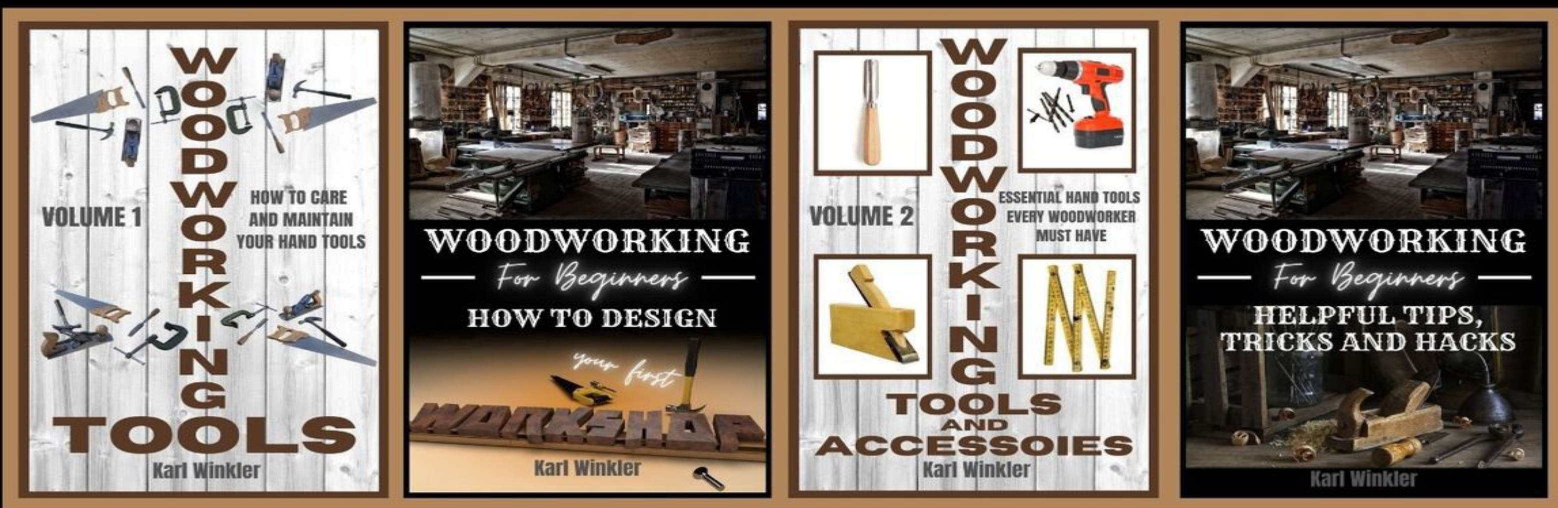
WOODWORKING

4 BOOKS IN 1



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TIPS AND TRICKS for WORKSHOP DESIGN and

HOW TO USE MUST HAVE WOODWORKING TOOLS for beginners

Karl Winkler

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Tips and Tricks for Workshop design
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How to use must have woodworking tools
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Disclaimer

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Introduction

Take the first step and dive into woodworking!

If you are new to working with wood, you may be wondering where to start. Hence, it's always a good idea to start with a few hand tools, such as a couple of planes, a set of chisels, some layout tools, and a handsaw. Using hand tools requires tolerance and a degree of skill, but in the process, you'll learn all about grain direction, accurate layout, and the importance of sharp tools. Learning to use power tools can be equally satisfying; woodworking machines provide accuracy and efficiency that's difficult to match with hand tools. The table saw is the first power tool that many woodworkers purchase. It can accurately rip and crosscut as well as cut many joints. The jointer and planer are a team that can efficiently flatten and plane lumber to size. Almost every woodworking shop has a band saw; it's the tool of choice for cutting curves and the only tool that can resaw book-matched panels and veneer. Mostly, power and hand tools are of equal importance: Machines provide efficiency for labour-intensive tasks, such as sawing and planing; hand tools are used to create fine details that machines can't duplicate. As you peruse the pages of this book, I hope that you'll learn many new skills while experiencing the intense enjoyment that woodworking provides. You will learn about power tool safety tips when working with wood, and how to look after your tools.

In book 1, we will begin with a little introduction to sharpening tools, cutting edge basics, how to use Benchstones and how to use bench grinders. Next, we are going to look at different ways to maintain hand tools such as handsaws, chisels, gouges, bench planes and scrapers. Next, we are going to cover how to maintain roughing and shaping tools, how to take care of braces and bits, how to sharpen power tool blades, router bits and shaper cutters. After that, you will learn how to maintain circular saw blades, band saw blades, jointer and planer knives and how to maintain portable power tools. Moving on, you will learn how to repair portable power tools, how to maintain stationary power tools, how to use table saws, radial arm saws, and band saws. Next, we will cover how to use jointers and planers, how to use drill presses, lathes and shapers and what other supplementary tools you need for your workshop.

Book 2 begins with the fundamentals of hand tools such as Combination square, Marking knife or Bevel gauge. Moving on, it covers Joinery tools such as Dovetail saw, Chisels, Coping saw and Shoulder plane. After that, you will learn about Tools for shaping and smoothing such as Block plane, Card scraper, Spokeshave or Smoothing plane. Next, you will learn about Essential handsaws such as Dovetail saw, Crosscut saw, Dozuki, Coping saw and Backsaw. Moving on, you will comprehend Essential handplanes such as Bench plane, Adjustable block plane, Jointer, Shoulder plane, Smoothing plane or a Small router plane. After that, you will learn proven Tips for handplaning such as How to adjust the blade, how to install the blade correctly or how to plane correctly. Next, you will learn how to use the Card Scraper and scraper planes or how to use Japanese chisels such as Mentori, Kinari or Shinogi. Moving on, you will learn how to use hammers and mallets and how to keep your tools sharp. Next, you will comprehend many tricks and tips about Tablesaw, Bandsaw, Miter Saw, Chopsaw, Router, Drill presses. Lastly, you will learn about Essential Measuring and Marking Tools such as Framing square, Engineer's square, Marking knife, Marking gauge and Pencils. In the Bonus Chapter you will also learn about Glue-Up Gears and how to choose the Best Glues for your Woodworking project.

Book 3 begins with some workshop tips for basements and design tips for garage conversion. Then we are going to look at small workshop options, low-cost workshop options, how to wire your workshop, and tips for light improvements. Next, you will learn plenty of tips and techniques for Workbenches and storages, dust collectors, bench vises, sawhorses, cabinet installations, wall storages and how to build a wall cabinet. After that, you will learn woodworking safety practices, tips for dust protection, dust mask and respirators usage. Lastly, you will comprehend how to start planning your ventures and how to develop your own designs.

Book 4 begins with tips and techniques on how to shape wood, how to use bandsaw, Jigsaw and a handplane like a pro. Next, you will learn how to smooth wood, ripping techniques, how to apply crosscuts, how to break edges, and how to taper legs using tablesaw. Moving on, you will comprehend wood moulding techniques, how to fix mistakes, joinery and miter Joint tips. After that, we will cover how to cut mortises, how to fit tenons using handplanes, and additional mortise and tenon joinery techniques. Next, you will learn how to work with curves, how to peg wood joints, how to layout dovetails, and how to use Dovetails on the tablesaw. Lastly, you will comprehend how to miter your dovetails and how to implement moulded joints.

Book 1

Woodworking Tools

How to care and maintain your hand tools

Karl Winkler

Power tool safety tips when working with wood

- Ensure that you wear appropriate safety tools: safety glasses, a face or dust mask if you are sanding, and hearing protection if you are operating tools for an extended period of time.
- Clamp all workpieces securely whenever possible to keep both hands free to operate the tool.
- Be aware of the position of the power cord at all times.
- Make all adjustments to a tool with the tool unplugged.
- Maintain and clean tools regularly.
- Keep all blades and bits sharp, clean, and undamaged.
- Confirm regularly for loose parts and frayed cords.
- Never carry a connected tool with your finger on the trigger.
- Tie back long hair and avoid wearing loose clothing.
- Eliminate rings and other jewelry that can catch accidentally in moving parts.
- Do not overreach.
- Keep appropriate footing and balance at all times.
- Ensure that lighting and ventilation in the work area are adequate.
- Do not use tools if the floor is damp or wet.
- Keep your work area clean and tidy; clutter can lead to accidents.
- Keep pets, children, and onlookers away from the work area.
- Concentrate on the job.
- Do not rush or take shortcuts.
- Never work if you are tired, stressed or have been drinking alcohol or utilizing any medication that induces drowsiness.

Chapter 1 How to look after your tools

When I come upon a craftsman who built fine country furniture, miles from the nearest power line, I was inspired to learn as much as I could about how to make tools work well. As a result, wood became a much more welcoming material to me. Today, as an experienced teacher of woodworking to children, my job is to help my apprentices escalate the possibilities of wood. The last thing I want to do is let them work with bum tools. It is easy to fall in love with hand tools. I have a small collection of time-mellowed implements that I would not think of putting to work. They represent a history of effort and issue-solving that is a comfort to my modern mind". I also have other fine old tools that are often put into service. But the tools I use every day in teaching have much less of an aura about them. Kids bang them around and drop than all too often. What is vital about them is that they work right. The difference between a dull tool and a sharp one is something every woodworker needs to know. It is the difference between the upset kid I was and the kids I teach today. When I show a child how to whittle, he or she is expected to try every knife on the rack, typically four or five tools. Only by making this comparison will it become clear which are really sharp and which are just okay. Every woodworker has his or her own favoured way to sharpen an edge tool. Some use oil stones, slow sandstone wheels, Arkansas stones or leather strops. Others favour Japanese water stones, the use of which is almost a ritual. In my school shop, I need to work rapidly and I have long since settled on a grinding belt and buffing wheel. At home, I have fallen in love with the new technology of diamond stones. I firmly believe that, while sharp tools are essential, there is no one right way to sharpen tools, only the best way for you. It takes time to figure it out, but it is time you must be willing to spend. It is like building the foundation of your home. Each item else rests on it.

Stepping up to a poorly upheld machine can create a spectrum of emotions from apprehension to frustration. When the hand wheel on your table saw forces you to one knee, requiring two hands and all of your strength to raise the blade, and when the machine screams and smoke billows as stock is fed through, face it: It’s time to do a little maintenance! Probably the most straightforward part of shop maintenance is the obvious reason behind it safety and efficiency. It is very vital to keep cutting implements sharp. More accidents arise with dull tools because more force is required to operate the tool. You will need a few tools to get you started, including a grease gun, oil can, graphite, silicon spray, and paste wax. It is also convenient to have a set of wrenches, sockets, hex wrenches, and brushes for cleaning gears. Lastly, pick up some abrasives such as steel wool, fine silicon carbide paper, and a mill file for deburring shafts and nicks in tabletops. Cutters such as saw blades, knives for jointers and planers, shaper cutters, bits for routers and drill presses and turning tools must be kept sharp and free of pitch and resin in order to cut efficiently. Pitch and resin on cutters and saw blades, which can cause kickback, can be removed with spray oven cleaner. Some in-house sharpening can be done to carbide tools with a diamond stone. High-speed steel cutters such as turning tools and shaper knives can be sharpened on a bench grinder or honed with a bench and slip stones. Alignment of tables and fences is also vital. The position of a tabletop is vital especially if it has slots cut in it for miter gauges. The slots need to be parallel to the cutters. The same is true for fences. Lubricate gears and ways that raise and lower arbors and tables. Lubrication of exposed gears and ways should be done with graphite, spray silicon, or paste wax. These dry lubricants prevent build up of sawdust that would occur if the parts were greased or oiled. Bearings with grease fittings or oil caps should be attended to periodically with the appropriate lubricant. The tables and beds of all machines should be inspected and, if necessary, filed flat. These exteriors should be kept free of rust and paint splatterings and should be cleaned with steel wool or fine silicon-carbide paper. Once clean, an application of paste wax will help prevent rust and allow stock to slide across the exterior with less effort.

Chapter 2 Introduction to sharpening tools

At one time or another, virtually every woodworker has looked upon tool sharpening as a rainy-day task, an onerous duty undertaken only as a last resort that seems calculated to delay progress on the moment's favourite venture. While it may be impossible to persuade all woodworkers to embrace the joys of tool sharpening-as some do-sooner or later, most adopt an attitude of enlightened self-interest, an understanding that regular attention to tool condition will speed, rather than retard, progress and improve both the quality of work and enjoyment of it. In Japan, apprentice woodworkers spend years at the sharpening bench before attempting to cut wood. The practice is rooted in reality: To cut and finish wood one must use sharp tools. The most realistic route to sharp tools for most woodworker lies in regular attention. When sharpening and maintenance adopted as part of regular workshop routine, the time require is decreased-and the benefits of keen edges are rapidly realized. There are many jigs and accessories that promise quick and easy results, and no shortage of techniques with the same objective.

But all sharpening work comes down to this: Tools are sharpened by wearing away steel to form a fine edge, and polishing that edge so it slices as accurately and effortlessly as possible. Among many tools, two are essential: a sharpening stone and a grinder. Once, all sharpening stones came from the ground; sandstone, novaculite, and other supplies have been quarried and cut into bench stones from the earliest days of woodworking. More recently, technology has developed synthetic stones that substitute for the dwindling supply of natural abrasives. A rather older technology also provided the foot-powered sandstone grinding wheel and its descendant, the bench grinder, which saves much labor in removing nicks and forming bevels before final honing. This chapter is intended to eliminate the mystery and some of the labor from the sharpening procedure. With a grinder, a few bench stones, an understanding of the procedure and practice, you can have sharper tools-and derive more pleasure from your woodworking.

Chapter 3 Cutting edge basics

A cutting edge can be defined as two flat, polished exteriors meeting at an angle. Since most blades are intended to be pushed through wood, a keen cutting edge is essential, particularly for dense hardwoods that can rapidly blunt tools. Any flaw, like a nick in a planer knife or a chisel blade, will be transferred to the wood being cut. Do not assume that just because a chisel is new that its edge is as sharp or as straight as it should be. Even the best tools need to be sharpened when new and regularly thereafter. In order to achieve a keen cutting edge, steel is tempered to certain hardness when the tool is forged. Since tempering is done at high temperatures, the tool may rather as it cools. You can skirt this issue by choosing tools made with high-quality steel. Even the best steel likely to show manufacturing imperfections. Low-quality tools, nevertheless, may never achieve and hold an edge.

In its straightforward form, sharpening is like sanding: It consists of the wearing a way of one material by a harder material, utilizing successive finer abrasives. When the bevel of a chisel is drawn across a sharpening stone, the abrasive particles scratch the exterior of the chisel uniformly creating a flat exterior. Finer and finer stones make the scratches finer and finer, until a mirror-like finish is achieved.

How to smooth a cutting edge

- The quality of the cutting edge and finish on a tool blade depends on the size of abrasive particles used to sharpen it.
- Just as you would sand a tabletop with progressively finer grades of paper, sharpening begins with coarse abrasives and moves up through finer grits.
- The only difference is the size of abrasive particles involved.
- For instance, a coarse Indian stone has particles measuring about 173 microns across, while a hard Arkansas oilstone has smaller particles about 10 microns.
- Commercial honing compound used for buffing has extremely fine particles, as small as 0.5 micron.
- By comparison, the diameter of a human hair is approximately 40 microns.
- A chisel blade magnified approximately 200 times can reveal how sharpening improves a tool's edge.
- A dull chisel has grooves and pits on its back and a nicked edge.
- These flaws will leave a rougher finish on wood than the smooth back and edge that is achieved after the chisel is sharpened and polished on a finish waterstone.
- The water stone has abrasive particles measuring 1 micron in diameter.

Sharpening procedure step by step

STEP 1: GRINDING 0R LAPPING

- For badly scratched or nicked cutting edges, start the procedure by squaring the cutting edge, grinding the bevel, then lapping or flattening the back of the blade.
- Grinding is done with a bench grinder and coarse stones such as Washita; lap with rough abrasives or lapping compounds on a lapping plate.

STEP 2: SHARPENING

- For tools that do not need grinding, sharpening can start here.
- Initial sharpening removes any roughness on the bevel and establishes a fine wire burr on the back of the blade.
- Sharpening is done by hand or with bevel-setting jigs on medium stone such as soft Arkansas.

STEP 3: H0NING

- Honing uses progressively finer stones such as hard Arkansas or Japanese finishing stones to smooth out the scratches on the bevel caused by sharpening.
- Then the tool is turned over and lapped to eliminate the burr on the cutting edge.
- The microbevel is also honed at this stage.

STEP 4: P0LISHING

- For a razor-sharp edge and a mirror-like finish, the tool can be polished with hard black Arkansas, ceramic or Japanese finish stones, as well as strops impregnated with fine buffing compound.

How to hone a microbevel

- When a tool blade is razor-sharp, more force is necessary to drive the blade into the wood, and its edge is more likely to be brittle.
- By honing a secondary bevel, or microbevel, on top of the first, you can increase the cutting effectiveness of the tool and prolong the life of the cutting edge.
- Microbevels are rather steeper than the original bevel of the tool.
- It can vary from as little as 2 degree to as much as 10 degree; the steeper the microbevel, the tougher the edge.
- Yet the microbevel should not be oven worked.
- A few light strokes on a benchstone is typically sufficient top develop a small hairline strip at the edge of the main bevel.
- It the microbevel is wider than half of the width of the bevel, the bevel should be re-established by sharpening

List of sharpening tools and accessories

- Multi-tool jig
- Honing compound
- Bench stone
- Neoprene polishing wheel
- Bench grinder
- Aluminium oxide wheel
- Dresser
- Felt wheel
- Wet/dry grinder
- Lapping compounds
- Auger bit file

- Three-square file
- Cant-saw file
- Sharpening stone holder
- Honing guide and angle jig
- Angle confirmer
- Waterstone storage unit
- Diamond needle file

Chapter 4 How to use Benchstones

The benchstone is the most commonly found sharpening accessory in the shop. Once referred to as natural stones, benchstones now encompass many man-made supplies, ranging from aluminum oxide to ceramics. Many "stones" include fine diamond bonded to steel. Sharpening stones are generally divided into two groups according to the lubricant used with them: oil and water. Lubrication serves to disperse ground particles and prevent them from clogging the stone. Choosing between the two is primarily a matter of feel; some woodworkers prefer the edge a glassy hard black Arkansas oilstone gives a tool; others like the fine control a softer Japanese finish waterstone offers. Naturally occurring oilstones have long been regarded as the finest sharpening stones. Quarried from novaculite and sold as Arkansas and Washita stones, these sharpening exteriors are becoming scarce. If your budget permits, natural stones are a good investment; they will last a lifetime. Synthetic substitutes made of aluminum oxide or silicon carbide is less expensive and just as effective as natural stones, though they tend to wear more rapidly. An economical compromise is the use of an India stone for rough sharpening and whetting, and a hard Arkansas stone for honing and polishing. When utilizing oilstones, wipe them often with a rag to prevent glazing. Do not use heavy oil, as it inhibits the abrading procedure; a light machine oil cut with kerosene works best. Waterstones are Japanese in origin, and cut much faster than oilstones.

Because they use water, rather than oil as the lubricant, there is no oily mess left on clothes and workpieces. Waterstones come in finer grades than oilstones, making them popular with woodworkers who like to hone and polish. Because they are softer than oilstones, new abrasive is continuously exposed while use, and the slurry formed by the water will form a fine polishing paste. Waterstones have their drawbacks, nevertheless. Because they are softer than oilstones, they must be trued more often. Tools should be dried and wiped with oil thoroughly after sharpening to prevent rust. Waterstones also should be stored in water. If your shop is prone to cold temperatures, keep your waterstones from freezing, as they will shatter.

How to flatten the stone

- All benchstones will develop a hollow in the center after prolonged use.
- To true a benchstone, flatten it on a machined exterior, such as glass pane or a lapping table.
- For oilstones, rub the exterior with a circular motion in slurry made from a coarse lapping compound blended with honing oil.
- Start with a coarse grit and work through finer grits until the stone is flat.
- To true a waterstone, use water instead of honing oil for the slurry, or wet / dry silicon carbide paper taped to the lapping exterior.

Chapter 5 Utilizing bench grinders

From squaring and sharpening plane irons to polishing chisels and turning tools, the bench grinder is a worthwhile addition to a woodworking shop's sharpening station. Bench grinders are classified according to their wheel diameter. Standard 5 to 8 inch benchtop models, with ¼ to ¾ horsepower motors, are the most popular sizes. Larger wheels are better, as smaller wheels can develop exaggerated hollow-ground bevels. Grinders can be mounted on a work exterior or fastened to a separate stand. Rotating around 3500 rpm, a bench grinder removes steel faster than a sharpening stone. Unfortunately, it also heats up the tool, and you may lose the tool's temper. If the steel begins to change color while grinding, deepening to a true blue, the temper has been lost, and the tool must be reground. Motorized whetstones and wet / dry grinders feature water bathed wheels that turn at slower speeds, such as 500 rpm, allowing you to grind tools without continuously dipping them in water for cooling. Most grinders can be equipped with optional rubber sharpening wheels, cloth buffing wheels, and leather strop wheels in addition to standard abrasive wheels. Which come in a diversity of grits. Grinding wheels will Ultimately become dull and clogged with metal particles, and their edges may go out of square. A wheel dresser can be used to true the face of a glazed wheel and square its edges.

Choosing a grinder wheel

- The wheels supplied on grinders are typically too coarse for use with finer tools.
- A wide diversity of replacement stones is obtainable, but selecting the right one is no straightforward matter.
- You need to decipher the codes marked on the sides of the wheels, describing their composition and abrasive quality.
- If you plan to use a wheel to grind carbon-steel tools, and then hone with a benchstone, buy a wheel marked A 80 H 8V.
- This means the wheel is aluminum oxide (A), fine-grained (80), and rather soft (H), with a medium structure or concentration of abrasives (8).
- The particles are bonded together by a procedure of heat and fusion known as vitrification (V).
- For high-speed steel tools, a medium hardness of I or J is better.
- If you plan to use your tools right off the grinder, select a wheel with a grain size of 100 or 120.

Truing the wheel

- A grinding wheel should be trued when ridges or hollows appear on the stone or if it becomes discolored.
- You can use either a star-wheel or diamond-point dresser.
- To use a star-wheel dresser, move the grinder's tool rest away from the wheel.
- With the guard in position, switch on the grinder and butt the tip of the dresser against the wheel.
- Then, with your index finger resting against the tool rest, move the dresser from side to side.
- To use a diamond-point dresser, hold the device between the index finger and the thumb of one hand, set it on the tool rest, and advance it toward the wheel until your index finger contacts the tool rest.

- Move either dresser back and forth across the wheel until the edges are square and you have exposed fresh abrasive.

Building a mobile sharpening dolly

- A sharpening station is more than just a dedicated space for sharpening.
- It is a way of keeping all of your benchstones, grinding jigs, and sharpening accessories clean and well organized.
- The sharpening station is actually a sturdy low bench with a storage shelf.
- The unit is built from ¾ inch plywood and 1-by-3 stock.
- By adding locking casters, it becomes a mobile sharpening dolly that you can wheel about the shop to wherever you need to sharpen: at the lathe, the carving bench, or near the sink.
- To build the dolly, cut the base from ¾ inch plywood.
- Make it large enough to incorporate all your sharpening gear so that it is not too cluttered; up to 3-by-6 feet is a good size.
- Screw four corner blocks to the underside of the base, and fasten a locking caster on each block.
- To strengthen the dolly, cut the pieces for the skirts and legs from 1-by-3 stock.
- The legs should be long enough for the top to sit at a comfortable height; between 32 and 36 inches is right for most people.
- Screw the leg pieces together, and then attach the skirts to the legs' inside faces.
- Fasten the shelf and the too to the skirts.
- If desired, glue a water and oil-proof plastic laminate work exterior to the top.
- Once you have built the dolly, mount a standard bench grinder or wet / dry grinder to the end of the bench so that both wheels are accessible.
- Secure a lapping table at the opposite end for lapping and flattening stones.
- This is simply a piece of 3/8 inch tempered plate glass secured with cleats to a piece of ½ inch plywood, fastened to the top.
- Have the glass cut three times larger than your largest bench stone.
- Now mount your most commonly used benchstones either by utilizing cleats or screwing their wooden storage boxes to the tabletop; countersink the fasteners.
- Other accessories could include a vise or a portable light situated to shine on the grinder.

Chapter 6 How to maintain hand tools

Despite the proliferation of power tools in recent years, hand tools are still a vital part of the modern woodworking shop. Handsaws, chisels, and planes play a vital role in many cabinetmaking tasks, from cutting joints and chopping mortises to smoothing stock. For some crafts, like carving and turning, hand-cutting tools such as gouges and skew chisels are virtually indispensable. One distinct advantage that hand tools offer over their electrically powered counterparts is that they are rather straightforward to sharpen and maintain. With hand tools, there are no hidden circuit boards or sealed components, no carbide-tipped blades that must be sharpened professionally. With most hand tools, such as saws and chisels, what you see is what you get a handle, often made of wood, and a steel cutting edge. True, not all hand tools are quite this straightforward. Bench planes feature screws and levers for adjusting the angle and position of the cutting edge. Still, all the parts are simply accessible, allowing you to sharpen and maintain the tool in the shop. In fact, with a little elbow grease and the right supplies, you can even restore a rusty old hand plane to better condition than when it was first bought. Setting yourself up for hand tool sharpening and maintenance requires no great investment. All you need are solvents for cleaning, a few commercial devices for adjusting blades, stones and files for honing and sharpening-and the appropriate technique. The following pages will describe how to care for and sharpen the most commonly used hand tools, from handsaws and chisels and gouges to bench planes, scrapers, and bits for braces and hand drills. The work is rather easy, but the rewards are reviewable. Hand tools that are well sharpened and appropriately maintained will improve the quality of your ventures and prolong the life of your tools.

Chapter 7 How to sharpen handsaws

Sharpening a handsaw is a three-step operation. The procedure begins with jointing, or filing the tips of the teeth so that they are all the same height. This is followed by setting the teeth to the correct angle. This ensures that the blade cuts straight and does not stick in the kerf. Setting involves bending the teeth alternately to each side of the blade's centerline. The final step in the procedure is sharpening itself, typically with a file. Not all handsaws are identical. The shape, spacing, and set of the teeth vary according to the type of cutting the saw will perform. The spacing between teeth is typically expressed in TPI or teeth per inch. The following pages will describe how to sharpen rip saws, combination saws, and both Japanese and Western-style crosscut saws. Because of their very fine teeth, dovetail and tenon saws should be sent out to a professional for sharpening.

How to fill ripsaw teeth

- Ripsaws have widely spaced teeth with from five to seven teeth per inch (TPl).
- They also have a more pronounced set than other saws.
- Both features enable them to cut rapidly along the grain.
- The leading edges of rip teeth are almost vertical.
- To sharpen the teeth, use a triangular mill file, drawing it straight across each tooth at a 90" angle to the blade axis.

Filing combination teeth

- Combination saws are dual-purpose saws that can be used for both rip cuts and crosscuts, while they rip more slowly than a rip saw and cut more roughly than a crosscut saw.
- Combination teeth slope forward and backward at the same angle (about 60') and both edges are beveled.
- Sharpen both edges utilizing a triangular mill file, tilting the handle of the file down rather.

Sharpening crosscut teeth

- The teeth of a crosscut saw are closely spaced-eight to 12 TPI is typical-and they have very little set.
- Crosscut teeth feature sloped leading edges with bevels, which enable them to cut cleanly across the grain.
- As with rip saws, the teeth are sharpened with a triangular mill file.
- Hold the file at the same angle as the bevel, which is typically 65".

Sharpening Japanese crosscut teeth

- Japanese saws, which cut on the pull stroke, have tall, narrow teeth with very little set.
- Also, the teeth are beveled on leading and trailing edges, and on the tips.
- All edges should be sharpened with a feather file held at about a 60'angle to the blade.

Building a bench vise saw holder

Secured in a vise, the straightforward jig will hold a saw at a convenient height for sharpening.

Make the jaws from two pieces of ½ inch plywood about 10 inches long and 7 inches wide.

Then saw two 1/8 inch thick strips and glue them along the inside faces of the jaws, flush with the top end; the strips will grip the saw blade.

Fasten the two jaws together near the bottom end, screwing a strip of ¼ inch plywood between them.

Lastly, bore a hole for a carriage bolt through the middle of the jaws and install the bolt with a washer and wing nut.

To use the jig, secure the bottom end in your vise.

Loosen the wing nut, slip a saw blade between the jaws, and tighten the nut to hold the saw securely.

How to sharpen a handsaw

1 - Jointing the teeth

- Mount the saw teeth-up in a vise with a wood pad on each side of the blade for protection.
- Install a flat mill bastard file in a commercial saw jointing jig.
- Hold the jig flat against the side of the blade and pass the file back and forth across the full distance of the teeth.
- This will flatten all of the teeth to the same height.
- A few passes should be sufficient.

2 - Setting the teeth

- With the saw still in the vise, adjust a saw set to the same TPI as the blade.
- Starting at either end of the blade, position the first tooth that is bent away from you between the anvil and the punch block.
- Squeeze the handle to set the tooth.
- Work your way down the distance of the blade, setting all teeth that are bent away from you.
- Then turn the saw around in the vise and repeat the procedure on the remaining teeth.

3 - Filing the teeth.

- For the crosscut saw, hold a triangular file at about a 65" angle to the blade with its handle tilted down rather.
- As you file the teeth, work from one end of the blade to the other, filing all the teeth that are set in one direction.
- Then turn the saw around to sharpen the remaining teeth.

Chapter 8 Utilizing chisels and gouges

Chisels and gouges must have razor sharp edges to work appropriately. Sharpening a standard woodworking chisel is straightforward; all you need is a combination sharpening stone. For most chisels and gouges, you will have to hone and polish the cutting edge as well as develop the correct bevel angle for the blade. Well-sharpened blades are essential for turning chisels and gouges. Dull cutting edges not only develop poor results; they are also more hard to control and dangerous to use. This section of the chapter explains how to sharpen and refurbish a wide range of chisels and gouges.

How to replace a chisel or gouge handle

1 - Turning the new handle

- Turn a new handle for a chisel or gouge on the lathe.
- Cut a blank from a dense, robust hardwood like ash or hickory.
- The grain should run the distance of the blank.
- A piece that is 1 ½ to 2 inches square and a few inches longer than the completed distance you need will yield a suitable handle.
- Mount the piece between centers on the lathe and turn it to a smooth cylinder utilizing a roughing gouge.
- Buy a brass ferrule for the handle.
- Then use a parting tool to turn a tenon on one end of the blank to accommodate the ferrule.
- Measure the inside diameter of the ferrule with dial calipers and size the tenon to fit firmly.

2 - Mounting the ferrule and the blade

- Eliminate the handle from the lathe, set it end-down on a work exterior, and tap the ferrule in place with a mallet.
- Then, remount the handle on the lathe and shape it with a skew chisel and spindle gouge.
- Once you are satisfied with the handle's shape and feel, bore a hole in the tenon end to accommodate the tang of the blade.
- Bore the hole on the lathe with a Jacobs chuck attached to the tailstock; ensure the hole is centered in the blank.
- The hole's diameter and depth depend on the type of tang.
- For a round section, un-tapered tang, the hole should be 2 to 3 inches deep and equal to the tang diameter.
- For a square-section, tapered tang, drill two holes as you would counterbore for a screw and plug:
- Make the top half the same diameter as the tang 1 ¼ inches from the tip and the bottom half the same width as the tang ¾ inch from its tip.
- Insert the blade into the handle and rap the butt end of the handle with a mallet.

How to sharpen a standard chisel

1 - Honing the cutting edge

- The two-step procedure can be used to sharpen any standard chisel, such as a firmer, paring, or mortise chisel.
- Start by honing a secondary bevel on the forward edge of the existing one called a microbevel, then polish and flatten the back side of the blade.
- To form the microbevel, lay a combination stone coarse side up on a work exterior between two cleats secured with screws.
- Saturate the stone with the appropriate lubricant, if necessary, until it pools on the exterior.
- Holding the blade with the existing bevel flat on the stone, raise it about 5 degree and slide the cutting edge along the stone in long, elliptical passes.
- Apply moderate pressure until a microbevel forms.
- Turn the stone over and make a few passes on the fine side.

2 - Polishing and flattening the back side of the blade

- Saturate the fine side of the stone and, holding the chisel blade flat on the stone, bevel-side up, move it in a circular pattern until the flat side of the cutting edge is smooth.

How to sharpen a roughing out gouge

1 - Grinding the cutting edge

- Sharpen a roughing-out gouge on a bench grinder equipped with a medium grinding wheel and a felt wheel.
- Position the guard and turn on the machine.
- Holding the blade between the fingers and thumb of one hand, set the cutting edge on the tool rest and advance it until the bevel lightly contacts the grinding wheel.
- If you want to change the bevel angle of the cutting edge, adjust the tool rest to the desired angle.
- With your index finger against the tool rest, roll the blade on the wheel until the entire edge is ground.
- Keep the bevel flat against the wheel at all times.
- Continue, confirming the blade regularly, until the cutting edge is sharp and the bevel angle is correct.
- To prevent the blade from overheating, in often dip it in water if it is carbon steel, or eliminate it from the wheel if it is high-speed steel to let it cool down.

2 - Polishing the cutting edge

- Shift the grinder's felt wheel and move the tool rest out of the way.
- Hold a stick of polishing compound against the felt wheel to impregnate i with abrasive.
- Grip the handle of the gouge in your right hand and hold the blade between the fingers and thumbs of your left hand.
- Then, with the gouge almost vertical, set the bevel flat against the wheel.
- Lightly roll the blade from side to side against the wheel to polish the bevel.

- A slight burr will form on the inside edge of the tool.
- To feel for the burr, run your finger gently across the inside edge of the blade.
- To eliminate it, roll the inside face of the blade against the wheel until the burr rubs off.
- Avoid over buffing the blade; this will dull the cutting edge.
- Test the tool for sharpness by cutting a scrap across the grain.
- The blade should develop a clean shaving.

How to build a gouge sharpening jig

- The jig described will hold a gouge so that the blade contacts the grinding wheel at the correct angle.
- The dimensions explained will accommodate most turning gouges.
- Cut the base and guide from ½ inch plywood.
- Screw the guide together and fasten it to the base with countersunk screws from underneath.
- Make the guide opening large enough for the arm to slide through freely.
- Cut the arm from 1-by-2 stock and the tool support from ½ inch plywood.
- Screw the two parts of the tool support together, then fasten the bottom to the arm flush with one end.
- For the V-block, cut a small block to size and saw a 90 degree wedge out of one side.
- Glue the piece to the tool support.
- To use the jig, secure it to a work exterior so the arm lines up directly under the grinding wheel.
- Seat the gouge handle in the V-block and slide the arm so the beveled edge of the gouge sits flat on the grinding wheel.
- Clamp the arm in place.
- Then, with the gouge clear of the wheel, switch on the grinder and reposition the tool on the jig.
- Roll the beveled edge across the wheel.

Spindle gouge sharpening

1 - Sharpening on a bench grinder

- Position the guard appropriately and turn on the grinder.
- Holding the blade between the fingers and thumb of one hand, set the blade flat on the tool rest and advance it until the blade lightly touches the stone.
- Adjust the tool rest to create the desired bevel angle.
- Roll the cutting edge on the wheel and pivot the handle from left to right while keeping the bevel flat on the grinding wheel at all times.
- Continue rolling the blade and moving the tool handle from side to side until the edge is sharpened, stopping often to confirm the grind and cool the tip.
- Hone the cutting edge and eliminate the burr by hand, or use the grinder's felt wheel.

2 - Honing the cutting edge

- Once the bevel has been sharpened on the grinder, use a flat benchstone to polish the tool

to a razor-sharp edge.
- Saturate the stone with oil, then roll the outside bevel across the abrasive exterior to hone the bevel on the cutting edge.

3 - Removing the burr

- Use a convex slip stone matching the curvature of the gouge to eliminate the burr that forms on the inside of the cutting edge.
- Lubricate the slip stone if required and hone the inside edge until the burr is eliminated.

How to sharpen a carving gouge

1 - Whetting the outside bevel

- Set an oilstone on a plywood base, screw cleats to the base around the stone to keep it from moving, and clamp the base to a work exterior.
- The leather strop is used to polish the outside bevel in step 4.
- Saturate the stone, and then set the outside bevel of the gouge flat on it.
- Starting at one end, move the blade back and forth along the stone with a rhythmic motion, simultaneously rolling the tool so the entire bevel contacts the sharpening exterior.
- Avoid rocking the blade too far, as this will tend to round over its curves and blunt the cutting edge.
- Continue until the bevel is smooth and a burr forms on the inside edge of the blade.
- You can also carry out this step on a grinder, but if you use the machine be sure to adjust the angle of the tool rest to match the bevel angle of the gouge.

2 - Honing an inside bevel

- Once you have sharpened the gouge's outside bevel, use a conical slip stone to hone a slight inside bevel on the blade and to eliminate the burr formed in step 1.
- Put a few drops of oil on the cutting edge of the gouge.
- Then, holding the stone on a work exterior, move the blade back and forth along the stone making sure that you keep the cutting edge well away from your fingers.
- Continue until the burr is removed and an inside bevel of approximately 5 degree forms.

3 - Polishing the inside bevel

- Use a folded piece of leather to strop the inside bevel of the gouge.
- Spread some polishing compound on the leather and fold it so its edge matches the inside curve of the gouge.
- Draw the blade along the leather repeatedly to polish the inside bevel.
- This can also be done utilizing the felt wheel of a bench grinder.

4 - Polishing the outside bevel

- Spread some polishing compound on the strop and use the same rolling technique described in step 1 to polish the outside bevel.
- Confirm the inside bevel; if a burr has formed, repeat step 3.
- You can also use a bench grinder and a felt wheel impregnated with polishing compound for this task.

How to sharpen a V-tool

1 - Whetting the outside edges

- Sharpen each side of a V-tool separately.
- Set up and saturate an oilstone as you would to sharpen a carving gouge.
- Hone one outside bevel of the V-tool as you would a chisel, moving the blade back and forth along the distance of the stone and keeping the bevel flat on the stone.
- Repeat on the other side of the V.
- Stop working when you have removed the rough marks from the ground edge and a small burr forms on the inside of the edge.

2 - Removing the hook

- When you sharpen the outside bevels of a V-tool, a hook of excess metal will form at the apex of the V.
- This hook must be ground away before you hone the inside bevel in step 3.
- Holding the tool on the stone, roll the corner across the exterior.
- Move the tool from end to end along the stone until you wear away the hook and an outside bevel forms at the apex of the V, forming one continuous beveled edge.
- This procedure will create a burr in the center of the inside edge, which is removed in step 3.

3 - Honing the inside bevel

- To eliminate the burr formed in steps 1 and 2, and none an inside bevel, use a triangular slip stone that matches the angle of the V-tool blade as closely as possible.
- Clamp the stone securely in a bench vise and saturate it with oil.
- To avoid crushing the stone, do not over tighten the vise.
- Draw the end of the blade's inside edge back and forth along the stone, applying light downward pressure until the burr is removed and a slight inside bevel forms.
- To finish, polish the edge with a leather strop or the felt wheel of a grinder.

Chapter 9 How to use bench planes

A good-quality bench plane can be costly, but there is no reason why it should not last a lifetime-or two. This section describes how to care for a plane, and includes information on sharpening and adjusting the tool. You can save yourself some money without sacrificing a whit of quality by refurbishing an old plane. Even a tool that has been abused and discarded by someone else can be brought back to life.

How to refurbish a bench plane

1 - Disassembling and cleaning the plane

- Start by loosening the lever cap screw and releasing the cap lock, then take off the lever cap, cap iron, and blade and set them aside.
- Then, loosen and eliminate the frog setscrews and separate the frog from the sole of the plane.
- You can also unscrew the front and back handles from the body.
- Clean each part individually utilizing a brass-bristled brush dipped in mineral spirits.

2 - Lapping the sole of the plane

- Tape a distance of emery paper to a smooth and flat exterior, such as a glass plate or saw table.
- Reattach the handles and the frog to the body of the plane, and then slide the sole along the emery paper, applying even pressure to keep the sole flat.
- Continue lapping the sole until the metal on its bottom exterior is uniformly bright and clean, indicating that the sole is level.
- Confirm the sole for square (step 3) periodically.

3 - Confirming the sole for square

- The bottom and sides of the plane's sole should be exactly at 90 degree to each other.
- Holding the plane in one hand, butt a combination square against the bottom and one side of the sole.
- Repeat for the other side.
- The exteriors should be square both ways.
- If not, you will need to continue lapping the sole and the sides.

How to sharpen a plane blade

1 - Confirming the cutting edge for square

- Use a combination square to determine whether the cutting edge of the plane blade is square to the sides.
- If it is not, square the cutting edge on a bench grinder, making sure to adjust the grinder's tool rest at 90" to the wheel.

2 - Creating a hollow-ground bevel

- Sharpening a plane blade involves three steps: creating a bevel on the blade's cutting edge, honing a microbevel on the first bevel, and removing the burr that results from the honing procedure.
- To create the first bevel, clamp the blade bevel-down in a commercial grinding jig and adjust the tool rest to create a 30 degree bevel.
- Holding the jig on the tool rest, advance it toward the wheel until the cutting edge makes contact.
- Slide the blade side-to-side across the wheel, pressing lightly.
- Confirm the cutting edge periodically and stop grinding when the bevel forms.

3 - Honing the microbevel

- Once you sharpen the plane blade's cutting edge on a grinder, as in step 2, the outcome will be a hollow-ground bevel.
- If you did the job by hand on a sharpening stone, you will obtain a flat bevel.
- In either case, you need to hone a microbevel on the first bevel.
- Place a combination sharpening stone fine side up on a work exterior.
- Screw cleats to the table against the stone to keep it from moving.
- For a hollow-ground bevel, clamp the blade in a commercial angle-setting honing guide with the bevel touching the stone.
- Saturate the stone with the appropriate lubricant and then, holding the honing guide, slide the blade back and forth from end to end along the sharpening exterior.
- Apply moderate pressure until a microbevel forms.
- If you are starting with a flat bevel, clamp the blade in a commercial angle-setting honing guide with the bevel touching the stone.
- Then raise the angle of the blade a few degrees and complete the operation as for a hollow-ground bevel.

4 - Lapping the bun

- The honing procedure will create a thin ridge of metal, or burr, on the flat face of the blade.
- To eliminate the burr, saturate the fine side of the stone again.
- Holding the blade perfectly flat on the stone, bevel side up, move it in a circular pattern until the flat side of the cutting edge is smooth

5 - Testing the blade for sharpness

- Clamp a softwood board to a work exterior and, holding the blade bevel-side up in your hands, cut across the grain of the exterior.
- A sharp blade will cleanly slice a sliver of wood from the board without tearing the wood fibers.

6 - Honing the end of the cap iron

- Secure a benchstone to your work exterior; a diamond stone, which should be lubricated with water.
- Set the front portion of the cap iron that contacts the blade flat on the stone and slide it in a circular pattern on the exterior.
- Continue until the tip of the cap iron is perfectly flat.
- This will guarantee that wood chips will not become trapped between the iron and the blade once the two pieces are reassembled.

How to assemble and adjust a bench plane

1 - Positioning the blade assembly

- Position the cap iron on the top face of the blade extending about 1/16 inch beyond the end of the cap iron.
- Tighten the cap iron screw.
- Then place the blade assembly-including the blade, cap iron, and lever cap-in position on the frog.
- The gap between the front edge of the blade and the front of the mouth should be between 1/32 and 1/16 inch.
- If the gap is too wide or narrow, eliminate the blade assembly and loosen both frog setscrews about ¼ turn.
- Then adjust the frog adjustment screw to set the appropriate gap.
- Tighten the setscrews and reposition the blade assembly on the frog, securing it in place with the cap lock

2 - Centering the blade and adjusting the depth of cut

- Holding the plane upside down, move the lateral adjustment lever until the cutting edge is parallel to the sole and centered in the mouth.
- To set the cutting depth, turn the depth-of-cut adjustment knob so the blade protrudes from the mouth.
- About 1/32 inch is desirable; less for highly figured woods.
- Confirm the setting with a test cut on a scrap board.
- The shavings should be paper thin.

Chapter 10 How to use scrapers

Appropriately honed, a hand or cabinet scraper is unsurpassed for smoothing and flattening a wood exterior before finishing. First, the edges of the scraper are filed square, and then honed, and lastly turned over into a burr and a hook. You can develop the burr and the hook in two steps with a standard burnisher, or create the hook in one operation with a variable burnisher. The outcome is a cutting edge that should be capable of slicing paper thin curls of wood from a workpiece.

How to sharpen a hand scraper

1 - Filing the edges square

- Secure the scraper in a vise, edge up, with a wood block on one side to keep it rigid.
- Clamp a mill bastard file in a commercial saw jointer and press the jointer firmly against one side of the scraper.
- Exert moderate pressure as you make numerous passes back and forth along the edge of the tool until the existing hook disseems and the edge is flat.
- Turn the scraper over in the vise and repeat the procedure for the other edge.

2 - Honing the edges

- Secure a combination sharpening stone fine side up on a work exterior with cleats and lubricate it.
- Pressing the scraper flat on the stone, rub each face with a circular motion until any roughness developed by filing disseems.
- Then, hold the scraper upright and slide the edges back and forth diagonally across the stone until they are smooth with sharp curves.
- To finish, again slide the face lightly over the stone to eliminate any burrs.

3 - Burnishing the edges

- Wipe a tiny amount of oil onto the edge of the scraper to decrease friction between the burnisher and the scraper.
- Start to form a hook on each cutting edge of the scraper by laying the scraper flat on a work exterior with an edge extending off the table, and then run the burnisher back and forth along the edge, exerting robust downward pressure.
- Turn the scraper over and burnish the edge on the other face.
- Now burnish the other cutting edge the same way.

4 - Turning the hook

- Secure the scraper edge up in the vise and wipe a little more oil onto its edge.
- Holding the burnisher level, make a few passes along the edge in one direction until the edge swells rather.
- Apply moderate pressure to turn the edge outward on one side.
- Then hold the burnisher so that the handle is 10" to 15" above the horizontal and continue to burnish until the edge turns over into a hook.

- To form a hook on the other side of the edge, repeat the procedure with the scraper turned around in the vise.
- The greater the pressure you apply, the larger the hook.
- Turn the scraper over in the vise and turn the hooks on the opposite edge.

How to sharpen a cabinet scraper

1 - Filing the edge

- While its edge is beveled, a cabinet scraper is sharpened in much the same way as a hand scraper.
- Start by filing the bevel, then polish the bevel (step 2) and turn over a hook.
- Eliminate the blade from the cabinet scraper by loosening the thumbscrews holding it in place.
- Clamp the blade bevelled edge up in a vise between two wood pads.
- Then run a bastard mill file along the bevel, utilizing a combination square periodically to confirm that the angle remains at 45 degree.

2 - Polishing the bevel

- Secure a sharpening stone to a work exterior, a diamond stone in a sharpening box. Lubricate the stone, then hold the scraper blade flat-side down and slide the blade in a circular pattern to eliminate any burr formed by filing.
- Then, turn the blade over so the bevel is flush on the stone and repeat to polish the bevel.
- A few passes should be sufficient, Use the combination square to help you maintain the bevel angle at 45 degree (step 1).

3 - Burnishing the cutting edge

- Hold the scraper blade bevel down on a work exterior with the cutting edge overhanging the table.
- Wipe some oil on the edge and, holding a burnisher at a slight angle to the blade, pass the rod back and forth across its flat edge.
- Apply robust downward pressure forming a hook on the cutting edge.

4 - Forming the hook

- Secure the blade bevel up in a machinist's vise and apply a little more oil on it.
- Holding the burnisher in both hands flush against the 45 degree bevel, pull the tool toward your body; maintain continuous downward pressure.
- Gradually tilt the handle of the burnisher until the rod is at angle of about 15 degree to the bevel.
- This will complete the hook on the cutting edge.

Chapter 11 How to maintain roughing and shaping tools

The hand tools featured in this section of the chapter are as diverse as the individual tasks required to work a standing tree into a piece of furniture. They range from rough to fine-axe to spokeshave, an implement most often used to whittle a workpiece to its final form. For the sharpener, nevertheless, all these tools share one feature: They are single bladed tools that rely on a correctly angled bevel to cut wood appropriately. The following pages will describe how to hone and polish each of the tools. The first step in the procedure involves smoothing away defects and restoring the bevel on the blade, if the cutting edge requires it. This can be done on a bench grinder as you would a plane blade or on a wet/dry grinder. To prolong blade life, grind only what is required to restore the edge. Also, be cautious not to overheat the blade; this can destroy the temper of the metal. One advantage of the wet/dry grinder is that you do not have to interrupt the grinding periodically to cool the blade. The water-bathed wheel automatically takes care of this concern.

How to sharpen a wooden spokeshave blade

- Eliminate the blade from the handle by pinching the tangs that protrude through the handle and pushing them downward.
- For sharpening, the blade is held upside down from its usual cutting position-that is, with the tangs facing down rather than up.
- To prevent the tangs from catching on your work exterior while sharpening, set your sharpening stone atop a wood block to provide the necessary clearance.
- Holding the blade by the tangs, set its bevel flat on the stone.
- Because the blade is longer than the width of the stone, hold the cutting edge diagonally as you slide the bevel back and forth on the stone.
- Repeat with the blade angled the other way. Repeat again with the blade held straight.
- Once the sharpening is complete, turn the blade over and hone the flat side to eliminate the burr formed by the sharpening procedure.

How to hone a metal spokeshave blade

- To eliminate the blade from the handle, loosen the screw in the middle of the handle.
- Set up a benchstone on a work exterior; a water-lubricated diamond stone in a sharpening box.
- Install the blade in a commercial honing guide and hone the cutting edge as you would a plane blade.
- To flatten the sole of a flat-soled spokeshave, pass the sole back and forth along a medium-grit benchstone.
- Continue until the metal has uniform sheen.

How to hone a drawknife

- Secure one handle of the drawknife in a machinist's vise with the blade Ievel and the bevel facing up.
- Then lubricate a fine benchstone in this case, a combination stone-and rub the stone along the distance of the bevel, utilizing a circular motion.

- To hone a microbevel on the primary bevel, adjust the angle of the stone rather.
- Lastly, make a few passes on the flat side of the blade to eliminate any burr formed by sharpening.

How to hone an inshave

- Clamp the inshave to a work exterior so the cutting edge is facing up.
- Use a slip stone to hone the edge.
- Start with a rough-grit stone and progress to a finer one.
- Work with a circular motion until a uniform shine develops on the blade.
- Give the flat side of the blade a few strokes to eliminate any burr.
- Once the blade is sharp, polish the bevel with a leather strop and polishing compound, finishing with a few passes on the flat side of the blade to eliminate the burr.
- If the inshave has a knife edge beveled on both sides-hone the other side.

How to hone an adze

- Secure the adze in a bench vise.
- Wrap a sheet of emery paper around a dowel whose diameter closely matches the curve of the adze blade.
- Hone the cutting edge utilizing a back-and-forth motion along the distance of the bevel.
- Hone the flat side of the blade with a slip stone to eliminate any burr.
- If the adze has a knife-edge hone the other side.

How to use a bench grinder

- Once you have sharpened the blade of a roughing or shaping tool, polish the bevel and eliminate any burr formed by the procedure on the felt wheel of a bench grinder.
- For a metal spokeshave blade, impregnate the wheel with polishing compound and place the bevel of the blade on the trailing edge of the wheel.
- Move the blade side to side to expose the entire bevel to the wheel.
- Buff the blade only enough to eliminate the burr, utilizing a light touch to avoid rounding the edge.
- Run the whole distance of the bevel back and forth across the wheel to polish it uniformly.
- Repeat on the flat side of the blade.
- Test the cutting edge for sharpness on a piece of softwood.

Chapter 12 How to take care of braces and bits

Electric drills have largely superseded hand tools for boring holes in the modern woodshop. Nevertheless, most woodworkers still keep braces and hand drills handy, because these tools have unique capabilities not readily duplicated by power tools, such as working in tight quarters or boring a hole to a precise depth. Maintaining these hand tools is mainly a question of keeping their moving parts clean and sharpening their bits. To clean a brace, unscrew the chuck shell and eliminate the jaws. Use the same cleaning procedure as you would for the parts of a bench plane. The remaining pages of this chapter describe how to sharpen auger and spoon bits.

How to sharpen an auger bit

1 - How to fill the cutting edge

- Secure the bit in a bench vise, and then use a needle file to sharpen the cutting edge.
- You can also use a specialized auger bit file for the job.
- Hold the file on the leading edge and make a few strokes along the exterior.
- Repeat with the other cutting edge

2 - How to fill the spur

- Position the bit upright in the vise.
- Holding the file flush against the inside edge of one spur, make numerous strokes across the exterior until you develop an even shine on the spur.
- Repeat with the other spur.

3 - How to eliminate burrs from the spurs

- Holding a very fine diamond hone on a work exterior, slide the outside edge of one of the bit spurs on the stone to eliminate any burr formed by sharpening.
- You can also use a piece of very fine emery cloth.
- Work with a light touch and use only enough strokes to eliminate the burr, or you risk reducing the bit diameter.
- Repeat with the other spur.

How to sharpen a spoon bit

- Spoon bits can be sharpen simply on a benchstone.
- Holding the outside of the bit's nose on the stone, rock the bit across the exterior with a semi circular motion.
- Hold the bit at the same angle throughout to ensure that the nose is honed uniformly.
- Once the sharpening is completed, polish both sides of the nose on the felt wheel of a bench grinder.
- Impregnate the wheel with polishing compound and, holding the bit vertically, lightly touch the front of the nose to the wheel.
- Repeat with the back side.

Chapter 13 How to sharpen power tool blades

Like any cutting or shaping tool, a power tool with a dull blade or bit cannot perform well. A dull drill bit will tend to skate off a workpiece, rather than biting cleanly into the wood. A sawblade or router bit with blunted cutting edges may burn stock. And wood that is exterior by a jointer or planer with unsharpened knives may be hard to glue up or finish. In addition to cutting and shaping appropriately, well-sharpened blades and bits offer other benefits, including decreased wear and tear on motors, less operator fatigue, and longer life for the blades and bits themselves. Manufacturers of power tool blades and bits generally recommend sending their merchandises to a professional sharpening service. Nevertheless, the job can often be done in the workshop. This chapter will describe how to sharpen a wide diversity of power tool blades and bits, from router bits and shaper cutters to jointer and planer knives. In a pinch, even a broken band sawblade can be soldered together.

Still, there are times when you should turn to a professional, particularly if blades and bits have chipped edges or have lost their temper as a outcome of overgrinding. Some router bits also must be specifically balanced, something that is hard to achieve in the shop. As a rule of thumb, it is a good idea to send out your bits and blades to a sharpening service periodically, or every second time they need a major sharpening. Once you have sharpened an edge appropriately, it should last for a long time-the occasional honing is all that it takes to maintain it. The pages that follow cover the basic techniques for sharpening power tool blades and bits in the shop. With a little practice and the right accessories, you can keep the cutting edges of your blades and bit razor-sharp. But Recall that a keen edge always tarts with the quality of the steel itself; for long life and ease of sharpening, always select bits and blades made from the best steel.

List of tools and accessories for sharpening

- Drill bit grinding attachment
- Router bit sharpener
- Drill bit-sharpening jig
- Circular saw blade-setting jig
- Knife-setting jigs
- Jointer planer-knife sharpening jig
- Circular saw blade sharpening jig

Chapter 14 Utilizing router bits and shaper cutters

Secured in a bench vise, one of the cutting edges of a shaper cutter receives its final sharpening with a fine diamond hone. The procedure is a two-step operation, beginning with a medium hone. Because they operate at high speeds, dull router bits and shaper cutters overheat rapidly. Cutters that are appropriately sharpened make smoother, more accurate cuts.

How to sharpen the inside faces

- Clean any pitch, gum, or sawdust off the bit with a commercial resin solvent, and then use a ceramic or diamond sharpening file to hone the inside faces of the bit's cutting edges.
- A coarse-grit file is best if a lot of material needs to be removed; use a finer grit file for a light touch-up.
- Holding the inside face of one cutting edge flat against the abrasive exterior, rub it back and forth.
- Repeat with the other cutting edge.
- Hone both inside faces equally to maintain the balance of the bit.
- Take care not to file the bevel behind the cutting edge.

How to sharpen a piloted router bit

1 - How to eliminate the pilot bearing

- Before you can sharpen a piloted router bit, you need to eliminate the pilot bearing. Use a hex wrench to loosen the bearing.

2 - How to sharpen the bit

- Sharpen the bit with a ceramic or diamond sharpening file as you would a non-piloted bit; then re-install the bearing with the hex wrench.
- If the bearing does not rotate smoothly, spray a little bearing lubricant on it.
- If it is worn out or damaged, replace

How to sharpen molding knives

- The cutting edges of table saw or radial arm saw molding knives are easy to touch up or sharpen while they are mounted in the molding head.
- Clamp the head in a bench vise with one of the knives clear of the bench, then use a slip stone to hone its inside face as you would a router bit.
- Reposition the head in the vise to hone the remaining knives.
- Use the same number of strokes to hone each knife so that you eliminate an equal amount of metal from them all, and maintain their identical shapes and weights.
- An alternative technique involves removing the knives with a hex wrench and sharpening them on a flat oilstone.

How to use a bench grinder

- Holding the bit between the index finger and thumb of one hand, set it on the grinder's tool rest and advance it toward the wheel until your index finger contacts the tool rest.
- Tilt the shaft of the bit down and to the left so that one of the cutting edges, or lips, is square to the wheel.
- Rotate the bit clockwise to grind the lip equally.
- Periodically confirm the angle of the cutting edge, and try to maintain the angle at about 60".
- Repeat for the second cutting edge.
- To keep bits sharp, use them at the speed recommended by the manufacturer.
- Wipe them in often with oil to prevent rust.

How to use a commercial jig

- Set up the jig following the manufacturer's instructions.
- A secure an electric drill to the jig; the drill will rotate the sharpening stone inside the device.
- Adjust the angle block to the appropriate angle for the bit to be sharpened and insert the bit in the depth gauge.
- The gauge will enable you to secure the bit at the correct height in the holder.
- Fit the bit holder over the bit and then use it to eliminate the bit from the gauge.
- Now secure the bit and holder to the angle block.
- Turn on the drill and, holding it steady, slowly rotate the bit holder a full 360' against the stone inside the jig.
- Apply light pressure; too much force will overheat the bit.

How to sharpen forester bits

1 - How to grind the inside bevel

To touch up a Forstner bit, true the top edge of the bit's rim with a file, removing any nicks.

If the beveled edges of the cutting spurs inside the rim are uneven, grind them utilizing an electric drill fitted with a rotary grinding attachment.

Secure the bit in a bench vise and grind the edges until they are all uniform.

2 - How to sharpen the chip lifters

- Use a single-cut mill bastard file to lightly file the inside faces of the cutters.
- Hold the file flat against one of the cutters-also known as chip lifters-and make a few strokes along the exterior.
- Repeat with the other cutter.
- Finish the job by honing the beveled edges inside the rim with a slip stone.

How to hone multi spur bits

1 - How to fill the cutting spurs

- Secure the bit upright in a bench vise and use a triangular file to hone the leading edge, or face, of each spur.
- File with each push stroke, towards the bit's brad point, tilting the handle of the file down rather.
- Then file the trailing edge, or back, of each spur the same way.
- File all the spurs by the same amount so that they remain at the same height.
- Ensure you do not over-file the cutting spurs; they are intended to be 1/32 inch longer than the chip lifters.

2 - How to fill the brad point

- File the chip lifters as you would those of a Forstner bit.
- Then, file the brad point until it is sharp.

How to sharpen brad point bits

1 - How to fill the chip lifters

- Clamp the bit upright in a bench vise and file the inside faces of the two chip lifters as you would those of a Forstner bit.
- For a brad-point bit, nevertheless, use a triangular needle file, honing until each cutting edge is sharp and each chip lifter is flat.

2 - How to fill the cutting spurs

- Use the needle file to hone the inside faces of the bit’s two cutting spur.
- Hold the tool with both hands and file towards the brad point until each spur is sharp.

How to fill a spade bit

- Secure the bit in a bench vise and use a smooth single-cut mill bastard file to touch up the two cutting edges.
- File on the push stroke, tilting the handle down rather to match the angle of the cutting edges; between 5" and 10" is typical.
- Then touch up the cutting edges on either side of the point the same way, taking care not to alter its taper.
- Do not eliminate too much metal at the base of the point, as this will weaken the bit.

Chapter 15 How to maintain circular saw blades

How to change a table saw blade

1 - How to eliminate a blade

- Working at the front of the table, eliminate the insert and wedge apiece of scrap wood under a blade tooth to prevent the blade from turning.
- Use the wrench supplied with the saw to loosen the arbor nut.
- Most table saw arbors have reverse threads; the nut is loosened in a clockwise direction.
- Finish loosening the nut by hand, making sure that it does not fall into the machine.
- Carefully lift the blade and washer off the arbor.
- Carbide tipped blades is best sharpened professionally; but high-speed steel models can be sharpened in the shop.
- A worn or damaged blade should be discarded and substituted.

2 - How to install a blade

- Slide the blade onto the arbor with its teeth pointing in the direction of blade rotation, toward the front of the table.
- Insert the flange and nut and straightening by hand.
- To finish tightening, grip the saw blade with a rag and use the wrench supplied with the saw.
- Do not use a piece of wood as a wedge, as this could outcome in over tightening the nut.

How to eliminate a portable circular saw blade

- Set the saw on its side on a work exterior with the blade housing facing up.
- Retract the lower blade guard and, gripping the blade with a rag, loosen the arbor nut with the wrench supplied with the saw.
- Eliminate the nut and the outer washer, and then slide the blade from the arbor.
- As with table saw blades, carbide-tipped blades should be sent out for sharpening, but high-speed steel versions can be sharpened in the shop.
- To install a blade, place it on the arbor with its teeth pointing in the direction of blade rotation.
- Install the washer and the nut, and tighten them by hand.
- Holding the blade with the rag, use the wrench to give the nut a supplementary quarter turn.
- Do not over tighten.

How to soak the blade

- Clean the blade utilizing a commercial resin solvent.
- Commercial oven cleaner, turpentine, or a solution of hot water with ammonia can also be used.
- For stubborn pitch and gum deposits, soak the blade in the cleaning agent in a shallow

pan and use a brass-bristled brush to clean the teeth.

How to sharpen circular saw blades

1 - How to joint the teeth

- To sharpen the teeth of a circular saw blade, install the blade in a commercial saw-setting jig following the manufacturer's instructions.
- Install the jointing head on the jig, butting its file up against the saw teeth.
- Then tighten the thumbscrew until the teeth drag against the file.
- To joint the teeth so they are all the same distance, clamp the jig in a bench vise and rotate the blade against the file clockwise.
- After each rotation, tighten the thumbscrew rather and repeat until the tip of each tooth has been filed flat.

2 - How to set the teeth

- Eliminate the jointing head from the jig and install the setting head.
- Also eliminate the jig from the vise and set it on the benchtop.
- Adjust the head for the appropriate amount of set, or bend.
- Utilizing a pin punch and ball-peen hammer, lightly strike every second tooth against the setting head.
- Eliminate the blade and reverse the position of the setting head.
- Reinstall the blade with the teeth pointing in the opposite direction and repeat for the teeth you skipped, again striking every second tooth.

3 - How to sharpen the teeth

- Once the saw teeth have been jointed and set, file them utilizing a commercial saw sharpening jig.
- Mount the jig to a workbench and install the blade loosely on the jig so the blade turns.
- Following the manufacturer's instructions, rotate the triangular file in the file holder and adjust the guide arm to match the required pitch and angle of the saw teeth.
- Starting with a tooth that is pointing to the right, file the cutting edge by sliding the file holder along the top of the jig.
- Rotate the blade counter clockwise, skipping one tooth, and repeat.
- Sharpen all the right-pointing teeth the same way.
- Adjust the triangular file and the guide arm to work on the left-pointing teeth and repeat, sharpening all the teeth you skipped.

Chapter 16 How to maintain band saw blades

Secured between two wood blocks in a bench vise, the teeth of a band saw blade are sharpened with a triangular file. Band saw blades can also be honed while they are installed on the machine. The teeth should be sharpened periodically and set after every three to five sharpenings. In fact, appropriately honed and set band saw blade will perform better than a brand new one

How to sharpen a band saw blade

1 - Gleaning the blade

- Before sharpening a band saw blade, eliminate sawdust and wood chips from it.
- Ensure you release the blade tension first before slipping the blade off the wheels.
- Then, holding the blade between two clean rags, pull it away in the direction opposite its normal rotation to avoid snagging the cutting edges in the material.

2 - How to install the blade for sharpening

- You can sharpen a band saw blade either on a bench vise or on the machine.
- To install the blade on the band saw for sharpening, mount it with the teeth pointing in the direction opposite their cutting position-that is, facing up instead of down.
- Turn the blade inside out and guide it through the table slot, holding it with the teeth facing you and pointing up.
- Slip the blade between the guide blocks and in the throat column slot, then center it on the wheels.
- Ensure the blade guide assembly is raised as high above the table as it will go.

3 - How to set the blade

- If the teeth need to be set, adjust a commercial saw set to the same number of teeth per inch as the band saw blade.
- Secure the blade in a handscrew and clamp the handscrew to the saw table.
- Starting at the handscrew end of the blade, position the first tooth that is bento the right between the anvil and punch block of the saw set and squeeze the handle to set the tooth.
- Work your way up to the guide assembly, setting all the teeth that are bento the right.
- Then turn the saw set over and repeat for the leftward-bent teeth.
- Continue setting all the blade teeth section by section.
- To ensure you do not omit any teeth, mark each section you work on with chalk.

4 - How to sharpen the blade

- Sharpen the teeth the same way you set them, working on one blade section at a time.
- Hold a triangular file at a 90" angle to the blade and sharpen each tooth that is set to the right, guiding the file in the same direction that the tooth is set.
- Then sharpen the leftward-bent teeth the same way.
- Use the same number of strokes on each tooth.

- Once all the teeth have been sharpened, eliminate the blade, turn it inside out and reinstall it for cutting, with the teeth pointing down.
- Tension and track the blade.

How to install heat-resistant guide blocks

- Replacing your band saw standard guide blocks with heat-resistant blocks will distanced blade life and promotes more accurate and controlled cuts.
- Eliminate the original blocks by utilizing a hex wrench to loosen the setscrews securing them to the upper guide assembly.
- Slip out the old blocks and insert the replacements.
- Pinch the blocks together with your thumb and index finger until they almost touch the blade.
- You can also use a slip of paper to set the space between the guide blocks and the blade.
- Tighten the setscrews.
- The front edges of the guide blocks should be just behind the blade gullets.
- To reposition the blocks, loosen their thumbscrew and turn their adjustment knob to advance or retract the blocks.
- Tighten the thumbscrew and repeat the procedure for the guide assembly.

How to repair a broken band saw blade

1 - How to grind the broken ends of the blade

- A broken band saw blade can be repaired in the shop.
- Start by creating a 20' bevel on each end of the blade utilizing a bench grinder.
- In the inset, the bevels will increase the contact area between the two blade ends when you join them, strengthening the joint.
- Then use a piece of emery cloth to roughen both blade ends; sand the exteriors until their bluish color disseems.
- This will help the soldering alloy adhere to the blade exterior appropriately.

2 - How to set up the blade in the soldering jig

- Secure a commercial soldering jig in a machinist's vise.
- Then, use a brush to spread flux on the beveled ends of the blade and ½ inch in from each end.
- Position the blade in the jig so the two beveled ends are in contact.
- Ensure the blade is tight and straight in the jig.

3 - Soldering the blade ends

- Heat the joint with a propane torch, then unroll a distance of the solder and touch the tip to the joint-not to the flame.
- Continue heating the joint until the solder covers the joint completely.

- Turn off the torch and let the joint cool.

4 - How to fill the joint

- Once the joint has cooled, eliminate the blade from the jig and wash off the flux with warm water.
- If there is an excess of solder on the blade, file it off carefully with a single-cut bastard mill file until the joint is no denser than the rest of the blade.
- If the joint separates, reheat it to melt the solder, pull it apart, and repeat steps 2 through 4.

How to fold and store a band saw blade

1 - How to hold the blade

- Before storing a band saw blade, eliminate any rust from it with steel wool and wipe it with an oily rag.
- Then, wearing safety goggles and gloves, grasp the blade with the teeth facing away from you; point your left thumb up and your right thumb down.

2 - How to twist the blade

- Pressing your right thumb firmly against the blade, twist it by pivoting your right hand upward.
- The blade will begin to form two loops.

3 - How to coil the blade

- Without stopping or releasing the blade, keep rotating it in the same direction while pivoting your left hand in the opposite direction.
- The blade will coil again, forming a third loop.
- Secure the blade with string, pipe cleaners, or plastic twist ties.

Chapter 17 Using jointer and planer knives

How to hone jointer knives

1 - Cleaning the knives

- Jointer knives can be honed while they are in the cutterhead.
- Start by cleaning them.
- Shift the fence away from the tables and move the guard out of the way.
- Making sure the jointer is unplugged, rotate the cutterhead with a stick until one of the knives is at the highest point in its rotation.
- Then, holding the cutterhead steady with one hand protected by a rag, use a small brass-bristled brush soaked in solvent to clean the knife.
- Repeat for the other knives.

2 - How to align the infeed table with the knives

- Cut a piece of ¼ inch plywood to the width of the jointer's infeed table and secure it to the table with double-faced tape.
- The plywood will protect the table from scratches when you hone the knives.
- Then, adjust the infeed table so that the beveled edge of the knives is at the same level as the top of the plywood.
- Set a straight board on the plywood and across the cutterhead and, holding the cutterhead steady with the beveled edge of one knife parallel to the table, lower the infeed table until the bottom of the board contacts the bevel.
- Use a wood shim to wedge the cutterhead in place.

3 - How to hone the knives

- Slide a combination stone equally across the beveled edge of the knife.
- Move the stone with a side-to-side motion until the bevel is flat and sharp, avoiding contact with the cutterhead.
- Repeat the procedure to hone the remaining knives.

How to sharpen jointer knives

1 - Removing the knives

- To give jointer knives a full-fledged sharpening, eliminate them from the cutterhead.
- Unplug the machine, shift the fence away from the tables, and move the guard out of the way.
- Use a small wood scrap to rotate the cutterhead until the lock screws securing one of the knives are accessible between the tables.
- Cover the edge of the knife with a rag to protect your hands, and then use a wrench to loosen each screw.
- Lift the knife and the retaining wedge out of the cutterhead.

2 - How to clean the retaining wedge

- Clean any pitch or gum from the retaining wedge utilizing a brass-bristled brush dipped in solvent.
- If the face of the retaining wedge that butts against the knife is pitted or rough, you may have trouble setting the knife height when reinstalling the knife.
- Flatten the face of the wedge as you would the sole of a plane until it is smooth.
- Also use the brush to clean the slot in the cutterhead that houses the retaining wedge and knife.

3 - How to install the knife in a sharpening jig

- Use a commercial knife-sharpening jig to sharpen the jointer knife.
- Center the knife in the jig bevel up and clamp it in place by tightening the wing nuts; use a rag to protect your hand.
- Ensure that the blade is parallel with the lip of the jig.
- If the knife does not extend out far enough from the jig, insert a wood shim between the knife and the jip clamps.

4 - How to sharpen the knife

- Set a sharpening stone on a flat, smooth work exterior.
- To adjust the jig so the beveled edge of the jointer knife is flat on the stone, turn the jig over, rest the bevel on the stone, and turn the wing nuts at the other end of the jig.
- Lubricate the stone-in this case with water-and slide the knife back and forth.
- Holding the knob-end of the jig flat on the work exterior and pressing the knife on the stone, move the jig to the Then pattern.
- Continue until the bevel is flat and sharp.
- Carefully eliminate the knife from the jig and hone the flat side of the knife to eliminate any burr formed in the sharpening procedure.

5 - How to reinstall the knife in the jointer

- Insert the retaining wedge in the cutterhead centering it in the slot with its grooved edge facing up.
- With the beveled edge of the knife facing the outfeed table, slip it between the retaining wedge and the front edge of the slot, leaving the bevel protruding from the cutterhead.

6 - How to set the knife height

- Adjust the height of the knife utilizing a commercial jig, or do the job by hand.
- Cover the edge of the knife with a rag and partially tighten each lock screw on the retaining wedge.
- Use a small wooden wedge to rotate the cutterhead until the edge of the knife is at its highest point also known as Top Dead Center or TDC.
- Then, holding the cutterhead stationary with a wedge, place a straight hardwood board

on the outfeed table so that it extends over the cutterhead.

- The knife should just brush against the board along the knife's entire distance.
- If not, use a hex wrench to adjust the knife jack screws.
- Once the knife is at the correct height, tighten the lock screws on the retaining wedge fully, beginning with the one in the center and working out toward the edges.
- Sharpen and install the remaining knives the same way.

How to use a knife-setting

- If the jig features magnetic arms that will hold a jointer knife at the correct height while you tighten the retaining wedge lock screws.
- Insert the knife in the cutterhead and position it at its highest point as you would to install the knife by hand.
- Then mark a line on the fence directly above the cutting edge.
- Position the knife-setting jig on the outfeed table, aligning the reference line on the jig arm with the marked line on the fence.
- Mark another line on the fence directly above the second reference line on the jig arm.
- Eliminate the jig and extend this line across the outfeed table.
- The line will help you rapidly position the jig the Then time you install a knife.
- Reposition the jig on the table, aligning its reference lines with the marked lines on the fence.
- Then use a wrench to tighten the lock screws.

How to eliminate and install a planer knife

- Eliminate a planer knife from the machine and sharpen it as you would a jointer knife.
- To reinstall the knife use the knife-setting guide supplied with the machine or a commercially obtainable model.
- Place the knife in the planer cutterhead and partially tighten the setscrews.
- Hold the knife-setting guide beside one of the setscrews so that its two feet are resting on the cutterhead on each side of the opening.
- Then adjust the setscrew with a hex wrench until the edge of the knife contacts the bottom of the guide.
- Repeat for the remaining setscrews.

Chapter 18 How to maintain portable power tools

Whatever their price range or list of features, all portable power tools will work better and last longer if they are cared for appropriately. At its most basic, preventive maintenance is easy to do and takes no more than a few minutes. At the end of your work day, For instance, get in the habit of cleaning dust and dirt from your tools. When you buy a new tool, register the warranty and file the owner's manual in a convenient place and follow all the operating and maintenance instructions suggested by the manufacturer. Owner's manuals typically include troubleshooting guides to help users recognize and handle malpurposes. Keep your tool's original packaging should you need to return an item for servicing. Because portable tools are electrically powered, caring for them is as much a matter of safety as of performance. Today's power tools are intended to insulate the user from electrical shock, but any tool that develops an electrical issue can be hazardous. This chapter provides explanations of the portable power tools commonly used in woodworking with cutaway views of their principal electrical and mechanical components. Fortunately, the parts of a power tool that endure the most abuse and most often suffer damage are those that are also the easiest to access: the plugs, power cords, motor brushes, and on/off switches. These components can be substituted simply and inexpensively. Before undertaking a repair, nevertheless, confirm whether the tool is still covered by the manufacturer's warranty. Opening up a tool that is still under warranty will typically void the guarantee. The decision to repair other parts of a portable power tool, such as the motor and motor bearing, For instance, depends on a number of factors, including your own abilities. Unless you feel comfortable making an electrical or mechanical repair, you are better off taking the tool to an authorized service center. If you do elect to open up a tool to repair or replace an internal component, label the wiring and the parts you disconnect to help you reassemble the tool appropriately. The age and value of a tool is also a consideration. The most worthwhile remedy for a 20-year old drill with a burned-out motor may be a new drill rather than a new motor.

Tips for maintenance

There are no industry wide standards for servicing portable power tools intended for the home shop. Manufacturers of industrial use power tools issue maintenance schedules for their merchandises, but these tools typically undertake heavier use than the regular home workshop tool. For industrial tools, servicing is typically scheduled every 100 hours of use and includes a complete overhaul. Brushes are substituted, bearings are cleaned and lubricate, or substituted, and the wiring, motor, and other electrical components are confirmed and, if necessary, repaired. For the typical power tool in the home shop, nevertheless, maintenance schedules and requirements are less clear cut. Much depends on how a tool is used. A circular saw used by the weekend woodworker to cut the occasional plank will obviously require less attention than one used by a busy carpenter or cabinetmaker who regularly relies on his tool to crosscut 8/4 stock and saw sheets of plywood to manageable distances.

Below lists provides particulars that should be made on many portable power tools. The tasks listed are straightforward and can be done in a matter of minutes. How often you perform these confirms will depend on your own needs and circumstances. As a rule of thumb, any tool that does not perform the way it is intended to should be investigated. You can do the work yourself but be aware that troubleshooting electrical issues in a power tool requires specialized, tools as well as a sound knowledge of how to use it. If you are uncomfortable working with electricity, take the tool to an authorized service center for repair. While tools made a few decades ago can be completely disassembled, many recent models feature internal components that are factory-sealed and virtually inaccessible. In some tools, For instance, the bearings are mechanically pressed onto the motor spindle.

Attempting to separate the bearing from the motor in such tools without the right instrument will destroy the bearing. Manufacturers claim that such developments in tool technology have developed sturdier, longer-lasting merchandises. While this is no doubt true, one consequence for the power tool buff of tools with no "user-serviceable parts" is that repairs can only be carried out by appropriately equipped service centers. To get the most from your tools and keep repairs to a minimum. Read your owner's manual before utilizing a tool to make certain you can operate it appropriately. And never try to use a tool for a task for which it is not intended. A tool will fail when subjected to stress it is not built to handle.

Confirming portable power tools

Below list provides the checks that should be made on portable power tools on a regular basis. Develop a timetable that suits your work habits. Tools that are used often or that get heavy use should be confirmed often.

Router

- Confirm the collet for play and run out
- Clean the collet and spindle
- Ensure that the sub-base is smooth and free of damage

Saber Saw

- Confirm the guide rollers and blade supports for wear
- Confirm the blade clamp
- Confirm that base is square to blade

Plate Joiner

- Confirm the plunge mechanism for play
- Confirm the blade and spindle for wear
- Inspect the pins and glides
- Inspect the drive belt

Electric Drill

- Confirm the chuck bearing for play Inspect the chuck for wear

Belt Sander

- Confirm the steel plates and cork pad for wear
- Confirm the drive belt
- Confirm the end roller for damage or excessive play
- Inspect the condition of the rubber on the drive roller

Circular Saw

- Lubricate the gears
- Confirm the arbor bearings
- Confirm the guard return springs
- Confirm blade alignment

Orbital Sander

- Confirm the pad for wear or splitting
- Confirm the eccentric bearing (on random-orbit sander)
- Confirm the pad support

Maintenance tips for portable power tools

- Read your owner's manual carefully before operating any tool.

- Do not use a tool if any of its parts is loose or damaged; inspect blades, bits, and accessories before starting an operation.
- Keep blades and bits clean and sharp; discard any that are chipped or damaged.
- Turn a tool off if it develops an unaware vibration or noise; have the tool serviced before resuming operations.
- Do not leave a tool running when it is unattended.
- Follow the manufacturer's instructions to change blades, bits, or accessories; unplug the tool first.
- Before cutting, shaping, or sanding a workpiece, eliminate loose knots utilizing a hammer; inspect salvaged wood for nails and screws before cutting.
- Do not attempt to cut through nails; this can cause kickback and also ruin a blade or bit.
- Use the appropriate wire gauge when replacing a damaged power cord or utilizing an extension cord.
- Keep the power cord out of the tool's path; do not use the tool if the cord is frayed.
- Ensure the blade or bit is not in contact with the workpiece when you turn on a tool; allow the cutter to come to full speed before feeding it into the stock.
- Do not force a tool through a cut; this can snap a blade or cause it to veer off course.
- Allow the blade or bit to cut at its own speed.
- Ensure that any keys and adjusting wrenches are removed from the tool before turning it on.
- Keep a tool's air vents clear of sawdust to avoid overheating the motor.
- Do not use a tool for extended periods of time without allowing it to cool.

How to select the appropriate wire gauge

- Utilizing an extension cord with the wrong gauge may cause a drop in line voltage, resulting in a loss of power, excessive heat, and tool burnout.
- If, for instance, your tool has a 4 amp motor and you are utilizing a 50 foot extension cord, the minimum gauge should be 18.
- Select only round-jacketed extension cords listed by the Underwriters Laboratory aka UL, or the Canadian Standards Association aka CSAI.

How to use a dial indicator and a magnetic base

- Install a centering pin in the router as you would a bit and set the tool upside down on a metal exterior, such as a table saw.
- Connect a dial indicator to a magnetic base and place the base next to the router.
- Turn on the magnet and position the router so the centering pin contacts the plunger of the dial indicator.
- Calibrate the dial indicator to zero following the manufacturer's instructions.
- Then turn the shaft of the router by hand to rotate the centering pin.
- The dial indicator will register collet run out the amount of wobble that the collet is causing the bit.
- If the run out exceeds 0.005 inch, replace the collet.

How to use a feeler gauge

- If you do not have a dial indicator, you can test for collet run out with a feeler gauge and a straight hardwood block.
- With the centering pin in the collet and the router upside down on a work exterior, clamp the block lightly to the tool's sub-base so the piece of wood touches the pin.
- Turn the router shaft by hand; any run out will cause the centering pin to move the block.
- Then use a feeler gauge to measure any gap between the pin and the block.
- If the gap exceeds 0.005 inch, replace the collet.

How to confirm the blade angle

- Square a saber saw blade each time you install a new blade.
- Unplug the saw, and then secure it upside down in a bench vise.
- Use a combination square to confirm whether the blade is square with the base plate.
- If not, loosen the base plate setscrew with a hex wrench and tilt the plate until the blade butts flush against the square.
- Then tighten the setscrew.

Chapter 19 How to repair portable power tools

Electrical safety tips:

- Unplug a tool before undertaking any repair to its internal components; you may inadvertently contact current in a defective tool-even with the on/off switch turned off.
- Allow a power tool to cool before servicing it.
- Use only replacement parts that meet the same specifications as the originals.
- When a power tool stops working, determine whether or not the issue originates outside of it before you take it apart.
- Carefully examine the tool's power cord; a frayed cord or a broken plug is a common cause of failure.
- Before disassembling a power tool, make a diagram of wire connections to make reassembly easier.
- Before undertaking a repair, contact the manufacturer to find out if a service manual for the tool is obtainable.

How to eliminate and install a brush assembly

- Brushes are spring-loaded carbon rods or blocks that conduct electricity to the rotating armature of a power tool's motor.
- Over time, brushes wear or become damaged.
- You can access the assembly by unscrewing the brush cap on the tool body-typically a plastic cap roughly the size of a dime.
- If there is no brush cap, you will have to eliminate the motor housing to access the brushes.
- Once you have located the brush assembly, carefully lift it out of the tool.
- To test the brush, push on it to confirm the spring.
- If the spring is damaged or the brush is pitted, uneven, or worn shorter than its width, you will need to replace the assembly.
- Some brushes are marked with a wear line.
- Buy a replacement at an authorized service center for your brand of tool.
- To reinstall a brush assembly, fit it into position in the tool.
- Then insert and tighten the brush cap or reattach the motor housing.

How to replace a switch

1 - Removing the old switch

- Set the tool on a work exterior, making sure that it is unplugged.
- For the router, eliminate the cap housing to expose the switch mechanism.
- Loosen the switch retaining nut and screws, and then disconnect the wires securing the mechanism to the tool.
- If the wires are connected by wire caps, simply loosen the caps and untwist the wires.
- If the connections are soldered, snip the connections with pliers.
- Use short strips of masking tape to label the wires to help you reconnect them

appropriately.

2 - How to install the replacement switch

- Buy a replacement switch at an authorized service center, noting the model and serial numbers of your tool.
- Connect the new switch to the wires in the tool housing, reversing the steps you took to take out the old one.
- Eliminate the masking tape strips from the wires, twist the wire ends from the tool and switch together, and screw a wire cap onto each connection to secure and insulate it.
- Fit the switch into position in the tool housing, screw the switch bracket in place, and tighten the switch retaining nut with a wrench.
- Replace the tool's cap housing.

How to replace a power cord

1 - Accessing the cord's wire terminals

- The wire terminals connecting a tool's power cord to the switch mechanism are contained within the motor housing.
- For the sander, reach the terminals by removing the auxiliary handle and loosening the screws securing the main handle to the tool body.
- Eliminate the handle to expose the wire terminals.

2 – Disconnecting the old power cord

- On a power cord with a two-prong plug, there are typically two wires from the cord connected to wire terminal screws in the tool housing.
- Unscrew the plug retaining bracket securing the cord to the tool housing, loosen the terminal screws, and carefully eliminate the power cord's wire ends from the terminals.
- Use strips of masking tape to Iabel each terminal to help you attach the wire ends of the new cord to the appropriate terminal.

3 - Preparing the replacement power cord

- Buy a replacement power cord at a hardware store or an authorized service center, making sure it has the same specifications as the original cord.
- The wire ends of new power cords are typically covered to the end with jacketing and insulation.
- To prepare the cord for installation, use a knife to cut away a few inches of the jacket covering the two wires.
- Then strip off about ½ inch of the plastic insulation around the wires, exposing the ends.
- You can also use wire strippers for this task.
- Avoid cutting into the metal wire; if you sever any of the strands, snip off the damaged section and eliminate more insulation to uncover a fresh section.
- Use needle-nose pliers to carefully twist the wire strands snugly together, and then bend the wire ends into semicircles that will hug the terminals in the tool housing.

- Place the wire around the screw clockwise from the left side, so it will wrap around as the screw is tightened.

4 - Installing the replacement cord

- Hook the wire ends around the terminals in the tool housing, making sure to attach each wire to the appropriate screw.
- Eliminate the masking tape.
- Holding the power cord in position, screw the cord retaining bracket in place, then reinstall the handles on the tool body.

How to replace a plug

1 - Removing the old plug and preparing the power cord

- Use a knife to slice through the power cord just above the plug.
- Prepare the cut end of the power cord for the replacement plug as you would when replacing a new power cord.
- Start by cutting away about 2 inches of the cord jacket with a knife, and then removing about ½ inch of insulation to expose the bare wire.
- This can be done with the knife or wire strippers.
- With the strippers, simply insert the wire end into the appropriate-size opening, squeeze the jaws of the strippers together, and pull the wire out.
- The device will sever the insulation.
- Then use needle nose pliers to twist the wire ends together and form them into a hook.

2 - Connecting the power cord to the replacement plug

- Buy a plug at a hardware store, making sure it has the same number and shape of prongs as the original.
- The plug consists of two parts: the prong section, which includes the terminal, a plug case, and retaining screws that hold the two parts together.
- Slip the end of the power cord through the plug case, and then attach each wire end to the terminals on the plug, tightening the screws to hold the wire ends securely.

3 - Assembling the plug

- Once the power cord wires are connected to the plug, assemble the two parts of the plug.
- Pull the casing over the plug and tighten the retaining screws until they are snug.
- To complete the repair, tighten the plug retaining clamp screw.
- This will securely hold the plug and the power cord together.

Chapter 20 How to maintain stationary power tools

The accuracy and consistency we expect from stationary woodworking machines are only possible if the tools are kept clean and find tuned. Whether you have a cantankerous old band saw that needs to be cajoled into making a straight cut, or a brand-new radial arm saw that has slipped out of alignment on the way from the factory, learning how to adjust your stationary machines appropriately will improve the results and increase your pleasure from them. Many woodworkers are apprehensive about exploring the nuts and bolts of their tools, and many owner's manuals do not encourage tinkering. Nevertheless, most stationary power tools are quite straightforward in their design and building. Taking the top off a table saw, which sounds like a major operation, is fairly straightforward to do and it can rapidly reveal how the machine works, and exactly what you should clean, adjust, or tweak to keep it running smoothly. The chapter that follows presents the major stationary power tools used by woodworkers and explains the basic maintenance and troubleshooting procedures for each one. Some of these tasks, such as confirming belts, cleaning switches, and keeping tabletops clean, apply to most of the tools. Other maintenance tasks are specific to the design of a particular machine, such as cleaning and adjusting the blade height and tilt mechanisms on a table saw, fixing an unbalanced band saw wheel, or bleeding water from an air compressor. Knowing how to tune up your stationary tools will not only give you a deeper understanding of how they work; it will also provide you with a list of things to confirm when shopping for used models. Is a jointer's fence square? How much run out does a drill press chuck have? Does the miter gauge of a table saw slide smoothly? Many woodworkers tune up their stationary tools just before the start of a major venture. This can be hard to schedule if you are one of those woodworkers who has many ventures on the go. In such cases, it is a good idea to devote a little time periodically to maintaining your stationary tools. That way, every venture will benefit from the best your tools can give.

How to confirm the belt tension

- Too much belt tension can strain a stationary tool's motor bearings, while too little tension often leads to slippage and excessive wear.
- To confirm drive belt tension on the jointer, unplug the tool and eliminate the panel covering the belt.
- Then pinch the belt between the pulleys with one hand.
- The amount of deflection will vary with the tool: as a rule of thumb, the belt should flex 1/32 inch for every inch of span between pulleys.
- If there is too little or too much tension, adjust it following the manufacturer's instructions.
- For smooth operation, the pulleys should be aligned; if they are not, loosen the adjustment setscrew on the motor pulley with a hex wrench, and slide the pulley in line with the other pulley.

How to clean a stationary machine tabletop

- To keep stock running smoothly, clean the tabletop often, wiping off any pitch or gum deposits with a rag and mineral spirits.
- Eliminate any rust or pitting with fine steel wool and penetrating oil, and then wipe off any residue and sand the area with fine sandpaper.
- A coat of paste wax rubbed on and then buffed will make pushing wood into the cutting

edge much less tiring.

How to clean a power switch

- The switches on stationary tools can become clogged, causing the switch to stick or even preventing it from operating.
- If the switch sticks, unplug the tool, eliminate the switch cover and clean the switch immediately.
- To prevent such issues, periodically clean out the switch by blowing compressed air into it.

Chapter 21 How to use table saws

The table saw is the curvestone of many workhops, put to use in nearly every phase of every venture. Because of its crucial role, your table saw must be consistently accurate and its parts square and true. The normal forces of routine use will ultimately throw a table saw out of alignment. Even a new machine straight off the assembly line typically needs a certain amount of adjustment before it can perform safely and appropriately.

The table saw components that need to be confirmed and aligned are those that come in contact with the workpiece while the cut: the blade, table, miter gauge, and rip fence. If any of these parts is not in appropriate alignment, you risk burn marks, tapered cuts, or kickback. The straightforward tune-up procedures will improve the performance of any table saw. It is a good idea to take the time to undertake them before starting a new venture. For the sake of efficiency, follow the steps in the order they appear. You will only be able to align the miter gauge with the saw blade, For instance, if the table has been squared with the blade. For safety, recall to unplug your saw before performing these confirms and adjustments.

How to confirm the table alignment

1 - Confirming the table alignment

- The face of the miter gauge and the blade must be perfectly perpendicular.
- To confirm this, position the miter gauge at the front of the saw blade.
- Clamp a square wood block against the miter gauge with the end of the block butted against a saw blade tooth.
- Mark an X on the blade Then to the tooth; this will enable you to confirm the same section of blade should you need to repeat the test after performing step 2.
- Slide the miter gauge and the block together toward the back of the table while rotating the blade by hand.
- The block should remain butted against the tooth as the blade rotates from front to back.
- If a gap opens between the block and the tooth, or the block binds against the blade as it is rotated, you will need to align the table (step 2).

2 - Aligning the saw table

- Adjust the saw table following the owner's manual instructions.
- Use a hex wrench to loosen the table bolts that secure the top to the saw stand; the bolts are located under the table.
- Loosen all but one of the bolts and adjust the table position rather; the bolt you leave tightened will act as a pivot, simplifying the alignment procedure.
- Repeat the blade test.
- Once the table is correctly aligned with the blade, tighten the table bolts.

3 - Confirming the blade angle

- Eliminate the table insert, and then butt a combination square against the saw blade between two teeth.

- The blade of the square should fit flush against the saw blade.
- If there is a gap between the two, rotate the blade angle adjustment crank until the saw blade rests flush against the square's blade.
- Reposition the angle adjustment stops so that the blade will return to its appropriate position each time it is adjusted.

How to align the miter gauge with the saw table

- With the miter gauge out of the table slot, use a combination square to confirm that the face of the gauge is square with the edge of the gauge bar.
- If it is not, use the adjustment handle on the gauge to square the two.
- Then place the miter gauge in its table slot and butt the square against the gauge.
- The blade of the square should fit flush against the gauge.
- If there is a gap between the two, have the gauge machined square at a metalworking shop.

How to confirm your adjustments

- Test the accuracy of your table saw adjustments by crosscutting a couple of scrap boards.
- To confirm the blade-to-table alignment, mark an X on a board and cut it face down at your mark.
- Then turn the cut off over and hold the cut ends together.
- Any gap between the two ends represents twice the error in the table alignment; if necessary, repeat the test.
- To confirm the miter gauge adjustment, crosscut the second board, face down as well, flip one piece over, and butt the two pieces together on edge.
- Again, any gap represents twice the error in the adjustment.
- If necessary, square the miter gauge again.

How to adjust the rip fence

- Lock the rip fence in place alongside the miter slot.
- If the fence and the slot are not parallel, adjust the angle of the fence following the manufacturer's instructions.
- Some models feature adjustment bolts at the front of the table that you can loosen tighten with a hex wrench to change the alignment; others have fence adjustment bolts that you can loosen with a wrench.
- Adjust the fence parallel to the miter slot, and then retighten the adjustment bolts.

How to adjust the leveling screws

- To set the table insert level with the saw table, place a square board across the insert and the table.
- Adjust the leveling screws at the curves of the insert with a hex wrench until the insert is flush with the tabletop.
- You can also adjust the insert rather below the table at the front and rather above the

table at the back; this will prevent the workpiece from catching or binding on the insert while the cut.

- If your saw's insert does not have leveling screws, file or shim the insert to make it lie flush with the table.

How to clean the trunnions

- lf your table saw's blade sticks or moves sluggishly when you raise or tilt it, clean the height and tilt adjustment mechanisms inside the saw.
- Start by removing the tabletop following the manufacturer's instructions.
- Blow out the sawdust with compressed air, and then clean the moving parts within the saw.
- Start with the blade height and tilt mechanisms, utilizing solvent and a brass-bristle brush to eliminate stubborn pitch and hardened sawdust deposit.
- Then scrub the machined ways on the front and rear trunnions.
- Once all the parts are clean, lubricate all the moving parts with graphite or silicon-based lubricant; oil and grease should be avoided as they tend to collect dust.
- Replace the tabletop and fine-tune the saw.

Chapter 22 How to use radial arm saws

A radial arm saw's many pivoting and sliding parts enable you to pull a blade through a workpiece in a diversity of angles and directions. This flexibility, nevertheless, can lead to issues. Unless the saw's moving parts are kept in alignment, its performance can become sloppy and potentially dangerous. The procedures that follow will help you fine-tune a radial arm saw so that it will cut accurately and safely. Adjusting a radial arm saw can be time-consuming because of its many moving parts. To make the adjustments manageable, you can perform them in two steps: testing and adjusting the table, clamps and roller bearings, and aligning and squaring the blade. For safety, unplug your saw while performing these confirms and adjustments.

How to clean the track and bearings

- Use a solution of ammonia and water to clean your radial arm saw's track and roller bearings.
- Pull the yoke as far back as it will go, then wipe the track utilizing a clean rag dampened with the solvent.
- Push the yoke toward the column and clean the front portion of the track.
- Then, clean the roller bearings, located to the front and rear of the carriage that connects the yoke to the arm.
- Wrap the rag around your finger, dip it in the solvent, and hold it against the roller bearing while pushing the yoke away from you.
- Coat the track and bearings with light machine oil, then wipe off the excess.

How to level the table with the arm

- Tilt the saw's motor until the arbor points down, its end rather above table Ievel.
- Then swivel the arm to position the arbor over the rail nuts on both sides of the table; in each position measure the gap between the arbor and the table.
- If the measurements are not equal, raise the low end of the table by turning the rail nut in a clockwise direction, utilizing the head of an adjustable wrench to lever up the table exterior.
- Then make the same adjustment on the other side of the table.
- Repeat the measurements to ensure the table is level.

How to adjust the clamps

1 - Adjusting the miter clamp

- Swivel the arm to the righto a position between 0" and 45".
- Lock the miter clamp, on the saw at the front end of the arm.
- Try to push the end of the arm toward the 0' position.
- If there is any play in the arm, adjust the clamp that holds it in place.
- Use a hex wrench to tighten the miter clamp adjustment screw, located inside an access hole at the back end of the arm.

2 - Adjusting the yoke clamp

- Rotate the yoke to a position between the ones used for crosscutting and ripping.
- Lock the yoke clamp handle, and then use both hands to try and push the motor to the crosscutting position.
- The motor should not budge; if it does, adjust the clamp that locks it in position.
- Tighten the adjustment nut located under the arm following the manufacturer's instructions.
- Lock the clamp and confirm again for play.

3 - Adjusting the bevel clamp

- Tilt the motor to a position between 0'and 45".
- Lock the bevel clamp, and then use both hands to try to move the motor.
- If there is any looseness, adjust the clamp.
- Use a socket wrench to tighten the motor support nut at the back of the motor, and then release the clamp and try tilting the motor to each of the prearrange angles; if you cannot move the motor, loosen the support nut rather.
- Otherwise, lock the clamp again and confirm once more for play in the motor.

4 - Adjusting the rip clamp

- Lock the rip clamp, and then use both hands to try to slide the yoke along the arm.
- The yoke should not move; if it does, adjust the clamp.
- Release the clamp, and then use a wrench to tighten the nut at the end of the rip clamp bolt.
- Try sliding the yoke along the arm; if it binds, loosen the lock nut rather.
- Otherwise, reconfirm the clamp and tighten the nut further if required.

How to look after the sliding mechanism

1 - How to adjust the carriage roller bearings

- To confirm the carriage roller bearings, press your thumb against each one in turn while sliding the carriage away from your hand.
- The bearings should turn as the carriage slides along the arm.
- If your thumb keeps one of them from turning, you will need to tighten the bearing; if the carriage binds on the arm, a bearing will need to be loosened.
- In either case, adjust the bearing while holding the bolt stationary with a second wrench.
- Tighten or loosen the bolt as required, then retighten the nut.

2 - Adjusting column-to-base tension

- Wipe the column clean, and then loosen the four setscrews on the front of the column base utilizing a hex wrench.
- To confirm column-to-base tension, use both hands to try to lift the end of the arm; there should be little or no give to the column.

- Turn the elevating crank in both directions; the arm should slide smoothly up and down.
- If there is excessive movement at the column-to-base joint, or if the arm jumps or vibrates as it is raised or lowered, adjust the four bolts located in the access holes on the back cover of the base.
- Repeat the tests and, if necessary, make supplementary adjustments.
- Then try pushing the arm sideways; if there is any rotation of the column, tighten the setscrews just enough to prevent movement.
- Run through the tests a final time, fine-tuning the adjustments.

How to square the blade

1 - Squaring the blade with the table

- Set the saw's yoke in the crosscutting position and install a blade.
- Release the bevel clamp and tilt the motor counter clockwise as far as it will go in the 0" position.
- Relock the clamp.
- To confirm the blade position, butt a framing square between two saw teeth.
- The square should fit flush against the side of the blade.
- If any gap shows between them, adjust the bevel clamp setscrews and tilt the motor to bring the blade flush against the square.

2 - Squaring the blade with the fence

- Release the miter clamp and swivel the arm to the right as far as it will go in the 0" position, and then relock the clamp.
- Release the rip clamp and butt one arm of a framing square against the fence while the other just touches the blade tooth nearest to the table.
- Holding the blade steady, slide the yoke along the arm; pull slowly to avoid dulling the tooth.
- The blade should make a continuous rubbing sound as it moves along the edge of the square.
- If a gap opens up between the blade and the square, or if the blade binds, adjust the setscrews in the column base following the manufacturer's instructions.

How to correct the blade heel

1 – Fine tuning horizontal rotation

- Install a blade and set the motor in its horizontal position; tilt the motor counter clockwise as far as it will go, then lock the bevel clamp.
- To test for blade heel, build an L-fashioned sounding jig and bore two holes in it.
- Sharpen the ends of two dowels and fit them into the jig.
- Then position the jig to align a blade tooth near the back of the table directly over the vertical dowel.
- Lower the blade until the tooth rests lightly on the dowel; clamp the jig in place.

- Wearing a work glove, spin the blade backward, listen, and carefully note the sound.
- Slide the yoke along the arm to align a tooth near the front of the table over the dowel and repeat the test.
- The sound should be the same in both positions.
- If it is not, adjust the motor support nut according to the manufacturer's instructions and repeat the test.

2 - Eliminating vertical blade heel

- Tilt the motor counter clockwise as far as it will go in the vertical position, then lock the bevel clamp.
- To test for vertical heeling, position the sounding jig so that the tip of the horizontal dowel aligns with a blade tooth near the back of the table.
- Lower the blade and send it spinning backward so you can sample the sound as in step 1.
- Slide the yoke along the arm and repeat the procedure, adjusting the height if necessary; once again listen for changes in tone.
- If there is a discrepancy, release the yoke clamp and adjust the motor's position following the manufacturer's instructions.
- Retest until each test develops similar tones.

How to test the saw for square

- You can confirm the accuracy of your adjustments to a radial arm saw much as you would for a table saw.
- To determine whether the blade is square to the saw table, mark an X on a wide board and crosscut it at your mark.
- Then turn one piece over and hold the cut ends together.
- Any gap between the two ends represents twice the error in the blade-to-table alignment; if necessary, repeat the adjustment.
- Now butt the two boards against the fence.
- If the two pieces do not fit together perfectly the blade is not square to the fence.
- Again, any gap represents twice the error; if necessary; square the blade to the fence.

How to cut a kerf in the fence and auxiliary table

- Install a fence of ¾ inch-thick, knot-free wood between the table spacer and the front table; make the fence rather higher than the thickness of your workpiece.
- For an auxiliary table, cut a piece of ¼ inch hardboard or plywood the same size as the front table and use contact cement to glue it down, leaving a slight gap between it and the fence to prevent sawdust from jamming between the two.
- Before crosscutting or making miter cuts, slice through the fence and 1/16 to 1/8 inch deep into the auxiliary table in the 90' and 45' oaths of the blade.
- Then, raise the blade above the table and rotate the motor to the ripping position.
- Turn on the saw and lower it to make a 1/16 inch-deep cut.
- Pull the yoke along the arm to furrow out a shallow rip through in the auxiliary table.

Chapter 23 How to use band saws

For many woodworkers the band -I saw's thin, flexible blade makes it the tool of choice for cutting curves, re sawing, and making fine, straight cuts. And because the blade teeth cut downward, there is no danger of kickback. Since the band saw blade is only supported on the crown of two large wheels, it must be appropriately tensioned and tracked every time you change blades, otherwise you risk crooked cuts and broken blades. Setup adjustments for the machine are not time-consuming, but they are vital. Particular attention should be paid to the alignment of the wheels. Misaligned wheels can cause excessive blade vibration. Also periodically adjust the guide assemblies and confirm the table for square. If these procedures do not restore a poorly cutting saw to peak performance, the wheels or tires may be to blame. The steps described below and on the following pages detail how to correct out-of round and unbalanced wheels, and will make your band saw cut straighter and help its blades last longer.

How to confirm the wheels

1 - Confirming the wheel bearings

- Open one wheel cover, grasps the wheel at the sides, and rocks it back and forth.
- Repeat while holding the wheel at the top and bottom.
- If there is play in the wheel or you hear a clunking noise, eliminate the wheel and replace the bearing.
- Then repeat the test for the other wheel.

2 - Testing for out-of-round wheels

- Start with the upper wheel.
- Bracing a stick against the upper guide assembly, hold the end of the stick about 1/16 inch away from the wheel's tire.
- Then spin the wheel by hand.
- If the wheel or tire is out of round, the gap between the stick and the wheel will fluctuate; the wheel may even hit the stick.
- If the discrepancy exceeds 1/32 inch, remedy the issue.
- Repeat the test for the lower wheel.

3 - Fixing an out-of-round wheel

- Start by determining whether the tire or the wheel itself is the issue.
- Try stretching the tire into shape with a screwdriver, and then repeat the test in step 2.
- If the wheel is still out of round, use a sanding block to sand the tire; this may compensate for unevenness in the tire.
- For the lower wheel, turn on the saw and hold the sanding block against the spinning tire.
- For the upper wheel, leave the saw unplugged and rotate the wheel by hand.
- Repeat step 2 again.
- If the issue persists, the wheel itself is out of round.
- Have it trued at a machinist's shop.

How to align the wheels

1 - Confirming wheel alignment

- To ensure that your band saw wheels are parallel to each other and in the same vertical plane, hold a straightedge against them.
- The straightedge should rest flush against the top and bottom of each wheel.
- If the wheels are out of alignment, try to bring the top wheel to a vertical position with the tilt knob.
- If the straightedge still will not rest flush, measure the gap between the recessed wheel and the straightedge to determine how far you need to move the outermost wheel in.

2 - Shifting the outermost wheel into alignment

- Eliminate the outermost wheel following the instructions in your owner's manual.
- It is better to shift the outermost wheel in to correct the alignment rather than to move the inner wheel out; this keeps the wheels as close as possible to the saw frame.
- Then shift the wheel by removing one or more of the factory-installed washers.
- If there are no washers, you can shim the recessed wheel with washers to bring the wheels into alignment.
- Reinstall the wheel and tighten the axle nut.
- Repeat step 1.

How to track the blade

- Unplug the saw and turn the tension handle at the top of the saw clockwise to raise the too wheel and increase tension on the blade.
- Deflect the blade from side to side to gauge the tension. Increase the tension until the blade deflects about ¼ inch to either side of the vertical.
- To track the blade, lower the upper guide assembly, then spin the upper wheel by hand to confirm whether the blade is tracking in the center of the wheel.
- If it is not, loosen the tilt knob lock screw.
- Then spin the wheel while turning the tilt knob to angle the wheel until the blade is centered.

How to adjust the guide assembles

1 - Setting the thrust bearings

- Confirm by eye to see if the upper guide assembly is square to the blade.
- If not, loosen the guide assembly setscrew, adjust the assembly so that the bearing is square to the blade, and tighten the setscrew.
- Then, loosen the bearing thumbscrew and turn the adjustment knob until the thrust bearing just touches the blade.
- Back the bearing off rather and tighten the thumbscrew.
- The lower guide assembly thrust bearing, which is located directly beneath the table insert, is adjusted the same way.
- To confirm the setting, spin the upper wheel by hand.

- If the blade makes either bearing spin, back the bearing off rather and reconfirm.

2 - Setting guide blocks

- To set the upper guide blocks, loosen their setscrews and pinch the blocks together utilizing your thumb and index finger until they almost touch the blade.
- Alternatively, use a slip of paper or a feeler gauge to set the space between the blocks and the blade.
- Tighten the setscrews.
- Then, loosen the thumbscrew and turn the adjustment knob until the front edges of the guide blocks are just behind the gullets.
- Tighten the thumbscrew.
- Set the lower guide blocks the same way.

How to square the table and the blade

1 - Aligning the table

- To ensure that the miter gauge slot is appropriately aligned on both sides of the table slot, set the miter gauge in its slot and slide the gauge back and forth across the table.
- The gauge should slide freely with only moderate pressure.
- If the gauge binds, use locking pliers to eliminate the alignment pin.
- Then, insert the pin into its hole and use a ball-peen hammer to tap it deeper until the miter gauge slides freely.

2 - Confirming the table angle

- With the table in the horizontal position, eliminate the table insert, then butt a combination square against the side of the saw blade.
- The square should fit flush against the table and blade.
- If there is a gap between the two, loosen the two table lock knobs underneath the table and ensure the table is seated appropriately on the table stop.
- Tighten the lock knobs.
- If the gap remains, adjust the table stop.

3 - Aligning the table stop

- Tilt the table out of the wav, and then use two wrenches to adjust the table stop.
- Use the lower wrench to hold the lock nut stationary and the upper wrench to turn the table stop.
- Turn the stop clockwise to lower it and counter clockwise to raise it.
- Reconfirm the table angle.

Chapter 24 How to use jointers and planers

The team of jointer and thickness I planer are responsible for squaring the edges and faces of a workpiece. The success of any woodworking venture rests on these first crucial steps, so it is essential that both machines are set up appropriately. Even the most accurate table saw will only compound errors made at the jointing and planing stage. Accurate jointing depends on precise alignment of the two tables and the fence. Begin by ensuring that the out feed table is at the same height as the cutting edges of the knives at their highest point, also known as Top Dead Center or TDC. Then confirm that the tables are perfectly square to the fence and aligned with each other. Because it has more moving parts, the thickness planer requires a little more attention. Most importantly, always confirm to see that the feed rollers are appropriately adjusted and that the planer's bed is parallel to the cutterhead along its distance.

How to set the outfeed table height

1 - Confirming table height

- With the jointer unplugged, use a small wooden wedge to rotate the cutterhead until the edge of one knife is at its highest point.
- Then hold a straight hardwood board on the outfeed table so that it extends over the cutterhead without contacting the infeed table.
- The knife should just brush against the board.
- Perform the test along the distance of the knife, moving the board from the fence to the rabbeting ledge.
- Repeat the test for the other knives.
- If a knife fails the test, adjust its height.
- If none of the knives is level with the board, raise or lower the outfeed table by loosening the table lock and moving the outfeed table adjustment handle.

2 - How to adjust the positive stop

- If the outfeed table is still not level with the knives, adjust the jointer's positive stops, which prevent the table from moving out of alignment while in use.
- First tighten the outfeed table lock and loosen the two lock nuts on the other side of the tool.
- Back off the two positive stops and then adjust the height of the outfeed table with the adjustment handle until the table is level with the knives at their highest point of rotation.
- Tighten the table lock.
- Tighten the positive stops as far as they will go, then tighten the lock nuts.

How to align the tables and fence

1 - Aligning the tables

- Eliminate the jointer's fence, and then raise the infeed table to the same height as the outfeed table.

- Use a straightedge to confirm that the two tables are absolutely level.
- If the alignment is not perfect, adjust the horizontal position of the tables.
- If the model features eccentric table supports that can be adjusted by first loosening a locking screw and then tapping an adjustment cam with a hammer and screwdriver.
- When the tables are perfectly level, tighten the locking screws.
- If you have a jointer with gib screws, adjust one or more of the gib screws at the back of the tool until the straightedge rests flush on both tables; eliminate the pulley cover, if necessary, to access the screws.
- If you moved the outfeed table while this procedure, reconfirm its height.

2 - Squaring the fence with the tables

- With the fence set in its vertical position, hold a try square on the outfeed table near the cutterhead and butt the square's blade against the fence.
- The square should fit flush against the fence.
- If there is any gap between the two, slacken the locking handle, tilt the fence until it is flush with the square, and retighten the handle.
- The 90' positive stop should be engaged in the index collar.
- If the fence is still out-of-square, adjust the positive stop.

How to clean planer rollers

- Planer feed rollers can get dirty rapidly when planing pitch filled softwoods such as pine.
- Periodically use mineral spirits or a solution of ammonia and water with a brass bristled brush to clean metal feed rollers of pitch and resin.
- Clean rubber feed rollers with a sharp cabinet scraper.

How to adjust feed rollers

- Sometimes it is necessary to increase pressure on a planer's feed rollers, as when planing narrow stock or when stock slips as it is fed into the machine.
- In either case, the infeed roller should firmly grip the board.
- Some planers feature a serrated metal infeed roller; in this case the pressure should be enough to move the board but not so much that the rollers leave a serrated pattern in the board after it is planed.
- On most planers, the feed rollers are adjusted by turning spring-loaded screws on top of the machine.
- Eliminate the plastic caps and adjust the hex nuts with an open-end wrench.
- Ensure after adjusting the feed rollers that the table is parallel to the rollers.
- If the rollers do not carry the wood smoothly through the planer after adjustments, clean the rollers or wax the table.

How to confirm the table for level

- To confirm if your planer's table is level and parallel to the cutterhead, run two jointed strips of wood of the same thickness through opposite sides of the machine, and then compare the resulting thicknesses.

- If there is a measurable difference, adjust the table according to the manufacturer's instructions.
- If your model of planer has no such adjustment, rearrange the knives in the cutterhead so that they are rather lower at the lower end of the table to compensate for the error.

How to lubricating the height adjustment

- To ensure smooth operation, periodically clean the planer's height adjustment mechanism, first utilizing a clean, dry cloth to eliminate sawdust and grease.
- Then lubricate the threads with a Teflon based lubricant or automotive bearing grease; oil should be avoided as it may stain the wood.

Chapter 25 How to use drill presses

Drill presses have a reputation as workhorse machines that seldom if ever-require maintenance. And yet they can slip out of alignment just as simply as any other stationary power tool. Most drill press issues are found in the chuck and table. A table that is not square to the spindle is the most common issue, and is simply remedied. Runout, or wobble, is a more serious issue, and can be traced to the spindle or chuck. If the issue lies with the spindle, it can often be fixed simply by striking the spindle with a hammer until it is true; if the chuck is at fault, it must be removed and substituted. Do not neglect the drill press belts and pulleys in your maintenance. Confirm the belts for wear, and always keep them tensioned appropriately. Periodically confirm the bearings in the pulleys, and replace them if they become worn.

How to square the table

1 - Aligning the table

- Install an 8 inch-long steel rod in the drill press chuck as you would a drill bit, then raises the table until it almost touches the rod.
- Butt a try square against the rod; the blade should rest flush against.
- If there is a gap, adjust the table following the manufacturer's instructions.
- Eliminate the alignment pin under the table, loosen the table locking bolt, and swivel the table until the rod is flush with the square.
- Tighten the locking bolt.

2 - How to correct chuck runout

- Use a dial indicator to see if there is any runout, or wobble, in the chuck.
- If there is, rap the rod with a ball-peen hammer and then measure for runout again; 0.005 inch is reviewed the maximum acceptable amount.
- Pull the arm of the dial indicator out of the way each time you tap the rod.

How to eliminate and remounting a chuck

- Chucks are commonly attached to the quill of a drill press with a tapered spindle.
- Older models often have chucks that are simply screwed in place.
- To eliminate a faulty chuck that features a tapered spindle, first lower the quill and lock it in place.
- Fit an open-end wrench around the spindle on top of the chuck and give the wrench a sharp upward blow.
- The chuck should slide out.
- If not, rotate the spindle and try again.
- To remount the chuck, press fit it into the spindle by hand.
- Then, with the chuck's jaws fully retracted, give the chuck a sharp blow with a wooden mallet.

Chapter 26 How to use lathes and shapers

How to sand the lathe bed

- If your shop is in a humid climate, the bed of your lathe may develop a thin layer of rust which can prevent the tailstock and tool rest from sliding smoothly.
- To keep the lathe bed clean, eliminate any rust as soon as it seems by sanding the bed with fine sandpaper, 200-grit or finer, and then apply a paste wax.

How to draw-fill the tool rest

- Because it is made of softer steel than the turning tools used against it, the bearing exterior of the tool rest will develop low spots, marks, and nicks with continuous use.
- If not remedied, these imperfections will be transferred to the workpieces you turn, or cause the tool to skip.
- You can redress a tool rest simply with a single-cut bastard mill file.
- Draw-file the rest by holding the file at an angle and pushing it across the work from right to left in overlapping strokes.
- Continue until you have removed the nicks and hollows, and then smooth the exterior with 200-grit sandpaper or emery cloth.

How to confirm for center alignment

- Turning between centers requires precise alignment of drive centers between headstock and tail stock, otherwise you will develop off center turnings.
- To see if the drive centers line up, insert a four-spur drive center in the headstock and a live center in the tailstock.
- Slide the tailstock along the bed up to the headstock.
- The points of the drive centers should meet exactly.
- If they do not, you may have to shim the tailstock or file down its base.

How to confirm for spindle runout

- Set a magnetic base dial indicator face up on the shaper table so the plunger of the device contacts the spindle.
- Calibrate the gauge to zero following the manufacturer's instructions.
- Then turn the spindle slowly by hand.
- The dial indicator will register spindle runout the amount of wobble that the spindle will transfer to the cutter.
- Perform the test at intervals along the distance of the spindle, adjusting its height ½ inch at a time.
- If the runout exceeds 0.005 inch for any of the tests, replace the spindle.

How to square the fences

- The two halves of a shaper fence-or a router table fence-must be perfectly parallel, otherwise your cuts will be uneven.

- To square the fences on a shaper, first loosen the fence locking handles.
- Hold a straightedge against the fences.
- The two halves should butt against the straightedge.
- If not, add wood shims behind the fences until they are parallel.

Chapter 27 Utilizing supplementary tools

Scroll saws - Confirming blade tension

- The blades of a scroll saw-like those of a band saw-require appropriate tension to cut effectively.
- Too little tension will cause excessive vibration and allow the blade to wander while the cut.
- Too much tension can lead to blade breakage.
- To adjust blade tension, first tilt the blade tension lever forward.
- Then adjust the blade tension knob to increase or decrease blade tension.
- Tilt the blade tension lever back and test the blade.
- It should deflect about 1/8 inch when pushed from side to side.
- Pluck the blade and Recall the sound.
- It will allow you to tension the blade rapidly in future.
- Always adjust the tension when you change blades.

How to square the blade

- To square the scroll saw's blade to the table, butt a combination square against the blade.
- The square should fit flush against the blade.
- If there is a gap, loosen the table lock knob and adjust the nut on the 90' stop until the table is level and there is no gap between the square and the blade.
- Tighten the lock knob.

Belt and disc senders - Testing for trueness

- To measure whether the wheel is true, first eliminate any abrasive discs.
- Connect a dial indicator to a magnetic base and set the base on the tool's disc table.
- Place the device so that its arm contacts the disc and turn on the magnet.
- Calibrate the dial indicator to zero following the manufacturer's instructions.
- Turn the sanding disc by hand, and read the result.
- The dial indicator will register the trueness of the wheel.
- Perform the test at various points around the disc.
- If the amount of wobble exceeds 0.005 inch for any of the tests, adjust the motor position or have the bearings substituted.

How to track the sanding belt

- To straighten a sanding belt that is not tracking true, turn the belt-and-disc sander's tracking knob clockwise or counter clockwise while the tool is running.
- To correct severe tracking issues, unplug the tool and release tension on the sanding belt by pushing down on the tracking knob.
- Center the belt on the pulleys and release the knob.
- Then turn on the tool and adjust the tracking knob as required.
- Always track the belt when changing belts or installing a new one.

Air compressors - Draining the compressor

- When an air compressor has been used for an extended period of time or in exceedingly humid conditions, moisture will collect in the tank.
- This moisture may cause rust; it can also be sprayed out with the air, which can ruin a spray lacquer finish.
- To drain the moisture, shut off the motor, relieve all pressure from the tank, and open the drainage valve at the bottom.
- Drain the tank periodically, depending on how often you use the compressor.

How to change the oil and air filters

- After every 100 hours of operation, change an air compressor's oil.
- To drain the oil, shut off the motor, relieve all pressure from the tank, and loosen the drain plug with a wrench.
- Collect the old oil in a container and dispose of it safely.
- Close the drain plug and fill the pump with the oil recommended by the manufacturer.
- Do not overfill the pump.
- Also confirm the air filter weekly.
- To clean the air filter, eliminate the housing and lift off the filter.
- Clean the filter in a solution of detergent and water; replace it if it cannot be cleaned.

Vocabulary

Abrasive:

A coarse powder or a piece of paper or fabric coated with grit particles used to smooth wood.

Arbor:

A shaft driven by a stationary power tool motor to turn a revolving blade or other cutting implement.

Bearing:

A machined part located on a motor shaft, permitting the shaft to turn without friction.

Belt tension:

The measure of how tight a stationary power tool drive belt or abrasive belt is stretched across its pulleys.

Benchstone:

Any natural or synthetic sharpening stone used at the bench.

Bevel cut:

Sawing at an angle from face to face through a workpiece.

Blade heel:

Blade rotation that is not perfectly parallel to the fence of a table saw or the arm of a radial arm saw.

Blade set:

The amount that saw teeth are alternately offset to left and right, allowing a blade to cut a kerf rather wider than its own thickness to help prevent binding.

Blade tension:

The measure of how tight a band saw blade is stretched across its wheels.

Brushes:

A carbon or copper conductor that delivers current from the stationary element of an electric motor to the rotating coil.

Buffing:

Polishing a sharpened edge to a mirror-like finish utilizing a cloth or rubber wheel impregnated with fine abrasive compounds.

Burnisher:

A rod-like steel tool used to turn a lip on a tool edge, especially scraper edges.

Burr:

A small ridge formed on the flat face of a tool blade as a outcome of the honing procedure.

Cap iron:

A metal plate screwed to a plane blade, preventing chatter and the build-up of wood chips.

Carbide-tipped blade:

A saw blade on which the teeth are made of a compound of carbon and steel; such blade edges are stronger and stay sharper longer than conventional high-speed steel blades.

Chip lifter:

The machined exteriors on a Fortsner or multi-spur bit directly behind the cutters.

Chuck:

Adjustable jaws on a drill or drill press for holding bits or other accessories.

Collet:

The sleeve that grips the shank of a router bit.

Combination blade:

A circular saw blade intended for making both crosscuts and rip cuts.

Crosscut:

A cut made across the grain of a workpiece.

Dado head:

A blade, or combination of blades and chippers, used to cut dadoes in wood.

Dado:

A rectangular channel cut into a workpiece.

Dial indicator:

A measuring device with a magnetic base used to determine runout on stationary and portable power tools, typically calibrated in thousandths of an inch.

Drill point angle:

The angle to which a drill bit must be ground and sharpened for efficient cutting.

Drive belt:

Any rubber belt that connects a stationary power tool motor with its arbor or spindle, sometimes through a system of pulleys.

Drive center:

A lathe accessory mounted in either the tailstock or headstock to support turning work; can either be fixed or turn with the work by means of ball-bearings.

Feeler gauge:

A specifically ground metal blade, furnished in sets, used to accurately measure the gap between tool parts.

Fence:

An adjustable guide intended to keep the edge or face of a workpiece a set distance from the cutting edge of a tool.

Ferrule:

A metal ring that tightens around the end of a handle to prevent splitting.

Frog:

The part ofa hand plane that supports the blade; typically the frog can be moved back and forth to adjust the mouth opening of the plane.

Grinding:

The initial step in sharpening where nicks are removed, the cutting edge is squared, and the bevel is established; typically done on a bench grinder.

Gullet

The gap between teeth on a saw blade.

Honing:

The procedure of converting a rough-ground edge to a smooth, uniform cutting edge.

Hook:

A uniform burr turned on the cutting edges of a scraper.

Infeed:

The part of a machine's table that is in front of the blade while a cutting operation.

Kerf:

The space left when wood is removed by the saw blade.

Kickback:

The tendency of a workpiece to be thrown back in the direction of the operator of a tool.

Lapping:

Rubbing the face of a plane or chisel blade across a sharpening stone to eliminate the burr that results from honing the blade.

Microbevel:

A secondary bevel honed on the cutting edge of a blade.

Miter cut

A cut that angles across the face of a workpiece.

Oilstone:

Any natural or synthetic sharpening stone that uses oil as a lubricant.

Orbital action:

The up-and-forward movement of some saber saw blades on their upstroke; replaces the traditional straight up-and-down action of a reciprocating-type saber saw. Also, the eccentric motion of the abrasive disc on an orbital or random-orbit sander.

Out-of-round wheel:

A band saw wheel that is not perfectly round.

Outfeed:

The part of a machine's table that is behind the blade while a cutting operation.

Platen:

A support plate for sandpaper belts on sanders.

Positive stop:

An adjustable screw on a stationary power tool used to keep the tool's table at a set angle, typically 90’ and 45’.

Quill:

A sleeve surrounding the spindle of a drill press; the amount that the quill can be raised and lowered determines the depth of hole a drill press can bore.

Raker:

A tooth in a saw blade that clears sawdust and wood chips out of the kerf.

Reverse thread:

A machined thread that tightens and loosens in the opposite direction to the rotation of the tool bit so that the cutter remains tight while operation.

Rip cut:

A cut that follows the grain of a workpiece-typically made along its distance.

Runout:

The amount of wobble in tool's arbor or spindle.

Sharp:

A cutting edge is said to be sharp where two flat, polished exteriors meet at an angle.

Slipstone:

A sharpening stone with curved edges used to sharpen gouges and other similarly fashioned tools.

Snipe:

A concave cut created by a jointer or planer at the end of a workpiece, the outcome of imappropriate pressure on the workpiece or inaccurately set table height.

Spindle:

The threaded arbor on a power tool that turns cutters and accessories.

Square:

Two exteriors of a workpiece that are at 90 degre to each other.

Stropping:

Polishing a sharpened edge to a mirror-like finish utilizing strips of leather impregnated with fine abrasive compounds

Tearout:

The tendency of a blade or cutter to tear the fibers of wood, leaving ragged edges on the exterior of the workpiece.

Teeth per inch (TPI):

A unit of measurement used to identify versions and uses of saw blades by the number of teeth per inch of blade distance.

Temper:

The degree of hardness in tool steel; also, the color of steel after the tempering procedure.

Tracking:

Adjusting a band saw blade or abrasive belt so that it is centered on the tool's wheels.

Waterstone:

Any natural or synthetic sharpening stone that uses water as a lubricant.

Wheel dresser:

A device used to true the working exterior of a grinding wheel and expose fresh abrasive.

Book 2

Woodworking Tools and Accessories

Essential Hand Tools Every Woodworker Must Have

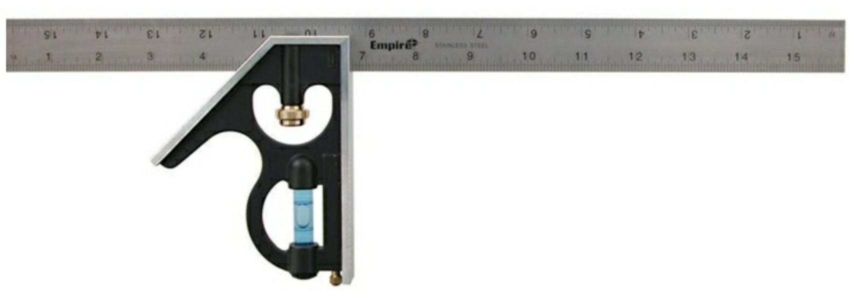
Karl Winkler

Chapter 1 Hand tools

The accurate layout is an essential part of making fine furniture, and it’s just as vital for power-tool work as it is for handwork. That’s because irrespective of the tools you’re using, you need precisely located and square joints. If you’re starting out in woodworking, these should be the first hand tools you buy.

Combination square

A combination square is indispensable for pencilling or knifing a line at 45° and 90°. It’s vital to get a good one, like those made by Starrett, because it will be accurate out of the box and it will stay that way.



The 12-in. Model is a workhorse, long enough to mark wide boards or across multiple pieces at once. It’s a good one to get first, but I’ve found a second, 6-in. Version is just as handy. Because of its small size, it fits better in your hand and is easier to use when laying out joints in tight places and across the end grain.

Marking knife

It would help if you also had a sharp marking knife. I’ve owned and used many different types, but the one I reach for time and again is a chip-carving knife. I like the blade’s double bevel, which lets me mark on either side of the blade.

 And the bevels extend the entire height of the blade (the cross-section is triangular), so I can rest the blade against the side of the workpiece and strike a line exactly adjacent to it. The blade also is long, thin, and stiff, so it fits in tight places without flexing.

Bevel gauge

Because it has a pivoting blade that can be locked into any angle, a bevel gauge is useful for transferring angles from plans to workpieces and setting tablesaw blade angles. Nevertheless, you'll perhaps use it first to lay out dovetails, a task it is perfect for. When buying a bevel gauge, look for two things: First, the blade should lock down firmly, so it doesn't move accidentally. Second, the nut used to lock it down shouldn't get in the way of using the gauge (a frequent issue with the wing nut used on some gauges).

Chapter 2 Joinery tools

Dovetails are the hallmark of craftsmanship, and the effort to cut them by hand is well worth it. However, even if you use power tools to cut all of your joinery, hand tools are still the best way to fine-tune the fit. In terms of hand-cut dovetails and tight-fitting tenons, I recommend a dovetail saw, a coping saw, a set of chisels, and a shoulder plane.

Dovetail saw

You have two choices for a dovetail saw: a Western backsaw or a Japanese pullsaw (dozuki). Japanese saws are a good place to start, because even the inexpensive ones are very sharp straight from the box.

Nonetheless, after 25 years of making furniture and using both types of saw, I can tell you that the pistol grip of Western backsaws positions your hand and arm for straighter cuts, so you will get more consistent and accurate results than from a dozuki. However don’t feel bad about buying the dozuki first. You’ll find plenty of uses for it, like cutting small parts and flush-trimming pegs.

Chisels

Begin with at least four: ¼ in., ⅜ in., ½ in. and ¾ in. The six-chisel Irwin Blue Chip set is a abundant value, with a ⅝-in. and a 1-in. chisel in addition to the other four. Steer away from chisels sized in millimeters; the first set I bought was metric and that was a error.

While their widths come close to their U.S. equivalents, they were far enough off to prove frustrating when squaring up mortises or cleaning out grooves made with fractional bits. Once you have the basic set, add a wide chisel (1½ in. to 2 in.) for paring and chamfering in tight spots.

Coping saw

There is no need to be dear about getting rid of the waste between pins and tails, so I use a coping saw to do it before paring to the baseline with a Chisel. You will save a huge amount of time compared to chopping away all of the waste with a chisel. In addition to cutting fast, coping saws also turn on a dime—unspoiled for maneuvering between pins or tails—and the inexpensive, replaceable blades mean you can always have a sharp one ready.

Shoulder plane

Regardless of how you cut joinery, you should have a shoulder plane, because nothing is better for fine-tuning joints for a faultless fit.


What makes this plane unique is that the blade extends the full width of the sole, so you can plane right into a corner. If you try to plane a tenon cheek with a block plane, you'll end up with a tapered tenon. Shoulder planes come in a range of widths from ½ in. to 1¼ in. wide, yet I find a wider plane is more versatile, handling broad tenon cheeks as well as narrow shoulders. Also, it has a ton of mass, which helps it stay flat on its sole and move with force when making cross-grain cuts.

Chapter 3 Tools for shaping and smoothing

A good finish starts with good exterior preparation, and hand tools are the fastest way to eliminate machine marks and tearout. The flat exteriors and crisp chamfers that handplanes create are impossible to replicate with a sander. A smoother and a block plane are the two planes to have. Add a card scraper to work really hard grain, and a spokeshave for cleaning up curved exteriors.

Block plane

For chamfering edges, leveling joints, and smoothing end grain, the block plane is indispensable. It also is perfect for paring the end grain on dovetails. Block planes are obtainable in standard and low angle models.

I recommend a low-angle plane with an adjustable throat. This allows you to take a fine cut with a small mouth, which helps to prevent tearout.

Card scraper

On woods with tricky grain, like tiger maple, or when you’ve got a small bit of tearout on an otherwise clean board, there’s no tool like a card scraper. Unlike a hand-plane, a scraper has no risk of tearout. Even when I hand-plane a exterior, I’ll often follow up with a card scraper to eliminate any imperfections.

Spokeshave

The spokeshave is perhaps the most overlooked tool in the shop. This odd-looking tool is essentially a short-soled handplane with handles on the side, rather than in front of and behind the blade. Nothing is faster at smoothing bandsawn curves. The tool is obtainable with a flat or curved sole, but I recommend the flat sole, as it works well even on concave exteriors.

Smoothing plane

At last we come to that most iconic hand tool, the bench plane. I fared well for many years using only sanders to smooth exteriors, though today I couldn't imagine being without a plane. You can go from machine marks to a glass-smooth exterior in just a few swipes. It's that rare instance in woodworking where the most enjoyable path is also the most efficient, and the results are superior to sanding. The size to start with is a No. 4. If you mill all your lumber with machines, you don't really need the flattening ability of a longer plane. The easiest path to making shavings is to buy a good-quality new plane—Lie-Nielsen and Veritas are proven merchandises. An old plane, like a venerable Stanley Bailey, offers good quality at an initial savings, but requires some tune-up work and perhaps a new replacement blade. Irrespective of the plane you buy, it has to be razor sharp. Even the most expensive plane is nothing but a paperweight if it's dull.

Chapter 4 Essential handsaws

I frequently use some handsaws in my woodshop, not because I’m a hand-tool enthusiast but because a handsaw is repeatedly the smartest, most effective choice for the job at hand. Just think about crosscutting or mitering subtle moldings and miter keys. You can do those tasks at the tablesaw or miter saw, nonetheless you’d need to devise a jig to hold the workpiece throughout the cut, and there’s no assurance that the spinning blade won’t chew up the project. It’s faster, safer, and cleaner to make the cut with a backsaw. Handsaws are excellent for getting into tight spaces also. A coping saw is the best tool to cut out the waste between dovetails. The thin blade is able to fit into even the snuggest pin socket and make a turn along the baseline, eliminating the waste in flashes. Slicing out waste with a chisel takes much lengthier, and routing it out is likely only when there’s enough clearance between the tails to fit the bit. Also then there are jobs that a power tool just couldn’t (or shouldn’t) do, like cutting pegs flush. The only power-tool choice is a router, and you have to make an auxiliary base to increase the router and then dial in the bit’s cut depth so that it doesn’t ruin the outside. Not to mention that pegs are frequently used on thin parts, like legs, where the router can tip and ruin the slice. There are loads of handsaws out there, but I think those you need most are a dovetail saw, a backsaw set up for crosscuts, a dozuki, and a coping saw.

Dovetail saw

I purchased my dovetail saw to make hand-cut dovetails, yet over the years I’ve found that it’s good for other tasks as well, such as notching a shelf or drawer divider to fit in a stopped dado cut in a case cross. For an even cut, I’d endorse a saw with about 19 teeth per inch (tpi), sharpened for a ripcut. Western-style saws cut on the push stroke and come with two diverse handle styles; straight or pistol grip. I favour a pistol-grip handle, which makes it stress-free to push the saw and regulate the cut.

How to start the cut

Once cutting a line with a marking gauge or a knife, put the nail of your forefinger and thumb into it, put the saw's teeth against the nails, and push gently.

Crosscut saw

Once you're making cabinets, there are always small parts, such as moldings, drawer stops, pulls, and pegs that require to be cut to length. As an alternative of using a tablesaw, which could terminate those delicate parts in a flash, I use a carcass backsaw. A crosscut saw with about 12 to 14 tpi and a blade that's a bit longer and taller than on a dovetail saw can solely make accurate, clean cuts in parts up to 1 in. thick and 3 in. to 4 in. wide. To upsurge exactness, I use the saw with a sawhook, which is just a flat board with a square fence. The hook is excellent because it gives you a way to hold the project still throughout the cut and aids to keep the saw cutting square and straight.

How to cut a clean shoulder

A crosscut backsaw is faultless for getting rid of the waste in the half sockets on the edges of a tail board. For the best results, chisel an angled groove along the scribed baseline and use the vertical wall of the groove to get the saw in progress. The groove supports to start the saw in a straight cut, therefore that as expected cuts down along the baseline, leaving no waste that requires paring.

Saw hook is great for small parts.

The saw cuts on the push stroke, that helps keep the part against the fence while you cut. A big fence with two kerfs in it; one at 45 and the other at 90° - increases the precision of your cuts and avoids tearout. Locate the kerfs so that the fence will support a venture on either side of each one.

Dozuki

A dozuki saw has a tinny, flexible blade, with sufficient teeth and a straight grip, which makes it well suited to flush-cutting pegs. The elastic tip helps it get close to the base of a pin, and the straight handle is cooler to hold and control with the saw on its side than a pistol grip. Get a crosscut dozuki with about 20 tpi. But why not just utilize a flush-cut saw? Well, their teeth have no set, therefore they clog and don't cut as great. Dozukis also don't have those concerns. The tinny blade can kink, thus get a saw with a throwaway blade.

While you saw, press down on the spine to keep the teeth away from the outside. Utilise a block plane or a chisel to flush the edging. Also using sandpaper halts scratches. Where the spine trick will not work, fold a small piece of sandpaper and place it under the blade to avert the teeth from marring the timber.

Coping saw

With its tinny blade and tall frame, the coping saw is skilful at cutting curls. It was utilised in the past to cope molding to get perfect miters. Yet I use it when cutting dovetails. I was trained to chop out all of the waste with a chisel—a dull job. Once I tried sawing out the waste with a coping saw, it was a great experience so I’ll never go back. It’s not essential to have an expensive frame, yet don’t go with the cheapest either. I spent about $30 on mine and it’s easy to adjust and tighten the blade. The grip is also at ease. As for blades, try to get the ones with a adequate cut. They cut gentler, which means that the saw is less likely to jump the kerf at the end of the cut and harm the pin or tail.

The saw cuts on the pull stroke, which puts the thin, narrow blade under tension so it will not buckle. In case you’ve found yourself at the lumberyard with numerous boards that are extremely long for your truck, you’ll like to having a panel saw. Transporting a circular saw and hoping to find an outlet is a hassle. Yet, leaving a panel saw (8 to 12 tpi) in the truck is not a problem. Lay the boards in the bed with the gate down, and cut them to fit. I also utilies a panel saw in the shop to cut a board to rough length once it’s too large for my chopsaw.

Backsaw

There’s no doubt that power tools like the tablesaw and router are efficient and put perfect joinery within the reach of even the newest woodworker. But that doesn’t mean you don’t need a backsaw. With a bit of practice a backsaw can become an extension of your arm, allowing you to make very accurate cuts rapidly. At that point, you’ll find that there are times when a backsaw is essentially a better option than a tablesaw or router, such as when you’re building one piece of furniture rather than numerous identical pieces at once. For a one-off table, you can cut tenons on the aprons with a backsaw as rapidly as you can with a tablesaw, because you don’t spend any time setting up the blade’s height, positioning a stop on your miter gauge, or dialing in the settings on your tenoning jig. A backsaw makes even better sense for hard joinery like angled tenons, where a tablesaw and routing jigs would require too many fussy setups. And there are parts, like bed rails, that are just too big to tenon on a tablesaw. Also, don’t forget that for many woodworkers, making furniture is as much about the journey as it is about the destination, and hand tools connect them to the act of creating a piece of furniture in a way that is more fulfilling than using power tools. Making furniture (and not just the furniture itself) becomes part of the reward. In any case, to get to the point where you can use a backsaw with efficiency and accuracy, you need to learn appropriate technique and then practice it. I’ll demonstrate how to cut straight, which is the most vital skill. I’ll also give you some tips on sawing the two most common joints: dovetails and tenons. One note before we get started. While Japanese saws are wonderful tools, I prefer Western backsaws for joinery. I find their pistol grip and D-shape handles are more comfortable and make it easier to control the saw. Also, in my involvement, Western saws are less prone to drift and deflect in use, because their blades are denser and stiffer than those on Japanese saws, which are intended to be pulled rather than pushed.

Sawing well is an activity for your entire body, from your feet and legs to your arms and hands. So, before you pick up a saw, take time to learn how to position your body. Your legs should be spread, one foot in front of the other, with knees somewhat bent. Your torso should be turned, too, so that your arm can move forward and back in a straight line. If you have to swing your arm around your body, you cannot saw straight. The distance between you and the workpiece is also critical. If you’re too far away or too close, your arm will curve and your cuts will, too. When you pick up the saw, hold it gently. And don't put any downward pressure on the saw as it cuts. A sharp saw—which yours should be—needs no more than its own weight to get the job done. In addition to having the right body mechanics, you also need a bench that's rigid, so it doesn't flex or deflect under use. And it should be heavy or bolted down, so it doesn't skip over the floor. It needs a vise and a saw hook for holding parts. And don't forget to have good lighting around the bench so you can see what you're doing.

How to set it all up

- To saw straight lines, the tool must move back and forth in a straight path, like a piston. If you align your body with the saw, that straight cut happens naturally.
- Grip the handle lightly with three fingers, your index finger pointing forward and your thumb wrapped around the back of the handle.
- For righties, the left foot goes out front.
- For lefties, it's the opposite.
- And your legs should be somewhat bent.
- Lastly, think of the saw as an extension of your hand, with a straight line running along the spine and through your hand, wrist, forearm, elbow, and shoulder, so they all work in harmony.

The best reason to get a backsaw is to cut dovetails and tenons by hand. Both involve a lot more cutting along the grain (ripcuts) than across it (crosscuts). So, when you get your first saw, select one that's sharpened for ripcuts. The secret to a great-cutting saw is a great sharpening job. That means a saw from the home center won't cut it. Instead, get one from one of the best saw manufacturers, who do this well. I've had good involvements with saws from Lie-Nielsen, Veritas, Bad Axe, Gramercy, Adria, and Wenzloff & Sons. Ripsaws come in a diversity of sizes. Don't get the dovetail size—they are too small for large dovetails in casework. Instead, get a carcase saw, which can handle tenons and case dovetails, as well as dovetails for drawers and smaller items like boxes. Your first backsaw should be around 11 in. to 12 in. long, have 14 ppi (points per inch), and 2 in. to 2-¼ in. of cutting depth beneath the spine. Don't worry about the crosscuts you'll have to make—a ripsaw works just fine for them. I've been using backsaws for decades and I don't own a crosscut saw. I've never had a issue with tearout or rough cuts. Nevertheless, if you are willing to spend a bit more, there's a new type of saw that handles both rip- and crosscuts extremely well. The teeth have an old-school shape (called a "hybrid cut") that lets them cut across the grain just as well as along it. Both Gramercy and Bad Axe make this type of saw.

How to use a basic technique

- The point of learning to saw is to cut joinery, but before you jump into dovetails or tenons, learn to cut a line straight and square to a board's face.
- That's the essential skill you'll need.
- Start on the far edge.
- Align the cut with your thumb.
- Without putting any weight on the saw, gently push it forward.
- It's easier to get just a few teeth started straight at the back edge than to get a straight start across the board's entire thickness.
- Lower the back of the saw as you cut deeper.

- After reaching the front edge, bring the saw horizontal and cut down to depth.
- Hold Steady It’s hard to saw fluidly and straight in a chattering board, a common event with cast-iron front vises, which only clamp a board on one edge.
- To eliminate vibration, clamp the board’s other edge to the bench.
- Repetition of good technique is the key to good joinery because it creates muscle memory.
- Don’t worry about complete joints at first.
- Instead, spend time practicing the individual cuts that make up a tail and pin.

Tails

- Repetition should simulate the real thing.
- Lay out both sides of the tail on the same board.
- For the cuts right of center, always cut to the right (waste side) of the layout line as you would on real dovetails.
- On the left side, do the opposite.

Pins

- Same goes for pins.
- Lay out both angles on the same board and cut to the right of the line on the right half and the left of the line on the left half.
- Line up your body with the angled cuts.
- Shoulder and cheek cuts are straight but big, and there’s a strategy for handling each one.
- Shoulder cuts are first.

- The cheeks follow.

How to practice the 2 basic cuts

- It takes crosscuts and ripcuts to make a tenon.
- Practice them separately.
- Here's the drill for shoulders.
- Use a saw hook and your off hand to keep the board still.
- To get used to cutting down to a horizontal line, mark the depth on both edges.
- Long cuts for cheeks.
- It's vital that the depth of your test cuts replicate what you'll do for tenons, so they should be 1-½ in. to 2 in. deep.

How to cut clean shoulders

- Shoulder cuts are tricky because aprons and rails can be numerous inches wide.
- It's hard to track a straight cut across that distance.
- Make a track.
- After cutting your layout lines with a knife or marking gauge, use a chisel to create a V-groove along the shoulder line.
- You'll get a clean shoulder that will keep the saw cutting straight down.
- Shoulder tracks the saw.
- Set the teeth in the V-groove, against the shoulder.
- Lower the blade until it rests in the groove across the board's entire width before you begin to cut.

- Let the saw do the work.
- There is no need to put any downward pressure on the saw.
- Its own weight is enough.
- The teeth will cut without any resistance or catching.

Steps to great cheeks

- This technique lets you cut along just one layout line at a time, with each new cut guided by the previous one.
- Across the end grain.
- Make a shallow kerf, starting at the far corner.
- You'll use it as a guide to keep the saw straight as you continue.
- Work down the near edge.
- Angle the saw up and cut down the layout line closest to you.
- Cut down the other edge.
- Turn the board around in the vise and make another angled cut.
- Level out and finish the job.
- All that's left now is a triangle of waste, but you have three straight kerfs to guide the saw as you cut down the middle.

Chapter 5 Essential handplanes

Every woodshop—even one that relies heavily on power tools—needs handplanes. For some tasks, such as smoothing a exterior or fitting a joint perfectly, handplanes fine-tune work that was begun on a machine. In other instances, they handle jobs that machines can't do as rapidly or nimbly. Handplanes are quiet, safe, and clean. They encourage working at a slower pace that is less prone to errors. And did I mention pleasure? The swish of a plane across a outside and the smell of fresh shavings are reason enough to pick up a handplane. To gain these rewards, though, you first have to spend some effort in learning to handle the tools and, most vitally, in learning to keep them sharp. The planes on this list are tools that I use day after day. Many do a variety of things very well; a few are the best tools for specialized tasks. I've listed them in rough order of importance.

Bench plane

Best for: Flattening and smoothing exteriors

These models feature unbreakable castings and thick alloy blades good for chatter-free cutting. If you have just one plane in your shop, ensure it's a No. 4 bench plane. I utlize mine all the time to flatten and smooth exteriors or to joint and trim edges in ways that power tools and sandpaper can not. In case you're fitting a drawer front, for instance, the plane lets you dial it in cautiously, one 0.001-in.- thick shaving at a time. In similarity, a single error on the tablesaw can condense the workpiece unusable. You'll also find that, with practice, you can use a No. 4 to smooth a fairly large drawer face with a few passes in less than a minute. Nothing like a sander, the plane leaves a smooth exterior that has deep clarity and is flat right to the edges. The No. 4 also is great for cutting bevels in a profiled edge and does a reputable job smoothing end grain, like that on the edge of a tabletop. It also works well for shaping convex curves such as a bowed drawer front. The key to the No. 4's versatility lies in its middle-of-the-road size. It takes a two-handed grip that delivers enough power to flatten and smooth large parts, yet it's small enough to use in tight places or for more subtle work. The blade can be accustomed to take a coarse shaving, or a very fine one that leaves a attractively smooth exterior. You can tackle both tasks with a single No. 4 plane by opening the throat wide for the rough work, then narrowing the opening for the smoothing passes. For some No. 4s with a "Bedrock" frog, this adjustment takes 15 seconds; with others, the blade must be removed to regulate the frog forward and tighten the mouth.

Adjustable block plane

Best for: Shaping curves and chamfers, smoothing small exteriors, trimming dovetails, and cutting end grain.

Stanley continues to make the classic 60½. This plane, patterned after the Stanley No. 60½ is another tool to keep within easy reach. Like the No. 4, it can be adjusted for rough or fine work, and it does a multitude of things well. I like this plane for the precise trimming of small exteriors, such as where stile and rail meet on a frame. In similar fashion, I keep the No. 60½ handy when sizing small parts because it can take fine shavings from edges too narrow for For these reasons, the 60½ is perfect for the very exact business of sizing inlays and trimming them flush after glue-up, where the grain might be going in many directions. For the smoothest cutting in these situations, you need a plane with a throat that can be adjusted to the thickness of a piece of thin paper. The block plane is also the best tool for trimming dovetail pins flush after glue-up. Because the plane cuts at a low angle, much like a paring chisel, it is ideal for cutting end grain smoothly. This plane is also great for shaping wood, giving you great flexibility when cutting tapered chamfers or rounded edges. In contrast to a router setup, the block plane lets you refine or alter a profile simply as you go.

Jointer

Best for: Jointing edges of any length, flattening large exteriors.

I rely on the mechanical jointer in my shop every day, but I wouldn’t be without my jointer plane. The No. 7 is ideal for jointing edges on boards that are too long, heavy, or awkward to handle on the jointer. I often use it to clean up machine-jointed edges, especially those that will be glued. This is because jointer knives that are somewhat dull or improperly set can create a scalloped exterior that leaves gaps in the glueline. And that could mean a glueline that shows or a joint that fails. The No. 7 perfectly trues the edge and cuts a clean glue exterior. I also can use the plane to make an edge somewhat concave along its length for a sprung joint. This plane and its beefier sibling, the No. 8, also are hefty and long enough to make quick work of flattening large exteriors or cutting a set of tapered legs dead straight. The long sole bridges valleys that a No. 4 would follow, making the jointer plane a better choice for flattening. The accuracy of a jointer plane depends on a sole that is flat from end to end. These planes cost more to make and Therefore are considerably more expensive than a No. 4. Otherwise, look for the same basic characteristics: comfortable handles, a thick blade, and easy throat adjustment.

Shoulder plane

Best for: Truing up tenon shoulders and trimming tenon cheeks.

I like to say that a perfectly fitted mortise-and-tenon joint looks like it grew together. Even with precise tablesaw tenoning jigs and hollow-chisel mortisers, though, it’s hard to get this sort of fit straight from the machines. So many things can prevent a joint from fitting perfectly. A tablesaw blade, even with stabilizers, can wobble and cut a shoulder that’s not perfectly straight. Or you could wobble when cutting the cheeks (even using a jig). You might have a joint ever so somewhat out of square in either plane, in which case one shoulder hits before the other or the bottom hits before the top. The longer the shoulder (breadboard ends being the extreme), the more likely or more obvious the issues. The shoulder plane fixes these slight imperfections, leaving you with a perfectly fitting joint. It can take a fine shaving precisely where you need it, whether on a shoulder or cheek. For somewhat angled joints, a shoulder plane is safer than trying to use jigs, where it is very easy to get something backward and cut at the wrong angle. I regularly use my Stanley No. 93 for adjusting rabbets cut by machine, such as on the meeting rails of two cabinet doors or when fitting a rabbeted panel. It also works respectably across the grain in other situations, such as sizing the bottom of a wide dado.

Smoothing plane

Best for: Cutting a smooth, highly polished exterior that is ready for a finish.

Vintage Norris or Spiers infill smoothers can be found. Sauer and Steiner make infill planes superior to many originals. Woodworkers smooth lots of exteriors. A smoothing plane is amazingly efficient at this, cutting flat exteriors so polished they shine with deep clarity. A No. 4 is an OK smoother, but it is a little light for really hard grain. It’s more efficient to have a plane dedicated to smoothing. It should have some mass, a super-fine throat, and a solidly supported, thick blade. That No. 4 is still very useful as a presmoother, flattening a exterior and doing the bulk of the work. That way, the smoothing plane need cut just a few gossamer shavings and stays at peak sharpness longer. A good smoother may be the most expensive plane on this list, but it's worth it. Among the best designs are heavy British planes such as those made by Norris and Spiers, with steel bodies infilled with dense rosewood, and very thick blades. A number of contemporary types are obtainable, some better than the originals. The heavy body and wide blade of the No. 4½ make it a very good smoother, especially with a 50° cutting angle (frog). Length is not vital for a smoother, but some like the mass of a No. 7, No. 6, or No. 5½ for this work.

Spokeshave

Best for: Shaping, smoothing, and refining curves.

For the most part, all of the planes listed so far work well to make wood flat, smooth, and square. But what about curves? For shaping or smoothing curves, nothing beats a spokeshave. The spokeshave, with its narrow sole and winglike handles, doesn't look like a handplane, but it works like one. It holds a rather wide iron at a fixed angle and depth. It registers the cut against a sole, and it takes a shaving. The spokeshave's long handles and narrow sole are ideal for steering around curves and working into tight places. They help maintain a consistent angle simply when cutting chamfers where a block plane won't reach, such as along a concave curve. The narrow sole allows the tool to work both inside and outside curves. Soles come in a diversity of shapes, including rounded for tighter curves. The spokeshave is a great tool for shaping the profile on the edge of a curved tabletop or an arched apron, or for smoothing the bandsawn profile of a cabriole leg.

A Second block plane

Best for: Roughing out curves, wide bevels, or straightforward molding profiles.

If you already have a No. 60½ tuned for precise work, you'll find you can work more rapidly if you set up a second block plane to make coarser cuts. Having twin block planes ensures that each is tuned precisely the way I want it for the work and spares me the hassle and variation of adjusting a single plane back and forth. I use this second plane to rough out a wide chamfer or bevel, or to shape a bullnose profile for a cabinet molding. The plane offers good control despite making aggressive cuts. I also use my second block plane, set for a light cut, to eliminate freshly dried glue from a panel, a far safer bet than risking tearout by scraping it off.

Small router plane

Best for: Cutting and cleaning up small grooves, cleaning up hinge mortises.

It offers a ¼-in. blade as well as pointed- and square-tipped 3 /32 -in. blades for inlay work. When working on just a few parts, I often find that to set up a machine to do 100% of a task takes far more time (what with test cuts and jigs) than to do 95% of the job rapidly and the rest by hand. A stopped groove for a box bottom is a good example. I can set up a tablesaw with a dado blade in a minute, but it leaves curved ends to be cleaned out. A small router plane is just the tool, with its right-angled blade projecting the sole and working as a paring chisel. The blade can be locked to cut consistently at any depth. For a long time this was a shopmade tool, with a straightforward wooden body and a bent chisel blade. The No. 271 router plane, the pint-sized sibling to the No. 71 router plane, is one of those planes that can make your life a lot easier. It can work in a groove or dado as narrow as ¼ in. wide, and it can work along a curve as simply as a flat exterior. For leveling the bottom of an inlay recess, a router plane is far easier to use than a chisel, and less apt to damage the walls. It’s also useful for installing drawer locks that mortise into the back of the face, and for cutting hinge mortises at a consistent depth. The No. 271 is worth having for cleaning up stopped dadoes and sliding dovetails alone.

Chapter 6 Tips for handplaning

The smoothing plane is the greatest tool in my woodshop, and I reach for it frequently. A sharp smoothing plane accurately shaves the outside of a board, making a glass-smooth sheen that highlights the wood's figure while leaving a dead flat exterior awaken. For most furniture fragments, a handplaned exterior is great for the finishing. Yet, not all woodworkers have victory with thisgreat tool. Those who purchase a smoothing plane have many issues getting great results that they set the tool on a shelf, and it becomes a dusty spectator in the woodshop. Problems happen for three main reasons:

- The tool is out of tune,
- The blade is not sharp,
- Being used incorrectly.

For space motives, we will take on a handplane is in good working order with a blade that is extreamly sharp.

How to install the chipbreaker and blade

- The first task is to comprehend the parts of the plane and to guarantee they are assembled appropriately.
- Mounted on top of the blade, the chipbreaker glances shavings up and out of the plane.
- The initial phase in setting up the plane is to lock the chipbreaker to the blade.
- Place the assembly on the frog then lock it with the lever cap.
- After that, you must set the tension on the lever cap to hold the blade assembly in place while tolerating for blade regulations.

How to open the mouth

- As the plane cuts, shavings pass through an opening in the sole called the mouth.
- How wide you open the mouth hinge on how thick you want the shavings.
- Heavier cuts need a larger opening, while lighter cuts need a smaller one.
- To adjust the mouth opening, advance the blade until it barely projects through the plane’s mouth.
- Then move the frog forward or backward until you get the desired mouth opening.
- The bedrock-style frog offered by Stanley, Lie-Nielsen, and Clifton makes these adjustments convenient.
- Merely loosen the two side screws at the rear of the frog, and then use the central adjusting screw to move the frog to open or close the mouth.
- When set, tighten the side screws to lock the frog in place.
- The Bailey pattern planes necessitate the blade to be eliminated to access the frog screws, making the adjustments a little less suitable.

How to adjust the blade

- With the mouth opening set, it’s time to alter the blade laterally and to fine-tune the depth of cut.
- Begin with adjusting the blade laterally so that the shaving is coming through the mouth in the center.
- Now set the depth of cut by advancing the blade.
- Intend for a shaving about 0.001 in. to 0.002 in. thick that’s near full width and tapers to nothing at its edges.

- A cut is too heavy if it causes excessive strain on the user, causes the plane to jump and chatter, or leaves unsightly plane tracks on the exterior.
- If the cut is too heavy, lighten it by rotating the adjustment knob counter clockwise.
- After raising the blade in this manner, eliminate the backlash, or slop, from the plane's regulating instrument.
- Rotating the knob clockwise until it is snug does it.
- Eliminating backlash prevents the cut from changing as you plane.

How to install the blade correctly

- Secure the chipbreaker.
- Keep its leading edge somewhat inset from the front of the blade, and parallel to it.
- Set the mouth opening.
- Small screws allow you to adjust the mouth opening to accommodate heavy or light cuts.

How to plane correctly

- If you've struggled with your plane, it may surprise you to know that a handplane naturally wants to make exteriors flat and smooth.
- But to get there, you need to pay attention to your grip, stance, and planing motion—all at the same time.
- Secure the board to the bench.
- Be sure the grain is oriented in the direction you wish to plane.
- The best way to hold the board is with the benchdogs on a cabinetmaker's bench.
- Do this by opening the tail vise, placing the board

between the dogs, and closing the vise to clamp the board.

- Do not overtighten the vise because this will bow the board upward.
- Complete the clamping procedure by tapping each dog somewhat downward with a hammer.
- This draws the board firmly against the bench.
- Alternatively, a planing stop, which is basically a wood strip that is secured across the width of your bench, will do the trick.
- Power through the cut.
- Once the board is secured, grasp the plane by the tote (the rear handle) and the knob.
- Use a three-fingered grasp on the tote with the index finger pointing forward.
- Hold the knob in a way that feels comfortable.
- Some utilise a fingertip grasp, while some hold it in the palm of their hand.
- I also endorse skewing the plane during the cut.
- Skewing lowers the blade’s cutting angle, plummeting resistance and helping to eliminate chatter, which is particularly useful on unruly grain.
- A skewed plane is also the most natural and contented way to hold the instrument.
- Because your stance is in a somewhat forward position, it’s uncooperative to align your hands one in front of the other.
- It is far more natural to have them spread apart, side to side.
- Use your entire body to drive the plane.
- At the start of the cut, focus pressure on the knob to counter the natural leaning of your hands to rock the plane as it come across the board.

- At that moment handover pressure to both the knob and tote in the same way.
- As you exit the cut, put more pressure on the tote and ease up on the knob.
- On the return stroke, it’s ok to maintain contact with the board, but tilt the plane somewhat on edge so as not to add needless wear to the cutting edge.
- Carry on planing end to end, working from the near edge to the far edge with reliable, overlapping passes.
- It is a lot like mowing the lawn, but far more pleasant.
- Repeat the pattern until all the mill marks and snipe are eliminated, leaving a exterior prepared for finishing.
- Dial in the depth of cut retract and rotate.
- With the blade retracted fully, move the plane across a flat board, slowly advancing the blade with the depth-of-cut knob.
- Halt when the blade contacts the board.
- Watch the shaving.
- Make a short pass, looking at where the shaving is coming up through the mouth.
- The shaving is leaning to the left or right.
- Move it to the center.
- Swing the lateral lever to bring the shaving closer to the center.
- In case the shaving comes out on the left, move the adjuster to the left.
- Do the opposite if the shaving is on the right.
- You’re accomplished with lateral adjustments when you have the shaving centered.

Adjusting lateral

- Move the lever toward the heavy side of the cut to bring the shaving to the center.
- Now move forward.
- Advance the blade until you’re cutting a gossamer-thin, near full-width shaving that tapers to nothing at its edges.
- Now you’re ready for the real work.
- Use Your Whole Body to Push the Plane

Power up

- For stability and power, stand with your legs comfortably spread apart and your feet facing forward.
- Lean somewhat forward, and put firm, downward pressure on the knob as you begin the cut.

Full contact

- Once the plane’s sole is completely on the board, apply pressure equally to both the tote and knob.
- Skewing the plane will decrease resistance and help eliminate chatter.
- Be sure to maintain your wide stance and use your body to drive the tool forward.

Exit strategy

- As you exit the board, ease up on the knob and focus pressure more on the tote.
- Continue working across the board using consistent, overlapping passes.

Resolutions to common issues

A smoothing plane is not a complicated tool, so it’s pretty easy to diagnose and cure the most common ills. By the way, none of these solutions will work if the blade isn’t sharp.

- Issue: When your plane stutters or skips through a cut, it’s called chatter. The issue often leaves a rippled exterior, but you typically can feel it happening as you plane.
- Solution: Take a lighter cut; put more pressure on the knob as you power into the cut; increase the angle of skew; resharpen the blade.

- Issue: Sometimes a plane stops cutting, even after successful passes.
- Solution: Confirm for a clogged mouth; advance the blade to take a heavier cut; inspect the chipbreaker for poor contact with the blade; resharpen the blade.

- Issue: Tearout is one of the most common issues associated with planing. Instead of shaving the wood cleanly, the iron pulls up the wood fibers, leaving a fuzzy, rough exterior.
- Solution: Take a lighter cut; change planing direction; plane straight on (don’t skew the plane); resharpen the blade.

- Issue: A plane is supposed to leave a smooth, flat exterior in its wake. But a plane that’s not set up right can make tracks, or ridges, in the exterior.
- Solution: Readjust the blade laterally; take a lighter cut; when resharpening the blade, push down on the curves to

relieve them somewhat, creating a cambered edge.

Chapter 7 How to use the Card Scraper

From all the tools in my woodshop, my favorite is the basic card scraper. It's a thin piece of steel that costs about five dollars, yet it greatly decreases my least favorite part of woodworking which is sanding. The scraper cleans up tool and milling marks, smooths exteriors and levels glue-ups. It eliminates material as efficiently as sandpaper but doesn't leave scratches in its wake. A scraper is at ease to control than a handplane and can exterior tricky grain where even a well tuned plane does more harm than good. Tuning a card scraper is rather easy using only a mill file, sandpaper, and a screwdriver. Using a card scraper takes practice, but only a little. In a very short time, you'll be able to cut constant shavings akin to those you get with a handplane.

New scrapers need a tune-up, and you'll have to repeat it from time to time, but the good news is that the procedure only takes three or four minutes. First, file the long edges flat and square to the faces of the scraper. You can clamp the scraper in a vise and work the edge freehand with a standard mill file, or lay the file flat on the bench and work the scraper across it. Take full-length strokes until you feel and hear the file cut continuously. Then, flatten the scraper's faces. Use a flat sharpening stone or 180-grit wet-or-dry sandpaper attached to a flat exterior. Do not work the entire face, just the leading ½ in. or so. Utilise all eight fingers to apply even pressure, and work until you see a smooth exterior with fresh steel exposed all the way to the edge. Then move to 320-grit paper to achieve a cleaner exterior. In case I'm trying to achieve a very fine, finish cut, I sometimes move on to 400 or even 600 grit. These filing and flattening steps build up a "wire edge" of thin and brittle waste material that must be eliminated. To do this, hold the face of the scraper at 90° to the stone or sandpaper and work the edge using graceful pressure. It’s easier to maintain the 90° angle if you skew the scraper. After a few strokes, the wire edge should fall off. If not, give the faces of the scraper a few passes across the sandpaper.

To create a tough burr for cutting wood, you need a burnisher—a rod of highly polished steel that is harder than the soft steel in the scraper. I’ve owned numerous commercially made burnishers over the years and they all worked fine. My favorite now is an old screwdriver. Creating a burr begins with the scraper flat on the edge of the bench. Hold the burnisher flat against the face while pushing it away from you for numerous strokes along the length of the edge. Concentrate downward pressure on the cutting edge to draw out the burr. Some woodworkers like to angle the burnisher down on the edge, but this angle should be very slight, only a degree or so. Work until you feel a slight burr when you cautiously touch the edge with your fingertip. Draw the burr along each of the scraper’s four long edges. Now clamp the scraper upright in a bench vise with the edge to be burnished parallel to the benchtop. You can turn the burr with the burnisher held freehand or, to ensure a consistent angle, let the handle of the burnisher ride on the benchtop during each stroke. Following this second approach means that adjusting the scraper’s height in the vise will alter the burnishing angle and, as a result, the cutting angle of the completed burr. The steeper the angle, the more aggressive the cut, but any angle between 1° and 15° works well. Turning the burr should take only two or three passes. Once you feel a turned burr along the entire edge, test the cut. If you’re making only dust, burnish some more. Once you’re making shavings with both sides, you’re ready to start scraping.

A scraper can either be pushed or pulled. I typically push the scraper to make aggressive, somewhat concave cuts when removing tearout or smoothing tricky grain. For finer cuts, I pull the scraper to flatten any dished areas and leave a exterior ready for finishing. To push the scraper, hold it with your fingers on the short edges and your thumbs together in the middle of the back, about ½ in. or so above the cutting edge. Use your thumbs to create a slight bow along the bottom edge. The deeper the bow, the more aggressive the cut. Conventional wisdom says to start by holding the scraper vertically and angling it forward until you feel the burr bite into the wood. It works, but in my involvement, it's easier for beginners to start with the scraper held at about 60° and, while pushing, slowly increase the angle until the burr begins to cut the wood. Then push forward in one smooth motion to get continuous, paper-thin shavings. To pull the scraper, place your fingers on the far side and your thumbs on the face closest to you. Unlike when pushing, your thumbs should be situated higher on the face of the scraper and your fingers lower. A pulled scraper is held with the edge bowed only enough to prevent the curves from digging into the wood. Some woodworkers avoid this issue by rounding the curves with a file or grinder.

In my shop, a card scraper touches virtually every exterior of a project, and is almost always the last tool to do so before the finish goes on. If I'm working simply planed, straight-grained stock, I typically clean up jointer and planer marks on larger exteriors with a handplane, then use the scraper to eliminate plane tracks and clean up tearout. To ensure a uniform appearance under a finish, I give all the exteriors at least a light scraping. In general, I scrape the entire exterior using a push stroke, then flatten the somewhat dished area using a pull stroke. For stock with trickier grain, such as bird's-eye or burl, I skip handplaning altogether. A scraper is much easier to control than a handplane, and there is almost no chance of tearout. In any case, if the milling marks are especially heavy, I typically start by power sanding to 120 grit. I prefer the way a scraped exterior looks under a finish, so at this point I thoroughly brush or vacuum away the sanding dust and scrape until the entire exterior is uniform.

A dull scraper takes more effort to push and a steeper cutting angle. It also creates dust instead of wide shavings. Fortunately, it’s possible to restore the burr numerous times simply by reburnishing the face and then the edge in the same way you initially turned the burr. After four to six burnishings, the metal becomes brittle and you need a new exterior. Return the scraper to the vise and start over with a file, removing any nicks along the edge that you’ve created by scraping. Then burnish the faces and edges to draw and turn new burrs. Because each tune-up eliminates so little steel, I still use the first scraper I bought a dozen years ago. Sandpaper, nevertheless, typically wears out in minutes.

Chapter 8 How to use cabinet scrapers and scraper planes

Once bench planes begin to tear out tricky grain or balk at tough woods, many woodworkers reach for a card scraper. Yet, that isn’t always the best choice. Often, especially on large, flat exteriors, the job can be done easier, faster, and better by using one of the card scraper’s larger, lesser-known brothers: the cabinet scraper and the scraper plane. I use all three scrapers in my shop, because each one has its place. Once you understand what they can do for you, what they cost, and how to use them, you can decide for yourself whether to add one or more to your tool cabinet.

As it’s held in both hands with finger pressure somewhat flexing the steel, a card scraper lets you make light to moderate cuts depending on how it is held and engaged with the wood exterior. The scraper can be pulled or pushed. To make cutting easier, I occasionally create a shearing cut by holding the scraper about 30° to the direction of travel. As valuable as a card scraper is, though, it has noteworthy boundaries. It is not an aggressive tool, so it won’t eliminate a lot of material rapidly. It cuts with a lot of resistance and, subsequently, the cutting edge dulls fairly rapidly. Largely, though, the card scraper is uncomfortable to hold because your hands are always in contact with sharp curves. After that, it creates a lot of friction as it cuts, so the steel can get hot to the touch within minutes. And because it lacks a flat sole to maintain a consistent cutting depth, you have to work cautiously to avoid creating shallow dips and valleys. So, I use a card scraper chiefly to smooth smaller exteriors, naturally under 18 in. sq. By the time my fingers are hot and my hands are tiring, the work is complete.

Compared to the card scraper, the cabinet scraper is considerably more comfortable to use, even over extended time periods. The handles provide a place for the hands, and because fingers never touch the blade, heat is a nonissue. Plus, a cabinet scraper is more likely to maintain a flat, even exterior because its sole helps regulate and control the depth of cut. The sole also makes it easy to start and finish cuts on the edges of panels. And a thumbscrew at the center of the scraper keeps the blade flexed for you. Versatile and easy to use - The cabinet scraper excels at removing mill marks from board edges. Its sole provides the control required to ensure that a board edge stays true as it is worked. I typically use a cabinet scraper when the exterior gets into the 18-in.-sq. to 36-in.-sq. range, such as a tabletop or panel. You can use one on even larger exteriors with good results, though that is where I turn to the scraper plane, which I'll cover shortly. In use, I typically push the tool, but it cuts just as well when pulled. Like a card scraper, a cabinet scraper generally cuts better when skewed to about 30°.

Differences between planing and scraping

Whenever I'm working to smooth a rather straight-grained wood, my tool of choice is a handplane. In my opinion, there's no better way to prepare a wood exterior for a finish. But wood is not always straight-grained. Sometimes grain is wavy, curly, bird's eye, or has some other form of general nonconformity. I often use such wood for panels and tabletops, as it's a sure way to add a dramatic look to a furniture piece. As you might expect, wild grain—with wood fibers going up, down, and sideways at all angles—can be hard to smooth. No matter how well the blade is sharpened, or how light a cut you make, a handplane tends to tear grain that runs helter-skelter. That's when I skip the plane and use a scraper. Contrary to the names, card scrapers, cabinet scrapers, and scraper blades don't scrape— they cut. Sharpened and properly tuned, they can develop a pile of shavings. A couple of factors enable them to smooth wood without tearing the wood fiber. First, scrapers meet the wood at a steep cutting angle. That means it’s almost impossible for the steel to get under the wood and lift and pry the fibers. Second, as a scraper cuts, the wood chip breaks immediately. That way, a long chip can’t peel back, only to eventually break and create a noticeable tear.

Different ways to sharpen the blade

You have two options when it comes to sharpening a cabinet scraper. You can sharpen it as you would a card scraper, with its edges filed at a right angle to its face and a small burr, or hook, burnished onto each of its cutting edges. I find that cabinet scrapers work very well with this configuration. They are easy to sharpen, and, like on a card scraper, you get two working burrs along each edge. To sharpen a blade to 90°, I start by securing it in a vise. Then, I use an 8-in. bastard file to create a flat, straight edge. As I push the file, I try to keep it at a right angle to the face exteriors of the blade. Three or four strokes typically are enough to get the job done. Then, with the blade still in the vise, I use a fine-grit, flat slipstone to smooth each side of the scraper at the filed edge. Once the edge is prepared, I’m ready to use a burnisher to form the cutting burr. The second approach is to sharpen the scraper edge with a 45° bevel. This technique develops a more aggressive cutting edge, useful if you want to eliminate material faster. For instance, if a thickness planer develops some fairly heavy tearout, I’d use the 45° edge to speed up the procedure of thinning the stock until the tearout disappeared.

How to set up a cabinet scraper

Place the freshly sharpened blade into the body of the scraper. To establish the blade extension, place one or two pieces of paper on a flat exterior. Then, to elevate the sole ever so somewhat, place the front of the sole on the paper. Press the blade down against the flat exterior while tightening the thumbscrews to secure the blade. This step sets the blade extension to match the thickness of the paper, typically about 0.004 in. per sheet. Then, turn the scraper over and sight down the bottom of the sole. The cutting edge of the blade should be parallel to the sole. If it isn't, lightly tap the side of the blade with a hammer until it is. Lastly, turn the thumbscrews that flex the blade until the blade has a very slight (about 0.002 in. to 0.003 in.) crown. The scraper is now ready to go to work.

Finest scraper plane choice for large exteriors

All the scraper planes on the market are patterned after the Stanley No. 112, a tool that was advanced in 1874. Like the original 112, the new scraper planes have a pivoting lever-cap and thumbscrew that clamp the blade to the frog. The frog is adjustable from zero to 25°, making it easy to dial in the cutting angle of the plane. This adjustment is critical, as the scraper's cutting angle needs to work in harmony with the angle of the burr on the scraper's edge. The pivoting frog also regulates the depth of cut.

Use it like a handplane

Handle the tool just as you would a bench plane. I find that a light touch, with a smooth, steady stroke, develops the best results. Just as with a bench plane, start the cut with pressure on the front knob. As the cut proceeds, equalize the pressure on the knob and the rear handle. Then, upon completing the pass, shift your weight to the rear handle.

How to select a scraper plane

Of the scraper planes on the market, the one made by Veritas (www.leevalley.com) is the only one with an adjustment screw that lets you flex the 0.055-in.-thick blade to develop a slight camber, a feature that makes it less likely that you'll dig into the wood and also gives a very smooth cutting action. On the other models, I keep dig-ins under control by rounding the curves of the blade to about a 1 /16 -in. radius.

How to sharpen a scraper plane

The 45° bevel can be created with a file, but I get the best results by "grinding" the edge with sandpaper. First I use spray adhesive to mount 120-grit sandpaper to a flat exterior such as a chunk of granite or a piece of plate glass. Then I mount the blade in a Veritas Mark II honing guide (the only guide I've found that can hold a thin, wide scraper blade without causing distortion). With the guide set to create a 45° bevel, I roll it back and forth until the bevel is formed. With the blade still in the jig, I hone the beveled edge on a 1,000-grit waterstone. Then I use a 6,000-grit stone to polish the edge. After honing the edge, I form the cutting burr using a burnisher.

How to set it up

- When setting up a scraper plane, the first thing to do is tilt the adjustable frog 15° forward.
- Then set the plane on a flat benchtop and insert the blade into the plane with its bevel facing toward the back.
- With the blade resting on the benchtop, clamp the blade in place by tensioning the thumbscrew.
- Then, to extend the blade somewhat from the sole, move the frog forward somewhat.

- This is done by backing the rear locking nut a quarter-turn off the post and tightening the front nut up against the post.
- Test the cut on a flat piece of wood and make depth adjustments accordingly.
- If the blade isn't parallel to the sole, you will feel the plane turning sideways as it cuts.
- If this occurs, make lateral adjustments by tapping the side of the blade with a hammer.
- A scraper plane works best when set for a light cut.
- That said, it should develop a nice, wide shaving, not dust.
- If your scraper is not cutting shavings, adjust the frog angle so that it is working in harmony with the burr you have created on the blade's edge.
- To find the best angle, eliminate the blade from the plane and make a pass or two while holding it like a card scraper.
- Find the angle at which the blade best engages the stock, then adjust the scraper frog to that angle, reinstall the blade, advance it somewhat, and take another test cut.
- After using the scraper plane for a while, the blade will dull and the cut will be lighter and less efficient.
- Tilt the frog forward a degree or so to reengage the blade.
- Wood with uneven grain is an inevitable part of woodworking.
- Short of sanding forever, the then best option is to use a tool from the scraper family.
- You'll end up with a smoother board, in less time, with less dust.
- That's a rare win-win situation.

Supplementary tips for setting it up

- Set the cutting depth. A sheet of paper and a flat exterior are all you need to set the depth of cut.
- Set the blade flex. Tighten the thumbscrew to flex the blade about 0.002 in. to 0.003 in.
- Start flat. The scraper cuts with less effort when at about 30° to the direction of travel. To start a cut at an edge, add pressure to the forward handle so that extra force is applied to the front of the sole. As the sole slides onto the stock, shift the hand pressure so that both handles end up with downward force.
- Finish flat. As the sole of the cabinet scraper begins to extend over the end of the board, decrease pressure on the forward handle while maintaining pressure on the trailing handle. Finish the cut with full pressure on the back handle.
- Keep the edges flat. When scraping close to the edge of a board, allow the sole to overhang only somewhat, keeping most of it on the board. That way the cabinet scraper can’t tip and give the exterior an unwanted taper.

Scraper Plane

The scraper plane has some advantages over a cabinet scraper. First, it’s secured to a cast-iron, plane-like body with a generous sole that helps ensure that the board exterior stays flat and true. Also, the angle of the blade and the depth of cut can be adjusted precisely. The handle and knob provide extra comfort and control. Pivoting the frog adjusts the angle of the blade and the depth of cut.

Supplementary tips on how to set it up and use it

- Load and lock. With the frog of the scraper plane set to a 15° angle, and with the plane on a flat exterior, slip the blade (bevel facing back) into the plane until the burred edge bottoms out on the flat exterior. Then turn the locking nut to secure the blade.
- Set the depth of cut. To set the depth of cut, pivot the frog forward 15°. When the blade begins to dull, pivot the frog farther forward to improve the cutting action.
- Skew the plane for easier cuts. Like a cabinet scraper, a scraper plane cuts more simply when angled about 30° to the direction of travel.
- Scraper plane has the edge when doing edges. When an edge requires scraping, the scraper plane has the best balance and control, so you’re less likely to tip the scraper and create an out-of-square edge.

Chapter 9 How to use Japanese chisels

The machine area of my woodshop is stocked with Western woodworking machines. Yet over at my workbench, all the hand tools are Japanese. Only as it's hard to beat hefty Western machines, I believe that Japanese hand tools clearly outperform their Western counterparts. When it comes to chisels, the Japanese diversity takes a sharper, sturdier edge than Western chisels; these tools simply work better and for a longer period of time.

Japanese chisels, such as other Japanese edge tools, are laminated, and this is the key. A thin layer of very hard and finely tuned high-carbon steel—the cutting edge—is forge-welded to a denser piece of iron or low-carbon steel that forms the body of the blade. The thick layer of softer metal provides mass and shock dampening and prevents the hard, brittle steel from fracturing. Once you buy a new Japanese chisel, there's some setup to do before you can put it to work— flattening the back, creating the cutting bevel, and setting the hoop. Here I'll explain the anatomy of Japanese bench chisels, walk you through the various types, and give you guidelines and specific recommendations for which chisels to buy. Good-quality Japanese chisels are still made one at a time by individual blacksmiths in small shops, and I like the idea that while buying the best tool I can find I'm also helping keep an age-old craft alive.

Using a Japanese Chisel

Utilising Japanese chisels doesn't present anything like the radical shift users involvement when going from Western to Japanese planes and saws. Japanese bench chisels are generally shorter than Western chisels and have a different feel and balance, but you'll work with them in the same ways. One slight difference in use is due to the hollows on the back of the blade. When you are paring with a Japanese chisel and the back is registered against a flat exterior, you have to adapt to the fact that you don't have the full width to ride on as you would with a Western chisel. Also note that Japanese chisels should never be used with a prying motion, as this action risks breaking the edge. Sharpening the laminated blade may essentially be easier than what you're used to. Because the thin steel cutting edge needs to be fully supported, the bevel of a Japanese chisel shouldn't be hollow ground or given a microbevel—the whole bevel stays flat and the whole thing is honed at each sharpening. But since the backing iron is soft, sharpening the bevel on stones is quick. And dispensing with the grinder shortens the sharpening procedure. In case you use a mallet with your chisels, you might consider getting a Japanese hammer to use with these chisels. The hoop at the end of a Japanese bench chisel keeps the wood from splitting when it's struck with a metal chisel hammer. These hammers are smaller, lighter, and easier to control than large wooden mallets, and deliver a more precise blow.

How to select a chisel

While there's no real learning curve in using a Japanese chisel, it will have a subtly different heft and feel in use than a Western one. If you are new to these chisels, consider buying one in a size that you use often and working with it for a while to see how you like it. If you prefer it, I still wouldn't advise buying a full set unless cost is no object. You get almost no discount for buying a set of 10 and you pay a hefty premium for the larger sizes. Instead, I'd buy five or so in the sizes you use most. For me, that would be: 3mm (⅛ in.), 6mm (¼ in.), 9mm (⅜ in.), 12mm (½ in.), and something wide like 24mm (1 in.) or 36mm (1-½ in.). Japanese chisels are typically sized metrically, and are somewhat narrower than their imperial equivalents. The smaller widths—⅛ in. to ½ in.—are good for the rather small dovetails I use on drawers. The ¼-in. and ½-in. chisels are also good for squaring mortises cut by machine. And having one or two wider chisels is nice for larger dovetails and larger mortises. All these chisels would work well for the various paring tasks that come up while making furniture. Depending on need, you could fill out the set over time. Or use the money not spent on a complete set of bench chisels to buy some specialty chisels. Because hand-tool use is still a living part of the woodworking culture in Japan and because much of the woodworking there is highly specialized, there is a wide diversity of chisel types. You could get a wide shinogi-style push chisel, which is great for general-purpose paring (and not meant to be struck); a crankneck chisel with a short foot for cleaning the bottoms of dadoes; a heavy mortising chisel for hand-chopping large mortises; or a fishtail-fashioned chisel, or bachi nomi, for working in tight spaces like the hard-to-clean rear curves of half-blind dovetails.

Basic Features

Nearly all Japanese-style chisels share a common anatomy, give or take the hoop, which is not found on dedicated paring chisels. Yet there are interesting differences in the blades, some noteworthy and some not.

Three defining features of Japanese bench chisels, or oire nomi, are a laminated blade, a hybrid tang-and ferrule joint between the blade and the handle, and a steel hoop at the end of the grip.

The Japanese bench chisel formats:

The Japanese bench chisel comes in a diversity of blade profiles. These are four of the most common and useful.

Kaku Uchi

- An old style with only somewhat raked sides, this profile delivers maximum power for chopping but is less versatile when paring.

Mentori

- The most common blade profile, it combines heft for chopping and striking with side bevels for paring access.

Kinari

- With longer bevels than the mentori, this more delicate profile is excellent for paring dovetails but still retains enough mass for effective chopping.

Shinogi

- The low, wide-beveled blade profile affords excellent access when paring in tight spaces. It is used only on push chisels—unhooped chisels not meant for striking.

You'll find one or more hollows on the back of a Japanese chisel. They make flattening and honing the hard, high-carbon steel back easier. Depending on the maker, the body of a Japanese chisel may be completed in a diversity of ways. The finishes are decorative and don't affect functionality. Polished, or file-finish; black; mokume, or wood-grained; and hammered.

Japanese chisel-makers still develop a wide array of specialty chisels for Japanese craftsmen plying traditional trades. Here are a few that are useful on the Western workbench. A long shinogi push chisel for paring; a hiramachi chisel for access to tight spaces; a crankneck chisel for cleaning the bottoms of dadoes and sliding dovetails; a heavy mortise chisel for chopping mortises; and a very wide chisel for paring or chopping.

The cutting edge of Japanese chisels is typically made from either “white steel,” which is a very pure high-carbon steel, or “blue steel,” which is white steel to which tungsten and chromium have been added to make the steel tougher. The names white and blue steel have nothing to do with the color of the metals—they refer to the paper that the steel comes wrapped in from the mill. There are different grades of both white and blue steel. White is said to take a sharper edge, blue to hold it longer in use. In my involvement, either kind can make an outstanding chisel. One of my favorite chisels is made with #1 white steel. It’s easy to sharpen, holds a great edge, and is fairly durable. But I also have chisels made with blue steel that perform similarly. To me, the skill of the blacksmith is more vital than the choice of steel. Japanese chisel handles are often made from red or white oak, but boxwood, gumi, ebony, and rosewood handles are also fairly common. All except the ebony and rosewood are strong, tough, and resilient enough to make excellent handles. I find rosewood and ebony too brittle for chisels that will receive hammer blows, but they are fine for push chisels, which are meant only for paring.

Good Japanese chisels are not inexpensive. They start at about $70 apiece. But these tools are hand-forged by blacksmiths drawing on years and typically generations of involvement who are at the top of their craft. They are using supplies that are hard to work and expensive. And they are creating arguably the finest tools of their kind. I’m continuously surprised that they don’t cost more. That said, in Japan there is definitely a level of “tools as art,” and there are collectors around the world who buy them. It is not necessary—

and it may be counterproductive—to go to that level to find a wonderful tool. For me, the most beautiful tools are those that perform their jobs the best.

Using Japanese Chisels

With their super-sharp blades and hooped handles, Japanese chisels perform both chopping and paring tasks with ease and accuracy.

- Chopping. Its hooped handle lets the Japanese chisel take a pounding.
- A steel striking hammer, or dai dogyu, delivers a sharp, accurate blow.
- Precision paring. Japanese bench chisels are superb for paring, but shouldn't be used with a prying action, which could chip the very hard cutting edge.
- Specialty tools in action.
- The shinogi push chisel excels at paring wide recesses like hinge mortises; the ultra-heavy duty tataki excels at hand-chopping large mortises.

Buying Guide Japanese chisels fall into three general categories according to cost.

LOW END ($30–$50)

In this range, the maker's name will not be known—possibly because the tools are mass-produced. The handle may be dyed to mask inferior wood, and poorly fitted to the ferrule. Blades may be stamped from sheet material and painted. Cutting steel may be soft and abrade away rapidly. Hollows may be ill-formed. Blades won't get as sharp as better brands and will lose their edge more rapidly.

MID RANGE ($80–$350)

While made one at a time in small shops and typically attributed to a particular blacksmith, these chisels offer the best value to furniture makers. Made with high-quality white or blue steel tempered to Rockwell c65 or higher, they should take a razor-sharp edge and hold it. Care in the making will be evident in the even shape of the hollow, a clean lamination line, a graceful transition from the neck to the body, and the fit of the handle to the ferrule.

HIGH END ($500+)

Some Japanese tools are treated as art, and with collectors in the picture, prices can get stratospheric. The provenance of a chisel—whether the blacksmith is a national figure—and features like folded-steel blades, exotic handles, and rustic, hammered exterior treatments can increase the value of a chisel, but they don't improve its performance.

Chapter 10 Using hammers and mallets

Sometimes a little compression is the most effective response to a persistent joint. In my woodshop I work with a variety of hammers and mallets to help me in a multitude of tasks: interior demolition and disassembly of existing work, dry-fitting of carcases, built-in installations and adjustment of tools like the blades on molding planes. Hammers and mallets that are like the most are as follows:

12-oz. curved-claw hammer

- For light assembly, this hammer’s compact size decreases the chance of causing inadvertent damage. The red-oak handle feels good, but I have had to tighten it with oak shims a couple of times. The curved claw gives good leverage for pulling out nails without destroying the work.

16-oz. straight-claw hammer

- This hammer is great for heavy work in the shop: assembling large-scale dovetails, driving lag bolts before wrenching them and setting the pronged drive center for a lathe into a blank. The head and handle are one piece, making this hammer a favorite among the pros because of its indestructible nature.

20-oz. straight-claw hammer

- I use this heavy bruiser for building and installation. The weight and length of this hammer are sufficient to drive an 8d common nail in two blows. The straight claw is useful for chipping stuff out of curves as well as for prying things apart. I prefer a fiberglass handle for a tight and permanent fit with the head; the rubber sheath gives a nonslip grip.

Japanese hammer

- This hammer is useful for setting the irons in Japanese planes, and for woodworking in tight curves. The head is of cast steel with a handle fitted through the eye and held firmly with wedges.

12-oz. ball-pein hammer

- A small-scale, machine-shop staple comes in handy in my woodshop. There is always some bit of metal needing to be coaxed into place or straightened out. This hammer also does more mundane duty, such as tamping down paint-can lids.

Cross-pein hammers

- Also known as a Warrington hammer, this style is considered a versatile shop hammer, as evidenced by the wide range of sizes it comes in. I use the 3 ½-oz. hammer for delicate tasks such as nailing brads in picture frames, while the 12- oz. size does universal duty. The tapered pein—the end of the head opposite the main striking head—can be used for starting small nails with less chance of hitting your fingers.

6-oz. tack hammer

- When I picked up this hammer almost 20 years ago at a five-and-dime store, I substituted the original, flimsy lauan handle with a hickory one. Now I love the feel of this tool. It is perfect for restoration work such as setting small, solid-wood patches and inlays. I also use it for setting wedges into joints and for adjusting blades and cutters on my antique planes.

2-lb. mason’s lump hammer

- I use this brute for light demolition work such as removing interior trim and woodwork. It also provides just the right force for assembling the undercarriage of my Windsor chairs. I substituted the original handle with one made of hickory.

Dead blow hammer

- This rubber mallet features a hollow head filled with lead shot that delivers a solid blow without damaging the work. It doesn’t have much visual or tactile appeal, but it’s good for assembling large carcases.

Brass-headed mallet

- This mallet definitely punches above its weight. I use this compact tool primarily for carving because its ergonomic shape decreases fatigue. An added bonus of its small size is that it takes up less space in a tool bag.

Laminated mallet

- The head on this mallet comprises 1 /16 -in.-thick layers of laminated beech, making it stronger, heavier and less prone to splitting than a solid-wood mallet. The face of this mallet is intended to strike the work at a more efficient angle than a square-headed mallet would.

Chapter 11 How to sharpen planes and chisels

For many woodworking professionals, sharpening plane irons and chisels is an intimidating and annoying task. I've travelled the country teaching and demonstrating sharpening and hand-tool skills and I've met many woodworkers who struggle to get a constantly sharp edge on their tools and are convinced that sharpening is beyond their skill. Yet, sharpening doesn't have to be hard. The technique I'll describe you combines ideas I've picked up over years of working with hand tools. I've demonstrated it numerous times. The heart of this approach is a collection of straightforward tools: a $15 side-clamping honing guide, a supply of sandpaper in numerous grits, 1,000- and 8,000-grit waterstones (or a combination stone if you like), a thin metal ruler, and a shopmade stop board that will help you rapidly and reliably set the correct honing angle every time. With these tools, you can handle the most common sharpening tasks —honing, grinding, and repairs—for every kind of blade. Utilising this technique, you'll get a truly sharp edge, tolerating your tools to cut more cleanly and resourcefully with less effort.

Many woodworkers buy a high-end handplane with the idea that their woodworking will get better. It's true that a better tool makes for a less frustrating involvement. But while you may think a new plane is ready to go right out of the box, think again. Even a new tool should be sharpened before you put it to wood. A brand new, high-quality plane iron should have a flat back. If it doesn't, or if you're working with an older iron, flattening is a must. Luckily, this should take no more than 5 or 10 minutes using the sandpaper method.

Your objective is not a high polish but simply a flat back with no heavy milling marks running to the cutting edge. This is so, whenI have the back flat, I use a ruler trick to create a subtle bevel on the blade’s back. The ruler trick puts the honed exterior at the cutting edge where it belongs and eliminates the tedium of polishing the entire back. Here’s how it works: Place a thin metal ruler (0.020 in. thick or less) on one side of the 8,000-grit stone. Now place the back of the blade on the ruler and lower the blade’s tip onto the stone. Work it up and down until you can see an even mirror polish about V32 in. wide, from corner to corner, at the edge of the blade. Now you’re ready to hone the bevel. The classic bevel-down smoothing plane blade comes with a main bevel of about 25°. There’s no need to hone the entire primary bevel to get a sharp edge, though. It’s more efficient to create a small, steeper secondary bevel right at the cutting edge. For the most common primary bevel of 25°, a secondary bevel of 30° works well. I use steeper angles with scraper planes, as well as bevel-up tools for working in hard, highly figured woods. The harder the wood, the higher the angle.

How to find and hold the right angle

- To hone the secondary bevel, I use a honing guide.
- Certain woodworkers call this cheating.
- As someone who learned long ago to sharpen freehand, I say it’s not.
- A honing guide holds the blade at a consistent angle as you work the edge and move from stone to stone.
- The secondary bevel remains flat, and each successive grit reaches all the way to the tip of the edge.
- I utilise a straightforward, side-clamping honing guide.
- To set the angle consistently, I constructed a stop board, which consists of a plywood base and numerous stops to set the blade a certain distance from the front of the guide.

- The shorter the distance, the steeper the honing angle.
- My board has stops for five common angles: 25°, 30°, 35°, 40°, and 45°.
- I also use a ⅛-in. shim to increase an angle at any of the stops.
- With a long projection like 25° to 30°, ⅛ in. represents roughly a 2° increase in angle.
- With a short projection like 45°, the same ⅛ in. represents about 5°.

How to hone rapidly

- Set the blade to the correct angle and tighten the guide so the blade won't shift.
- Initiate with the 1,000- grit stone, working back and forth and applying even pressure.
- After four or five passes, you should be able to see and feel a burr or "wire edge" on the back of the blade.
- This burr indicates that you have eliminated the dulled edge and it's time to change stones.
- Before sharpening on the 8,000-grit stone, wipe off the roller wheel of the honing guide so that you don't transfer grit from stone to stone.
- To ease off some of the burr, take one pass on the blade's back, drawing the blade toward you.
- Now work the bevel side, taking another four or five passes.
- When you see a clean and brightly polished parallel line right at the blade's tip, you are done.
- Nevertheless, if you applied uneven pressure on the blade, the polish line will be wider at one corner than the other.
- This can be corrected simply on the 8,000-grit stone by

placing extra pressure on the narrower side with just a few more strokes.

- As a final step, eliminate the blade from the honing guide and touch up the back using the ruler trick to fully eliminate any burr that is still present.

How to grind without a grinder

- With repeated honings, the secondary bevel will grow wider.
- When it becomes too large, and you’re spending 20 to 30 passes honing on the 8,000-grit stone, you need to re-establish the primary bevel.
- A lot of woodworkers use a grinder for this, but I’ve found that working by hand on sandpaper is just as fast, won’t burn the tip and soften the steel, and gives me more control.
- You need a flat, hard substrate to attach the sandpaper to. I use granite, but plate glass works too.

Re-establishing the primary bevel

Use the stop board to set the blade in the guide to the correct primary bevel. Attach three or four grits of 3-in.-wide adhesive-backed paper to the substrate. Take 10 to 15 passes on each grit, switching from a coarse (P80 to P180 grit) to a medium (P220), to a fine grit (P400). Switching grits often avoids working too long in the same scratch pattern. It also helps prevent unintentionally crowning the blade, which makes honing hard. Continue cycling through the grits until you achieve a consistent and straight bevel at the desired angle. Do not work the edge down to a point. Stop just short of creating a burr. You are done when you can see a very thin, flat line on the tip of the blade, about 0.01 in. or 0.02 in. thick. A jeweler’s loupe can help you see this line. If you are having trouble, you can work down until you feel a very slight burr. With the primary bevel re-established, rework the secondary bevel, starting with the ruler trick.

A New blade only needs honing

- Hone just the tip of the back.
- Tiny ruler is a huge time saver.
- Lifting the iron’s back off the stone lets you polish only a thin band at the cutting edge, instead of the entire back.
- The work is done with just 10 to 20 passes on an 8,000-grit stone.
- Honing on the 1,000-grit stone eliminates a narrow band of metal near the cutting edge.
- A few passes on the 8,000-grit stone creates the highly polished exterior required for a sharp edge.
- Use the 30° stop on the board to set the iron in the honing guide.

- Four or five passes on the 1,000-grit stone should be enough to raise a burr on the iron’s back.
- Take a handful of passes on the 8,000-grit stone to create a highly polished narrow band at the tip.
- Lastly, repeat the ruler trick to eliminate any remaining burr on the back.
- Test the edge.
- Replace the iron and set it for a light cut.
- See-through shavings should be the result.

You can use this technique with any abrasive. I like waterstones, 1,000 and 8,000 grit, precisely the new Shapton glass-backed stones. These stones cut aggressively but have a ceramic binder holding the stone together, so they only need to be spritzed with water. Don’t soak them as you would a regular water-stone; they will soften and can be ruined. You may also want a 4,000-grit stone for inoften lapping the back of a plane iron or chisel. Keep your stones flat for consistent results. This is simply done by lapping often with a coarse wet-or- dry paper (150 to 220 grit) on a flat reference plate, granite or glass, or a coarse diamond lapping plate (45 to 55 micron). Also, be sure to wipe off the roller of your honing guide before switching stones, to avoid transferring grit from one to another.

Keep your stones flat.

Lap your sharpening stones often with a diamond plate or coarse wet/dry sandpaper on a flat exterior. Do this often and it will be less work each time.

Same Technique for Chisels, With a Few Tweaks

Like new plane blades, chisels aren’t ready to go right out of the box. The good news is that this sharpening technique works for chisels, too. The bad news is that the ruler trick won’t work. You need to flatten (on sandpaper) and polish (on stones) the entire back because it serves as a reference for paring and other fine work. Once the back is flat, mount the chisel in the honing guide. Its lower position in the guide creates a honing angle that is about 5° shallower than the marked angles on your board. So your 30° stop becomes 25° and so on. Because I can control the angle and am not removing much material, I work the entire face of the primary bevel on the 1,000-grit stone, then hone a secondary bevel a few degrees steeper on the 8,000-grit stone. Use the ⅛-in. shim to increase the angle. I avoid sandpaper grinding unless I get a heavy nick in the edge.

Fix the nicks first.

There’s no point in honing this edge until the nicks have been eliminated. Puchal-ski uses a block of wood to hold the chisel perpendicular to the sandpaper as he grinds the edge back to eliminate the nicks. Then he regrinds the primary bevel with the chisel in a honing guide. The same technique works for plane blades.

Fitting the chisel in the honing guide

The chisel rides in the lower set of jaws. The lower jaws also hold narrow plane blades.

The angles are different

Chisels ride lower in the honing guide and project farther out of it. To compensate, select a stop that is 5° steeper than your desired angle. Honing in two steps. Puchalski works the entire face of the bevel on the 1,000-grit stone, then hones a secondary bevel a few degrees steeper on the 8,000-grit stone.

NOTE: Avoid the ruler trick with chisels. Once you’re done honing, take a couple of passes on the back to eliminate the burr. Keep the back flat on the stone.

Chapter 12 How to keep your tools sharp

One of the most laborious tasks in a woodworking shop is sharpening, whether that means grinding and honing chisels, running to the store for a new cutter, or sending planer blades out to be sharpened. While it's a chore that can't be avoided, it can be overdue. A diversity of hazards will dull cutting edges prematurely. Steering clear of them will let you work more and sharpen less. Among the worst of these is dirt. Cleaning debris off rough lumber before machining can help maintain a sharp edge on jointer and planer knives and sawblades. Eradicating pitch and sawdust to prevent buildup helps avert cutters from dulling too soon. It's also vital to protect your tools from collisions with other metal or hard exteriors that can mar a sharp edge.

Roughsawn lumber holds lots of dust and debris, which can act like sandpaper on cutting tools. A light brushing will not always get it out of the exterior pores. A great way to clean the exterior is to use compressed air and a wire brush. A quick blast will eliminate the bulk of dirt and debris, and a good brushing will dislodge the remaining grit. It's best to clean lumber outdoors so as not to spread dust on nearby material, tools, or workbenches. While it cleans a bit more slowly than compressed air, a good shop vacuum can be used indoors because it will not spread dust around the shop. Used lumber poses diverse hazards. I use a metal detector to find embedded nails or screws that can dull or damage tool edges and eliminate them before proceeding with the cut. Hand scraping or chemical removal will take care of old paint, which will dull a cutting edge rapidly and leave a residue on tools. Yet the wood has to be pretty valuable to go through all that trouble. The best bet is to avoid painted lumber altogether.

Toothed cutting blades on bandsaws, tablesaws, and chop-saws rely on clearance immediately alongside the sawteeth to help eliminate drag, and on gullets behind the cutter to eliminate the freshly cut wood fibers. If the teeth have pitch baked on their sides or if the gullets have crud built up on their edges, the blade will heat up and dull rapidly. I clean my tablesaw blade often with a blade cleaner such as OxiSolv Blade & Bit Cleaner or CMT Formula 2050 Blade and Bit Cleaner. I am cautious to keep the gullets clean on my bandsaw blade, especially when resawing—a brass brush can clear blocked bandsaw gullets rapidly without dulling the edges. In addition, a regular waxing or dry lubricant coating on the blade will minimize buildup and decrease friction in the cut. I find that paraffin wax or DriCote works well. Before applying DriCote, clean the blade with a solvent because this product needs to adhere to bare metal. Drill bits, especially twist bits, suffer when chips build up in the flutes and can’t be extracted from the bore hole. This is an especially big issue with bits used in hollow-chisel mortisers. The friction from the compacted chips can create enough heat to turn the metal of the chisel and the bit blue, effectively ruining the temper, or hardness, in both. Once steel loses its hardness, the cutting edge won’t stay sharp for long. To improve the ability of bits to eject chips, I coat bits with DriCote. Specialized lubricants can significantly enhance the operation of tools that rely on metal tables to support work being sawn, edged, or molded. Merchandises such as Empire’s TopSaver will keep a steel or cast-iron top slick, resulting in less effort required to push material past a blade or cutter. Continuous feed rates, essential to producing a consistent knife-mark pattern on molded edges, are easier to maintain when the table’s friction is low.

ELIMINATE PITCH AND SAWDUST

Clean bandsaw gullets. With the machine turned off, rotate the upper wheel by hand as you pass a brass brush over the blade.

Use a blade-and-bit cleaner on tablesaw blades. Spray it on the buildup and let it sit before scrubbing with a brass brush.

LUBRICATION SLOWS DULLING, RUST

Apply a dry lubricant on chisel mortisers. The lubricant helps prevent buildup and keeps bits from dulling prematurely. Wax bandsaw blades to decrease friction. With the blade running, hold a piece of paraffin wax on the table and against the blade.

How to protect sharp tool edges from hard knocks

I have an ongoing debate with a friend about the appropriate way to set a sharp handplane on a benchtop. I always set mine on the sole with the blade resting on a fairly clean wooden benchtop exterior. I reason that there is less chance of damaging the blade, or myself, when the blade is covered. Resting the plane on its side exposes the blade, increasing the chances that I'll get a flesh wound or my plane will be damaged by another metallic tool. Chisels laid on a benchtop should always point away from the woodworker, the project, and the other tools on the bench. Be cautious to avoid clutter on a workbench; it is too easy to bump sharp cutting edges against metal. Debris in tool trays, and the trays themselves, can nick and dull cutting edges. Keep trays clean and organized. Put a divider between each tool in a toolbox and if the toolbox is metal, line the interior with wood or heavy card stock. Provide a safe haven for all cutting edges. I have a rack for my chisels; dowels on the wall for my files, rasps, and planes; trays for my router and drill bits that keep the sharp sides up and separated from one another; individual shelves for my tablesaw blades; and a separate dowel for hanging each of my bandsaw blades.

It is faster and easier to hone a somewhat dull tool than to regrind a really dull tool. As soon as the performance drops in any cutting device, it is time to give it a touch-up. Sometimes honing is as straightforward as running the flat face of a bit over the edge of a diamond stone to restore full performance. Steel cutters such as plane blades and chisels also should be honed often during use and ground only sometimes. Carvers are seldom far from their honing system, whether it is a leather strop and diamond paste or a buffing system. The same goes for scrapers. The burr that does the cutting on a scraper is rather fragile and can start to lose its sharpness within a few strokes. But a quick once-over with a burnishing tool will restore the edge. There's nothing like seeing fine shavings roll off the cutting edge of a tool. Protecting those edges and touching them up often will extend your working time between full sharpenings. Sharpen router bits with a small diamond stone. Run the flat face of a bit over the stone, using the same number of strokes for each edge. Hone plane irons regularly. Diamond paste on a piece of leather rapidly renews an edge.

Chapter 13 Ripping and Crosscutting on the Tablesaw

Crosscutting and ripping most woodworking professionals will answer yes to the following two questions;

- Did you ignore the “Using Your Saw” section in the owner’s manual when you got your first tablesaw?
- Have you experienced kickback?

I have had projects kick back a few times in my life. Luckly, I wasn’t injured. Yet others that instant on the tablesaw has been tragic. I’ve innovated firm rules for safe tablesaw use, regardless of skill level. My rule is to keep all my saws appropriately set up and retained. Yet this chapter emphases on a knowledgeable operative. In case you comprehend how the saw works and know the best practices for its usage, the chance for a bad accident can be reduced.

Kickback

When it comes to kickbacks, it counts for most of the tablesaw accidents. Awkwardly, I run into many woodworking professionals who don’t apprehend the cause of kickback. How it happens? Well, the teeth at the front of the blade do the cutting, while they move downward, helping to keep the board safely on the table. Yet the teeth at the back of the blade are not your friend; they spin in your direction at over 100 mph. Throughout a safe cut, the slot made by the blade brushes past the back teeth without event. Yet if the back of the board pivots as you push it, or one of the halves is pinched into the blade somehow, only one of those back teeth needs to grab the workpiece to set kickback in wave. Then it happens in milliseconds, as the lifting act converts nearly instantly to horizontal force aimed right at youself. The projectile can hurt you, yet it can also pull your hand into the blade. The great news is that kickback can be easily prevented. Utilise a splitter whenever conceivable, aka riving knife or spreader, a splitter keeps a board from making contact with the teeth at the back of the blade. Problem resolved? Well, not really. The splitter has to be there to do its job, and until recently, most splitters were downright inconvenient and were therefore forbidden. Saws that are more than a few years old will have a crude splitter that spreads high above the blade and too far behind it. The main issue is that these splitters have to come off the saw for all non-through-cuts, such as grooves. The big blade covers are just as inconvenient. This outdated safety tools are hard to detach and reinstall, so most of these blade splitter cover assemblies find a everlasting home in a woodshop. In case you have one of these saws, you should still use a splitter if you can. Luckily, a few years ago Underwriters Laboratories have suggested that all new tablesaws have a more versatile type of splitter and a riving knife borrowed from European tablesaws, and all American tablesaw manufacturers meet the terms. In case you can afford to buy one, you will have a more safety envintument. The riving knife can stay on for almost every type of cut, and the new blade covers are narrower and come off the saw more simply when they get in the way. Inappropriately, today's knives still contain "anti-kickback fingers," which are profoundly unusable and frequently in the way, therefore I don't use them. But getting your riving knife or splitter to fit through a shopmade throat plate. On my saw, I just extend the blade slot (using my scrollsaw) to allow the low-profile riving knife to fit through. Yet the taller knife will not work as it is lengthier, and I would have to make the slot so long it would weaken the insert plate. Therefore I utilise my zero-clearance throat plate only for crosscutting, where tearout is the main issue and where I require to use my low-profile knife anyway to fit through the fence on my miter gauge and crosscut sled. In terms of ripping, I utilise the standard throat plate. This lets me utilise the full height riving blade and knife cover.

Preserve control

- Do not cut stock freehand.
- The stock must be controlled always, utilising either a jig or a fence.
- Fences and miter slots should also be aligned accurately.
- Likewise, a workpiece must be straight and flat on its control exteriors: at least one face and one edge.
- Be sure to push it all the way past the blade.

Utilise a splitter

- Kickback is the main danger on a tablesaw, and a splitter is the cure.
- Also called a spreader or riving knife, this thin wood o tab of metal sits right behind the blade.
- The slot made by the blade slides onto the splitter, averting the board from pivoting onto the teeth at the back of the blade.
- Without having to steer the board to prevent kickback, you can focus on keeping your hands out of harm’s way.

Limit your representation to the blade

- Keep the blade only about ¼ in. higher than the workpiece.
- Anytime when it’s conceivable, keep the cover attached to the splitter, acting as a physical fence.

- Keep your fingers 3 – 6 in. away from the cover, away from the exposed blade.
- For many cuts, this means using push sticks or push pads.

Supplementary tips

- Even if a board is already jointed straight and flat, it might not stay that way as internal tensions are released during a cut.
- If a board jams during the cut, use one hand to turn off the saw, wait for the blade to stop, and finish the cut on the bandsaw.
- Also, be aware that a short board is more likely to pivot onto the back of the blade.
- If you are not sure about a workpiece, rip it on the bandsaw.
- And on some smaller, portable saws, the rip fence won't stay parallel to the blade when you move it, which can cause binding, so you'll need to confirm it each time.
- One no-no when crosscutting is using the rip fence as a stop.
- This traps the offcut, and the friction against the fence can cause it to pivot and bind, causing kickback.
- Follow these basic safety guidelines and you'll turn the most dangerous machine in the shop into a trusted friend.

Recent saws have better guards

A few years back, Underwriters Laboratories mandated that all saws sold in the United States have much-improved, European-style safety systems, and all North American manufacturers complied. Better blade covers and splitters. Today’s blade covers are narrower, allowing a push stick to pass by more simply. And the riving knife, an improved version of the splitter, moves up and down with the blade, hugging it closely to prevent kickback.

Low-profile option. For very thin rips and non-through-cuts, the blade cover comes off simply, and you can either adjust the riving knife downward or replace it rapidly with a low-profile version.

Having an older Saw?

Older splitter systems are troublesome, and often discarded. Yet no worries—there are two good ways to replace them. Purchuse a better splitter. Attainable online for about $180. You can install its holder in the throat of your saw, and then the splitter pops in and out fast. Or make a stub splitter. You will need to lengthen the saw slot to house it. In case it binds in the saw kerf, plane or sand the sides a little. Ensure that the grain runs vertically for strength.

Crosscut basics

- First, make a zero-clearance throat insert.
- Next, the crosscuts develops the most tearout at the bottom edge, and a zero clearance insert will avert it.
- This will also keep small offcuts from diving into the throat of the saw.

How to apply safe ripping

- Begin the cut with your hands, as a push stick could tip the back of the board down and the front up.

- Once your back hand is within 6 in. of the blade, end pushing for a moment and grab the push stick, protecting the board stable with your left.
- Complete the cut with the push stick, moving your left hand safely out of the way and pushing the stock all the way past the blade.
- Take a note on how the outfeed table supports the board.

How to handle plywood

- Concentrate on the area where the panel rides the rip fence, yet remain aware of your hands, too, keeping them clear of the blade. Once again, outfeed support is vital.
- Straightforward job. Trace your stock insert plate onto a piece of MDF of the right thickness to fit your saw, and then bandsaw it close, utilising a sander to work up to the line. On many of the saws, a 10-in.-dia. blade will not go low enough to let you insert the blank plate, so make a ripcut along the bottom to make the clearance. After that, install the blank insert, place the rip fence on top of it, and bring the spinning blade up through it. Lastly, extend the slot with a jigsaw or scrollsaw to house your splitter or riving knife. You will also require to use tape or screws underneath to shim the plate level with the table.

How to make a miter gauge fence

A typical miter gauge desires some support. A long fence will expand control and accuracy, tame tearout on the back edge, and push the offcut safely past the blade.

- Smart, safe design. Screw a long piece of MDF to your miter gauge, cut a slot through it, and then attach a wood block on the back edge where the blade arises. The slots in your outfeed table, envisioned to house miter gauges and sled runners, are the textbook spot for a straightforward stick that limits their travel, ensuring the blade does not pass through the safety block at the back.

- Once cutting one end of the stock square, youhave to mark the length at the other end, and utilise the slot in your miter-gauge fence to set up the last cut.
- The long MDF auxiliary fence allows you set up a stop at the far end for cutting a series of ventures to the same measurement.
- With a stable bed and two runners in the miter slots, a crosscut sled cuts big workpieces with unmatched precision. For the larger, longer ventures, clamp a hook-type stop above the project.

Chapter 14 How to cut joinery on the tablesaw

The tablesaw can do more than make squares. In case you add a dado set and a few shopmade jigs and fixtures, it can become your favorite machine for cutting perfect joinery. The tablesaw compromises an unmatched combination of precision, speed, repeatability control, and endless jigs. To develop joint-quality cuts, both across the grain and with it, you'll need two types of blades. You could stick with your normal combination blade, but ensure you keep the teeth clean of pitch buildup. A clean blade will always cut well. For wider notches in wood, whether rabbets, dadoes, grooves, tenons, or lap joints, I ustilise an 8-in. stack dado set. Quality is very vital here. You need a set that cuts clean edges and flat bottoms. A dado set's inside and outside blades have angled teeth intended to eliminate tearout at the edges of the cut. A diversity of chipper blades go between, allowing ½-in.- to ⅞-in.-wide dadoes. Thin shims go in to fine-tune the width, if essential. Be aware that dado sets take big cuts and can cause underpowered saws to bog down, and that the shorter arbors on certain portable saws won't allow the full stack to be used.

You could cut most of the common joints on the tablesaw with just four straightforward jigs and fixtures: a zero clearance throat plate, a miter-gauge extension fence, a crosscut sled, and a sacrificial fence for rabbeting. The cool thing about learning the fundamental joints, like dadoes and rabbets, is that the same performances work for many others, such as laps, bridle and tongues joints. The design of a tablesaw invites a host of joints and jigs.

Dado

For many joinery cuts, you'll need a good dado set. Get the best stack-type dado set you can afford. It should cut slots with clean edges and flat bottoms.

Combo

A basic combination blade is fine for miters and grooves. For the cleanest cuts, buy a good one and keep its teeth free of pitch.

Grooves

Grooves are the easiest joint to cut. Since they are aligned with the grain, you can use the rip fence to guide the workpiece. I typically use my combo blade, adjusting the fence and taking multiple passes for a wider groove. If the bottom needs to be dead flat, you can also use your dado set. The advantage of the single blade is that it lets you use a riving knife to prevent kickback. If your saw doesn’t have one, you can use a shop made stub splitter. In any case, always use a push stick or push pads to maintain good control while keeping your fingers safe (you can’t see the blade until it exits the board). Pay special attention to keeping the workpiece flat at the point of contact.

Clean dadoes

A dado is a groove cut across the grain and is typically sized precisely for a second piece to fit into. Since dadoes are crosscuts, tearout can be a issue without a zero-clearance exterior below the cut. If the back edge will show, you’ll need zero clearance there, too. You can use a diversity of fences to make a dado cut safely, but it depends on the size of the workpiece and location of the dado. On wide workpieces with the dado close to the end of the piece, you can run the stock against the rip fence. But the crosscut sled is my favorite tool for dadoing, because it carries pieces with excellent control and great accuracy. That control is especially vital because you can’t use a splitter or riving knife in conjunction with a dado set on most saws. A crosscut sled also accepts all types of stops.

Precise rabbets

To cut rabbets, you should bury the dado set in a sacrificial rip fence. This makes it easy to adjust the width of the rabbet: You simply nudge the fence a bit instead of fine-tuning the width of the dado stack. But a sacrificial fence can be hard to clamp to the short sides of a standard rip fence without the clamps getting in the way. My solution is to build a straightforward MDF box that fits snugly over the fence, and then tape the sacrificial piece to that. The box allows the sacrificial fence to be eliminated and substituted simply, on either side, so it works with the fence on either side of the blade. And a single piece of MDF can be situated four different ways to extend its use.

How to build a box to bury the blades

- Box must fit snugly on sides of rip fence, but gap is OK at top.
- Cut the sides 1 in. taller than the rip fence, and long enough to allow clearance for the lever at the end.
- Clamp the sides in place to measure for the top plate and attach it.
- Drill pilot holes to prevent splitting.
- Keep the clamps on as you screw on the end caps.
- Add the fence and bury the blades.

- Use thick carpet tape to attach a tall MDF fence, and then move the fence over the top of the dado set and bring the spinning blades up into it, only as high as required.
- Fast, accurate rabbets.
- Whether the rabbets are along the edge or end of a workpiece, you can run the workpiece against the fence.
- But you'll need a zero-clearance throat plate to prevent tearout when working across the grain.
- Push pads do a good job controlling the workpiece, but you'll need to support narrow workpieces with the miter gauge.

TIP: Get Square First

- To get even tenon shoulders, you need a perfectly square miter gauge.
- You can place a square or drafting triangle against the blade to confirm, but inconsistencies in the fence or blade can throw it off.
- Instead, do this straightforward test.
- It works for squaring up fences and blades for all sorts of joinery tasks.
- Rip parallel edges on a long piece of scrap, and mark one side for reference.
- Make a crosscut and then flip one of the pieces.
- Set both against a straight exterior like the rip fence.
- A gap means you need to adjust the miter gauge and try again.

Quick tenons

One way to cut tenons on the tablesaw is to first make shoulder cuts with the pieces lying flat, and then make the cheek cuts using a tenoning fixture. But my favorite technique is to cut them with a dado set, which is faster and easier and works on larger workpieces. Long pieces are an issue on a tenoning jig, because they have to stand straight up in the air. With a dado set, the workpiece lies flat on the table, where it is easier to control. You can control the work with a miter gauge and use the rip fence as the stop. You’ll need a zeroclearance throat plate to prevent tearout at the shoulders. I stack my dado set to about ¾ in. wide, and I always start with the stock against the rip fence for the first cut and then nibble away the rest. Do not lift the stock when you finish a cut; just keep a tight grip as you pull it back. Start with the two opposite cheeks, testing the fit in one of your mortises as you dial in the setup. Then change the blade height to trim the tenons to width. You’ll notice that the outside blades leave fine lines on the exterior, but these will not affect joint strength. Some woodworkers leave the tenon a bit fat and finish the job with a shoulder or rabbeting plane. Using a test mortise, I am able to get a good fit right off the tablesaw.

Set the rip fence to position the first cut at the shoulder (top), and make a series of nibbling cuts (center) to finish the job. To cut the top and bottom of the tenon, change the height of the blades if necessary and just flip the workpiece on edge (bottom).

Tight miters on a crosscut sled

The most common type of miter is the flat type used to join frame pieces. They often surround a plywood panel to make a door or a tabletop, and standard moldings are cut this way, too. The challenge with flat miters is the wide cut, which makes it hard to end up with a 90° corner and no gaps. If you rely on your miter gauge, you will struggle with accuracy and repeatability. That’s why I cut them on my crosscut sled using a straightforward 45° fence. You use the sled to make the fence, too, and the whole procedure is easy. In this case, with flat stock and zero-clearance below the blade, you could keep the fence in one position for all of the miter cuts, simply flipping the pieces to miter the second side. But if the front of the stock is molded or you are getting chipout on the bottom edge, you’ll want to flip the fence to the other side of the blade when cutting the second end of each piece, in order to keep the same side up. Aside from accuracy, what I love about this setup is how easy it is to attach a stop: You just tape it down.

How to make an accurate fence

- Start with a perfectly square piece of MDF and use your crosscut sled to turn it into an accurate 45° fence.
- Use a 45° drafting triangle to position the MDF fence on the sled. Use carpet tape to hold it down, but keep the triangle in place as you cut, to be sure the workpiece doesn’t shift.
- Put the fence on the left or right, pressing it down very firmly on the carpet tape, and then use it to miter one end of each workpiece.
- Hold the workpiece firmly to be sure it doesn’t drift.
- Flip the fence over to set it up on the other side.
- This time you’ll need a stop to set the final length of each piece, but that’s as straightforward as taping a block to the sled.
- The miters should come out perfect.

Chapter 15 Bandsaw tips and fundamentals

In my first year of design school, I recall the shop manager telling me that the bandsaw was the most valuable piece of tools in a shop. This struck me as a doubtful declaration, given that we were standing in a shop filled with state-of-the-art tools. Yet at time and again he proved it. Once I graduated, my first purchase was a 15-in. bandsaw. Nevertheless, I slowly realized I could achieve the versatility and accuracy I had experienced at school only if I set up the saw the way my manager did at the time. When I figured out the keys to victory, I came to rely on that bandsaw too. With a single blade, I routinely cut smooth tenon cheeks, fine inlay stringing, and textbook veneers that use the entire height capacity of my machine.

Moreover, I do all of my ripping on that 15-in. bandsaw. The task is safer and necessitates less horsepower than the tablesaw, and the narrow kerf ingests less wood. Students are surprised at first by my preference for ripping on the bandsaw, yet they are converted quickly. While I have three outstanding industrial tablesaws in my workshop, they are used exclusively for dadoing, cutting shoulders on joints and squaring panels. There are few key elements to getting the most from your bandsaw: blade type, moderate tension and blade alignment. My method contradicts some of the common advice for setting up bandsaws. It does not necessitate high blade tension, special tools, exotic blades, high horsepower, or continual fence adjustments to house blade drift.

I know that many woodworking professionals experiencing hardies with their bandsaws. They say that severely cupped kerfs, poor tracking, and saws that seem underpowered, so their bandsaws are demoted to cutting curves in thin stock. The number-one culprit behind all of these hardies is a bandsaw blade that has too many teeth, with small gullets in between. Sawdust produced in the kerf must be eliminated professionally. An incredible amount of heat is created by the friction from the sawdust that is jam-packed in each small gullet right at the point where the wood fibers are being cut. The penetrating heat can cause the blade to lose its temper and dull impulsively. The heat and pressure buildup also can cause the blade to flex sideways and backward. A classic response here is to tighten the tension on the blade. Yet over tensioning the blade creates a whole new set of problems.

My bandsaw does everything, every day: cutting joints, resawing wide laminates in exotic woods, making curved patterns in 1 /16 -in.-thick stock. It is not practical to change the blade and the guide blocks for each situation, nor is it indispensable. With rare exception, a standard carbon-steel ½-in.-wide, 3-tpi, skip-tooth blade installed on my bandsaw achieves all of the above tasks. Blades are low-cost, so keep a sharp one loaded—The blades I use are made by Starrett. By delightful coincidence, these blades are rather inexpensive. It helps that I buy them in groups of 10, which earns me a 20% discount. Unfortunately, not all blade distributors weld bandsaw blades appropriately. An ill welded, misaligned sawblade will not give you the smooth and effortless results you are after. Just using a 3-tpi blade, with its larger gullets, will eliminate many matters. Even 4 tpi is too fine a tooth pattern for general woodworking and resawing. In case you want a fine cut, use a coarse blade, even on thin stock. In my involvement, the old rule of thumb about having two teeth engaged in the stock at all times is false. The motive I use a ½-in.-wide blade is that it is stiff enough to resaw but flexible enough to follow a curve down to a 2 ½-in. radius. Cutting particleboard is tremendously hard on carbon-steel bandsaw blades and can decrease their life by 75%. High horsepower is another myth - For most 14-in. bandsaws with a ½-in.-wide, 3-tpi blade, a ⅓-hp motor is acceptable. The same saw with a riser block in the column could use a ½-hp motor for big resawing tasks, yet something larger is too much. In case the motor is bogging down, you are either forcing the cut or using a dull blade.

It is vital that the tires on the bandsaw remain in outstanding shape. Grooves in the rubber tire on either the upper or the lower wheel will make it impossible to keep the blade on the centerline, in line with the rip fence. And the most common cause of grooves in the tires is over-tensioned blades. Very high tension even can flex the saw frame out of position. I somewhat undertension my ½-in.-wide blade. Because of its superb ability to clear sawdust, the blade is not inclined to flex, wander, or heat up. For the ½-in.-wide blade I alter the tension scale to the ⅜-in. setting. If no scale is present on the machine, I tighten the adjustment knob (with the machine off and unplugged) until the blade deflects about ¼ in. to the side without making my fingertips go white. A side value of lower blade tension is that I rarely have to release the tension on the saw, as is commonly endorsed to extend blade life.

Once I purchased my bandsaw, I set the fence parallel to the miter-gauge slot in the table, and I haven’t had to correct it ever since. I utilise the tracking adjustment on the upper bandsaw wheel to bring into line the blade. A nightmare of fence alterations succeeds if each new blade is allowed to track contrarily. Merely by keeping the centerline of the blade (irrespective of width) in line with the centerline of the upper wheel, I am able to keep the blade aligned appropriately at the blade guides. The connection between tracking the blade on the centerline of the upper wheel and having the fence affiliated parallel to the miter slot should develop a kerf with equal space on either side of the blade. In my workshop and in my travels to schools around America, I have never found this to be a matter. Tracing the blade accurately on the upper wheel has always been sufficient, except in the case of a severely injured bandsaw. Now square the table and align the fence. Once the table is aligned with the cutting course, yet it also should be accustomed so that it is square with the vertical line of the blade. Lastly, the fence should be lined up parallel to the blade and square to the table. I utilise a 3½-in.-high birch plywood rip fence screwed onto the metal fence. I have shimmed the plywood with masking tape to get it vertical to the table. Taller plywood fences can be screwed to the standing plywood fence, still I utilise these only when resawing to the maximum capability of my bandsaw.

For a second time, straightforward is the way to go. Once setting up my bandsaw, I took out the metal guide blocks and squared their working faces against the side of the wheel on my bench grinder, being vigilant to confirm the blocks for square. I have not had to replace them or resquare them ever since. The order for setting the guide blocks is as below;

- Unplug the saw, pull the guides well back, tension the blade, and then spin it a few times backward and forward by hand.
- Now turn on the saw and adjust the tracking of the blade to center it on the upper wheel.
- After that, turn off the saw again, and bring the guide assembly forward so that the front of the blocks aligns with the back of the blade’s gullets.
- Then correct each guide block to within the thickness of cigarette paper, or 0.001 in., of the blade.
- The Allen screw might pull the blocks in or out when

they are tightened, so this procedure could necessitate one or two challenges.

- With repetition, you will be able to adjust the guides by eye, looking for the smallest crack of light between the blade and the guide blocks.
- Lastly, bring the thrust bearing in the rear to within 1 /32 in. of the blade.
- This bearing is the only part that necessitates replacing, when it becomes stiff or scarred.
- Yet it is a standard part and can be bought in most automotive- or bearing-supply houses.
- With the guide blocks set this close, and with the back of the gullets just aligned with the front of the blocks, there is no room for the blade to twist or for the teeth to hit the metal guide blocks.
- In case I thought there was some advantage to replacing the guides or the blocks, then I would, yet I find the original system gives me excellent outcome.
- With the blade and fence lined up appropriately, the metal guide blocks are not rubbing continuously against one side of the blade or the other and creating friction hotness.
- The lower guides are set in the same way as the upper ones, however I frequently leave them backed somewhat away from the blade, except I am resawing chiefly hardwood.
- I have worked in numerous workshops, and none of the bandsaws I utilised there had lower bearing associations.
- With the saw properly set up, it is necessary to place only two of your fingers against the venture:
- You should be able to use one finger to push the stock and the other to hold it against the rip fence.
- In case you have to use the butt of your hand to push the

stock, something is wrong—either the blade is dull or it is no longer tracking on the centerline of the upper wheel and is misaligned with the fence, causing the wood to bind.

- Utilise mild but reliable feed force, permitting the blade to do the work.
- The sawdust should have a chance to be cleared from the kerf.
- For security, once your pushing fingers are within 6 in. of the blade, utilise a push stick.

Chapter 16 Miter Saw Fundamentals

Because miter saws were not around when many of us took a high school shop class, the majority of us were never taught how to use them. The hosts of those television DIY shows are no help. While rather lightweight and portable, the “chopsaw” deserves as much respect as any machine in the shop. It certainly carries as much potential danger. On the other hand, it is capable of more than you might know. With a few tips and upgrades, you’ll be able to do almost all of your crosscutting and mitering on the miter saw, like I do, getting furniture-quality cuts in half the time it takes to drag out your crosscut sled. Of course, the miter saw is also the quickest way to rough-cut lumber to size, and I have tips for that, too. My tips and techniques are based on the type of saw that I favor, the straightforward chopsaw, but many will work for sliding miter saws, too.

The first step is to replace the blade that came with your saw. It will struggle through big hardwood lumber, and it won’t have enough teeth for the finest cuts. You don’t have to buy the most expensive one, but do get a good blade intended for a miter saw. With any crosscutting tool, you have to deal with tearout. One of the best ways to enhance your miter saw is to add a zero-clearance throat plate and a sacrificial fence. These straightforward upgrades do three great things: They eliminate chipout at the bottom and back edges of the cut; they describe exactly where the blade will cut, at any angle, making it easy to line up a mark accurately; and they make the saw safer, preventing small offcuts from getting trapped against the blade and kicking back at you. To tame tearout along the bottom edge, some woodworkers cover the base of the saw with a full layer of plywood, but I prefer to replace the throat plate. That way, you don’t lose thickness capacity. Also, the saw always comes down in the same slot, even when pivoted for miter cuts, so you don’t have to replace that shopmade plate unless you change blades or make a bevel cut with the head tilted. I’ve made these inserts successfully for at least five different brands of saw. Just trace the standard plastic insert on a piece of ¼-in.-thick MDF. Then bandsaw and sand the edges to fit. If necessary, you can plane the insert to bring it flush with the exterior. To install it, you can use thick (exterior grade) carpet tape, or redrill the screw holes and use those. To prevent tearout along the back edge of the board, you can’t simply make a sacrificial insert in the metal fence. So I use a full layer of plywood there, which does steal some width capacity. I recommend ½-in.-thick MDF or plywood cut roughly 6 ft. long and just wide (tall) enough to fit under the motor or handle in its lowest position. The extra length comes in handy for attaching stops. Again I use carpet tape to hold the fence in place, making it easy to change. You’ll need to replace it when you change cutting angles. Using stops for repeat cuts is one of the best moves you can make on a miter saw. You can place them on either side of the saw, but for shorter cuts, the stop might need to go on the opposite side from the motor to avoid bumping it.

Chapter 17 Chopsaw fundamentals

Chopsaw is intended for carpenters and contractors of all stripes, miter saws come in a bewildering diversity of configurations. One advantage of running a woodworking school is that I get to purchase lots of tools and learn which features are truly worthwhile. For woodworkers, I've found that the simple chopsaw is the best bet and the most accurate. You don't need to pay extra for a big sliding model if you have a tablesaw and crosscut sled for wider stock. But the cost savings don't end there. You also can skip the double-bevel feature, since you'll get better cuts when pivoting the head rather than tilting it. And I'm not a fan of laser guides. They don't work in every blade position, and they need regular adjustment. On the other hand, I would go for the full 12-in. blade over the 10-in. size, and I'd ensure the saw has an automatic brake (most do) that stops the blade when the trigger is released. You'll understand why shortly. Another feature I find handy is a miter range of 50° or more.

All miter saws have a degree of slop in the arbor, which allows blade runout. That's why appropriate technique is so critical to getting accurate cuts. I don't essentially like the term "chopsaw" because it reminds me of words like "hack" and "slash." Forcing the blade will make it deflect and wobble. Also, a blade with more teeth needs more time to get through the wood. On the other hand, if you go too slowly, you'll get a burnt or burnished cut. So let the blade cut at its own pace—not yours. Go by feel. The same blade will cut differently in soft and hard wood, through larger and smaller workpieces. If yours is a sliding model, pull it all the way toward you before lowering it and pushing it through the cut. Again, go by feel. The second vital rule is to let the blade come to a stop before raising it back up through the cut. The cutting action tends to stabilize the blade, but it can wobble again when the cut is done. Also, you tend to raise the blade faster than you cut with it. That’s why you will hear that “twanggg” sound when you bring a spinning blade back up through the cut, and will see deep sawmarks. If the brake is working well, you’ll only have to wait a couple of seconds for the blade to stop, but the quality of the cut will be considerably better. So force yourself to develop this habit.

Miters vs. bevels

Because of the way the guard works, I do not like using a miter saw’s bevel function, in other words, tilting the head. There is just too much blade exposure, and it ruins the zero clearance insert. It also puts the weight of the motor on the side of its pivot point, causing it to flex sideways as you pull it downward, compromising the cut. The good news is that you can stand a narrow board up against the fence, turning a wobbly bevel cut into an accurate miter cut. There is also a great trick for avoiding compound-angled (bevel and miter) cuts on crown molding, turning those into straightforward miters, too.

Coax extra width out of your saw

There are a number of ways to get more width capacity from your saw. This is most often a issue when cutting rough lumber to approximate length, and typically on a chopsaw. Sliding miter saws are not my favorite, but they do have significantly more cutting capacity. First let’s cover an vital safety tip. When cutting bowed, twisted, or cupped boards, always ensure the stock is touching the fence and base in the cutting area. Otherwise it will dive down or backward as you finish the cut, pinching and binding dangerously against the blade. The first tip is that if your cut leaves ½ in. or less to be nicked off at the end, you often can simply lift the front edge of the board a bit to finish the cut. The other trick for rough lumber is to make as wide a cut as possible and then let the blade stop, flip the board over, realign the blade with the kerf or mark, and finish the job. For accurate, furniture-quality cuts, I have another handy tip. Just put some scrapwood underneath to raise up your stock to the larger part of the blade. You can add an inch or more to the width of the cut this way on a 12-in.-dia. blade.

Few more safety tips

In 2010, the University of Cincinnati did a study at our school on woodshop noise levels. The miter saw developd more decibels than any other tool in the shop. So always wear ear muffs or plugs, and of course, protect your eyes at all times. Never cross your arms. Most people do this when cutting miters, choosing to use their normal trigger hand no matter which way the miter is pointing. Miter-saw triggers will work with either hand, and for miter cuts you want to stand opposite where the saw is pointing. That might mean putting the board on the opposite side you are used to, and switching hands. This will give you better visibility and help you hold the stock more firmly so it isn't pulled sideways by the blade. Another time you might want to switch hands is to hold onto the piece that is trapped against a stop. I have a 3-in. rule on all power tools, making sure my hands always stay out of this danger zone. So for smaller pieces, I use a special stop and hold-down to keep the stock safely in place against the fence and table. These are easy to make. So make a few upgrades to your saw, let it come to a stop after each cut, and follow a few straightforward rules. Then you'll really see what a miter saw can do.

Chapter 18 Router Tips and Fundamentals

Doing a quick inventory of my shop recently, I discovered that over the years I have accumulated nine routers. Nine! How did that happen? Does the regular woodworker really need that many routers? The short answer, happily, is no. Still, the argument for having more than one router is powerful. You can leave one in your router table and have another for handheld work. Second, adding a router with particular strengths can make certain tasks much more convenient, whether you're cutting edge profiles with large, heavy bits or routing shallow hinge mortises on narrow stock. There are many router types obtainable, but which ones do you really need? I'll suggest two approaches. Either one will tackle a wide range of work, but the first is kinder to your wallet.

A combination router kit is a very cost effective way of setting up your shop for both table and handheld routing. The kit comes with one router motor and two bases—one fixed, one plunge. This lets you mount the fixed base in a table and keep the other for topside use. I recommend putting the fixed base in the table, mainly because the plunge base is so much more versatile for topside use. Second, when the router is mounted in the table, it's often easier to adjust bit height with the fixed base than it is with the plunge. This makes for an economical choice—you can find a good combination kit for around $200, saving $60 to $120 or more compared with the purchase of two individual routers of a similar size and power. To the combo kit, add a trim router. While its limited horsepower confines it to lighter-duty tasks, it is much easier to control than a larger router. It is also limited to working with ¼-in.-shank bits, but its lower torque and one-handed size are perfect for hinge mortising, inlay, and small edge profiles like chamfers and roundovers. It's great for any task that doesn't call for large bits, deep cuts, or lots of horsepower. With this package of routers, you can tackle almost each item .

The combination kit is a great value, but it does force a few compromises. For one, switching one motor between table and topside is much less convenient than having two individual routers. Second, in most combination kits, the motor is limited to 2 hp or 2¼ hp. If you cut deep mortises with your router or work with large shaping or panel-raising bits, you should consider investing in more horsepower. A heavy-duty plunge router like those reviewed in FWW #214 ("Heavy-Duty Plunge Routers") will typically come with better features than the plunge base in a combo kit. You'll get height adjustment that is easier and more accurate, a smoother plunge mechanism, and a handle mounted power switch. Also, the 3¼ hp motor will provide smooth, effortless action on the heaviest cuts. As another step up from the combination-kit approach, I'd recommend getting a router built to be installed in a table. This lets your router table become a dedicated shop tool with excellent controls, like a tablesaw, instead of something you have to fuss with for 15 minutes just so you can spend 30 seconds cutting an edge. Again, add a trim router to this combination and you're set to tackle the full range of routing tasks.

Chapter 19 Must have router bits

You’ve purchased a new router, unpacked it, and even found the switch on it. Yet, that’s only half the battle. Woodworking professionals new to the router will bump into a bewildering array of bits that do all types of work. Which ones do you buy first? High-quality router bits are not inexpensive, and making the wrong selections can hurt your wallet and border your woodworking skills. Consequently I’ve come up with a basic set of bits that will do a lot of things fine, from cutting joinery to pattern-routing to shaping profiles. You could get the whole kit for around $290—well worth the money when you contemplate all the tasks you can finish with it. Many of the bits in this group are carbide-tipped, which makes them sturdier than high-speed steel bits but less exclusive than solid carbide bits. Likewise, most have ½-in. shanks, which are less prone to breaking than bits with ¼-in. shanks. I don’t claim that these bits will be the only ones you’ll ever need, but they will create a rock-solid, versatile foundation for routing that can be expanded as your woodworking range increases.

Handheld vs. Table Mounted

For protection, I always do my routing on a table, because it delivers a stable work peripheral. I utilise a handheld router when a workpiece is too unwieldy to handle on a table or when the task simply is more suited to handheld routing, like running dadoes across a case side or chopping mortises. Once using a handheld router, work left to right. When routing on a table, work right to left.

GROOVES AND DADOES

A groove is cut along the long grain of a board, while a dado is cut across the grain. A sharp straight bit makes quick work of both tasks and gives you grooves and dadoes of even size. Commonly, grooves are easier to cut on a router table, but it's possible to cut them with a handheld router. Use a plunge router for stopped grooves. For accuracy, you'll need to employ the router's edge guide or secure a straightedge to the workpiece to guide the router. Dadoes often are cut in multiples and on longer, wider stock for case goods, so it makes sense to cut them with a handheld router. For speed and exactness, it's a good idea to use a right-angle jig that clamps to the workbench and across the stock. Fed appropriately, the router base will be pushed by the cutting action against the fence of the jig, ensuring a straight cut. Make the jig out of ¾-in.-thick plywood: Screw a fence to the base (both about 4 in. wide) at a precise 90° angle. Put the router base against the fence, then rout a dado in the base of the jig. Utilise that dado to align the jig with layout lines on the venture.

EDGE TRIMMIMG

You can use straight bits to make edge cuts just like a jointer. I frequently use this technique on workpieces such as tabletops that are too unwieldy to clean up on a jointer. To confirm a straight cut, make a jig a bit longer than the longest edge you need to rout. The jig should have a base of ¼-in.-thick medium-density fiberboard (MDF) and a ¾-in.-thick fence. Start by using the router to trim the edge of the base. After that just put that edge on the line you wish to cut. Ensure that the cutting edge of the bit is long enough to reach past the bottom of your project.

USE A SPIRALBIT FOR MORTISING

It's hard to find carbide-tipped spiral bits nowdays, therefore I selected a solid carbide bit for the kit. It’s an expensive piece of tooling, yet in case you plan to cut mortises with a router, this is the bit you should have. The flutes spiral around the bit, alike to the way a drill bit is cut, so it pulls chips up and out of the mortise. And with spiral flutes, there are always two cutting edges in the work, shearing cut, making for a smooth.

Chapter 20 How to use rabbeting bits

As the name implies, a bearing-guided rabbeting bit excels at cutting rabbets of varying sizes. While a straight bit can do the job, the bearing-guided bit ensures uniformity, an advantage if you're cutting a number of identical rabbets. A rabbeting bit with a set of different-diameter bearings allows you to change the width of the rabbet simply by switching out the bearings. Rabbets typically are not much deeper than ½ in., so the set I recommend adjusts to cut rabbets from 5 /16 in. to ½ in. wide. You can use the bit in a router table or in a handheld router. One advantage of a bearing-guided rabbeting bit is that you can cut rabbets in frames after they have been glued together, which ensures perfect alignment. The bearing controls the rabbet's width, so there's no need for a fence to guide the cut. Move the router clockwise around the inside of the frame.

Three-wing slot cutter, ¼-in.

Thick A slot cutter makes grooves to a precise, reliable width and depth, with a cleaner cutting action than a straight bit. It is utilised chiefly for cutting grooves for a frame-and-panel assembly, but it also can be used to rabbet the edges of panels and to carve attractive grooves in pilasters or panels. These ventures are best done on a router table. I pick a bit with three wings that cuts a ¼-in. kerf. Three wings provide more balance than two. The slighter kerf lets you to cut grooves for ¼-in.-thick panels as well as larger ones with a series of passes. You could alter the depth of cut by varying the bearing.

½-in. Dovetail bit

Dovetail bits are envisioned to make dovetails for drawers or carcases as well as sliding dovetails. Many of the dovetail bits have angles ranging from 7° to 12°. I favour the 10° angle that works well for both soft and hard woods. Both parts of a sliding dovetail joint can be cut on a router table. Dovetail bits are made to cut full depth. Therefore before you cut a sliding dovetail slot, run a ½-in. straight bit through first to clean out most of the remainings. Follow with the dovetail bit. This will encompass the life of the bit and leave a cleaner cut. Firs, cut the slot with the stock held flat on the table and a backer board behind it to keep the venture, square to the fence and avert blowout. With the bit height untouched, reorganize the fence to cut the dovetail on the end of the mating portion. Make test cuts in a scrap piece the same width as the stock.

45° Chamfer bit

The chamfer bit is used to bevel the edge of a project. The 45° model I've included in this kit (1¼ in. dia.) is the most known. It's quicker than a block plane for creating uniform chamfers on legs, aprons, and tabletops. You also can utilise it to achieve great visual effects. The bearing on the bottom of the bit allows you to make cuts without a fence. To upsurge the depth of the chamfer, raise the bit.

¼-in. Roundover bit

A bearing guided roundover bit facilities sharp curves and softens the look of a piece. The ¼-in. bit is a good moderate size to start your collection, as it will cut roundovers with or without a step and can be used to create ½-in.-thick loose tenon stock as well as molding profiles. To help avert tearout, take light passes, progressively raising the bit until you're cutting at full depth. End grain is prone to blowout at the end where the wood fibers are unsubstantiated. The answer is straightforward: Round over the end-grain edges first, then rout the long grain. Working this way eliminates any blowout that occurs on the end grain.

⅜-in.-Radius cove bit

Certain router bits are intended simply to make attractive cuts. One example is the cove bit, which creates a straightforward concave edge. I utilise this bit frequently to create a hidden pull in a drawer front. As the cove bit is intended to make profile cuts, this outstanding is simply a matter of perception. You might choice a dissimilar profile, depending on the project you do. The extra of having both a cove and a roundover bit in your kit is that you can utilise the bits in tandem to create a dense profile, or a drop-leaf table edge if both bits are the same radius.

½-in. Flush-trimming bit

With a bearing guided flush-trimming bit, ½ in. dia. is ordinary, yet you could hand-picked a different diameter if you'd like. I endorse getting a 1 ½-in.-long bit, though, as the extra length comes in handy when working with thick stock. The flush trimming bit is indispensable for trimming face frames flush to carcases, and for trimming edge-banding flush. With the flush-trimming bit, you also can replace pieces simply on a router table. The bearing rides either against the original piece or against a pattern or template secured in a jig with hold-down clamps. Before mounting the workpiece in the jig, cut away most of the waste. Be vigilant not to rout uphill, as that could cause severe tearout. When you reach the point where the grain changes course, inverse the project in the jig.

Chapter 21 Drill press tips and fundamentals

There's no disputing the usefulness of a handheld drill. It's perfect in situations when you need to bring the tool to the work. It can drill pilot holes and drive screws at the bench or inside cabinets. But that flexibility comes at a cost. A handheld drill is prone to tearout and lacks the power to drive larger bits. And even with cautious layout, drilling in exactly the right place at the right angle can be hit-or-miss. To do your best work, you need a drill press. The drill press is all about control. It lets you precisely determine the placement and angle of the hole as well as its depth. It also provides power and leverage to drive the bit simply, even in hard stock, and it lets you raise and lower the bit repeatedly without altering the shape of the hole. The table supports the workpiece nicely, and makes it easy to place a backer board below the hole, which prevents ugly blowout on the bottom side. You'll end up with perfect holes, plus counter bores and countersinks that are precise and chatter-free. The drill press is a useful machine, but not an especially expensive one. It's intended for metalworking, so even the less-expensive models have plenty of power and stability for woodwork. And they are hard to damage, so it is easy to find a good used one. I bought a big, strong benchtop model out of the local classifieds for $150. You won't want to throw out your cordless drill, but once you have a drill press in your shop, you'll appreciate the power, accuracy, and control of a real drilling machine.

The first thing to do with a new drill press is to fit it with an auxiliary table. That's because the typical drill-press table is too small to support big workpieces. The stock table also has a big hole in the center for bit clearance. That big opening allows far too much tearout on the bottom of the workpiece. To eliminate that issue, and to give yourself plenty of room to work, you can install one of the snazzy auxiliary tables obtainable in woodworking catalogs. These typically feature accessories like zero-clearance plates in the middle, and handy fences that lock down rapidly and accurately. Or just make your own table. It can be as straightforward as a piece of MDF, with the occasional fence clamped on for repetitive work. Two other accessories you'll love are a clip-on light (the top of a drill press tends to cast a shadow on the work area), and a foot-activated switch.

How to set it up

ADJUST THE TABLE HEIGHT

- You can raise or lower the table to accommodate any drilling task.
- Set the height so you'll have enough room for the bit to clear the work, but not so much travel that it makes drilling inconvenient.

SET THE DRILLING DEPTH

- A stop on the drill-press column lets you make repeated cuts at the same depth.
- Mark the desired depth on the side of the stock, plunge the bit to that point, then adjust and lock the depth stop.
- Plunge the bit once more to be sure it stops at the right spot.

ADD A FENCE FOR ALIGNMENT

- Once you've established the distance between the bit and the edge of the workpiece, you can lock down the fence and drill dozens of holes in a row.

The three adjustments you’ll make most often are speed, table height, and plunge depth. Each of these takes less than a minute. You can buy a variable-speed model for on-the-fly speed changes —and spend a lot more money— but I think the old-produced pulley-style machines offer plenty of speed settings for woodworking tasks. On pulley-driven drill presses, you’ll find a speed guide somewhere near the top of the machine, often inside the pulley cover. The recommended speed varies with the size of the bit. You should not run any bit faster than 3,000 rpm, and you should slow the speed considerably for larger bits. For instance, a 1-in.-dia. bit should run at 300 rpm to 500 rpm in hardwood. After setting the speed, put the bit in the chuck and tighten it. Unlike modern handheld drills with keyless chucks, most drill presses still use a keyed chuck that must be tightened manually to hold the bit in place. Be sure the bit isn’t bottomed out in the chuck, or hung up between two of the three jaws. The chuck is self-centering, meaning that all three jaws move in unison when the key is turned. This means it is not necessary to tighten each jaw individually. Always eliminate the chuck key right away! You don’t want any surprises when you hit the “on” switch. Also, find a way to keep track of the chuck key. Mine hangs on a chain, but I’ve also seen lots of ideas for chuck-key holders, using magnets, pen caps, etc. Now, with the bit in place and the workpiece on the table, you’ll know where to set the table’s height. For deep holes, you want the tip of the bit just above the workpiece so you can take advantage of the drill press’s full plunge depth. Lastly, if you are not drilling all the way through the workpiece, you’ll need to set the depth stop. This is easy, too: Mark the desired depth on the side of the stock, plunge the bit down to that point, spin the depth stop down until it is snug, and lock it there. Plunge the bit once to be sure it stops at precisely the right spot, and you are set.

Another great thing about a drill press is that you can put a fence on it. This means that once you've dialed in the distance between the bit and the edge of the workpiece, you can lock down the fence and drill dozens of holes in a row. Add a stop block to the fence, and you've locked in the hole location in both directions. I still recommend laying out the holes cautiously (or at least the first one in a series) using a crisscross mark, and sighting cautiously along both axes as you bring the tip of the bit down. When it looks perfect, turn on the machine, and touch the tip down lightly to double-confirm the position. Fine tune the fence or the stop if necessary. Even if I have only one hole to drill, I still use the fence in most cases. If nothing else, it keeps the stock from spinning when the going gets tough. By the way, the lower the fence the better; tall fences sometimes get in the way of the crank handles.

How to drill clean holes

- Even with all this heavy-duty drilling hardware at your fingertips, getting the best results calls for some attention to the particulars.
- To avoid burning the stock, be sure to use a sharp, high-quality bit.
- Also, don't set the bit speed too fast or lower the bit into the work too slowly.
- Clogged chips are the only other thing that will cause burning.
- The solution is straightforward: As you feel the bit start to hesitate in the hole, withdraw it momentarily to allow the flutes to clear themselves.

- But here’s the trick: Don’t bring the bit all the way out of the hole.
- If you do, it will sometimes tear the rim.
- Just bring it up high enough to let the packed chips fly free.
- Tearout is more of an issue on the bottom of the workpiece, but again prevention is painless: Ensure there is a fresh wood exterior under the workpiece at the exit point.
- Some auxiliary tables have removable panels in the middle, and these can be flipped around to find a fresh exterior.
- Or you can loosen the drill-press table and shift it sideways.
- A straightforward approach is just to keep a big piece of MDF or plywood on the table, shifting it around to find a fresh exterior.
- When it becomes riddled with holes, you can just replace it.
- There are lots more things you can do with your drill press, like tilting the table or making ramplike jigs to drill angled holes, but I’ll leave it to you to discover those.

Chapter 22 Essential Measuring and Marking Tools

Guarded layout is vital to every woodworking venture. Measure or mark a part imprecisely and it almost certainly will cause issues along the way. That point was driven home recently as I taught a woodworking class where students used principally hand tools to build a writing desk. As the course advanced, the correlation between operational layout and effective woodworking was clear. Students who watchfully laid out their ventures, short markings built their desks rapidly and competently, with fewer obstacles. Students who laid out their ventures with faint and uneven markings had to work at a slower, less useful pace. Not unexpectedly, the second group took lengthier to complete their desks. This has made me consider my favorite marking and measuring tools, the ones I keep within easy reach and use nearly each day. These tools are as vital to my work as any hand or powered cutting instrument. A well-equipped shop, I feel, should contain one of each as follows:

12-in. Combination square

The 12-in. combination square is an 8-in-1 tool that I find crucial. Its adaptability comes from the unique shape of its head and an adjustable blade that's incrementally marked as a rule. This tool can be used as a long- or short-bladed try square, and as a miter square. The adjustable rule allows it to serve as a depth gauge to validate the depth of a mortise, dado, or hole. It too can be set up as a height gauge to confirm tablesaw-blade or router-bit height. Utilised with a pencil, it can scribe lines parallel to board edges, much like a marking gauge. A glass level vial, set in its head, authenticates that things are level and plumb. The last advantage is that the blade can be eliminated and utilised as a straightedge or precision rule. Inexpensive, store variations are typically not well machined or marked. To get the most out of it, purchase it from a trustworthy maker.

Framing square

Another square I find valuable, chiefly for large-scale work, is the framing square. While normally viewed as a carpenter's tool, it is extremely useful in the shop. Made from one piece of aluminum or steel, roughly ⅛ in. thick, with one arm incrementally marked to 16 in. and the other to 24 in., it serves as a jumbo try square for larger work. Amongst other tasks, I utilise mine to lay out cut lines on panels or wide lumber, to define joinery across wide case pieces, to test the curves of panels to validate correctness, and to confirm case assemblies for squareness. While framing squares are not costly and in general are not viewed as exactitude tools, I've utilised the same one for many years and have never had an issue with it.

4-in. Engineer's square

A 4-in. engineer's square is great for setting up or confirming machinery fences, blades, or tables for correctness. It too helps in authenticating that stock is true and square. I utilise it for layout tasks where pencil or knife marks are scribed on board edges or narrow faces, as in door, chair, or frame building. It too can be utilised to validate the squareness of smaller assemblies, such as doors, cases or drawers. Made of precision-milled steel, engineer's squares are dead precise. And they stay that way forever, assumed correct upkeep. They are rather inexpensive, and the little extra spent on a trustworthy brand will pay for itself in the long run.

12-ft. Tape measure

I use a steel tape for many of my day-to-day measuring tasks. Tapes range in length from 8 ft. to 25 ft.; the blade widths run from ½ in. to 1 in. I like a 12-ft. tape. It's long enough for most furniture-making needs, but not so heavy as to weigh down my pocket or belt. I prefer a ¾-in.-wide blade, simply because it is more rigid than the ½-in. That's useful when the blade must extend unsupported in order to make a measurement. The blade markings should be clear and easy to read. I utilise a tape for most inside and outside measuring tasks. The hook on the tape end is envisioned to move in or out its exact thickness, enabling the tape to read inside and outside measurements precisely. If the hook is bent, the measurement will be inaccurate. Periodically confirm the hook against an accurate rule, and correct as necessary. In case there is a real precision is needed, I like to bypass the tape's hook and line up the tape on the 10-in. mark, take the reading, and then subtract 10 in.

6-in. Steel rule

A 6-in. steel rule is handy for setting the fences on tablesaws, routers, marking gauges, or plow planes. I also use it to set up blade or bit heights and to confirm stock thickness. It's great for laying out the full range of joinery, from mortise-and-tenon and dovetail joints to dowels and biscuits. Look for a rule with markings etched into the steel, as they generally are easier to read. The markings should run from end to end so that you can measure from an inside corner. A rule that also has marks parallel to one end is a plus, as it makes some height adjustments easier.

Marking knife

When a task requires a finer line than a pencil can make, a marking knife is my tool of choice. One of my favorites is a version made by Veritas, called a striking knife. It has a slender blade that tapers to an acute point, which is easy to slip between tight spaces and reach into tight curves. The blade is flat on one face but has two bevels on the other, making it suitable for both left- and right-handed marking. The flat face also allows it to fit right up to an edge. The blade is housed in a comfortable rosewood handle that is easy to grasp and enhances precision and control. The sides of the handle are flattened so that it won't roll off the workbench.

Pencils

I use a diversity of pencils, each suited to a particular task, such as marking boards for rough dimensions, basic joinery layout, designating waste areas, and shop math. For general shop use, I prefer a No. 2 pencil, sharpened to a point with a conventional sharpener. For jobs such as dovetailing, where a finer, more precise line is required, I use a No. 3 pencil because it has harder lead. I shape the point with a block plane and sandpaper to create a fine, knifelike edge. Colored pencils also are useful. For dark-colored woods like walnut and wenge, the mark from a white-lead pencil is easier to see. I use other colors on all wood types to define and designate cabinet or chair parts.

Fractional dial caliper

Dial calipers generally are viewed as machinists' tools, but they are great in the woodshop. They are capable of inside, outside, and depth measurements. A thumbscrew locks the jaws for measurement transfer. I find dial calipers helpful for verifying stock thickness, confirming joinery size and spacing, and measuring turned parts. Unless you enjoy reading conversion charts, I would recommend the type with a dial incrementally marked in both fractions and decimals.

Marking gauge

A combination-type marking gauge offers the user two options. One side of the gauge has a single pin, the other has a pair of pins. It is vital to sharpen all the pins to a keen edge that will develop a knifelike cut. The single pin is used to scribe lines parallel to a board edge. It’s used across the grain for such tasks as scribing a baseline for dovetails or a tenon shoulder. Working with the grain, the single pin on a combination gauge can define a rabbet cut, or scribe a reference line to work to while preparing stock with hand tools. The side with two pins can serve as a mortise gauge, allowing you to scribe simultaneously two lines parallel to a board’s edge.

Scratch awl

Traditionally, an awl was used for scribing lines with the grain or on end grain where knife marks are more difficoult to see. I like to use an awl to mark the center of drill-hole locations. The impression left by this pointed tool helps to center the bit and ensure precise drilling whether you use a twist, brad-point, or auger bit. It also can be used to locate or start a center for lathe work. Awls come in all shapes and sizes. The bottom line is to get one with a comfortable handle. I like it to have a few flat spots to keep it from rolling off the bench and a tapered, cylindrical shaft that terminates in a sharp conical point. Plain or fancy, take your pick.

You don’t need to be high-tech to achieve high precision. Whether you need to move your tablesaw fence a few thousandths of an inch or craft a perfectly fitted mortise-and-tenon joint, you can see and control nearly invisible differences by using two of the most common and ancient tools around—a pencil and paper. The Then time you want to dial in a higher level of accuracy, don’t reach for your credit card to buy the latest alignment gadget. Instead, pull a few business cards from your wallet and a pencil from your tool belt.

Whether sharpening, planing, or routing, sometimes the amount that needs to be eliminated is so little it’s hard to see with the naked eye. Drawing pencil lines on the workpiece or the tool can make your progress simply visible.

A waterstone needs to be perfectly flat to work well, but it is hard to tell when this has been achieved. To track your progress, draw light pencil strokes on the face of the stone before flattening it. The marks will disappear first on the high points, so keep rubbing until all pencil strokes are gone.

A jointer or handplane is used to refine tablesawn tapers on a leg, with each pass extending the taper farther up the leg. But stray into the designated flat area, and you’ll see a gap when the apron is attached to the leg. A few pencil strokes near the start of the taper highlight when to stop planing.

When fitting a tenon to its mortise, it can be hard to assess where the tenon is too thick. Pencil strokes on the tenon cheeks will rub off where the fit is too tight.

If you’re flattening a glued-up panel, start by finding all of the high areas using a straightedge and marking them with pencil strokes. This way you can concentrate on the areas that need the most wood eliminated. You’ll also be able to track any places you missed. Use a different pattern of pencil strokes in the lowest spots as a warning to avoid planing these areas.

When bringing trim or a plug level with its surroundings, you need to set a straight bit to cut exactly level with the exterior. Mark a piece of plywood with some heavy pencil strokes, then gradually lower the bit until the pencil marks get lighter but are just visible. While this might sound hard to attain, a good micro adjust system on your router will simply allow you to dial in just a couple of thousandths of an inch at a time. If you go too deep, back off, draw some more lines, and try again.

Paper shims

I continuously need to adjust a setup, fence, or workpiece by a few thousandths of an inch to achieve perfect accuracy. Paper is a great way to make precise adjustments. A non-embossed business card is typically 0.011 in. to 0.012 in. thick, standard 24-lb. printer paper is 0.005 in., and phone-directory paper 0.002 in. to 0.003 in.

Chapter 23 Clamping Tips and Tricks

Most woodworking professionals have only the imprecise idea of how much clamping force to put on when gluing boards. Even those obsessives who depend on on dial calipers and feeler gauges when cutting and planing wood frequently judge clamping pressure simply by the amount of glue that squashes out. The consequences are occasional joint let-downs and awkward gaps between boards on the ends of tabletops. Throughout my career in wood technology I've done technical studies of glue joints using diverse types of glue, different clamping pressures, different grain orientations and different species of wood. I'll take up you're using yellow (polyvinyl acetate—PVA) glue and I'll try to answer the following questions:

- What is the optimum force when clamping soft and hard woods?
- How many clamps should you use and how should you position them?
- And lastly, how can you test a sample joint to see if you are getting great effects?

Use this info to approach your next glue-up with newfound sureness, and the only thing under pressure will be the wood. Optimal clamping pressure creates strong glueline joints in numerous ways. First, it disables the viscous resistance of the glue and forces it into a thin, unceasing film in contact with the wood, which is essential for a strong joint. Additionally, as the glue releases moisture, causing the wood to swell, clamping overcomes this weight and averts the joint from opening up. Thirdly, it overcomes minor exterior inadequacies between mating surfaces. And fourthly, clamping holds parts in place until the glue cures. Too tiny pressure will fail to achieve any of these welfares.

Equally, great pressure can develop weaker joints, while as I'll explain later, this is unlikely with common woodworking clamps. As modern glues are sturdier than the wood fibers, a good glue joint should break in the wood, a procedure known as wood failure, rather than along the glueline. Therefore rather puzzlingly, the higher the percentage of wood let-down, the better the joint. The wood-failure percentage starts to reduce as clamping. Both the wood species and the grain orientation mark the clamping pressure required for a strong glue joint. Overall, dense and tight-grained woods require the application of greater force. On hardwoods, glue joints between radial or quartersawn faces involve half the pressure of tangential or flatsawn face joints. This is because on hardwoods, the quartersawn face has half the density strength of the flatsawn face, so the fibers are more simply crushed. On softwoods, the opposite is true, with the quartersawn-face gluelines necessitating twice the pressure of the flatsawn face gluelines.

Bonus Chapter Glue-Up Gear and Accessories

I use a few types of clamps and a wide diversity of cauls to put pressure right where I want it and to keep parts in place. Thais chapter covers a variety of specific circumstances; this one covers the glue-up gear I keep on hand. The beauty of these basic cauls and supplies is that they will handle the vast majority of work you will bump into. I utilise common types of clamps. I use a bunch of custom cauls in my work, made from what-ever hardwood I can spare, but I keep a diversity of common sizes in buckets. When clamping pieces that are pre-completed or will be hard to sand or repair later, I use small pads under the clamp heads. In case the jaws don't have pads already, I tape pieces of wood to the venture. You don't want to be wrestling with little wood pads as you try to position the clamps flawlessly and tighten them. I keep a pile of these pads on hand, made from basswood and poplar—softer than the furniture woods I use but strong enough to stand up to the pressure. As for glue, some people pour it into little dishes before spreading it, but I almost always spread over it right out of the bottle, and I use my finger, wiping it clean on one of the world's crispiest aprons.

Best Glues for Woodworking

Unless they confine their woodworking to knockdown equipment, all woodworkers rely on glue. As a result, there are dozens of types of glue and masses of competing brands all declaring their advantage. To help make sense of it all, I have run a test with three main objectives. The first was to compare six common types of wood glue; the second was to see if the type of wood might affect the bonding strength of the different glues; the third was to conclude how tolerant the glues are to poorly cut joints. The results were enlightening. Some older glues performed excellently, while a newer glue was less than imposing. The wood type does make a change, yet don't believe the stories that say all dense tropical woods are hard to glue. It is not true. And, while glue hunger seems to be a myth, so does the gap-filling skill of some glues.

Selecting glues, woods, and gaps

To see whether an open-grained wood bonds otherwise from a tight-grained one, we selected hard maple and white oak. Dense tropical woods have a reputation as being hard to glue. We envisioned to ustilise teak, but the lumberyard owner suggested ipé, as he had heard many grievances about glue failure with this wood. We selected a traditional interior polyvinyl acetate yellow glue; a newer PVA glue with a Type I waterproof rating in the form of Titebond III; two types of hide glue, a room-temperature version and traditional granules that must be blended with water and heated; a two-part, slow-set epoxy. In case the joint is messy, will the glue fill the gaps? On the other hand, in case the joint is so tight it has to be hammered home, will it be hungry of glue? Does a flawlessly fitting joint advance the strongest glue bond? To answer these questions, we tested bridle joints with three types of fit: tight, snug, and loose.

If you are self-assured in your joint-making skill, then stick with good old-produced interior yellow glue. It was only a little weaker than Type I PVAon tight and snug maple and oak joints, and it was stronger on ipé. In case your joint-making skills still need a little help, go with the more expensive Type I PVA.

Based on the consistent strength of all the joints, liquid hide glue beat out hot hide glue. Nevertheless, in case you look at specific joints and woods, hot hide glue was toughest in five of the nine classifications. I had predictable liquid hide glue to be weaker due to the addition of urea to keep it workable at room temperature, nevertheless in this test the two glue types were about equivalent. Where hot hide glue was moderately weakest was on snug and loose ipé joints.

In only two of 16 classifications did maple develop a stronger joint than oak. Hide glues in particular give the impression to get a better bond on open-pored woods. This may clarify why period furniture makers have great achievement using hide glue on mahogany, another rather open-pored wood.

The strongest joint in the whole test was yellow glue on ipé - a real amazement. Certainly, both yellow glue and Type I PVA were tougher than epoxy in tight and snug ipé joints. On loose ipé joints, epoxy exhibited no great improvement, therefore I would stick with either interior PVAor Type I PVA on this tropical wood. At all costs, don’t expect that polyurethane will fill a loose ipé joint.

Book 3

Woodworking for Beginners

How to design your first Workshop

Karl Winkler

Chapter 1 Workshop tips for basements

A basement is a hole in the ground and attracts all manner of moisture, with questions such as mildew, rust, even small floods. Underground rooms aren't flooded with natural sunlight, either; single incandescent fixtures are the norm, typically scattered where you don't require them. Additionally, basements are where household items go to die, so space is tight. Still, for lack of an alternative, numerous woodworkers set up shop in the basement and have to deal with any or all these dreads. To help them out, we asked our experienced friends for tips on making a basement workshop drier, brighter, and more space-efficient. We also asked folks how they prevent noise and dust from infiltrating the living areas above. The reaction was overpowering, and we got plenty of nifty solutions to common issues. We used those thoughts to create a virtual basement shop that is as comfortable to work in as it is inconspicuous to the rest of the household.

Basement walls are concrete, a absorbent material that allows moisture penetration if you don't take measures to stop that migration. It's well worth the effort, though. For instance, numerous basements are moist, and folks who have basements are familiar with the term "musty." In summer, there's an odor in the basement that's impossible to miss but hard to pinpoint. In wintertime, the cold, moist air can chill even your fingernails. And the moisture does not just create a painful working atmosphere. It too will rust your tools and increase the moisture content of lumber to undesirable levels. In case you get standing water frequently, you may have issues that need to be addressed by a professional waterproofing contractor before placing expensive tools and supplies in harm's way. Nonetheless if you simply have a damp space, there are numerous ways to fight the fog. If you're battling moisture, the cause may be rooted outside the house. Confirm that the house gutters are not stopped and that the downspouts are directed away from the foundation. Where conceivable, try to grade the appropriately so that it slopes away from the house. This may be easier said than done. One of the first things we heard from our online responders was to add a dehumidifier. You can get one at any home center. Dependent on the size, the cost will run from about $150 to $250. Once you install the dehumidifier, make a habit of emptying it regularly, especially during the humid summer months. You could decrease moisture by sealing the walls and floor with a moisture blocking paint, such Damplock. These thick coatings have the added benefit of giving the area a bright face-lift that reflects light. Last of all, you can fight rust directly by placing desiccants in tool drawers or coating exteriors lightly with paste wax. Dust is a known poison, so it's vital to avoid as much of it as possible from floating around. In case you work in an underground room, the dust also becomes a nuisance upstairs, as it will migrate into living zones. So get a dust collector and an air cleaner to help keep the particles at bay. You'll too appreciate the fact that there will be less to sweep up. Along with dust, a woodworker's passion for building things comes with another inhospitable by product: noise. Once you're working below the living area of your home, you must be mindful of others above. We have uncovered some nuggets that helps drop the noise that can invade living areas. You can launch a systematic, all-out unpleasant against sound. Nonetheless there are smaller steps you can take to help turn down the volume. One way to decrease sound transmission is to separate the drywall from the edging. You can install resistant metal channel in the ceiling, yet a cheaper substitute is stapling polystyrene sill sealer to studs and ceiling joists to create a cushion between the wood and the drywall. Insulation between framing also will help decrease sound transmission; the higher the R-value, the superior the insulation will dampen sound. Though you can't put a muffler on your tools, you can decrease the output of two of the more annoying accessories in the shop: the compressor and the shop vacuum. By housing each of these in a soundproof chamber made of plywood and acoustic padding, you drop the noise level of each machine. Just ensure that the box has enough holes or vents for airflow out. One of the sole aspects of a basement shop is that there's often a door leading directly to the living zones of the household. Choosing the correct door, or adjusting your existing one, can help decrease the amount of noise and dust that enters the home. High-frequency noises produced by routers and shop vacuums get in through cracks, while low-frequency sounds, such as those generated by a deadblow mallet on a workpiece, migrate through mass. It is suggested treating the basement door as though it were an exterior entry, where you want to stop air infiltration. Your first option is install a weighty, prehung exterior door, with all the attendant weather-stripping in place. The weatherstripping will cut down on the high-frequency sound, and the mass of the door itself will soften the low-frequency noise. In case you don't want to add a new door, retrofit the basement door with weather-stripping along the door stops, and add a vinyl sweep to the door bottom. By their nature, basements don't get ordinary light, therefore you need a boost here. Naturally, basement lighting schemes are not well-thought-out by builders. You often get a small handful of single bulbs scattered here and there. Yet you can change the lighting scheme to generate a more inviting, happy workplace. The objective is to create uniform lighting from corner to corner, and fluorescent fixtures are the most economical way to do it. In case you have existing incandescent fixtures, replace them with banks of fluorescent lights to illuminate as much of the space as possible. If you don’t have existing fixtures and wiring, it’s worth the investment to hire an electrician to run the wiring and install the fixtures. In order to help with light reflectivity, you can paint the walls white and coat the concrete floor with epoxy paint. An additional choice is to lay down light-colored vinyl tile. Looking after the floor not only helps with light reflection, yet it also fights moisture and makes it easier to sweep up any wreckage. In case you need to, add task lighting at your bench or at machines that cast shadows on their own tables, such as a floor-standing drill press or a bandsaw. It’s also beneficial to illuminate storage zones. As with most woodworking workshops, a basement can get filled with tools fast. Yet basement areas can be small to start with, and often store stuff for everyone in the household, therefore storage for your lumber, tools, and accessories becomes even more of a contest. Numerous people recommended using narrow or oddly shaped areas, such as the space under stairs, to store lumber and scraps. Those with larger basements built separate storage rooms around their water heaters and furnaces. This resolution not only creates a neat storage selection, but it also separates the utilities from dust. Certain folks simply store most of their wood outside, bringing in stock as they require it. Other folks built wood stud walls over the concrete exteriors, making it easy to hang cabinets, lumber racks, or other storage systems. The bottom line: Use spaces smartly, and you’ll stay well organized and avoid mixing your lumber scraps with the laundry. A basement may not be the ideal place to set up shop, but for numerous folks it’s the best option. Instead of toiling in a dungeon, you can create a clean, well-lighted place. In the end, you’ll be more comfortable and so will your housemates—a win-win for everyone.

Chapter 2 Design Tips for Garage Conversion

It’s possible to build furniture just about anywhere—I’ve done it in an attic and on a narrow balcony —but it’s more enjoyable and easier in a shop dedicated to woodworking. You don’t have to pack up your tools and ventures at the end of the day or work around a lawn mower, bicycles, or cars. The good news is that it’s not as hard as you might think to have a dedicated shop. The three shops featured here are great examples of how it can be done on a diversity of budgets. And all of them are detached from the house, which minimizes the amount of dust and noise that make it into the living space.

It was easy to see I was losing numerous of my heating dollars through the gaps in the garage doors. Weather stripping and insulation kits are obtainable for doors in good repair, but my old rotting doors had to go. The question was how to replace them. I thought about a set of steel insulated doors, but I didn’t like the idea of hoisting open a roll-up door in the middle of winter and letting the cold air rush in. Instead, I decided to replace one of the overhead doors with a normal walk-out door. This would provide easy entry and create a few extra feet of much-required wall space. I did this by framing in a pair of narrow panels that would flank an inexpensive, prehung steel entry door. Each panel consists of a 2x4 frame faced with CDX plywood (rated for exterior use). The frame is filled with rigid insulation and covered with drywall on the interior face. To dress up the exterior, I glued and nailed pine boards to the plywood for a frame-and-panel look. Windows with square corbels below the sill added an Arts and Crafts element that would complement my home’s bungalow style. For the second bay, I required a different approach. Even though I never intend to park a car in the space, I still wanted to leave a door wide enough to drive through in case we ever decide to sell the house. I also like the idea of having a large opening for machinery and lumber, and letting in sunshine on nice days. Instead of a roll-up door, I opted for a pair of swing-out carriage doors. I thought the carriage doors would be easier to weather-seal and would offer more insulation. Eliminating the garage door’s overhead tracks would also give me supplementary headroom and provide greater flexibility with the lighting layout.

After getting a quote of $6,000 for professionally made doors, I decided I could make my own. I wanted the doors to be lightweight, well insulated, and really rigid to resist sagging over time. True frame-and-panel building didn’t seem to be a good way to accomplish any of those tasks. Instead, I chose a torsion-box design consisting of a solid wood frame with plywood on each face, similar to the way a hollow-core door is made. This would create a very rigid structure with plenty of room for insulation. I started with a 1 ½-in.-thick poplar frame joined with stub tenons. Long tenons aren’t necessary; in fact, biscuits would work fine, because all the strength comes from the plywood skins. I used a dado blade to cut a ½-in.-wide by 1-in.-deep groove in the frame parts. I also used the dado blade to cut stub tenons on the ends of the parts to fit the groove. The frame was glued and screwed through the tenons. I filled the cavity with rigid insulation and glued and nailed plywood to each face. This created a very rigid torsion box that should resist sagging for numerous years. The outer face is ½-in. plywood while the inside face is ¼-in. plywood to help keep the weight down. I added windows and framed the outside face with ¾-in.-thick lumber for a frame-and-panel look similar to the other bay. The final outcome is 48-in.-wide door that weighs less than a typical solid-oak entry door, and at $450, is far cheaper than a custom-built door. I mounted the doors with long strap hinges that are plenty robust and look great. They were also very easy to install. First, I attached the hinges to the doors with lag screws. Then I set the doors in place using shims to locate them appropriately. With consistent gaps all around, I bolted the hinges to the door frame.

I glued and nailed pressure-treated 2x4s to the concrete floor, placing rigid insulation in between. The insulation I used was the same thickness as the 2x4s, so I spaced the sleepers 24 in. on center. Typically a spacing of 16 in. would be necessary to prevent the floor from sagging under the weight of heavy machines, but since the rigid insulation has good compressive strength, 24 in. is fine. Before screwing the ¾-in tongue-and-groove plywood in place, I stapled 6-mil plastic over the insulation to act as a vapor barrier, just as Gibson recommended. I moved as much as possible out of the shop by filling an 8-ft. by 12-ft. portable storage container that was dropped off in my driveway before building started. Unfortunately, some machinery didn’t fit, so I had to install the floor in two parts, moving the tools from one side to the other. Installation would have been easier in an empty shop, but I was able to get the entire floor done in a day. The new floor is warmer, easier to sweep, and much kinder to my feet and joints.

The ceiling posed a challenge. I like the looks and reflected light provided by an enclosed ceiling, but the bottom of my ceiling joists were now only 7 ½ ft. off my new plywood floor. The space felt more cramped and claustrophobic. My first thought was to spray insulation on the underside of the roof and leave the ceiling joists open. The insulation contractor said I'd still need to cover the insulation with plywood or drywall if the joists were left open, so I decided to look into raising the joists and enclosing the ceiling. I spoke to the local building department about my situation and an engineer in the department concluded I could raise the ceiling joists 2 ft. without creating structural issues. I had always thought of building inspectors as something best avoided on small home-improvement jobs, but on this venture, they were a big help. I'm a woodworker, so the idea of raising ceiling joists was a little scary. Fortunately, the actual procedure wasn't that bad. I was able to reuse the existing joists by cutting them one at a time and nailing them in their new location. One smart thing I did was to rent a cordless Paslode framing nailer from my local home center. The final ceiling is a lofty 9 ft. While the floor plan didn't grow, the shop now has a more spacious feel and by adding some ½-in oriented strand board on top of the ceiling joists, I have some much-required storage above the ceiling. To access that space, I installed a fold-down attic ladder and wired a light in the attic. For insulation, I decided to spray the underside of the roof with open-cell foam insulation. Since my rafters are only 6 in. deep, I only was able to achieve an R20. But since foam practically eliminates air movement, which experts say is the real nemesis in heat loss, it should perform very well. When it came time to reinstall the lights, I decided on an upgrade. I substituted my three old 8-ft. two-bulb fixtures with nine 4-ft. four-bulb fixtures, effectively tripling the amount of light in the shop. With the addition of the white ceiling and walls, my shop now glows.

The walls of a typical frame-building garage are easy to insulate. But the walls of my shop are concrete block, so I used an insulation technique more suited to a basement shop, but with a modern twist. Rather than frame out the concrete wall in the typical fashion with studs on edge and the insulation in between, I took a different approach. I started by covering the masonry wall with a continuous layer of rigid insulation, wedging it between a top and bottom plate that I nailed to the block wall. Over that, I attached the studs flat against the insulation, nailing them to the plates. From there, I installed a second layer of insulation between the studs and completed with drywall.

Installing the studs on edge would have created a thermal bridge from the block wall to the drywall, reducing the insulating appropriateties of the wall. The continuous layer of insulation between the block wall and studs acts as a thermal break and should outcome in lower heating bills. The completed wall is only 3 ½ in. thick but boasts an R-value over 20.

What started as a long-overdue insulation job ended up as completely transformed workspace. In replacing the doors, I wasn’t looking to beautify my home, but the outcome is a quaint backyard shop that’s bright and inviting. It’s not just the shop that has had a makeover. I’ve also picked up a few new skills. I’ve done some serious framing and remodelling. I’ve acquired new drywall skills and an appreciation for those people who do it well. Basic wiring is no longer a mystery to me. But, as much as I’ve enjoyed the new challenges, I’m happy to put my tool belt aside and get back to woodworking.

If you’re building a shop and you’re concerned about either its look or resale value, hiring an architect is worth the rather small outlay of money. In my case, he devised building alternatives to raise the ceiling without raising the roof; he helped convince me—against the contractor’s suggestion—to keep the bumped-out roof over the entry door; and he was obtainable for last-minute phone calls to help solve the inevitable snafus that pop up during building. Also, having full renderings of the building plan helped us skate past an otherwise overbearing inspection department. In short, if I had to do it again, I’d perhaps ask more of the architect instead of less. For resale reasons, we intended the building to serve as a two-car garage, though we’ll never park a car in it ourselves. Even on paper, anything larger looked like a monstrosity alongside our humble home. The architect helped to ensure that the design complements our brick ranch house: He drew in a low-slung hip roof like the one on the house and then, to prevent the building from looking like a box with a cap, he set the front door in a small bump-out under a cantilevered roof. While the architect worried mostly about the exterior of the shop, I spent countless hours sketching the interior. I wanted plenty of natural light inside, a comfortable office space, and, for waterstones and general cleanup, the luxury of running water. I settled on a toilet and a mop sink, with room for later expansion, combined with a small office for books and a computer—together the two rooms take up only 100 sq. ft. of space, but they save countless trips to the house. With the office and bath in the back corner of the shop, I was left with a generous 500 sq. ft. of L-shaped shop space. Once we had a working drawing, I made scaled cut outs of all my tools and set them in place. Before we broke ground, I required to know that each item would fit.

Chapter 3 Small workshop options

As for what to do on my own, like numerous of you I had to weigh what I was willing to do against how much money I could make working the same number of hours. In most cases, it was cheaper to hire out. Case in point: I was willing to buy rolls of insulation and install it myself. But at the behest of my builder I checked with a local insulation crew. They installed better insulation than I had planned to buy, and for about $450 less than I would have paid for supplies alone. They showed up a day after I called them and were gone in an hour and a half. Better yet, I didn’t itch at all. As for enlisting the help of friends, on large building jobs, you realize pretty soon that you’ll need a crew of buddies for almost every task at hand. And since you can call on them only so often, you have to pick your battles. Consider this, too: If you can’t get to a task immediately, it puts off all the subcontractors in line behind you. Even with all I subbed out, there were plenty of building concerns to keep me busy. In cases where the work was relaxing or really mattered to me, I did it myself. I built the cabinetry and storage units and did all of the trim work. I also installed the dust collector and ducting.

At the very least, starting a woodworking shop requires two things: good woodworking tools and adequate space. Using Sketch Up, I have intended a fully functioning shop that would fit into a 5-ft. by 5-ft. storage room when not in use. To make it work, I converted the portable power tools I already had into stationary machines, mounting them on a compact, rolling bench. This bench houses five major tools: tablesaw, router table, jigsaw, drill press, and disk sander. And it leaves plenty of space in my store room for lumber and other tools. Of course, the shop has limits. I don’t have a jointer or a planer, so I have to start with stock that is already jointed flat and milled to thickness. Also, the tools must be rolled out into the covered parking area of my apartment complex for use. It’s not good for cold weather, but fortunately, we have very little of that here. Apart from those drawbacks, my little shop can do a lot of woodworking.

Chapter 4 Low-Cost workshop options

Numerous shops are a converted two-car garage built on a concrete slab. I'll say this much for concrete: It's easy to sweep clean. It's also unforgiving. By mid-afternoon, feet hurt. By evening, a dull ache creeps up the back. Tools can be damaged if they're dropped on concrete. And in cold climates, concrete can be a heat sink. One solution is to install a wood floor directly over the concrete. A wood exterior is easier on your feet as well as any tools that roll off the bench. There are other advantages. Electric cable can be routed beneath the floor to power tools located away from walls. Stationary tools, workbenches and other fixtures can be screwed down simply. If there is enough headroom, a wood floor can be raised enough to locate dust-collection ducts below. And the cost of material for covering a concrete floor with wood is minimal—about $2.10 per square foot. Nevertheless, if a wood floor is going to drop the ceiling height to less than 9 ft., I'd think twice about adding one. But a floor consisting of 2x4 sleepers and ¾-in.-thick plywood is only 2¼ in. thick.

Because the sleepers will be in direct contact with concrete, they should be pressure-treated material rated for ground contact. Concrete can absorb water like a sponge, and untreated wood not only decays, but it also invites carpenter ants and termites. Don't forget to wear eye and lung protection when cutting pressure-treated wood and to wear gloves when handling it. Even though damp concrete won't degrade pressure treated material for a very long time, really serious water issues should be cured before the new floor goes down. In a basement shop, that may mean cutting a trench at the perimeter of the room and installing a subexterior drain system and sump pump. Better to do that now. Sleepers are laid flat, not on edge, over the concrete. They should be spaced 16 in. on center so that the long edges of the plywood always fall on solid wood. An easy way to get the layout right is to snap chalklines on the concrete to mark the edge of each 2x4. Snap the first line 14 ¾ in. from the wall, then add 16 in. to each successive line. Sleepers will span minor gaps and voids in the concrete, but serious dips should be filled before installing the floor. Be sure to use a cold chisel to knock off any obstructions that would prevent the sleepers from lying flat. Once all of the sleepers have been cut to size, place them on or near the layout lines. Then, starting at one end of the room, pick up a sleeper and lay a fat bead of building adhesive on the floor where the center of the sleeper will fall. Press the sleeper into place. Adhesive alone should hold down the 2x4s, but I recommend using powder-actuated nails, which will ensure that the wood is secure. Powder-actuated nails are inexpensive, and you can find them at a local hardware store. Don’t skip the adhesive and rely on powder-actuated fasteners alone. Over time, the floor can wiggle loose. Because the adhesive starts to dry rapidly, glue down one sleeper at a time. Recall to leave a ½-in. gap between the walls and perimeter sleepers. In a cold climate, a layer of rigid-foam insulation cut to fit snugly between the 2x4s helps keep out the chill.

Once the 2x4s have been anchored to the floor, they should be covered with a layer of 6-mil polyethylene sheeting. The sheeting prevents moisture from migrating up through the floor and protects the plywood from damp air. Overlap any seams by 6 in. and tape them with housewrap tape. If the floor is not to be permanent, omit the adhesive and fasteners and allow the sleepers to float on the concrete. Lay the polyethylene directly over the concrete first, and then lay the sleepers on top of the polyethylene. Plywood is next. My first choice would be ¾-in.-thick tongue-and-groove, exterior-grade plywood, but you also can use oriented-strand board, which is less expensive. Arrange the sheets so that the seams are staggered. That is, start in one corner with a half sheet. On the next course, start with a full sheet. That way, the seams will be staggered 4 ft. apart. The plywood can be nailed to the sleepers, but screws allow you to eliminate and replace damaged plywood sheets simply. Fasten the plywood every 16 in. with either steel wood screws or drywall screws. While plywood is more dimensionally stable than solid wood, it’s not a good idea to run the edge of the sheets right up to the wall. Leave a gap of ½ in. all the way around to give the plywood a little breathing room. You can cover the gap with a piece of baseboard or shoe molding. Finishing the floor is a matter of personal preference. A coat or two of paint or clear finish will help protect the plywood from the inevitable coffee or paint spill. But for a shop, that may be more trouble than it’s worth. Your feet, knees, ankles and back—as well as your edge tools—will be just as happy with an uncompleted floor.

Chapter 5 How to wire your workshop

The electrical wiring, outlets, and lighting in your shop should be as specialized as your tools. It's hard to turn out high-quality work—or to work safely—in a poorly illuminated shop. It is equally frustrating and potentially dangerous if your tools keep tripping breakers on under-powered circuits or if your floor is a tangle of extension cords. To upgrade your workspace to meet the special needs of woodworking, you should know how to identify your needs and then communicate them to an electrician with the skills to turn your plan into reality. If you put these ideas to use, your woodworking will be safer and more satisfying

Installing the wiring for a workshop is done most simply during building or remodelling with the walls open, but it can be done anytime. If the walls are closed in, either have the wiring run in exterior-mounted conduit or hire an electrician who can run wires in existing walls and make a minimum of holes to be patched later. To feed the shop circuits, the best approach is to install an electrical subpanel precisely for the shop. In a well-intended system a breaker will seldom trip, but if it does, it helps to have the panel nearby. There's a wide range of subpanels obtainable, and your choice will depend on how much power and how numerous circuits you need. At any given time, most one-person shops will be running one major stationary tool, a dust collector, an air filtration system, and lights. In this case, 60 amps at 240/120v likely will provide enough power. If there's heating or air conditioning running as well, a 100-amp subpanel perhaps will be adequate. I suggest a panel with room for 16 or 20 circuit breakers. These are starting points. Because each shop is different, you should calculate the number of circuits and power needs of your own. There are two interdependent aspects to wiring a shop. One is circuit design—how the various things that use power are arranged and grouped, and how they are connected to their electricity source through wiring and circuit breakers. The other is the choice and location of light fixtures, receptacles, and switches.

Depending on the size of the shop, you should have one or more 120v, 15-amp circuits dedicated to lighting. That way if you are ripping a board and your tablesaw trips a breaker, you won't be plunged into darkness and into a dangerous situation. To compute how numerous lighting circuits you will need, add up the total wattage of the lights and provide one 15-amp lighting circuit for every 1,500 watts. This is based on loading each circuit to about 80% of its capacity. This cushion, though not required in non-commercial applications, is still a good idea. For instance, to provide lighting for a single-car garage-size shop (240 sq. ft.) with 96-in., high output (HO) fluorescent lights, you would need four separate 2-lamp fixtures. Each 8-ft. lamp requires 110 watts, so you would need a total of 880 watts to light this shop. Consider installing some task lighting (say a track fixture with three, 65-watt flood lamps or equivalent fluorescent floods) as well. I'd put this lighting on one 15-amp circuit. Consider setting up the lighting so that the general lighting fixtures are wired to two or more separate switches, with the task lights switched separately from the general lighting. This way, if your machine and bench areas are separate, you can save energy by illuminating only the area in which you're working.

It's a fact that a shop can never have too numerous clamps, and it's equally true that it can't have too numerous receptacles. Receptacles should go on 20-amp circuits. There's no limit set by the National Electrical Code (NEC) for the number of outlets that can go on a circuit in a residential application. For a shop, it makes sense to identify the loads you expect to operate at the same time and group the receptacles onto circuits so that each circuit can comfortably support the expected demand. A 120v, 20-amp circuit can provide 2,400 watts, While it's a good idea to keep the load to 80% or less, or about 1,900 watts. To figure out how numerous circuits are required, look at the power required on the tool nameplate (some nameplates will specify watts, and some amps). If the tool specs give amps only, convert from amps to watts for a 120v tool by multiplying amps times 120. For instance, if you have a small air compressor that draws 13 amps (1,560 watts), put in a receptacle supplied by its own 20-amp circuit, called a "dedicated" circuit. For outlets that won't be supplying a specific tool, as in an area like an assembly bench where you will be using various small power tools, I suggest three or four outlets on a 20-amp circuit. The NEC requires ground fault circuit interrupter (GFCI) protection for any 15-amp or 20-amp branch circuits supplying a garage or other work area at grade level. You can meet this requirement by using a GFCI circuit breaker or by having a GFCI receptacle first in line and wired to protect the downstream receptacles.

Think about how you work, and then plan to have ample power exactly where you need it. The right array of circuits, switches, and outlets makes the shop more pleasant to work in, and a few key accessories complete the picture. For general-use outlets, like the ones used for routers, hand sanders, and corded drills, it is a good idea to set up circuits based on the area served. For instance, you might set up a separate circuit for each wall. Or you may want a couple of 20-amp circuits to serve your workbench, where you might have three or four outlets on each circuit. A neat trick is to run two circuits along the wall and feed alternating receptacles from the two different circuits. Don’t use a shared neutral circuit for this; you have to GFCI-protect the outlets, and keeping the two circuits completely separate makes this easier. A product called Plugmold is useful for providing workbench power. It is a steel channel with outlets spaced at intervals. Plugmold stands about 1¼ in. wide and above the exterior and is obtainable in various receptacle spacings (12 in. is best for shop use). Plugmold is much sturdier than a typical cord-connected “power strip” and is the right way to pack a lot of outlets along a wall. It’s a good idea to place wall outlets 50 in. above the floor. That way if you lean sheet goods against the wall, they won’t cover the outlets. And the outlets will be well above any benchtop or other work surface. Another nice setup is to set aside a shelf area for cordless-tool chargers, and put a 3-plus-ft. strip of Plugmold with 6-in. receptacle spacing on the wall behind the shelf. Put this on a separate 20-amp circuit, so you can leave it powered up while turning the other receptacle circuits off at the breakers for safety when you’re not in the shop.

Stationary tablesaw, jointer, planer, dust collector—draw so much power that they each require their own circuit. Without it, running two simultaneously will trip a breaker. If the motor can be set up to run on 240v, have an electrician do it. It will perhaps require taking the motor out of the machine. There’s no power efficiency advantage to running a machine at 240v vs. 120v in a single-phase system, but the higher voltage means lower amperage, and as a outcome, you can use smaller-gauge power-supply wiring. That translates into less expense to run the wire and to hook it up. To figure out what size circuits you will need, confirm the amp rating on each tool’s data plate or in its product manual. Keep in mind that the circuit breaker at the sub-panel is intended to protect the building’s wiring from an overcurrent condition—it does not, Nevertheless, ensure that the machine’s motor won’t overload. If the motor does not have an internal circuit breaker for overload protection (the tool manual will indicate this), a fused disconnect may be required. Ask the electrician to install it. The fuses in the disconnect box will protect the motor windings from overheating.

Getting power to a machine in the middle of the floor can be a challenge. You don't want a cord running along the floor that you might trip over. If there's a basement or crawlspace below, I would run cable or conduit below the floor and use a monument-style housing to hold the receptacle at the base of the machine. A flush-mounted floor outlet is a poor choice for a shop. It will fill with debris and could be shorted out by a stray nail or staple. If you plan to move shop machines around and you want to keep the floor clear, use a hanging outlet about 6 ft. to 7 ft. above the floor. To prevent accidental unplugging, a locking cord cap on the receptacle end of the pendant outlet is a good idea. This will require you to put a compatible locking plug on the machine cord, or make an adapter.

Even though they are full of flammable supplies, most woodshops have no smoke alarms. That is because airborne sawdust can set off the photo-ionization or photoelectric sensors typically used in smoke alarms to detect smoke. The solution is to install a heat-detecting fire alarm that can activate the smoke alarms in the house. Firex has a complete line of smoke alarms that embraces compatible heat-detector units. It's nice to have a phone in the shop, but how do you hear it ring while planing boards and wearing hearing protectors? You can add a flashing visual alert. Another convenience is to have your dust collector start automatically when you switch on a machine it serves. It's possible to build a current sensor/relay setup, but there are commercially obtainable ones. Ecogate sells a system that not only turns on the dust collector when it senses that a tool has started, but also opens and closes the adjacent blast gate. Alternatively, you could install a relay and receiver on the dust collector's cord that switches on and off with a remote-control transmitter that can sit in a convenient spot or hang on your key ring.

Unless you're a qualified electrician or are willing to take the time to become familiar with the techniques of the trade, the numerous requirements of the NEC, and any local codes pertinent to shop wiring, you should find a licensed electrician or electrical contractor to wire your shop. Look for one who does both residential and commercial work; a strictly residential electrician might not be familiar with some of the merchandises and design elements suggested here. When working with an electrician, it's more productive to explain the objective or objective than to try to dictate a precise technique or approach. Sit down with the electrician before work begins, and lay out your requirements clearly. If your plan and objectives are not clear at the outset, be prepared to pay for changes. Lastly, don’t expect to find an electrician who will just do the hook-ups after you’ve pulled the wires. Few licensed electricians will take the risk of putting the finishing touches on work they didn’t do themselves.

Chapter 6 Tips for light improvements

Perhaps a fresh finish looked great in the workshop, yet once you brought it into the house you found sanding scrapes. Your issue might be inadequate shop lighting. Light fixtures are seldom at the top of tool and tools wish lists, therefore most home workshops are illuminated with a collection of uneven, out-of-date fixtures, with little thought given to their overall placement and how they're substituted. As an outcome, enlightening your workshop lighting will likely mean starting over with new fixtures and wiring. Numerous woodworkers will think they can handle this work, yet it's perhaps better to hire an electrician who'll let you do some of the work yourself. An electrician looking at the job can confirm that your electrical panel isn't overtaxed and that there are no other pressing electrical issues. Then you could save some money by mounting the fixtures and running the conduit by yourself. Later, the electrician can confirm the job, run the wires, and make the connections. Certain electricians are good with this type of procedure. Others will need to do each item themselves, therefore ensure that you work out the division of labor beforehand.

Any discussion of artificial light starts with the distinction between ambient and task lighting, you'll need both types for a well-lit shop. Ambient lighting describes general lighting for common cutting and shaping errands. Task lighting describes a higher level of illumination focused right on the job. Nevertheless, it's vital to recall that once you have an even blanket of bright light, task lighting is reserved for filling in the dark zones. It might be appealing to save money on lighting by arranging the ambient overhead lights so that they're strategically placed over benches and machines. Yet we endorse against this approach because the lights will be in the wrong locations in case you ever decide to change your shop setup. And you never know quite where you'll need light: Will it be on the floor when cutting up a sheet of plywood, or in the corner when picking through the scrap pile? With an even blanket of ambient light, you'll be able to work anywhere. You could save the task lighting for when you require it, like finishing and joinery. The Illuminating Engineering Society of North America aka IES, endorses between 15 and 45 foot candles for woodworking. 1 foot-candle is the amount of light developd by an ordinary candle measured from 1 ft. away. We recommend 75 foot-candles because you'll need more light in the future, and the cost difference is insignificant. Even if your eyes are good now, you’ll require the supplementary light in a little while.

Another contemplation is how much of the light required by your fixtures is reflected by the walls and ceiling. A clean exterior may reflect as much as 80% of the light that initially, while a dark exterior can reflect as little as 8% or 10%. If your workshop is cluttered and dusty or has exposed insulation, then you’ll require to boost lighting levels by another 20% to 60%, paralleled to workshops with white ceilings and walls.

When you’ve made a decision on the level of lighting you want in your shop, laying it out is stress-free.

1 - Choice your fixture

- The most corporate workshop fixture is an open fluorescent.
- These work extremely well.
- It’s easy to clean off the fixtures once in a while with compressed air, yet it’s easier to select fixtures with an acrylic lens.
- Not only does the lens keep out much of the dust and spread the light, but it too delivers a bit of safety when you’re swinging around your boards.
- Our favorite fixture for a home workshop is any model that have a lens, and their electronic ballast means they won’t hum loudly and they’ll work in cold temperatures.

2 - Choice the bulbs

- One of the criticisms we often hear about fluorescent bulbs is that the light is unnatural and bluish.
- This was true, yet fluorescent bulbs are now obtainable in a wide variety of colors.
- Measured in kelvins, color temperatures generally range from 2000 K to 7500 K.
- Ideally, the lighting in the shop should be the same as the lighting inside your home, so your ventures look the same in both environments.
- Most likely you have warm incandescent lighting in your home, so

you should select warm fluorescent bulbs with a 3000 K color temperature.
- This will help your completed ventures look the way you envisioned, and the cost difference compared to standard bulbs is insignificant.

3 - Plan your layout

- Certain electricians and lighting showrooms can provide a lighting layout for a garage shop simply, yet if you want to do the layout yourself, we recommend using Visual Basic.
- Begin the program by entering the workshop dimensions and ceiling height, and then specify a lighting level.
- The software then gives you many choices on the reflectivity of your walls.
- You can then chose a light fixture from a pull-down menu, and select the type of ceiling and lens cover, and then the program will let you know how many fixtures you require and how to position them.
- Utilising the SB 432 fixture and assuming a 22-ft. by 24-ft. garage work shop with 8-ft. ceilings, the software told us that we need 9 fixtures.
- Instead of having all your lights controlled by a single switch, it’s a great idea to divide the space into your zones.
- For instance, you could put the finishing table in one zone, the bench or assembly table in another, and the machine area in a third.
- For the cost of a little extra cable and a few switches, the energy savings is worth it.
- An additional great feature is a sensor that turns on a single light every time you walk into the workshop, particularly when your hands are filled with supplies or tools.
- Because an occupancy sensor will turn off the lights when it doesn’t detect movement, it can inoften leave you in the dark.

Task Lighting

- Overhead fluorescents are good for general ambient light, yet for finishing and bench work you'll need supplementary task lighting.
- Swing-arm lamps like those found on drafting tables are great for aiming light directly where you require it.
- Twin-head halogen work lights are great for finishing because they can provide raking light that makes it easier to see runs and other issues.
- Having a well-lit shop is a lot like having a well-heated one.
- The shop becomes a more welcoming place, a playground for your imagination.

Chapter 7 - Workbenches and storage tips

A workbench with an end vise and front vise is simply the most vital tool in your workshop, one that you use on every venture. In case you don't already have one, or if yours is old and rickety, it's time to upgrade. You could just buy a bench—there are some good ones out there, yet you can simply spend $800 and not improve on the bench. This bench is each item a good workbench should be: It is heavy and robust, so it won't wobble or skate. It has a flat exterior big enough to support a medium case side or table top. And it's completed of holding your work steadily, with an end vise that can be utilised with benchdogs to hold work flat. You could make this bench in a weekend, to your own dimensions, and you don't need a ton of tools. In case you're speculating whether a bench like this can actually do the job.

I prefer to make the base from maple, or poplar. For the base, it entails of 2 end assemblies, each built from a pair of crosspieces dadoed into the legs. These assemblies are associated by two long stretchers bolted in place on both side. The top long stretchers are rabbeted into the tops of the legs. All of this joinery is best cut on the tablesaw with a dado set, yet it's also probable to do the work with a standard blade and a miter gauge. A single fence setting and a spacer block is utilised to cut each corresponding joint exactly the same width and in exactly the same place on all legs. In case you leave the crosspieces and stretchers a bit wide, you can edge-plane them in the thickness planer for a precise fit in the dadoes and rabbets. With the joinery cut, begin building of the base with the two end assemblies. Before beginning, make sure that you break all the edges with a roundover or chamfer. Confirm for square during glue-up by measuring diagonally across the assembly in each course. Regulate at the curves if required until the measurements match. The rest of the assembly consists of connecting the two ends by attaching the long stretchers. Fix the base upside down on a level work exterior and clamp the stretchers in place while drilling the bolt holes. With the base accumulated, you could turn it over and utilise it to build the top.

How to make the top:

- First of all, when you hace to cut 4 x 8 sheets of medium density fiberboard aka MDF, and particleboard it's not an easy task.
- You can buy 1 sheet of each and then have your supplier rough them down to make each piece 1 in. larger at each direction.
- Next, you could utilise the particleboard offcuts to piece together the top's middle layer.
- If you do you plan your cuts watchfully, the middle layer will entail of 2 pieces with only 1 seam.
- Before you start the assembly, utilise a router or a tablesaw and straightedge to cut the top layer precisely to final extent.
- Next, you can cut the other layers about ¼ inch to 3/8 inch larger than this layer.
- Begin the glue-up with the top layer face down on the base.
- Roll yellow glue onto the exterior, then place the pieces of the middle layer on the waiting piece.
- Ensure that the middle layer extends beyond the top on all edges, and then screw them all together.
- You also need to ensure that you don't drive any screws where you plan to drill dog holes.
- After that, utilise a router and a flush-trimming bit to bring the middle layer flush with the top.
- Complete the glue-up by repeating the entire procedure to attach the bottom layer.
- Next, you should cut the stock for the solid-wood edging no more than ⅛ inch wider than the thickness of the top, with each piece about 1 inch longer than its completed extend.

- Once gluing the edging to the sides, utilise thick clamping cauls to distribute the pressure correspondingly.
- After completing gluing the edging in place and trimming the ends, utilise a router to flush-trim the protruding edging to the core, top and bottom.
- Then switch bits and round over all the edges.
- Now is also a great time to sand the benchtop.
- This bench has one vise, which acts a both an end vise and a front vise.
- You can utilise it to hold your work vertically for any sawing or chiseling task or you can use it in conjunction with benchdogs to simply hold a board flat on the benchtop.
- Before installing the vise, I utilise an inexpensive ¾ inch spade bit to drill a row of holes in the top for the bench-dogs.
- I start the row 5 inch from the vise end of the bench and space them about 4 in apart, yet the spacing can vary according to your requirements.
- What is vital is that the holes line up with the dog in the vise.
- To mount the vise, first you need to make a spacer to fit between the vise and the bottom of the benchtop.
- It should be rather wider and longer than the vise’s footprint, and thick enough to drop the cast iron jaws about ½ inch below the top.
- Hardwood jaw pads go on before fitting, and then get planed flush with the benchtop.
- Next, you need to glue and screw the block to the underside of the bench and then clamp the vise in its final place.
- Mark the location of the vise bolt holes on the bottom of the bench, then use an adjustable square to transfer the locations to the top.
- After drilling from the top, begin with a Forstner bit to counterbore each hole deep enough to completly recess the washer and bolt head.
- Utilise the center dimple left by the bit to drill the through-holes, and then bolt the vise in position.
- The last thing you need to do is attach the top to the base.
- I utilise 6 small angle irons obtainable from most stores and screw

them in.

- For a tough, water-resistant finish, I utilise 4 coats of Minwax High Gloss Polyurethane on the bottom and top.
- The finish is durable, and can be renewed by scuff sanding with 220-grit sandpaper and brushing on a new coat.

When I built my first bench well over 30 years ago, I had limited furniture-making involvement, so I adapted the design from some benches I had used in various classes. That first bench has been a solid friend in the shop for numerous years. But as my involvement level increased, I kept a mental list of improvements I'd make if I were to build a new one. Over the years, I've advanced a love of hand tools. I use them in every aspect of furniture making, and particulars made with these elegant tools are a signature of my work. So my first priority was to make the new bench better suited to my hand-tool habits. In building this bench, I wanted a tool that would withstand the daily stresses heaped upon it, and the supplies and design reflect that approach. A bench can be produced with humble supplies (any dense and stable hardwood will do) and basic joinery and work very well. The benchtop is big enough to clamp a large case piece in almost any arrangement, with room for numerous tools, and it's thick and sturdy. The base of the bench can hold a heavy load (the top weighs more than 200 lb.), but more vitally, it's rigid enough to withstand the racking forces created by handplaning. At 35 in. tall, my bench will work for a wide range of tasks, from handwork to machine work to assembly jobs. You may have to experiment to find a comfortable height. Because I do a lot of handwork, I need surefire ways to hold workpieces. In my involvement, the best tools for the job are a front vise and a tail vise, used in tandem with benchdogs and a holdfast. Lastly, I added a sliding stop at the left end. It can be set high or low and is useful for planing panels, thin drawer bottoms, tabletops, or multiple parts.

How to build it

- The top looks like a bunch of 12/4 planks glued together, but it's essentially three layers of 1-in.-thick boards. This design is very stable so it will stay flat, and it's an economical way to use supplies.
- I used hard maple, yellow birch, and beech, dedicating the best of

the maple to the top layer and the breadboard ends, and using narrower and rather lower-quality material for the middle and bottom layers.

- Glue up the top one section at a time.
- To make the job less stressful, I recommend Unibond 800, a slow-setting urea-formaldehyde glue typically used in vacuum veneering.
- Once you have the top glued together, use a circular saw to trim the benchtop to length.
- Clean up the edges with a scraper and a handplane, and flatten the top.
- When the top is flat, rout the rabbet for the till bottom on the back lower edge.
- The benchdog apron is laminated from two pieces.
- After gluing the pieces together, lay out and cut the mortise for the front vise hardware in the apron; depending on the vise, you may need to cut a hollow under the top to accommodate the hardware.
- Once that's done, use a dado set to cut the dog holes.
- Attach the vise's rear jaw to the apron and then set the piece aside as you start working on the breadboard ends.
- Cut the breadboard ends to width and thickness but leave them a bit long.
- Cut them to size after you lay out and cut the joinery to attach them to the benchtop.
- At the rear of each breadboard, rout the groove for the till bottom; it should align with the rabbet in the benchtop.
- Then drill holes for the lag screws that will help anchor the breadboards to the top.
- Lastly, lay out and cut the dovetails.
- Use a router and fence to cut the tenon cheeks on the ends of the top.
- Then lay out and cut the long tenons that will go deep into the breadboards.
- Clean up the inside curves with a chisel, and fine-tune the fit using handplanes.
- Once the breadboards have been fitted, drill the pilot holes for the lag screws.

- To give the screws extra purchase, I mortised hardwood dowels from under the benchtop, in line with the pilot holes.
- Start by gluing the apron to its breadboard end.
- Then apply glue to the apron and front edge of the benchtop.
- Screw on the breadboard end, and clamp the apron in place, working from the corner out.
- Don’t worry about exactly where the apron ends; you’ll be notching out that end of the bench-top for the tail vise.
- Lastly, install the other breadboard end.
- After the glue cures on the breadboard ends and the benchdog apron, install the till parts and 1x blocking underneath, which increases stiffness and gives better clamp purchase.
- Once the top has been glued together, build the trestles and make the stretchers of the base.
- Before gluing and wedging the top of the trestles, notch both ends to go around the benchdog apron in front and the till in back.

How to build a smooth-working tail vise

- Building a smooth-working tail vise can take nearly as long as building the benchtop or base.
- The work is worthwhile because a tail vise is unmatched at holding work flat on the benchtop between dogs.
- Have the hardware in hand before you start and make a full-scale drawing of the whole assembly to make layout easier.
- Use a circular saw and hand tools to cut a notch in the benchtop for the vise, and tune the vertical exteriors square with the top.
- Rout the groove for the top plate a bit oversize to provide a little clearance and leave room for adjustment, if required.
- Now attach the vertical mounting plate to the bench (with only two screws so you can adjust it later if need be), aligned with the top-plate slot and perfectly parallel with the benchtop.
- The core of the vise accommodates the screw and nut, and is laminated from two pieces.
- Before gluing them together, hollow out the interior of one piece with a core-box bit and router.
- The other piece has a rectangular section eliminated with a saw.

- Glue these two pieces together and let them dry.
- Now make the dog-hole plank and dovetail it to the end cap.
- Cut two mortises in the end cap and mating tenons on the end of the core, for alignment and added strength.
- Also, cut the shallow mortise into the end cap and a tenon on the end of the top cover.
- Cut a shallow rabbet in the top edge for the top guide plate.
- Attach the top and bottom guide plates to the core and slide it onto the plate on the bench.
- There should be little wiggle when you lift the front edge, and the core should move parallel to the bench.
- If the guide plates grip the steel plate on the bench too firmly, the core movement will be stiff.
- Shim the bottom guide plate with a piece of veneer or a business card.
- If you have lots of wiggle, the plates need to be tighter together, so deepen the rabbet for the top guide into the core rather and retest.
- When the core moves smoothly, eliminate it from the bench.
- Now glue the dog-hole plank and end cap together and to the core.
- Mount the assembly to the benchtop, adding the last screws to the mounting plate.
- Thread in the lead screw and fasten the flange to the end cap and test the vise action.
- Lastly, install the top piece, which is tenoned into the end cap and glued to the top of the core.
- Now finish the exterior prep on the benchtop.
- Bring all exteriors flush and smooth using handplanes.
- I chamfered all edges with a block plane.
- Add the slide-up stop on the end of the bench, install the drawers, and make a couple of handles for your vises.
- Last, finish the top with two coats of boiled linseed oil.

Building a wired workbench

- In a modern workshop, many work gets done with power tools such as biscuit joiners, routers, or random orbit sanders aka ROS.
- Yet most of us utilise them on benches intended around

handplaning.

- This means that each item from the height to the mass to the vises and benchdogs is geared toward hand tool usage.
- Power tools require electricity to run and they make a lots of dust.
- Certain people agree that the first thing this bench needed was a built in source of electricity and dust collection ferature.
- I kept things straightforward by attaching a commercially obtainable automated vacuum that turns on the dust collection once you power it up.
- I also made room in the base for a shop vacuum and a cyclone that both has proven its worth trapping the fine dust before it too late.
- This wired workbench also is taller than traditional benches, moving the tool and the workpiece up to a height where you have better vision and control.
- It’s wider, too, yet not as long.
- I eliminated the traditional front and tail vises, opting for a straightforward yet operational clamping tool made from 2 pipe clamps.
- The benchdogs have soft heads that hold workpieces confidently, yet will not dent them.
- There are also locking casters underneath to make the bench mobile.
- Lastly, the wired workbench is at ease to make.
- Because it won’t take the forces a hand-tool bench does, the entire bench is made from plywood.
- And there is no complex joinery, just butt joints held together by screws.
- I’ve utilised stainless steel deck screws and finish washers for a modern, clean look.
- If you already have a heavy hand-tool workbench, this one will make a great, mobile, secondary workstation.
- And in case you depend on power tools, this could be the only bench you will ever require.

Chapter 8 Dust Collector Tips

It’s not too hard to cut precise parts from plywood. I’ll skip over that procedure now and explain how the parts go together. I normally put the vacuum and the mini-cyclone in the base for two reasons: enclosing the vacuum muffles it, and it makes the bench a self-contained element. There’s no vacuum trailing behind it. Begin assembling the base with the bottom panel, pre-drilling holes for the casters. Then attach the front panel to the bottom. Screw the interior divider to the base and then to the front panel. After that, you can attach the back panel to the base and divider, still before you would do, make sure that you drill the ventilation hole. An apron runs crosswise the top of the door opening at both ends of the base. Every one apron is screwed to plywood cleats. The top cleat attaches the top assembly. The side cleats serve as door stops. Once completed assembling the cleats and the aprons, you can screw them between the back and front panels. Only then you should turn over the bolt and base the casters to it. Next, you can flip the cabinet back over and install the doors. Lastly, you can attach the lower door stops to both; to the bottom panel and the sides of the cabinet. Then you can screw the pivoting door to the apron.

The dust deputy is a plastic cyclone naturally attached to the lid of a 5 gallon bucket, that collects the dust and chips once they fall out of the cyclone. Yet, such an assembly is very tall to fit inside the cabinet, therefore there is additional way to collect the debris. The cyclone to work correctly, the box needs to be sealed. Luckily, you don’t require any superior tools to make it. The cyclone sits on top of a box, and inside the box is a removable drawer that catches the dust and chips. Once it is full, you just open the box, pull out the drawer, dump it in a trash can, and put it back in. Next, the butt joints in the box are tight enough to avert airflow and the door can be utilised to create a tight seal around the opening. Thus, apply foam gasket the kind that is for climate disrobing on entry doors, mitering the arches and gluing them together utilising cyanoacrylate glue. Once the door closes against the gasket, it then creates a sealed closure. In order to polish up how much the door compresses the gasket, you can drive 2 drywall screws into the back of the outer dust bin. Regulating the screws in and out moves the box farther from and closer to the door and compresses the gasket less or more. Lastly, to whole the airtight box, smear a bead of acrylic caulk nearby the opening for the cyclone before securing it in position.

The great thing about this top is that it has a clamping system built into it. Therefore, you need 2 ¾ inch pipe clamps, some ¾-inch diameter dowel, and ¾ inch internal diameter vinyl tubing. The dowel is cut into short lengths to make benchdogs and the tubing slides over the dogs to keep them from marring or denting your venture, something you don’t want to have happen when you’re sanding a door only before finishing. The extra jaw is fixed to the apron. You could then move the sliding jaw, and then the dog hole moves along with it. The top is made from layers of plywood strips, yet it is plenty rigid for power tool work. Next, you can screw the top and middle layers both together. After that, you should mark the locations of the stationary benchdogs, partly disassemble the parts, and drill the holes. Next, that the basic structure of the top has been assembled, make and attach the riser layer. The two end risers need holes for the pipes to pass through. Drill them at the drill press. Next, you have to install the sliding benchdog blocks. You have to then bring together the layers and drill a hole for the benchdog. Next, you have to take off the bottom layer, and add a little tape to make the groove broader than the tongue, and then the blocks needs installing. After that, you have to attach the bottom panel to the risers. Then set the entire assembly onto the base and attach it by screwing through the cleats and into the bottom panel. After that, you have to make a few benchdogs from a length of dowel and slip. Lastly, you have to fit the pipe clamps.

Chapter 9 Bench vise tips

A great bench vise is nearly as valuable as a shop student. On my bench I have a front vise and a large tail vise. It’s hard to imagine woodworking deprived of them; they hold my work confidently thus that I can focus fully on powering and governing the tool I’m utilising. You will find vises at 2 locations on a woodworker’s bench: one on the long side of the bench, usually at the left-hand corner for those right-handed, and another on the short side at the reverse end. The first, recognized variously as a side vise or front vise, matches the mental picture that certain people have of a vise, with a movable jaw capturing work between it and the edge of the bench. The 2nd, called an end vise, can clamp work like a front vise, yet it’s often utilised to hold boards flat on the bench. These 2 vises can meet all of a woodworking professionals rudimentary desires when it comes to holding work within reach.

A front vise, naturally found on the bench’s left-front corner, is ideal when you need to clamp a board to plane an edge, hold a chair leg while shaping it, or hold a board upright for sawing dovetails. The most common strategy is straightforward: a jaw of wood, or cast iron lined with wood that transfers with a single screw and a T-handle. The rest of the vise is mortised into the front edge of the bench. Mine opens about 10 inch and has about 4 inch of depth. You can look for one that has a large screw with well cut threads. These are the same square threads found on decent clamps; they can smoothly deliver lots of force over a long life. To hold long boards, wide panels, or doors securely on edge in a front vise, you need the added support of the deep front apron of the bench. Suitably fit, the fixed half of the vise should be mortised into the bench so that the movable jaw clamps against the apron. This creates a great deal of stability, making it possible to clamp most boards on edge with no other support. For extensive panels, you could put one end in the front vise and rest the other on a short board clamped in the tail or end vise. You could clamp a big tabletop vertically against the front edge of a bench, one end held in the front vise and the other held by a bar clamp across the bench. An issue can arise once clamping on just one side of the vise, such as when holding just the end of a much larger piece, clamping pieces vertically for laying out holding tapered pieces or sawing dovetails. Once one side of the jaw is applying all the pressure. One resolution is to slip a block as thick as the piece into the other side of the jaw. This can keep the jaws parallel so you can smear all the pressure you require. Certain bench producers equip their front vises with a threaded stop that does the same work.

At the other end of the bench, you typically will find one of two distinct types of vises, aka end vises. Their drive is to hold work flat on the external bench. An out-dated tail vise, with one row of dog holes along the front edge of the bench and several more in the movable jaw, lets you to hold work flat over nearly the entire length of the bench. This is ideal for holding long boards to smooth a face, bead one edge, or hold a leg while chopping a mortise. You can also clamp across the grain to bevel a panel end or shape the skirt of a chest side. Be vigilant to smear only shy pressure to hold the work, or you will bow it up. The tail vise is also great for holding long or odd pieces at any angle, there are no screws in the way and the hefty building tends to prevent racking on odd shapes. Also, it can hold a workpiece at right angles to the bench edge, ideal for planing an end-grain edge, shooting a miter on a molding, or paring a tenon shoulder. One drawback with this vise is that the large movable jaw can sag. A misaligned jaw makes it hard to hold work flat on the benchtop. Avoid chopping or pounding over the movable jaw; it isn't as solid as the benchtop itself. Support the work as much as possible over the bench, with the least amount of jaw open. I keep small, square blocks handy to shim my work toward the bench or protect it from the dogs. I shouldn't have to say this, but never sit on your tail vise. The other prevalent type of end vise looks and works like a front vise, apart from that the movable jaw is mounted to, and set parallel with, the end of the bench. In case I had to outfit a bench with just one vise, it could be this type. My small wandering bench has an old front vise mounted on one end in line with a row of dog holes. Certain end vises of this type have a jaw that spans the entire width of the bench. Fitted out with a dog on each end of the jaw, and paired with a double row of dog holes down the front and back of the bench, this is a great system for holding wide parts flat on the benchtop. More than a few ready made benches are constructed this way. The bench vise is one of woodworking's most essential and necessary tools, vital for holding work while you saw, pare, chop, scrape, plane, and accomplish any number of other tasks on your ventures. Despite the vise being used so often, it is ordinarily distorted. In my workshops, I regularly see apprentices clamping stock the incorrect way in the vise, sawing or paring in the wrong direction, and risking injury when the work slips and the tool jumps. You could circumvent accidents like that by adopting a few rudimentary practices to hold your work securely and avoid it from sliding. And with a few straightforward shopmade fittings, you could use your vise to tackle an even wider diversity of tasks securely.

Chapter 10 How to use the Bench Vise

- I typically use my bench vise in one of three ways: by itself, with benchdogs, or with other clamping fixtures.
- On its own, the vise is great for holding smaller workpieces during sawing, chisel work, edgeplaning, or other tasks. But for best outcomes—and safety—it's vital to orient the work appropriately in the vise.
- For vertical work, consider your task and orient the workpiece so that you'll be working across the jaws and not in line with them.
- You want the back jaw to brace against the thrust of the saw or chisel.
- Also, to decrease the likelihood of slipping and racking the vise, position the stock between the vise screw and a guide bar, as low in the jaw as possible.
- The farther up from the jaws the operation gets, the greater the potential for losing control.
- For horizontal work, you may need support under the workpiece if the task calls mainly for downward force.
- So I keep a piece of ¾-in. stock handy that is as long as my vise and comes to about ⅛ in. below the top of the jaws when resting on the guide bars.
- Resting a workpiece on top of this board provides supplementary support and enhances safety.
- For edge-planing short pieces, simply clamp them in the vise.
- For longer pieces, I add a support block with a piece of sandpaper glued to both faces.
- The sandpaper bites into both jaw and workpiece, keeping it from slipping when I get to the ends of the board.

- For exterior planing and some other tasks, the workpiece needs to be held flat on the benchtop.
- You can do this using the sliding stop on top of the vise and a row of dog-holes bored into the bench exterior.
- Numerous vises come with a metal stop that slides up out of the front jaw.
- If yours doesn't have one, you can create one by boring a hole in

the front auxiliary jaw to fit a commercially obtainable or shopmade dog.

- For best support underneath the work, don’t open the vise wide to accommodate the workpiece.
- Instead, use the most distant doghole you can, and keep the vise opening narrow.
- This puts the bulk of the stock over the bench exterior, making planing easier and more stable.
- Also, ensure that the dog is below the board’s exterior.
- Nicking a steel or brass dog can damage a plane iron.
- There are several accessories and attachments that work well with a vise.
- Inserting this scrap in the opposite end of the vise helps prevent the vise from racking (pivoting and losing its grip) when work is clamped on the other side of the vise.
- Taking this further to prevent racking with any thickness of stock, I made an angled block that slides in a dovetail key cut along the length of the vise.
- Also in the very straightforward category, just about any bench hook or shooting board that typically braces against the edge of the bench can be made more stable by clamping it into the vise—a practice I recommend.
- Other accessories help with larger stock or specialized tasks.
- For instance, when edge-planing longer stock or working the end grain of wider boards, you need a way to hold the free end of the workpiece.
- I do this with a clamping block made from two pieces of scrap joined at a right angle.
- This block gives me a exterior against which I can clamp the work, and a plate that lets me secure the block to the workbench.
- A different fixture helps when dovetailing the top of a table leg.
- To hold the work and support the router, I use an L-shaped block that clamps securely in the vise.
- The fixture anchors the leg, letting me eliminate much of the socket with a router and do final cleanup with a chisel.

Chapter 11 Tips for Sawhorses

Every woodworker wants a few sawhorses. They're countless for rough-milling lumber and assembling ventures, and could even be utilised as a sturdy base for a temporary worktable. But the horses I have built are diverse from the normal sorts, completed of 2 x 4s with opened legs. Those chunky designs can be hard to utilise and don't store very simply. These horses are light and have a small footprint. They are easy to move and the long feet give the horses a wide stance that repels tipping. The upright design lets you position them close together for small glue-ups or veneer pressing jobs. Old-style sawhorses with splayed legs will not cozy up as straightforwardly. This nesting capability is also great for stowing the horses when you're done with them. Notwithstanding their sleek profile, these horses could provision hundreds of pounds. I often pile a big stack of lumber on top of them for storage or milling. I attribute this strength to the solid mortise-and-tenon joinery and an overall design that carries stresses downward instead of out so the joints aren't pushed apart. The stretchers not just add constancy and forte, yet they also are practical. The lower stretcher can hold clamps and lumber. The top stretcher is notched into the uprights and screwed in place without glue. It's not challenging to eliminate and substitute when it gets worn. This top stretcher likewise can act as a caul during a glue-up.

How to make them

- The loveliness of these horses is their straightforwardness, and the materials and building imitate that.
- They will get knocked about and loaded severely, therefore select supplies in view of that.
- Avoid weaker woods like pine and poplar.
- Hardwoods will last much lengthier, yet these are only workhorses, therefore consider your wallet also.
- Red oak or hickory are cheap alternatives.
- Once milling the lumber, you should mark the upright mortises in the bases and then cut them utilising a plunge router.
- Cut the mortises in the uprights for the lower stretcher the same way, but utilise a backer board underneath to avert any blowout on the other side and to guard the exterior.

- This joint is wedged, consequently I flare the mortises with a rounded file to house the wedges.
- Next, cut the tenons on the bottom of the uprights and the ends of the lower stretcher.
- After that, cut the shoulders on the tablesaw utilising a stop on the crosscut sled, and then cut the cheeks with an over the fence tenoning jig.
- Then you can chisel and file the tenons round to equal the mortises.
- The notched top stretcher sits in corresponding notches in the uprights and gets screwed in place through the uprights, making it easy to replace when it gets worn.
- The distance between the inside shoulders of the notches should match the length of the lower stretcher from shoulder to shoulder.
- Next, you can cut the notches in the upper stretcher using a crosscut sled on the tablesaw.
- As there are only 4 narrow notches, you don’t have to bother with a dado blade.
- I do the same for the uprights, utilising a tall fence on the sled.
- My bases have only an angled cut on each end and a shallow cutout with the similar angle on the bottom.
- Of any kind the shape, this cutout on the bottom is vital as it generates 4 feet instead of just 2 long planks that sit on the floor.
- Without the center area cut out, the horses are likely to wobble.
- Before glue-up, use a file or block plane to break the sharp edges, and use a handsaw to cut kerfs in the tenons that will hold the wedges.
- Drill and counter-bore the top of the upright for the screw that will secure the top stretcher.
- Now dry-fit the assembly.
- Mark and trim the through-tenons on the lower stretcher so they protrude about ⅛ in.
- Next, you can glue the uprights into the bases.
- Once they are dry, glue the lower stretcher into the two uprights.
- Once this assembly is in clamps, tap and glue the wedges into place before the glue sets up in the mortise.
- Afterward the glue dries, trim and file the wedge flush on the end

of the tenon.

- You can screw the top stretcher in position, and you are ready to put the horses to work.

Chapter 12 Workshop Storage Tips

By the time you're into woodworking seriously enough to set up your own shop, several things may have already happened, or will happen soon. You will search catalogs, yard sales, and the Internet for tools large and small that you need, think you need, or just plain want—and you will buy them. You will bring home great-looking lumber because it is beautiful, even though you have no immediate plans for it. And someone, possibly a friend, will tell you that "you can never have too numerous clamps," and you will believe that person. Each of these things will happen repeatedly, and your space, no matter how voluminous, will soon be a cluttered mess.

Cabinets Building techniques

- I especially like base cabinets in the shop because they provide horizontal work exteriors along with plenty of storage.
- For the Venture House shop, I made a set of fixed and rolling cabinets that occupy most of a long wall.
- The fixed units create 20 square feet of countertop in addition to nearly 50 cubic feet of storage in the spaces underneath.
- The top rank of shallow drawers works well for smaller items, while the deeper drawers underneath can hold routers, belt sanders, biscuit joiners, and other large tools.
- One open cabinet provides space for a shop vacuum, and an opening in the MDF top makes it easy to connect to any tool you roll into place.
- A backsplash prevents anything from falling behind the cabinet. I build shop furniture like this from ¾-in.
- You perhaps won't find this at your local home center, but it's worth seeking out at a plywood or lumber dealer because it is rigid, stable, and without voids.
- The cabinets are sized to be cut efficiently from standard 4x8 sheets.

- The boxes can be assembled simply with coarse-thread drywall screws.
- Be sure to drill pilot and clearance holes for each screw or you'll split the plywood and lose strength.
- With the exclusion of the MDF top, White built the cabinets excusively from Baltic-birch plywood.
- Basic butt joints, held with plenty of countersunk, coarse-thread drywall screws, make a sturdy box.
- For the fixed cabinets, White mounted the boxes on skids milled from kiln-dried 4x4s, with a ½-in. lag screw at each corner for leveling.
- The scrap is there to set the initial height.
- The rolling cabinets ride on heavy-duty casters.
- To the plywood subtop, White screwed a layer of ¾-in. MDF for a replaceable, low-friction exterior.
- Also had to create a large overhang in back to accommodate a protruding foundation wall, but you might not have to.

Chapter 13 Cabinet Installation Tips

- Whenever possible, I like to position base cabinets on a long stretch of unbroken wall.
- This makes an ideal location for a chopsaw station, offering plenty of room to orient long stock for cutting, with the countertops working as long support wings.
- I leave space between the fixed cabinets to accommodate a rolling tool stand.
- I built two of those: a low one to hold the compound-miter saw and a second to carry a benchtop router table.
- A benchtop planer would be another great candidate for a rolling cart.
- The rolling cabinets swap in and out of a central “parking space” when I’m ready to use them, and hook up in seconds to the shop vacuum that lives just next door.
- There’s no need to anchor the fixed cabinets to the wall; they aren’t going anywhere.
- Once they’re in position, adjust the lag-screw feet to ensure that they are level and in the same plane.
- Then roll the chopsaw into place and adjust the saw’s height so that its bed is level with the countertops.
- To do this, I measured the distance between the bed and countertops and then bolted the saw to a pair of riser blocks milled to that thickness.
- After moving the fixed cabinets into place, White used a long level to span the gap between them and adjusted the lag-screw feet to ensure that the tops were level and coplanar.
- White deliberately built the chopsaw stand low, so the tool’s height could be dialed in precisely to match the cabinet height.
- To do this, you have to measure from the saw’s bed to the countertop height, then mounted the saw on blocks milled to the corresponding thickness.
- An open cabinet bay holds a shop vacuum.
- The hose threads through a hole in the cabinet’s top for connection to the miter saw and router table, as well as any power tools used on the countertop.

- A sliding bin underneath the saw collects cutoffs.
- The router-table cabinet is sized to put the tool’s work exterior at a comfortable working height.
- After rolling either cart into place, White secures it with two straightforward screendoor hooks.

Chapter 14 Wall Storage tips

- Cabinets are great for stowing tools and supplies that don’t see action every day.
- Tools used all the time should be closer at hand.
- This is especially true near the bench, where I keep chisels, saws, and layout tools in open racks on the wall.
- This makes them easy to find, retrieve, and stow.
- The same system works terrifically for clamps.
- A lot of woodworkers stow their clamps on a cart that rolls out of the way when not in use.
- For a smaller shop, it makes more sense to use open wall space.
- A fast and flexible way to create this storage is by covering the studs or wallboard with sheets of T-111 plywood.
- I like T-111 because, like any plywood, its strength means you can install tool racks anywhere, without searching for a wall stud.
- But I like the roughsawn look of T-111, and its exterior disguises abandoned screw holes.
- The plywood exterior makes it easy to attach an assortment of shelves and custom holders for a wide diversity of tools and clamps.
- And the arrangement is easy to reconfigure as your tools and needs change.
- White used T-111 plywood, an inexpensive exterior sheathing product, as a base for mounting tools and clamps.
- Battens screwed to the wall provide more attachment points for the siding and eliminate the worry of aligning seams with stud locations.
- Near the bench, White mounted an array of holders for hand tools of all kinds.
- For chisels, you can route dadoes of differing widths in a long board, and then added strips on the front side to keep the chisels in place.
- The tool walls make it easy to find, retrieve, and stow the items you need most often.
- Because they are heavy and hard to handle, the most efficient place to store sheet goods is near the entrance where you bring

them into the shop.

- In this shop, I placed the plywood rack right next to the twin carriage doors.
- And, because the tablesaw is only a couple of steps away, there won’t be any trouble maneuvering through the shop with a cumbersome 4x8 sheet.
- The rack holds the sheets between the wall and a support arm that can mount to a wall or a ceiling joist.
- The support arm stops the travel of the sheet tops; this lets the user flip the sheets forward to view and retrieve a sheet from anywhere in the pile.
- The bottom ends of the sheets rest on a rather raised platform covered with melamine particleboard with a UHMW plastic strip on the open end for easy sliding in and out of the rack.
- The restraining bars lift out of the way for loading.
- A lipped platform secures the sheets at the bottom.
- Lastly, some folks say that a shop is only as good as its lumber stash.
- But how good is that, really, if the stash is disorganized?
- The solution is to get your lumber up on a good sturdy rack.
- It’s not much more expensive to buy one than build one, so we bought one.
- I put the rack along the shop’s back wall, with long stock below the window and shorter boards higher up, between the back door and the back window.

Chapter 15 Building a Wall Cabinet

When the dust and noise from milling parts settles and I head to my bench, that's when the fun begins—when I feel like I'm really woodworking. And that's why my cobbled together hand-tool cabinet was always the heart of my shop. Over the years, though, as my tool collection grew, I Lastly had to admit that I had outgrown my old friend and it was time to build a new one. Space is limited in my shop, so I required a way to pack more storage into the new cabinet without taking up more wall space than the old one. I solved the issue in two ways. First, I made the case deeper, giving me more room for handplane storage in the lower portion and enough depth for swingout panels above. Also, I built the doors as shallow boxes instead of flat panels. These deeper doors combine shelf space for smaller planes and swing-out panels for extra space to hang tools. After some cautious design and layout, I now have all my hand tools in one easy-to-reach place—and the cabinet looks great, too.

Design considerations

- Designing a tool cabinet can be a challenge. It's not just the number of tools.
- You have to figure out ways to store tools of varied sizes and shapes.
- Even a larger cabinet would not have room for every tool I own, so I took a hard look at my collection to determine which tools I use regularly, which ones I use often, and which ones simply gather dust.
- I wanted to ensure that the tools I use most are always within easy reach; that the tools I use once in a while, like carving gouges, are stored in less accessible parts of the cabinet; and that the dust gatherers find a home somewhere else.
- By the way, I also built in a little extra space for new tools I have my eye on.
- To help with the design, I made a full-sized mock-up out of plywood scraps.
- This gave me a better idea of the space I had and how to use it to its fullest.

- To customize the cabinet for your tools, I'd recommend you do the same.

How to build it

- I think a tool cabinet deserves some extra attention.
- For me, that means a solid-wood case with dovetails at the curves, and frame-and-panel doors mounted with mortised butt hinges.
- Still, I made good use of Baltic-birch plywood in the back and door panels as well as in the interior of the case. It provides a solid exterior for mounting tool holders and its thin, void-free plies mean that the exposed edges look nice.
- You could certainly build the whole cabinet from plywood or go to the other extreme by adding veneer or marquetry.
- It's a great place to show some flair and dress up your shop, or you can keep it straightforward.
- I cut the dovetails on the tablesaw.
- Then I cut the pins with a handsaw, hogging out the waste between pins with a router and paring to the line with chisels.
- To give the case more rigidity, I joined the fixed shelf to the sides with through-tenons.
- Typically I start by cutting the mortises, but in this case it was easier to transfer the tenon layout to the mortises rather than vice-versa.
- First I cut the tenon shoulders using the tablesaw.
- I formed the cheeks by cutting a shallow rabbet, with the blade buried in a sacrificial fence.
- The rabbet has three benefits.
- First, it provides a consistent shoulder line to pare to when removing waste between the tenons.
- Second, it obscures any gap at the mortise.
- And Lastly, I can give a shelf a final handplaning without affecting the thickness of the tenons.
- For the mortises, I started by marking the shelf location on the back edges of the sides and then carried those lines across the faces.
- Next, I stood the shelf on each case side to mark the mortises on

the inside and outside faces. I roughed out the mortises on the drill press and squared them up with a chisel.

- Once the joinery was completed, I dry-fitted the case, making sure the assembly was square.
- I also lightly chamfered the ends of the dovetails and through-tenons with a block plane because I planned to leave them proud instead of trimming them flush after glue-up.
- After gluing up the case, I made and installed the plywood back panel.
- I cut it and the lower French cleat from the same piece, beveling their mating edges at 45°.
- The bevel cut is hidden by the fixed shelf and centered in its thickness.
- Then I assembled the doors and the door boxes

Building the storage components

- With the case complete, it was time to work on the storage components.
- I started at the heart of the cabinet with the plane till and the gallery, intended to hold my collection of handplanes.
- The till not only displays the larger planes nicely but it also makes them simply accessible because it tilts back at 30°.
- Triangular cleats screwed to the case sides support the till.
- The planes are separated by a series of dividers screwed to the till.
- I used the actual planes and a ¼-in.-wide spacer strip to locate the dividers.
- At the bottom of the cabinet I created a gallery that also embraces a couple of drawers, useful for each item from drill bits to tape measures.
- The whole section slides in and out as a unit and is screwed to the base of the cabinet at the back.
- The gallery is narrower at the top than at the bottom, and the dividers are curved.
- This allows easier access to the handplanes.
- The ¼-in.-thick plywood dividers slide into dadoes in the ½-in.-thick top and bottom.

- I added horizontal dividers to two of the partitions to double-up block plane storage, gluing in stops to keep the smaller planes from sliding in too far.
- At the top of the cabinet, just above the plane till, I added cleats to the cabinet sides.
- These not only support a small shelf but also act as a place to attach a pair of swing-out plywood panels made from ½-in.-thick Baltic-birch plywood.
- I relieved the bottoms of each panel so they wouldn’t block access to the planes below.
- I also added swing-out panels to the inside of each cabinet door.
- The panels give me another robust exterior to attach tool holders, helping the cabinet pack in even more storage in a shallow space.

Chapter 16 Storing handplanes

Handplanes are expensive, costing as much as or more than a benchtop power tool. To keep these investments safe, numerous woodworkers tuck their planes inside drawers or cabinets. Though the tools are safe and sound, it's a nuisance to keep opening a door or drawer to access the planes while they're working. For convenience, numerous folks end up keeping their most-used planes on top of the bench. That technique is not so convenient, nevertheless, because the planes can get in the way, and they're just inches from getting knocked to the floor accidentally. My plane rack solves all of those issues. Though straightforward in design, the rack has a unique way of holding the planes. The knobs are suspended from loops made from bootlaces, and the soles rest on an angled panel. The system is robust and stable, and the bootlace hangers allow me to grab and store planes with ease. This rack holds what I consider to be a full set of handplanes—a jointer, fore, jack, two smoothers (Nos. 4 and 4 ½), three block planes—with room below for some specialty planes, such as a shoulder plane. But the rack can be modified to fit more or fewer planes, or planes of different sizes.

How to build it

- The case is assembled with straightforward dadoes and rabbeted dadoes.
- After cutting these joints, you can take on the trickiest part of the assembly: cutting the grooves for the angled back panel.
- Start by making the grooves in the underside of the top and in the top of the horizontal divider.
- These through grooves are cut on the tablesaw using a dado set tilted to the panel angle (5°).
- Then, dry-assemble the case.
- Place a spacer, the same thickness as the back panel and about 1 in. wide by 3 in. long, into the grooves in the top and divider.
- Knife around the spacer to locate the grooves in the sides.
- Clamp the sides together and to the benchtop and clamp a long plywood fence to one side, aligned with the groove marks.
- Rout the groove using a plunge router and a ½-in.-dia. pattern bit.
- Rout the groove in the other side piece in the same way.

- With all the grooves made, cut and fit the plywood back panel and glue up the case.
- Then make and fit the french cleat.
- Note how it is angled to sit flat against the back panel.

How to fit the interior frame

- Start by making the top and bottom pieces of the frame.
- Cut them to length, and then bevel one edge 5° so that the inward facing edge is at a right angle to the back panel.
- That means you bevel the top edge of the top piece and the bottom edge of the bottom piece.
- Next, cut the dadoes for the vertical frame pieces in the top and bottom of the frame.
- Fit the vertical pieces, and then cut the dadoes in them for the short horizontal frame pieces.
- After cutting and fitting the shorter pieces, drill ¼-in.-dia. holes in them for the lower bootlace hooks.
- Now glue the interior frame into the case.
- These tight-fitting parts require only spring clamps to hold them while the glue cures.
- After the interior frame has been installed, drill holes through the top of the case for the top bootlace hooks.
- Clamp a backer board to the opposite side to prevent tearout.
- Cut the top and bottom grooves for the back panel with a tilted dado blade.
- Then use a plunge router and angled fence to make the grooves in the sides.
- Cut the grooves in the top and the horizontal divider at 5°.
- With the case dry-assembled, use offcuts from the back-panel stock to lay out the side grooves.
- Place these blocks in the top and bottom grooves and scribe around them with a knife.
- Clamp a fence aligned with the scribe marks, and use a plunge router and ½-in. pattern bit.
- Assemble the carcase first.
- Once that's done, make the french cleat, then cut and assemble the

interior frame.

- The plywood back panel is glued into its grooves, making the cabinet rigid.
- Install the top and bottom frame pieces first, and then attach the vertical pieces.
- You can glue them to the back panel without clamps, but the joinery must be tight.
- Drill the bootlace holes in the short horizontal pieces before gluing them in.
- Once the case is glued up, drill holes through the top piece for the bootlace hooks.
- Clamp a backer board underneath to prevent tearout.
- Make a loop using a square knot and thread it through its hole.
- Experiment to get the right-length loop for each plane.
- I completed the rack with three coats of Danish Oil, which brings out the beauty of the wood, protects it from grime, and touches up simply if required.
- Once the finish is dry, make the bootlace hooks.
- It will take some tries to get the right-length loop for each compartment.
- As long as you can hook the knob of the plane through the loop and the plane sits in its compartment, you’re good to go.
- Singe the ends of the loops to prevent fraying.
- It won’t take long to get the hang of this rack.
- Soon you’ll be removing and replacing the planes with just one hand.

Chapter 17 Woodworking safety practices

Woodworking professionals do spend a long time handling sharp working tools, with wide-open blades, and boards that harbor fasteners and splinters. In this atmosphere, there is always the danger of a possible injury. Naturally Woodworking professionals do cut their fingers, and frequently the palms of their hands too. Although the hand can recover from minor wounds even if it receives no care, recovery is quicker with less damaging and less risk of infection if it's treated correctly. For more severe cuts or eye injuries, what you do first could have an impact on the rest of your life. These sorts of injuries that are common in the workshop. The woodworking atmosphere is exceptional, so let me share with you some great tools and supplies that work extremely well. I'll likewise explain a few tips on treating wounds; such as how to stop the bleeding, cleaning the wound or bandaging. Shortly, you'll understand how to treat injuries in a way that gets you back to work ASAP.

Handling Cuts

1 - Soap and Water

- The rival of healing is infection.
- The germs that live on lumber and tools generally do not cause disease; all the risk is from bacteria you already carry on your skin.
- A wound allows those skin germs to reach the more vulnerable tissue beneath the skin.
- The issue gets worse in case there is sawdust, dirt, dead tissue and debris goes into the wound.
- The most effective way of handling all wounds is instant washing with soap and clean tap water.
- You could skip this in case you need to go to the emergency room (ER), because they can and will clean it there.
- Washing drastically decreases the number of germs, and takes away dirt and debris in which bacteria could hide and multiply.
- The best way to clean a wound is to hold the cut under running water for several minutes.
- If you have no soap around, plain tapwater will do a great job.

- Wash every wound, even if you can see contamination or not.
- Waterless hand cleaners and antiseptic solutions may be better than nothing, yet they are not a proven substitute.
- If you are able to wash the wound successfully, you don't need these supplies.
- Doctors and first-aid manuals in the past have routinely recommended the usage of an antibiotic ointment, yet recent research proves that clean wounds need no antibiotic if they are washed properly and closed quickly.
- Furthermore, the ointment preparation discourages the formation of a scab, which is the most effective wound closure obtainable.
- Skip any antibiotic ointment unless dirt and debris were driven into the wound and cannot be washed out.
- Wash both hands vigorously enough to generate lots of lather under a robust stream of warm running water for several minutes.
- While washing, hold the cut open and flush the wound for at least a minute.
- Ignore any bleeding this may cause.
- Dry both hands on a clean paper towel.

Weak areas of the hand

- Unless the wound obviously penetrates into a bone or joint, cuts here typically could be treated simply at home.
- Deep cuts in these areas are likely to have damaged the tendons or tendon sheaths and should be examined by a doctor.
- Cuts that do not slice all the way through do not require stitches because the lower layer of skin keeps the wound reasonably closed.
- The cut can penetrate all the way through the skin, revealing the fat beneath.
- A deep cut like this that's under 1 inch long typically could be treated at home; in case it's longer than 2 inch, the wound needs to be stitched. In between 1 inch and 2 inch, the decision to get stitched depends on the location of the wound.
- The cut on the thumb could be treated at home.
- Normal hand actions will not apply stress to the wound.

- The cut on the palm and index finger begs for stitches.
- It is long and deep and in a location where every hand activity will stretch the wound apart.

2 – Using 5 minutes pressure

- Once washing the wound, you have to stop the bleeding.
- You should apply pressure directly over the wound for five minutes without interruption to help form a clot.
- In case you peek, the clock starts all over again.
- Don’t be afraid to touch the cut.
- Make sure that you apply pressure directly over the wound, not below it.

Using a glove

- In case you get a minor cut, say, while you’re in the middle of a glue-up, you don’t have to stop working.
- Put on an examination glove, and wrap masking tape snugly around the finger directly over the cut.
- The glove keeps blood off the woodwork, and pressure from the tape will typically stop the bleeding in 5 to 10 minutes.
- After removing the glove and tape, you have to wash your hands properly, and close and dress the wound.

3 - Close the Wound

- When you get cut, keeping the two edges of the wound firmly closed will help it heal rapidly.
- Cuts from sharp tools penetrate cleanly, which makes them easier to close and faster to heal.
- Wounds with frayed or crushed edges take a bit longer to heal. In either case, you want to wash and close the wound to pull the sliced skin back together.
- Standard adhesive bandages cover the wound but don’t securely close it.
- As soon as you start using your hands, skin movement will reopen

the cut.

- Hospitals often utilise a specialized tape product called Steri-Strips, which you could buy without a prescription in most drugstores or online.
- It is likewise possible to glue wounds closed with ordinary cyanoacrylate glue.
- Both practices work better in case you have a helper to either hold the wound closed or to apply the Steril or glue.
- Dry the skin around the wound, then cut the strips to length.
- Eliminate the paper backing, and apply.
- Adhere the strip to one side of the cut, push the wound edges together so they just meet, and stick the strip down on the other side.
- Cyanoacrylate glue works for closing a wound.
- But the job is not like butting two boards together.
- Do not apply glue inside the wound. Instead, push the skin edges together and spread a thin layer of glue across the top of the skin, interrupting the glue at short intervals to preserve flexibility.
- Don't utilise the activator spray that comes with some glues.

4 - Smarter Bandages

- In case you go to an emergency room with a hand injury, you'll come home with a huge bandage that will attract many sympathy.
- Emergency rooms often use gauze as the main element of bandaging.
- Gauze is light as air, extremely flexible, and breathes like it wasn't there at all.
- Nevertheless, you cannot work wood while wearing gauze.
- Woodworkers need bandages that are flexible, thin, and tough.
- It is likewise convenient to have bandages that shed water, sawdust, and glue, and yet breathe so the skin stays dry.
- Here are two bandages that you could utilise after you've closed the wound or after you've come home from the ER.
- The first option is to cover the area with a Tegaderm dressing.
- Tegaderm is a transparent medical dressing that's flexible, tough, and stretchy.

- It is great for hand wounds because it could be conformed to a number of shapes and is so smooth that it won’t catch on any sharp edges.
- This product is obtainable with and without a non-stick, absorbent pad in the center.
- Numerous wounds will seep a small amount of serum in the first few hours after bandaging, and the absorbent pads are useful then.
- Later, they may be unnecessary.
- In case you have to handle rough lumber, or do work that applies a lot of friction or abrasion to your hands, consider wearing leather or fabric gloves to protect the dressing.
- Injuries that involve the palm or the webs between the fingers are very hard to bandage.
- Once closing the wound with a Steri-Strip, apply a Tegaderm bandage.
- Put on the bandage and then peel off the paper frame.
- In case you need to cut the bandage to a smaller size, do it while all the backing paper is still in place.
- The bandage is thin and flexible, allowing nearly full knuckle movement
- It’s hard to keep a bandage in place on the palm of your hand, thus wrap the dressing with Coban tape.
- First you have to take a couple of wraps around the wrist.
- This serves to anchor the whole bandage.
- Then continue with several wraps around the palm.
- Lastly, end the Coban on the back of the hand or wrist, where it will receive the least rubbing.

Punctures treatment

- Punctures from clean, sharp tools like narrow chisels, scratch awls, and marking knives should pose very little hazard and require very little treatment.
- The wounds tend to close themselves.
- Wash thoroughly and apply a small bandage until bleeding stops.
- If you have a puncture wound caused by a dull tool, you have an

increased chance of infection.

- First wash the area thoroughly.
- As you wash, flush out the wound with water using a squeeze bottle or glue syringe.
- Apply Tegaderm with an absorbent pad.
- If the wound becomes more puffy and painful over a period of several days, have it seen by a doctor.
- Puncture wounds carry a very small risk of tetanus.
- You were immunized against tetanus in childhood, but your immunity needs a booster every 10 years.
- Keep this up to date.
- As you wash, open the wound as much as possible, and squirt water in with a squeeze bottle or a glue syringe.
- Don’t be bashful about the amount of water.
- You want to flush the wound vigorously enough to get rid of any debris at the bottom of the puncture.
- Punctures from dull tools like screwdrivers leave more crushed and damaged cells, and the dull edge often pushes the skin, dirt, and debris back into the wound, creating more chance for exterior skin bacteria to be lodged in underlying tissue.
- These wounds really need to be flushed out.

Splinters

- Everyone who works with wood has had splinters in their skin, and virtually everyone has struggled to eliminate them.
- If you have trouble seeing the splinter, use magnifying glasses, whether it’s a pair of inexpensive reading glasses or visor-type magnifiers that you can wear over eyeglasses.
- These magnifiers may come in handy for other shop uses, too, like working with small parts or chiseling to a line in tight spaces between dovetails.
- Typically you can pull out the splinter with a pair of tweezers.
- Nevertheless, if a splinter has tunneled a long distance under your skin, you’ll have to gently slice the skin to reach it using a No. 11 blade in either a disposable scalpel or an X-Acto knife.
- After slicing, pull out the splinter with tweezers.

- Be sure to wash your hands and the blade thoroughly before you probe around in the skin.
- Sterility is not necessary, but cleanliness is very vital.
- Typically no dressing is required; but if you had to dig so deeply that the wound bleeds significantly, and then dress this as you would a cut.
- To reach long slivers that tunnel through the skin, use an X-Acto knife with a No. 11 blade.
- First wash your hand and the blade. Insert the back of the blade along the top of the splinter, and gently slice open the skin with the tip of the blade.
- Slice along the splinter's length to expose it as much as possible, and then pull it out with tweezers.

Looking after your eyes

- When you cut wood, especially with a router or tablesaw, sawdust or sometimes other material will fly.
- If some of that small debris ends up in your eye, your natural tears will typically wash it away.
- If the debris digs in and resists being washed away by tears, the best answer is to retract the eyelid away from the eyeball, and flush the eye with an eye-wash solution.
- Get someone to help you.
- Lie on your back; it is hard to flood the eye with solution while you are upright.
- Have your helper put on your magnifiers and look in your eye for the debris.
- Regardless of whether they see the offending particle or not, have them squirt the solution under both lids.
- Use towels or tissues to sop up the excess, and use plenty of liquid.
- If that does not work, do it again.
- If repeated irrigation of the eye does not dislodge the particle, seek professional help.
- Never use tweezers or hard instruments in the area of the eye.
- If there is so much spasm of the eyelids that you cannot open the

eye enough to see what is going on, that suggests a more serious eye injury, and you should get immediate professional help.
- The safest and easiest way to eliminate foreign particles in the eye is to rinse them away with a spray of eye wash.
- Lift the eyelid and spray vigorously.
- If necessary, repeat several times.

On your way to the Hospital

- Some woodworking injuries demand professional care.
- Cuts that are deep enough to obviously penetrate into joints or bone, or that appear to cut tendons, should be treated by a doctor within a couple of hours.
- These injuries require the removal of foreign material embedded at the bottom of the wound, and may require special suturing.
- They also carry greater risks of infection, and preventive antibiotic treatment is sometimes required.
- For these wounds, stop the bleeding by applying pressure with a gauze pad or a clean paper towel and have someone drive you to the emergency room.
- If you tangle with a power saw, that is going to mean a trip to the hospital.
- There is little that can or should be done in the shop, other than applying pressure to the wound and arranging for rapid transportation to the hospital.
- If you cut off some part of your hand, press directly on the wound to stop the bleeding, seal the amputated part in a zippered plastic bag, and get to the hospital fast.
- Don’t try to drive yourself.
- If that trip is going to take more than an hour, carry the plastic bag in some ice or cold merchandises from your freezer.
- Amputated fingers can survive for more than six hours.
- Any kind of injury to the eyes is scary.
- Any injury that penetrates the eyeball or cuts through the eyelid must be seen by a specialist.
- If tiny flecks of wood or metal embed themselves in the cornea have them eliminated in the ER.

- When in doubt about any eye injury, you should have the eye examined by a pro.
- Tape a gauze pad or a tissue over the closed eye while you are on your way to the hospital.
- This discourages the eyelids from moving, which typically decreases any discomfort.

Chapter 18 Tips for Dust Protection

Wood dust is a woodworker’s continuous companion and a continuous threat. It doesn’t take much airborne dust to exceed the exposure limits recommended by the National Institute for Occupational Safety and Health. In fact, you’ll rapidly blow past them when machining or sanding wood. Dust collectors and air cleaners help control wood dust, but even when optimized for your shop they don’t catch it all. The smallest and most dangerous particles escape them. Exposure to those minute particles can cause nasal and sinus-cavity irritation, allergies, lung congestion, chronic cough, and cancer. That’s why it’s vital to wear a dust mask or a powered respirator whenever you’re producing dust, or working in the shop afterward. You’re more likely to wear a dust mask or respirator if it’s comfortable and fits well. You might need to look beyond your local hardware store, but great choices are out there. In fact, there are so numerous options you might feel overwhelmed. But that won’t happen if you know how dust masks and respirators work, how to tell if one fits you well, and which features make one more comfortable. I’ll tell you what we liked about them and what we didn’t. That will help you know where to begin your search for a good-fitting and effective dust mask or respirator. After all of our testing, it’s clear that there are a few key features that make for a great mask or respirator. You should put them at the top of your list before you shop.

Should you have an exhaust valve

- An exhaust valve is an indispensable feature on a dust mask.
- In fact, we recommend you steer clear of any dust mask that doesn’t have one.
- Exhaust valves clear the warm air you exhale, prevent safety glasses from fogging, and help keep your face cooler.
- You also should look for a mask that is made from face-friendly material.
- The interior of the 3M 8511, For instance, is soft and fleece-like.
- An adjustable nosepiece is vital, because it allows the mask to form a tighter seal against your face and allows you to customize the mask to the shape of your nose.

- Adjustable straps are a big plus, because they make for a tighter fit.
- Testers liked the adjustability of the straps on allow you to hang the mask comfortably around your neck.
- Some features don’t reveal themselves until you have a mask on.
- You don’t want a mask that interferes with your vision or safety glasses, prevents you from speaking audibly, or interferes with hearing protection.
- Because they have nearly all of these features, two masks really stood out from the rest: the Willson Saf-T-Fit.
- Respirators are harder to peg than dust masks, but there are a few key features to look for.
- The weight and balance of the helmet, For instance, are vital.
- If a respirator doesn’t sit well on your head, you’ll take it off very rapidly.
- And the face shield shouldn’t distort or interfere with your vision.
- You also should be able to wear some kind of hearing protection with the respirator on.
- Of the respirators we tested, the Airshield Pro differentiated themselves for comfort, clarity of vision, and overall user-friendliness.
- Dust masks don’t last forever.
- Replace yours when it becomes hard to breathe through, when the mask no longer seals appropriately, or when it is damaged.
- If you use a respirator, ensure that you confirm its airflow regularly.
- When it doesn’t move enough clean air, it’s time to replace the batteries, the filter, or both.

Chapter 19 Dust Mask and Respirators Tips

Our testers clearly favored vented masks because they are more comfortable. They allow hot air to simply escape through the front of the mask, so your face stays cooler and your glasses won't fog. The Moldex Handy Strap makes hanging a mask around your neck a snap, a big plus when you need to take it off momentarily to speak, get a drink, or make an adjustment. The strap makes putting the mask on easier, too. Masks with adjustable nosepieces work for more people because they can be tailored to the individual's nose. The nosepieces help prevent fogging by giving a better seal around the nose. For protection from wood dust, look for a mask rated N95, N99, or N100. The ratings don't apply to powered respirators, but all the respirators tested clean the air as well as an N95 mask.

Reusable Masks as an alternative

Disposable masks and those with replaceable filters clean air in the same way. The difference shows up when it's time to replace the filter. With a reusable mask, you replace just the filter section, and keep the "frame" that holds it. While they cost more up front, their filters last longer and are less expensive. They are heavier and can be less comfortable than disposables, but if you find one that fits you well, a reusable mask could be a good option.

Powered Respirators tips

If you've got a beard, a respirator is the way to go. And if you turn, you can find one with a safety rated face shield for added protection. Numerous respirators have an integrated safety-rated face shield, which makes them great for turners.

For most people, a high-quality dust mask works great. A powered respirator is a better choice if you need protection from flying chips, or if you have facial hair, which keeps a dust mask from working appropriately. Most respirators have integrated, safety-rated face shields. A dust mask should seal firmly against your face. That keeps bad air from seeping in. Respirators use a fan to pull dirty air through a filter. The clean air flows down over the face, preventing bad air from flowing into the mask. In 2001, wood dust went from being a nuisance to an official health risk. That's when the U.S. government put it on their list of “known carcinogens,” linking it to a diversity of nose, throat, and lung cancers. But it has taken our corner of the woodworking industry a while to catch up with reality. The best way to manage dust is to collect it at the source, and one of the industry’s first vital realizations was that the dust ports were sadly lacking on most woodworking tools, and nonexistent on others. That was pretty easy to fix, and the improvements have been steady and significant. So before you spend money on ceiling-hung air filters or expensive respirators, go to the source of the issue. Connect your dust collector and shop vacuum to every possible power tool. If you are buying new tools, look for manufacturers that make dust collection convenient and effective. For your existing tools, take a day in the shop to improve the ports.

In the past 1 or two decades, if you collected dust at all, you perhaps did it with a single-stage collector and a 30-micron polyester bag. Those porous bags act like fine-dust delivery systems, blasting out a cloud of the most dangerous stuff at head height. The irony is that people who didn’t bother with dust collection at all, leaving big piles of sawdust under their tablesaws, were perhaps safer! The trouble with wood dust is that the most dangerous particles, the very fine ones, are the hardest to collect. Under 10 microns in size, they hang longest in the air, penetrate deepest into the lungs, and are the hardest for the body to eject. So the tool companies knew they had to get serious about filtration. Felt bags were an early response, borrowed from industry. But the finer the felt, the taller the bag required to be in order to have enough exterior area for good airflow. There’s room for that in a factory but not a small shop. Enter the pleated filter, which packs hundreds of square feet of exterior area into a small canister. You see these now on the latest cyclones, single-stage dust collectors, and shop vacuums, and they certainly are a major upgrade from the filters of the past. But for each item but the cyclones, there is a issue: The filters can only get so fine before they start clogging and killing airflow. Why the cyclone is still best. A two stage system catches most of the dust before it can get to the filter. That means the filter can be much finer. On single-stage dust collectors (and most shop vacs), most of the fine dust reaches the filter, so the very finest pleated filters will rapidly pack with dust and start killing suction. At least five manufacturers of single-stage dust collectors told me the same thing: that they had to stop at 2-micron pleated filters when outfitting those machines. On the other hand, cyclone collectors can have state of-the-art filters that capture particles as small as 0.3 microns. So my first piece of advice is to buy a cyclone dust collector if you can. While the first cyclones for small shops were big, expensive, stationary machines, requiring long hose or rigid-duct runs to reach all four curves of a shop, almost every cyclone manufacturer now makes compact, roll-around models, and numerous are under $800.

I would love to trade up for a cyclone collector, but I recently exhausted my marital capital on a larger band-saw and a planer/jointer with a segmented cutter head. So I have the same setup you perhaps have: a single-stage collector and a shop vacuum. I've done my best to upgrade them. I put a "2-micron" cartridge filter on my dust collector and substituted the standard filter on my vac with a HEPA model (the finest filtration obtainable). But the HEPA filter came with a cost: I have to bang it against my trash can regularly to unclog it and restore the vacuum's suction. That's not only a pain, but it also fills my head with the same fine dust I'm trying to avoid. And I've known for some time that the 2-micron filter on my collector was not up to snuff. The light went on for me when I recently reviewed Oneida's new Dust Deputy. It is a small plastic cyclone separator for shop vacuums, and I was astounded at how clean it kept my HEPA filter, and how much more powerful the airflow was as a outcome. Dust separators are nothing new, and they are made for both shop vacuums and single-stage dust collectors. The common type is not much more than an inlet and outlet that attach to the top of a barrel. Dust reaches the barrel first, where the larger particles spin around and settle out before the air passes out of the barrel and into the dust collector itself. Oneida's little cyclone is just a new type of separator. My involvement with the Dust Deputy got me thinking: Could I upgrade the cartridge filter on my single-stage dust collector and then install a separator to keep that filter from clogging continuously? Or do I have to spring for a cyclone to be truly safe?

One of the breakthroughs in dust collection involves downsizing. There is no doubt that the cyclone is the best way to collect dust. New portable models are a more affordable option for small shops, while even smaller types work wonders as dust separators for shop vacuums and single-stage dust collectors.

I spoke with product managers from eight companies; brought in the best cyclones, single-stagers, shop vacuums, aftermarket filters, and dust separators for testing. First, measured the initial airflow on every dust collector and vacuum to get a baseline for each with a clean filter. Then turned them on, and sucked up enough dust to fill each one to capacity, measuring flow the whole time. That told us that the experts are right about cyclones: They work better than any other type of collector. While the airflow/suction on the other dust collectors and vacs dipped up to 40 percent as their filters clogged, the filters on the cyclones stayed clean and the airflow barely wavered. How to test single-stagers? After seeing what a dust separator did for my shop vacuum, allowing it to have a much finer filter without clogging, I couldn't wait to try out the separators made for single-stage dust collectors. That's when we hit a roadblock: No one makes an after-market filter for single-stage collectors that's any better than the standard-issue models. So we couldn't upgrade the filters on the single-stage collectors, but we could do two things that would get us very close to a definitive answer. First, we could test the effect of a dust separator on a single-stage collector with its standard pleated filter in place. If the separators worked well for those, they should help even finer filters too. Second, we could do the full test on our army of shop vacuums, since there are dust separators and upgraded filters obtainable for all of those.

We started by testing a number of typical single-stage collectors, trying them without a separator in place, and the outcomes were sobering: Airflow dropped by an regular of 40 percent after filling the bags just once. One has to assume that number would be even higher with finer filters. Then we picked a typical performer, and tried it with various dust separators. With the best separators, the airflow hardly budged! Jet makes a “Vortex” version of its single-stage collectors, and the one we tested recently kept its filter clean without the need for a separator. We also tested the effectiveness of those internal flappers that manufacturers have embraced on their cartridge filters. They worked great, too. A few spins of the handles this way and that unpacked the pleats and brought the airflow back to normal. Blowing compressed air through the pleats also worked very well, and won't abrade the filter media the way flappers might. We also found that a full bag drives the dust swirl higher, clogging the filter more rapidly, so we recommend emptying the bag when it is half full or so.

The next test was tougher. We put both standard and HEPA filters onto a number of shop vacuums, sucked up gallons of dust, and measured the flow. Sure enough, the HEPA filters clogged more rapidly than standard models, just as I experienced in my own shop. Then we attached the separators, and they did their magic once again, keeping the filters clean and flowing free. Our tests showed that adding a separator does steal a small amount of initial airflow, but that loss is vastly outweighed by their advantage once you start pouring dust into the system.

If you want to be safe from fine wood dust and have a cleaner shop in general, you should focus on two things: Bringing the appropriate amount of suction to the source, and putting the finest filtration you can buy at the other end.

Your primary source of suction for woodworking machinery should be a dust collector, not a shop vacuum. That's because you need as much as 700 cfm of airflow at the end of the hose for larger machines. But it is possible to overbuild your system. Too much air pressure is essentially a bad thing, since it can force dust right through a fine filter. So unless you are installing a full-shop system, with a stationary collector and permanent duct runs to every corner, a 2- hp dust collector with a 12-in. impeller is perhaps right for a basement or garage shop. With anything smaller, and even for 2-hp collectors, I recommend keeping the biggest machines as close as possible to each other to keep hose runs shorter.

If you can afford it, get one of the new compact cyclones, with a filter that has been rated by a reputable third party. We found a few manufacturers with certified, state-of the art filters called Oneida, Penn State and Grizzly. And filters from those companies can be purchased as accessories and retrofit onto an existing cyclone. But other manufacturers are upgrading all the time, so confirm websites for current stats and testing info. If a single-stage collector is a better fit for your budget, or if you already own one, consider the upgraded filters coming from Oneida and Grizzly.

Most collectors have similar dimensions and designs, so there should be an aftermarket filter that will fit yours. After upgrading, consider adding a dust separator to keep the filter clean and the airflow powerful. Of course, no matter what type of collector you get, you'll need a shop vacuum that can go where its big brother can't. Put a HEPA filter on yours, or buy a new one with HEPA standard. And unless your vac has some kind of self-cleaning feature (a few have built-in filter shakers), add a dust separator to keep that HEPA filter from clogging and killing airflow. While doing all this testing, we ended up testing the best new vacuums.

Bottom line about Filtration

- There is a lot of mystery and misinformation surrounding filtration specs, so I took a closer look.
- Manufacturers tend to give vague ratings like “2 micron.”
- If a filter rating doesn’t tell you what percentage of what size particles it can capture, the manufacturer perhaps doesn’t know exactly.
- While the science of filter ratings is new to our corner of the woodworking industry, there are plenty of independent companies in Europe and the United States that can test and rate filter media at very low cost, and a few manufacturers have taken advantage of that.
- Ratings are standardized.
- The widely accepted standard in the United States comes from the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), and is expressed as a minimum efficiency reporting value (MERV), or as HEPA (high-efficiency particulate air), a rating that exceeds the MERV scale.
- True HEPA filters capture 99.97% of 0.3-micron particles, which is as small as wood dust gets.
- For shop-vacuum filters, buy a certified HEPA filter, not “HEPA-type” or anything vague-sounding.
- For all other dust collectors, look for a filter that is third-party-rated to capture more than 85% of the 0.3-micron to 1.0-micron particles (MERV 15 or higher).

Chapter 20 How to start planning your ventures

Making furniture isn't easy, especially if you do it in your spare time. When it comes to complex tasks like dovetailing a carcase or sanding a big piece, it's challenging to get consistent outcomes when working in short bursts. I've long thought that if I could make wiser use of my limited shop time, I'd make fewer mistakes, get more done, and build better furniture. To that end, I recently asked some of my friends for suggestions, tapping their combined decades of involvement. Astonishingly, none of them focused on technical skills; I guess these just come naturally over time. Instead, their advice dealt with things like venture planning, tool maintenance, and basic milling operations. And there was a surprising amount of agreement among them. In all, their tips boiled down to a set of good bedrock habits that will enhance anyone's work and enjoyment in the shop..

1 - Plan the work

- Begin each venture by drafting an overall plan.
- This plan should start with a detailed drawing and cutting list, but just about everyone agreed it pays to think through the whole venture in advance and map out a logical step-by-step sequence for every facet, from milling and shaping parts to joinery, glue-up, sanding, and finishing.
- Planning ahead yields a number of benefits. It helps ensure that you won't forget any crucial steps.
- It also breaks up the venture into a series of tasks, each of which can be made small enough to treat as a objective for an individual shop session.
- As you develop your plan, you'll learn to spot natural breaks in the action that afford their own very real woodworking advantages.
- For instance, if you conclude a shop session with a final sanding of your venture, you'll be ready to apply finish when the next session starts—after the sanding dust has completely settled.
- You'll also find that short shop sessions are ideal for applying a single coat of finish that can dry during the interval between them.

2 – Do not hurry

- Great woodworkers work rapidly, but they never rush.
- Hurrying leads to mental mistakes like chamfering the wrong edge of a stretcher or cutting an apron too short.
- Make a conscious effort to slow down and work cautiously.
- You’ll make fewer big mistakes and avoid major backtracking, like remaking parts or even a whole assembly.
- As a outcome, you’ll finish your work more rapidly.
- A routine hand-tool exercise is a great way to begin a shop session because it helps ease you into a focused, deliberate pace.

3 – Get ready for mistakes

- Cautious planning can help you avoid numerous mistakes, but we’re human, so something will go wrong ultimately.
- Accept your fallibility.
- Mistakes are far less likely to ruin your fun if you’re ready for them.
- One way to prepare is to mill extra parts—five legs instead of four, For instance.
- That way, if you cut a mortise in the wrong place, you can grab a spare and keep going.
- It’s also wise to mill stock for test cuts and test joints while milling the workpieces, cutting to exactly the same dimensions.
- A test piece that is even a few thousandths off will cause inaccurate setups.
- Lastly, avoid working while frustrated.
- Frustration has caused me to drill holes in the wrong place, cut tenons too narrow, and accept iffy outcomes just so I could move on.
- It’s better to stop, walk out of the shop, and stay away until your head clears.
- Ten minutes or ten days —it’s worth the wait.

4 - Keep your tools where they should be

- Organize your shop in a way that keeps tools close to where they will be used most often.

- And make a point of returning them to their places when you are done.
- We've all had work come to a screeching halt while we searched a jumbled and dusty shop for a tool that "was just here!"
- A good shop apron is like a shop assistant.
- It can keep handy the tools you use most often: a square, a ruler, a marking knife, a pencil, a sliding bevel, and your safety glasses.
- If these tools are always at hand, you won't waste time hunting for them or making do with a substitute

5 – Use the power of Hand Tools

- The block plane is a great introduction to the utility of hand tools.
- Unlike a fussy router setup, it takes just a few quick passes to flush-trim a plug or the tails and pins of a dovetail joint.
- Leveling an apron with the top of a leg is also quicker and cleaner with a block plane than any power tool.
- And it's far quicker to break a sharp edge with a block plane than with a router.
- Hand tools are also great for smoothing convex curves and rough-shaping wood.

6 - Document each stage as you progress

- Sometimes, I leave the shop and don't get back until a week or more has passed.
- The lapse of time can make it hard to Recall particulars.
- Suppose, after measuring a cabinet opening at the end of a previous shop session, I decided to widen the stiles for the door I'm about to build.
- With no reminder, I might go merrily on my way at the start of the next session, milling the pieces to the width, and end up having to remake them.
- To avoid such gaffes, take detailed notes about what you are doing and thinking before you leave the shop.
- A quick note—"widen stiles ¼ in."—will put you right on track

when you return. In addition, a note or two made on your original drawings will help you keep track of modifications to the design should you decide to build the piece again.

7 – Ensure that you keep your tools sharpened

- Sharpening tools isn’t fun.
- Neither is checking the accuracy and setup of your machinery.
- But it’s really an investment in the quality of your work and the quality of your involvement in the shop.
- Nothing slows you down more than dull or out-of-tune tools.
- Plan a shop session precisely to sharpen and maintain your machines.
- Perhaps the best time to do this is between ventures, so you won’t be interrupting other work.
- In this way, you’ll have come full circle and be ready again for step one, which is planning your next venture.

Chapter 21 Supplementary tips for beginners

We're all busier these days, feeling the pressure for quick outcomes in every area of life, even in the last place we woodworkers should tolerate it; the shop. I trick myself into believing I can skip vital steps that prevent mistakes but slow me down. I ignore the quiet voice in my head that tells me I am gambling. Temptation arises at every stage of a venture, from choosing what to build to buying lumber and milling it, from cutting joints to assembly and finishing. And a mistake at any stage can show in the final product. On the other hand, if you go the extra mile, you'll appreciate the gorgeous exteriors, tight joints, and flawless finish for years to come. I've never regretted taking my time on a piece. #so here are my final tips for starting a venture.

- If you are a hobbyist, don't put yourself on a deadline.
- Leave those for your day job.
- Take a breath, clear your mind, and let that quiet voice guide you.
- It will warn you about every shortcut, and you'll be surprised at what you can accomplish.
- When I was starting out, I couldn't wait to begin cutting and building, so I intended pieces without much fore-thought.
- As a outcome, my work wound up with proportions, moldings, and other elements that I didn't like.
- I keep my first bookcase well hidden in a basement playroom.
- If you're creating a design from scratch, you'll need to iron out the particulars before you buy lumber.
- The best approach is to make scale models and mock-ups.
- After the bookcase, I built a cradle from a plan in a book.
- That one came out great, and sits proudly in my daughter's bedroom.
- We all get sticker shock at the lumberyard, but it's not worth the savings to buy subpar wood, or just enough to cover your cut list.
- The trade-off comes when you are forced to accept defects in the completed piece, or make the long drive to get more wood later.
- You won't regret buying 10% or 20% extra.
- You can cut around defects, reject a board that warps severely or looks worse than you thought it would, or replace one if you make mistakes.

- Before you open your wallet, though, take care at the lumberyard to find the right board for each part.
- Look for matching color and great grain where it counts most.
- Then use a lumber crayon to mark each board for the parts it will yield.
- Also, if you buy your wood already surfaced, take extra care to ensure that each board is straight, flat, and smooth before putting it in the take-home pile.
- You need patience and attention to detail when cutting pieces to rough length and width, then jointing and planing them to achieve flat, parallel faces and square curves.
- These tasks are crucial, but dull, and it's too easy to treat them like a speed bump on the road to building your venture.
- You might decide, for instance, to skip the step of milling your stock rather oversize and letting it acclimate for a few days before bringing it to final dimension.
- You might select not to bother marking which faces you've already milled, and end up with lumber that is not straight or square.
- Attention to these particulars will make you much happier when the work is done.
- It's also worth recalling to mill extra pieces as replacements or test parts.
- If I don't sharpen my hand tools at the beginning of a venture, I tend to avoid it when I'm in the thick of things later.
- So I try to make do with dull tools, swearing when they dive too deep or tear at the wood.
- I end up with torn-up exteriors and joints that don't fit well. I've learned to commit to a sharpening session early on.
- At a minimum, I hit my block plane, smoothing plane, and scraper.
- If there are any mortises and tenons, I also sharpen my shoulder plane and chisels.
- If you don't know how to sharpen blades well, read about it, buy the gear you need, and learn to use it.
- I recommend a high-quality honing guide and waterstones, getting the final polish on an 8,000-grit stone.

- Once you use a truly sharp tool, you'll know what all those hand-tool nuts have been crowing about.
- Confirm the bits and blades on your power tools, too.
- They should be free of gunk and sharp to the touch.
- Cutting joinery is another place where I sometimes have tempted fate.
- In a rush and overconfident, I sometimes try to make the first cut on my actual workpieces.
- That's where extra lumber can come in handy.
- Mill an extra part here and there to dial in your setups for perfect outcomes.
- Another trap I sometimes fall into is trying to work around the fact that I don't have the right tool or jig for the job.
- For instance, I used to struggle to cut tenons with my sloppy shopmade tablesaw jig until I Lastly made a second one—cautiously.
- Sometimes you need a certain tool for best outcomes.
- I use spiral upcutting bits for mortising.
- Until I got serious and bought a few of these pricey bits in different sizes, I struggled with straight bits that wouldn't clear chips, stopping every five seconds to blow them out.
- Once all the joinery is cut, I can't wait to get the whole thing glued up.
- At that point, two huge temptations arise: avoiding a bunch of sanding and scraping, and not doing a dry-fit to test the clamping setup.
- Skip either, and you'll be sorry.
- Some beginners try to skip exterior prep—either in part or exclusively—leaving behind jointer, planer, and tablesaw marks that become painfully obvious once a finish is applied.
- Once the exteriors are prepped, don't rush into a glue-up.
- Stop to do a real dry-fit, and you won't have any surprises once the glue is spread and the clock is ticking.
- You don't want to be caught scrambling around the shop for a missing clamp or caul, or be forced to pull apart a whole assembly that doesn't fit right.
- By now the exterior should be mostly prepped, with just a bit of

touch-up to do after the clamps come off and the squeeze-out is scraped away, but you still need to apply a nice finish.

- Once again, you'll be tempted to dive right in, slapping finish on the real piece.
- Stop, take a breath, and make a test panel.
- A test panel is simply a piece or two of extra venture wood, used to test the finish.
- Even if you are using a finish you've already mastered, you shouldn't skip this step, because each board can respond differently to a finish.
- You should try out most or all of any procedure, coat by coat, on some scrap.
- If you are unsure of your exterior-prep technique, try that out too.
- Drawings are vital in any furniture venture, but they don't tell you where to start building.
- The choice is an vital one.
- Building in the right order helps ensure that parts fit appropriately, and it gives you the flexibility to work around the small variations that are bound to occur.
- Select poorly and the venture can get a lot more complex.
- This approach goes hand in hand with another vital idea, which is to avoid precutting all of your parts to final dimension. Instead, leave them rather oversize.
- That way, you can cut them to fit the piece perfectly as it comes together.
- So how do you select where to start?
- The clearest general rule is to build the case first.
- Doing so lets you start with a single assembly that will control the dimensions of just about every other part in the venture.
- Even in pieces that aren't case pieces, this underlying idea still applies: Look for the assembly with the most control over other parts, and start there.
- Practice this and you'll find that for any piece of furniture, there's a sequence that will make the task straightforward.
- Here are four basic furniture types, with time-tested advice on what to build first, next, and last.
- If you understand these, you should be able to handle almost each

item else.

Bonus Chapter How to develop your own designs

For numerous furniture makers, even those with advanced technical skills—design is the most daunting aspect of the craft. Learning to design can seem intimidating, even mysterious. But there's no magic involved. Anyone with the desire and a little perseverance can be creative. In fact, the overall concept for a piece of furniture can be discovered and its particulars beautifully resolved by walking through a series of straightforward steps. When strung together, these steps form a dependable design procedure. The more you use it, the more intuitive it becomes. Whether I'm designing a chest, a chair, a bed, or a bench, I follow the same steps. I always generate multiple options to select from—the more the better. To keep the ideas flowing fast, I focus only on the visual aspect of the pieces at this point and figure out how to build them later. This approach has the great benefit of forcing me to explore new woodworking techniques, which makes the work more fun and adds arrows to my quiver for future designs. Along the way, I discard nothing, so with each venture I add to my idea bank, building up a repository of sketches, models, and techniques that I'll draw from for the rest of my life. Here are the seven basic steps:

1 - Identify and analyse

- I start my design procedure by identifying what I want to make—a chair, a cabinet, a built in bench—and analyzing the hard constraints on the piece: what purposes it will serve, what space is obtainable, and the requirements of weight, stability, and traffic around it.

2 - Set the objective

- I clarify what I want from the piece aesthetically and technically.
- Do I want a completely new design, or something to match an existing style?
- Do I want to learn new techniques?
- Work with specific supplies?
- Is the priority function or appearance?
- Or are the two equal?

3 - Generate ideas

- This is the fun part, and it's the heart of the matter.
- The key is to generate as numerous ideas as possible, either on paper or in model form.
- The tools can embrace transparent paper and a soft pencil for doodling and drawing, and whatever else works for making quick models: wire, foam, MDF, softwood, Popsicle sticks, and straws.

4 – Select

- Withhold judgment on your ideas for a couple of days.
- Then give them a cautious review and pick one.
- The trick here is to make a decision and proceed.
- Recall that you can make any of the other ideas at a later date.
- If you procrastinate, you don't learn anything.

5 – Build

- Make a full-size mock-up if you need one, but make it rapidly and inexpensively.
- You're looking to refine the proportions of the piece, not work out all the particulars.
- Then make a full-size drawing to determine the particulars of joinery.
- Proceed to building of the real piece.

6 – Document

- While you're building the piece, take photos and make sketches and notes to document the procedure.
- Add them to a file with all your design sketches for the piece, along with photographs of the models and mock-ups.

7 - Evaluate

- When you've built the piece, always review the steps you took and

look for ways to make the procedure more enjoyable and productive.
- Next time you design, revisit the files for successful pieces to see how their designs advanced.

Woodworking professionals love to run into a weekend venture. They can then spend weeks if not months on their projects, only to find out one sad day that the completed piece doesn't look quite right. It may sound familiar? Well, you can avoid this dilemma with a straightforward and rewarding exercise: Build a scale model first.

Drawing plans

- Drawing plans, whether full or partial, are extremely beneficial.
- Yet, adding a three-dimensional model made with ordinary shop tools and obtainable supplies will help you learn extra.
- The model will show you form, help you fix the sizes, and help you think about the best way to build your project.
- This way, you will save time and money building the precise design, instead of one that may never feel correct.
- Building a model will also help you envision your new design, yet it's best to launch the venture on paper initially.
- How do you get from an idea to the point where you can build a model?
- Well, I find it easiest to begin by sketching.
- You never know how one idea could give life to a completely new design at some point.
- This procedure normally yields several ideas that appeal to you for your venture.
- At this point, you can establish basic dimensions and draw a box that represents the proportions of your project.
- With this visual key, you now can sketch to general proportions so you don't end up with a great looking cabinet design in your notebook and a bad looking shoebox in reality.
- You can then narrow down in your notebook sketches to three ideas and work up more detailed ideas on a drawing paper.
- Then you can let these ideas percolate for a while. Lastly you can

boil down the best elements in each to a single design and do a final sketch.

- Once a design is sketched and you like its elements, you can make your elevation and plan drawings to scale.
- After that, if you are confident about the elements of the piece, you can do full scale drawings.
- But if you still have questions about the form or proportions, you might want another level of information.
- That’s when you can make the model.

Supplies:

Cardboard

- Commonly obtainable and inexpensive, it’s best for full-scale or half-scale models, and great for modeling full-size tabletops.
- Cardboard cuts simply with a bandsaw, a tablesaw, or a knife and straightedge, holds with yellow glue or hot-melt glue, and is sturdy enough for straightforward tenon joints.
- Particulars can be drawn or painted on the exterior.

Foamcore

- Sold at art-supply houses in ⅛-in., 3 /16 -in., and ½-in. thicknesses, its higher price makes it a better choice for small-scale models or full-size mock-ups of small pieces.
- Any saw or sharp knife will cut it.
- Use pins, glue, or even packing tape to hold it together.
- Advantages are its stiffness, light weight, and white color, which forces you to concentrate on the shape of the piece. Its exteriors can be painted, inked, stenciled, you name it.

Wood

- Material can come from the shop scrap barrel, typically ⅛-in. or ¼-in. resawing offcuts or other scraps.
- Working in small scale makes parts easier to handle and the design

easier to see.

- Wood scraps can be cut with saws and joined with a diversity of glues.

Models can help you work out design ideas for all types of pieces. They don’t require much time or material to build, but they can save a lot of both in the building of your furniture.

- Softwoods are easy to shape and carve.
- Experiment with design particulars.
- Photocopied contents can fill out an interior.
- Models can be as detailed as the final piece.
- Components can simply be drawn in place.

Procedure:

- First, decide on scale.
- Are your questions about the design mostly about the rightness of its basic proportions?
- Do you need to transport the model and show it to clients?
- A small-scale model will perhaps answer.
- Or do you need to live with the piece for a while, to see how it casts shadows and fits into its intended space?
- If so, full-scale is perhaps your best bet.
- When I built library tables, I made a ⅛-scale model for several reasons.
- One was to impress the selection jury with my design, giving them something tangible to see and discuss.
- I built the model in cherry, the same as the tables would be, but I sketched in the inlay particulars with a pen.
- The other advantage?
- It forced me to walk through the stages of building the piece and led me to resolve key questions about building.
- Which parts would I put together first?
- What steps had to be completed before moving to the next phase?
- Would this design hold up over time, or did I need to modify the

structure?

- For my Greene table, I worked full-scale with cardboard.
- I made up hollow table legs that were 1 ½ in. thick by 2 ½ in. wide by slicing up parts on the saw and hot-gluing them into elongated boxes.
- Having a leg that doesn't collapse when you walk by is great.
- I cut apron pieces to length and made up a top with drawn-in breadboard ends.
- I made straightforward mortise-and-tenon joints and used corner blocks on the inside curves for strength.
- Now here was something to walk around and examine.
- At this point in the procedure, you can congratulate yourself for building the model, but then let it rest for a couple of days.
- Let it sit in a corner of your shop or in the place where the completed piece will
- Then come back to it and see how it feels.
- Your gut will tell you a lot about whether you got it right.
- If it's not, then you'll need to start figuring out where to cut and where to add.
- I tell my students that planning at this stage may feel like it's slowing you down, but in the end it can save you time as you build with confidence, knowing you have a design that works, fits the space, and looks great.

Working Small

- Small-scale models are easy to build and transport, and they take up little space.
- They also can be made from the same stock as the full-scale piece.
- Nothing beats a wooden model for selling a furniture design to a client or spouse.
- First, mill the stock to whatever thickness you need.
- Cut lengths using a tablesaw crosscut sled or chopsaw.
- Be cautious in cutting these smaller parts.
- Sometimes a pencil eraser end is a better and safer grip than your fingertip for holding things in place.

- Straightforward joints can be made on this scale, but most pieces are just butt-jointed together and glued.
- Strengthen where required with gussets and corner blocks.

Working Big

- When you want to see how a piece will take up space and work with other furniture around it, build a full-scale model.
- Cardboard works best for full-scale or half-scale models.
- In just a few hours, you can create models as large as 2 ft. by 7 ft. with moving parts to help clients see how something might fit or look.
- Draw in door stiles and rails, or stack one layer of cardboard on another to create depth and texture.
- Use a sheet of single-wall cardboard and glue on an edge to give it thickness.
- Spray-paint the cardboard if you want to look at another color besides tan.
- Use white if you simply want to concentrate on the form of the piece.

Book 4

Woodworking for Beginners

Helpful Tips, Tricks and Hacks

Karl Winkler

Chapter 1 How to shape wood

Imagine trying to build a skyscraper from bent or twisted beams. It would be an overwhelming challenge, if not downright impossible. Woodworking professionals face the same dilemma when they try to work with boards that have more curves than straight lines. It's a common issue, because nearly all boards we bring home from the lumberyard or home center have at least some measure of warp. And once they acclimate to the humidity level in your shop, they tend to warp even more. So before you begin any venture, some preliminary work is in order. That work, called milling, is done with the jointer, planer, and tablesaw. When you're done, the six surfaces of each board—two faces, two edges, and two ends—should be flat and straight, with all the curves perfectly square.

Milling procedure

- To make the milling procedure as easy as possible, begin thinking about flat, straight, and square stock when you're selecting the wood, no matter if it has been planed already or is still rough-sawn.
- Circumvent badly warped stock.
- You'll have to remove far too much material from a board with a big bend or a substantial twist to get it flat, straight, and square.
- And even if the boards look good, buy them somewhat denser, wider, and longer than the final dimensions you need.
- That way, when you do mill away some extra material to remove whatever warp is there, you'll have enough stock remaining to provide the right-sized board.
- As a general rule, I begin by cutting each board to a manageable length and width.
- I cut the board about an inch longer than its approximate final length.
- Then I utilize a bandsaw to rip the boards to their approximate final width.
- The bandsaw is safer than the tablesaw when cutting warped stock.
- Depending on the width, I allow an extra ¼ in. to ½ in. of stock

during this initial cut.

- Keep in mind, though, that the maximum width is limited by the size of your jointer.
- If you need to end up with a 10- in.-wide board and you have a 6-in. jointer, you'll want to rip two pieces of stock to about 5-½ in. wide and edge-glue them after they've been milled.
- The next step is to flatten one face of each board.
- The jointer gets that job. For safety, always utilise push blocks when planing a face surface.
- I generally take light cuts, no more than 1 /32 in.
- If I have a lot of material to remove, I might increase the next couple of cuts by a supplementary 1 /64 in., but rarely do I remove more than a fat 1 /32 in. with a single pass.
- A cut that's too heavy requires you to exert more pushing force on the board and is likely to develop tearout or splintering.
- To plane the face, place the board on the infeed table with one edge against the fence.
- Using a push block in each hand, feed the board into the knives.
- Once the knives begin cutting, I utilise the push block in my left hand to apply downward pressure to the lead end of the board, pressing it against the outfeed table while pushing it forward.
- As soon as I get 12 in. or so of the board on the outfeed table, the push-block in my right hand joins the one in my left at the outfeed table.
- Then, with both hands in line on the board, and situated toward the front of the outfeed table, I push the boards forward.
- At this point, all the downward and forward pressure from the push block is over the outfeed table, just past the knives.
- To keep the board moving, I pick up my lead hand and place it behind the other one and keep repeating the procedure until the board has cleared the knives.
- Use extra care as the board exits the infeed table because, for an instant, the guard doesn't cover the spinning knives.
- Keep making passes until the entire exterior is planed.
- At that point, your stock is perfectly flat on one face.
- Now, utilise the jointer to straighten and smooth one edge of the board, making it square to the face you just planed.

- The planed face goes against the fence. If the edge has a front-to-back bend, be sure to place the concave edge against the jointer table.
- This ensures that the board won't rock because two points are always in contact with the table.
- For safety's sake, I never push with my fingers over the blade area.
- Continue making passes until the board is planed along its entire length.

Working on the remaining face

- It should be flat and straight, parallel to the opposite face.
- Your first instinct might be to utilise the jointer again.
- After all, it excels at making boards flat and straight.
- But unless you are very lucky, the jointer won't make the second face parallel to the first.
- Only a thickness planer can do that.
- Once again, check the grain direction.
- I make light cuts, typically no more than 1 /32 in.
- Feed the board with the unplaned exterior faceup.
- Make passes until the entire exterior is planed and decreased to the desired thickness.

The board now has both faces flat, straight, and parallel, and one edge that's flat, smooth, and square to the faces. The tablesaw handles the last assignment, cutting the second edge parallel to the first and square to the face surfaces. Make the ripcut first. If you want a smoother edge, cut the board a little wide and then edge-joint it to the final width. With two faces and two edges of the board now flat, straight, and square to each other, you can cut the board to length. First, trim one end to make sure it's square. Then, measuring from the trimmed and squared end, mark the final length. Now, crosscut the second end at the marked line. The board is ready to be used on your venture.

Procedure:

- The milling procedure starts on the jointer.
- To minimize tearout or splintering, take a reading of the grain direction by looking at the edge of the board.
- If it tends to run more in one direction than another, feed it into the planer with that grain direction in mind.

- After making sure the fence is square to the jointer table, place the planed face of the board against the fence and joint one edge.
- With the previously flattened face against the bed of the thickness planer, feed the board through the machine to plane the other face.
- Place the planed edge against the tablesaw fence, then rip the board to final width. The tablesaw is the machine of choice here because it cuts an edge parallel to the opposite edge.
- Use the tablesaw and miter gauge to cut one end square.
- Measure from the trimmed end of the board, then cut it to final length on the tablesaw.
- The infeed and outfeed table surfaces are flat and parallel to each other.
- All the cutterhead knives are flush with the top of the outfeed table.
- The infeed table is set somewhat below the outfeed table.
- As the board travels from the infeed table to the higher outfeed table, the knives shave an amount equal to the difference in table height.
- With the bowed, cupped, or crooked exterior facedown, the board rests steady on two points.
- The flattened area gets wider with each pass over the cutterhead until the entire exterior is flat.

Chapter 2 Bandsaw and Jigsaw tips

The switch from using surfaced lumber to milling your own boards from rough stock is a watershed for most woodworking professionals. It saves you money, unchains you from the standard thicknesses obtainable in surfaced lumber, and gives you greater control over the accuracy of your work and the look of your boards. But this business of taming roughsawn stock can be a challenge. The wood is rarely flat to begin with, and it often releases inner stresses when cut that can pinch or bind a sawblade, resulting in a violent kickback. I eliminate these dangers by using a bandsaw instead of a tablesaw for initial ripping and by using a jigsaw instead of a chopsaw for crosscutting rough stock to length. Both of these saws employ narrow blades that make them less susceptible to binding. Besides being safer, the procedure I follow is straightforward and straightforward. Make sure your machines are set up appropriately and check the stock with a precise square as you progress through these steps. Your objective, of course, is boards that are completely flat, straight, and square.

Rough lumber that is twisted or cupped won't sit flat on a chopsaw. As the cut is made, the stock can drop into the blade, pinching and binding. For this reason, I utilise a jigsaw with the stock set across three or four sawhorses. A jigsaw with an oscillating cutting action and a very coarse blade will cut through the hardest wood up to 2 in. thick. Always cut off the rough ends of the boards, which may be checked and embedded with grit, staples, and other debris that could nick your jointer and planer knives. Now utilise the jigsaw to cut the rough stock into pieces that are 1 in. or 2 in. over the completed length. The next step—cutting pieces to rough width—is the point at which numerous woodworking professionals utilise the tablesaw. Here's why I head for the bandsaw instead: Wood can release inner tension when sawn down its length, springing apart after being cut. On the tablesaw, the wood may bow away from the fence and into the blade, or the kerf can close up on the blade, with either one potentially resulting in a violent kickback. On a bandsaw, the short fence is less likely to push bowed stock into the blade, and the blade's downward cutting action isn't aimed at the operator. Utilise the bandsaw to cut the pieces to rough width, about ⅛ in. oversize. Run one straight edge of the stock along the bandsaw's fence to get a straight cut. Depending on the straightness of each piece, you may need to pass an edge over the jointer first to get this straight reference edge. Sometimes, if I can't joint the edge because it is too wavy, still has bark on it, or has a big knot, I'll mark a pencil or chalk line and trim the entire edge freehand on the bandsaw. Above all, this technique lets you to lay out the first edge so the board will have straight grain. A surer way of cutting a straight line is to attach a straightedge with a couple of finishing nails in the over-length portion of the stock. The jointed edge will ride the fence and guide the stock through a straight cut. Don't sink the nails flush; you'll pull them out when you are done.

After the stock has been ripped to rough length and width, and after it has rested overnight, the next step is to joint one face flat. A thickness planer cannot do this job—it can only mill one side of a board parallel with the other. Inspect the stock for grain orientation and pass it over the jointer in the appropriate direction. Sometimes the grain direction won't be apparent, so utilise several light passes rather than one heavy cut. If particularly bad tearout occurs in one area, then you still have the option to flip it end for end to reorient the grain and try again. Bear in mind that you will be removing material from the other face later with the planer. Try to balance out how much wood is removed from each face. This will help avoid an unbalanced release of tension, which would cause twist or cup. Next, if I haven't done so already, I'll joint one edge, using the freshly jointed face as a reference exterior against the fence of my jointer. Then it's back to the bandsaw

Because I typically bring the piece to completed width on a benchtop planer, I find it helpful to rip again on the bandsaw—this time to about 1 /16 in. over completed width. This lets me take the lightest possible passes, saving wear and tear on the planer knives and ensuring the best performance. Sometimes there is so little waste material left after jointing that this step isn't essential. But most often I'll return to the bandsaw, even if it means the blade is not fully embedded in the cut. With a appropriately set up saw and an unhurried feed rate, the blade does not wander. Next, if the stock is much denser than the completed thickness, I'll "resaw" it a little over thickness, about a heavy 1 /16 in. If you resaw away a large amount, or to yield two or more boards from thick stock, be sure to let the pieces sit for a day or so and then re-mill as required to alleviate any twist or cup. Once the piece is close to final thickness, mill the unjointed face in the planer to make it parallel with the opposite exterior and to bring the piece to final thickness. Again, light passes are best. Roughsawn lumber can vary in thickness; you don't want your planer to bog down if the wood increases in thickness down the length. Also, a heavy cut will yield a rough exterior and promote snipe at the ends. Next, clean up the bandsawn edge and bring the piece to final width by standing the piece on its jointed edge and passing it through the planer. I utilise the 1-to-5 rule here. If the stock is 1 in. thick, I can plane a board up to 5 in. wide. If it is ½ in. thick, then the maximum width is 2½ in., and so on. Always utilise the center portion of the planer for this. Because the infeed rollers are mounted on either end and held in place with springs, they will tilt the wood somewhat if it is put too close to either end. If the dimensions exceed the 1-to-5 rule, then I trim to final width on the tablesaw. Because so little waste material is left, this cut is often exposed on the waste side, cutting away just 1 /16 in. or so. I essentially favour this because it avoids creating narrow strips of waste that can fall into the throat plate and cause issues. The last step is to cut the ends. If the pieces are too long to handle with a tablesaw's crosscut sled, cut them on the chopsaw.

Procedure:

1 - Cut to Rough Length with a Jigsaw

- Because roughsawn stock isn't flat, it won't always sit still under the circular cutting action of a chopsaw. It may fall into and bind the blade during the cut.
- With a jigsaw, the vertical cutting action doesn't push the stock around.
- The narrower blade is likewise much less likely to be pinched.
- Position the sawhorses so that stock on both sides of each cut is fully supported.

2 - Snap a line or Add a Guide

- A carpenter's chalk line produces a bright, straight line on stock that's too long for marking with a straight edge.
- A better path to a straight rip is to attach a piece of edge-jointed stock, nailing into the waste area of the rough board.
- The jig's jointed edge rides the bandsaw fence and guides the

stock in a straight path through the blade.

- On the bandsaw, it’s easy to “correct” grain that runs out of parallel to the edge of roughsawn stock.
- Just make your first cut follow the grain.

3 - Cut a Straight edge on the Bandsaw

- On the tablesaw, tensions in the wood may cause a long rip to close up again behind the blade, pinching it and creating a kickback hazard.
- Because the band-saw’s blade is much narrower from front to back, it is much less likely to be pinched in the same way.
- You can set up your bandsaw with a coarse, 3-tpi, skip-tooth blade, tracked on the centerline of the upper wheel.
- This makes it easy to cut thick stock.
- Boards without a straight reference edge can be ripped freehand.
- Or utilise a straight-line jig to guide the stock through the blade.

4 - Rip to Rough Width

- With one rather straight edge established, you can rip your stock to rough width, about ⅛ in. over final width to accommodate any unevenness in your straight edge and for the release of any tension in the wood.
- Let the stock rest overnight before milling to final dimension.
- To provide adequate support to long or heavy stock, you can mount an outfeed roller on an adjustable stand modified to mount directly to the saw’s housing.
- This provides a sturdy outfeed that stays level and doesn’t tip.

5 - Joint a Face and Square an Edge

- Joint with the cupped side down.
- Take light passes until the face is flat.
- To decrease tearout, review the rotation of the cutterhead and the direction of the grain when deciding which way to feed a board.
- You can mark your jointer near the cutterhead for easy reference.

- The diagonal lines represent appropriate grain orientation.
- Register the freshly jointed face against the fence and again take light passes until the edge is flat.
- If the fence is set at 90 degree to the jointer table, the two jointed surfaces should now be square to one another.

6 - Saw and Plane to Thickness

- If you still have a fair amount of material to remove, a thin bandsaw cut lets you approach final thickness rapidly and circumvent repeated passes in the planer.
- Take passes of no more than 1 /16 in.
- The planed exterior will now be parallel to the previously jointed face.
- It’s likewise possible to resaw to yield two or more boards from one piece of stock.
- If you resaw away a lot of material, the tensions released in the wood might cause twist or cupping.
- In that case, rejoint the boards.

7 - Trim to Final Width

- This is a safe technique of trimming to width as long as the stock is no more than five times as wide as its thickness.
- Trim wider stock on the tablesaw.

8 - Cut to Final Length

- You can make your final crosscuts on the chopsaw.
- If the stock is too wide, you can utilise a crosscut sled on your tablesaw.

Chapter 3 How to handplane like a pro

You often don’t learn the value of stock that is flat, straight, and square until you’ve made furniture from material that isn’t. You find out soon enough. A cupped drawer side fights back when you try dovetailing it to the front. A twisted apron can set a table’s legs askew. That’s why the first task my students must complete is to mill by hand a piece of hardwood stock flat, straight, and square. This assignment trains the eye to recognize appropriately milled stock, and it builds rudimentary skills in layout and handplaning.

Procedure:

- Begin with a No. 5 jack plane or a No. 4 smoothing plane.
- If the edge of the plane iron is perfectly straight, the curves of the iron will score the work as you plane.
- You can circumvent this by sharpening the iron with a very slight convex edge. This is especially useful when planing edges.
- I get a convex edge by bringing the iron across a grinding wheel at a slight arc.
- You likewise can utilise a coarse stone and apply greater downward pressure at the curves of the iron.
- For a smoothing plane, aim for a difference of about 1 /64 in. between the crown’s peak and the edges of the iron.
- For a jack plane, aim for 1 /32 in.
- Begin with a piece of stock roughly 1 in. thick, 8 in. wide, and 10 in. long.
- Lay a straightedge across one of the broad surfaces from end to end, edge to edge, and diagonally across the curves.
- Note the high and low spots.
- Begin taking strokes to bring the high spots in line with the lowest point on the surface.
- If the board is somewhat twisted, with one or two high curves, take diagonal passes from high corner to high corner, working enough of the exterior to bring the high areas down to the low spots.
- A board that is somewhat cupped across its width can be worked with the convex face either up or down.

- With the convex side down, make straight cuts along both edges to lower the high curves, or make strokes across the board from edge to edge with the plane in a skewed position, working your way down the length to remove the high curves.
- Use the same technique if the board is tapered, removing thickness at one end.
- If the board is cupped and the convex side is up, plane straight down the middle until you have flattened the high center.
- Check your progress often with the straight-edge.
- When the board is nearly flat, finish with a series of straight smoothing cuts along the board’s length and in the same direction as the grain.
- For the first pass, align the center of the blade—the peak of its crown—with the left- or right-hand edge of the board.
- The cut will be deepest at the board’s edge.
- Overlap each stroke by about half the blade’s width.
- This will put the blade’s crown into the shallowest part of the previous cut, minimizing exterior undulations.
- Check your work again.
- You’ll know the exterior is flat when no light can be seen under the straightedge in any direction.
- Mark the flattened exterior for utilise as a reference face in laying out subsequent cuts.
- The next step is to plane one long edge straight and flat so that it is square to the reference exterior you just flattened.
- Beginners often want to correct an angled edge by tilting the plane’s body to compensate.
- This would be required if the iron were ground and honed straight.
- With a crowned iron, it’s unnecessary. Instead, set the sole in full contact with the edge, aligned so the blade’s crown cuts on the high side of the angle.
- As you make cuts to remove the angle, shift the plane with each cut until the blade is centered on the edge, bringing the high side down and into square.
- To remove a convex exterior on an edge, simply make short strokes in the center of the edge and lengthen each consecutive cut until the edge is straight.

- For an edge that is twisted or high at opposite curves, move the plane laterally from one edge to the other, starting with the plane off to one side as though you were addressing an out-of-square edge.
- As the cut progresses, the plane will shift so that it is making a cut with the crown in the center, at the square point of the twist, and then gradually will shift to have the opposite side of the crown cutting to remove the opposite angle of the twist.
- Use a straightedge to check that the edge is straight and flat.
- Use a square, with the head registered against the reference face, to check that the edge is square.
- Once the edge is straight and square, mark it, too, as a reference edge.
- You'll utilise it to check that the ends are square and that the opposite edge is parallel.
- Next, utilise the edge-planing practices to plane the ends of the board so that each is square to both reference exterior and edge.
- With the iron adjusted to make a finer cut, utilise deliberate strokes, working in from both edges and stopping short of the curves to circumvent chipping out.

Last touches:

- Set the head of the square against the reference edge and utilise the square's blade to scribe a reference line indicating the board's completed width.
- Plane the opposite edge to this width, checking with the square against the reference face for squareness, and using the head of the square and the blade to check for parallel.
- Lastly, plane the remaining exterior to bring the stock to completed thickness.
- Use a cutting gauge to scribe a line indicating the final thickness.
- Working off the reference face, scribe the line all the way around the piece of stock.
- This line will be parallel to the original reference face.
- Work to bring the high spots in line with the low point on the surface.

- As you approach the scribe line, you'll begin to create a feather edge just above it that falls away as you reach final thickness.
- This feather edge provides great visual evidence that you are getting the exterior flat and parallel.
- If the feathering develops equally on all four edges, you're on the right track.
- If you've reached the scribe line and still don't have a parallel surface, strike another line and keep going.
- Don't get discouraged.
- By the time some of my students have completed this exercise, their original 1-in.-thick workpiece is no more than ½ in. or ⅛ in. thick.

Chapter 4 How to smooth wood

There's no denying my love of hand tools and the romantic notions I have about building furniture by hand. But I don't turn a deaf ear to the need for woodworking machinery. When I'm building furniture on commission, time is money, and easy listening must give way to the heavy-metal roar of machinery. Luckily, my hand tools, planes in particular, don't sit backstage for long. In my shop, machines tackle the rough work, with handplanes following to eliminate evidence of machine work. But planes are more than cleanup tools. No matter what piece of furniture you are building, whether a case or a table, a chair or a box, handplanes can step in to polish a exterior with a sheen unmatched by machine or paper. And these tools excel at fine-tuning and trimming components, allowing you to creep up on the fit of parts in nearly microscopic increments. Most of the time, I go straight from planing to finishing, but if I am dealing with tricky cross-grain situations, such as breadboard ends or some obstinate figured wood, I reach for a scraper or sandpaper to eliminate tearout. The two bench planes I utilise most often are the jack and the smoother. Here I'll explain you where and how to incorporate these planes into your furniture making, not only for rudimentary stock preparation but likewise for refining glued-up assemblies such as doors and drawers. Let's begin with the basics. The most rudimentary task of a handplane is to remove the ripples and ridges left by machines on the faces, edges, and ends of parts. So let's begin by planing the edges. While certain woodworking professionals utilise a block plane on an edge, I favour the heft and control that bench planes offer. Whether you select a jack or a smoother depends on the amount of work that’s required. If the machine work is not high quality, begin with a jack to remove heavy mill marks and finish with the smoother; otherwise, you can clean up marks with the smoother.

Procedure:

- First, secure the board in a front vise, with the edge about 2 in. to 3 in. above the bench, and make pencil lines across the edge every 4 in. or 5 in.
- Grasp the tote of the plane in one hand and the front of the plane’s side rail with the other.
- Holding the tool this way will help your fingertips keep the plane level as you work the edge of the board.
- As you plane, watch the pencil lines you made earlier.
- If the lines are removed along one side only, adjust the pressure on the tool to make a more uniform cut.
- Work until all pencil and mill marks are gone.
- Once you’ve mastered the fundamental skills of planing, you can utilise those skills to refine furniture parts, giving them a fit and finish that no machine can achieve.
- Let’s begin with a glued-up panel.

Working with a glued-up panel

- A glued-up panel, whether for a door or a tabletop, typically has high spots where the boards didn’t align perfectly.
- A wide-belt sander will develop a flat surface, but these machines cost thousands of dollars yet still leave a lot of hand-sanding to be done.
- The most precise way to level and clean up those surfaces is with handplanes.
- Secure the panel to the bench between benchdogs in the tail vise and benchtop.
- Mark surfaces with a pencil to show high and low spots.
- Make passes diagonally across the exterior with the jack plane to bring each item into alignment.

- Work corner to corner, using overlapping passes.
- Next, plane with the grain from end to end, starting at one edge and working to the other using overlapping passes.
- Repeat the procedure until all remnants of the diagonal passes are eliminated.
- Complete the exterior preparation with a smoothing plane, working with the grain.
- After finishing the top and bottom, clean up the end grain and edges.
- End grain is prone to tearout and chatter.
- But you need to clean it up if the edges are to be exposed, as they often are on a tabletop.
- The smoothing plane, set for a very light cut, deftly handles the challenge.
- Be sure to skew the plane throughout the cut.
- This not only makes the work easier but likewise produces a high-quality surface.
- Avoid chipout at the end of the cut by clamping a backer block to the far end.
- If required, lubricate the end grain with paint thinner, which makes the ends slick and supple, reducing chatter and extending blade life.
- Use the sawmarks on the board end as a reference, planing until the marks just disappear.
- The last step is to plane the edges.
- A smoother may be enough here, but if there’s any damage from clamping, I’d recommend starting with a jack to handle the heavy planing.

Working with glued-up door frames

- Glued-up door frames often have issues with misalignment of parts, such as a rail that’s proud of a stile, and often have blemishes and scars from glue squeeze-out and clamps.
- Handplanes are the cure-all for these issues.
- With the door secured to the benchtop, visually identify any high spots.

- If the rail or stile is high on one end and low on the other, utilise a tapering approach.
- Take the first couple of passes with a jack plane in the vicinity of the high spots.
- Gradually extend the length of each successive stroke toward the flush end until both ends are flush with the mating parts.
- If the rail or stile is offset equally on both ends, simply plane uniformly with the jack plane until each item is flush.
- Lastly, take a few final passes with a smoothing plane, starting with the rails.
- Be sure to skew the plane to decrease the chances of tearout across the grain of the stile.
- If you get a few catches, don't worry, you'll clean up the stiles in the next step.
- Also, lift the plane on the return strokes so that its heel doesn't accidentally bruise the stile.
- When the rails are smooth and blemish-free, plane the stiles.
- Once you have the exterior of the door planed smooth and even, utilise handplanes to dial in the reveal, or gap, around the door.

How to level face frame parts

- Often, a woodworker applies a solid-wood face frame to a plywood case to conceal the plywood edges.
- The frame often is left proud of the case and must be trimmed flush later without damaging the veneer.
- The safest tool for the job is a handplane.
- Begin by making a series of pencil marks every 3 in. to 4 in. across the face frame edge and onto the veneered exterior to serve as reference lines to gauge your progress.
- Use the jack plane to begin working the solid wood flush.
- Watch the pencil lines and utilise your fingertips to feel the surfaces for misalignment to determine where and how much material must be removed.
- Skew the plane so that its heel references on the veneered panel, and work with care until you have planed to within 1 /64 in. of the veneer.

- Now switch to the smoothing plane and work until the pencil marks on the veneer just begin to disappear.
- Stop at this point and, if essential, blend things in with a scraper or a sanding block.

Finishing touches

- The easiest way to get perfectly flush joints in a dovetailed drawer is to leave the tails proud and then take a few skilled swipes with a handplane to trim them flush after assembly.
- The ideal tool for the job is the smoothing plane, set for a very light cut.
- Before planing, it’s a great idea to protect the fragile edges of the dovetails by chamfering the curves.
- Plane parallel to the row of dovetails until the surfaces are just flush.
- Skewing the plane makes end grain easier to handle and gives the tool sure footing on the workpiece.
- Finish by planing from the end of the drawer toward the center.
- When you glue up a drawer, edges don’t always align perfectly; typically one edge is proud.
- On a small drawer, you can utilise a smoothing plane to level the parts, but a large drawer requires the longer jack plane, which will help keep the edges straight.
- Plane uphill near the high spot and gradually extend the length of the stroke until the parts are flush.
- Finish by going around the rim with the smoother.

Chapter 5 Ripping techniques

The tablesaw is a wonderful tool for cutting parts to size, and ripping is its most common task. Ripping means sawing wood parallel to its grain; typically when cutting boards to narrower widths. You can do the job with a bandsaw or a portable circular saw, but a tablesaw is much more efficient. It is powerful, and the rip fence lets you to cut identical multiples. The large exterior likewise makes handling stock of all sizes much easier. This chapter will tell you how to safely and precisely utilise the tablesaw to rip solid lumber as well as sheet stock. To do the work safely, you need to follow the appropriate steps and utilise the right accessories, including a splitter. A riving knife is a more sophisticated splitter, and works even better.

Most tablesaw accidents result from violent kickback during ripping, but a appropriately aligned splitter will avoid kickback by keeping the workpiece from contacting the rising rear teeth of the blade and being thrown back at you. Also, when possible, utilise a blade guard to avoid hand-to-blade contact and keep sawdust out of your face. Safety and quality of cut likewise depend greatly on a straight fence that's set parallel to the blade. Even a premium fence goes out of alignment after a while, so make sure to check it for parallel often by measuring from the blade to the locked fence at both the front and the rear of the blade. Some woodworking professionals cock the outfeed end of the fence away from the blade by 1 /32 in. or so, which is fine. Lastly, an outfeed table is an absolute necessity, even when ripping short pieces. Without one, your work just falls to the floor, possibly damaging edges and curves. Outfeed support is critical when ripping long stock, which may otherwise begin to tip off the saw table before the cut is complete, forcing you to bear down on the trailing end of the board right at the spinning blade. You might likewise want to set up infeed support, especially for long, heavy boards or sheet goods.

To rip safely, the edge that contacts the rip fence must be straight, and the face that bears against the table should be flat. That way, the board doesn't pinch against the blade or rock as you're feeding it. So the first step is to create a straight edge. If the edge is already reasonably straight, the quickest approach is to run it across the jointer. If the edge is severely crooked or is a waney, live edge, you'll need to saw it. You can trim the edge straight on the tablesaw by temporarily tacking a straightedge guide board to the workpiece and running that edge against the fence. Alternatively, strike a cut line on the board and saw to it using a bandsaw, which poses no danger of kickback. After bandsawing, joint the edge straight. Ideally, your stock should be jointed and planed to final thickness before ripping. In the procedure, you create the flat face for safe feeding. But this isn’t always possible. For instance, a board that’s too wide for your jointer may have to be ripped into narrower widths first.

With one edge of the board jointed straight you’re ready to make the cut. The exact way you handle the workpiece will depend on the material itself, how long, thick, or heavy it is, and how wide a rip you’re making. Turn on the saw first, and then lay the board on the table against the fence with the leading end a couple of inches from the blade. Utilise your left hand to press the board downward and against the fence at the same time. With your right hand on the trailing end, push the board steadily forward into the spinning blade. When the trailing end of the board is completely on the table, pick up the push stick with your right hand and utilise it to continue feeding the stock. As the cut nears completion, remove your left hand from the board for safety’s sake, continuing forward with the push stick until the right hand is past the splitter.

The key to ripping large sheets of MDF or plywood is appropriate support. Best is a large outfeed table that extends at least 50 in. beyond the splitter. You might likewise want infeed support for heavier panels. For easiest handling, begin with the cut closest to the center. Lock the rip fence in position. Instead of hoisting the panel onto the saw and infeed support at the same time, place the panel on the saw, and then drag it onto the infeed support. With the blade raised and the splitter reinstalled, turn on the saw and stand at the left rear corner of the panel. Keep your eyes glued to the fence, push the panel forward with your right hand, and apply enough sideways pressure with your left to keep the panel against the fence. Push until the saw table is carrying the full weight of the sheet. Let the panel sit for a moment, move around to its rear edge, and place your hands so that each one is centered between the blade and the panel edge. Maintain your focus on the fence. Push straight forward until the cut is complete

Chapter 6 – Resawing using Bandsaw

Resawing thick stock on the bandsaw to create thinner lumber or veneer offers a diversity of benefits to woodworking professionals. It not only lets you to move beyond the standard lumber dimensions obtainable at lumberyards and home centers, but it likewise opens all sorts of design options. For instance, you can slice a board in half to create book-matched panels; you can slice extra thin stock for dividers and delicate boxes; and you can cut your own veneers to get the most from a prized plank of figured wood. Yet, with all the benefits resawing offers, few machine practices seem as hard to master. Because the blade is embedded along the width of the wood, resawing places a lot of demands on both the bandsaw and the blade. If the saw isn't powerful enough or the blade isn't sharp enough, the blade can buckle and bow, the motor can bog down and stall, or the blade can wander out of the cut and spoil the workpiece. But with the right setup, you'll overcome these obstacles and achieve uniform, flat cuts every time. Perhaps no factor affects your success as much as blade selection. I find a coarse, narrow blade with a positive rake angle works best. For most resawing, I'd utilise a hook-tooth blade with 2 tpi to 3 tpi, ⅜ in. to ½ in. wide and 0.025 in. thick. This coarse blade effectively pulls sawdust out of the kerf, allowing the blade to run cooler and Therefore cut faster. The positive rake angle pulls the wood forward, making it easy to feed with a light touch. The only downside of such a coarse blade is that the cut will be somewhat rough and prone to vibration, so it may not be suitable for resawing thin veneers, which are spoiled simply. If you plan to resaw veneers from denser stock, you may want to utilise a variable-tooth, hook-type blade. The teeth on this blade are the same shape but vary in size, which results in less vibration.

Not only does resawing require the appropriate blade, but for consistent results and smooth cuts, it's likewise critical to adjust the bandsaw. These adjustments must be made in the appropriate sequence. First mount, track, and tension the blade; then square the table to the blade and adjust the guides. Lastly, if the fence on the machine is too short to support wide stock, build an auxiliary fence. Because resawing generates a lot of dust, utilise dust collection at the source as well as an ambient air cleaner. Increased blade tension produces flatter cuts, Re-sawing places a greater burden on a bandsaw blade because of the increased forces and the heat generated during the procedure. As the stock is fed into the blade, it places the front of the blade in compression and the back in tension. The combination of these opposing forces can cause the blade to buckle and spoil the workpiece. The best way to circumvent this scenario and ensure smooth cuts of uniform thickness is to place the blade under lots of tension and employ a steady feed rate; don't force the stock. The most precise technique for measuring tension is with a tension gauge, but this device costs around $400. If you don't want to shell out that kind of cash, you'll have to rely on your saw's built-in tension scale. Unluckily, most of these scales tend to provide a low reading, so I came up with a low-tech solution. Simply adjust the blade tension to the next mark on the scale; for instance, if you are using a ⅜-in.-wide blade, adjust the tension for a ½-in.-wide blade. To decrease strain on the saw, I decrease the tension when I'm completed resawing.

Preparing for resawing:

- A narrow, coarse hook-tooth blade will clear sawdust out of the kerf simply, and a positive rake angle will make it easy to feed a board through with a light touch.
- A straightforward technique is to set the tension one mark higher on the tension scale of your bandsaw.
- You likewise can check the tension by pressing your finger against the side of the blade; if it deflects more than ¼ in., crank up the tension.
- With the blade tension set, make sure that the table is square to the blade.
- Next, position the guide blocks and thrust bearing about 0.002 in. to 0.003 in. from the blade.
- Be sure that the guide blocks do not contact the teeth.
- Then, adjust the upper guides so that they're no more than ⅛ in. above the workpiece.
- Place a square against the side of the blade, and adjust the table until the sawblade is flush against the blade of the square.
- Guides should be 0.002 in. to 0.003 in. from the blade and should not touch the teeth.
- You have the right spacing if you can just slide a slip of paper between the guides and the blade.
- The same goes for the thrust bearing, which shouldn't spin until

you begin to feed stock into the blade

- If you’re sawing just a few drawer parts from inexpensive stock, you can utilise the fence that came with your bandsaw.
- But for precise, uniform cuts, it’s better to build a taller auxiliary fence.
- Before resawing, it’s vital to determine and adjust for blade drift, the tendency of the thin blade to begin cutting out of parallel with the fence.
- One way to decrease drift is to track the blade so that it’s in the exact center of the tire, which can be hard to do with the flat tires on numerous European bandsaws.
- I find it easier to adjust the fence for drift
- A tall auxiliary fence made from ¾-in.-thick plywood or medium-density fiberboard (MDF) helps support wide stock for resawing, ensuring cuts that are true and smooth.
- Raise the guides and cut along a scribed line freehand.
- Stop midway through the cut, hold the test piece in place, and clamp the auxiliary fence against it.
- This ensures that the blade won’t wander during the cut.
- To ensure a true cut, utilise one hand to push the board and the other to hold it flat against the fence throughout the cut.
- Before the board starts to fall off the table on the back side, walk around to the other side of the saw and pull the board through.
- Support the board with one hand while using the other to hold it flat against the fence.
- This technique likewise keeps your hands away from the blade.
- As you near the end of the cut, push the stock through with a push stick to keep your fingers clear of the blade.
- Run the just-cut face of the workpiece lightly over the jointer before slicing the next sheet.

The procedure of resawing

- It starts with stock that is flat and square so that you have a flat exterior to register against the fence.
- As you resaw down the thickness of a board, you typically eliminate the tension in the wood that was keeping it square and

flat.

- With that tension unleashed, the natural side effect is that the resawn stock can tend to twist, cup, or bow.
- Resawing parts a bit oversize lets you to straighten and flatten them later.
- For denser stock, such as that used for drawer fronts or sides, I cut boards about 1 /16 in. to ⅛ in. denser than I need.
- I cut veneer sheets only about 1 /32 in. denser than essential, just enough to allow for easy removal of sawmarks.
- As you cut, listen for the sounds of overfeeding.
- If you push the saw too hard, the motor may bog down, or the blade may twist or bow and ruin the cut.
- At about 6 in. from the end of the cut, substitute your pushing hand with a push stick for safety.
- If you’re resawing a long board, pull the last length of the workpiece through.
- When resawing veneer, run the workpiece lightly over the jointer after each cut, removing only about 1 /64 in. of material.
- This gives you one flat face to glue to the substrate, allowing you to smooth the rough outer face simply without fear of spoiling the veneer.
- Then place the jointed face against the bandsaw fence, and continue cutting.
- If you plan to book-match the resawn boards, stack them in the order that you cut them so that it will be easier to find great matches.

Chapter 7 How to apply crosscuts

Wood is an amazing material, widely obtainable in all sorts of colors, with beautiful grain patterns. It cuts simply with small machines and tools, merchandises that are accessible to the home craftsman—and its strength-to-weight ratio rivals high-tech supplies. But it is organic, and therefore comes with some strings attached. One is movement, and there is no stopping it. The other is tearout. A budding hobbyist soon encounters splintered edges and pockmarked surfaces, damage that grows more obvious when finish is applied. It happens with nearly every tool in the shop. The great news is that it can be stopped, in most cases simply. Tearout happens when wood is cut and its plant fibers aren't held firmly in place. There are two main types: One happens when wood is cut across its grain, and the other when the exterior is planed. I'll begin with crosscutting, which is the easiest to handle.

Ripping happens along the grain, and generally causes little to no tearout. The few long fibers involved simply shear away from each other. But crosscutting applies pressure across every fiber in a board. That's fine through most of the cut, but near the bottom or back edge, the last few fibers have nothing behind them and would much rather splinter away than be sliced through. On most tools, there is nothing there to stop them. Manufacturers build those tools to make both square and angled cuts, so the opening in the table or fence needs to be extra-large to allow the blade to be tilted. Carpenters don't mind, because tearout doesn't matter on framing, and they typically can hide the bottom side of a trim- or deck board. But furniture makers can't always hide a splintered edge, and they rapidly learn to close up that big gap with a zero-clearance plate, typically just a piece of plywood tacked or clamped onto the tool. The principle is always the same: The blank plate is attached, and the sawblade is used to cut a kerf through it. Then, when wood is crosscut on top or in front of that plate, the lower or back edge is supported completely on both sides of the blade. Granted, that plate will need to come off or be substituted for angled cuts, but most cuts are at 90°

On tablesaws, you should substitute the throat plate with a blank plywood one for all square cuts. But you can utilise a zero-clearance plate on the miter gauge fence, too, to support the back edge of the cut. This is nothing more than some plywood or MDF (medium-density fiberboard) screwed to the existing fence. The same goes for any crosscut sled you build for the saw: You can tape or tack sacrificial surfaces onto the base and the fence. Don't utilise thick pieces on the base; you'll steal too much of the blade's height capacity. Later, when the zero-clearance slots on these plates get beat up by angled cuts or different-size blades, you just attach new ones. On miter and chopsaws, you can eliminate tearout on both square and 45 degree cuts by attaching similar plates to the bed and fence. The principle even holds true for handheld power tools. A shopmade straightedge jig for a circular saw uses the same zero clearance idea to eliminate tearout on at least one side of the cut, where it matters most.

While these don't exactly crosscut wood, they cut across the fibers in a similar way. And you utilise the exact same treatment. Most drill presses have a big hole in the cast-iron table to accommodate the largest drill bits. Without a backer board under your workpiece, you'll get terrible blowout on the bottom side of the hole you are drilling. A straightforward piece of plywood or MDF prevents this. Just move it around to get a solid exterior under each new hole. On router tables, the force of the spinning bit is horizontal, so you will sometimes need a zero clearance plate on the fence, but nearly never in the table. There are a number of ways to do it: Make the whole fence sacrificial and replaceable, attach a thin blank plate to the fence, or design a fence with replaceable inserts

Jointers, planers, and handplanes all can create nasty tear-out in wood surfaces, especially when they hit grain that changes directions. But the power tools require a different approach than the hand tools. I don't believe there is a way to utilise the zero-clearance principle on the jointer and planer, but there are other ways to decrease tearout. Cut with the grain as much possible. If you are getting tearout, try reversing direction. Also, try replacing dull knives with sharp ones. Sometimes it likewise helps to dampen the exterior with water before sending the board through. Handplanes, on the other hand, do benefit from the zero-clearance principle, or, more precisely, the tight-clearance principle. The force of the blade tends to pry fibers upward, while the plane's sole holds them down. A tighter blade opening puts the sole closer to the front of the blade and prevents the fibers from lifting during the cut. For the final, critical passes on a board, resharpen the blade, set it for a fine cut, and adjust the mouth to a very tight opening. Depending on the plane, you either adjust the frog forward or adjust the toe of the sole backward to close the mouth. And on planes with a chipbreaker, it helps to place it as close as possible to the tip of the blade, so it applies supplementary downward pressure on the chip as it curls it, fighting its tendency to tear upward. Last, when tearout is unavoidable, utilise scrapers and, or sandpaper to work past it and develop a flawless surface.

Chapter 8 How to break edges

Some tasks in woodworking are so rudimentary and crucial that they apply to virtually every piece of wood in a venture. Rudimentary milling and exterior preparation come to mind, but for me, breaking edges is just as vital. I utilise sandpaper or a block plane to relieve every edge of just about every part of my furniture. It’s quick work, but it needs to be done systematically. Do too little, and your furniture won’t look or feel completed. Overdo it, and your heavily rounded edges will look like unskilled factory work. Not all furniture should get the same edge treatment, nevertheless. Contemporary furniture, For instance, typically wants crisp edges, which work fine if relieved adequately. Arts and Crafts go to the other extreme with rectangular parts broken with sensible—sometimes bold—chamfers. The procedure calls for two skills that take a little practice but aren’t at all hard to master: the cleanly planed chamfer and the lightly sanded roundover.

I like the visual effect of chamfers so much that I typically cut a light chamfer into all the visible edges of a piece. I do this with a block plane rather than a router because this is light work; to effectively break an edge, a chamfer doesn’t need to be more than about 1 /32 in. wide. The block plane is likewise easy to maneuver one-handed, works well in tight quarters, and leaves an eye-catching flat and polished cut. Set up the plane for a light cut, with a narrow throat opening. A well-tuned plane will often chamfer an edge flawlessly, regardless of grain direction, but if you’re getting resistance or small tearouts, turn around. Align the plane’s body lengthwise with the corner you’re chamfering. Tilt the body with the blade centered on the workpiece edge. Keep a standard grip on the plane but, if possible, ride a knuckle or the tip of your thumb on the stock to help maintain a consistent chamfer angle. Skewing the plane, on the other hand, lets you cut cleaner chamfers in end grain and work deeper into inside curves.

On nearly any venture, you can streamline the task of breaking edges by doing some of the work before assembly. On a table, For instance, all the edges can be worked beforehand. This includes the legs and the bottom edges of the aprons, inside and out. The tabletop edges can be done before or after assembly, but you’ll find them easier to work as long as you can run around all four edges at once. Even with an underbeveled edge, you’ll need to break the edges on this bevel with sandpaper or a light chamfer. A frame-and-panel door is another great example. I chamfer the inside edges of the stiles and rails before putting the frame together. These edges are harder to reach once the panel is in place. To circumvent creating a gap at the end of the rails, be sure to stop well short of the joinery when chamfering the inside edges of the stiles. After glue-up, utilise a paring chisel and a rabbet plane to carry these chamfers into the curves. Now chamfer the outer edges. Work cautiously on the top and bottom areas where the long grain of the rails joins the cross grain of the stiles. Giving the plane a healthy skew as you come onto the cross grain should leave a polished facet there. Lastly, give the inside of the closing stile an extra pass or two, to ease this area of potential wear

A quick and effective technique:

- A straightforward way to break an edge is to round over the corner with fine sandpaper (P220-grit, then P320).
- And it's perfect for preserving wood's wonderful tactile quality, softening sharp, sometimes fragile curves and making them easier to handle for builder and user alike.
- I tend to utilise the roundover technique mostly on less-visible parts like drawer sides and the inside edges of table aprons.
- Out of sight as they are, these areas still get handled and require safeguard from wear and tear.
- Sanding freehand can make it challenging to get a consistent shape on all of your edges, especially when working into curves.
- You'll improve your results by supporting the sandpaper with some type of backing that gives a little and lets you control the shape you're creating.
- Woodworking suppliers sell foam or cork sanding blocks, but I find it straightforward and effective to attach sandpaper to a narrow scrap of ¼-in.-thick softwood or a scrap of leather.
- The sandpaper likewise makes it straightforward to control the size of the roundover you're creating.
- If a few passes aren't enough, keep going.
- Stop when the edge feels comfortable and fits your design.
- Again, some of this work is easier done before the piece comes together.
- On a drawer, For instance, I lightly round the inside edges of the

drawer sides and both top edges of the back before assembly.

- I do the rest after the drawer is together, using a file or chisel to hit the curves on the back of the drawer front.
- I utilise a block plane to chamfer the visible front edges of the drawer front.

Chapter 9 How to taper legs using tablesaw

It’s no secret why woodworking professionals taper the legs of tables and chairs: It improves the appearance of the entire piece. Tapering breaks up that boxy square look, lightens the visual weight, and helps direct the eye toward the center. Tapered legs are found across the range of furniture styles. The majority have tapers on two adjacent faces that begin just below the apron or rail, keeping the joinery square. But you can likewise find tapers that extend to the top of the leg, and tapers on all four sides. What they all demand is a way to cut them precisely and safely. While you can cut tapers on the bandsaw or the jointer, tablesaw cuts are cleaner and more precise. Nevertheless, the standard commercial tapering jig has always scared me. Because the workpiece isn’t clamped to the jig, your fingers have to come dangerously close to the blade.

Numerous of my students are new to woodworking, so any jig has to be straightforward and safe to use. The jig we utilise to taper legs ticks both these boxes. It falls under the broader category of what I call carriage jigs, in that the work is carried on some sort of sled. Because one edge of the sled lines up with the path of the blade, setting the location of the workpiece is very easy, and with a built-in clamp to secure the workpiece, your hands remain well clear of the blade. Instead of the sled being guided by the miter slot, as in most cases, I have it hooked to the fence. If the sled only rides in the miter slot, it wants to dip and come out of the slot before and after the cut. Some people try to utilise one knee to support the sled while doing an odd little one-legged dance in front of the spinning saw. Not with this sled. It is tied to the fence with an interlocking strip that keeps it flat on the table at all times. What’s more, one edge of the jig is near-zero-clearance, so it tells you where the blade will cut. That means you can simply align the layout marks on a leg with the edge of the jig, and cut with confidence.

An easy technique for construction

- To make the jig, begin with a piece of hardwood, roughly ⅞ in. thick by 2 in. wide by 38 in. long, rip off a ⅜-in.-wide strip, and cut it to 33 in. long.
- This strip will ride against the rip fence, so you want it just proud of the edge of the sled.
- To achieve this, place a piece of masking tape along the edge of the sled, place the strip and the sled base against the rip fence, and then glue and either screw or staple the strip to the sled.
- Peel off the tape, and you're all set.
- The two long sides of the sled must be parallel, so with the sled riding against the rip fence, trim the opposite side.
- But before you do that, attach the stop block, so it gets trimmed flush, too.
- Afterward, attach the sled's adjustable fence, push handle, and toggle clamp.
- An L-guide locks the jig parallel to the fence yet lets it to glide smoothly with no slop.
- To make the guide, glue and nail or staple a 2-in.-wide by 38-in.-long strip of ½-in.-thick plywood to the remaining piece of hardwood that you ripped earlier.
- Place the side of the base with the maple strip adjacent to the saw's fence and clamp the guide to the fence.
- Check to see if the sled slides back and forth.
- If it is too tight, simply add a strip or two of blue painter's tape to the hardwood side of the guide before re-clamping it and testing the movement again.

On traditional furniture across a range of styles, there is a rudimentary rule for which faces of a leg to taper: If it falls under the aprons, it gets tapered. A tapered leg lends a piece the lightness and grace mentioned earlier, plus gives it a stable-looking stance without making it look splay-legged. On a typical four-legged table with a rectangular top, or even variations such as a bow or serpentine front, the two inside faces of the legs are tapered. To describe how the jig works, I'll cut one of these legs. First, cut any joinery on the leg. It is much easier while the blank has straight sides. Layout, or more precisely the lack of it, is another advantage to this jig. A line marking the begin of the taper and another on the bottom of the foot are all you need. The taper typically starts where the bottom of the apron or rail intersects the leg. I utilise a combination square to set the lines on the top, being cautious to mark only the sides to be cut. Too many lines leads to mistakes! If the taper has a completed dimension of, say ⅛ in. at the bottom, I cut a piece of stock that thick, line up the blanks, and mark the bottoms with one swipe of the pencil. I rotate each leg 90° and make a second mark. Lastly, I utilise a wax crayon to highlight the faces to be tapered. When using the sled, the thin end of the tapered leg should always be closest to the operator. This way not only are you cutting "downhill" with the grain, but the action of the blade helps push the blank onto the sled. You likewise want to rotate the leg clockwise after the first cut, so the leg is resting flat on a non-tapered face during the second cut.

Procedure:

- Adjust the jig and cut the first taper.
- There is no need to adjust any setting; just reposition the leg while the blade is spinning and clamp it down.
- With the first taper facing up, make the second tapering cut
- To position the leg in the sled, align the mark on the bottom of the foot with the edge of the sled and push the foot into the tip of the screw protruding from the stop block.
- Now align the begin of the taper with the edge of the sled and set the adjustable fence against the leg.
- Lastly, deploy the toggle clamp.
- Leave a little extra material to handplane and sand by setting the saw fence so that the side of the sled is about 1 /32 in. from the blade.
- Make the cut, using the handle to push the sled so that your fingers come nowhere near the blade.
- Pull the jig back to the front of the saw, loosen the clamp, rotate the leg 90° clockwise, and secure it again.
- Cut the second taper.
- When cleaning up the saw marks, don't remove any wood above the taper because this will leave a gap between the leg and the

apron.

- To sneak up on the line, I mark the area below the line with a crayon, and then plane up the marked area, stopping just before the line.
- A final light sanding completes the job.
- To circumvent extending the taper too far, mark the exterior of the leg a few inches below the layout mark with a wax crayon.
- This makes it easier to measure your progress and to stop before you reach the line.
- You need to set up the sled only once to cut tapers on two adjacent sides, but lay out each leg to keep track of your cuts.
- Line up the layout mark with the edge of the sled and stop block, and push the leg gently against the screw in the block.
- You need only a small tick mark at the begin of the taper.
- Line it up with the edge of the sled, and then slide the adjustable fence against the back of the leg blank.
- You want the edge of the sled to be about 1 /32 in. away from the blade.
- In this way the taper is cut somewhat proud to leave room for handplaning and sanding.

On a round or oval period table with corresponding shaped aprons, the legs can be tapered on three or four faces. Further, on contemporary furniture, it is common to find legs tapered on four sides, often extending all the way to the top, or even inverted with the wider part at the base of the leg. Never fear, this jig can handle all of these tapers and then some. For instance, with four-sided tapers, cut the first two adjacent sides. To cut the last two sides, first adjust the sled’s fence to take into account the tapered side of the leg that will now be against it. After cutting the third taper, you may need to place an offcut under the blank to support it during the fourth cut.

Chapter 10 Wood moulding techniques

A crisp molding lends the same touch of elegance to a well-made cabinet that a silk tie bestows on a sharp-dressed man. But in order for their magic to work, neckties and moldings both must be treated with care. A molding with torn-out grain or fuzzy edges will spoil the effect—like a soup stain in the middle of your chest. I don’t have to fuss with a necktie very often, but my students and I do run plenty of molding. I’ve adopted several practices for making sure the results fit well and look their best. Creating molding safely and cleanly requires cautious attention in three areas: cutting profiles, cleaning them up, and lastly, ripping the individual molding strips. The suggestions here touch on all of these areas.

How to eliminate tearout

- To eliminate tearout, I like to bury the bit in a wooden fence, creating a zero-clearance cavity that lets the fence serve as a chipbreaker.
- There are two types of this fence that I make most often; both begin with a great scrap of wide 2x stock with a jointed face and edge.
- The first is a very straightforward fence that I make by using the bit itself to cut the zero-clearance cavity.
- Clamp one end, bury the bit a little deeper than you need, then bring the fence back to the appropriate setting and clamp the free end.
- If you are raising the bit into the fence, go only as high as essential.
- Creating a cavity taller than your final bit height decreases the chipbreaking effectiveness.
- For complex bits or those that can’t cut their way into the fence, such as bearing-guided bits, I drill the fence opening with a Forstner bit.
- This likewise makes it easier for me to joint the infeed side if I need an offset fence.
- I likewise cut a channel in the back of the fence for chip removal.
- To avoid chipout in heavily figured stock, I reorient this fence so

that the bit is literally buried in the infeed side.
- To do this safely, clamp a straight backer board behind the fence.
- Loosen the clamps that hold the fence and, with the router running, slide the infeed side of the fence into the bit.
- The movement is very controlled because the rotation of the bit pushes the fence against the backer board.
- After setting the fence, reclamp and continue running the molding.
- Another advantage of any sacrificial wooden fence: I can rapidly screw guards or hold-downs in place.
- A great table and router are likewise important.
- Reinforce an MDF top with angle iron or C-channel, if need be, to avoid sag.
- As for routers, I recommend a fixed-base model with at least a 1½-hp motor.

How to cut moulding on a wide bank

- Choose a piece of stock that is wide enough to run a profile on each edge while leaving a few inches in the middle.
- A larger workpiece means less vibration and better results.
- It likewise lets you run the molding much more safely, keeping your hands well clear of the spinning bit while controlling the stock.
- It's likewise much easier to clean up moldings while they are part of a wider piece that can be clamped simply while the profile is scraped or sanded.
- Pay close attention to the feed rate.
- Too fast leads to chipping; too slow can cause burns.
- Wax the table and fence to keep resistance to a minimum.
- After the molding is done, rip it away on the tablesaw.

How to glue up your own stock

- When you want to cut a wide molding in figured wood like bird's-eye maple, you might not find stock thick enough.
- I do this by ripping a thinner board into strips a little wider than the thickness I want.

- Stand these strips on edge and laminate them face-to-face to create a glued-up board with enough thickness for the desired moldings.
- Glue up the blank with a piece of scrap stock as a backer board.
- This lets you cut multiple molding strips in the reoriented face grain while keeping your hands safely away from the bit.
- Assemble the blank so that each glue joint falls in a tablesaw kerf when the moldings are ripped.
- You'll need to account for the kerf width, the amount of stock removed in cutting the profile, and the thickness of the completed molding.

How to decrease chipout

- Sometimes a straightforward profile requires multiple passes of the same bit.
- Because I don't have a specific bit that cuts the proportions I need, I run this molding with multiple passes using a core-box bit.
- In this situation, I find that I can decrease chipout dramatically by making the first pass with the bit set at the point farthest from the fence.
- I then raise the bit and move the fence toward the workpiece with each successive pass.
- In this way, the chipout created by each pass is removed by the subsequent passes.
- For the final run, I make sure the bit is buried in the fence, reducing the likelihood of any chipout.
- This technique likewise helps when cutting complex profiles using a combination of different bits.
- This is sometimes essential because numerous complex-profile bits don't quite fit specific design requirements.
- By combining cutters, you can match older moldings or create original designs.
- The delicate crown molding at right—for a small chest—is made by combining three cutters: an oversize beading bit from Eagle America, a core-box bit, and a straight bit.
- Begin by cutting a sample section of the profile to utilise as a

setup piece.
- Creating this piece likewise brings to light any unforeseen issues in the procedure.
- If you create the molding often, hang the sample on the wall for future use.

Procedure when using multiple bit profile:

- Sequence the profiles to eliminate tearout, starting at the bottom and inside on the molding.
- Running this bit first will cause some tearout at its top edge.
- This line of tearout will be eliminated when the core-box bit establishes the cove
- Raise the bit a little each time.
- Any chipout along the outside edge will be eliminated when the fillet is cut.
- Use a straight bit buried in a fresh fence to avoid tearout.

How to utilise an offset fence

- Profiling an entire edge is very much like jointing the edge of a board: the entire original exterior is eliminated to create the profile.
- With a standard setup, this means the profiled workpiece won’t ride against the outfeed fence.
- For appropriate support, the outfeed fence should be set flush with the cutter while the infeed fence steps in about 1 /32 in.
- Make passes on a scrap piece to dial in the offset.
- While this might sound a little complex, it’s essentially quite straightforward to set up.
- Take a jointed piece of 2x stock and drill an opening for the bit.

Clean up procedure before ripping

- Moldings generally need some cleanup, especially if the profile was generated by a combination of bits.

- Still, if the milling was executed appropriately, that cleanup should require minimal effort.
- A diversity of tools come into play for taking off tearout, tool marks, chatter, or burn marks.
- The list includes scrapers, a shoulder plane, files, and various sanding blocks.
- Scrape first, using scrapers produced to a diversity of profiles to fit the need.
- Shape cutoffs from card scrapers into an assortment of beads and rounds.
- For moldings like bracket feet, grind a scraper close to the profile.
- Don’t go for an exact match because you’ll need to attack from various angles.
- Detail files work well for small radii and leave marks small enough to be eliminated rapidly with sandpaper.
- Sanding, nevertheless, should always be kept to the essential minimum.
- I tell my students that after just a few minutes of sanding, the only thing they are really sanding away is their grade.
- I tend to utilise aluminum-oxide paper ranging in grit from P150 to P220.
- Most times, I utilise a sanding block or a piece of dowel stock for an appropriate curve.
- Contour sanding grips are obtainable, but these seem like one more thing I don’t really need to accomplish a rudimentary task.

How to rip between the blade and fence

- When cutting molding from a blank, standard safety practice calls for setting the tablesaw fence so that the ripped molding falls to the outside of the blade.
- The fence is then reset and the procedure repeated for the molding on the other edge.
- But repeatedly resetting the fence can lead to variations in the thickness of the different pieces.
- This issue can make it harder to fit the molding appropriately.
- To circumvent this, I rip off the molding between the blade and

the fence.

- The distance between the fence and the blade never changes, so the thicknesses are far more consistent.
- And because you’re not resetting the fence after each cut, the work likewise goes more rapidly.
- But this technique demands extra precautions.
- Use a splitter to avoid the molding from curling into the back of the blade and causing kickback.
- Stub splitters stay out of the way but get the job done.
- Push sticks and hold-downs are likewise important.
- A small bandsaw cut in the end of the molding stock lets you hook a narrow push stick into it.
- A hold-down clamped to the fence keeps the stock from lifting off the table.

Chapter 11 How to fix mistakes

The difference between a professional and an amateur is that the pro knows how to cover up his mistakes. We all make mistakes, so it is nearly certain that the hole you find yourself in has been previously occupied, and that a former occupant found a successful way out. I've divided the issues into defects and flaws in the wood, miscut joinery, and undersize parts, but there are some tips that apply to every mistake and every venture. There was a student who once had nearly completed a violin. He was applying a French polish when his pad stuck to the surface, leaving a blemish in the otherwise flawless finish. In a rage, the student smashed the violin to pieces. Too bad he didn't take an advice and sleep on the issue. More often than not inspiration will strike, either in the early hours or the next morning when you are no longer angry at yourself. In the case of the violin, rubbing the spot with an alcohol-dampened pad would have eliminated the error in minutes! As a common tip; you should hang onto every piece of scrap until a venture has left the workshop. It's much easier to get a great grain and color match for a patch if you still have part of the board left over.

How to create an invisible patch

- Take a deep carving gouge that is somewhat wider than the damage, in this case 8/10mm, and carve out a shallow depression around the hole.
- Practice on some scrap first.
- After dry-fitting the patch, glue it and clamp it in place with plenty of pressure.
- Waxed paper prevents the caul from sticking to any squeeze-out.

How to substitute a loose knot

- A loose knot doesn't add character; it detracts from the wood's beauty.
- Instead of scrapping a nice board or cutting it in two.
- Draw the outline of the loose knot on a piece of clear plastic, such as a three-ring file divider.
- Use the transparent pattern to find a nice, tight knot of similar size

on a piece of scrap and resaw it to about 3 /16 in. thick.
- Draw a similar outline and cut it out on a scrollsaw.
- Place the patch so that it covers the whole knot and draw around it with a very sharp pencil.
- Use a small plunge router or a rotary tool in a plunge base to excavate to a depth of about ⅛ in.
- After that, work up to the layout lines with a small chisel or gouge.

How to repair moulding

- Sometimes tearout just happens, particularly on curly wood.
- If it occurs while profiling the edge of a tabletop, you may not be able to simply trim that edge and re-rout, as that will affect the overhang.
- Instead, I will describe how to add a strip and conceal the joint in the profile.
- Saw in line with the fillet of the profile to leave the center of the tabletop untouched.
- Find a piece of scrap that closely matches the rest of the top in color and figure and glue it on.
- After trimming the strip to leave the table top approximately 3 /32 in. wider than the desired final width, re-rout the profile.
- Measure how far the fillet of the profile is from the glueline of the repair.
- Set the tablesaw to rip off this exact amount, leaving a flat edge.
- Make one final pass on the router table to bring the fillet of the molding in line with the joint for a nearly invisible repair

How to hide an incorrect mortise

- The secret to numerous repairs is to circumvent straight lines.
- They aren’t found in nature and they will attract the eye.
- Glue a piece of tracing paper over the damaged area, then glue the patch to the paper over the hole.
- When the glue is dry, mark around the patch with a knife.
- Then break off the patch at the paper line.
- Adjust the size and shape of the patch using sandpaper until it fits

seamlessly.

- The curved shape of the patch helps it blend into the background.
- Now just rip away the waste, leaving 1 /16 in. glued to the damaged face.
- Trim the strip to match the leg’s taper, then break its edges to conceal the seam.

How to eliminate a groove

- It’s a common mistake to cut a groove for the drawer bottom on the incorrect side of a drawer side.
- Instead of cutting all those dovetails again, I will describe how to rapidly substitute the miscut section only.
- This goes rapidly compared to dovetailing a brand-new side completely

Chapter 12 Rudimentary Joinery techniques

Most students always find it more satisfying to perfect their joinery by creating a piece of furniture rather than by adding to the kindling in the scrap bin. The dado and the rabbet are fundamental woodworking joints found in all kinds of furniture, from bookcases to highboys. Building this organizer, which either can be hung on a wall or stood on a table, lets you to practice these joints while creating a useful piece of furniture. This piece features dadoes that run the width of the sides to support the shelves, and stopped dadoes in the upper shelf and the underside of the top to receive the partitions. Rabbets in the cabinet include those at the top of each side piece and partition as well as in the drawer construction. Both joints provide precise alignment of the parts, load-bearing cap capability, and increased glue surface. They can be cut precisely on the tablesaw, with or without a dado set, and with a router using various fences and jigs.

I chose red oak as the primary wood for this venture and pine for the drawer boxes and the back slats. If you can find 11-in.-wide oak boards, you will be spared the step of gluing up panels, but glue-up is not a big procedure for a venture this size. The oak for the partitions needs to be thicknessed to ½ in., and most of the pine needs to be ⅜ in. thick; this is best done with a planer rather trying to resaw denser stock. You will need about 18 ft. of 8-in.-wide oak boards, and 7 ft. of pine, which includes an extra 20% to be on the safe side.

How to cut dadoes and rubbets using tablesaw

- Most of the dadoes and rabbets for this venture can be cut on the tablesaw using a set of dado blades.
- There are two types of dado blades: stackable blades, which consist of two outside blades to cut the sides of the joint and multiple chipper blades to eliminate the waste in the middle, and adjustable blades, likewise known as wobble blades.
- I favour the stackable dado set because it makes a cleaner cut.
- Install a throat insert made for a dado set.
- Mount the two outside blades and sufficient chippers to make a cut just under ¾ in. wide.
- Using a piece of surplus oak as a gauge to make test cuts, fine-

tune the width by adding or removing shims between the blades until you achieve a snug fit.

- Each side piece gets a pair of dadoes for the shelves, and the top and bottom shelves each receives one narrow dado for the drawer divider.
- Dadoes shallower than ¼ in. deep can be cut in one pass, but feed the workpiece slowly to achieve a clean cut and circumvent straining the motor.
- Use the rip fence to guide the location of each dado, making the same cut on both side pieces before adjusting the fence for the next dado.
- Apply firm downward pressure on the workpiece to ensure that the depth of each dado is consistent throughout its length.
- Even though the cut for the rabbets on the top of each side piece is ⅜ in. square, there is no need to reset the width of the dado set.
- Instead, clamp a piece of ¾-in.-thick plywood or medium-density fiberboard (MDF) to the rip fence, locate the fence for the cut, and gradually raise the blade so that it eats into this sacrificial fence.
- The final cuts with the dado blade are ⅛-in.-deep by 3 /16 -in.-wide rabbets on both sides of each end of the three partitions, and 3 /16 -in.-deep by ¼-in.-wide rabbets on overlapping sides of the pine back slats.
- Known as a shiplap joint, this lets the boards to move seasonally without creating a gap between them.
- While you have the router out, now’s a great time to profile the edge of the top.
- Though this venture has a cove on the underside of the front and sides of the top piece, you may favour the look of a chamfer.
- Regardless, utilise a bearing-guided bit running along the edge of the workpiece.
- For a clean cut with minimal tearout or burning, make the cut in two stages with the second cut at the final depth removing only a small amount of wood.

Procedure:

- The outside cutters of a stackable set of blades are placed on the arbor first and last, with chipper blades between them.

- The width of the cut is fine-tuned by placing metal or paper shims between the blades.
- Adjustable blades, likewise called wobble blades, can be adjusted to width by rotating a dial on the side of the blade.
- The depth of the dado should equal about a third of the wood's thickness.
- Apply continuous pressure both against the fence and downward to ensure that the cut is consistent in depth across the piece.
- With narrow workpieces, utilise a miter gauge for guidance and support.
- After cutting the dadoes for the shelves, flip the board and cut the rabbet on the top of each side, creating a narrow tongue that will enter the top.
- To circumvent damage to the rip fence, clamp on a sacrificial plywood fence.
- On this venture the partitions are secured in stopped dadoes in the upper shelf and the top.
- The stopped dadoes must be cut in identical positions on the top shelf and the underside of the top piece.
- To achieve this I utilise a rub collar in conjunction with a template.
- The collar has a tubelike piece of metal that surrounds the router bit and guides it by means of a template placed on the workpiece.
- When laying out the job and making the router template, the difference between the outer diameter of the rub collar and the router bit must be taken into account.
- Blocks of wood glued to the underside of the template act as stops to ensure precise placement on both of the pieces to be cut.
- I likewise utilise the router to cut ⅜-in.-square stopped dadoes on the sides for the back slats and on the underside of the top for the sides.
- Because these cuts are near the edges of the workpiece, a fence attached to the router and guided by these edges works well.
- You will need to stop the router just before the end of each cut and square up the end with a chisel.
- Due to the drawers have false fronts and are fitted with guides, it

is safe to make up the drawer boxes before the carcase is assembled.

- The front, back, and sides of the boxes are connected by dado and rabbet joints cut on the tablesaw:
- First cut two dadoes on each side piece; the distance from the end is determined by the thickness of the front and back pieces.
- Because the next cut is made with only a thin section of wood in contact with the tablesaw, fit a zero-clearance insert around the sawblade to avoid the workpiece from getting wedged between the table and the blade.
- In two cuts you can make rabbets on the ends of the drawer back and sides to create a tongue that connects with the dadoes on the drawer sides.
- Before assembling the boxes, cut grooves on the inside of the front and sides, and cut away the back of the drawers so that the bottom can be slid in.
- The drawer partition simply is a ¾-in.-thick piece of pine that is joined to the two shelves with ¼- in. dadoes.
- These can be cut on the tablesaw with two passes over a conventional blade.
- To circumvent having end grain exposed on the front of the cabinet, utilise a tongue-and-groove joint to attach a thin facing piece of oak.

Completion:

- You will find that the assembly of this venture will be much easier to do on a pair of sawhorses, because the gap between the horses lets more room for clamping.
- Glue the shelves to the cabinet sides and slide in the drawer divider from the front.
- When these joints are dry, slide in the back slats, glue in the three partitions, and then glue on the top.
- Screw the center of each back slat to the sides.
- Before fitting the drawers, mill some rabbeted drawer guides from pine and set them in place with glue.
- The rabbet along the bottom and the fact that they are 1½ in. short

allow them to be trimmed in place with a block plane.

- Once you have achieved a snug fit for each drawer box, mark its location on the back of each false drawer front.
- Transfer the location of the holes on the drawer box and drill pilot holes in the false front to circumvent splitting the wood with the screws.
- The last pieces to add are a valance that is set just in from the sides and glued to the lower shelf, and a two-part French cleat if you are going to hang the organizer on a wall.
- Before assembly you should sand the interior sections with 100, 150, and 220-grit paper.
- With the piece assembled, plane all of the joints flush and repeat the sanding sequence on the outside.
- Wiping the wood with denatured alcohol will reveal any glue that has squeezed out.
- Sand these areas again with 220-grit paper.
- Finish the wood with three coats of an oil-varnish mixture, such as Waterlox, sanding between the first two coats with 220-grit paper.
- When the finish has cured, rub the cabinet with 0000 steel wool, and wax and buff the wood for a smooth, satin finish.

Chapter 13 Miter Joint techniques

The attraction of a miter joint is easy to see. It is an elegant and straightforward technique for joining parts that meet at an angle without showing any end grain. Whether you are building the frame for a veneered panel, applying wrap-around molding or constructing a straightforward picture frame, a miter joint will serve your needs. But as the saying goes, the devil is in the particulars. The very visibility of the miter joint means that errors in machining or assembly are hard to conceal. Nevertheless, with a little patience and lots of practice cutting and assembling miters, you too can master the joint. Generally used for right-angle curves between two boards of equal thickness and width, miters are made with matching cuts. These cuts are at 45 degree so no end grain is visible. But the miter joint isn't reliable solely as a glue joint for most constructions. Where any real tenacity is required, strengthening with biscuits, splines or keys is always the prudent choice. In short, to get perfect miters requires perfectly mating joints, a slip-proof gluing system and at least one form of strengthening.

Procedure:

- It doesn't matter what type of saw you cut miters with, utilise a sharp, clean blade.
- Generally the more teeth to a blade, the smoother the cut, but no blade will cut well if it's dull or covered with pitch.
- Every cut is made in two directions: at 45 degree across the width of a board and at 90 degree across its face.
- For a miter to close up well, both angles need to be cut exactly.
- Make rough adjustments using a plastic 45 degree drafting triangle, then take several practice cuts, checking the results with a combination square.
- A chopsaw works great at cutting miters.
- Just make sure the fence is flat and straight.
- If essential, add an auxiliary fence and shim it to make it square to the table.
- Frame parts can lie flat on the chopsaw table.
- Angle the blade 45 degree to the fence to make the cuts.
- Clamp stops onto the auxiliary fence to index matching cuts.

- When cutting miters on a tablesaw, you’ll get the best results using a jig that holds your work to move it past the blade.
- The miter gauge is, of course, the standard jig used for cutting miters.
- Be sure to check your settings for the angle of cut.
- Attach an auxiliary fence to the miter gauge to support the workpiece near the blade.
- When cutting frame miters, angle the gauge down and away from the blade.
- This way, if the workpiece slips, it will slide away from the blade, not into it.
- A piece of sandpaper glued to the fence will help avoid slipping.
- Make certain that your gauge is cutting a true 45 degree angle, and then cut one end of each matching part.
- Measure and mark off the required length and clamp a stop onto the auxiliary fence to index the cut so matching parts are the same length.
- A picture frame jig has four parts: a flat base, two runners, a fence and clamping blocks. The base can be made of any flat 1½-in.-thick sheet stock.
- Make the runners, which attach to the bottom of the base, out of quartersawn hardwood, so seasonal movement won’t affect their fit.
- The fence of the jig is ¾-in.-thick plywood.
- Cut the corner of the fence at a right angle, and then screw it to the base.
- It won’t matter if it’s mounted a little off a true 45 degree angle as long as you always cut one piece of the miter joint on the left side of the fence and the other on the right side.
- The cuts will always be complementary and mate perfectly.
- Put on the clamping blocks last.
- You can clamp a stop block to these blocks to make cuts of uniform length.
- After cutting the miters, do yourself a favor and take some time to prepare them for gluing.
- First check your cuts to see how well your saw performed.
- There are several ways to remedy a cut that is less than smooth.

- Trim the miter with a low-angle block plane, tuned up with a freshly sharpened blade.
- Put the workpiece in a vise and take a few light passes off each mating face, but don’t change the angle.
- Check your results with a combination square.
- A disc sander outfitted with a miter-gauge jig can likewise be used to fine-tune miters.
- This jig rides in the slot in the sander table and has a plate on it cut at 90 degree but situated 45 degree to the sanding disc.
- Work on both sides of this fence to ensure that mating pieces get complementary cuts, but always work on the left side of the moving disc.
- In this way your work will always get pushed down into the supporting table.
- Take only light passes, and try to move the work past the disc so you don’t burn the wood or load up the disc in one spot.
- Before starting, double-check that the sander’s table is exactly 90 degree to the disc.
- A third technique of trimming is to utilise a shooting board.
- A stop angled 45 degree on both sides is screwed to the base.
- When used with a square-sided plane, this jig will trim the miter at 45 degree across its width and at 90 degree to its face.

Wood is made up like a bundle of straws. Crosscut or miter the end of a board, and you expose the ends of those straws, which suck up glue and starve a joint, weakening it. The faces of a miter joint should be sized by precoating them with a light wash of glue to fill the pores. Scrape off any excess glue before it dries. Despite the normal warning not to apply glue to an already glued surface, in this case sizing will strengthen the glue joint. Dry-fit and clamp each item before the final glue-up, and you’ll thank yourself later for your calm demeanor and slow heart rate. Band clamps fit around a box or a picture frame to apply even pressure to the miter joints. Practice locating and tightening the band clamp in place right over the joint. Utilise several clamps for wider glue-ups, and stagger the clamp heads so they’re not in each other’s way. You can put clamping curves over the joint to help spread the pressure. Some band clamps come with self-adjusting curves suitable for any angle; you can likewise buy aftermarket types. Again, practice with these systems before gluing. When gluing up miters with splines or keys that would interfere with a band clamp, I utilise shopmade clamping blocks clamped right onto the frame side. These blocks have a notch cut right into them where you can place another clamp to apply pressure directly across the joint. If your clamping blocks slip too much, glue a piece of sandpaper to them on the side that rests against the workpiece.

Splined miters in frames

- Reinforce miter joints by using splines or biscuits, which are inserted before the joint is glued up, or keys, which are added after glue-up.
- Which technique you utilise is determined by several factors, the most vital being aesthetic considerations.
- Do you want to conceal the strengthening for a seamless look, as with a gilded picture frame, or do you favour to emphasize it, as with face-frame keys?
- The second factor is the hardy and length of time involved.
- Through spline cuts are made along the length of the miter.
- They're most simply made on the tablesaw.
- Use a spline-cutting jig to support the workpiece at a 45 degree angle to the blade.
- Make this jig out of a straight piece of ¾-in.-thick plywood and a support piece glued and screwed on at a 45 degree angle.
- Make certain that your fasteners are higher than the tablesaw blade at its highest setting.
- With your frame piece in the jig, set the fence so that the sawkerf is centered in the thickness of the stock.
- If it's not, the faces of your frame members will not be flush.
- One way to avoid this is by having a miter jig with two fences on it for each side of the miter.
- The jig is rotated 90° to cut the spline in the adjoining workpiece.
- Set the blade height for a ¼-in.- to ⅜-in.-deep cut, but no deeper.
- Because the grain direction of a spline in a solid-wood frame has to run in the same direction as the frame members, too deep a spline cut makes for a wide and fragile spline.
- Hold or clamp the work firmly in the jig.

- Place your hands cautiously out of harm’s way and make a pass.
- Use a flat-grind blade to put a flat bottom on the cut.
- Mill up the spline material out of a contrasting wood to set off the joint.
- Using a tenoning jig, hold the board vertically and run it past the blade to trim your spline to thickness.
- Then cut the spline to length.
- If your spline doesn’t quite fit, utilise a block plane to trim it to thickness.
- Be cautious not to snap the short grain of the spline as you plane.
- You’re looking for a snug fit, not one that’s overly tight.
- Fit one side of the spline and check to see that it will let the joint close up nicely.
- Trim its end grain with a block plane, if required.
- Size the end grain of the miter, then put glue in one of the spline cuts with a thin piece of wood.
- Set the spline in place all the way down to the bottom of the groove.
- Then put glue on the rest of the joint and clamp it up.
- If the fit is a bit loose, clamp across the face of the joint as well.
- You can likewise pin this spline in place with dowels for extra strength and an supplementary design detail.
- You can likewise strengthen a miter with a biscuit joint.
- Mark the frame members across their faces with a pencil at the center of the joint or closer toward the inside corner of the joint so that the cut won’t show at the curves.
- Center the joiner in the thickness of the stock.
- Support or clamp the frame members securely, and hold the joiner tight to the miter as you cut.
- Mitered frames may likewise be reinforced after glue-up using exposed keys.
- These keys are inserted into mitered curves from the outside after cutting the appropriately sized slots.
- Slots may be cut on a tablesaw or on a router table

A keyed miter jig works great for holding a glued-up frame in place while you pass it through the sawblade. Set the blade height for the full depth of cut, and utilise a flat-grind blade if you have one. Cut each corner, holding the same face of the frame to the jig. Mill up key stock wider than the depth of the key cut. Trim the stock to thickness on the tablesaw. You should utilise a thin push stick to help you move the work safely past the blade. Utilise a handplane to trim the key exactly to thickness, then cut it longer than essential.

Fit keys in their cuts so that they're snug and only require a light tap to position them. Make sure when gluing that they fit all the way down in the key cut at both its sides. Once the keys are dry, clean them up on the bandsaw. Sight along the edge of your frame as you make the cut so you don't cut into the piece. Then handplane away from the corner in each direction to trim the key flush. If you plane toward the corner, you will tear out the tip of the key.

Face-keyed miters for frames perhaps originated when someone made a straight key cut in the incorrect spot. It was a pretty mistake. Make these cuts using the keyed miter jig on the tablesaw. Place the cut just on the outside edge of each corner on both faces of the frame. Make up key stock as before, but this time just make it conveniently thick. When gluing, make sure the keys fit down to the bottom of the cut on both sides of the joint. Put clamps across the keys to hold them in place. The final step is to plane the keys flush with the face of the frame, being cautious of the contrasting grain directions.

Chapter 14 How to cut mortises

Numerous woodworking professionals cut mortises by drilling away much of the waste with a drill press, then cleaning up what remains using a bench chisel. The technique is prevalent because it doesn't require a special machine or jig. It's a challenge, though, mainly because the chiseling procedure is slow and simply goes awry. I've been building furniture full time for more than 30 years, and I still utilise drilling and chiseling to make numerous of my mortises. But I've managed to refine the procedure to just a few steps. The tools are straightforward. After removing most of the waste using the drill press, I utilise a mortising chisel to square an end and lever away, in one shot, most of the waste. A bench chisel rapidly cleans up what's left. This technique delivers clean, precise mortises, and rapidly. Including the drill-press work, I can finish a ⅜-in.-thick by 1½-in.-wide by 1½-in.-deep mortise in about 5 to 8 minutes. As a side note, if you don't have a drill press, utilise a doweling jig and handheld drill to eliminate the waste precisely.

How to apply the bench chisel

- A bench chisel is ideal for a lot of applications, but it's not the best choice to clean up the waste after drilling a mortise.
- When driving a bench chisel with a mallet to square the end of the mortise, the chisel tends to twist.
- That's because the blade is rather thin and the edges are beveled, so there is little side support.
- Typically, you'll need to begin and stop the cut several times to keep it on track.
- And chances are it won't be as clean a cut as you'd like.
- It's likewise challenging to keep a bench chisel square when cleaning up the sides.
- So the mortise may not end up straight and smooth.
- Plus, compared to my technique, it's slow.
- The solution is a mortise chisel.
- They come in two rudimentary types: One has a blade with a rectangular cross-section, and the other has a blade with a trapezoidal cross-section.
- You want the rectangular one.

- A rectangular mortising chisel won't twist simply as you bang it with a mallet to square the end of the mortise.
- And because the curves of the chisel meet at sharp right angles, you get a shearing cut when you lever it forward.
- That means much of the sidewall waste can be eliminated in one quick motion.
- In addition, while bench chisels are typically sharpened to 25 degree, most mortising chisels are sharpened to 30 degree.
- That means the sharpened edge is less likely to fracture when levered.
- Last, mortising chisels are denser and longer than bench chisels.
- That adds stiffness and leverage, making them better suited to the forceful levering action.
- It takes just four steps to cut any mortise.
- But first, make sure your chisels are sharp.
- Keep in mind that this technique requires that the mortise and the mortising chisel are the same width.
- That means if you want a ⅜-in.-wide mortise, you need a ⅜-in.-wide mortising chisel.
- I find that three different chisel widths ¼ in., ⅜ in., and ½ in., cover nearly any mortise I need.

Layout technique

- Begin by cautiously laying out and marking the length and width of the mortise.
- Use a sharp pencil to mark the ends.
- Then utilise a marking gauge to cut the two scribe lines for the sides.
- Now, with a square and a marking knife, cut scribe lines at the mortise ends.
- The cut lines are important: When you slip the sharpened edge of the chisel into them, they align it perfectly for the beginning of the cut.

How to eliminate the waste wood

- You could eliminate all the waste with the mortise chisel, but it’s a lot faster to eliminate most of it by drilling a series of holes.
- Also, drilling makes it easier to maintain a consistent depth along the length of the mortise.
- I put the drill press to work here.
- Either a brad-point or Forstner bit works fine.
- Both of these bits let you drill overlapping holes to eliminate the maximum waste from the mortise.
- Just be sure that the bit diameter is the same as the mortise width, and position the fence cautiously so that all the holes are bored dead-center into the mortise.
- Begin by drilling the first hole at one end of the mortise, and then do the same at the other end.
- After that, drill as numerous non-overlapping holes as possible.
- Then cut overlapping holes as required to eliminate most of the remaining waste.
- With most of the waste drilled out, mark the depth of the mortise on the chisel blade.
- Place the tip of the cutting edge into the scribe line on one end with the bevel facing away from the end.
- Make sure the chisel is plumb.
- Also, with thin stock, it’s a great idea to clamp the sides of the stock at the mortise so it won’t split.
- Now, utilise the mallet to pound the chisel to the full depth.
- Keep the chisel plumb as you go.
- Once you reach the full depth, lever the chisel forward, toward the opposite end of the mortise.
- This is where the rectangular chisel pays big dividends.
- Because the chisel sides are parallel, their leading edges slice away, in one quick motion, a great portion of the waste at one end.
- Repeat the cut-and-lever technique on the opposite end.
- If the wood is hard, utilise both hands and lean into the chisel a bit.

You now have only a small triangular section of waste in the middle of the mortise. Since this is mainly a paring operation, utilise a normal, bevel-edged bench chisel. Simply begin at the top of the waste triangle and cautiously pare down to the bottom. Utilise the mortise chisel to clean up what remains.

Procedure:

- Keep the mortise at least ¾ in. away from the end of the workpiece.
- Otherwise the end-grain at the end of the mortise could blow out when you drive in the chisel.
- After marking the location with a pencil, utilise a marking gauge to scribe each side of the mortise, stopping at the pencil lines.
- To complete the layout, utilise a knife to scribe a cut line at each end of the mortise.
- With an ink marker and a square, mark the mortise depth on the blade of the chisel.
- Place the tip of the chisel into the cut line on one end of the mortise, and then utilise a mallet to drive it to the full mortise depth.
- Use a bit that matches the mortise width.
- Clamp a fence to the table to ensure that the bit drills into the center of the piece.
- After drilling a single hole in the test piece, utilise a dial caliper to make sure the hole is centered.
- With the stock against the fence, drill a hole at each end of the mortise.
- In between, drill as numerous non-overlapping holes as possible, leaving ⅛ in. between holes.
- Then drill overlapping holes, anchoring the center spur in the material between each hole to help keep the bit from drifting.
- Lever the chisel toward the opposite end of the mortise.
- As you do, the square curves of the mortise chisel shave a great part of the waste stock.
- Repeat from the other end.
- The levering trick eliminates all but a small triangle of waste.
- Bench chisel eliminates the remaining triangle.
- Elapsed chiseling time for both the mortise and bench chisels: one to two minutes.
- If keeping the chisel plumb is a issue, clamp a block of wood to

the workpiece.

- Hold the blade against the block and you can drive the chisel knowing it’s aligned perfectly.

Chapter 15 How to fit tenons using handplanes

Numerous woodworking professionals select to cut tenons with a tablesaw, thinking it will be fast and dead-on, only to get frustrated when their precise setup results in ill-fitting cheeks or misaligned shoulders. Truth is, it’s hard to cut perfect-fitting tenons using just machinery, whether a tablesaw, a router, or a bandsaw. A better approach is to cut the tenon close and dial in the fit using hand tools. But is there one that’s best for the job? To find the answer, I compared shoulder planes, rabbet block planes, fillister planes, and bullnose planes to see which one is best for trimming tenon shoulders and cheeks. All are essentially planes intended to cut into curves, leaving crisp, square edges and removing material systematically in a way that power tools cannot.

For a plane to be effective at trimming tenon cheeks and shoulders, it must have some rudimentary characteristics. First, it must be adept at cross-grain and end-grain cuts, so it should have a low cutting angle. Precision manufacturing likewise is critical, and the way the blade aligns with the body is vital for peak performance. The blade should silhouette the body precisely, projecting somewhat beyond each side and parallel with the sole to achieve the desired amount of cut. If the blade ventures excessively from the side of the plane, it will dig into and mark the joint’s side. If it doesn’t venture enough, the plane is pushed away from the corner and produces a sloping or wandering cut. The sole of the plane should be flat and the plane sides should be perfectly square to the sole. The blade should hold up to the rigors of end-grain planing. As with any handplane, the depth and lateral adjustments should be easy and should hold. Lastly, since these planes may be used in multiple positions, the body should be comfortable to grip with one or two hands.

I used all of the planes on tablesawn tenons to fine-tune the shoulders and cheeks, a job that involves tricky end-grain and cross-grain work. The stock was cherry, and the tenons were ¼ in. thick by 4 in. wide by 1¼ in. long. I judged the planes based on the test, as well as on their fit and finish and ergonomics. After all the testing, bullnose and fillister planes fell out of contention while shoulder and block rabbet planes rose to the fore. With their low cutting angle, both of these planes handle end-grain and cross-grain cuts. And they’re made for utilise with one or two hands, so you can hold them in a number of positions to handle any trimming job. I’d recommend buying a shoulder plane first, and adding a rabbet block plane later.

You may be tempted to file, sand, or chisel your way to perfect tenons. But these practices are inconsistent. Files and sandpaper tend to round over the work, especially in the corner, and it’s hard to control a chisel over a longer exterior without creating a taper. The key to achieving a piston fit is working logically. Cut the tenon on the tablesaw, and then cautiously trim the shoulders and cheeks with a shoulder plane and rabbet block plane. Shoulder planes and rabbet block planes reach into curves and eliminate material systematically in a way that power tools cannot, and they’re more precise than files, sandpaper, or chisels. With each one, the blade should venture somewhat beyond the side for best performance. If it doesn’t venture enough, the plane is pushed away from the corner and won’t eliminate stock equally. Bullnose and fillister planes are not intended to trim tenon cheeks and shoulders. The bullnose plane has too short of a nose and does not register appropriately to begin a cut. The fillister is really a joint making tool, made for cutting rabbets and raised panels. It’s not intended to be used on its side for trimming shoulders, and it’s too long to utilise with one hand, a essential trait for trimming tenons with the workpiece supported on a bench hook.

With its tall body, a shoulder plane is ideal for trimming tenon shoulders, offering great control while keeping your hands away from the work. It likewise can be used to trim tenon cheeks. Buy the biggest one you can, which can handle any size shoulder and any tenon cheek. The issue with a shoulder plane, even a large one, is that it’s not the most efficient tool for cheeks, requiring multiple overlapping passes to tackle long tenons, which could result in a tapered tenon if you’re not cautious. That job is best handled by a rabbet block plane, which has a wider blade. Though it can be used on a shoulder, its short body is a bit harder to hold on its side. Out of both, the first one I’d recommend is the large shoulder plane, because it can do both shoulders and tenons pretty simply. Ideally, though, if you can afford it, add a rabbet block plane for cheeks. With both tools you’ll be set up to trim tenons perfectly every time, rapidly and efficiently.

Chapter 16 Mortise and Tenon Joinery techniques

It’s hard to hide mistakes in through mortise-and-tenon joints. Both the tenon and the mortise are there for anyone to see. I found it tough to get crisp, chip-free mortises that were uniform and had clean, square curves. Then, recently, I came across a drawing of a straightforward bench made from 1 x 12 stock. I wanted to build several of them, but the joint that held the bench together was a wedged through mortise and tenon. The bench was an incentive. I worked on my technique and experimented with prototypes until I could cut this joint rapidly and precisely. In a through mortise and tenon, the tenon goes all the way through its mating piece and shows on the other side. Wedges are often added to spread the end of the tenon and lock the joint together. It’s a robust, eye-catching joint. I can cut the mortises by hand, but when I’m faced with making a lot of them, I like to utilise a machine. In my shop, that means using either the drill press or the router. I favour using the drill press because it’s quiet and setup is fast and precise. I can simply see the cut in progress. When I’m boring holes for a through mortise, I try to minimize tearout where the bit exits the stock. If possible, I’ll select the side where tearout will be the least noticeable; then I’ll lay out and cut the mortise from the opposite side. If tearout is unacceptable on either side, then I’ll utilise a router and a jig. For this bench, though, I decided I could live with some minor tearout on the back side because this area is fairly well-hidden.

The usual approach is to build from the inside out. Meaning, cut the tenons first, and then utilise the tenons as a template to mark the mortise locations. The issue is that you drill the mortises from the back, which virtually guarantees some tearout on the face of the piece, no matter how cautious you are. I favour the outside-in approach-cut the mortises first by drilling from the face side, and then mark the tenon locations from the mortises. To do it this way, I set up my drill press with a Forstner bit and a fence to register the workpiece. Forstner bits are best for this operation because they make such clean cuts. Just Recall that the bit diameter should be equal to or somewhat smaller than the tenon thickness. You can always enlarge a mortise that’s too narrow. To minimize tearout, I set the drill-press depth stop so that the bit just goes through the workpiece or leaves a paper-thin layer of material on the bottom of the mortise. It’s best to back up the workpiece with a clean piece of scrap. I drill the first hole at one end of the mortise. Then I nibble away the remaining waste by sliding the work face down on the fence and drilling successive holes every ¼ in. or so until I reach the other end. Toward the bottom of each hole, I slow down and utilise light pressure on the drill-press arm.

After roughing out the mortise on the drill press, I trim up those little waves on the sides and any remaining waste on the bottom of the mortise with a sharp chisel. This can be done by eye, but you'll get better results if you clamp a straight piece of ¾-in.-thick scrap across the workpiece to serve as a guide. You can utilise the guide to square up the curves by working toward the corner from one direction and then swinging the guide 90 degree and working in from the other. If you utilise a chisel to square up the curves, be sure to work in from both sides of the workpiece, or you'll tear out some really nasty chipping on the back side. The way I square up the curves is to saw them out with a small, stiff saw. I made my saw by filing teeth into the back of a carbon-steel paring knife. But you could likewise modify a wallboard saw by hammering the teeth flat, filling the sides of the blade to eliminate all set and the filing the teeth straight across like a rip saw. I lay the saw against the wooden guide clamped to the workpiece and saw to the corner of the mortise. I utilise the saw as a rough me to square out the curves.

I mark the tenon directly from the mortise using a small knife or pencil sharpened to a chisel point. Because the tenon thickness is the full stock thickness, only the width must be marked. I utilise a square to extend this line down the face of the stock and a marking gauge to scribe the tenon length. The tenon should extend completely through the mortised stock with an extra 1 /32 in. or so. This will be trimmed flush later, after the wedges have been glued in place. I bandsaw the tenons using the cutting sequence. If all goes well, the tenons will fit snugly into the mortises on the first try. This never happens for me, though, so some fitting is typically required. Filing either the mortise or the tenon typically will take care of a too tight fit. If you have some gaps, don't worry. Small shims cut from the same stock will hide them

After fitting the mortises and tenons, I cut the wedge slots in the tenons. A thin-kerf cutoff blade in a tablesaw will develop a clean slot that's about the right width. Depending on the size of the tenon and its direction in the mating stock, I utilise one or two wedges to spread the tenon and create a tight joint. Wedges should always exert pressure against the end grain of the mortise to keep the workpiece from splitting. I locate the slots. I saw the wedge material by ripping the stock, on edge, on the tablesaw. I angle the blade at 30, and adjust the fence until the point of the wedge will just fit into the kerfs I've sawed into the tenons. I cut the wedge material to length, and now I'm ready to assemble the joint. After clamping each item together, I drive the wedges home with a bit of glue on the leading edge.

Procedure:

- Back up workpiece with clean scrap; utilise a Forstner bit to eliminate most of the waste. Set depth stop so bit just cuts through stock.
- Guide chisel with a straight piece of scrap, and pare remaining waste from walls of the mortise.
- A shop made saw used like a rough file squares the curves.
- Cautiously work the saw into the corner.
- Transfer the mortise location to tenon stock.
- Use a knife or sharp pencil to mark out the tenon width.
- Extend tenon layout lines down the face of the stock with a square
- Mark the length of the tenons with a marking gauge or knife, and then cut to the line on a bandsaw.
- Wedges spread the tenon and lock the joints together.
- The wedge should exert pressure against the end grain of the mortise so it won't split the stock.
- Set the tablesaw blade tilt to 3°, and elevate blade to about 1 in.
- Set the rip fence so the wedge tip just fits the kerf in the tenon.
- The end grain of the stock should sit on the saw table.

Chapter 17 How to work with curves

My first saw was a bandsaw, so from the very beginning of my woodworking career, I found myself working with curves. If you've only been a straight-shooter until now, you'll find that curves not only open up a world of design possibilities, but they likewise offer plenty of chances to expand your repertoire of woodworking skills: from laying out eye-pleasing shapes to cutting and smoothing those shapes, or even bending them. What stops most people, nevertheless, is the prospect of cutting and fitting joinery on these curved parts. I'll describe you three practices that I've used over the years with great success. There's nothing exotic or hard about them, and once you see them in action, you'll soon be adding graceful curves to your own work.

In summary:

- Create a subtle flat as an easier landing spot.
- Make the flat stand out for a curved transition.
- For inside curves, scribe the tenon shoulders.

Procedure:

- A straightforward way to join two pieces when one of them is curved is by leaving or creating a flat area on the curved work where the mortise is to be cut.
- If you are cutting the curved piece out of square stock, it's easiest to locate and cut the mortise while the workpiece is still square.
- Then you can leave the area around the joint flat when cutting the curve.
- The tenon on the mating rail can then be cut and fitted just as for any other mortise-and-tenon joint.
- When creating the flat, be sure to extend it ⅛ in. or so beyond the rail both above and below the joint to accommodate any expansion across the width of the rail.
- When the piece is glued up, you can sand lightly to ease the transition from flat to curve, leaving about 1 /16 in. flat.
- Things get more challenging if you're cutting several identical parts from square stock.

- If you want to minimize waste, you'll need to nest the layout of the parts and cut them all out before doing anything else.
- This means you'll then have to create the flat, and cut the mortise, in an already curved part.
- To do this, I make a straightforward jig that holds the work while I create the flat spot and then cut the mortise.
- Clamp the curved piece into the jig so that the area to be flattened ventures above the jig's fence.
- Now you can create the flat spot, using a handplane to eliminate the projecting material and bring the part flush with the top of the fence.
- To utilise the jig with a router, screw on a top plate to support the router.
- Use a spiral upcut bit or a straight bit, set to cut flush with the top of the jig's fence.
- The first cut should be a clockwise pass around the area to be flattened; this is a climb cut to circumvent tearout.
- To mortise with the same setup, equip a plunge router with a fence that will ride along the back of the jig.
- Adjust the fence to locate the mortise on the thickness of the workpiece.
- Rout between the layout lines in shallow passes until you reach the desired depth.

Some designs call for seamless curves that flow from one part to the next, regardless of whether the parts themselves are curved. In these cases, don't shape the curve, or much of it anyway, on the end of the tenoned piece. The outer tips of the curved ends will consist of very fragile short-grained stock. Instead, leave a raised area on the mortised part, and form the transitional curves there. Just rough them in, and then refine the transitions after gluing the joint together. A well-known example of this technique can be seen on the leg-to-rocker joints of a rocking chair. As a side note, another excellent solution to this issue is the gunstock joint used in hall table. Here's a final point to review when using this type of joinery: It makes a lot of sense to utilise quartersawn wood for the rail. This is because, after the joint has been smoothed to seamlessly flow together, seasonal expansion and contraction of the rail across its width could create minor misalignment between the parts.

Quartersawn stock, which moves less across its width than flatsawn material, will minimize this issue.

When you're joining a tenoned part like a chair's crest rail or a table apron to a concave section of curve, it won't work to create a flat spot on the curve. A straightforward approach is to scribe the tenon shoulders on one piece to exactly match the curve of the adjoining piece. As a side note, this is another instance where a quartersawn rail is a great idea. Excessive wood movement can cause gaps to appear in a scribed joint, because expansion or contraction will essentially change the curvature of the shoulder.

How to cut the mortise and tenon

- You can utilise the jig again to cut the mortise, while you may need to utilise a curved offcut as a brace between the jig and the workpiece to help hold the work squarely when clamping.
- The real trick in this technique lies in shaping the tenon shoulders to firmly hug the curve of the mating part and create a gap-free joint.
- This procedure will be straightforwardr if, when cutting the tenon, you angle the tenon shoulder so that it generally follows the direction of the curve to which you'll be scribing.
- You can do this with a tablesaw tenoning jig, clamping the workpiece in the jig against a precut wedge.
- Cut the tenon to normal length to fit in the mortise.
- Begin the scribing procedure by inserting the tenon fully into the mortise.
- Next, utilise a marking knife to ride along the curved workpiece and scribe a line into the shoulder of the mating part.
- It's ideal if the scribed line is made with a single-bevel knife so that the straight side of the cut is toward the shoulder, this will leave a very crisp edge to pare toward.
- Facing the knife that way often will create the offset you need to transfer the full curve to the shoulder, while ultimately shortening the tenoned part as little as possible.
- But you can utilise a shim of some kind to increase the scribing offset for deeper curves.

- The paring requires a very sharp chisel with a flat back.
- Nibble a little bit away at a time, until you are just one or two paring cuts away from the scribe line.
- Now put the chisel’s edge right in the scribed line and pare down.
- The easiest way to keep the cut perfectly on your line is to make each cut after the first one with only the leading quarter of the chisel, registering the rest of the chisel against the existing shoulder.
- A gentle twist of the chisel, applying a little extra force against the existing shoulder, should keep you from inadvertently crossing the line. It likewise helps to undercut the shoulder a little.
- Just be cautious not to do that at the curves, where undercutting from one side will leave unsightly gaps on the adjacent face.
- As you trim back the shoulders, you might likewise need to trim the tenon length back so the final depth is about 1 /32 in. less than the depth of the mortise.
- This leaves room for excess glue.

Chapter 18 How to peg wood joints

I rarely cut mortises and tenons, whether in doors, leg-to-apron joints, or on breadboard ends, without pegging the joints. Driving a wood peg through a mortise and tenon not only strengthens the joint, but it likewise adds a decorative element that I've come to depend on in most of my designs. Because I lean toward joinery that is honest and exposed, using pegs makes the construction procedure transparent. If you see pegs, you can bet that they're more than ornamental, and you can tell at a glance how the piece is held together. Reinforcing a joint in this manner involves driving a hardwood peg through the mortise and tenon. Structurally, the peg strengthens the mechanical connection between mortise and tenon, often to the extent that glue isn't essential. Visually, the peg can add a subtle or bold detail to your work. Most of the time, I drive pegs into a mortise-and-tenon joint that has already been assembled. But with appropriate planning, pegs likewise can be integral to the assembly procedure, exerting their own clamping pressure. This technique, called drawbored pegging, calls for some drilling and layout work before assembly. Both practices make for bombproof joints, and the practices are rather straightforward.

Pegs can be intended to suit most furniture styles. For starters, you can make them round, square, flush, or even proud and faceted. Then there is the species of wood. Because the end grain of the pegs is exposed and will darken with an applied finish, they will offer contrast in some form. For a more subtle appearance, cut the pegs from the same primary wood you're using on the venture. To pump up the contrast, select pegs of a darker or lighter species. I often utilise walnut to add a darker accent to cherry designs. Ebony is dense and robust, and the near-black color offsets mahogany or walnut well. On occasion, especially if I want a more contemporary look, I'll utilise pegs of a lighter color: holly pegs in a mahogany door, for instance. Regardless of your design, select a dense and robust hardwood peg that is as robust as, or faster than, the material you are pegging. On a few occasions, I have pegged joints with a softer wood, but in these cases the pegs are simply a design element—not a means of strengthening the joinery.

There's more to pegging a joint than the appearance. It's likewise vital to get as robust a mechanical connection as possible. A few factors come into play here: the size, placement, and number of the pegs. Without calling in the engineers, you can determine the size of the peg by reviewing the joint you're reinforcing and the desired effect. In general, I utilise pegs between 3 /16 in. and ⅜ in. dia. That said, even smaller decorative pegs of ⅛ in. dia. would not be out of place on a delicate box, and ½- in. pegs might work better on a beefy trestle base. Position pegs so that neither the mortised nor the tenoned stock splits as the peg is driven home. You likewise may utilise multiple pegs to secure wide mortises and tenons, such as those on table apron-to leg joints. In these cases, double pegs help strengthen the joint and lend the design a more balanced appearance.

Whether you're installing round or square pegs, begin by choosing a bit that closely matches the peg size. Just make sure the bit isn't much larger than the peg stock. If you're drilling into softer stock, you can make the hole about 1/32 in. smaller than the peg stock because the primary wood will offer a little give. But you may need to whittle the bottom two-thirds of the peg to get it to fit the hole. Shoot for a snug fit, but not so tight that the peg could split either the mortised or tenoned stock. Different woods react differently, so test the fit on scrap pieces. Before gluing the mortise-and-tenon joint, transfer the mortise/tenon location around to the face of the stock and then mark out the center point of the peg locations. If you are pegging an exposed mortise and tenon, such as a bridle joint, you can mark the locations after glue-up. Simply drill at the center points all the way through the tenon and about ⅛ in. to ¼ in. beyond. On thinner stock, common on door frames, ¼ in. is not always possible. In these cases, simply drill about a third or half of the way into the opposite wall of the mortise, just make sure the back wall of the door stock isn't thinner than about ⅛ in. utilise a piece of tape attached to the bit to control the depth, and keep the drill perpendicular to the workpiece. On smaller workpieces, using a drill press guarantees perpendicular holes. If your design calls for square pegs, you'll need to square up the top third of the hole using a chisel.

Both round and square pegs need a little prep work before you drive them home. After cutting the pegs to length, they should be about ⅜ in. longer than the depth of the hole, ease the edges on the bottom of the pegs using sandpaper, a chisel, or a small knife. Doing so lets you to drive the peg into the hole without splitting or damaging any parts, and gives excess glue a place to go when you drive the pegs home. Once both hole and peg are prepped, place a small drop of glue in the hole and apply a thin layer to the lower third of the peg. To drive the peg home, utilise a small metal finishing hammer. Its light weight won't stress the stock you're pounding, and the tone of the metal hammer will deepen as the peg bottoms out in the hole. Once the peg bottoms out, stop hammering or you'll risk cracking the stock.

You can trim pegs flush, but leaving them proud of the exterior they're driven into is a great way to accentuate the joinery even more. I often leave small pegs about 1 /16 in. proud of the surface, larger ones a little more. After installation, the exposed end of the peg can be softened with sandpaper, chamfered with a chisel or plane, or, my favorite, faceted. The first few times I tried to utilise faceted pegs, I made it a lot more hard than essential.

Simply drive the peg into place as usual, and then wait for the glue to dry. To cut the pegs to a consistent size, utilise a shim whose thickness matches the desired ventureion of the peg, and register the saw against it as you trim the pegs to length. To cut the facets, utilise a chisel that's wider than the peg, and hold it bevel-side down against the exterior adjacent to the peg. Working in from one side at a time, utilise the bevel as a lever to angle the blade upward as you cut toward the center. To avoid denting or scarring the exterior you're bearing against, place a thin shim between the chisel's bevel and the exterior of the wood. You'll have the best luck if you cut each facet in a single sweep of the chisel, every time you stop to realign the chisel, you're left with a small ridge on the peg's pyramid top that will have to be cleaned up. Before working on a venture, practice the technique on a scrap peg and joint.

Procedure:

- Driving wood pegs into mortise-and-tenon joints adds strength and visual appeal to furniture.
- Typically, the joint is glued up before pegs are installed, but you don't have to wait for the glue to dry before adding pegs.
- You might want to leave the clamps on, though.
- Draw the outline of the tenon on the mortised stock.
- Locate the pegs' center points, and then define them with an awl so that the drill bit won't wander.
- You can buy dowel stock for pegs, but you'll have more design options if you make your own from hardwood scraps in your shop or from purchased pen blanks, which come in a diversity of exotic

species.

- Begin with a ¾-in.-sq. blank.
- Set the tablesaw fence and the blade height based on the size of the pegs you're cutting.
- If you're making 3 /16 -in. pegs, set the fence to 3 /16 in. but leave the blade height just shy of 3 /16 in.
- Using a push stick at the end of each cut, rip along each corner of the blank, adjusting the blade height until only a sliver holds each corner together.
- Ultimately, you'll be able to peel away the strips.
- To make round pegs, place the square strip in a V-grooved trough and plane away equal amounts of stock at the curves.
- The pegs will go in easier if you chamfer the bottom edges.
- Use a metal hammer to drive in the pegs.
- Stop when the hammer tone deepens; it means the peg has bottomed out.
- Attach a tape "flag" to the drill bit, and stop drilling when the flag knocks the chips away.
- Drill perpendicular to the workpiece to circumvent tearout.
- Set the fence to match the peg width and set the blade height to just under that measurement.
- Use a push stick at the end of each cut, and raise the blade until only a sliver of material holds the peg stock to the blank.
- Then peel away the strips.
- With the blank set in a V-grooved trough, utilise a block plane to eliminate the curves, rotating the blank as you go.
- Use a handsaw to trim the peg nearly flush.
- Place a shim under the saw to protect the workpiece.
- Dampen the peg with water, then mash it a few times with a hammer, causing the head to mushroom somewhat.
- The water softens the fibers and mashing helps spread the peg to fill any gaps.
- Pare the peg flush using a chisel.
- Rest the chisel flat on the work-surface.
- Slowly work your way around the outside of the peg and toward the middle to circumvent tearout as you finish the cut.
- Pegging the breadboard ends of a tabletop is a great way to

reinforce that joint.

- But you must allow for wood movement by elongating the outermost peg holes.
- With the breadboard ends clamped to the tabletop, drill the holes for the pegs at their marked locations.
- Again, flag the bit to gauge the drilling depth.
- Eliminate the breadboard end, utilise the drill to elongate the holes in the outer tenon, and then clean up the holes with a chisel.
- Glue the breadboard ends to the tabletop, being sure the holes in the breadboards align with the holes in the tenons.
- Clamp them in place, and tap the pegs home.
- By drilling the tenon peg holes somewhat toward the shoulder, the mortised joint will be drawn tight as the peg is driven in.
- Go through one side and partway into the other.
- Use a Forstner bit for a clean cut
- Use a combination square and a knife to offset the hole 1 /32 in. to 1 /16 in., depending on the hardness of the supplies.
- With the joint re assembled and clamped together, mark the center point of the hole.
- An easy way to do this is to insert a Forstner bit into the hole and tap lightly.
- Drill through the tenon.
- Align the tip of the Forstner bit so that it engages the offset line.
- If you need to drill multiple holes, using a fence helps ensure consistency.

Chapter 19 How to layout Dovetails

Striking a perfect blend of form and function, dovetail joints add great interest and detail while enhancing the structural integrity of a case, box, or drawer. Cutting dovetails can become second nature after plenty of practice with saw and chisel. Dovetail layout, on the other hand, is where I see students get frustrated. Here are the key steps in laying out a rudimentary through-dovetail joint, with tips on creating an eye-catching joint that is sturdy enough to last generations.

Several factors go into the design of a dovetail joint. These include the size and spacing of the tails and pins, and the slope of the tails. Most dovetail joints begin and end with a half-pin on the outside, with the rest of the space subdivided into multiple pins and tails. This creates plenty of long-grain glue surfaces as well as mechanical strength to tie the elements together. A common practice is to span the joint with pins and tails of equal proportions. While it's structurally very sound and typical of machine-cut dovetails, this joint has little design appeal. A better technique is to span the joint with tails that are larger than the pins. This is a common practice with hand-cut dovetails and likewise can be done on the bandsaw or tablesaw, as well as with the better machine-dovetail systems. I recommend sizing the half-pins on the outer edges from ¼ in. to ⅜ in. at their narrow end. Interior pins range from ⅛ in. to ¼ in. wide and can be spaced anywhere from ¾ in. to 2 in. on center, depending on the application. Last, it's vital to select an appropriate slope, or angle, for the tails. That slope is what draws the pin board up tight during assembly. More slope pulls the joint together efficiently; too little slope may require clamps or other aids to pull the joint together, much like a box or finger joint requires clamping pressure in two directions. Partly a matter of preference, the traditional ratio is 1:6 for softwoods and 1:8 for hardwoods; the reason being that the fibers of softwoods can compress more simply and therefore require a bit more angle to ensure that the pins are drawn tight to the tail board.

Layout procedure

- When laying out dovetails, utilise as few steps as possible.
- Begin by marking out the orientation of the pin and tail boards: inside and outside faces, top and bottom, front and back.

- Recall that tail boards generally make up the sides of drawers and cases, and the fronts and backs of chests; pin boards are typically the fronts and backs of drawers, tops and bottoms of cases, and ends of chests.
- With the orientation of the tail board and the pin board established, scribe the baselines on both using a marking gauge.
- Set the gauge to the exact thickness of the pin board and scribe the tail board on both faces and edges.
- Setting the gauge to the pin board's exact thickness means there are no proud pins to interfere with clamping and leaves little to trim flush after glue-up.
- After scribing the tail board, scribe the inside and outside faces of the pin board in the same way.

While some woodworking professionals will argue that it's best to lay out and cut the pins first, I favour to work the tails first for a few reasons. First, I can lay out and cut more than one tail board at a time. Second, I find it easier to align, hold, and transfer the tails to the pin board because the pin board can be held securely in a vise and the tail board can lay horizontally, simply registering on the pin-board ends. Last, any adjustments or fine-tuning during assembly will be done to the pins, and it is much easier to trim and fit the open, right-angled pins than the tight, angular confines of the tails. Clamp both tail boards in a shoulder vise so that they are 2 in. to 3 in. above the benchtop and square to it. Measure and mark the half-pins across the ends of the boards and perpendicular to the faces.

Now divide the tails based on the number that you want and the pin sizes between them. For instance, say you want four tails with 3 /16 -in.-wide pins and two ⅜-in. half-pins. Lay out the half-pins ⅜ in. from both edges, then make a mark on the end of the tail board 3 /16 in. past the half-pin mark on the right side. Then measure from that mark to the half-pin mark on the left side. Say that distance equals 6½ in. Because you want four tails, divide the 6½ in. by 4, which equals 1⅝ in. Now adjust a set of dividers with the points 1⅝ in. apart. Lay one point of the divider on the right half-pin and walk it across the board end until you pass the half-pin on the left. If your math has been done correctly, the divider should be 3 /16 in. past this mark. Now put one of the divider points on the left half-pin mark and walk back across the board end to the right.

How to mark out the tails

- The divider technique will leave a series of impressions spaced appropriately, in this case 3 /16 in. apart.
- Place a sharp pencil in each impression, slide a square up to the pencil, and square a line across the ends of the boards.
- Next, set a bevel gauge to the appropriate slope and mark the face of the tail board.
- A dovetail saddle marker can be handy here because it lets you to draw the two lines across the top and down the face rapidly and without misalignment.
- Dovetail saddle markers generally come with one of two slope ratios, 1:6 or 1:8, and are obtainable from a number of sources.
- Now you’re ready to cut the tails and eliminate the waste.
- The end-grain cuts must be absolutely perpendicular to each face of the board.
- Otherwise, during the next step the information transferred from inside the boards will not match the outside, causing issues.
- With the tails laid out, cut, and pared, secure the pin board in the shoulder vise, with its outside facing you and its end 2½ in. to 3 in. above the benchtop.
- Place the tail board with the outside face up on the end of the pin board.
- Use a spacer to keep the tail board level.
- Line up the baseline of the tail board with the inside edge of the pin board.
- If the tail’s baseline overlaps the pin board’s inner edge, the tails will be too tight.
- If the baseline is proud of the pin board’s inner face, the pins will be too small, resulting in a loose joint.
- Holding the tail board securely, utilise clamps if required-knife in the tails clearly on the pin board.
- Extend the marks perpendicularly down the pin board’s face to the baseline.
- Now you are ready to cut the pins and complete the joint.

Chapter 20 Using Dovetails on the tablesaw

It takes an awful lot of practice to cut dovetails by hand and to do it well. Your sawcuts should be straight, at a consistent angle, and square to the board's face. And you can't cut into the baseline. Later, when you're paring and attempting to make up for bad sawcuts, you can make things much worse. There are ways to cut dovetails that bypass those challenges. With a router and jig, you'll get straight and square tails and pins that have consistent angles. Unluckily, they won't look as nice as hand-cut dovetails. It's hard to redevelop the wide tails and narrow pins that make the hand-cut version so appealing. Nevertheless, there is one power tool in your shop that excels at cutting straight and square, and can simply maintain the same angled cut for both tails and pins: the tablesaw. What's more, because tablesaw blades are no more than ⅛ in. thick, you can redevelop hand-cut dovetail spacing, too. Of course, because both the tails and the pins are cut at the tablesaw, you're limited to through dovetails. That's great for case joints and the back joints on a drawer, but what about the half-blind dovetails we all utilise to join the drawer front to the sides? No issue. I have a trick that turns a through-dovetail into a half-blind, with added benefits you can't get the traditional way. But let's begin with the basics.

To cut dovetails this way, you need only your stock miter gauge and a blade. I utilise a rip blade because these are ripcuts and because it has a flat-top grind, which leaves a flat shoulder when I cut the pins, with no paring required. Nevertheless, any standard blade will leave a bit of material between tails, so you'll still have some paring to do. If you're going to cut dovetails this way all the time, get a blade with the teeth ground to match the dovetails'slope. Any saw-sharpening service can do it. Utilise it for the tails and you won't have any paring to do in the curves, either. You likewise need two L-shaped fences for the miter gauge—one for the tails and one for the pins. They should be at least twice as long as the drawer sides are wide, so the sides always have support as you move them to cut the pins and tails. After the fence is attached to the gauge and a kerf is cut into it, it's easy to align layout lines with the kerf so the blade cuts exactly where you want it to.

Procedure:

- To take advantage of the tablesaw's accuracy, you need to set it up precisely.

- Mark the tails, setting the gauge at your favorite dovetail angle.
- Then utilise the same bevelgauge setting to angle the blade to cut the tails.
- With the blade at 90°, angle the miter gauge for the pins.
- Don’t change the setting on the bevel gauge, and the pins are sure to match the tails.
- The tablesaw locks in the cutting angle and a stop block lets you to make eight cuts from a single layout line.
- So all you need to do is lay out the tails at one end of one board.
- Scribe all the boards, wrapping the marks around the edges on the tail boards.
- You can space the dovetails any way you want, but they should be symmetrical around the centerline.
- Make sure the bevel gauge’s setting hasn’t changed and that it’s flat against the blade’s plate, coming up in a gullet between teeth.
- Flip the board to make two mirror-image cuts, then rotate it end for end to make the same two cuts on the opposite end.
- When you’ve done the same with the second tail board, you’ve made eight cuts without moving the stop block.
- As you work across the board, moving the board to a new layout line and making all four cuts each time, you naturally begin to cut the second side of every tail.
- A few eyeballed cuts knock off most of the waste at the ends
- After defining all of the tails at the tablesaw, cleanup goes rapidly.
- Work to your scribe lines.
- Move the blade back to 90 degree.
- One side of every pin is cut with the miter gauge angled in one direction.
- Angle it in the other direction to cut the second side.
- Do this on all your boards.
- You can utilise a 0.5mm mechanical pencil because of its very fine line.
- You can’t see the end grain when the board is standing on the auxiliary fence, so you’ll need these lines to align the board for cutting.
- Use the bevel gauge, still set to the angle used for the tails.

- You can attach a new auxiliary fence so that the kerf for this cut doesn't overlap the one used for the tails.
- You can't flip the board this time to make a mirror-image cut on the same end, but you can invert it. Keep the same face out.
- If you do, the pin will be too narrow and you'll have gaps in the joint.
- Take advantage of the zero-clearance kerf, aligning the board so that the pencil line is right next to the kerf, but not in it.
- You can utilise through-dovetails in lots of places, but typically not drawer fronts.
- There, you want half-blind dovetails.
- But you can still utilise this dovetailing technique by gluing a thin board (⅛ in. to ¼ in. thick) to the front of the drawer box after it's glued together.
- That lets you to utilise through-dovetails for all of the joints, but still get the half-blind look.
- You get more mileage from your best lumber, which you can resaw to get book- and slip-matched fronts.
- Resawing from a denser board lets you spread a beautiful board over several drawers.
- You can utilise a caul made from melamine-covered particleboard to protect the front and help spread the pressure over the entire surface.
- Cut them off short and they'll stick into the front and avoid it from creeping under clamping pressure.
- Routing is faster than a handplane and makes it easier to keep the edge square to the face.
- Do the ends before the long edges, and utilise a pin in your router table to help you enter the cut safely.
- There's no way around it to cut the second side of the pins.
- Be sure the bevel gauge is still locked into its original setting.
- This is just like cutting the first side of the pins, apart from the board goes through the blade at a different angle.
- Most of the waste can be cut out with the fence at the second setting, but you'll need to move it back to the first setting to get all of the waste.
- After cleaning up the baseline of the pin board with a file, the joint

should come together square, without gaps, and without much persuasion.

Chapter 21 How to Miter your Dovetails

Among my favorite things about making this small dresser mirror is the joinery—two different combinations of dovetails and miters that are robust, look great, and allow me to cut molded profiles on the edges and faces of the piece.

On the case, the lap of the half-blind dovetails enables me to cut a continuous ovolo edge detail around the top. The miter at the front of the joint likewise lets me cut a molded profile on the front of the case. I wanted the same molding particulars on the edge and face of the mirror frame, and I wanted its joinery to visually echo the dovetails on the case. The joint I utilise a dovetailed through-tenon with a miter in front and a half-lap in back, is challenging but fun to execute, and the results speak for themselves. The interlocking nature of a dovetail adds strength to the miter. The square shoulders of the half-lap make it easy to square the frame and avoid the miters from slipping during glue-up.

Procedure:

- Use a marking gauge to scribe the width of each piece onto both edges of its mate. Then utilise a bevel gauge to lay out the angles on the front faces.
- Use the bevel gauge to mark the angled socket cheeks on the edge of the piece.
- For the pin, the straight lines are on the edge and the angles go on the end grain.
- For easier layout on narrow stock, you can make an adjustable jig by fitting Plexiglas into a kerf in a hardwood block and adding screws.
- A cleat on the end helps locate the jig.
- The front cheek is cut at an angle with the saw stopping just before the outside corner of the miter.
- The rear cheek is cut to the baseline.
- Clamp the stock horizontally to cut away the waste.
- Cut on the waste side of the line and pare with a chisel.
- A pair of angled cuts establishes the socket walls.
- Cautiously saw to the waste sides of your marks, and then utilise a

bandsaw or coping saw to hog out the majority of the socket.

- The remaining waste can then be cleared with a coping saw and chisel.
- With a router and fence, eliminate the extra material.
- Use a chisel to square up the tab, which will form one half of the mitered front.
- Its rear face likewise captures the half-pin behind the miter.
- Scribe a line for the tail length using a gauge setting picked up from the pin board.
- You can scribe the underside of the top all the way across, but scribe the show face only between your angled pencil lines.
- To pare the waste from the narrow sockets, you can utilise a chisel that ground to 1 /16 in. wide.
- Scribe the socket shoulders with a knife, then flip the piece in the vise and mark the vertical portion of the pins with a pencil.
- After sawing to the lines and hogging away the waste with a router, you can do a cautious final cleanup with a chisel.
- Adjust the sliding bevel to the angle between the top’s outside corner and the scribe line for the tails on the underside.
- Trim the miter.
- After sawing tight to the line with a fine saw, the paring required should be minimal.
- If all is well, you should now be able to tap the top and sides together, and you should have a tightfitting miter at the front.
- The dovetails for the case are, ordinary half-blinds.
- Nevertheless, the mitered front complicates the layout and joinery somewhat.
- To begin with, you’ll need to dimension the top piece so that it is the full length of the case, to allow for the miter at the front.
- And before laying out for the tails, you’ll need to eliminate a narrow band of stock so that the tails will come up short of the end of the case.
- On this case, the top and sides were likewise of different thicknesses.
- This meant the miter wasn’t 45 degree, requiring different bevel-gauge settings to create the mating angles.

Chapter 22 Biscuit Joint Techniques

It will never match the beauty of a dovetail or the strength of a mortise-and-tenon, but for speed, accuracy, and ease of use, it’s hard to beat the biscuit joint. Biscuit joints can be used on all wood merchandises: solid wood, plywood, medium-density fiberboard (MDF), and particleboard. For this reason, they are great for cabinetry, which typically involves a mix of solid wood and sheet goods. Biscuits are a great way to join a plywood carcase and attach an assembled face frame. They likewise help keep things aligned when gluing solid-wood edging to plywood or assembling solid boards into a wide panel.

A dedicated tool and an oddly shaped tenon combine to create a biscuit joint. At the heart of the procedure is a power tool called a biscuit joiner or a plate joiner. To make a joint, utilise the tool to cut a shallow slot in each of the mating parts. Then, after adding glue to each slot, insert a thin, football shaped biscuit into one slot. A little more than half the biscuit’s width goes into the slot; the other half sticks out. To complete the joint, just slip the mating slot onto the tenon and clamp the parts together. The biscuit joiner has just four main parts: a motor, a blade that cuts the slot, an adjustable fence that aligns some types of cut, and a base that houses the blade and likewise can align cuts. The 4-in.-dia. blade looks like a miniature tablesaw blade. Unlike a tablesaw blade, nevertheless, the biscuit-joiner blade cuts horizontally. The kerf it creates, commonly called the slot, measures about ⅛ in., just wide enough to accept standard-thickness biscuits. Thanks to a spring-loaded sliding way that connects the base and motor, you can butt the front of the base against a workpiece, begin the motor, and push it forward. The spinning blade emerges from the front of the tool to cut a shallow arc-shaped slot in the workpiece. Release the forward pressure, and the springs push the motor back to retract the spinning blade safely into the base.

The second element in this joint is the biscuit. Made from beechwood or white birch that has been thoroughly dried, biscuits are compressed by machine to a standard thickness. For maximum all-around strength, the biscuits are cut so the grain runs diagonally. When a biscuit comes into contact with moisture, it swells. So when you insert a biscuit into a gluelined slot, the biscuit expands, creating a snug fit and a tight joint. It is vital to utilise only water-based glues such as common yellow PVA glue. Biscuits won’t work with epoxy, cyanoacrylate super glue, or polyurethane glues. Biscuits come in three standard sizes, No. 0, No. 10, and No. 20. The biscuit joiner has preset depth stops that match these sizes.

When using a biscuit joiner, you have two ways; the fence or the base, to register the slot in the workpiece. Each has advantages. For extra flexibility, the adjustable fence lets you position the slot anywhere between 3 /16 in. and 1 in. from the fence. Also, you can set the fence to cut slots in angled joints. Nevertheless, if all you want to do is center a slot on ¾-in.-thick stock, it’s easier to register off the base. This is because the center of the kerf is located ⅜ in. from the bottom of the base. To create a slot in ⅜-in.-thick stock, place the base and the stock on the same flat exterior and make the cut. It’s OK if the slot isn’t exactly centered; just recall not to flip the parts when it comes time to glue them.

How to cut and assemble a biscuit joint

- With a biscuit joiner in hand, it takes just four steps to join a pair of ¾-in.-thick boards end to edge.
- This joint is useful for making light-duty door frames, especially when the panel is plywood or MDF.
- That’s because plywood and MDF don’t expand and contract with changes in humidity, so they can be glued in place to add strength to the frame.

Step 1:

- Align the boards as you want to see them joined, and utilise a single line to mark the biscuit centerline on the top face of both parts.

Step 2:

- Based on the width of the board, select the largest biscuit that it can accept.
- For the 3-in.-wide stock, No. 20 biscuits are a great choice.

Step 3:

- Cut the slots—Clamp one of the workpieces in place.
- Set the depth-adjustment knob for the No. 20 biscuit.
- Align the center-registration mark on the biscuit joiner with the biscuit-centerline mark made in step one.
- Begin the motor and, with one hand on the top handle and one hand on the motor housing, push the motor toward the stock.
- Continue cutting until you reach the stop, and then allow the spring action to return the motor to the starting point.
- Repeat the procedure to cut a slot in the second piece.

Step 4:

- Use a small brush to apply a generous coat of glue to each slot.
- Be sure to coat the sides of the slots, that's where a lot of the glue strength comes from.
- Add glue to the biscuit and insert it into one of the slots, then attach the other piece and clamp them together.
- Don't answer the phone after the biscuit has been inserted into the first slot.
- By the time you come back, it will already have swelled enough that you won't be able to insert it in the second part of the joint.
- The only thing you can do then is let the glue dry, saw away the protruding part of the biscuit, and recut the slot.

Biscuit joinery is useful in a wide range of applications, from aligning edge-glued boards to securing shelves to assembling and attaching frames, miters, and more.

Chapter 23 Joints using Dowels

In all of woodworking, no joint is as undervalued or underused as the one held together by the lowly dowel. Why? The answer lies in a mountain of broken chairs and cabinets. Decades of bad factory-made furniture have given the sturdy little peg a rickety reputation. But pros know better. Dowel joints offer a straightforward, robust way to make fine furniture, and they often succeed where other joints can't. Dowels are easy to utilise in part because they are cylindrical, meaning you can rapidly create precise holes for them using a handheld drill. As to strength, our recent joint test showed that appropriately executed dowel joints are robust enough for all but the most demanding applications. This strength means you only have to make straightforward butt joints before drilling holes. And the best news, especially for beginning woodworking professionals, is that all you need is that drill, a couple of great drill bits, and an inexpensive jig. Here are my favorite ways to utilise dowels.

Woodworking professionals often edge-glue several boards into a panel for a wide part like a door or tabletop. Dowels work well to keep the boards aligned so their surfaces stay flush. To mark out for the joinery, draw tick marks across the joints, about 6 in. or 8 in. apart. Utilise these marks to align the doweling jig for drilling. This joint's strength comes from the long, edge-grain glue surface, so the dowels don't need to be several or large. I typically utilise ⅜-in.-dia. dowels, unless the panel is less than ⅝ in. thick. Be sure to drill 1 /16 in. or so deeper than required to hold excess glue when the joint goes together. Also, when gluing any dowel joints, don't put glue on the dowel itself; the hole will scrape it off and create a mess. Instead, put glue in each hole and spread it with a small brush or stick.

Nearly any joint that calls for a mortise-and-tenon, table bases, door frames or face frames, is a candidate for dowel joinery. Because this joint relies exclusively on the dowels for strength, you need longer dowels, and more of them. A great rule for dowel size here is one-half the thickness of the workpiece, with ¾ in. or more extending into each hole. A ⅜-in.-dia., 2-in.-long dowel works great in most situations. To ensure that the holes in the mating pieces line up precisely, begin with the jig referenced along a common edge. In this case, utilise the top edge of the rail and the top of the leg, which will be flush when the pieces are assembled. Also, don't apply glue to the mating surfaces. The end grain won't add much strength and you'll get excess squeeze-out, which is best avoided.

A great dowel joint depends on a snug fit between dowel and hole. Hardware-store dowels won't do, but good, inexpensive dowels are obtainable from online woodworking suppliers. To drill precise holes, utilise a brad-point bit. Its center spur prevents the bit from wandering and enlarging the hole. To keep mating holes aligned and ensure that the holes are square to the surface, you'll need a doweling jig. Low-cost models work with dowels of ⅜-in. diameter, a great all-purpose size. For places where the jig can't go, a set of dowel centers is a smart accessory. These metal plugs fit a hole precisely and transfer its location to the mating piece.

How to hide a joint

- Furniture makers often draft an overall design for a piece first and sort out the joinery afterward.
- This lets creative freedom but can lead to situations where traditional joinery won't work.
- One example is the lower shelf on this table.
- Rest it on stretchers or cleats and it will look clunky.
- Traditional joinery would be hard to execute or visually distracting.
- Dowels offer a clean solution.
- You can utilise the jig to drill the dowel holes in the table legs, but the jig won't work on the small notched curves of the shelf.
- Instead, dry-fit the legs to the aprons, and clamp a support block to each leg so that its top is level with the shelf bottom.
- Then insert a dowel center into each hole and rest the shelf on the blocks.
- A light mallet tap on the outside of each leg will press the dowel center's point into the shelf edge, marking for the mating hole.
- Now drill the dowel hole in the shelf edge.
- Again, place glue only in the dowel holes.

Bonus Chapter How to implement moulded joints

Most commonly found on drop-leaf tables, the rule joint lets the outside leaves to be lifted to create a large, useful surface, or folded down to save space. The beauty of this molded joint is that it looks eye-catching whether open or closed, and it keeps the hinges hidden. You need to understand the mechanics of this joint in order to lay it out and cut it precisely, and blogs rarely go into enough detail. A rule joint consists of a board with a bead and a board with a cove, or cope. When the joint is closed, the two boards meet firmly and on an even plane. As the leaf is lowered, the cove rolls equally around the bead. Two or more hinges support the leaf. The secret is to place the center of the hinge barrel in line with the center of the bead. While you can create this joint with matching molding planes or shaper knives, the technique I'll explain uses two widely obtainable router bits. And construction is easy when divided into three main steps: Cut the bead, cut the matching cove, and lastly, fit the hinges.

Procedure:

- It is vital to the smooth operation of the rule joint that the boards remain flat and true, so rough-mill the boards a little oversize and allow them to rest in your shop for a week or so to make sure they are stable and don't cup or twist.
- Then mill them to final thickness, in this case ¾ in.
- I always mill a sample board to the same thickness as the tabletop and utilise it for layout and test cuts all the way through the procedure to ensure the rule joint fits appropriately.
- This makes me confident that each item will work when I begin cutting my valuable tabletop.
- The rule joint revolves around the barrel of the hinge, so begin laying out the joint by setting a marking gauge to the distance from the flat side of a drop-leaf hinge to the center of its barrel.
- The grain of the tabletop and the drop leaf runs parallel to the rule joint, so the layout is done on the end grain.
- Scribe a line along the end grain of the sample board, registering off the bottom edge of the board.
- Make sure you lay out the end of the board that will contact the

router bit first on the router table.

- I used a ⅜-in. radius half-round or bullnose bit to cut the bead, so I set a compass to this distance.
- Put one point of the compass on the scribe line and the other where this line reaches the edge of the board.
- Now draw an arc of about 180° whose apex just touches the edge of the board.
- Use a knife and a square to mark a line perpendicular to the scribed line at the location of the compass point away from the edge of the board.
- You now have established the location of the hinge and the profile of the bead.
- I utilise a full half-round bit rather than a quarter-round beading bit because the half-round bit will cut a return past the centerline.
- If this is not cut, the bottom edge will bind as the leaf drops and the cope of the drop leaf will not roll equally.
- You’ll likewise need a ¾-in. diameter core-box or round-nose bit, which should nest perfectly with the half-round bit.
- With the half-round bit mounted in a router table, utilise the sample board to set the correct height of the bit and then gradually move the fence back to sneak up on the exact line of the bead.
- Once set, clamp a hold-down board to the fence, and make the cut to both sides of the fixed part of the tabletop.
- With a sharp bit, you can do this simply in one pass.
- Depending on the thickness of the board, you may be left with a thin strip of wood attached to the fillet.
- Cut this away on the tablesaw and clean up the edge with sandpaper wrapped around a block, using a light touch.
- With the bead side complete, the next step is to cut the matching coves on the leaves.
- To get the approximate location of the cove, I butt the beaded board against the uncut side of the sample board and trace the bead onto the end of the board.
- Eliminate the bulk of the waste with a ¼-in.-wide dado blade on the tablesaw, staying away from the traced line.
- This will avoid the core-box bit from having to make too large of a cut in a single pass.

- Set up the router table with the ¾-in.-dia. core-box bit.
- Use your sample board to make a trial cut just below the outline you drew.
- Now check the fit of cove to bead, and raise the height of the bit accordingly.
- The cut should develop a cove that perfectly matches the bead when the boards are mated on a flat surface.
- When set up, I take a secondary fence and align it parallel to the primary fence with the sample board as a spacer.
- This fence acts like a featherboard to keep the leaf tight to the fence, ensuring a smooth, consistent cut.
- With the beads and coves cut, you can move on to the hinges.

How to locate and fit the hinges

- Locating and installing the hinges is the most critical part of the procedure.
- The first step is to determine the number of hinges.
- For smaller pieces such as a Pembroke table, I utilise two hinges.
- For large tables or a dining-room table, I would utilise up to four.
- Set a marking gauge to the width from the edge of the bead to the vertical line you drew during layout.
- Now take the actual tabletop, and scribe a line along the underside of the bead to mark the centerline of the hinges.
- Clamp the top and a leaf together, face down.
- Now place the hinge upside down with the barrel in line with the scribe mark.
- Using a knife, outline the location of the hinge across both boards.
- Set up a router with a ¼-in. straight bit and adjust the depth of cut to the thickness of the hinge leaf.
- Separate the boards and rout away the waste, staying away from the knifed line.
- Then clean up the walls with a chisel.
- To make room for the hinge barrel, I utilise an 8 carving gouge to create a round-bottomed trench.
- You likewise could utilise chisels to create a straight-sided recess.
- Set the hinge in the mortise to check that no part of the hinge

ventures above the bottom exterior of either board.

- Fasten the hinge with appropriate screws and swing the leaf to check the fit.
- You may have to sand the surfaces very lightly, but that should be the limit to your fine-tuning.
- While this joint takes patience, you'll see the reward on your next table, whether the leaves are open or closed.

Procedure:

- The joint revolves around the barrel of a special drop-leaf hinge.
- When the leaf is raised, it should be flush with the tabletop.
- When lowered, there should be no gap between the parts.
- For the two halves of the rule joint to meet without a gap, it is critical that the radii of these two router bits match exactly.
- Because the joint revolves around the center of the hinge's barrel, you need to mark this location.
- Set a marking gauge to the distance from the flat side of the hinge to the center of the barrel, and scratch a line on the end of the sample board that will enter the router bit first.
- Set a compass to equal the radius of the half-round bit you'll be using, in this case ⅜ in.
- Place one point on the edge of the board and the other on the center-point line created in step one.
- Draw an arc of about 180°.
- Drop a line at right-angles to the center point.
- This gives the location of the fillet, or straight section above the bead.
- The shaded area is eliminated on the router table to leave the beaded half.
- Using the layout on the end of the sample board, set the half-round bit to the correct height.
- Make the first pass with the fence somewhat forward, and then ease it back until the bead is cut perfectly
- Now that the router has been set up using the sample board, clamp a hold-down board to the fence of the router table and cut the bead on both sides of the fixed tabletop.

- Because only a small amount of wood is being eliminated, you can cut each bead in one pass.
- If a thin strip of wood is left attached to the top of the fillet, cut it off on the tablesaw and cautiously sand it flush.
- Butt the tabletop to a fresh edge of the sample board with the fillet in line with that uncut edge.
- Transfer the outline of the bead.
- Use dado blades to cut away the bulk of the waste in what will become the cove.
- Align the sample board with the round-nose bit, but make the first cut with the bit somewhat too low
- After the first cut, the bead and cove should nest perfectly, but the coved sample board should still sit a little higher than the beaded board.
- Sneak up on the cut until the two boards are level.
- Once the sample board is right, clamp a second fence to the router table so that the wide leaves won't wobble as they pass the router bit
- A regular hinge with its barrel in the middle won't work for this type of joint. Instead you need a drop-leaf hinge with sides of different lengths.
- The short side is attached to the beaded board, while the longer side is attached to the drop leaf so that the underside swings under the beaded board.
- Set a marking gauge to the distance from the edge of the bead to the vertical line below the fillet.
- This marks the center of the hinge barrel.
- Scratch a line where the hinges will be centered.
- Then clamp the drop leaf to the tabletop, and locate the hinge upside down straddling the joint, with the barrel centered on the scribed line.
- Mark the outline deeply with a knife.
- The drop-leaf hinge should sit flat with the barrel facing up.
- If the leaves rise up as they approach the barrel, the hinge may not work appropriately.
- Set the depth of a straight bit to match the thickness of a hinge's leaf.

- Clean up the recess alter routing away the bulk of the waste.
- Use a chisel to square up the sides of the hinge recess.
- Hold one leaf firmly in a vise and utilise a block of wood and a hammer to gently straighten the leaf.
- Use a carving gouge or a chisel to cut a trench for the barrel of the hinge.
- Use full-threaded screws to attach the hinge to the tabletop and the drop leaf.
- Check that the two surfaces of the rule joint remain parallel throughout the movement with no binding or unsightly gaps.
- A bit of sanding smooths out the action.

Conclusion

Thank you for finishing this book. Hope it was useful and able to provide you with a great knowledge base you will need to achieve your objectives whatever they may be.

Woodworking can be an extremely satisfying and possibly even life-changing interest! Producing artwork with wood can lead to skills you never knew you could have and maybe even fatten your wallet, and who wouldn't love that?

Woodworking has been around since the beginning and is still a privileged skill. The best thing is to learn new skills that can transfer over to several facets of life. Plus, woodworking is as timeless as we are. The next step is to pick out a field you may want to try out. Contemplate the time you have to spend per venture, the amount of funds you have to commit, and the work space you have or can build. Begin with the basics, and slowly build your skill set with repetition. Have fun and try new practices or tools whenever you can. You won't regret learning this noble skill.

Lastly, if you found this book valuable in anyway, a review is always appreciated!