different matter. They actually are a metalworking tool and there are a lot of files available. For woodworking (and the metalworking involved in woodworking) I think you simply need one file; a bastard-cut file will do – either the 8" or 10" length. This file will smooth wood nicely, plus it is quite useful for sharpening a card scraper, a topic we'll tackle later on.

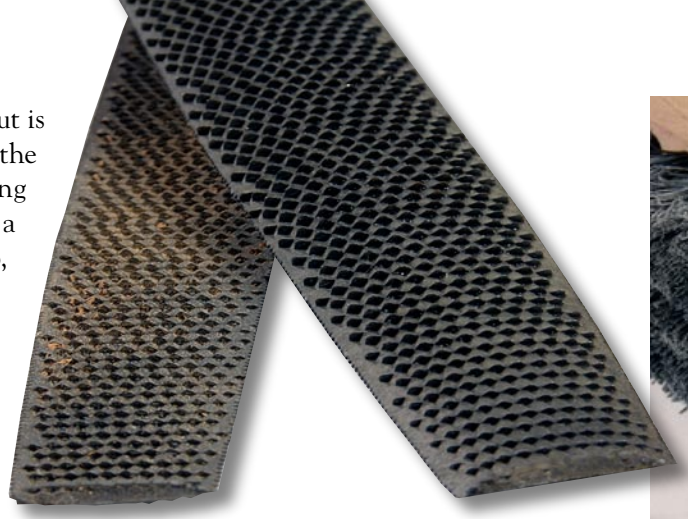
Rasps are merely the coarser cousins of files. Finding a good rasp can be a challenge in some stores, but most home centers carry at least one. You'll typically find them labeled as bastard cut, second cut and smooth cut, which is an indicator

A good selection of rasps and files. The tool on the top that looks like a cheese grater is a Microplane, a high-tech rasp. They work great, but seem to dull faster in my experience. The rasp below it is what you'll commonly find at the hardware store. The two files at the bottom are both good for woodworking as fine finishing tools.

of their coarseness. Bastard cut is the coarser one; smooth cut is the finer one. Because we're going to do most of the work with a jigsaw before turning to a rasp, I recommend you try to get a smooth cut rasp. Look for one that has one flat face and one face that curves out. Sometimes this is labeled as a half-round profile. This will allow you to shape inside curves.

Avoid the "Four in One" rasps, sometimes labeled "Shoe Rasps." These tools have two working ends, one coarse and one fine. They seem like a good idea, but the tools are actually too short for many woodworking applications. Longer rasps are better. You get more control from taking two long strokes rather than 10 short strokes.

In addition to your rasp and file, you'll need what's called a "file card" to clean them. As you use a rasp or file, the teeth will get clogged with wood fibers. The file card is a brush that cleans the tools so they continue to cut well. Most file cards are like a small hairbrush with two faces. One side has synthetic black bristles; the other has metal bristles. Use the black bristles to clean your rasp; use the metal bristles to clean your file.



Get a rasp with a "half-round" profile like the ones shown here. The round profile allows you to sneak into inside curves that the flat face would butcher.

Keeping your files clean is the key to keeping them working. A good file card will have stiff brush bristles on one face to clean rasps. On the other side will be wire bristles, which are good for cleaning files.

One more accessory: a handle. Files and rasps have a pointed tang at one end. The tools are much more comfortable to use if you have a handle on one end. The handles, sold in the same section as the tools, simply screw off and on the tang.

A typical file handle. Some people swear by them; others never use them. I'm somewhere in between.

The rules for using files and rasps are the same. Use the tools with two hands: One hand on the handle the other on the end. Like a saw, the tools cut only in one direction – on the push cut. If you drag the tool across the work on your return stroke you will dull the teeth faster and clog the tool.

After every few strokes, tap the tool against your sawhorse or workbench. This shakes loose the big particles. When the tool starts to cut slowly, clean it with your card file.

When working with a surface fresh from your jigsaw, begin by using the rasp. Always begin your work with light strokes, which will mostly show you where you are cutting more than they will remove material. After a couple light strokes you'll know if you have the tool at the right angle and you can then add some downward pressure.

Once all the marks left by the jigsaw are replaced by marks made by your rasp, you can switch tools. Use the same techniques with your file as you did with your rasp and work the area until all the toolmarks left by the rasp are gone. The file can leave a good surface, but I still usually finish things up with some sandpaper.

The rasp and file are generally two-handed tools. You'll get better control and a more square cut if you adopt the two-handed approach.

After a little practice, you'll find that these tools (even the cheap ones) are extraordinary shaping tools. You can

round over an edge easily and quickly clean up tool marks that would take an impossible amount of sanding. They also allow you to easily incorporate sculptural elements to your work that make you look a lot more advanced than you are (and that's what this is all about, right?)

Random-orbit Sander

Good sanding is the modern foundation of a good finish. And a good finish can make an average project look fantastic. Though sanding is a chore, it's something you need to get good at to produce good work as you begin your craft.

We do a lot more sanding these days than our forebears, who used bench planes, scrapers and some hand-sanding to prepare their surfaces for finishing. And truth be told, I do very little sanding in my shop, but that's because I've spent years using hand planes, learning to sharpen and so on. But that takes time, and the real beauty of our modern sanders is that they can produce an extraordinary surface with a far smaller investment in skill.

Oh, there are still some skills involved in using a sander properly and most effectively, but they can be taught in an hour or so and the basic moves are easy to pick up without a lot of instruction. The downsides to sanding with a machine are that it's mind-numbing work and generates a lot of unhealthy dust.

So if you want to start building today, you are going to need a sander. Don't buy a belt sander – that's for hogging material off. Don't buy a pad sander. These vibrating tools use sheets of sandpaper and aren't very aggressive. Buy a random-orbit sander. These high-tech tools are a marvel. Though they have a disk that spins rapidly, it's also wiggling eccentrically. The result is that the tools strike a nice balance between aggressively removing stock and leaving a fine finished surface.

Random-orbit sanders are excellent fine-finishing tools for the money and they don't require a lot of skill to learn.

There are three body styles available: the small palm-grip tools, the big right-angle tools (that look like an angle grinder) and an intermediate tool that's between the two. I have used them all and recommend you get a palm-grip tool for furniture work. It's inexpensive, the 5"-diameter sandpaper is available everywhere and the tool is lightweight enough to use one-handed and get you in tight spots. The bigger tools are better for sanding big tabletops and the like.

Generally, the variable-speed feature is unnecessary on a random-orbit sander. The only time I've slowed down the tool is when I was dealing with some really thin veneer. That's it.

So what should you look for when buying a random-orbit sander? Here's the funny thing, I have yet to find one I really dislike. They all work pretty well. Some vibrate a little more, some are a little slower, but they all pretty much do the job. These tools don't have a lot of bells and whistles available, so I think you can buy a basic tool and be just fine. Some of them are variable speed – I have yet to find a moment where I thought to myself: "Boy, I sure wish I could slow down the sanding process so I could really enjoy it." I'm sure there's some delicate jobs that benefit from this feature, but I think you'll be hard-pressed to say it's essential.

These tools don't have lasers, worklights or wrist-straps (yet), so that's not a consideration. But one thing you should pay close attention to is the dust collection. Dust collection on almost all of these machines is a spotty business, and sanding kicks up a lot of the dangerous dust – the sub-micron stuff that gets lodged in your lungs. If you own a shop vacuum,

After some experience with these sanders, you'll want to hook it up to a shop vacuum. The dust this tool makes is the worst. It's unhealthy and annoying. Adding a vacuum and hose to your sander will make your sanding faster (because the dust won't interfere) and (almost) pleasant.

get the upgraded filters for the vacuum and buy the hoses that attach it to the sander. If you can't afford a shop vacuum, then you need a face mask that filters out this nasty dust. And not just a paper mask – I'm talking about a mask that's NIOSH

approved. These are available at the home centers and are essential sanding equipment.

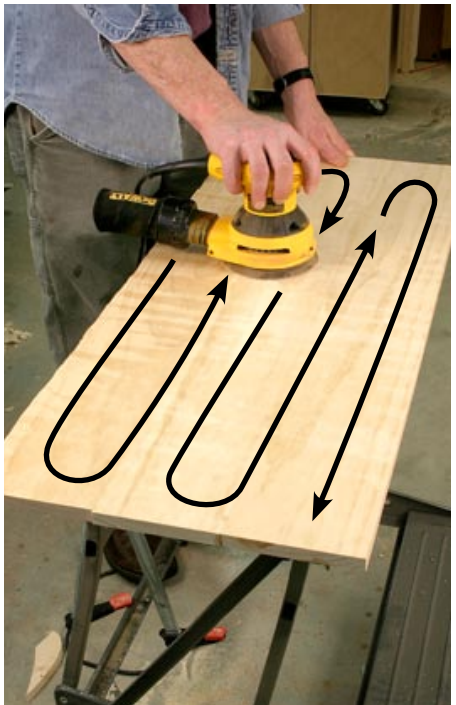
The other consideration is the sandpaper. Sandpaper can be expensive, but there's nothing more expensive than cheap sandpaper. The quality stuff (Norton 3X and Klingspor are both good brands) lasts a long time. I think you really need three grits to handle most project building. Get #100- or #120-grit paper for your coarse grit. Buy the most discs of this grit because you will go through a lot of it. Do as much sanding with this grit as you can because it does the job fast. Then get a smaller quantity of #150-grit paper for your medium grit. This intermediate grit goes pretty quickly if you did a good job with the coarse grit. And then get a small quantity of #220-grit paper. Again, if you did a good job in the earlier grits, the #220 work will go quite fast.

People sometimes laugh when they hear there is a proper way to sand. After all, you simply put the tool on the work and move it around until everything is consistently sanded right? There actually is a little more to it than that, and proper use of the tool will ensure you get the job done in short order.

First thing to know: hand pressure. Try not to bear down too hard on the tool while you are working. It's tempting to do this when you're sanding a rough patch, but it's not so good for the tool and there's a risk of you going too far when you get rowdy. Similarly, try to keep the tool flat on the work. It's tempting to sometimes tip the tool so one edge of the pad is contacting the work so you can work a small area of tear-out. This will work with a little skill and if the tear-out is shallow. If it's deep tear-out or you linger too long, you will create a valley in the work that may not be evident until you put a shiny finish on the work.

Second thing: Don't move too fast. Zipping around a board with a sander doesn't do the job. Manufacturers

You'll need the biggest supply of #120-grit sandpaper (left) because it does the most work and needs to be replaced more regularly. You'll need less of the #150 (middle) and even less of the #220.

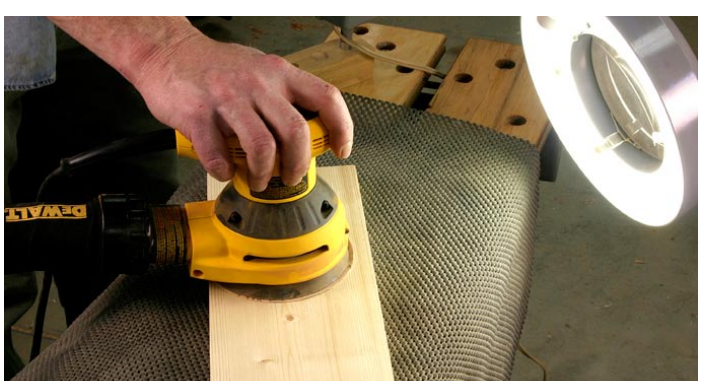


Move your sander in a regular pattern to ensure a consistent job. I'll start with overlapping strokes along the length of the board. Then I'll do overlapping strokes across the width. Then I repeat.

recommend moving the tool about a foot every 10 seconds (at least, that's what a couple engineers told me). I think that's too slow to be practical – try it and I think you'll agree. I go faster – maybe a foot every seven seconds.

Third: Work each surface in a consistent pattern. I like to work a panel left to right, slightly overlapping my passes. Then I come back and work the panel front to back in this way. This ensures I don't miss any spots.

Again, you'll do most of the work with the coarse grits. But how do you know when to switch to a higher grit? Once the workpiece looks consistently scratched to the naked eye, I'll take a desk lamp with a movable head or one of the yellow job-site lights and position it so there's a low, raking light across the work and give it a quick look. The raking light will point out any dings or divots or tear-out you missed as areas in shadow. If the board looks good under raking light, then switch grits.



A raking light, such as the one shown here from a desk lamp, will point out the dings and scratches that your overhead lights will conceal. It helps to turn out your overhead lights as you sand critical areas (such as tabletops).

The higher grits go faster. Much faster. Usually, I spend half the time (or less) with the #150-grit paper. And the #220 is used even less than that. After everything is sanded with the random-orbit sander, you might need to do a little hand-sanding with #220 paper in a few areas, sand the boards' edges and then "break" the corners and sharp edges of all the touchable pieces. Sharp edges are fragile and don't feel good to the hand.

Always "break" the edges of your work before finishing. This makes your project nicer to the touch and makes your edges less susceptible to damage.

Breaking the edges is quick and greatly improves the tactile quality of your work. Use #150-grit paper in your hand and quickly take down the corners slightly. A couple strokes is usually enough.

Block Plane

Buying and sharpening a block plane is probably the most involved task we're going to ask of you as you get started in the craft. The barrier here is sharpening the blade – lots of woodworkers get tied up in knots about this simple and very important skill. Here's the promise: Once you learn to sharpen a single woodworking tool, the same principles will allow you to sharpen a lot of other things: chisels, carving gouges, all manner of plane blades, turning tools, marking knives and so on.

Sharpening is one of those "minute to learn; lifetime to master" things. The principle is so simple: A sharp edge is the intersection of (sorry for the geometry) two planes. The smaller the point of the intersection, the sharper the edge is. The

Block planes are commonly available. Paying a little more will add some nice features – a blade adjuster, a mouth that you can close up for high-tolerance work and the blade pitched at a lower angle. That said, even the cheap ones work well on softwoods when sharpened.

act of sharpening is simply the abrading of those two planes until they meet at the smallest point possible. That's it.

Like sanding, you start sharpening with a coarse grit and move up in grits. You can use almost any medium to sharpen. Sandpaper works well as you're learning. You'll also find diamond stones and oilstones at the home center. Pick a system that fits your budget. If there's an oilstone that has coarse grit on one side and fine grit on the other, that's what I'd get. Sometimes it's called an "India" stone. Buy a little 3-in-1 oil and you're in business.

The Basic Strokes

There are lots of good books and web sites that can help you with sharpening. I'm going to tell you here how to get a good working edge that will get you started cutting pine and other work-a-day woods. My personal sharpening regimen is different, but everyone's is. The following requires the absolute fewest tools.

Disassemble the block plane and clean off the cutter. Notice that one end is wedge-shaped. This is called the "bevel" of the cutter. The flat part of the cutter that intersects the bevel is called the "back" of the blade. The back and the bevel are the two "planes" of your cutting edge and are what is to be abraded.

Begin with the back. There's a lot of metal here. Abrading all that metal flat would be a massive task. Remember that only the very end of the back is what does the cutting. That's all you need to worry about. So we're going to cheat so that we work only that area (and get to work much faster). Take a thin, cheap 6" ruler and stick it along one edge of your sharpening stone. Now rub the back of the cutter on the stone with the cutting edge on the stone and the back part of the cutter propped up on the ruler. The ruler holds the back end of the cutter in the air so you work only the area up by the edge.

If you use the ruler in the same way

By propping up the back of the blade as you work the back, you'll greatly speed the polishing action of this critical surface. The ruler ensures that every time you do this it will be consistent.

every time you sharpen you'll find that the angle stays the same. This is called the "ruler trick" and it was developed by British craftsman David Charlesworth. It's a big time-saver. Use the "ruler trick" on the coarse side of the stone and then on the fine. Look at the cutter, the scratches should be consistent and the metal should be shinier than when you started.

Now turn your attention to the bevel. This is the part that trips people up because they have trouble balancing the tool on the narrow bevel on the stone. I like to use a little jig to hold the cutter for this part, but if you don't have a jig, it's still easy to pick up the skill. Start at the far end of the stone. Rest the tool's bevel flat on the stone (don't forget the oil). Now raise the tool up just a tad so you're working only at the tip. Drag the tool toward you. Lift up and repeat the stroke about four or five times.

Now feel the back of the blade with your thumb. There should be a little burr of metal curled over on the back. That's good; that means you really sharpened up at the tip of the tool. Work the bevel some more with your coarse stone and then your fine stone until your scratches look good. At the very end, you want to remove the burr. Put the ruler back on your fine stone and stroke the iron over the stone and ruler – this is called "backing off." Wipe down the blade and reassemble the tool.

Setting a block plane is pretty easy. You want to project the iron equally all across the mouth. Turn the tool's adjuster to project the blade until it looks like it's just starting to emerge. You can feel this by passing your fingers lightly over the mouth or by sighting down the sole of the plane head-on. Then use a little scrap of wood to confirm your setting. Rub the block over the mouth. You should feel it drag as

Learning to hone the bevel takes a little practice. Take it slow and check your work frequently. A honing guide is a good $12 investment if you can find one at your home center.

the iron removes a tiny shaving. And you should be able to hear it. Try it in several places along the mouth. If the drag feels the same and the sound is the same, then your iron is square in the mouth.

Using a block plane is a one- or two-handed operation – I prefer to use two hands as much as possible. Once you sharpen it up, you'll find endless uses for it. After you rip a board with your jigsaw, the block plane cleans up the sawblade marks, making the edge ready to finish (no sanding necessary). If two parts of a joint aren't in line with one another, the block plane can trim the proud surface flush.

One thing you should be aware of is that you will have better results if you cut "with the grain." Think of each board like a furry animal – the grain lines are the fur. If your tool is pressing down the fur as you cut, it's like petting an animal correctly. If you rub (or cut) the wrong way then the animal will get mad and the work will tear out.

A small block of wood can check the setting of your plane's iron. If the block of wood has the same amount of drag all across the mouth, then your blade is centered in the mouth and is projecting squarely – get to work!

Note the grain on the face of the board. See how it is heading up toward the edge being planed? Think of those grain lines as fur. If the tool is pushing them down as it works, the chances are your cut will be sweet.

Joinery Tools – biscuit joiner, pocket hole jig

Joining flat panels to make a box is the ultimate and basic goal of a lot of woodworking. There are a lot of ways to get there, from nails to fancy locking sliding dovetails. All the methods work, and all are valid when used properly. The problem is that most of the techniques require a number of large machines with special bits or blades. We wanted to keep things simple and strong. So when it comes to case joinery, we think you should choose either a pocket-hole jig or a biscuit joiner.

The pocket-hole jig bores an angled hole (a pocket) in one half of your joint with a special bit included in the kit. The pocket is sized and shaped perfectly for a special screw designed for the jig. You put glue on your pieces, clamp them together and drive in the screw. Most people conceal the pockets by placing them on the underside or backside of their

Biscuit joiners cut a football-shaped recess in two parts to be joined. The biscuits fit into that recess and (with a little glue) hold the joint together.

A pocket-hole jig allows you to join two pieces of wood without clamping. The only real downside is the fact that you have to conceal the holes made by the stepped drill bit.

work and some people plug the pockets with specially angled plug.

The biscuit joiner simply cuts out a recess on each edge of the pieces you are joining. The recess is shaped and sized perfectly for a thin wafer of beech or birch, called a biscuit. Add glue to the recesses, add the biscuit and clamp up your work.

Both of these modern gizmos are accurate, fast and easy to master. They both cost about the same and both produce joints that are strong enough for most woodworking jobs.

Biscuit Joiner

Choosing a biscuit joiner is going to be limited by what's available at your home center – most stores will have one or two brands at most. If you're ambitious, you can find a couple more to choose from at a local Sears.

They aren't significantly different at the low end of the price scale – but the ones that show up for less than $100 are usually things I'd avoid. These have plastic fences or oddball ergonomics or are a brand we have never heard of (all those factors are danger signs). Once the price of the tool hits about $150 or so, it's a contender.

Using a biscuit joiner is simple, but you really have to pay attention because it's easy to make stupid mistakes without knowing it. Essentially, the tool is a small plunging circular saw. Press the tool against your work and it cuts one-half of a football-shaped recess. Press the tool against the mating part and it cuts the other half of the joint. Add glue and a biscuit and clamp things up.

It sounds easy, but I've seen a lot of beginners struggle with this tool. The biggest problem is that the tool is not aligned where it should be when you make that plunge cut. It's not really a matter of being a little off on the left or right – the process is forgiving enough to allow you to miss your mark by a surprisingly large margin.

Where most people trip themselves up is in getting the up and down part right. If the fence isn't firmly on the work, or you tip the tool a bit, or it sags a bit under its own weight one of the slots is going to be off. You also can be thrown off by the tool's base. If it rests against anything – and you think you're referencing off the fence instead – you're in for trouble.

I think most problems come from over-confidence. The tool is so easy to learn and seems so effortless that the user starts moving too quickly. Plus, there's the problem of our sensitive fingers. Our fingers can feel a misalignment or ridge of just a couple thousandths of an inch when pieces are not assembled in perfect alignment. I'm not saying you should be worried about a couple thousandths – sandpaper can take care of that. But every error (even small ones) is magnified by the fact that it's an easy error for our fingers to detect.

There are a couple ways to make sure your work is accurate. When you use the fence to position the tool, the trick is to

slow down the pace of your work and ensure the fence is positioned flat on your work. Once you have the fence flat on the work, you need to make sure the tool stays positioned correctly as you plunge it into the work. A little misdirected hand pressure here or there can spoil the alignment. Senior Editor Bob Lang is a *connoisseur* of biscuit joiners and keeps one hand on the handle, one hand on the trigger and braces the tool against his body. When he plunges, he shifts his weight forward rather than relying on his arms to do the job.

The other option is to use your hand like a clamp, squeezing the fence and handle to plunge the tool. Me personally, I've always put my fingers on the fence to keep it registered on the work. This operation opens up a remote chance for injury, but it does keep the fence in place.

The other way to get around the problem of the fence is to take the fence off and use the base of the tool as the

A textbook way of holding a biscuit joiner. Note that Bob's hip is braced against the rear of the tool. He'll shift his body forward during the plunge cut and use his arms to steady the tool.

An alternate way to plunge: Squeeze the fence and tool handle together to make the cut.

reference surface. This involves working off your work surface, which might not always be convenient or possible. However, once you remove the fence, you'll realize that when these tools are used this way they center a slot in ¾"-thick material. Hey some engineer or tool designer really was thinking that day!

The other thing you'll find with biscuit joiners is that you have to take care of your biscuits. Keep them in their plastic tube or in a sealed plastic bag. Otherwise they tend to swell and become too thick to fit in their slots. And that really stinks when the glue is out and the assembly is halfway put together.

(By the way, whatever you do, do not listen to the joker who tells you that you can shrink the biscuits by microwaving them. That is – as far as I can tell – a sick joke. We zapped a bunch of them in our lunchroom microwave a few years ago and I officially became persona non grata when the biscuits scorched and filled the lunchroom with a nasty smell. Even when we tried nuking them for less time, nothing happened except the biscuits got warm and a little smelly. Anyway, you've been warned.)

Some woodworkers prefer to work without the fence when they can. Here we're using the Workmate to control the tool instead of the fence. If you go this route, make sure your work surface is flat and debris-free.

All this is enough to make you buy a pocket-hole jig.

With all these issues, why are we saying it's a good tool? Biscuit joiners have one big advantage over the pocket-hole jigs: they create an invisible joint. There is no hole or screw head visible. The overall work looks tidier inside and out. Usually you can hide your pocket holes inside your projects, but with biscuit joints you can put the joint almost anyplace.

If you never had to turn a corner,

woodworking would be much easier. Glue alone will hold two pieces together if both surfaces are along the length of the grain. When one of the surfaces is the end of a piece, however, a glued butt joint will fail under very little force. To reinforce the glue joint, you can do one of two things; add a fastener such as a nail or screw, or cut parts of the wood away to make a joint. Most joints provide both long-grain gluing surfaces and hold the two pieces together mechanically. Dowels and biscuit joints fall somewhere in between. They aren't really joints, but they aren't fasteners either. The advantage to nails and screws is they not only strengthen the joint, they act as clamps to pull and hold the parts together as the glue dries.

The disadvantage to nails or screws is most of the time you don't want to see any evidence of them in the finished product. If you can drive the fastener from a side that won't be seen in the finished product, you won't have to worry about concealing the evidence. Pocket-hole screws let you just do that by coming in at an angle from behind the finished surface. We're recommending it as the first joinery system to be adopted in the "I Can Do That" series. It is simple, strong and there are few things that can go disastrously wrong. In addition, it will enable you to put a lot of things together without needing to buy clamps.

Dowels and biscuits are an alternative, but we aren't suggesting either of those for the beginner. In the first place, you would need to invest in several clamps to hold the joints while the glue dries. Every time you move on to a larger project, you will need to get more clamps. The second reason is that pocket screws are simple to lay out and put together, and will keep your work moving along. You can screw a joint together and go on to the next one without having clamps in your way or a long wait for the glue to dry. The third reason is half practical and half philosophical. Dowels and biscuits were developed to make adequate joints in a production setting. Many woodworkers try one or both when starting out, only to leave their doweling jigs and biscuit-joining machines gathering dust as their skills develop.

Because they are a reliable, quick and hidden fastener, the pocket hole screw can often be found in advanced woodworking projects. When your skills have developed to the point where you can cut a nice mortise and tenon or dovetail joint, you will likely still find a use for pocket holes as a utility joint.

The difference between a pocket hole screw and a regular screw is the angle of the hole and screw. The 15° angle lets the head of the screw be accessed from the side of the piece rather than the end. This leaves a large elliptical-shaped hole, but if you plan ahead, you will make these holes where they won't be seen once the joint is assembled. The drill bit used is called a step drill. The large diameter is 3/8" to allow access for the screw head and driver, and the end of the bit creates a pilot hole

for the screw threads. Because the angle is steep, you need a special jig to control the angle and the depth of the hole.

Pocket Hole Jig

When you go shopping for a pocket-hole jig, your choices will be based mainly on price. What you need to come home with is the right drill bit and screws, a way to guide the bit while you drill the hole, a way to hold the guide to the wood while you drill, and a way to hold the two pieces together while you drive the screws. You will also need a #2 square-drive screwdriver. Most home centers will have a basic kit for around $50. You might also see a guide and drill bit combination for $20. The $20 kit doesn't include any clamps, and doesn't have a fence to align it to the end of the board you'll be drilling. The lack of an alignment fence makes this very frustrating to use, and when you add in the price of the clamps you'll need, you'll be close to the $50 mark.

The $50 kit is a step up, but isn't quite what you need. To use it you must clamp the work and the guide horizontally to your bench. This can be slow and tedious, and it puts your hands in an awkward position when drilling. What we recommend, if it's in your budget, is a system that holds the work piece vertically and can be fastened to your bench with screws. You probably won't find this at your local home center, but it's easy to find one online or through a catalog. We think the best choice for the beginner or the occasional user is the Kreg K3 standard pack. This includes all the bits and pieces mentioned above, and costs about $80.

This setup costs a bit more than the least expensive ones available, and less than the most expensive. It contains everything you need to get started in pocket-hole joinery.

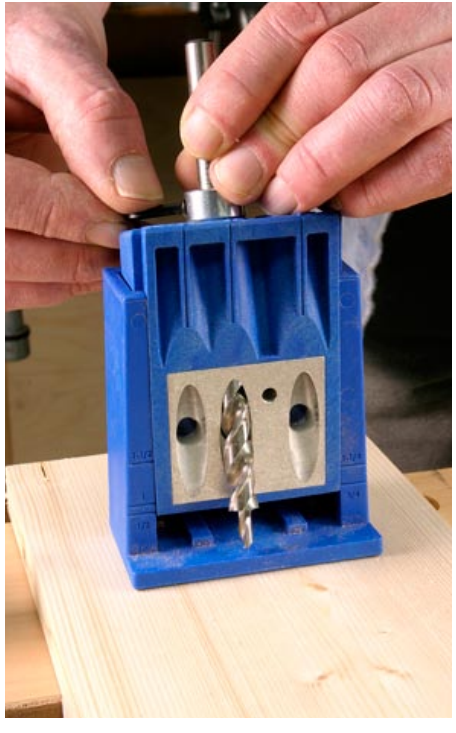
Avoid any pocket-hole jigs that use a screw-type clamp to hold the work in place. The one we recommend uses the same locking pliers-style clamp to hold the work to the jig as you drill, and the two pieces together when you drive the screws. The more expensive kits have a lever-action clamp to hold the work in the jig, and a locking pliers-style clamp to hold the work together as you drive the screws. This is more convenient if you have a lot of parts to drill, or if you are working on panels more than 12" wide. With the Kreg K3, you can upgrade.

When you put the jig together, look for marks on the side of the part that holds the drill bushings that indicate the

thickness of the stock you will be using. That should put the hole where you want it, exiting the end of the piece at or very close to the thickness of the stock. Next you need to adjust the clamp that holds the work on the jig. If you're using the locking-pliers clamp, fasten it to the jig, put a piece of wood in place and open the clamp. If it's too tight to clamp, loosen it up farther than you need to, close it and then tighten the screw until it makes contact with the wood. Open it back up, and tighten the screw another turn or two. The wood should be held firmly, but you should also be able to open and close the clamp without too much effort.

The last adjustment to make is to put the stop collar on the drill bit. When you drill the pocket hole, you need to control the depth so that the pointed end of the

Adjust the clamp to hold the wood firmly in the jig without taking too much effort to set the clamp.



Setting the depth of the stop collar is simple. With one hand, you can push the collar down on the jig and hold the tip of the bit about 1/8" above the jig. Use your other hand to tighten the set screw on the collar.

screw doesn't come out on the finished side of your work. With ¾"-thick material, a good place to start is with the end of the drill bit about ⅛" above the surface of the jig.

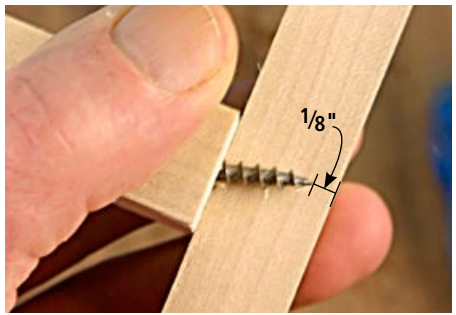
The screw will make its way through that last ⅛"; if you set the bit to go entirely through it can leave a little bump on the bottom that may keep the joint from coming together. Drop the bit in the jig, loosen the set screw on the collar, and slip the collar over the end of the bit. Lift the bit up about ⅛", letting the collar rest on the jig and tighten the set screw. Don't worry about being exact at this point. You will drill some test holes and make a practice joint to confirm your settings.

Place a piece of wood in the jig and drill a hole, using the highest speed possible on your drill, checking to see that the stop collar doesn't slip on the drill bit and that the wood doesn't slip from under the clamp.

Remove the wood from the jig, place a screw in the hole, and drive it in. When

Use the high speed setting on your drill to make the pocket hole.

The screw should exit the end of the wood near the center of the board's thickness. Don't worry about getting it precisely placed. The next step will let you know if your setup will work.



Hold a piece of scrap against the piece with the screw in it. Check to see that the end of the screw is about ⅛" away from the surface.

the bottom of the screw head meets the bottom of the larger hole, you will feel it. Look at the end of the piece. The exit point of the screw should be close to the center of the board's thickness.

Next, you want to make sure that the end of the screw won't come out of the face of the piece you will be attaching. Hold the end of a piece of scrap against the face of the piece with the screw in it There should be 1/8" or more between the point of the screw and the edge of the wood. If there isn't, you need to adjust the stop collar on the drill bit. You're almost ready to make a joint, but first you need to adjust the locking-pliers assembly clamp.

Open the clamp and then close it on a piece of scrap the same thickness as the material you will be using for your joints. Adjust the clamping pressure in the same way you adjusted the clamp on the jig; open it up farther than you need to, tighten the screw until it makes contact with the wood, then open it up and tighten the screw another turn or two. When you use the locking-pliers clamp to hold two pieces together, keep the larger of the two pads on the finished face. This distributes the pressure along the surfaces you want to have lined up when you're done, and won't mar the work.

The most typical use of pocket screws is in a face-frame joint and the clamp is used to keep the pieces lined up, not to pull them together. If one piece meets the other at the end, hold them in line with your hand as you set the clamp. If they come together at any other point, you need to mark the location with your square, and hold the piece to the line as you clamp. Obviously, the end needs to be smooth and square for the joint to pull together and hold properly.

You need to decide where to locate the holes in the width of the piece, and that will depend on how wide the piece actually is. You want to use at least two holes if possible, as the parts could pivot on just one screw. If the material is 1½" to 2" thick, the middle of the board should be

Line up the two pieces and set the clamp to hold them together.

in between the two closest-spaced holes on the jig. Once again, you don't need to be concerned about getting the board exactly centered; you only need to be close for the joint to work. If the work piece is wider than 4", use three or more screws. On wide pieces, the spacing between screw holes should be between 2" and 4". Don't waste your time measuring and marking exact locations, it's OK to do it by eye.

When you're ready to put the joint together, apply some glue to the end

The long driver bit that comes in the kit keeps the drill chuck away from the wood.

grain of the piece that the screws go in. As you practice, try varying the amount of glue that you use until you get just a small amount squeezing out when you drive the screws. Using more glue than necessary will only create a mess to clean up, and can lead to some big problems when finishing. If you're driving the screws with a cordless drill, use the lowest speed available and the long driver bit that comes with the kit.

You're not limited to face-frame joints with pocket screws. You can also join pieces on edge, but when you do this, you lose the ability to clamp them together with the locking pliers. Because the screw is being driven at an angle, it tends to push the pieces out of alignment so it helps to clamp them together while you tighten the screw.

One last thing – you really do need to use the pan-head screws that come with the jig. If you try using a screw with a countersunk head, it won't stop when it hits the bottom of the large diameter hole. The clamping action of this joint depends on the pan head stopping so that the threads can bite into the second piece of wood and pull it tight to the first piece.

Fastening Tools – hammer, screwdriver

Lots of furniture can be built using a hammer and screwdriver. Because these are two tools you'll never outgrow, you should select your first hammer and screwdriver with care.

A good wooden-handled hammer and a few nail sets can serve you for a lifetime. Avoid the fiberglass and metal hammers. They are not as forgiving on your joints (as in your shoulder and elbow).

Hammer and Nail Set

You'd think that there isn't much to be said about buying a hammer. It's just a metal rock on a stick, right? Well yes, but buying the wrong hammer will trip you up. Buy a hammer for making furniture, not some hammer for chipping rocks. We recommend a claw hammer that has a head that weighs 16 oz. and has a wooden handle.

The all-metal and composite hammers work, but I find them less forgiving on your elbows and arms. I get sore a lot faster. The wooden hammers are, by and large, cheaper, too. And here's another bonus: You can sand off the junky, gloppy finish on the handle and finish it to your liking. Sanding it nicely up to #220 grit and then adding a coat of wax or linseed oil will result in a hammer that is a joy to pick up. Seriously. Most new woodworkers are loathe to modify or improve the wooden handles of the tools. Hello? That's why they're made of wood – so you can make them suit you.

There are other things to look for, too. The business end of a hammer can be flat or slightly bellied. Go for the hammer with the bellied face – sometimes called a bell face. This results in fewer mis-strikes and allows you to drive the nail in much closer to flush than a flat-faced tool will.

Also, look at the claw. Does it stick straight out, almost straight out or does it curve down back toward the handle? If it doesn't curve much it's called a "ripping hammer." These hammers are used for disassembling things – the claw is actually a crowbar. You want the claw to curve down – this gives you more leverage to remove a nail.

Using a hammer is straightforward, but keep these tips in mind. There are two basic grips. One is the power stroke. You grasp the end of the handle to get more bang when driving a nail. If you're after more control, choke up toward the middle of the handle and extend your thumb up the handle. This will reduce the force you transmit into the nail (which can be

This is the power stroke with a hammer. When you build a deck, or really need to wallop something, grip the tool at the end of the handle. Sticking your thumb out will help steady the tool a bit.

By choking up on the handle you can gain some finesse and reduce the force (sometimes a good thing, really). Note again the position of my thumb.

a good thing) and it will help keep your strikes where you intended them to be.

Also, there's a lot of confusion about how to buy nails. Most places denote the length of a nail using the English pennyweight system. The origin of "pennyweight" is a mite murky, so let's stick to the facts. Pennyweight is denoted by "*d*." So a two-penny nail is 2*d*. And a 2*d* nail is 1" long. For every penny you add, the nail gets 1/4" longer. So a 3*d* nail is 1 1/4" long. A 4*d* nail is 1 1/2" long. A 5*d* nail is 1 3/4" long. And so on.

You select your nail's length based on the thickness and density of board you are fastening in place to another board. Here's how the old rule works:

1. Determine the thickness of your board in eighths of an inch. For example, a 1"-thick board would be eight-eighths. A 3/4"-thick board would be six-eighths. And so on.

2. For a wood of medium density (walnut or cherry, for example), pick a nail where the pennyweight matches that thickness – an 8*d* nail for 1" stock. A 6*d* nail for 3/4".

3. For softwoods (white pine), select a nail that's one penny larger. For harder woods (maple), use one penny smaller. This seems complex at first, but it quickly becomes second nature.

Once you drive a nail into your work, you'll almost always want to "set" the nail so the head is slightly below the surface. Then, for nice pieces, you'll putty the hole. The tool to do this is a "nail set," which essentially is a pointy steel rod. The shaft is knurled so you can hold onto the tool easily. The tips come in a variety of shapes and sizes. Because nail sets are inexpensive, buy a variety of sizes, mostly ones with small tips, which are suited for woodworking (as opposed to deck building). Get at least one nail set that has a cone-shaped tip. Some finishing nails have a matching depression on their heads and the cone-like tip helps secure the nail set as you strike it.

There are only a couple things to remember about using a nail set: When you hold it, I find it's best to keep the edge of your hand against your work – don't suspend your hand in space as you grip the set. Grasp the nail set between your thumb and forefingers. Whack away until the nail head is 1/16" to 1/8" below the surface of the wood.

Screwdriver

One of the easiest mistakes to make when buying tools is to snap up a bargain thinking you are getting all the tools you will ever need in one decisive move. This is especially true with screwdrivers. In the tool aisle there will always be a great deal on a complete set of screwdrivers. If you aren't sure what you need, and what the difference is between a good quality tool and a poor one, it's tempting to spend $20 for a set of screwdrivers, especially when a single screwdriver might cost $7 or $8.

You will need the ability to drive and remove several different sizes and types of screws, but you don't want to buy a cheap

set and you don't want to spend a small fortune buying a bunch of individual tools. What makes the most sense is to invest in a good-quality handle that will hold different driver bits. Look for one that holds the same short bits that are used for driving screws with a cordless drill. The one in the picture has been in use for more than 10 years, and stores extra bits in the handle. It replaced a drawer full of miscellaneous screwdrivers.

A decent screwdriver that holds magnetic bits will replace a drawer full of cheap ones and you won't need to worry about wearing it out.

The tip of any screwdriver is the part that takes all the abuse from the twisting forces exerted on it. The screwdrivers that come in sets won't last very long. If you buy an inexpensive set, you will soon find yourself the owner of several screwdrivers with damaged tips (the ones you need to use most often) and a few good ones you likely won't ever need. When you try to use the good ones you have left you will find they are a little smaller than they should be to fit the screw. This in turn will damage these drivers (or the screws) and eventually you will have 15 or 20 tools that are only useful for prying open paint cans.

If you're using individual bits, damaging one bit or needing a new size or type has a quick, inexpensive solution. You should pick up a set of bits of different sizes and types, but once again you should avoid the temptation of buying a cheap set that includes everything you'll ever need in

This selection of bits will fill most of your woodworking needs; small, medium and large slotted, #1 and #2 square drive, and #1 and #2 Phillips.

favor of a quality set of the few you will really need.

The one size you will need most often is the #2 Phillips. The crossed recess of this bit is much easier to use than the common slotted screw because the driver will center itself in the screw head and won't slip sideways as you turn it. If you have a choice when buying screws for assembling woodwork, get Phillips, not slotted heads. Drywall screws are more brittle than woodscrews, but work fine in most cases and cost less.

The downside to the Phillips head is that the end of the bit will eventually wear out. When a Phillips-head screw is fully tight, the bit slips out of the recess in the screw head. This helps you keep from over tightening or stripping the screw, but it is hard on the driver. Get several extra bits of this size.

The #1 Phillips is smaller, and you won't use it as often as the #2. Usually it is only used for attaching hardware, not in building. There is a wood screw called a "trim head" screw with a very small head that comes in either a #1 Phillips drive, or a #1 square drive. If you have the choice, go with the square drive. Like its big brother, the #1 Phillips is susceptible to damage and once the bit is torn up, it will start damaging the screws. If you are attaching hardware and can't drive the screws without doing any damage you should make sure your pilot hole is the correct size. If it is and you still have trouble, try lubricating the threads of the screw with some wax. Be especially careful with brass screws. They are softer than the tip of the screwdriver and so are easily damaged. Try driving in a steel screw of the same size first to cut the threads, and lubricate the brass screws.

There is a large, #3 size of Phillips head, but it isn't likely you will need one unless you are working with large diameter screws. If you have a large screw, and your #2 bit has a sloppy fit in the screw head, you need to head to the store and get a #3 driver bit.

Square-drive screws won't slip out of the recess when the screw is tightened, and generally work better than Phillips

The square drive holds so well that the screw will hang on the end of the bit.

heads. A square-drive screw will hang on to the tip of the driver by itself so it's easier to use if you have to reach in a tight spot. You can apply more force to the square drive without it slipping or damaging the screw head. Pocket-hole screws use a #2 square drive, and the trim-head screws mentioned earlier use a #1 square drive. With either of these applications, don't use Phillips-head screws if you have a choice.

Square-drive woodworking screws can be hard to find at your local home center, but they are readily available from online and catalog sources. Many woodworkers prefer the square drive for all applications, but you will still need to have other bits on hand.

Slotted screws used to be called "common" because the vast majority of screws were made with that type of head. The technology to manufacture other types was developed after the 1930s. The newer types are much easier to use, and less likely to damage either the screw or the screwdriver in use. There's an excellent chance that you will come across them, so having a few sizes of bits on hand is a good idea.

If you have a cordless drill, you'll probably use it for driving screws as well as drilling holes. A magnetic bit holder will make your life much easier. It's a lot easier to handle and holds better in the drill chuck than the smaller individual bits. In addition, the magnet will hold the screw to the driver, making it much easier to place the screws where you want them. When you drive screws with your drill, adjust the clutch settings so that the clutch engages at the point where the screw is tight. This will keep you from driving screws in too far or stripping the threads. It will also extend the life of your drill.

The magnetic bit holder chucks in your cordless drill and uses replaceable insert bits.

Workholding – Workmate, clamps

Your accuracy will be greatly increased if you can immobilize your wood as you work it. And that's why you need some kind of bench and clamps. Here is a bare-bones but workable setup.

Workmate

You need a surface to work on, but it doesn't have to be fancy or even permanent. A couple sawhorses and a solid door is a primo break-down work surface. I think the case can be made that you can build almost anything on a Workmate.

These wonders of engineering and marketing have dominated home garages since they were introduced in the early 1970s. (If you want to read a fascinating history of the Workmate, pick up a copy of Scott Landis' "The Workbench Book.") The workmate is going to cost you anywhere from $50 to $100 (or hit the garage sales; they're everywhere).

You won't outgrow your Workmate – I've always had one in my shop. It's a bench, vise and (don't tell) a big stepstool. The new ones are good, but if you can find an older one, you'll have found a friend for life.

And for your money you're going to get a workstation that can be positioned at two heights: Kinda low, which is great for sawing and kinda high, which is good for everything else. Plus you get a big workholding kinda-sorta vise. It's not going to do the job of a big metal woodworking vise, but with the plastic dogs provided with the Workmate, you'll be able to clamp most things.

One nice thing about a Workmate is that it folds up reasonably flat so you can stow it away or throw it in your trunk. Plus, it's not something you'll ever outgrow. Even if you become a professional cabinetmaker and have a $100,000 in tools you'll still find a good use for your Workmate.

There are some off-brands out there. We haven't used them. They might be fine; they might not. You're on your own there.

These two F-style clamps are absolutely your best friend when working wood. They hold things in place as you cut and shape them.

Clamps

You need some clamps to hold your work while you cut it or drill it and to hold parts together while the glue sets or you drive a nail or screw. People spend a fortune on clamps, and someday you might also do the same. But to get started, we think you need only about six clamps.

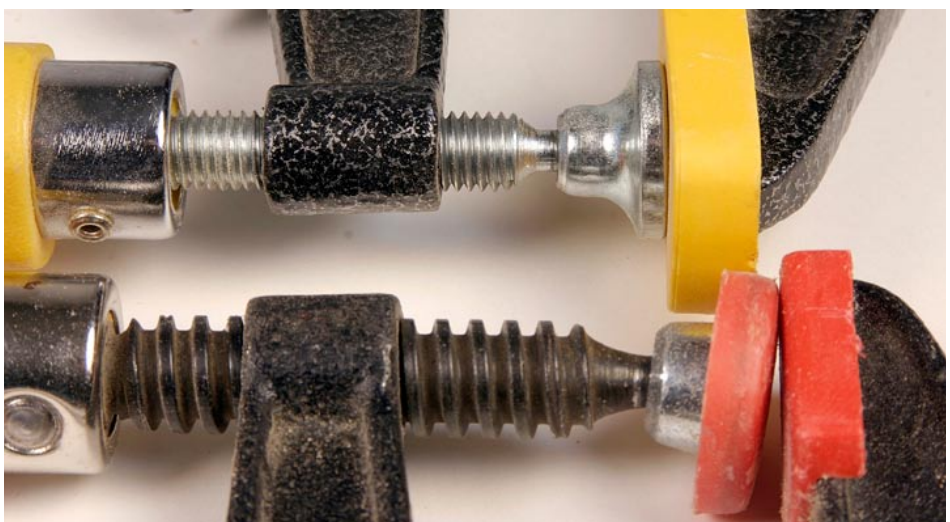
F-style clamps are so named because they look kinda like an "F." Usually they have a wooden or plastic handle. The typical and most useful of all F-style clamps has a bar that is about 12" long with a throat (the distance from the bar to the tip of the clamping pad) of about 3".

How do you pick a good F-style clamp? Good question. I hate – let me repeat that, hate – cheap, cheesy clamps. They usually aren't much less expensive than the good stuff, but they are much less useful and durable. Even if you abandon woodworking, you'll probably keep your F-style clamps to hold stuff for household repairs.

So how do you separate the good clamps from the bad? The first place to look is at the metal screw between the handle and the pad. Look closely. Think of the threads like mountains and valleys. Some screws will have threads with a pronounced flat or plateau at the top of each mountain. Some will have a sharp peak. Likewise, the mating valleys can be either flat or pointy.

The flat-topped threads are commonly called "Acme" threads and are far superior. They are more durable. They don't seem to get gummed up as much. They generally work faster. They also are more expensive, but they're worth it.

The other thing to look for on the clamps are the "teeth" or serrations that are cut into the bar. Cheap clamps will have teeth that are short and spaced far apart. Good clamps will have finely milled



The threads on the clamp in the bottom of the photo are Acme threads. This is a durable, lifetime clamp. The cheesy threads on the clamp above will strip out eventually.

The teeth on the left are on the cheaper clamp. They're coarser and are only on a small portion of the bar. The teeth on the right are finer and there's more of them.

teeth that are generally bigger. I know all this stuff sounds minor, but it really makes a difference. Also, some clamps come with plastic pads on each head; some don't. Don't walk out of the store without pads for your clamps, otherwise you'll mar the work.

The F-style clamps will hold your work down as you cut, drill and shape it, though they also can be used for attaching pieces together when you're gluing things.

For most assembly tasks, you're also going to want bar clamps. These are remarkably similar to F-style clamps in that they have the same issues with their threads and their teeth. The other factor is the bar itself. Many woodworkers use "pipe clamps" for assembly chores. Pipe clamps are made from plumber's pipe. You screw the clamp parts onto the threads of the pipe – instant clamp of any length.

Other bar clamps come with a bar made of aluminum or some other metal. Now a lot of people are going to talk to you about how much these bars flex under clamping pressure. Truth is, they do all flex. But here's what's important: If the bars of any clamp are flexing so much that it's distorting your assembly, then there's something wrong with your assembly, not your clamps. A well-cut joint will close with just a little clamp pressure. If you're using your clamps to make up for a poor joint, you'll be sorry later – the wood always wins in the end.

So don't get too worked up about the bar material. Pick a bar clamp that fits your budget and has quality screw threads and teeth on the bar. You'll be fine.

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Routers & Router Bits

Selecting your first router can be a daunting task without guidance. With the many different designs, motors and options available, what do you look for?

Should you choose a fixed-base or plunge-base router? Is a D-handle design better than a trim router (sometimes called a laminate trimmer)? What about multi-base kits? And then the world of router bits opens for discussion. When does shank size matter? When do you choose a bearing-guided router bit over a non-guided bit?

Also, there's technique to be considered. In what direction do you move the router during normal routing operations? What is a climb-cut and when should you use it?

Routers are available in many designs and at many different horsepower ratings. From left to right standing is a plunge router, a two-handle, fixed-base router, and a D-handle, fixed-base router. Lying at the center is a trim router, sometimes called a laminate trimmer.

Router Designs

There are two distinct router types: plunge base and fixed base. Plunge bases are

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spring-loaded units that, with the motor slid into the base, have the ability to adjust up or down as you work. Plunge cuts can be started and completed without moving the tool off the workpiece. While plunge-base routers do have a place in the shop, these routers, usually taller than fixed-base routers with handle placement set higher off the workpiece, are a bit top heavy and awkward. Therefore, a plunge-base router is not recommended as your first router.

In fixed-base routers, removable motors are slid or threaded into bases that are then clamped around the motors to form a fixed unit with which to work. Fixed-base routers include trim routers, as well as two-handle and D-handle designs.

Trim routers are small tools that are easily held with a single hand. Generally, there are no handles associated with these small routers; you simply wrap your hand around the tool and begin your cut. Trim routers would make a good introductory router except for the fact that they accept only 1/4"-shank router bits. (You'll learn more about this shortly.) Also, small routers have small bases, and that makes it more likely you'll tip the tool as you work. Tipping the tool causes problems when routing. You can replace the stock base plate with a custom-made plate if you desire, but we think there is a better introductory router choice.

Fixed-base routers with two handles are most often thought of as a router for entry-level woodworkers. These routers sit flat in your workpiece with handles set close to the work. As you use the tools, the balance

The base on a trim router is small and that presents problems with tipping the router as you cut. To improve the usefulness of this small router, add a shop-made, oversized base with an extra handle. Also, the tool is held with one hand.

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is right and there is no top-heaviness to speak of. But there is a problem as you begin or end your operation.

To reach the on/off switch, you must remove one hand from the tool. When you do that, the router is difficult to hold steady. This unsteadiness is reduced when the router has a "soft start" feature, a gentle motor increase to full speed. (Without soft start, the tool has a small kick that can catch you off guard.) When ending a cut, if you take your hand from the router handle, the tool has a tendency to wobble – and because the router bit is still turning at a high rpm, that can be a dangerous scenario.

D-handle routers are well balanced and can be held steady with a single hand. And the on/off trigger is right at your finger. It's hard to look anywhere else for a first router.

D-handle routers have the on/off switch set in the handle of the base; it's a trigger control. This, coupled with a well-balanced tool, allows the router to be easily operated without any tipping or wobble as you begin the cut, work through the cut and come to the end. This is the router we feel should be your choice as a first router.

What about router multi-base router kits? Kits generally are two-base setups that include a two-handle base along with a plunge base. It's sometimes hard to pass on a deal such as this, but we've discussed the problems for someone just beginning to use a router. If you can find a multi-base setup that includes a D-handle base as part of the set, then I would look closely at the tool, as long as the desirable features discussed below are met.

Horsepower & Variable Speeds

Horsepower ratings for routers can also be an indication of router size. Trim routers, which are the smallest in size, have the smaller horsepower (hp) ratings. Generally, these routers come in around 1 horsepower; some are slightly less.

The highest hp ratings belong to the largest routers. These routers are primarily used as table-mounted routers where the increased power can spin larger-diameter router bits to remove waste material quickly. Larger routers have horsepower ratings at 3 - 3½ hp. They are unwieldy to work easily as hand-held tools and we don't consider them to be a good first router. Routers in the middle category are normally rated with 1¾ or 2¼ hp. The difference in hp ratings is negligible,

so choosing one over the other can be a toss-up. However, a D-handle base is more often found with the 1¾ hp routers, but you can find the 2¼ hp routers available with that base design. Then you should consider price and if you can work with a slightly heavier tool.

Variable speed is something to look for in your first router. Adjusting the speed is necessary when you're using router bits with a larger mass in the profile. As the bit's mass increases, you should slow the tool's rpm.

Other Features

Other features one should consider when evaluating routers are the collets and how router bit changes are made – do you need two wrenches or is there a spindle lock?

A collet is part of the motor shaft assembly; it's the piece that holds the router bits safely in the router. On early routers, the collet was separate from the collet nut, but most routers today have a collet assembly where the two pieces are joined together. Collets are made to fit and work on the router model with which they came and should not be considered interchangeable between different models, although some companies produce a single collet design that can be used on many routers produced by that company. Also, collets sizes must match the shank on your router bits. Most routers, other than trim routers, include two collets: ¼" and ½". Other sizes, ⅜" and 8mm, are commonly found accessories. Collets should grip the bit shank tightly and not release once tightened.

Many routers come equipped with a spindle lock and a single collet wrench. To swap router bits, your thumb depresses a lock into the router shaft, then you operate

The collet, the part of the router that grabs and secures the router bit, is the piece inside the collet nut. Today, these two important pieces are generally joined as a single unit. Different size collets accept different size router bit shanks.

Wrenches are as varied as routers. Cast is better than stamped, although we wouldn't walk by a router without cast wrenches. We would, however, pass on a router that insisted we change bits using a thumb-activated spindle.lock.

the wrench with your second hand. This process is inefficient and can result in the setup slipping during changes, and sometimes the lock slips out of the spindle as you attempt to loosen or tighten the collet. The best arrangement is to use two wrenches: one wrench on the spindle and a second on the collet nut. Look for a router that comes with two wrenches. It's better if those wrenches are cast metal instead of stamped.

A Look At Router Bits

What about router bits? There are a number of designs from which to choose; just as there are easy calls on what not to use. The vast majority of entry-level router work is to produce edge profiles. The best results are accomplished when using guided router bits – router bits that self-limit their travel into the wood.

If you're rummaging around a flea market or a garage sale, don't pick up pilot-guided router bits – bits that have a portion of the shank extended below the cutting profile. That extension rides against the wood to guide the bit in the cut. Pilot-guided router bits mar the edge of your workpiece and are likely to burn as they cut. Today, this design is all but vanished, but can at times be purchased.

A better choice is a bearing-guided bit. Bearings spin freely as the bit is moved along the wood. There is little chance of marring the edge, and if the cut burns as it shapes, chances are there is operator error involved (we cover that later) or your router bit is dull and should be replaced. Bits can be found with bearings placed above or below the router bit profile. Different bearing placement is for different

These router bits create a 3/8" roundover profile, but the router bit on the right is by far better. The bearing rolls along the edge of your workpiece as it guides the router bit. The piloted bit on the left is an older design. The shaft guiding the bit often produced a burnt edge below the cutting profile.

Guide bushings, also known as template guides, are another method to guide your router bit. The bushing, available in different diameters, rides along a fence or pattern to guide your cut.

routing operation. Generally, being new to routers, you'll be most interested in router bits with a bearing mounted below the profile.

Of course, there are times when a non-guided router bit is called for. In these operations, you are either making a cut free-hand – a procedure that's inefficient and difficult to master – or you'll guide the router in some other manner such as running the base plate along a straightedge or using router guide bushings.

Router Bit Profile Choice

The most often-asked question about router bits focuses on what profile or profiles should a woodworker purchase. The answer is whatever bit profiles you need. Of course, to someone not familiar with routers and router bits, that answer is meaningless. Our suggestion, if you're just beginning down this path, is to purchase a set of inexpensive bits in different profiles. As you become more experienced, watch to see what router bit profiles you use the most. At that point, purchase better-quality router bits with that profile. And don't be afraid to experiment with different profiles as you learn.

One important furniture profile is a roundover bit. Roundover router bits are available in a variety of sizes – 1/4", 3/8" and 1/2" radii are the most common. These bits produce a smooth roundover detail, or if set for a deeper cut, the same bit forms a fillet (or step) in the design.

A few other router bits are commonly used in woodworking. A classic ogee profile – as is its cousin the classic Roman

Roundover router bits produce two distinct profiles depending on the depth of cut. Set flush with the workpiece, the bit produces a roundover design. The same bit creates a thumbnail design which includes a small fillet if set deeper.

ogee – is used as a tabletop edge profile and sometimes found as a door edge design.

Rabbeting bits, used to produce stepped profiles along the edge of boards, are available in either a fixed setup that is good for a single rabbet profile, or the router bit includes additional bearings that can be switched to produce varying sized rabbets. There are dovetail bits used to create dovetail joints and sliding dovetail joints – more advanced router operations. Dovetail router bits can be bearing guided, but most often you'll find them without. And there are straight bits, including pattern bits.

Pattern bits have become more popular recently. These router bits are simply straight bits with a bearing mounted to guide the cut along a predetermined shape. That shape is only limited by what you can imagine – it can be a straight cut to house shelf standards for a bookcase, curved to form a round or oval tabletop, or an intricate design used on the side of a piece of case furniture.

Pattern router bits are available in many lengths and bit diameters. Small diameters allow you to get crisp details in your work. Here an elaborate pattern, half the overall length of the workpiece, is used. (Flip the pattern to complete the piece).

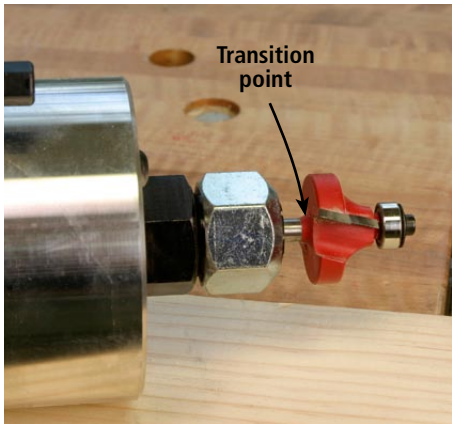
Size Does Matter

When talking about router bit shank sizes, the mass of the cutter profile helps determine the shank size. Many profiles are available with either 1/4" and 1/2" shanks. However, when the cutter profile becomes larger, the router bits are generally limited to 1/2" shanks. As a result, a trim router, due to its 1/4" shank limitations, is not used for larger-diameter router bits.

So with many routers able to work with both router bit shank sizes, why choose one size over another? The answer most often given is for durability and longevity. A 1/2"-shank router bit experiences less vibration than the smaller diameter shank. That lack of vibration extends the useful life. But as discussed above, some routers use only 1/4"-shank bits.

Proper Router Techniques

Bit installation is important. A router bit should be fully engaged by the collet. A simple rule of thumb is to slide the bit completely into the collet, then pull the bit out anywhere from 1/16" to 1/8" before tightening. It's imperative to not leave the bit fully set into the collet; doing so could cause two problems. First and most important, the collet could tighten at the area where the shank blends into the cutter and not only on the shank. The connection could loosen as the collet slips down onto the shank and the router bit could fall free. Second, if the bit shank is against the motor shaft, as the tool is used and heat builds, any expansion could push the bit away from the shaft causing problems with your depth-of-cut settings.



Install the router bit by sliding it fully into the collet then pull it out about 1/8". If the collet tightens around the transition point (shown by the arrow) it's probable the collet would slip and the bit could fall from the router.

The procedure for edge routing is to first securely clamp your workpiece so it will not move as you work. Next, move the router from the left to the right as you're routing an outside edge, or against the rotation of the router bit. On an inside edge, such as the interior edge of a frame, you have to move from right to left or again, work against the rotation of the router bit. That's why it's best to remember to move against the bit rotation.

Begin with the router bit away from the workpiece, but with the router base resting on your work. Wait for the tool to come to full speed (soft start), then move the router and bit into the work and move slowly along the edge. As you reach the end of your cut, pull the spinning bit away from the workpiece and allow the router to come to a complete stop prior to removing the tool completely.

The speed at which you move is vital for a clean router cut. If you move too fast, the cut will be rough and jagged. But if you move too slow, you are apt to create burn marks on the routed edge. Finding the sweet spot is important. This is an area

where being able to adjust the router speed (rpm) is nice. If you feel uncomfortable moving along the edge quickly enough to prevent burn while maintaining a clean cut, slow the spin of the router bit.

There are a couple tricks to eliminate burning. One trick is to increase your speed as you rout – find that sweet spot. If that fails, a trick we find useful is to rout the entire edge of your workpiece, then adjust the depth of your router bit just a fuzz deeper to run the edge a second time. This is a surefire method to a clean, burn-free edge profile. (Tip: Whenever you are routing a panel that has both long grain and end grain, you should work the end grain first. This helps to prevent tear-out as you profile the edges.)

If your first pass produces a charred profile, a technique used to remove the discoloration is to lower the bit a small amount then rerun the edge. Without having to remove a huge amount of material, the second pass is quick, the bit cuts cleaner and the charred edges disappear.

Pattern Routing

As mentioned above, pattern routing is gaining popularity in woodworking. Place your pattern on to your workpiece then draw a line along the pattern. It's better to remove most of the waste with a jigsaw or some other tool prior to routing. Next, clamp the pattern in position and rout the design just as you would an edge profile, allowing the bearing to ride along the pattern. Here, whatever the pattern shape is, an identical shape is made in your workpiece.

To rout an inside area such as a handle,

- ROUTER DESIGNS
- HORSEPOWER & VARIABLE SPEEDS
- OTHER FEATURES
- A LOOK AT ROUTER BITS
- ROUTER BIT PROFILE CHOICE
- SIZE DOES MATTER
- PROPER ROUTER TECHNIQUES
- PATTERN ROUTING
- CLIMB-CUTTING
- SAFETY FIRST

begin by transferring the pattern to the workpiece just as before, then drill a hole through the area large enough for your pattern bit to pass through – or your jigsaw blade if you have a lot of waste to remove. As before, the closer to your cut lines you can get, the easier the task will be. Clamp the pattern in place, then rout the waste from inside the pattern – remember that you're on the inside edges so you'll have to move the router from right to left.

Pattern routing can be as intricate as you need, or it can be simple and a great way to make matching pieces. And it's a real timesaver when woodworking.

Climb-cutting

Until now, we've talked about moving the router against the rotation of the router bit. Working with the rotation is called climb-cutting. While this is an operation often used in woodworking, it has potential problems. When moving with the router bit rotation, the router bit has a tendency to grab the work and propel the router forward. If you're not prepared for this, the router can be pulled from your hands and your workpiece ruined. In this scenario, it's best to take very light cuts and not try to hog off heavy-duty waste. Even with that in mind, make sure to brace yourself as you cut. Stand in front of the cut and lock your elbow to absorb any kick.

With these potential problems, why would you climb-cut at all? When you're routing hills and valleys, it's better to work

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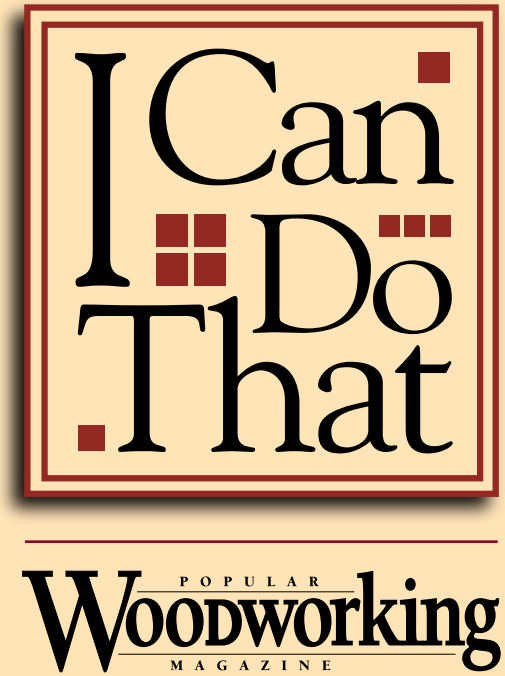
down the hills. If you move only right to left, as you work up the hills, you're apt to tear out sections of your workpiece that are vital to the finished design as the spin of the bit cuts away from the workpiece. By climb-cutting from the apex of the hill down into the valley, the router bit, as it spins into the wood during a climb-cut, cuts the waste material while pushing into the finished stock. This helps to keep the wood intact.

Safety First

Remember to protect your eyes, ears and lungs when using a router. Eye protection is key whenever you're working in a woodshop, but it's of particular importance when using a router. The decibels reading for most routers is more than 100, which is over the danger threshold, so hearing protection should always be worn. And fine wood dust gathers in your lungs and accumulates over time, so it's best to wear a mask as you rout – especially when working with exotic woods.

Safety gear – safety glasses, hearing protection and some type of dust mask – should always be used when routing.



2 · Techniques

"Everything should be made as simple as possible, but not simpler."

— Albert Einstein
scientist, mathematician, inventor

Ripping

Ripping lumber is a lot of work. In fact, we try to plan projects to do the least amount of it possible. When you do rip – which is the act of sawing with the grain as opposed to across it – here's how to do it. Mark your cutting line all along your board – mark both faces of the board if you can. Use a combination square or play "connect the dots." Cut outside of the line with your jigsaw – get as close as you can without crossing it. Secure the board with the sawn edge facing up. Use your block plane to smooth the jigsawn edge down to your pencil lines. Check your edge with your combination square to make sure you are planing square.

1 ■ Mark your cutting line on both faces of your work – this will help you plane down to the line later.

2 ■ Jigsaw as close to the line as possible without crossing it. Move the saw swiftly yet surely for a smooth cut.

3 ▪ Use a block plane to remove the saw marks and create a square edge. Plane down to your cutting line (check both faces of your work).

4 ▪ Check your work in several places along the edge to ensure it's square. Work on the areas that aren't.

Layout – Egg Crate Shelf Joint

Long before the term "ergonomics" was invented, the combination square was designed to neatly fit the hand. In the egg crate shelf project, the square is used in several different ways, many of them with the left hand holding the square. Once you get used to using it and the way it works, you can use it as an all-purpose layout and marking guide. Find a comfortable way to hold it firmly against the edge of your material.

Layout

We want the joints to be in the same place on all the parts, even if our measurements are off a little. By clamping all the uprights together, we can measure and mark the locations of joints only once, and then use the square to transfer the marks to all the pieces by drawing a line across the edges of the boards. This saves time, and it also guarantees that the locations marked are in the same place on each piece.

Next we want to be sure that the slot we cut is the same size as the thickness of our wood. It isn't safe to assume that the ¾" material really is that size, so use a piece of scrap to get the size right, even if the material is too thick or too thin. Draw a line to represent one edge of the notch, and slide the blade of the square over to barely cover the line.

Holding the square firmly in place, the scrap is placed against it, and a pencil line is drawn against its edge as seen in the photo at right. After drawing the line, you can remove the square and look down on the scrap and the two lines. If you can see both lines against the edge of the scrap your layout is accurate.

If we're confident that the shelf will fit between the lines, then we can preserve the lines until the final fitting, cutting inside of them, and trimming down to

Measuring isn't always the best way to work accurately. Holding a block of scrap against the blade of the square guarantees that the line drawn will represent the thickness of the piece that will fit in the notch. It's much more important that the slot and the shelf be identical in size than it is to know the exact thickness of the shelf. Every time you measure and mark something you introduce the opportunity to make a mistake. I consider measuring to be a last resort, and avoid it when I can.

them. The lines will let us know if our cuts are straight, and how much more material we have left to remove.

The ends of the notches need to be marked, and we'll use the end of the blade of the square as our guide after we adjust it to be centered in the width of the board. Measuring will get us close, but not exactly there. Make your best guess as to the center measurement, and make a mark with your pencil.

Adjust the blade of the square to meet that mark, and draw a short line against the end of the blade. Now, flip the square over so that it's against the opposite edge of the board, and make a second mark. If these two lines coincide, you got lucky and hit the center on your first try. Chances are there's a gap between the two. Adjust the blade again, trying to place the end of it between the two marks. When you have it set, make a mark from each edge as you did before. You should be able to get the lines to meet in a couple attempts.

We can also use the square to guide the jigsaw to make straighter cuts than we could make if we were trying to saw freehand, as seen in the photo at left. Clamp the board down, and with the square in one hand, and the jigsaw in the other, line up the saw so that the blade is just inside one of the lines.

Cutting Joints

Back the saw away from the line while holding the square firmly against the edge of the board. Turn on the saw and push it in against the blade of the square to make the cut. Hold the base of the saw flat, and release the trigger when you get to the line at the end of the notch.

Making the square cut at the end of the notch seems impossible. There isn't a way to start the cut on the line, so you need to create some space for the blade. Run the sawblade down one of the previously cut lines, and aim for a corner. After the waste piece falls away, you have room to turn the saw as you head to the other corner. It may take a few times going back

It takes some practice to coordinate sliding the saw and square to get in position to make the cut, and to hold the square steady as you push the base of the saw against it. Make some practice cuts in the wasted space between the two lines before trying to cut precisely to the line. When you're ready, hold the base of the saw down to keep from lifting it over the edge of the square. Release the trigger when you hit the cross line and wait for the blade to come to a stop before removing it from the cut.

and forth, but eventually you can cut to the line. If you go too far, or end up with some ugliness, don't worry. This end of the joint will be covered up when you put the pieces together.

After making both of the long cuts, make a curved cut in the waste toward one of the corners. This will give you room to maneuver the saw to cut the end of the notch.

Fitting Joints

We used a rasp to clean up the saw cuts, removing material back to the pencil lines. Holding it in both hands as shown helps to keep it square to the face of the board. When you get close, take a piece of scrap and see if you can fit it in the notch. If you can get it in with the pressure of your hand, you're ready to move on to the next joint.

If the scrap won't fit with hand pressure, take a close look at the joint and layout lines. Take a few more strokes with the rasp and try again. By checking the fit of each notch as you cut it, you will increase the chances of the entire project fitting together, and you will get instant feedback on your sawing technique.

When you assemble the entire piece, keep the joints lined up to each other as you push them in to place. Avoid the temptation to force them together. If you hit a point where the parts are stuck and won't go any further, examine the joints to make sure they are lined up, and look

Using both hands helps to keep the rasp in a vertical position. Remove material evenly with long strokes of the rasp until you are down to the layout lines. Working to the lines will help you to keep the edges of the notches straight.

for any tight spots that are keeping them from going together.

When you're satisfied that you have a good fit, pull the joints apart about halfway, spread some glue carefully on the inside surfaces of the joints, then put the joint back together.

Test fit each joint as you go by fitting a piece of scrap wood. Take note of where the joints are too loose or too tight and correct your technique when you cut the next joint. Don't worry if the first joints have some gaps. The project will still come together if you're not perfect. The idea is to practice and get better with each attempt.

I Can Do That

POPULAR Woodworking MAGAZINE

3 · Materials & Hardware

"One minute of patience, ten years of peace."

— Greek proverb

Materials: Selecting Lumber

Selecting the lumber for your project is almost as important as choosing the project. Trips to the home improvement stores can be overwhelming when you are looking for material the first time. What lumber do you choose?

Resist the temptation to go directly to the vinyl-coated particleboard that some use for bookshelves. That is not what you need. Instead, look up and find the aisle marked "Lumber" – the material that you will need for your project is in that section of the store.

As you approach the lumber you'll notice that the aroma changes to a pungent, wood-like smell. This is where you'll start to notice the many choices available for your project.

And boy do you have choices! In the store that I visited I found that the first area I came to was the sheet-goods section. Sheet goods are plywood, both veneered and construction-grade selections, as well as Medium-density Fiberboard (MDF) and oriented strand board. We'll get involved with these at a later sequence in the series.

For now, let's look at dimensional lumber – material that is S4S (surfaced four sides). This lumber has had all four sides smoothed and is cut to a specific measurement.

Dimensional Lumber

Dimensional lumber is an enormous area that we need to continue to refine. All lumber has a grading designation. For our purposes, we're most interested in both #2 and prime grades, which is generally what you'll find at the home-center stores. The #2 grade denotes that these boards have knots that are large in size and possibly loose; the prime grade, on the other hand, is lumber relatively free of knots.

Within dimensional lumber you'll find material such as 2x4, 2x6 and 2x8, etc. Lumber that is 2x is actually 1½" in thickness and the second measurement will be slightly less than the number shown, too. How much less? For numbers 6 and under, the actual size of the piece is a ½" less in width, so a 2x4 is actually 1½" x 3½". For the numbers above 6, such as 8, 10 and 12, the actual width will be ¾" less. It seems confusing but it is a standard within the industry.

Different species that fall into this category are treated lumber, SPF (spruce, pine or fir), hemlock and yellow pine. Depending on your area you might have one or all of these selections. Do you want to use this material for your projects? Sometimes you might.

Treated lumber is meant to be used outside. This is most often seen as deck material. If I were building a table for my

deck I would consider using this material, however, I would have some reservations. Lumber intended for this use is treated with a type of chemical that helps preserve the wood when it is exposed to the elements. It is not for interior use. Take proper precautions when working with this stock.

The balance of the selections can be used in furniture, but there is something to consider. This lumber can have a higher level of moisture content (around 19 percent). Moisture is not a friend of woodworking. Once a finished project is brought into the house moisture will dry or evaporate, which causes shrinkage across the width of the board (the length changes only minutely). That could result in your project having splits and cracks.

If you plan to use this wood in your project, OK. Just let it dry or acclimate to the surroundings before beginning. If you have a moisture meter to check the moisture content, it shouldn't be above 10-12 percent, depending on where you live. No moisture meter? You can wing it by choosing lightweight boards (water makes them heavy) or buying your wood and letting it acclimate in your house for a month.

Prime(ary) Lumber for Furniture

Lumber used most often for furniture is 1x material (1x4 or 1x6). Here is the good news, the variations between the stated measurement and the actual sizes is the same here as it is on 2x material, except that the 1x is actually ¾" in thickness. The width variances are identical to the 2x lumber.

Each home store might have different species of this type of lumber for sale. Mostly, you will find pine, poplar and red oak. In my area they also have aspen but in other locales across the United States, they have maple in place of the oak (check your store for species availability).

The biggest differences between this lumber and the thicker stock previously discussed are the moisture content and the grading. The moisture content in this type of lumber should be in the six- to eight-percent range.

Grading this lumber is the same as the thicker stock. In this discussion the lumber from the home stores should be considered

This clearly shows the difference between the #2 pine and the prime grading of the same species.

prime, however, you will generally find #2 pine in these stores and the knots will be obvious (sometimes you can find #2 pine with clear areas; that allows you to make small cuttings without the problem of knots. And that will save you money).

Hardwoods will be better in quality. Poplar, red oak and other available species should be free of large or loose knots throughout the board. Avoid shrink-wrapped lumber.

Picking & Choosing

Now that we know the type of lumber for which we are searching, we have to determine how we should select from the individual boards.

To begin with, you are paying good money for this lumber, so if you have to pick through every piece in order to get the best board, so be it! Plan to look at a few pieces.

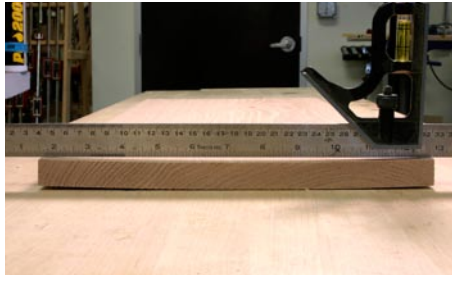
The first test is to look at the grain and overall appearance of the board. If the coloration is off as you view the piece, move on to the next one. If the grain doesn't look appealing, move on.

Next, I suggest that you carry your combination square into the store if possible. This will help you check the board for cupping (bending from side to side) by placing the straightedge against the face of the lumber. At any areas where the straightedge of the square is not in contact with the board at the center, you'll see light between the edge of the square and the flat face of the lumber. (The straightedge will only contact the board in the center if you are checking the opposite side).

Or, at the ends of the board you can sight along the end grain of the piece to make this determination. If there is a cup in the board put it back and check the next piece. Continue until you get the boards that you want.

Finally, I look at the board from end to end viewing the piece down the edge. This will expose any warping, twisting or crowning in the board.

Warping is a defect in lumber where the boards will move in one or more directions over the length of the piece, while twisting will cause the piece to not lay flat when placed on a flat surface. A good way to check for this defect is to lay the piece onto the floor at the store. If one of the corners is off of the floor, press down on that corner. If the diagonal, opposing corner raises you have a board with twist. Put this piece back into the rack and move to the next. You can imagine



The use of the straightedge portion of the combination square will help to identify any cupping in the board. Return these boards to the stack and select another!

Looking down the edge of any board will help to uncover any defects in the lumber such as twisting, warping or crowning.

how this type of problem will affect your woodworking.

To discover crowning you also need to look at the edge of the stock from end. (Crowning is when the edge of the board is bowed, so it isn't straight.) A simple test for this is to place the piece onto the floor while holding it on the edge. If the stock rocks from end to end (crown is down) or if it is touching only on both ends and there is space between the piece and the floor in the middle of the board (crown is up), you have a crowned or bowed piece. This affects your work by not allowing you to place the pieces side by side to achieve a larger surface, i.e. gluing a panel together. Choose another board.

Once all the selections are made and the tests are complete, you have chosen a quality piece of lumber for your project.

How Dimensional Lumber Measures Up

Nominal	Actual	Nominal	Actual
1x2	¾" x 1½"	2x2	1½" x 1½"
1x3	¾" x 2½"	2x3	1½" x 2½"
1x4	¾" x 3½"	2x4	1½" x 3½"
1x6	¾" x 5½"	2x6	1½" x 5½"
1x8	¾" x 7¼"	2x8	1½" x 7¼"
1x10	¾" x 9¼"	2x10	1½" x 9¼"
1x12	¾" x 11¼"	2x12	1½" x 11¼"

This may sound like a good deal of trouble but I suggest that you make these steadfast rules for selecting lumber. If you bypass them you may find even more trouble while building your projects.

In addition to dimensional lumber, you may also find assembled or glued together panels at your home center. Should you choose these for your furniture? Maybe. The problem with most assembled panels is that they are usually comprised of a number of narrow pieces. This does not present the best look when staining a piece of furniture.But, if paint is your finish of choice for your project – take a look at them. But, use the same decision-making process and apply the same tests for these panels as you do in selecting dimensional lumber for the projects.

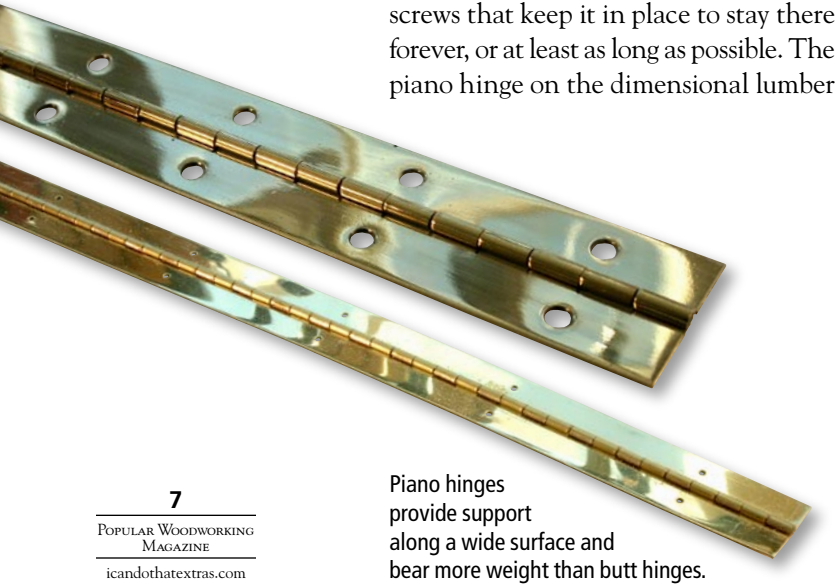
Hardware: Piano Hinge

There are two important things to remember when setting hinges. The first is that you need to place the hinge exactly where you want it for it to function correctly. The second is you want the screws that keep it in place to stay there forever, or at least as long as possible. The piano hinge on the dimensional lumber bench is relatively easy to put in place, and the number of screws will give you plenty of practice, as well as some insurance if you don't get the first few in properly.

The simplest and one of the most accurate ways to locate the hinge is to arrange the top and the chest in a way that will let you put the hinge in place without trying to overcome the law of gravity.

Put the lid upside down on your Workmate, then place your assembled bench over it. You'll need to let the sides of the bench hang over the top of the Workmate. Once you have both parts in place, line them up where they will be after you've installed the hinge.

Piano hinges are usually sold in 1' increments. You can either use a 24" hinge and leave equal spaces on each end, or you can use a 36" hinge and cut it to fit. To cut the hinge, use a Sharpie marker to



Piano hinges provide support along a wide surface and bear more weight than butt hinges.

The edge of the lid is in from the edge of the bench. Set the combination square to the right distance, hold it against the back edge of the side, and push the back edge of the top in place.

mark your cut line, and cut the hinge with a hacksaw or with a metal-cutting blade in your jigsaw. With either method, you need to clamp the work securely to your bench to make the cut. You don't need to fill the space exactly, you should cut it a bit smaller than the opening.

Put the hinge in place with the leaves of the hinge flat on the two pieces of wood. Hold the hinge in place with one hand, and use an awl to make a mark in the center of two or three holes. The hinge is held in place with small screws, so you don't need a big hole to get them started. You also don't have the space to get your power drill in position to make a vertical hole, centered in the opening of the hinge. If your holes for the screws are off-center, the beveled underside of the screwhead will move it as you tighten the screw.

When you attach the hinge, put two or three screws in one leaf, make sure the hinge is still in position, then put a few screws in the other leaf. This lets you check to see if the hinge will work the

When installing a piano hinge, first install just a few of the screws. Then test the hinge.

Check the action of the hinge before you finish your work. If you need to make adjustments, you won't risk damaging a painted surface.

way you want it to before putting in all the screws. If you've made a mistake, you can remove the screws, adjust the position, then reattach the hinge with screws in different holes. You'll find it's difficult to move a hole.

Once you're happy with the way the hinge operates, make the rest of the pilot holes and drive the remaining screws. You'll face the same problem with driving the screws you had in making the holes – there isn't room to use your cordless drill without the chuck rubbing on the wood.

Even though there are a lot of screws to drive, if you have a good pilot hole, they will be easy to drive by hand, especially if you used softwood. If you used a hardwood, it will be more difficult. You might want to lubricate the screws with paraffin or another wax to make the screws easier to drive. Think of this as skill-building practice. Make a few holes, drive a few screws, and compare the results with the last round.

You'll notice that I put the hinge on before I painted the bench. Once I had the hinge working properly, I took it back off to paint the bench, then put it back on after the paint had dried. This may seem like a waste of time, but there is a good reason to do it this way.

If I had to make any adjustments that involved removing some wood, or if the top rubbed against the side as the hinge opens and closes, I wouldn't be ruining the paint job. Repainting to cover some damage would be a much greater waste of time, and there is enough risk of that happening to make it worthwhile to take extra time to reinstall the hinge.