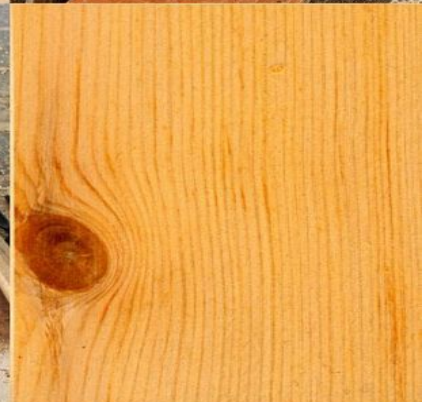
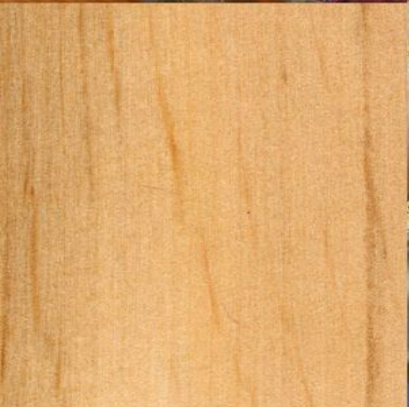


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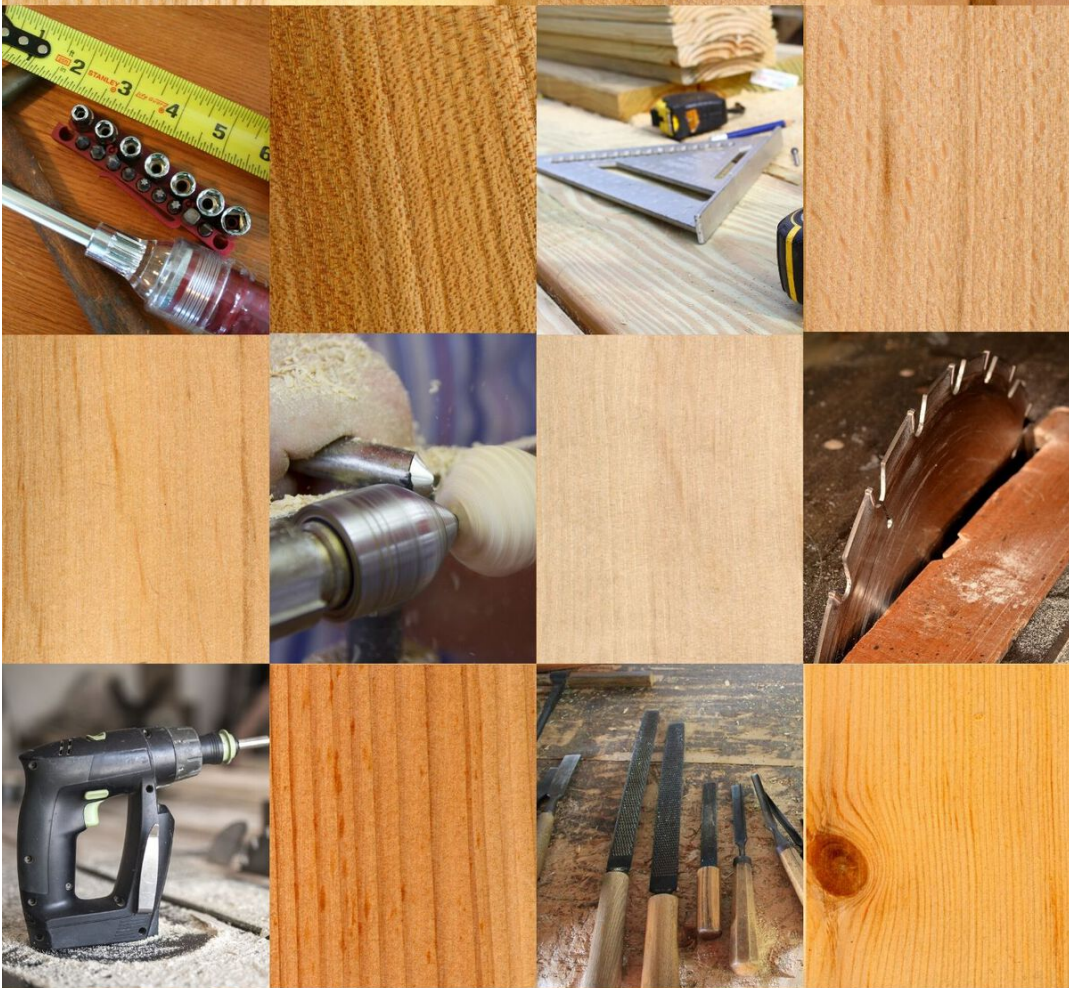
WOODWORKING FOR BEGINNERS



WOODWORKING TOOLS & ACCESSORIES

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Woodworking Tools & Accessories

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Introduction

If you are new to woodworking, you may be wondering where to begin. 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 patience and a measure of skill, but in the procedure, you'll learn all about grain direction, accurate layout, and the importance of sharp tools.

As you learn to cut and fit a dovetail joint or cautiously shape the sensual curves of a table leg, the hand tools will create textures and surfaces that distinctly say, "Handmade."

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. First, we are going to start looking into some safety tips for beginners.

Next, you will learn how to use the Circular saw, how to eliminate and install Circular saw blades, how to perform basic cuts and crosscutting. After that, you will learn how to use an electric drill, how to use spade bits and Hole saw, and how to Drill a dowel joint.

Next, we are going to look at Sanding and Scraping and how to use a drum sander. After that, we are going to look at working with a router, how to adjust a standard router, how to make a stopped groove, how to use a standard router, how to work with a plunge router, and how to joint with a router table.

Next, you will learn how to use a Saber Saw, how to install and square the blade, how to make an interior cut, and how to do repeated curved cuts. Moving on, you will learn how to use a Sander, Orbital sander, Plate Joiner, how to add a shelf to a carcass, and how to join bevelled corners.

Next, we are going to look at Edge Tools, Measuring and marking tools, Sharpening Tools, Honing Tools and how to sharpen chisels & scrapers. Then, you will learn about Planing Techniques, Scraping Techniques, Sanding Techniques, Patching Techniques and Graining Techniques.

After that, we are going to look at how to use a random-orbit sander on curved surfaces, and how to repair damaged surfaces. Lastly, we are going to cover how to change the Wood colour, Bleaching Techniques, Wood Stains Variations, Dye Stains, Pigment Stains, how to stain wood, how to pickle a wood surface, how to Apply Compound Stain, and how to use a fuming tent.

There are many more topics we will cover in this book, and hope this summary will get you excited on reading this book. If you are ready, let's begin by looking at some safety tips that you should be aware.

Chapter 1 Safety Tips for Beginners

Without the appropriate safety gear and precautions, short-term exposure to these solvents can outcome in irritation to the skin, eyes, and throat, as well as dizziness, headache, nausea and shortness of breath.

Longer-term exposure poses more potential risks; some effects may not be apparent until you have used the substances for months or even years. In addition to the health risks, most of these solvents are flammable.

Some oil-derived merchandise like linseed oil can catch fire spontaneously at room temperature if it's not sufficiently concentrated. When vaporized in a small enough concentration of air, a small quantity of lacquer thinner can cause a life-threatening explosion.

All this is not to suggest that working with finishing merchandises has to be dangerous-only that it can be if you take a cavalier attitude towards the risks. If you spray finishes, consider buying a spray booth or constructing a spray room of your own.

As most of the harm from organic solvents come from inhalation, wear a dual-cartridge respirator, mainly if you are spraying or will be exposed to fumes for more than an hour.

To prevent eye injury, wear satiety goggles, and rubber gloves when working with caustic or toxic finishing merchandises. Whenever possible, select a product that combines the finish you want with low volatility and toxicity.

Work with the windows open, and use a certified spark-profane to keep the air moving. This will help prevent the fumes in your work area from reaching a toxic or flammable level.

If you have drowsiness, fatigue, headache, blurred vision, weakness, numbness, irritation of the eyes, skin or throat, shortness of breath, or a loss of coordination while finishing, stop immediately and leave the work area until the symptoms clear. Afterward, ventilate the work area thoroughly fully and use a different finishing product.

Wear appropriate safety tools: safety glasses, a face or dust mask if you are using sanding accessories, and heading protector when you are operating tools for an extended period of time.

- Clamp all work pieces secure wherever possible to keep both hands free to operate the tools.
- Be aware of the position of the power cord at all times.
- Make all adjustments to the tools with the tool unplugged.
- Maintain and clean tools averagely.
- Keep all blades and bits sharp, clean and undamaged.
- Check periodically for loose parts and frayed cords.
- Never carry a connected tool with your finger on the trigger.
- Tie back long hair.
- Roll-up sleeves, and avoid wearing loose clothing.
- Eliminate rings and other jewellery that can be caught accidentally in moving parts.
- Do not over-reach.
- Keep your 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, as clutter can lead to accidents.
- Keep children 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 using any medication that induces drowsiness.
- Do not eat, drink or smoke while working with wood.
- Keep finishing merchandises away from children.
- Avoid exposure to organic solvents if you are pregnant or breast-feeding.
- Install at least one smoke detector on the ceiling of your shop above potential fire hazards; keep a fully charged ABC fire extinguisher nearby.
- Never store solvents or compounds in unmarked containers.
- Compound solutions should always be stored in dark glass jars to shield them from light, which may change their composition.
- Do not flush used solvents down the drain.
- Consult the Yellow Pages to find out who handles compound disposal in your area, or check with your local fire department.

Few tools that you should have in hand are as follows

Dual-cartridge respirator

Use when spraying a finish or working with compounds; interchangeable filters and cartridge protect against specific hazards. Cartridges purify air contaminated with toxins as they are inhaled, then expel them through exhalation valve; filter prevents inhalation of dust.

Rubber apron

Provides protection when working with a wood bleach or compound stain.

Safety goggles

Use when spraying a finish; vented goggles prevent finishing fumes from irritating the eyes.

Neoprene rubber gloves

Use to protect the skin when spraying or mixing caustic finishing merchandises; snug-fitting surgeon's gloves are suitable for most other finishing tasks.

Class ABC fire extinguisher

This is required for putting out a small fire in the shop.

Steel waste disposal container

For temporary safe disposal of solvent-soaked rags; dampen rags with water first.

Spraying any finishing material develops potentially toxic or flammable vapours, or both. Even the fumes coming out from spraying water-based resins with lower organic solvent counts can be hazardous, unless they are properly ventilated.

A spray booth makes spraying cleaner and safer, reducing health hazards by containing the overspray and fumes by filtering and exhausting them. There

are different models intended for different spraying applications.

They range in size from a complete room to small room is differ, especially if space is a priority in your workshop or if you only spray small pieces of furniture.

Since of the toxic and volatile nature of most finishing merchandises, all spray booths must meet Occupational Safety and Health Association guidelines In many states.

For example spraying wood is illegal in urban areas unless you have a properly built spray room. Further topics on finishing wood will be discussed later, but for now, let's late a look at the Circular saw.

Chapter 2 How to use the Circular saw

Traditionally thought of as only a carpenter's tool, the circular saw has earned a vital place in the woodworking shop. It is the ideal cutting tool for reducing large panels or long boards to a manageable size.

Accordingly, the circular saw is frequently the first tool woodworkers reach for when they are working with heavy or unwieldy stock. Imagine trying to rip a 4-by-8 panel of $\frac{3}{4}$ inch plywood in half on a radial arm saw or crosscutting 10-foot-long planks of 2-by-6 hardwood into 24-inch lengths on a table saw.

Both cuts are certainly feasible, but in the time that it would take to set the cuts and wrestle the wood onto the saw table, the circular saw could have already done the job.

The only limitation is that you have to expect its cuts to be rather inaccurate, compared to the precise outcomes that a well-tuned stationary saw can deliver. Nevertheless, in the first stages of a woodworking venture, you are usually only cutting stock to rough length and width.

It is only later, when the pieces have been decreased to a workable size that you will cut to their final dimensions. Still, do not think of the circular saw as strictly a rough cut off tool.

With a plywood blade on its arbour, the saw can make quick work of crosscutting a plywood or hardboard panel without splintering the edges. An edge guide will make a big difference, improving the accuracy of both rip cuts and crosscuts.

Shop-made jigs and accessories will also help guide the saw for miter and taper cuts, and most saws have a built-in adjustment that tilts the base plate for bevel cuts.

If you wish to make dadoes or grooves, a circular saw can cut away most of the waste in less time than it would take to install a dado head on a table or radial arm saw.

The job can then be completed with a chisel. Portable power saws can also make plunge cuts, an operation beyond the scope of any stationary saw. Circular saws are designated according to their blade diameter.

Models range from 4 to 16 inches, but the 7¼ and 8¼ inch sizes are the most popular home workshop saws. Some woodworkers prefer the smaller 5¼ and 6-inch saws.

Apart from being less expensive than the larger models, these compact tools are lightweight and easy to use. They also usually have the blade on the left-hand side of the motor, making the cutting line easier to see.

Power is another factor that differentiates one model from another. The larger the motor, the longer a circular saw will cut without stalling or overheating; If you plan to use the tool principally on hardwood, a saw with a higher horsepower or ampere rating is perhaps your best bet.

There are approximately 75 million portable circular saws in the United States. They vary widely in their design, but all models share certain common features; most vitally, they are powered by a motor connected to an arbor assembly that turns a blade counter clockwise.

Depending on the height or angle of the base plate relative to the blade, a saw can be set to cut stock of different thicknesses at a diversity of angles between 45 degree and 90 degree.

When shopping for a circular saw, keep numerous factors in mind. Most tools range in horsepower from 0.5 to 2.5 horsepower. Get a saw with at least 1 horsepower.

For the sake of convenience, the tool should have a comfortable handle and a balanced design. Ensure that the depth of-cut and bevel settings are easy to adjust and that the saw has a large, stable base plate with both a long straight edge and a precise tilting mechanism.

For safety's sake, select a saw that features a lock-off switch that must be depressed along with the trigger to turn on the tool. This will prevent accidental starting of the motor.

There are two main designs obtainable for setting a circular saw's depth of cut. On pivot-foot saw is a tool swivels up or down from a point at the front of the base plate. The angle of the handle changes with the depth of cut.

On drop foot saws, the motor and blade housings are raised or lowered straight up or down relative to the base plate. The angle of the handle remains continuous, and this feature many users find convenient.

Safety Tips

- Avoid steadying a work piece by hand or propping it on your knee; always clamp stock to a work surface or sawhorses. If the blade binds during a cut, kickback can hurl the work piece back toward you unless it is securely supported.
- To keep a panel from sagging in the middle and causing the blade to bind, support it all along its length on a platform of 2-by-4s.
- Unplug the saw before changing the blade or making any other adjustments.
- Do not use the saw if either blade guard is missing or damaged; keep the tool clean to ensure that the guards endure in good working order.
- Do not use a saw with parts that are loose or damaged.
- Keep the power cord out of the saw's cutting path.
- Maintain a comfortable, balanced stance when cutting; avoid overreaching.
- Always wear safety glasses when operating the saw; since it cuts on the upstroke, the blade develops a shower of wood chips.
- Keep your hands away from the underside of the base plate when the blade is spinning; whenever possible; keep both hands on the saw throughout a cutting operation.
- Ensure the blade is not in contact with the work piece when you turn on the saw. Allow the blade to come to full speed before feeding it into the stock.
- Do not force the saw through a cut; allow the blade to cut at its own speed.
- If the blade binds during a cut, do not lift the saw out of the kerf. First, turn the saw off, back the blade up slowly and allow it to stop spinning.
- Ensure that the lower blade guard springs back over the blade at the end of a cut before setting the saw down.
- Do not attempt to cut through nails; this can cause kickback and ruin a blade.

With the dozens of specialty blades on the market it is entirely possible to transform a circular saw from a job site workhorse into a precision cutting tool.

Equipped with a standard combination blade and ones intended to cut specific materials, a saw can crosscut and rip accurately through hardwood, softwood or produced panels such as plywood.

The cutting ability of a circular saw blade depends on numerous factors. A blade's hook angle, which determines how much bite it will take, is a key variable. The angle is formed by the intersection of one line drawn from the tip of a tooth to the centre of the arbor hole and one drawn parallel to the tooth's face.

The width of the kerf that the cutting edge creates is also vital so too is the number of Teeth Per Inch (TPI). A 40 TPI crosscut blade will do its job more slowly than a 20 TPI combination blade for example, but the finer toothed model will develop a cleaner cut.

While all these blade versions are obtainable in high-speed steel, carbide-tipped models has for years been the first choice of the majority of woodworkers.

While they are more expensive than their steel counterparts, carbide-tipped blades are more economical in the long run. The small tips of carbide alloy welded onto the bodies of these blades can be sharpened dozens of times and hold their edge up to 50 times longer than steel blades.

But even carbide-tipped blades dull with extended use. Smoking, burning, off-line cutting and frequent binding are all signs of a blade in need of sharpening. A great way to keep a blade sharp is to select the right one for the material you are cutting and to avoid cutting into fasteners or accumulations of pitch.

Chapter 3 How to eliminate and install Circular saw blades

Unplug the saw, and then set it on its side on a work surface with the blade housing facing up. Retract the lower blade guard and grip 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. 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. Hold the blade with the rag, and use the wrench to give the nut an additional quarter turn. Avoid over tightening

Instead of buying a kerf splitter, you can simply make your own. Select 1/8 inch hardboard for the splitter piece and 3/4 inch plywood for the shoulders, and fasten the three pieces together with screws.

To use the jig, start the cut, turn off the saw, then insert the splitter in the kerf a few inches behind the saw. Pull the saw back to some extent and continue the operation. For particularly long cuts, keep a few kerf splitters on hand, and slip them into the kerf at 2 to 3 foot intervals.

How to align the blade with the base plate

After pulling the plug, set the saw upside down on a work surface with the blade at its maximum cutting depth. Retract the lower blade guard, and then butt the two sides of a try square against the base plate and the blade between two teeth.

The square should fit flush against the blade. If there is a gap between the two, loosen the bevel adjustment knob and tilt the base plate until it touches the square, then tighten the knob.

How to adjust blade height

With the saw unplugged, retract the lower blade guard and set the base plate on the work piece, butting the blade against the edge of the stock. When cutting through a work piece, set the blade to clear the stock by about $\frac{1}{4}$ inch.

For most blades, one tooth and at least part of the adjoining gullets should project a work piece; but if not, a sawdust will fail to clear the kerf, causing burning. For a pivot-foot saw, release the depth adjustment lever.

Then, keeping the base plate flat on the work piece, hold the handle and pivot the saw up or down until the blade reaches the correct depth. Tighten the lever.

For a drop-foot model, loosen the depth adjustment knob, then hold the base plate steady as you pull up or press down on the handle. When you have the blade at the depth you need, tighten the knob.

Chapter 4 How to perform basic cuts

Whether you are crosscutting a narrow board or ripping a sheet of plywood, always protect yourself from kickback by clamping stock to a work surface before cutting it with a circular saw.

When applying the clamps, protect the surfaces of the work piece with wood pads. Other safeguards include keeping saw blades clean, setting the cutting depth no deeper than you need, and making sure that the stock you are cutting is dry and free of any fasteners.

To get accurate outcomes, cut with the blade to the waste side of the cutting line. Edge guides can also improve precision. While commercial guides are obtainable in various sizes and at a wide range of prices, a straight board clamped to your work piece will serve just as well for most jobs.

Since circular saw blades cut on the upstroke, splintering occurs on the visible face of a work piece. Get in the habit of cutting your stock good face down. If you are working with hardwood or veneered plywood, which has two good faces, score the cutting line with a utility knife before making the cut.

How to cut stock to length

Clamp the work piece to sawhorses. Align the blade with the cutting line, and then clamp a straightedge guide to the work piece flush against the saw's base plate.

The guide should be longer than the width of the work piece and square to the edges of the stock. Take care also to set up the clamps so that they will not interfere with the motor as you make the cut.

Turn on the saw with the base plate flush against the guide and the blade clear of the stock. Then, gripping the handles firmly with both hands, feed the saw steadily into the work piece.

Chapter 5 Crosscutting jig

Simple to make, the shop-built jig will ensure that your crosscuts are square to the edges of the stock. Select $\frac{1}{2}$ inch plywood for the edge guide and $\frac{3}{4}$ inch plywood for the fence.

The dimensions of the jig depend on the width of the stock you will be cutting and the width of your saw's base plate.

Make the edge guide at least as long as the width of your work piece and wide enough to clamp to the board without getting in the way of the saw as you are making the cut.

The fence should be about 4 inches wide and longer than the combined width of the edge guide and the base plate of the saw. Screw the two parts of the jig together, checking with a try square to ensure that they are perfectly vertical.

To use the jig, clamp it to the work piece as you would for a standard crosscut making sure the blade is held in alignment with the cutting mark on the work piece.

The fence should always be kept flush against the edge of the work piece. Run the saw along the edge guide to make the cut.

The first use of the jig will immediately trim the end of the fence flush with the blade. For subsequent cuts, clamp the jig to the work piece, aligning the end of the fence with the cutting mark on your stock.

How to cut a long work piece to width

Install a commercial edge guide on the saw, and then align the blade with the cutting line on the board. Butt the edge guide's fence against the edge of the work piece, and then lock it in place.

Holding the saw firmly, feed the blade into the board, keeping the edge guide fence flush against the stock. To prevent the blade from binding in a long work piece, turn off the saw a few inches into the cut and insert a kerf splitter. Pull the saw back a bit, then turn it on and continue the cut.

How to cut thick stock

To crosscut stock denser than the maximum blade depth of your saw, make intersecting cuts from opposite sides of the work piece. First, mark a cutting line on one face of the stock, then use a try square to extend the line around the other three faces.

Set the work piece on sawhorses and clamp it in position. Align the blade with the cutting line, then butt an edge guide against the saw's base plate and clamp it to the work piece.

Set the cutting depth at to some extent more than one-half the thickness of the stock, and then make the cut. Flip the work piece over, reposition the clamps and the edge guide, and then complete the cut.

How to cut large panels

To prevent a panel from sagging in the middle during a cut and causing the blade to bind, support the stock on a platform of sawhorses 2-by-4. Ensure that two of the boards will be about 3 inches on either side of the cutting line.

Position the panel on the 2-by-4s and clamp it in place. For extra accuracy, clamp a straightedge guide to the panel. Aligning the blade with the cutting line, cut slowly and steadily while guiding the saw with both hands. Insert kerf splitters as you go to keep the blade from binding.

Chapter 6 How to do crosscutting

Set enough 2-by-4s face up on the shop floor to support the panel at 12-inch intervals; the boards should be a few feet longer than the width of the panel. Position the stock on the boards, shifting two of them to rest about 3 inches on either side of the cutting line.

To make the cut, drop to one knee and align the blade with the cutting mark. Gripping the saw with both hands, cut steadily while cautiously maintaining your balance. As much as possible, keep your weight on the 2-by-4 immediately to the side of the cutting line, rather than on the panel itself.

The shop-built straightedge guide makes it easy to rip produced panels like plywood with great accuracy. Make the base from $\frac{1}{4}$ inch plywood; use $\frac{3}{4}$ inch plywood for the edge strip.

Glue the strip parallel to the base, offsetting its edge about 4 inches in from one edge of the base. Trim the base to its appropriate width for your saw by butting the tool's base plate against the jig's edge strip and cutting along the base.

To use the jig, make a cutting mark on the panel, then clamp the stock to a platform of 2-by-4s resting sturdily over the sawhorses. Clamp the guide to the panel, aligning the trimmed edge of the base with the mark on the work piece.

Make the cut as you would a standard rip cut, keeping the saw's base plate flush against the edge strip throughout the operation.

How to use a guide to cut miters

Clamp the work piece to sawhorses, and then set a protractor guide or a miter guide to the angle you wish to cut. Align the saw blade with the cutting line on the work piece.

Place the protractor on the stock, holding its guiding edge against the saw's base plate and its fence against the edge of the work piece. Grasp the saw and the guide firmly while you are making the cut.

How to make a bevel cut

Loosen the bevel adjustment knob on the saw and set the blade to the desired angle, then tighten the knob. Clamp the work piece to sawhorses, making sure that nothing will be in the way of the blade during the cut.

Align the blade with the cutting mark, then butt an edge guide flush against the saw's base plate. Clamp the guide to the board. Make the cut as you would a standard crosscut, holding the saw firmly with both hands and keeping the base plate flat on the work piece.

How to cut a taper

Set the stock on a work surface with the cutting line extending numerous inches off the edge. Position the work piece so that you will be able to start the cut at the end of the board, rather than on its edge.

Line up the blade with the cutting mark, then clamp an edge guide on top of the stock flush against the saw's base plate; measure if necessary to ensure that the guide is parallel to the line.

Make the cut as you would a standard rip cut. Keep a firm hold on the saw, especially near the end of the cut, when the waste section supporting the tool becomes progressively narrower.

Guide to miter and crosscutting

For a multipurpose edge guide that is helpful in making either 45 degree miter cuts or crosscuts, try the jig. It can be made from a piece of $\frac{3}{4}$ inch plywood.

Cut a triangle with one 90 degree angle and two 45 degree angles, but to make a jig for 30 degree or 60 degree angles, the sides should be 12, 16 and 20 inches - or any other variation with a 3-4-5 ratio.

Screw the fences to the base, one on each side, opposite one of the 45 degree angles. The fences must be flush with the edge of the jig base. To use the jig for a miter cut, first clamp the work piece to sawhorses.

Then align the blade of the saw with the cutting line on the stock and butt the long side of the jig against the saw's base plate. The fence on the bottom of the guide will need to be flush against the work piece.

Clamp the jig in place, and make the cut as you would a standard miter. Keep the saw flush against the jig throughout the operation. To make a crosscut, use the other side of the jig as your guide.

How to perform advanced cuts

A little ingenuity-along with the appropriate jigs and setups-can greatly expand the versatility of a circular saw. While the tool is not a substitute for a table saw or radial arm saw, it can do much more than simple dimensioning of stock.

When it is inconvenient to use a larger stationary saw you can call on your portable tool to cut some of the joints for cabinetmaking ventures, for instance.

Dadoes, rabbets and miters can be formed with precision approaching that of a stationary saw for cleaner outcomes and less tear out, use a fine-tooth blade when performing such tasks.

While the circular saw may not always cut wood as rapidly as the table saw or radial arm saw, the tool's portability allows it to work in places that are off limits to the stationary machines.

The saw can plunge into the middle of a panel, for example, cutting a rectangular hole out of it while leaving the edges intact. You can also saw arcs or circles by making a series of tangent cuts.

1 - Cutting kerfs within the dado outline

- Mark the width of the dado on the face of the stock, and then clamp it to a work surface.
- Mark a depth line on the edge of the work piece as a reference point and set the cutting depth of the blade appropriately for the dado you are making.
- Align the blade with one of the width marks and clamp an edge guide in place to keep the saw from cutting beyond that mark.
- Repeat for the other side of the dado.

- Gripping the saw firmly, ride the base plate along one guide to cut an edge of the dado.
- Then run the saw along the second support to cut the channel's other edge.
- To eliminate as much waste as possible, saw a number of kerfs between the two cuts, working at roughly 1/8 inch intervals.

2 - Chiseling out the waste

- Holding a wood chisel at a slight angle, strike the handle with a wooden mallet to split off the ridges between the edges of the dado.
- Ensure that the beveled side of the chisel is facing up.
- After the bulk of the waste has been eliminated, pare away at the bottom of the dado until it is smooth and even.

How to make a plunge cut

1 - Biting into the stock

- Clamp the work piece to sawhorses and align the blade with one of the cutting lines.
- Then clamp an edge guide to the work piece flush against the base plate of the saw.
- Make the guide longer than the cutting mark and high enough to guide the saw when it is tilted up.
- Retracting the lower blade guard with one hand and gripping the handle firmly with the other, rest the toe of the base plate on the work piece and pivot the saw forward to raise the blade completely clear of the stock.
- With the back of the blade directly above the start of the cutting line, turn on the saw and slowly lower the cutting edge into the stock, keeping the base plate flush against the edge guide.
- Once the saw is flat on the work piece. Release the blade guard and push the tool forward.
- When the blade reaches the end of the cutting line, turn off the saw, let the blade stop, and pivot the tool forward to lift it out of the kerf.
- Make plunge cuts along the three remaining cutting lines, repositioning the edge guide as necessary.

2 - Completing the plunge cut

- Since of its circular blade, a portable power saw will leave a small amount of waste at the beginning and end of each plunge cut.
- Square the corners with a saber saw or a hand saw, making sure that you keep the blade vertical as you cut.

Chapter 7 How to use an electric drill

Despite the fact that it is capable of one basic action rotating whatever is clutched in its jaws-the electric drill is perhaps the most frequently used portable power tool in a woodworker's shop. The better-quality models are suited for more than simply boring holes; they are true multipurpose tools.

You can rely on your drill to make precise holes, ranging in size from tiny 1/32 inch incisions to 4 inch cavities cut with a hole saw. With a stop collar or shop-made depth guide fastened to the bit, you have the ability to precisely control the depth of the hole you are making.

Certain specialized bits for the power drill let you control the shape of the hole as well. A counterbore bit, for example, makes three sizes of holes in a single operation: one as a pilot hole for a screw tip, a little larger opening for the screw shank, and a hole is large enough for a wood plug to conceal the head of the screw.

Other accessories greatly expand the portable drills capabilities. Depending on the attachment, a drill can drive screws and nails; shape, sand and scrape wood surfaces; and power a grinding wheel for sharpening bits.

Attached to a guide, the tool gains enough stability to cut wood plugs, a task that would be difficult to perform well with a hand-held drill. Mounted in a stand, the drill becomes a stationary tool, freeing your hands to manipulate the work piece.

A stand will also give your drill a level of precision approaching that of a drill press. Portable drills are classified according to the maximum bit shank diameter that can be fitted into their chucks. The most common home workshop sizes are 1/4, 3/8 and 1/2 inch drills.

A system of gears between a drill's chuck and motor rotates the chuck at a certain speed and with a certain amount of torque, or twisting force. Depending on the job at hand, either drill speed or torque will be the crucial factor.

Higher speeds are required for small diameter holes and for jobs like sanding or scraping; higher torque will help out when you are making larger holes. In general, the higher a drill's maximum speed, the less torque it can generate. A typical 1/4 inch drill rated at 3 amps can develop speeds up to

4000 rpm, but it will lack the necessary power for boring larger holes in hardwood.

A ½ inch hammer drill rated at 4.5 amps develops enough torque to punch a hole in concrete, but the tool will not run faster than 850 rpm, insufficient to spin a sanding disk rapidly enough for smoothing wood.

Between the two extremes is the 3/8 inch drill. With typical speeds as high as 1200 rpm and ample torque, it is considered an all-purpose drill for most woodworkers.

While all electric drills operate essentially the same way, woodworkers frequently keep numerous different models on hand to take care of any drilling operation.

For most applications, a corded 3/8 inch variable speed, reversible drill is the finest choice. A ¼ inch drill also has its special uses. While it lacks the power and bit capacity of a larger drill, a ¼ inch model can generate more rpm, enabling it to bore cleaner small diameter holes.

A third choice of many woodworkers is the cordless drill. Early models frequently sacrificed power for portability, but more recent versions have solved this issue and can develop enough torque for most drilling jobs.

A common feature is an adjustable slip-clutch mechanism, intended to make driving and removing screws easy and precise. The clutch allows the bit to spin only as fast as the screw turns; when the screw stops rotating so too does the bit.

This prevents the bit from stripping the screw head or slipping off the screw and possibly marring the work piece. For maximum flexibility, many cordless drills offer a range of slip-clutch settings.

Whatever the type or size of a drill, there are numerous other features you should keep in mind. A reversing switch is essential for removing screws; it can also be useful for withdrawing a bit that is stuck in a hole.

A chuck key that can be stored on the drill or the power cord is a small but significant convenience. For prolonged operations such as sanding or scraping, ensure that your drill has a locking switch that will keep the motor running without requiring that the trigger switch be depressed.

Safety tips:

- Always wear safety glasses when operating a drill; also put on a dust mask if you are using a sanding or scraping accessory.
- Do not use the drill if any of its parts is loose or damaged; inspect your drill bits and accessories before drilling.
- Keep all cords clear of the cutting area.
- Disconnect the drill from its power source before changing a bit or accessory, or making any other adjustments to the tool.
- Keep your hands away from the underside of a work piece when the bit is cutting into it.
- When installing a bit, ensure that you insert it fully into the chuck.
- Do not tighten the chuck by hand; insert the chuck key in each of the three holes in the chuck to tighten.
- Eliminate the chuck key after installing a bit or accessory.
- Keep the drill's air vents clear of sawdust to avoid overheating the motor.
- Avoid steadying a work piece by hand; clamp your stock to a work surface whenever possible to keep both your hands free to operate the tool.
- Maintain a comfortable, balanced stance when operating the drill; avoid over-reaching.
- Do not force the drill; allow it to bore at its own speed, withdrawing the bit from the hole periodically to clear out the waste if necessary.
- Do not wear loose fitting clothing or jewellery. They can be caught by a spinning bit.

Your electric drill's versatility is limited only by the range of bits and accessories you accumulate in the shop. With the appropriate attachment in its chuck, the drill can be an ideal tool for a great many jobs, making it invaluable at many stages of a venture.

A flap sander and a stand, for example, transform the drill into a stationary tool for smoothing wood. With a rotary rasp, the tool can shape decorative contours.

A right angle head or a flexible shaft will get a bit into tight spots. Once the job is done, a bit sharpener will restore sharp cutting edges to ensure that you bore cleanly drilled holes.

Nevertheless, bits are likely to be the accessories you use most. There is a wide array of these implements is obtainable, from twist and brad-point bits for boring holes of different diameters and depths to counterbore bits for drilling recessed screw holes.

The popular twist bit bores holes from 1/32 to 1/2 inch in diameter. Initially intended for drilling into metal, twist bits have a tendency to skate on a surface before penetrating it. You can improve their performance by punching a starting hole in your work piece with an awl before boring a hole.

Most woodworkers prefer brad-point bits. Obtainable with either carbon steel, high-speed steel or carbide-tipped cutting edges, the sharpened centre point of a brad-point bit allows accurate positioning.

Better-quality bits feature two spurs on the perimeter that score the circumference of the hole before the chipping bevels clear away the stock. Twist bits, nevertheless, are a better choice for angled holes.

While drill bits are virtually maintenance-free, remember that they will only work properly for as long as they are kept sharp. Boring a hole into a piece of wood may seem like a simple task.

But when you consider that some wood species are harder to penetrate than others, and that holes for woodworking ventures from time to time need to be drilled at precise angles and to exact depths, it becomes clear that this deceptively easy operation holds the potential for error.

Precision is as vital in drilling as in any other phase of a venture. A dowel hole that is off-centre or too deep, or a pocket hole drilled at the wrong angle, can mar a venture as badly as an inaccurate saw cut or a poorly applied finish. For most operations, accuracy begins with the appropriate setup.

While you can depend on a steady hand to bore a perfectly straight hole, there is a wide diversity of commercial guides to ensure that your drill bit will not wander off-line.

A couple of simple shop-made jigs make it easy to drill both straight and angled holes. If you are using a twist bit, punch a starting hole for the bit with an awl.

To prevent splintering as the bit exits from a work piece, clamp a support board between the stock and the work surface. For the best outcomes, avoid starting a hole with the drill running at full speed.

Instead, begin slowly, and then gradually increase the speed as you drill. Control the depth of a hole by installing a commercial stop collar on the bit or using the shop-made alternative.

A try square or a shop-made block will help you keep a drill bit perpendicular to a work piece when you bore a hole. To use the square, line up its handle with the mark for the hole, with the blade pointing up.

Centering the bit over the mark, align it with the blade and bore the hole. Be sure to keep the bit parallel to the square throughout the operation. To make the guide block, cut a 90 degree angle wedge out of one corner of a board.

Center the bit over the mark, then butt the notched corner of the guide block against it. Clamp the block in place. Keeping the bit flush against the corner of the block, bore the hole.

Set a sliding bevel to the appropriate angle, then line up its handle beside the point where you need the hole. Center the bit over the mark, then bore the hole, keeping the bit parallel to the blade while you drill.

Chapter 8 How to use spade bits and hole saws

Drill holes up to 1½ inches in diameter with a spade bit; for wider holes, use a hole saw. In either case, punch a starting hole in the work piece with an awl. For the spade bit, put the centerpoint in the indentation left by the awl.

Holding the tool steady, bore the hole. If you are using a hole saw, install an auxiliary handle whenever possible to give the drill more stability. In any case, center the pilot bit over the starting point, and holding the drill with both hands, start drilling slowly.

Increase the speed gradually, feeding with only enough pressure to keep the bit cutting into the wood. To bore a hole that is deeper than your bit is long, make intersecting holes from opposite ends of the work piece.

Begin by punching starting holes at the same point on both ends of the stock. Then secure the work piece in a hand screw and clamp it to a work surface with one of the starting points facing up.

Centering the bit over the mark and bore a hole to some extent more than halfway through the stock. Flip the work piece over and clamp it in position. Center the bit over the other starting point and complete the drilling operation.

To widen a hole that has already been bored by a brad-point or a spade bit, you will need a solid surface to brace the centerpoint of the bit against. First plug the hole by tapping a dowel into it.

Use a dowel the same diameter as the hole for a snug fit and ensure that it is flush with the surface of the work piece. Mark the center of the dowel, then install the appropriate bit in the drill and bore the wider hole.

To bore a row of equally spaced holes, use a hole-drilling template made in the shop from ¼ inch plywood. The dimensions of the jig will depend on the size of your work piece. To make the template, mark a line on the plywood to align the holes, and then drill at the spacing you require.

Cut a piece of 1-by-1 stock to the same length as the base and rout a ½ inch-deep, ¼ inch-wide groove along one edge. Glue the 1 by-1 to the base to serve as a fence.

Set your work piece on a support board, and then clamp the template to the stock with the fence flush against its edge. Use the holes in the template to guide the bit into the work piece.

Driving a screw into hardwood without predrilling the hole risks splitting the work piece or breaking off the head of the screw. Depending on how deeply you need to sink the screw, you may have to bore up to four overlapping holes of different diameters, one inside the next.

If you want the screw head to sit on the surface of the wood, bore a pilot hole for the threads and a clearance hole for the shank. For the finest grip, a pilot hole should be to some extent smaller than the threads of the screw.

To set the head flush with the surface, bore a countersinking hole. If you wish to conceal the screw under a wood plug, add a counterbore hole. There are two ways to bore holes for screws. You can use a different bit for each hole or bore them simultaneously with a counterbore bit.

To screw two pieces of stock together, fit your drill with a counterbore bit of a size appropriate to the size of your hardware. Such a bit will bore a pilot hole and has a stop collar that slides up and down to adjust it for making either counterbore or countersinking holes.

Clamp the work pieces one atop the other on a work surface, and then bore the hole. If you will be using a screwdriver to install the screw, coat the threads with the surface, bore a countersinking hole.

Thanks to their variable speed and reversible motors, electric drills are ideal for driving or removing screws rapidly with a minimum of effort. To screw two pieces of stock together, fit your drill with a counterbore bit of a size appropriate to the size of your hardware.

Such a bit will bore a pilot hole and has a stop collar that slides up and down to adjust it for making either counterbore or countersinking holes. To use the drill, install a screwdriver bit and set the screw in the hole by hand.

For a slotted head screw, slip a short length of copper tubing around it to prevent the bit from slipping off the head and marring the stock. Fit the bit into the screw head and apply light pressure as you slowly start the drill; gradually increase the feed pressure and drill speed as the screw takes hold.

How to use a plug cutter

Fit your drill into a commercial guide following the manufacturer's instructions. You must eliminate the chuck from the drill; attach the center spindle of the guide to the tool, then replace the chuck on the spindle.

Next, install a plug cutter in the chuck and slip the spindle onto the guide rods. Adjust the cutting depth with the locking collar. Keeping the guide steady on the work piece, raise the tool to hold the cutter just above the stock.

Turn on the power and push the drill down to feed the cutter into the wood. Release the pressure when the center spindle hits the locking collar. Free the plug from the stock with a chisel.

The portable electric drill may not be the first tool that springs to mind when you think of joinery. Only the most innovative woodworker would contemplate using the tool to make a dovetail or finger joint, for example.

Nevertheless, for any technique of joinery requiring a cavity cut to an exact depth, the drill is a workable choice. It is especially practical for mortise-and-tenon and dowel joints.

For the mortise-and-tenon, the tool will rough out a mortise, while you will need to square the corners with a chisel. A stop collar or a depth guide will guarantee that the bottom of the cavity will be even and level.

A brad-point bit will develop the finest outcomes. Select one with a diameter equal to the width of the mortise outline, rather than relying on overlapping cuts with a smaller bit.

Most woodworkers prefer to cut the tenon first and then use it to mark the dimensions of the mortise. A drill can perform all the steps required to prepare stock for a dowel joint.

The key to an accurate point is to center the dowel holes on the work piece; otherwise, the two pieces being joined will be out of alignment.

Center your bit on the edge of a work piece with a commercial doweling jig or build your own center-drilling device.

How to cut a mortise

Clamp the work piece in hand screws, and then secure the stock to a work surface with the mortise outline facing up. Mark a line through the center of

the outline to help you align the bit.

Install a stop collar and adjust the drilling depth to correspond to the length of the tenon. With the bit directly over the centerline, bore a hole at each end of the mortise outline; hold the drill with both hands to keep the tool perpendicular to the edge of the stock.

Chapter 9 How to Drill a dowel joint

1 - Boring the dowel holes

- Secure one of the boards to be joined with hand screws as you would when drilling a mortise.
- Clamp a doweling jig onto the edge of the work piece.
- To avoid splitting the boards, use grooved dowels that are no more than half the thickness of the stock.
- Fit your drill with a bit the same diameter as the dowels, then install a stop collar to mark the drilling depth, which should be to some extent more than half the length of the dowels.
- Slide the bushing carrier along the jig and insert the appropriate bushing in the hole through which you are planning to drill.
- The bushing ensures that the bit is kept perfectly square to the board.
- Holding the drill firmly bore the hole.
- Make the remaining holes for the dowels.

2 – Gluing up the boards

- Apply a thin bead of glue and spread it evenly along the edges that will be joined.
- Also dab a small amount of adhesive in the bottom of each dowel hole: a pencil can be useful in getting the glue in the holes.
- Avoid spreading glue directly on the dowels; they absorb moisture rapidly and will swell, making them difficult to fit into their holes.
- Insert the dowels, and then tap them into final position with a mallet.
- Avoid pounding, which can cause a board to split.
- Close up the joint, then use bar clamps to hold the pieces in place until the glue is dry.
- To bore holes that are centered on the surface of a board, use the shop made center-drilling jig.
- Use a straight piece of 1-by-1 stock for the jig arm.

- You can make such a device any length you select, but cutting it to the length described allows it to accommodate even the widest stock used in a typical venture.
- Mark the center of the top face of the arm and bore a hole through it for a guide bushing.
- The hole should be 1/8 inch larger in diameter than the bushing, which should be to some extent larger than the holes you wish to make with the jig.
- Press the bushing into place.
- Next, turn the arm over and mark a line down the middle.
- Mark points on the line $\frac{3}{4}$ inch from each end, then bore holes halfway through the stock at these points, making them large enough to hold a $\frac{3}{8}$ inch grooved dowel.
- Dab some glue into the holes and insert the dowels.
- To use the jig, position it on the stock and pivot the arm until the dowels are up against the opposite edges of the work piece.
- Holding the jig with one hand fit the drill bit into the bushing and bore the hole.
- For a hole centered on the edge of a board, first secure the work piece edge-up in a vise.
- Then position the jig on the edge of the stock with the dowels flush against its opposite faces.

Chapter 10 Sanding and Scraping

Coupled with a sanding drum, flap sander, or rasp, your drill can perform many tasks, from smoothing stock to shaping contoured edges. You can bring the drill to the job or, if you prefer to feed the stock into the tool, mount the drill in a stand, transforming it into a stationary sander.

If you are holding the tool by hand, ensure that you clamp the stock to a work surface to keep it steady during the sanding operation. Sanding drums are ideal for smoothing curved edges.

Frequently sold in sets, the drums typically consist of replaceable sanding sleeves that fit tightly around solid rubber ones, ranging in diameter from ½ inch to 3 inches.

Flap sanders are made up of abrasive strips with pliable brush backing that can be forced into corners and small openings. Unscoored strips are best for flat surfaces, while scored strips work well on contours.

Whichever sanding accessory you insert in your drill, use a fast drill speed along with a light feed pressure. The finer the grit of the abrasive, the faster the drill speed should be.

For quick stock removal, use a rotary or disk rasp. The type or shape of rasp you select will depend on the job at hand. Cylindrical rasps are ideal for forming edges and corners, while conical rasps work great in tight spots. Disk rasps are for use on flat surfaces.

As with sanding drums, rasps should be applied only with light feed pressure. Too much force will cause a build-up of heat, possibly burning the surface of the stock and clogging the teeth of the rasp.

Chapter 11 How to use a drum sander

Holding the drill parallel to the surface to be sanded, turn on the power and move the sanding drum from left to right while applying light pressure. To develop a more even finish and prolong the life of the sanding sleeve, reverse the direction of the drill's motor midway through the operation; finish the job sanding from right to left.

For a work piece that is awkward to clamp down, you may prefer to use a commercial drill stand. Screw the stand to a plywood base, and then attach the drill.

Lock the motor in the On position, then feed the stock across the sleeve against the direction of drum rotation. Once again, switch the direction of the motor at some point during the procedure.

To use your drill as a stationary sander, construct a sanding disk table for your tool from $\frac{3}{4}$ inch plywood. The table will allow you to feed stock into the rotating abrasive surface in a controlled fashion, keeping the work piece square to the tool.

Cut a notch in the edge of the jig top that will sit nearest the sanding disk. Temporarily affix the drill stand to the base, then mount the tool in the stand and install the disk in the drill chuck.

Trim the two sides so that the upper surface of the table top sits just above the level of the washer on the disk. Screw the sides to the top; if you wish to conceal the screws, counterbore them and cover their heads with wood plugs.

Screw the sides to the base. Position the stand so that the disk will rotate freely within the notch in the top, and then screw the stand to the base. Before beginning to sand, bolt or clamp the table to a work surface.

Lock the motor in the On position, and then feed the work piece at a uniform speed across the disk, working against the direction of drill rotation. Avoid burning or gouging the wood by feeding the stock with one smooth, continuous motion.

To even out wear of the sanding disk, reverse the direction of the drill motor midway through the operation, and feed the stock from the other side of the table.

How to work with a rotary rasp

A rotary rasp is an effective tool for roughing out decorative curves along the edges of a work piece. To cut a tight curve, hold the drill with both hands and apply moderate pressure to the surface until the rasp cuts the shape you need.

To rough out a gentle curve, press more lightly and move the rasp along the wood surface, proceeding opposite the direction of drill rotation. If you want to eliminate stock more rapidly than a sander will permit, use a disk rasp.

With a firm grip on the drill, hold the tool perpendicular to the surface, applying only enough pressure to allow the rasp teeth to cut into the wood.

Too much pressure may cause the desk to bite too deeply into the wood, stalling the drill motor. Move the tool across the surface following the grain of the wood.

If your workshop does not include a drill press, and you have no immediate plans to buy one, mounting your portable tool in a drill press stand can provide some of the capabilities of the stationary tool.

Naturally, such a compromise solution cannot rival the real thing when it comes to precision and versatility. Depending on your needs, nevertheless, a drill press stand may serve you just fine, and you will perhaps find that it allows you to do some jobs much better than if you had been holding the drilling your hand.

With the added stability afforded by the stand, you can install a small-diameter Forstner bit in the drill and develop perfectly perpendicular, flat-bottomed holes. Most stands include a depth adjustment feature, useful if you want to bore a uniform series of holes.

In selecting a stand, keep in mind that some models can accommodate any make of drill while others will only accept certain varieties. For convenience and maximum stability, bolt your drill press stand to a base of $\frac{3}{4}$ inch plywood, then clamp the base to a work surface.

How to drill with a commercial stand

Install a bit in the drill and mount the tool in the stand following the manufacturer's instructions. Set your stock on the table of the stand and align the drilling mark directly under the bit before clamping the work piece in place.

If you are boring a stopped hole, set the drilling depth. Lock the motor in the On position, then rotate the feed lever steadily to feed the bit into the work piece.

Chapter 12 Working with a router

Comprising little more than a base plate and a motor that spins a cutting edge, the router's simplicity belies its versatility. Unlike other portable power tools, the router has no stationary counterpart that can outperform it.

As such, the router is a must-have tool for most woodworkers; some claim that it is the single most vital shop tool invention of the twentieth century. The earliest model, developed during the First World War, featured a cutter created from the worm gear of an electric barber's clipper.

Within 10 years, more than 100,000 "Electric Hand Shapers" had been developed. Shaping the edge of a work piece with a decorative profile is perhaps the router's most common task.

It can do the job as reliably on a circular work piece as on a straight board. The great number of bits obtainable—from rabbet and chamfering cutters to corner round and beading bits allows you to create dozens of distinctive profiles.

There are also a number of accessories intended to keep the cut consistent from the beginning of a pass to the end. For straight cuts, an edge guide keeps the bit from veering off the cutting path.

For shaping the circumference of a circle, or cutting out a circle, special guides will hold the bit a uniform distance from the center, ensuring perfect outcomes. Both versions of guides can be purchased, but you can also make them in the shop.

Mounting the router in a table transforms it into a stationary tool and frees your hands for feeding stock into the bit. You can also install certain bits in a table-mounted router that offer profiles you cannot use when operating the router by hand.

A table also makes the router an excellent tool for cutting joints, including the tongue-and-groove and the sliding dovetail. But with one of the many commercial jigs on the market, you can develop accurate mortise-and tenon joints and dovetail joints with a hand-held router.

Despite the various design differences, all routers fall into two basic categories; standard and plunge models. The main difference between them

has to do with the way the bit bites into the wood at the beginning of a stopped-groove cut.

The base plate of a standard router must be held at an angle to the surface so that the bit can be lowered gradually into the wood.

The plunge router can be held flat on the surface before the cut since the entire motor assembly, along with the bit, is mounted above the base on spring loaded columns. Downward pressure on the handles feeds the bit into the wood.

While all routers are intended to spin bits, no two makes or models share exactly the same features or design. Some of the differences, such as the place of the On/off switch, are strictly a matter of convenience or personal preference; other variations determine the kind of work you can perform with the tool.

The collets of many smaller routers only accept bits with $\frac{1}{4}$ inch-diameter shanks. Larger models can also accommodate $\frac{3}{8}$ - or $\frac{1}{2}$ inch cutters. Tool power and bit capacity typically go hand in hand.

Smaller routers start at $\frac{1}{2}$ horsepower, while manufacturers claim as much as 3 horsepower for some larger models. Greater power enables a router to turn larger bits and make deeper cuts, so it is worth buying a tool with at least 1 horsepower.

Many routers feature variable speed control, which enables you to match the bit speed to the job at hand. Depending on the model, you can set the speed at levels between 8,000 and 24,000 rpm.

Slow speeds are great for deep cuts such as when you are using a panel-raising bit; very high speeds come in handy for jobs such as trimming laminate. In general, high speed will develop a cleaner cut.

It's one drawback is the increased risk of burning. While some routers include a plunge base that can be added to the standard machine, you can also buy a tool precisely intended for plunge routing.

Pressing down on the handles plunges the bit directly into the stock-ideal if you have to start a cut in the middle of a work piece.

Safety Tips:

- Keep router bits clean and sharp; replace any damaged cutters.
- Unplug the router before changing a bit.
- Wear safety glasses and a dust mask for cutting operations.
- Always clamp stock to a work surface for hand-held routing; do not use your hands to support a work piece unless the router is mounted in a table.
- Switch the router off before plugging it in.
- Grip the router firmly when switching it on; the start-up torque, or twisting power of the tool, can make it difficult to control at the start of a cut.
- Allow the motor to reach full speed before feeding the cutter into the work piece.
- Do not attempt to make a deep cut in a single pass; make two or more passes at intermediate depths.
- Keep your hands away from the underside of the work piece when the router is operating.
- Do not touch a bit immediately after using the router; the cutting edge can become very hot.
- Turn off the router as soon as a pass is completed; do not set the tool down until the bit has stopped spinning.

Fitted with the right bit for the job at hand, a router can cut anything from a rabbet to an intricate molded edge. The selection of cutters obtainable today is very broad.

Some tool and hardware catalogues boast page after page of router bits, with scores of different profiles-each obtainable in numerous cutting diameters. No matter what kind of cut you have in mind, you can almost always find the appropriate bit.

Standard bits for portable routers consist of a steel body with one or more cutting surfaces and a shank that fits into the collet. Cutters for this tool are generally obtainable in two materials: high-speed steel or HSS and high-speed steel with carbide cutting edges.

While carbide-tipped bits are more expensive, they stay sharp longer and cut more simply through tough materials. One drawback, nevertheless, is that they tend to chip if they strike a hard surface.

Router bits fall into two categories; those for shaping edges and those for cutting grooves. As their name implies, edge-forming bits are used to cut decorative profiles into stock or prepare board edges for joinery.

These bits generally have a pilot located below the cutter to ride along the edge of the work piece and guide the bit. Ball-bearing pilots are preferable to fixed pilots since they do not generate heat from friction and thus will not cause burns or compression marks on your stock.

Grooving bits are used for making dados. If the dado will not run to the edge of the stock, a plunge router is the finest choice. Your router's performance will benefit from appropriate storage and cautious maintenance of your bits. Use a clean cloth to wipe off dust and dirt.

Protect bits from damage in a simple to make holder. Keep the edges sharp and avoid using cutters that are dirty, rusted or damaged. Be sure to unplug the tool whenever you change a bit.

How to eliminate and install bits

Set the router upside down on a work surface and loosen the clamp screw to eliminate the base plate. Change bits using the two wrenches supplied with the machine.

To eliminate a cutter, hold the shaft steady with one wrench and loosen the collet with the other tool. For extra leverage, position the wrenches so that you can squeeze them together.

Pull the bit out of the collet; if it is stuck, gently tap the collet with the wrench. Do not strike the bit or try to extract it from the collet with pliers; this may damage the cutting edge.

Before installing a new bit, clean any sawdust from the collet. Insert the replacement all the way into the collet, and then raise it about 1/16 inches. Then retighten the collet.

Chapter 13 How to adjust a standard router

Set the router on the work piece. Loosen the clamp screw with one hand and rotate the motor to raise or lower it, also raising or lowering the bit. For the straight bit, align its tip with the depth line, and then tighten the clamp screw.

An alternative technique is to set the router upside down on a work surface, loosen the clamp screw and rotate the base plate until the bit protrudes by the amount you want.

How to adjust a plunge router

Set the router on the work piece and rotate the turret stop to position the shortest stop screw directly under the depth stop bar. Loosen the clamp screw to release the bar and seat it on the turret screw.

Then loosen the plunge lock knob and push the motor down until the bit contacts the work piece. Tighten the knob and raise the stop bar until the gap between it and the turret stop screw equals the depth of cut.

Tighten the depth stop clamp screw and loosen the plunge lock knob, allowing the motor and bit to spring back up. When you plunge the bit into the stock, it will penetrate until the bar contacts the turret stop screw.

For deep cuts, it is generally preferable to reach your final depth in stages. You can set the height of the other two turret stop screws to make passes at intermediate depths: loosen the nut with a wrench and then raise or lower the screw with a screwdriver.

Since the development of the portable router, an entire segment of the power tool industry has burgeoned. The purpose of the new activity is to design accessories that widen the router's usefulness and enhance its capabilities. Some of these merchandises, like the foot switch, make the router more convenient to use.

The switch is especially hand with routers whose on/off controls are not close to the handles. If you use such a device, be sure to disconnect it from

the tool when you are changing a bit or performing any other maintenance operation. This will prevent accidental start-up of the motor.

The edge and circle guide enables a router to cut grooves a set distance in from the work piece edge, rout a molding or follow the contours of curves. The jig also can be used to keep a router bit a uniform distance from the center of a work piece, ensuring accurate circle cuts.

The dovetail jig is one of numerous accessories intended to make the router a key part of the joint-making procedure. This model features adjustable fingers that allow you to create your own dovetail pattern by varying the widths and spacing of the pins and tails.

Whether you are carving a decorative molding into a work piece or preparing boards for a joint, shaping edges will perhaps be one of your most common uses of the router.

The manner in which you guide the bit along the stock depends on the type of cutter you are using. With piloted bits, the pilot rides along the edge, keeping penetration of the cutting edges continuous.

With non-piloted bits, the router base plate runs along an edge guide clamped to the work piece, achieving the same outcome. Either technique will work on a straight edge, but for a curved cut you will need a piloted bit.

One note of caution: Kickback can occur at any time until the pilot contacts the stock, so maintain a firm grasp on the router. For any routing operation, be aware of the feed direction.

It should generally be counter to the direction of bit rotation. Before starting a cut, clamp your stock to a work surface and ensure that the clamps will not get in the way of the router.

How to feed the router

Moving the router in the wrong direction can make the tool difficult to control, outcompeting in kickback and tear out. For most operations, guide the bit into a work piece against the direction of bit rotation: this will tend to pull the bit into the wood.

On an outside edge, move the router in a counter clockwise direction; on an inside edge feed the tool clockwise. Start with cuts that are against the grain; this way, you will be able to eliminate any tear out with the cuts along the grain that follow.

Position yourself so that you can pull the router toward you, rather than having to push it: this will enable you to see the bit at all times. Throughout the operation, maintain a firm hold on the tool and apply moderate pressure to keep the bit biting into the wood.

How to route with a piloted bit

Clamp your stock to a work surface with the edge you want to shape extending off the table by numerous inches. Holding the router with both hands, rest its base plate on the work piece at one end with the bit clear of the wood and turn on the tool.

Ease the bit into the stock until the pilot contacts the edge, keeping the base plate flat on the work piece. For deep cuts, make two or more passes to reach your final dent on a curved cut the router bit will round off any inside corners along the edge of the work piece, square these corners with a chisel.

How to use a non-piloted bit

To prepare for the cut, install a commercial edge guide on the router. Set the tool upside down on a work surface and insert the rods of the guide into the predrilled holes in the router base plate.

Hold a scrap board on the bit to help you position the guide for the width of cut, then butt its fence against the board. Tighten the screws in the router base plate to fix the guide in position. To make the cut, clamp your stock to the work surface.

Then, keeping the guide fence flush against the edge you wish to shape, start the cut at one end of the work piece and feed the router along the board

edge until you reach the other end.

How to cut with a piloted bit

Set your stock on a work surface and mark lines for the beginning and end of the stopped rabbet on the edge you wish to cut. Align the rabbetting bit with one of the marks and clamp a board as a stop block to the work piece flush against the router base plate.

Then line up the bit with the other mark and clamp another stop guide in place. Gripping the router firmly with both hands, butt its base plate against one stop block and guide the bit into the stock at the rabbet start line. Continue the cut along the edge until the base plate touches the other stop block.

How to use a non-piloted bit

Clamp your stock to a work surface, and then mark a line for the end of the stopped rabbet on the edge of the work piece. Align the bit on the too face of the stock for the width of the rabbet, then clamp an edge guide to the work piece flush against the router base plate.

With a firm grip on the router, feed the bit into the stock at the starting end of the rabbet, butting the router base plate against the edge guide. Then feed the bit along the edge of the work piece, keeping the base plate flush against the guide. Stop the cut when the bit reaches the rabbet end line.

While any router can be used to make dado cuts, it is much easier to cut channels that stop in the middle of a work piece if you have access to a plunge router. With the tool flat on your work piece, you simply press the bit straight down into the wood and feed it to the end of the cut.

With a standard router, you need to raise the bit clear of the stock and pivot it into the wood. In either case, the end of the stopped dado or groove will be rounded and will have to be squared off with a chisel.

Most dado cuts are made with straight bits. The maximum depth of a single pass will depend on the hardness of the wood you are milling and the power of your router.

As a rule of thumb, make numerous passes for deep channels in hardwood. For cuts whose width exceeds the diameter of the bits you have on hand, make two or more passes, repositioning your edge guide after each pass by an amount equal to the bit diameter.

Three adjacent passes with a $\frac{1}{4}$ inch bit, for example, will yield a $\frac{3}{4}$ inch-wide dado or groove. The edge guide supplied with routers is a handy prop for cuts close to the edge or end of a work piece. But you can simply set up a guide for cuts that are farther in from the sides.

The T-square will make quick work of dados and grooves. Built from $\frac{3}{4}$ inch plywood, the jig ensures that dado cuts will be square to the edges of your stock. The dimensions of the jig depend on the width of the stock you will be using and the diameter of your router base plate.

Make the edge guide at least as long as the work piece is wide. The fence should be about 4 inches wide and long enough to clamp to the stock without getting in the way of the router.

Screw the two parts of the jig together, checking with a try square to make certain that they are perfectly perpendicular to each other. Then clamp the T-square to a work surface and rout a dado across the fence.

Keep the router base plate butted against the edge guide as you make the cut. To use the jig, clamp it to the work piece with the dado in the fence aligned with the cutting mark on the stock. Make the cut, pressing the router base plate firmly against the edge guide.

Chapter 14 How to make a stopped grove

1 - Plunging the bit into the stock

- Set the stock on a work surface, and then align the bit with one edge of the outline.
- Clamp a board as a stop block to the work piece flush with the router base plate.
- Repeat on the other edges until you have a stop block on all four sides of the outline.
- To start the cut with a plunge router, set the tool flat on the work piece with the bit above the outline and clear of the stock.

- Then loosen the plunge lock knob, turn the router on and use both hands to plunge the bit into the stock.
- Once the bit reaches the required depth, lock the knob.
- To start the cut with a standard router, rest its sub-base on the work piece with the bit clear of the stock and above the outline.
- Then, gripping the tool firmly, turn it on and lower the bit into the work piece until the sub-base is flat on the surface.

2 - Completing the groove

- Guide the router in a clockwise direction to cut the outside edges of the groove, keeping the base plate flush against a stop block at all times.
- To complete the groove, rout out the remaining waste, feeding the tool against the direction of bit rotation as much as possible.

Aided by a guide that keeps the bit a set distance from a centerpoint, your router can cut arcs and circles or add a decorative flourish by carving rings in a work piece.

Different styles of guides are obtainable, but from time to time you can make do with the edge guide supplied with your router. Some woodworkers even improvise with a chain tether attached to the tool's handle.

While commercial guides can be adjusted to cut circles of varying diameters, the length of some guides will limit the size of your circles. You can always use a shop-built jig, nevertheless, to rout larger disks. As with the cutting of dados, plunge routers are more convenient than their standard counterparts for circle cutting.

For through cuts, to prevent the bit from marring your work surface when it finishes severing the circle, work atop a thin sheet of scrap wood. You can also shift the work piece so that the part being routed sticks over the edge of the work surface as you completes the cut.

Chapter 15 How to use a standard router

Set your stock on a work surface. Butt wood scraps against the edges of the work piece to act as stop blocks, and then nail them in place. Install a straight bit in the router.

To attach the commercial circle-cutting guide, eliminate the tool's subbase, and then screw the guide to the base plate through the predrilled holes.

Determine the radius of the circle you wish to cut-the distance between the circumference and the center-and mark this length on the guide, measuring from the center of the bit.

Drill a hole through the guide at the center of the circle, halfway between the edges of the jig. Then screw it to the work piece until it is secure but still able to swivel. Gripping the router firmly, tilt the tool until the bit is clear of the stock.

Turn it on and lower the cutter into the work piece until the guide is flat on the surface. Move the router clockwise, readjusting the cutting depth as necessary until you finish routing the circle.

Chapter 16 How to work with a plunge router

Set up your stock and router as you would for working with a standard router, then mark the radius of the circle and mark its counterpoint. For a deep cut, set the cutting depth so that you can gradually reach the final depth with two or more passes.

Fix the pivot point of a commercial circle-cutting guide to the center of the circle, and then install the guide on the router so that the bit is aligned with the radius mark.

With the cutter clear of the work piece, grip the router firmly and plunge the bit into the stock. Feed the tool steadily in a clockwise direction until the circle is completed, keeping the router flat on the work piece throughout the operation.

For cutting circles of different sizes, use the shop-made jig. The diameter of the dowels depends on the size of the predrilled slots in the base plate of your router; make the wooden rods at least as long as the radius of the largest circle you expect to cut.

To assemble the jig, insert the dowels into the slots on the router, then set the tool flat on a work surface. Butt one edge of the center block against the ends of the dowels and mark the two points where they touch.

At each spot, bore a hole at least halfway through the block with a drill bit the same diameter as the dowels. Dab some glue into the holes and insert the dowels.

Then fix them in place with small finishing nails. Next, mark the center of the block and bore a hole through it for a screw. Use the jig as you would a commercial circle-cutting guide.

Screw the block to the center of the circle and slide the dowels along the router base plate until the bit is aligned with the outline. Then rout the circle, feeding the router in a clockwise direction.

The shop-made compass jig from $\frac{1}{4}$ inch plywood will enable you to cut larger circles than is possible with most commercial circle cutting guides. The dimensions of the jig will depend on the size of your router and the radius of the largest circle that you plan to cut.

Make the circular part of the jig to some extent larger than your tool's base plate. The arm of the jig should be about 2 inches wide and longer than the radius of the circle you will be cutting.

Cut out the jig with a band saw or a saber saw, then bore a hole in the center of the rounded end, making it large enough to accommodate the router bit. To customize the jig for your router, eliminate the sub-base of the tool and set it on the circular section of the jig.

With the bit centered over the hole, mark the positions of the screw holes in the base. Bore the holes and attach the jig to your router. Then draw a line down the center of the jig arm.

To use the jig, determine the radius of the circle you want to cut and transfer this length to the guide, measuring from the center of the bit along the line you have already drawn.

Mark a point on the arm for the center of the circle, then bore a hole and screw the jig to the work piece. Lower the bit into the stock as you would for a commercial guide and cut the circle, moving the router in a clockwise direction.

Pattern routing is a timesaving technique of routing multiple copies of the same contoured shape. The technique involves making a template of the pattern you wish to redevelop, then using the cut-out shape to guide the router bit during subsequent cuts.

The exact procedure you follow will depend on the type of bit you are using. With the non-piloted diversity, you need to attach a template guide—a metal collar that surrounds the bit shank, leaving the cutting edges protruding.

With the pattern clamped atop the work piece, the guide rides along the edge of the cut-out while the bit bites into the stock. With the piloted bit, you need only to clamp the template atop your work piece, since the pilot of a pattern routing bit is above the cutting edges.

The pilot will follow the template, enabling the cutting edge to redevelop the pattern on the work piece. Whichever technique you use, make the template from durable wood, such as plywood or hardboard.

Cut the pattern with a band saw or a saber saw, and then cautiously sand the edges that will be guiding the router. The template must be smooth since any imperfections will be transferred to your stock.

Make the template to some extent denser than the height of the template guide. One advantage of using piloted bits is that you can make the template precisely the same size as the completed pieces you wish to cut.

With a template guide, you will have to compensate for the difference between the bit diameter and the diameter of the template collar. Pattern routing can be done with either a plunge router or a standard router.

If you are working with a plunge model you will need to lock the tool at its appropriate cutting depth before switching on the motor. For the standard router, set the depth of cut in the average manner.

How to install and use a template guide

To install the guide, loosen the clamp screw on the router base plate and eliminate the plate. Insert the threaded part of the guide through the hole in the middle of the sub-base, then screw it to the ring to hold the two together; reassemble the router. Set your stock on a work surface and clamp the template on top of it in the desired position.

To make the interior cut, plunge the bit into the stock as you would when making a dado cut, then feed the cutter in a clockwise direction until the guide contacts the template. Complete the cut making sure that the guide is always pressed flush against the edge of the pattern throughout the operation.

How to work with a piloted bit

Use the template to outline the pattern on your work piece, and then cut out most of the waste with a band saw or saber saw, leaving about 1/8 inch of stock outside the cutting line.

Place the template on top of your stock and secure the two to a work surface. Cut the pattern as you would when edge forming, keeping the pilot pressed up against the edge of the template.

With its bit whirring at 20,000 rpm or faster, the router can be fairly intimidating. Among the many benefits of installing your router in a table is the extra margin of safety such an arrangement provides.

Solidly mounted to a table with its bit barely producing above the work surface, the router seems much more manageable. The router table adds a range of versatility that no other single accessory can provide.

Among other things, it frees your hands to feed stock into the tool, allowing you to exert greater control on the cutting operation. In addition, there are bits that can only be used on a table mounted router.

While some of the cutters beading bit, for instance-can also be used in hand-held work, router table bits are generally significantly larger, giving you much greater flexibility when preparing stock for joinery or cutting decorative shapes.

Commercial router tables are obtainable in many sizes and configurations. All models have a guard to cover the bit; many feature an adjustable fence and a groove for a miter gauge.

Cutting depth on a router table depends on how far the bit protrudes; the width of cut will depend on how much of the bit extends beyond the fence. On commercial tables, the fence is commonly split.

The two halves are typically left in alignment for shallow cuts; the out feed fence can be set behind the in feed fence for more aggressive removal of stock. For a customized router table, you can also build your own.

Chapter 17 How to setup a table router

1 - Mounting the router in the table

- Install your router in a table following the manufacturer's instructions.
- Loosen the clamp screw on the router base plate and eliminate the plate from the body of the tool.
- Unscrew the sub-base and fasten the base plate to the underside of the router table, aligning the predrilled holes in the plate with those in the table.
- Install a bit in the router, and then screw the body of the tool into the base plate.
- Tighten the clamp screw.

2 - Adjusting the fence

- Loosen the four adjustment screws and move the two halves of the fence as close as possible to the bit without touching the cutting edges.
- Tighten the screws, and then set the width of cut, moving the fence back from the bit for a wide cut and advancing it for a shallow pass.
- For a cutting width equal to the diameter of the piloted panel-raising bit, loosen the four thumbscrews behind the fence.
- Then hold a straight board against the fence and move both halves together until the board contacts the pilot.
- Tighten the thumbscrews.

How to make the pass

To hold the work piece in place, clamp two feather boards to the table. Be sure to feed the stock into the cutter against the direction of bit rotation.

With your work piece clear of the bit, turn on the router and slowly feed the stock into the cutting edge while holding it flush against the fence. To keep your hands safely away from the bit, finish the pass with a push stick. Position the safety guard over the bit whenever possible.

If you do not have a miter gauge or if your router table does not have a slot for one, use the shop-made jig to guide stock accurately across the table.

This device is especially helpful for keeping long, narrow boards perpendicular to the fence while cutting into their ends.

Since the fence butts against the work piece, the jig also helps to decrease tear out. The dimensions of the jig will depend on the size of your table, but these suggestions are suitable for most commercial models.

The length of the gauge-less the thickness of the guide-should not exceed the distance between the bit's pilot and the edge of the table. To assemble the jig, screw together the gauge and support board, making sure that they are aligned at one end.

Countersink the screws into the face of the gauge. Then screw this assembly into the top edge of the guide. To use the miter gauge, position it on the infeed side of the bit with the guide flush against the edge of the table.

Then butt the end of the work piece against the fence while holding its edge flush against the gauge. With the thumbs of both hands hooked over the jig, push the work piece and the gauge together to make the cut.

How to make a stopped router table

1 - Setting up the cut

- Mark a cutting line on the face of the work piece for the end of the cut.
- Align the end of the stock with the cutting edge of the bit, and then draw a line on a strip of masking tape to mark the position of the cutter when it is hidden by the work piece tight.

2 - Feeding the stock

- With the work piece clear of the bit, position the guard and turn on the router. Press the stock flush against the fence while feeding it into the bit.
- Stop the cut once the cutting line of the work piece meets the bit place mark.

Chapter 18 How to joint with a router table

1 - Setting up the table

- Install a straight bit in the router, with a cutting edge longer than the thickness of your work piece.
- To eliminate 1/16 inch of wood from your stock-a typical amount when jointing-adjust the position of the fence for a cut of that amount.
- Make a test cut a few inches into a scrap board, then hold the board in place against the fence.
- For a router table with an adjustable split fence, loosen the fence thumbscrews and advance the outfeed half until it butts against the cut part of the stock.
- Tighten the thumbscrews.
- If your router table has a one-piece fence, fasten a strip of veneer on the outfeed side the same width as the amount of stock eliminated in the test cut.

2 - Jointing an edge

- Butt the work piece against the router table fence a few inches from the bit.
- Slowly feed the stock into the cutter, while keeping it pressed snugly against the fence. Apply side pressure just to the outfeed side of the bit.

The router's ability to plunge into wood and cut precise grooves makes it an excellent tool for joinery. The pages that follow provide a sampling of the joints you can cut with the router.

You can rough out a mortise freehand, but many jobs are best executed with the aid of a special-purpose jig or a router table. Commercial mortise-and-tenon and dovetail jigs, for example, can help make joints rapidly and with unerring accuracy.

For the long cuts required in making tongue-and-groove and sliding dovetail joints, the router table is considered by many woodworkers to be a requirement. It will give you much greater control in feeding the stock past the bit.

How to route out the cavity with a plunge router

Cut the tenon with a table saw or handsaw and use it to outline the mortise on your stock. Secure the work piece in a workbench, along with a board of the same width.

The board will provide extra support for the router as you make the cut; ensure that the top edges of the two pieces are level. Install a mortising bit in the router the same diameter as the width of the mortise, then set the depth of cut.

For a deep mortise, adjust the tool to make one or more intermediate passes. Center the bit over the outline and install a commercial edge guide on the router with the fence flush against the edge of the work piece.

Holding the tool firmly, plunge the bit into the stock at one end of the outline, then feed the cutter to the other end. Secure the work piece in hand screws in the inset and square the corners of the mortise with a chisel, keeping the blade square to the work piece and the bevel facing the waste.

Chapter 19 Routing with a mortise and tenon jig

1 - Setting up the jig

- Assemble a commercial mortise and tenon jig following the manufacturer's instructions.
- This description allows you to cut both the mortise and tenon with the same setup.
- To prepare the jig to make the cut, fit the stop in the fence at the mortise-end of the device.
- Secure the jig in a vise, and then clamp the work piece to it with the end of the board butted against the stop and the edge flush against the template.
- Protect the stock with wood pads. Install the bit supplied with the template in your router.
- To set the cutting depth, hold the tool's base plate against the edge of the template and align the tip of the bit with the bottom of the depth-of-cut notch.

2 - Routing the mortise with a plunge router

- Hold the router flat on the jig template with the bit centered over one end of the mortise slot.
- Plunge the bit into the stock, and then feed the tool along the template to the other end of the slot to finish the cut.
- Ensure you keep the bit pilot against the inside edges of the slot throughout the operation.
- Router sub-base eliminated for clarity.
- Eliminate the work piece from the jig and the jig from the vise.

3 - Adjusting the jig for the tenon

- Fit the stop in the slot in the fence at the opposite end of the jig.
- Unscrew the template and shift it toward the tenon-end slots so that one of the alignment pins on the jig body is exposed.

- Refasten the template, and then secure the jig and the tenon work piece in the vise: position the board so that its edge butts against the stop and its end rests against the template.

4 - Routing the tenon

- The tenon is cut in two passes.
- Make the first cut the same way you routed the mortise in step 2, riding the pilot along the inside edges of the tenon-end slots.
- Then turn off the router and unscrew the template from the jig body.
- Turn the template over end-for-end and refasten it to the jig, keeping the same alignment pin exposed as for the first pass, then finish routing the tenon.

How to make a tongue and groove joint

1 – Cutting the groove

- Install an appropriate-sized three wing slotting cutter in the router, and then mount the tool in a table.
- Adjust the fence to make the width of cut equal to the bit diameter.
- To set the cutting depth, place the work piece flat on the table and center the bit on the edge of the stock.
- For added stability, clamp one feather board to the table, and a second one to the fence above the bit.
- With the stock clear of the bit, turn on the router and slowly feed the work piece into the cutter. Finish the pass with a push stick.

2 - Gutting the tongue

- Eliminate the router from the table, insert a straight-cutting bit and remount the tool.
- Adjust the fence to make the width of cut equal to the depth of the groove you have already cut.
- The cutting depth should equal the amount of stock remaining on either side of the groove.
- Feed the work piece into the cutter as in step 1.

Chapter 20 How to cut a half blind dovetail joint

1 - Securing the boards in the jig

- Set up a router jig for cutting dovetails following the manufacturer's instructions.
- To get the jig ready, slide the two stop bars on the left-hand side of the jig body out of the way by loosening the setscrews and hex nuts holding them in place.
- Loosen the template knobs and eliminate the pattern.
- Install both boards inside face out in the jig: the tail board against the front of the jig body with its end venturing $\frac{1}{4}$ inch above the body, and the pin board flat on the jig butted against the tail board.
- Position the template on the work pieces leaving a gap of $\frac{19}{32}$ inch between the end of the pin board and the bottom of the template slots.
- Turn the rod nuts for fine adjustment of the template's position, and then tighten the template knobs to secure the pattern in place.
- To position the stock for the cut, mark a line $\frac{3}{16}$ inch from the left-hand edge of the pin board.
- Slide the board over to align the mark with the left-hand edge of the first template slot.
- Use the clamping knob to secure the board in position.
- Then move the tail board so that its left-hand edge is $\frac{7}{16}$ inch from the edge of the pin board.
- Butt the two stop bars against the boards and fix them in place.

2 - Routing the dovetails

- To prepare your router to cut $\frac{1}{2}$ inch dovetails, install a $\frac{5}{8}$ inch template guide on the tool.
- Insert a $\frac{1}{2}$ inch dovetail bit and set the cutting depth to $\frac{21}{32}$ inch.
- Route the pins and tails in two passes.

- Start the first pass at the right-hand edge of the tail board; cut in a straight line to its left-hand edge, running the template guide along the tips of the slots.
- This will eliminate about half of the waste wood from the tail board.
- Then rout back in the opposite direction, following the contours of the template.
- Move in and out of the slots, keeping the guide flush against the edges of the fingers at all times.
- Continue to the right-hand edge of the boards.
- This pass will cut the pins and eliminate the remaining waste from the tail board.

How to cut grooves

Make 45 degree miter cuts at both ends of the work piece. Then mount your router in a table with a three-wing slotting cutter and set the width and depth of cut as you would to cut the groove for a tongue-and groove joint.

Feed the stock into the bit with a miter gauge, holding the edge of the board flush against the gauge and one mitered end flat along the fence. Repeat to cut the groove in the other board end.

Cut a spline for each joint, making each one twice as wide as the groove depth, fewer than 1/16 inch for clearance.

For maximum strength, use plywood or solid wood cut with the grain of the splines running across their width, rather than along their length.

Chapter 21 How to make a sliding dovetail joint

1 – Cutting a preliminary straight groove

- Cut a dovetail groove in two passes, first with a straight-cutting bit to eliminate most of the waste wood, and then with a dovetail bit to complete the groove.
- For the first pass, install a straight cutting bit in your router, then mount the tool in a table.
- Set the cutting depth, and then position the fence for the width of cut by centering an edge of the work piece over the bit and butting the fence against the face of the stock.
- Clamp a feather board to the table to secure the work piece during the cut.
- Feed the stock into the bit with both hands, making sure you keep the work piece flush against the fence.
- Complete the pass with a push stick, and then eliminate the router from the table.

2 - Making the dovetail groove

- For the second pass, install a dovetail bit in the router.
- Feed the work piece into the bit the same way you cut the straight groove, taking care to press the edge of the stock flat against the table throughout the operation.

3 - Routing the matching dovetail slide

- With the dovetail bit still in the router, lower the cutting depth to some extent to make the slide shorter than the depth of the groove; this will improve the fit of the joint.
- Move the fence toward the bit until exactly half the diameter of the cutter ventures beyond the fence, and then shift the feather board accordingly.
- Cut the slide in two passes, removing the waste from each side at a time.

- Make the first pass the same way you cut the groove, running the face of the work piece along the fence.
- To finish cutting the slide, turn the work piece around and make the second pass with the opposite face of the stock flush against the fence.

Chapter 22 How to cut a dovetail spline joint

1 - Preparing the jig

- To cut perfectly matching grooves into the ends of two boards for a dovetail spline joint, using a shop-built jig from $\frac{3}{4}$ inch plywood.
- Before assembling the jig cut an oval fashioned slot in the middle of the base with a saber saw; the hole should be large enough to accommodate the router bit you will use to cut the grooves.
- Then make 45 degree bevels at the top ends of the arms and the bottom ends of the support brackets.
- Fasten the arms to the base and the support brackets to both the base and the arms with screws and glue.
- Ensure that the arms are perfectly perpendicular to each other; check that the joint between them is centered under the slot.
- Install a dovetail bit in your router, secure the jig in a vise, then cut a channel through the slot across the mitered ends of the arms.
- Turn off the tool and, with the bit still in the channel, butt a board as an edge guide against the tool's base plate, and then screw it to the jig base.

2 – Routing the grooves

- Make a 45 degree bevel cuts at the mating ends of both work pieces, then mark cutting lines for the grooves.
- Position the work pieces in the jig under the arms, with their beveled ends butted against each other under the channel you routed in step 1.
- Align the cutting lines on the boards with the edges of the channel, and then secure them in place with a clamp.
- To route the grooves, repeat the cut you made to rout the channel, feeding the bit through the ends of both work pieces.
- Be sure to keep the router flat on the jig base as you make the cut.

3 - Making the dovetail splines

- You will need splines to fit into the grooves cut in step 2.
- To make enough splines for numerous joints, rout a dovetail slide as you would for a sliding dovetail joint, using the same dovetail bit that cut the grooves.
- Then cut the slide from the edge of the board on a table saw.
- Feed the stock with your right hand, making sure that your fingers are not in line with the blade.
- Cut the slide into individual splines.
- Then clamp the mating boards to a work surface, spread some glue in the grooves and on the splines and drive them in place with a mallet.
- Once the glue has dried, cut and sand the ends of the splines flush with the boards.

Chapter 23 How to use a Saber Saw

The saber saw is frequently likened to its larger shop cousin, the band saw. While few woodworkers would consider using the portable tool to resaw a hardwood plank or carve out a cabriole leg, the comparison is apt in other ways.

With its rather narrow blade, the saber saw makes straight and curved cuts with equal ease and accuracy. Aided by commercial or shop-made jigs, it can carve out a perfect circle.

And like the band saw, the saber saw can be set up to cut identical copies of a curved pattern. In certain situations, a portable saw may even be a better choice than its stationary counterpart.

If you are working with a long board or wide panel that might require a time-consuming setup on a saw table, it is sometimes simpler to carry the saber saw to the work for a quick cut.

Since one end of the blade is free, the cutting edge can be plunged into a work piece for interior cuts on which a band saw would have to begin at the edge of the stock.

The saber saw has come a long way since its introduction. Woodworkers complained that the first generation of saws were plagued by inconsistent motor speeds and blades that tended to bend, making it difficult to follow a cutting line.

The newest models feature electronic motors that can maintain a continuous speed under changing load conditions. Blade manufacturers also offer a wide diversity of sturdy blades suitable for any situation.

Making precise, splinter-free cuts requires attention to numerous factors. A key variable is choosing the finest blade for the job at hand. For straight and angled cuts, an edge guide will be of great assistance in keeping the blade in line.

Since the saber saw blade cuts on the upstroke, there is a tendency for splintering to occur on the top face of a work piece. One way to counteract this issue is to slow the rate at which you make the cut. And remember to buff the bottom of your saw's base plate infrequently with steel wool to eliminate dirt, grime and burrs that could scratch the work piece.

There is no prescribed way to grip a saber saw. The manner in which you handle the tool will depend on the design of your particular model.

Many cuts can be performed with one hand on the handle squeezing the trigger, while the other hand is set on the work piece safely away from the blade.

Other woodworkers prefer to keep both hands on the saw: one on the handle and the other wrapped around the front of the body or barrel of the tool.

All saber saws convert the rotary action of an electric motor into the up-and-down movement of a blade, intended to cut on the upstroke. Tool manufacturers offer three variations on this basic principle.

On reciprocating action machines once, the standard for saber saws-the blade moves straight up and down. On orbital-action saws-now the most common diversity-the blade moves to some extent forward on the upstroke, then draws away on the down stroke.

Many models these feature both options, permitting you to select either reciprocating or orbital blade movement. Orbital-action cutting was developed to make saber saws work more efficiently.

By moving away from the work piece on the down stroke, the blade generates less friction. The blade cuts more rapidly, but it enters the stock at a slight angle, increasing the risk of tear out and splintering.

Hence, the greater the amount of orbital movement, the faster and rougher the outcomes. Selecting the appropriate setting on your saw involves a compromise between speed and quality of cut.

A third type of saw is the scrolling mode, which features a blade that can rotate in a complete circle within its housing, making the saw particularly well suited to intricate contour cutting.

Aided by an edge guide, scrolling saws are also capable of making precise rip cuts. Whatever type of saw you select, one particularly desirable feature is variable speed, controlled by either trigger switch pressure or a separate dial.

This added control allows you to match the cutting speed of the blade to the stock. You would generally use a higher blade speed with denser stock.

Also look for a saw with a solid base plate that will keep the blade square to the stock for standard cuts and one that can be tilted up to 45 degree for bevel cuts.

The tool should include a roller guide that supports the back of the blade as it cuts. Some models also feature a sawdust blower to keep the cutting line from becoming obscured and on-tool storage of the blade-changing and base plate adjustment wrench.

For fine cutting with decreased splintering, some models include a removable plastic insert featuring a slot that fits snugly around the blade, by bearing down on the cutting line, the insert helps to eliminate tear out on the top face of the stock.

Safety tips:

- Do not use the saw if any of its parts are loose or damaged.
- Keep saw blades sharp, clean and undamaged; do not use a blade unless it is in good condition.
- Unplug the saw before changing a blade or making any other adjustments to the tool.
- Install a blade that is appropriate for the material you are cutting.
- Wear safety glasses and a dust mask for cutting operations that generate a large volume of wood chips or sawdust.
- Always clamp stock to a work surface.
- To avoid vibration, support the work piece as close to the cutting line as possible.
- Keep the power cord out of the saw's cutting path; do not use the tool if the cord is frayed.
- Maintain a comfortable, balanced stance when cutting; avoid over-reaching.
- Always keep the saw base plate flush against the work piece during a cut.
- Keep your hands away from the underside of the saw when it is operating.
- Do not touch a blade immediately after using the saw; the cutting edge can become very hot.

- Ensure the blade is not in contact with the work piece when you turn on the saw.
- Allow the blade to come to full speed before feeding it into the stock.
- Do not force the saw through a cut; this can snap a blade or cause it to veer off course.
- Allow the blade to cut at its own speed.
- Turn off the saw before backing the blade out of a cut.
- Ensure that any keys and adjusting wrenches are eliminated from the tool before turning it on.
- Stay alert. Do not operate the tool when you are tired.

While the skill you bring to a venture will always be reflected in the outcomes, the single most vital factor in working with a saber saw is selection of the appropriate blade.

Most saber saws are supplied with a combination blade that works well for many cuts. But since the blades for this tool are rather inexpensive-and since they tend to break frequently-you should keep an assortment on hand in anticipation of a diversity of materials and situations.

When buying a blade, pay particular attention to its composition, the number of teeth, the length and width of the blade, and the technique of mounting.

Most blades are obtainable in high-speed steel, but bimetal versions-with high-speed steel teeth welded onto a flexible body-are sturdier.

Blades with a larger number of teeth per inch (TPI) are intended for fine cutting and tend to create a rather narrow kerf, and develop less tear out; they also cut more slowly than models with fewer TPI.

Length varies from 1¾ to 12 inches, but the standard size is 3 to 4 inches long. Not all saws accept every blade length, so consult your owner's manual for the range of sizes appropriate for your tool.

Until recently, all saber saw blades were produced with a universal shank-meaning that they were all mounted in the same way. In an effort to extend blade longevity, tang and hook mountings were developed.

While some models will accept the shank of any blade, others will not. Before buying blades, check the manual for the shank versions suitable for your saber saw.

Chapter 24 How to install and square the blade

Unplug the saw, and then set it on a work surface. As described here, removing the blade involves loosening the clamp setscrew with the hex wrench supplied with the saw and pulling out the old blade.

On some models, the wrench is attached to the power cord. Insert the new cutting edge in the clamp with its teeth facing the front of the saw and its back seated against the roller guide.

Tighten the setscrew. Use a try square to ascertain whether the blade is square with the base plate. If not, loosen the base plate setscrew with a hex wrench and swivel the plate until the blade butts flush against the square. Tighten the setscrew.

With a firm hand, a slow, steady feed rate, and a straight cutting line on your work piece, you can make an accurate crosscut and rips using a saber saw freehand.

Part of the attraction of this tool, after all, is that it cuts rapidly and with a minimum of setup time. For added precision, you can make use of an edge guide with your tool.

Most saw base plates have holes machined in them to accept the arm of such a guide. The fence of the device is set for the appropriate cutting width, and then the arm is fixed in place.

Nevertheless, the length of most commercial guides is limited, making them impractical for virtually any crosscut and for rip cuts in wide stock. You can also guide the saw with a straight edge, such as a board or a try square.

For the best outcomes when making straight cuts, install a wide blade, especially if you are sawing through thick stock. Ensure the blade is long enough to cut through the wood in one pass.

Resist the temptation to hold the stock with your free hand as you are cutting. Take an extra moment to clamp-down the work piece to a work surface, avoiding the risk of a spoiled cut or an accident.

How to use a try square as a guide

Clamp the stock to a work surface, arranging the board so that the cutting line is beyond the edge of the table. Align the blade with the cutting mark,

then butt one edge of a try square against the saw's base plate.

Ensure that the handle of the square is flush against the edge of the stock. With the saw blade clear of the stock, squeeze the trigger. Feed the cutting edge steadily into the work piece.

How to use a commercial edge guide

Clamp down the work piece, making sure that your cutting line is beyond the edge of the work surface. Install a commercial edge guide on the saw, and then align the blade with the mark on the board.

Butt the guide against the edge of the work piece, and then lock it in place. Holding the saw firmly, feed the blade into the board, making sure that the fence stays flush against the edge of the stock.

How to use a shop-made edge guide

If you are ripping a board too wide for a commercial edge guide, use a straight edged board to keep the blade in line. The guide can be secured with the same clamps that hold the stock to the work surface.

The base plate on most saber saws it can be tilted to either side up to an angle of 45 degree, enabling the tool to make both bevel and compound cuts.

Some models include a gauge that indicates the bevel angle, but you should always make a test cut to confirm that the saw is set for the angle you need.

Since the saw blade will be in contact with more of the wood surface, use a slower feed rate when making these angle cuts.

For the same reason, it is generally a good idea to use a wider blade on the saw; a thin blade will be more prone to getting twisted. While any angle cut can be made freehand, you will get better outcomes if you take the time to set up an edge guide.

The saber saw is capable of making compound cuts sawing through a board with the blade presented at angles other than 90 degree relative to both the face and edge of the stock.

Two setup procedures are required: The base plate has to be tilted to the appropriate bevel angle, and an edge guide has to be clamped to the work

piece to establish the miter angle you need.

Making a miter cut with a protractor guide

Clamp the work piece to a work surface, making certain that the cutting line is clear of the table. Set a protractor guide to the angle you wish to cut, then align the saw blade with the cutting line.

Place the ruled edge of the guide against the saw's base plate; butt its other arm against the edge of the work piece. Gripping the saw and protractor firmly, make the cut.

Cutting bevels with an edge guide

Loosen the setscrew on the underside of the base plate, then set the blade to the desired angle, and tighten the setscrew. The setup and cutting procedure are the same as when you are ripping lumber with a shop-made guide.

The saber saw is one of the few power tools adept at cutting curves. Nevertheless, you need to keep a few things in mind when you are making such cuts.

Whether you are cutting a tight curve with a scrolling model, or using a standard orbital-action or reciprocating machine to form a gentle curve, remember to feed slowly. Cutting too rapidly can bend or break the blade.

A common drawback is blade strain. This typically occurs when the back of the blade hits the side of the kerf as it rounds a corner. The outcome can be a twisted or broken blade, or a blade that simply binds in the cut, marring the work piece or forcing you to back the blade out of the kerf.

The cause is invariably the use of a blade that is too wide for the curve being cut. The solution is a narrower blade or release cuts running from the edge of the work piece to the tightest parts of the curve.

Rather than the blade binding in the kerf at these points, the waste will fall away, giving the cutting edge some room to manoeuvre. Like the band saw, the saber saw is useful for cutting circles.

While you can make such cuts freehand, both store-bought and shop-made jigs will improve precision. In either case, ensure you secure the stock to a work surface.

Depending on whether the circle or the surrounding stock will be the completed product, you can get the blade to the cutting line by making a plunge cut, boring a hole, or sawing a wedge out of the surrounding stock.

Before starting a cut, ensure that the cutting line is clearly marked on the work piece. Also check that any clamps used to secure the stock are not in the path of the saw.

How to cut a gentle curve

To keep the blade from binding in the kerf, make release cuts from the edge of the work piece to the tightest turns. Begin by aligning the blade with the cutting line at the end or edge of the work piece.

Feed the saw into the stock, guiding the tool slowly to keep the blade on line. For a cut, saw to the first release cut; once the waste falls away, turn off the saw.

Continue at the next point where the cutting mark contacts the edge of the stock and work between release cuts. Complete the job by sawing back from the opposite end of the line to the final release cut.

Following an intricate path

If the operation starts with a straight cut, feed the saw into the stock as you would a standard crosscut or rip cut. As the blade reaches the curved portion of the cutting line, release the scroller lock button, then use the scrolling knob to steer the cutting edge in the desired direction.

Continue to the end of the cutting line, gripping the saw firmly with one hand and guiding it with your other hand on the scrolling knob. The blade can also be steered along a curved path by exerting moderate steering pressure on the handle.

How to use a commercial circle-cutting guide

Clamp down the stock with as much of the work piece as possible extending off the table. Ensure the setup is steady, nevertheless.

If the area inside the circle will be the waste wood, make a plunge cut or bore a hole within the cutting line; if the material surrounding the circle will be the waste, make a release cut to the cutting line from the edge of the stock.

Fit a commercial circle-cutting guide on the arm of the saw and drive the pivot point into the stock at the center of the circle you will be cutting.

Adjust the guide until the distance between the blade and the pivot point equals the radius of the circle.

Holding the saw and the stock firmly cut out the circle. To avoid sawing into the work surface, turn off the saw and reposition the work piece as necessary.

To cut circles that exceed the capacity of a commercial guide, use a shop made jig customized for your saber saw.

To make the jig, eliminate the blade from your saw and outline its base plate on a piece of $\frac{1}{2}$ inch plywood.

Reinstall the blade and cut along the marks, making the section that will be beneath the base plate to some extent larger than the plate.

Streamline the jig by trimming it down to the shape of an L, then cut out the notch for the blade.

Screw the jig to the base plate, ensuring that the back of the blade is flush against the bottom of the notch.

Next, use a pencil to mark a pivot line on the jig that is aligned with the blade.

Cut into the stock to bring the blade up to the outline of the circle you will be cutting.

Then drive a nail or a screw into the jig on the pivot line at the center of the circle. Cut the circle as you would when using a commercial guide.

The saber saw's design makes it ideal for the tricky job of making interior cuts. There are two ways to begin the operation.

You can use a drill to bore a hole or plunge the blade into the work piece. This second technique will make the cut much more rapidly, but it is also a little more challenging to perform.

It takes some practice to keep the blade from skating on the surface of the stock. For the best outcomes, work with a short, stiff blade in the saw.

Ensure that you have a firm grip on your saber saw when making a plunge cut, otherwise the blade will tend to jump off the surface of the wood at the start of the cut.

Chapter 25 How to make an interior cut

1 - Plunging into the stock

- Align a guide block with one of the cutting lines and clamp it in place.
- Resting the front of the base plate on the work piece flush against the guide block, pivot the saw forward until the blade is above the stock.
- Then, gripping the saw firmly, turn it on and slowly lower the blade into the stock, keeping the base plate butted against the guide block.
- Once the saw sits flat on the work piece, turn off the tool.

2 – Completing the cut

- Eliminate the guide block and continue the cut.
- To eliminate the bulk of the waste in a single pass, saw to one of the cutting lines.
- For the rectangular outline, follow the marks, but do not try to cut the corners square.
- Instead, bypass the corners with contour cuts, continuing until you reach your starting point and the waste piece falls away.

3 - Squaring the corners

- Cut away the remaining waste with two intersecting cuts at each corner.
- Holding the edge of the blade flat against one of the cut edges saw along the line until the blade reaches the corner.
- Repeat this procedure on the adjoining side to clear the waste wood from the first corner.
- Then do the same thing at the remaining corners.

The saber saw lends itself to the production of multiple copies of a shape. Provided the stock is not too thick, stack sawing is an effective technique for cutting duplicate pieces.

Using this approach, layers of stock are fastened together and the pieces are cut in a single operation. Not only is stack sawing more efficient than cutting all the pieces separately, it ensures that the completed merchandises are exact copies.

Some woodworkers use nails screws or screws to bond the layers together in preparation for cutting; others prefer clamps. Both approaches can be hazardous, nevertheless, if the blade accidentally strikes a fastener or clamp.

A safer way is to use double-sided tape to hold the pieces together. There are some limitations on stack sawing with a saber saw. First, the blade must be longer than the combined thicknesses of the work pieces.

Depending on the model you have, you can buy saber saw blades up to 12 inches long, but do not attempt to use a blade that is too short. You will also perhaps need to make the cut fairly slowly.

Another option for repeat curved cuts is to use the first piece you cut as an edge guide for subsequent cuts. Clamping the guide to the work pieces can make a contour cut as straightforwardness as a crosscut.

How to cut through stacked wood

Use double-sided tape to fasten the layers of stock together, making sure that the ends and edges of the pieces are perfectly aligned.

Mark a cutting line on the top piece, then clamp the stack to a work surface with the portion to be cut completely off the table. Align the saw blade with the line, and then make the cut as you would for any other curve.

Chapter 26 How to do repeat curved cuts

1 - Setting up an edge guide

- To cut a rather gentle curve in numerous work pieces, saw the first piece freehand, and then use it as an edge guide in making the others.
- Cut the guide to some extent longer than the subsequent pieces to help in aligning the saw.
- Since the tool's base plate will be riding along the guide, cautiously sand the curved edge.
- Set the next piece of stock on a work surface.
- Mark a cutting line on its leading edge.
- Then align the blade with the mark and butt the edge guide flush against the saw's base plate.
- Measure the gap between the back edges of the two pieces at both ends to ensure they are perfectly parallel, and then clamp the guide in place.

2 - Making the cut

- To help in keeping the saw directly on its cutting path, place a small strip of masking tape on the base plate in line with the blade.
- To start the cut, butt the base plate up against the edge guide and align the blade with the cutting mark.
- Feed the blade into the stock, keeping the part of the base plate with the masking tape flush against the edge guide.

Chapter 27 How to use a Sander

Even before the invention of power tools, sanding played an integral role in the procedure of transforming raw wood into completed furniture. In the 18th Century, for example, English cabinetmakers fashioned their own abrasives by bonding particles of flint, quartz and volcanic pumice to parchment with hide glue.

Following a more natural approach, some of their contemporaries relied on sharkskin to smooth wood. While today's woodworkers may marvel at such painstaking sanding techniques, the procedure of smoothing wood has in some ways remained unchanged over the past 300 years.

Sanding a piece of furniture today, as in Queen Anne's London, still consists of three distinct stages, which must be followed to ensure a perfect finish. First, the marks and blemishes left by saws, planes and other cutting and shaping tools are eliminated.

Then the wood surfaces are cautiously smoothed to accept a finish. And finally, each intermediate finish coat is abraded before the final coat is applied.

Typically, each step in the sequence is performed with a finer grade-or grit-of sandpaper, diminishing the abrasive effect of the paper until the final sanding does little more than dull the gloss of the previous finish coat.

In spite of the vital role played by sanding, it is frequently regarded as drudgery and is given less attention than it needs. Yet no stain or finish can mask a hastily performed sanding job.

Usually, they only tend to highlight it instead. This section of the book features three versions of sanders: the belt sander, the orbital sander and the random-orbit sander. Belt sanders are generally used to level stock and eliminate flaws on wood surfaces.

Their powerful motors, rigid metal platens and rather coarse sanding belts make them well suited for the first stage of sanding. The orbital and random-orbit sanders are both capable of removing blemishes from stock, but their main purpose is to prepare surfaces for finishing.

With their soft sanding pads that rotate in rapid, elliptical orbits and fine-grade sanding disk, they are ideal for this task. The random-orbit sander

will even eliminate scratches and swirl marks made by the belt or orbital sander, leaving a uniformly smooth surface.

As the name suggests, a belt sander rotates a continuous sanding belt around two rubber-coated rollers and across a rectangular platen. The rear roller is usually the one driven by the motor.

A tracking adjustment knob that swivels the front roller is used to keep the loop of sandpaper centered on the wheels. The metal platen between the rollers provides a flat, rigid base for sanding.

Most belt sanders are equipped with 3-inch-wide belts; heavy-duty models use 4-inch-wide belts. Belt sanders typically have one of two motor designs. Newer models feature an in-line configuration, with a motor mounted parallel to the body of the sander.

This design gives the tool a lower center of gravity and a more balanced feel than the traditional transverse design, in which the motor is mounted off center. There are also two main versions of orbital sanders.

The two-hand finishing sander holds either a third or a half of a standard 9-by-11-inch sheet of sandpaper, depending on the model. The smaller palm sander works with quarter-size sheets.

Compared to other power tools, sanders are rather safe. Nevertheless, since they develop a lot of dust and noise, you should wear a dust mask and ear protection. Belt sanders warrant a few extra precautions.

Use clamps or stop blocks to secure a work piece; your sander can send a loose board hurtling toward you. Always operate the sander with both hands and wait until the motor stops running before setting the tool down.

The circular sanding pad of the random-orbit sander makes this tool ideal for smoothing contoured wood surfaces without leaving scratches or swirl marks. The orbital sander rapidly develops smooth surface ready for finishing.

The two tools owe their eccentric sanding motions to motors that are linked to sanding pads by an off-center bearing. While you can buy a diversity of accessories for your power sander to extend its versatility, only one is absolutely essential: sandpaper.

Since it no longer contains real sand and is obtainable on sturdier backings than paper, sandpaper is usually labelled as an abrasive. Nowadays, it is sold in sheets, belts and disks, made of materials such as aluminium oxide, garnet and silicon carbide-each with its own applications.

Sandpaper comes in different grades, from extra coarse to super fine, depending on the abrasive effect required. Each grade is assigned a different number, known as grit, ranging from 20 to 600.

Sanding belts are obtainable in grits between 36 and 320. Precut sheets and disks for orbital and random-orbit sanders are sold in virtually every grade, from 36 to 600. Selecting the right abrasive for the job and installing it properly are crucial first steps.

If your orbital sander is equipped with a dust extraction system, use papers with pre-punched holes. These are intended to allow vacuum ducts in the body of the sander to collect dust particles generated by sanding and expel them to a collection system.

If you cannot find pre-punched papers, use the hole-punching plate supplied with your sander to make the holes. Most of the accessories shown below are intended for random-orbit sanders.

As a rule, they fasten to the sander's backup pad in one of two ways: the hook-and-loop or Velcro system or with pressure-sensitive adhesive aka PSA discs. Be sure to eliminate a PSA disk from the pad after using it.

Otherwise, it may bond to the pad permanently. Store disks in a cool, dust-free place to keep the adhesive from deteriorating.

How to select sandpaper

For most finishing jobs, you should prepare the surface of your stock with papers from the grit categories. Start with a paper up to 80 grit for levelling a surface and aggressively removing stock. Move to a grit between 100 and 180 for smoothing.

Use finer papers for sanding between finish coats. When buying sandpaper, consider its composition. Aluminum oxide paper is great for use with a belt sander.

For grits above 150 with an orbital sander, garnet paper is the ideal. The hardest and sharpest abrasive material-silicon carbide is recommended in grits above 220 for finish sanding with an orbital sander.

Buy closed-coat paper for sanding hardwood and open-coat paper for softwood. The abrasive particles in open-coat paper are spaced farther apart, reducing clogging.

Chapter 28 How to change a sanding belt

- Set the sander on its side, then pull the belt tension level all the way out and slip the old belt off the rollers; slide a new belt in place.
- To avoid tearing a belt, refer to the arrows marked on the inside of the belt to orient it in the direction that the rollers revolve some tools feature a directional arrow marked on the tool next to the front roller.
- Center the sandpaper on the drums, and then push the tension lever back in place to lock the belt in position.
- To adjust the belt tracking, hold the sander upside down and switch it on.
- Turn the tracking adjustment knob as the belt rotates until the abrasive loop is centered on the front roller.

How to change sandpaper on an orbital sander

- Stand the tool on end and retract one of the paper clamps to free one end of the sheet; then eliminate the other end.
- To install a new sheet, retract a clamp and fold one end of the paper over the edge of the platen and tuck it under the clamp.
- Release the clamp to lock the sheet in place.
- Making certain that the paper is covering the platen completely, pull the other end taut and clamp it in position.

How to eliminate the backup pad from a random-orbit sander

The backup pad of a random-orbit sander may need to be eliminated to install a finishing accessory in its place. Set the sander upside down on a work surface.

Fit the wrench supplied with the tool around the motor shaft between the pad and the body of the sander, then turn the pad counter clockwise to loosen it. A belt sander can perform two versions of smoothing operations, depending on its orientation to the wood grain.

At a 45 degree angle to the grain, it will eliminate stock rapidly from a surface; running parallel to the grain, the tool will smooth even the roughest

board. Whatever the operation is, clamp or nail stop blocks to your work surface to keep the work piece from moving.

Use straight, smooth, overlapping strokes, and avoid sweeping the sander in a circular pattern. To prevent gouges or rounded edges, do not turn on the sander while it sits on the work piece.

Instead, start the tool above this surface and gently lay the belt on the stock, never allowing more than one half its lengths to run off the end or edge of the work piece.

How to sand a board

To eliminate stock rapidly, set the sander flat on the surface at a 45 degree angle to the grain of the wood at one end of the work piece. Move the sander forward immediately.

Once the tool reaches the edge of the board, pull it back, overlapping your forward stroke by one-half the width of the belt. To smooth the surface, use the same technique, but this time, work with the sander parallel to the grain.

How to sand a panel

Starting at one edge of the panel, make a pass along the stock as you would when sanding a board. Shift the sander over by one-half the width of the belt and pull the tool back toward you. Continue sanding back and forth, following a U-fashioned pattern.

It can be tricky keeping a belt sander perfectly level while sanding a board edge, but the jig solves the issue. Cut two support boards from $\frac{3}{4}$ inch stock to about the length of your work piece.

Then saw bridge pieces and nail them to the support boards leaving a gap equal to the thickness of the work piece. To use the jig, secure the work piece in hand screws, and then position the jig on the edge.

Move the sander along the edge of the work piece following the wood grain. Smooth the portions of the edge that are covered by the bridge pieces with a sanding block.

How to sand a board end

Install your belt sander in a commercial bench stand or the shop-built equivalent, and then secure the device to a work surface. Draw a line with a combination square at the end of the work piece to mark the point where you want the sanding to stop.

Turn on the tool. Holding the work piece with both hands, rest it flat on the stand's auxiliary table. Slowly advance the board until the end touches the belt, keeping your hands clear of the sandpaper.

Apply only moderate pressure; let the belt do the work. For a smooth finish, flip the board over numerous times during the operation. Sand up to the marked line on the work piece.

How to sand a mitered corner

To avoid the scratches created by sanding stock against the grain, smooth the boards that meet at a mitered corner in two steps.

First, sand one of the boards with the grain, sanding the other board against the grain at the same time.

Then make a pass on the second board; this time avoiding contact with the first board. Slide the tool diagonally toward the outside edge of the second board, lifting it off the stock as it reaches the joint between the boards.

To sand the ends and edges of a work piece as well as mitered and beveled surfaces, mount your belt sander in a shop-built stand. The setup will free your hands to control stock as you feed it into the sanding belt. The dimensions of your jig will depend on the size of your tool.

Cut the base and the raised table from $\frac{3}{4}$ inch plywood. The base should be large enough to hold the sander and the table. Next, cut the support posts to fit in the handles of the sander.

Set the tool on its side on the jig and slip the posts in place, then screw them to the base. Screw the raised table in place, with its edge just clear of the sanding belt. Check that the belt is parallel to the raised table.

Turn on the tool and ensure that it operates smoothly without moving about in the jig. Clamp the stand to a work surface and set the sander in place. To sand the mitered end, secure a stop block to the raised table at the same angle as the miter.

The block will help you hold the mitered end parallel to the sanding belt. Lock the sander's trigger in the on position. To sand the work piece, follow the same procedure you would use for a square end, keeping the edge of the board butted against the stop block.

To smooth the edges of numerous work pieces of the same width, sand them together in a single operation known as gang sanding. Place the stock face to face and align their ends, then secure them with hand screws and clamps. Working with the grain, sand the pieces just as though they were a single board.

Circle sanding jig

The circle sanding jig will allow you to smooth the edges of a circular work piece with a belt sander in a uniform and controlled fashion. The dimensions of the jig will depend on the size of your sander.

Make the base and the support posts the same way as a sander stand, built without the raised table. Use 1-by-2 stock for the support boards and the Pivot bar, cutting the boards longer than the diameter of your work piece and making the bar longer than the boards.

Screw the boards to the work surface so they will support the work piece near its circumference. Drive a nail through the middle of the pivot bar and press it into the center of the underside of the stock.

Flip the two pieces over and screw one end of the pivot bar to the work surface midway between the support boards, leaving the screw loose enough to allow you to pivot the bar's other end.

To use the jig, set the sander in place on the base, fitting the support posts through the tool's handles. Turn on the sander and, if necessary, readjust the tracking to move the belt down to the jig base; lock the trigger.

To sand the work piece, pull the free end of the pivot bar toward the sander until the stock touches the sanding belt. Clamp the free end of the bar to the work surface.

Then rotate the work piece steadily against the direction of belt rotation until the edge is smooth, periodically shifting the pivot bar toward the sander.

Chapter 29 Orbital sander

Orbital sanders are from time to time called "finish sanders" since they are ideal for smoothing surfaces between finish coats. But their fast and tight orbiting movements (the sanding pad moves only 1/16 to 3/32 inch with each stroke), make them equally handy for knocking down edges or smoothing wood prior to finishing.

In fact, two-handed and palm orbital sanders do most of the sanding in many woodworking shops. The orbital sander's single drawback is its tendency to leave swirl marks on a surface.

These are actually dozens of tiny spiral scratches in the wood. To avoid such imperfections, use high quality paper. Do not skip grades when moving to a finer paper, and set the sander down on your work piece gently when you start a job. To eliminate any remaining swirl marks, use a sanding block.

Sanding a board face

After clamping the board to a work surface, hold the sander above it and turn on the tool. Bring the sander gently down onto the wood surface parallel to the grain at one end of the board.

Move the tool forward, applying light downward pressure. Do not let the sander rest in one place. At the end of the board, pull the sander back, overlapping your forward stroke.

Continue in this manner until you cover the entire surface. To avoid rounding the edges of your stock, do not let more than one-half of the platen extend off the work piece.

Sanding inside a carcass

Smooth the interior surfaces of a carcass the same way you would sand a board. To avoid marring adjoining panels with protruding parts of the sander such as the paper clamp handles, place a sheet of cardboard up against the vertical surfaces.

Sanding rounding edges and ends

Holding your stock securely on the work surface, grip an orbital palm sander firmly and turn it on. Set the tool on the end of the work piece at a 45 degree angle and move it back and forth until the end or edge is rounded to your satisfaction. For the best outcomes, make a series of passes with progressively finer grit sandpaper.

Sanding in a drawer

An orbital palm sander is your best bet for smoothing interior surfaces in confined areas, such as small drawers. To sand the drawer bottom, hold the piece steady on a work surface and turn on the tool.

Set the sander flat on the drawer bottom at one corner, then move it along the surface in overlapping, parallel strokes until the surface is smooth.

Ride the edges of the sander along the drawer sides; the design of the palm sander will enable you to sand right up to the adjoining surfaces.

Standard tools in auto body shops for many years, the random orbit sander has recently found a well-deserved home in woodworking shops.

This tool's ability to eliminate stock rapidly while leaving the surface underneath rather scratch- and swirl-free makes it a good choice for many jobs.

Its rapid, random orbits are good for removing old finishes from an antique or buffing final coat of lacquer. The tool's round backup pad also makes it ideal for sanding contoured and curved surfaces.

For the best result, keep the sanding disk flat on the surface while you are sanding. Follow the direction of the wood grain, moving the sander in a circular pattern.

When polishing a surface with the sander, avoid excessive downward pressure; the pad should "float" over the finish. Also remember to use the sander's lowest speed setting; high-speed buffing tends to wipe off the finish.

Smoothing a contoured surface

Clamp your stock to a work surface. Eliminate the backup pad from the sander and replace it with a contour sanding pad; install a sanding disk.

Holding the tool with both hands above the work piece, turn it on and lower the pad onto the surface.

Apply moderate downward pressure while you move the sander back and forth along the work piece until the surface is smooth; reposition any clamps and turn the work piece as necessary.

The random-orbit sander is an ideal choice for smoothing the rails and stiles of a tongue-and-groove door. Since its sanding pad rotates in random orbits, the tool does not leave swirl marks or scratches when sanding against the grain.

Buffing a completed surface

Clean the surface to eliminate all dust and ensure that it is dry. Smear a thin layer of paste wax over the surface by hand. Eliminate the backup pad from the sander and install a sponge applicator pad.

Set the sander to its lowest speed and turn it on. Lower the pad onto the surface and move the sander back and forth along the surface, applying light pressure to spread the wax evenly.

Once the surface has a smooth and uniform luster, replace the sponge applicator pad with the sander's backup pad, then install a lamb's wool buffing pad. Switch on the tool again and repeat the procedure to obtain a bright and uniform shine.

Chapter 30 How to use Plate Joiner

Popular with European cabinetmakers since the 1950s, plate joiners are still a novelty to many American woodworkers. This is destined to change, for while a plate joiner is usually intended to perform only one task-joining two boards - it does that job very rapidly and well.

The tool features a retractable, spring-mounted blade that cuts slots in mating work pieces. Glue is applied to the slots and an oval-fashioned biscuit of compressed beech is inserted in each one.

The wooden wafers rapidly absorb the adhesive and swell, making a solid joint. Plate joinery is a simple way to fasten boards together edge-to-edge or join carcass panels at the corners whether the ends are square or beveled.

It is also a quick technique for installing shelves in a carcass. Compared to cutting a dovetail or mortise-and-tenon joint, operating a plate joiner is rather simple.

The tool's faceplate is butted against the work piece, guidelines on the tool are aligned with cutting marks on the stock and the motor housing is then pushed forward, plunging the blade into the wood.

The only accessories you will need are an assortment of biscuits and a supply of white or yellow glue. Plate joiners are also known as biscuit joiners since of the central role the wood biscuits play in the joinery technique.

Three different sizes of wafers are obtainable, depending on the thickness of the stock that you are joining. Plate joiners are rather safe to use; the blade ventures from the tool only while it is cutting. They are also forgiving tools.

Since the slots are cut to some extent larger than the biscuits, a groove can be off-centre by as much as 1/16 inch without affecting the alignment of a joint.

The same error in a dovetail joint would add another piece of wood to your scrap pile. Most plate joiners are equipped to cut slots at either 90 degree or 45 degree to the top face of the stock.

While these angles will cover most joints you are likely to design, you should consider buying a joiner with an adjustable fence. It will enable you

to cut a slot at any angle from 0 to 90 degree.

Possibly in response to the impression that plate joiners are strictly one-dimensional tools, most manufacturers now offer wood-trimming blades as an option.

Some have even intended their joiners to serve as mini-power saws, which can comfortably trim a plywood panel or cut grooves. With a spray of sawdust, a plate joiner cuts a semi-circular slot in a tapered leg.

A wood biscuit and glue will be added to the cut and then fitted into a mating slot in a rail. The out coming joint will be as strong as a mortise-and-tenon-and far easier to make.

Though all plate joiners cut slots in essentially the same way, their designs differ.

Most joiners have motors mounted in line with the cutter wheel; to cut a slot the housing is pushed forward so the blade protrudes through its opening and plunges into the stock.

An alternate design features a motor and a handle mounted at an angle to the cutter wheel - either with the motor completely upright or, at a 45 degree angle to the blade.

In this case, the handle must be pivoted forward to cut a biscuit slot. A third, less-common option is the stationary plate joiner, a useful addition for a shop that depends heavily on plate joinery.

All joiners are a depth-of-cut adjustment for each of the three biscuit sizes. Some models offer additional settings to cut slots for accessories such as hinges and knockdown fittings.

Other desirable features to look for when buying a tool include an adjustable fence for cutting slots in beveled surfaces, a fixed angle fence that references the cutter wheel to the top face of a work piece, and a dust collection bag.

Safety tips:

- Unplug the plate joiner before changing a cutter wheel or blade.

- Keep cutter wheels and blades clean and sharp; replace any damaged cutting edges.
- If your joiner is equipped with a blade guard, keep it in place and in good working order when operating the tool.
- Keep your hands away from the cutter wheel slot of the joiner when the tool is operating.
- Always clamp stock to a work surface when cutting into end grain or into a mitered surface.

The most vital accessories for a plate joiner are the biscuits used to join boards or panels. Wood biscuits come in three sizes; as a general rule, the size of the biscuit increases with the thickness of the stock being joined.

Beech biscuits are much stronger than they appear. The wooden wafers are cut with the grain running diagonal to their edges, making them virtually impossible to snap down the middle.

Their surfaces also feature an embossed crosshatch pattern. This helps glue adhere to the biscuits, which swell as they absorb the adhesive. Other versions of biscuits are also obtainable.

There are plastic versions that help to hold a joint together when clamping the pieces is difficult or impractical. And there are metal knockdown fittings that mesh together, so as to allow furniture to be assembled without glue, and then be taken apart again. These specialty biscuits are only obtainable in the large size.

The standard cutter wheel supplied with some plate joiners can be exchanged for a wood-trimming or grooving blade, transforming the joiner into a power saw that can make quick work of cutting grooves for splines or trimming thin plywood panels to width. While the teeth on the cutter wheel should hold a sharp cutting edge through years of use, they may need to be sharpened from time to time.

How to change a blade

Unscrew the nuts holding the guard in place and set it aside. Fit the open-end wrench supplied with the tool around the inner clamp washer under the cutter wheel.

Then loosen the outer clamp washer by turning it clockwise with the pin wrench. Wear leather gloves to protect your hands in case one of the wrenches slips.

Eliminate the washer and the cutter wheel from the spindle, and then install the wood-trimming blade with its teeth pointing in a clockwise direction. Retighten the outer clamp washer and screw the guard back in place.

While not decorative like dovetails, plate joints are a quick technique of joining carcass panels together, edge gluing boards into panels, or adding shelves to a carcass.

As strong and durable as mortise-and-tenon joints, they are also ideal for straightening warped boards when edge gluing them to make a broad surface like a table top. The biscuit size you select for a venture will depend on the thickness of your stock.

Use No. 0 biscuits for wood $\frac{1}{4}$ to $\frac{1}{2}$ inch thick, No. 10s for $\frac{1}{2}$ to $\frac{3}{4}$ inch-thick stock, and No. 20s for denser boards. For even larger stock, you can provide additional reinforcement by cutting parallel slots for two biscuits.

Set the depth offset on a joiner according to the biscuit size you are using. There are no prescribed rules for spacing biscuits, but the closer you place them, the stronger the joint.

As a rule of thumb, locate them 4 to 8 inches apart. Biscuits are effective since they absorb moisture and swell, but humidity will also make them expand, so store them in sealed plastic bags in a dry place.

Plate joints do not demand the same precision involved in other techniques of joinery. For example, the slots need not be centered exactly in a board's edge or end. Nevertheless, avoid making the slots too close to a board face.

While it may not show through initially, a biscuit inserted within $\frac{1}{4}$ inch of a face may develop a dimple on the surface after the stock is sanded. This unsightly effect is known as "biscuit pucker."

Always dry assemble a joint to test its fit. Plate joints are virtually impossible to adjust after gluing. The biscuits swell so rapidly that trying to eliminate one from a slot-even only minutes after applying the glue-is difficult. The thin wooden wafers or the sides of the slots may break instead.

Chapter 31 Edge gluing boards

1 - Marking the place of the slots

- Mark the end grain orientation of the boards, and then arrange the stock to develop a pattern that is visually interesting.
- To minimize cupping on the completed surface, ensure that the end grain of adjacent boards runs in opposite directions.
- Draw a triangle across the face of the stock once you have a satisfactory arrangement; this will help you rapidly realign the boards when necessary.
- Mark center lines for the slots across the seams between adjacent boards.
- Start at least 2 inches in from each end and add a mark every 4 to 8 inches.

2 - Cutting the slots

- Resting the fence on top of the stock, align the guideline on the faceplate with a slot place mark.
- Switch on the tool and push it into the board to cut the groove.
- Repeat the procedure at the other places.
- With thin stock, the base plate may touch the work surface, shifting the alignment of the slots.
- To prevent this, position the work piece at the table's edge so the base plate does not contact the table top.

3 - Inserting the biscuits

- Once all the slots have been cut, leave the last board face down and stand the others on edge with the slots facing up.
- Squeeze a bead of glue into the slots and along the edges of the boards, inserting biscuits as you go.
- The glue bottle automatically applies adhesive evenly on the sides of the slots; if you are using a standard bottle, spread the glue with a thin wooden stick.

- Assemble the boards rapidly to prevent the biscuits from expanding prematurely.

4 - Gluing up the boards

- Fit the boards together, making sure that the sides of the triangle are aligned.
- Lay the boards on bar clamps-one for each 24 to 36-inch interval.
- To keep the clamps from moving, place them in notched wood blocks.
- Protect the stock with wood pads, then tighten the clamps just enough to close the joints.
- Place a third clamp across the top, centering it between the other two.
- Continue tightening all the clamps until glue squeezes out of the joints.

Chapter 32 Joining carcass corners

1 – Cutting slots in the top panel

- Lay one of the side panels outside face down on a work surface and set the top piece outside-face up on top of it, adding reference letters to identify the corners.
- Set back the edge of the top panel by an amount equal to the thickness of the stock, and then clamp the two pieces in place.
- Set a support board the same thickness as the stock in front of the work pieces, then mark slot place lines on the top panel.
- This setup will allow you to cut all the grooves for one corner of the carcass without moving the panels.
- Resting the plate joiner on the support board, align the guideline on the faceplate with a slot place mark on the stock.
- Hold the joiner with both hands and make the cut.
- Repeat the procedure at the other marks.

2 – Cutting slots in the side panel

- Once all the grooves have been cut in the top panel, align the guideline in the center of the tool's base plate with a slot mark.
- Cut all the grooves in the side panel, and then repeat the clamping and cutting procedure on the other corners of the carcass.

3 - Gluing up the carcass

- Set the side panels on the work surface outside face down.
- Apply glue and insert biscuits into their slots as for edge gluing boards.
- On the top and bottom panels, squeeze a bead of glue into each slot and along the edges between the slots.
- Assemble the carcass, fitting the top and bottom panels onto one side and then adding the other side.

- Install two bar clamps across the top and bottom, protecting the work pieces with wood pads.
- Tighten the clamps a little at a time until glue starts to squeeze out of the joints.
- To check whether the carcass is square, measure the diagonals between opposite corners immediately after tightening the clamps.
- The outcomes should be the same.
- If not, install a fifth clamp across the longer diagonal and tighten it until the carcass is square.

Chapter 33 How to add a shelf to a carcass

1 – Making the slot places

- Cut slots for the corner joints, and then lay the side panel on the work surface, outside-face down.
- Draw slot place marks at both ends of the shelf.
- Decide where you want the shelf and draw a line on the side panel with a carpenter's square to mark its position.
- Draw a correcting line on the other side panel, making sure that the ends of the two pieces are aligned so the opposite ends of the shelf will be perfectly level.
- To help you keep track of how the parts join together, use matching reference letters.

2 – Cutting the slots

- Position the shelf atop one side panel, its edge aligned with the reference line.
- Place a support board the same thickness as the panel under the shelf to keep it level, and then clamp the work pieces in position.
- To cut the slots in the panel, butt the tool's base plate against the shelf, aligning the guideline in the center of the plate with the shelf's slot place marks.
- To cut the slots in the shelf, line up the guide line on the face plate with each of the marks.
- Reposition the shelf with its uncut end on the reference line of the other side panel, and repeat the slot-cutting procedure.

3 - Gluing up the carcass

- Apply glue and add biscuits to the shelf and corner joints following the procedure for gluing a carcass without a shelf.
- Assemble the carcass with the shelf in place and clamp it at top and bottom.
- Close the shelf joints with bar clamps at front and back, protecting the side panels with wood pads; place a 1/4 inch thick

wood chip under each pad to focus some of the pressure midway between the edges of the shelf.

- Tighten the clamps a little at a time until a trace of glue squeezes out of the joints.

Chapter 34 How to join bevelled corners

1 - Marking the place of the slots

- Place two adjacent panels on a work surface, inside-faces up.
- Use a tape measure and pencil to mark slot places on both pieces,
- Start about 2 inches in from the edges, spacing the lines at 4 to 8-inch intervals.
- Repeat the procedure at the other three corners of the carcass.

2 – Cutting the slots

- Clamp a panel to a work surface with one of its beveled ends venturing off the edge of the table.
- Butt the plate joiner's faceplate against the end and loosen the locking lever to release the adjustable fence.
- Swivel the fence downward against the face of the panel, and then lock it in place while the faceplate is perfectly flush against the bevel.
- If your joiner does not have an adjustable fence, use an angled block instead.
- Align the guideline on the faceplate with a slot place and plunge the cutter into the stock.
- Use the same technique to cut all the remaining slots.

3 - Gluing up the carcass

- Apply glue and insert biscuits in the slots the same way you would for a carcass without beveled corners.
- To prevent the beveled edges from slipping out of alignment as the adhesive is drying; secure the carcass with web clamps.
- Set the carcass on its back on a work surface and fit the corner brackets in place.
- The brackets will help to distribute pressure evenly along the length of the joint.
- Wrap straps around the unit and tighten them with the buckles before locking them in place.

How to make a plate joiner stand

To decrease the setup time required to cut slots in a series of work pieces, mount your plate joiner in a shop made stand. Build the jig from $\frac{3}{4}$ inch plywood, except for the barrel support, which should be solid wood.

Screw the handle support to the base, then attach the handle brackets, spacing them to fit your tool. With the plate joiner resting upside down on the handle support, butt the barrel support against the motor housing and trace the outline of the barrel on the stock.

Cut or bore a hole for the barrel then cut the support in two across its width, through the center of the hole. Screw the bottom part to the base and fit the other half on top.

Bore holes for hanger bolts through the top on each side of the opening, and then drive the hanger bolts into the bottom of the support. For quick installation and removal of the tool, use wing nuts to hold the two halves together.

Screw the auxiliary table to the fixed-angle fence of the joiner. It may be necessary to drill holes in the fence for the screws. To use the stand, secure the joiner in it, and then clamp the base to a work surface.

Set the fence at the correct height and, for repeat cuts, clamp stop blocks to the auxiliary table to center the work piece on the cutter wheel. To cut a slot, put the work piece flat on the table and butted against the joiner's faceplate, then turn on the tool and push the stock and the table toward the cutter.

Some plate joiners are intended to do more than cut slots for biscuits. Equipped with the appropriate blade, it can make an accurate crosscut or rip through a $\frac{1}{4}$ inch plywood panel, or mill a groove from one end of a work piece to the other.

The cutter wheels that joiners typically use have 6 to 12 teeth. To ensure smooth cuts, the wood-trimming blade obtainable for the jointer/spliner has more than double that number. Always attach an edge guide to the base plate to keep the tool cutting in a straight line. And remember to always push the tool, and never pull it.

How to trim a panel

1 – Setting the cutting depth

- Clamp down the panel so that its edge extends beyond the work surface.
- Unscrew the pins that are typically fixed to the bottom of the guard to prevent them from gouging your stock.
- Set the joiner on the work piece, tilt the barrel forward to lower the blade, and butt the blade against the edge of the stock.
- Turn the depth adjustment knob on the opposite side of the guard until the bottom teeth are about $\frac{1}{4}$ inch below the stock.

2 - Making a crosscut

- Install the joiner's auxiliary handle, then attach a commercial edge guide.
- Align the blade with the cutting line, butt the fence of the guide against the end of the panel, and lock the guide in place.
- Clamp the work piece with the cutting line beyond the edge of the work surface.
- Holding the joiner by the barrel and the auxiliary handle, turn it on.
- Tilt the blade down and push it into the panel, keeping the edge guide fence flush against the stock as you make the cut.

Chapter 35 Edge Tools

Edge tools include chisels, planes, handsaws, scrapers, and gouges for turning and carving. This collection of hand tools shapes, cuts, smooths, and otherwise creates the details in the furniture that machines simply cannot.

Chisels are obtainable in various shapes, widths, and lengths. The most common, bench chisels, are used to cut joinery and fit hinges and other hardware.

Carving and turning gouges create shapes for adding decorative embellishments to your work. For the greatest control with any chisel or gouge, it is vital to keep it sharp.

Planes are the workhorses among hand tools and are used for smoothing, shaping, and fitting joints. A finely tuned bench plane will create a smoother surface than any sander.

Bench planes can also be used for flattening and squaring stock that is too large for your jointer. For one-handed trimming and fitting, especially of small parts, include a block plane in your tool kit; low angle block planes are ideal for trimming end grain.

Shoulder planes are finely tuned precision tools intended for cautious fitting of joints. They feature precisely ground soles and irons for removing feathery-thin shavings. Wooden molding planes feature a profiled sole and matching iron that creates a contoured surface.

Many molding planes, such as hollows and rounds, were once developed in mass quantity and are still obtainable today. These old planes are still useful for shaping large moldings beyond the capabilities of your router table.

You will be able to sharpen, tune, and use your edge tools most effectively, and you'll get more enjoyment from them, if you understand the dynamics of the cutting edge.

An edge is formed by two surfaces that intersect; the angle and sharpness of the intersection directly affects how well the edge cuts. A sharply honed edge will slice the wood and create a thin, delicate shaving while a dull edge works more like a thick wedge to splinter the wood.

A low-bevel angle, 20 degrees, for example, will slice more cleanly and with less resistance than a higher angle of 30 degrees. Of course, there are trade-offs, too.

A lower angle weakens the edge, which makes it prone to fracturing. This is why you should avoid striking paring chisels with a mallet. Also, a lower-bevel angle is not as effective at breaking and curling the shaving, which can lead to tear out in difficult grain such as curly maple.

A higher-bevel angle, such as 30 degrees, is stronger which is why it works well for mortising chisels but also has a greater cutting resistance. An angle of 25 degrees is a compromise that works well for most chisels and plane irons.

A plane is essentially a souped-up chisel. As the cutting edge lifts the shaving, the sole holds it down while the cap iron breaks and curls it. This is why it is essential to set the cap iron close to the edge of the blade and close the mouth of the plane as tightly as possible.

Handsaws are for cutting fine joinery and cutting away large portions of stock before planes refine the surface. Dovetail joinery, for example, is cut with a small backsaw, known as a dovetail saw.

Backsaws work finest for joinery since they cut a fine kerf, and the back is reinforced with a brass or steel spine. Coping saws have a narrow blade intended for cutting curves and scrollwork.

Saws are designated by the teeth, either rip or crosscut. Rip teeth are intended for cutting parallel to the grain, while crosscut teeth are fashioned like tiny knives to cleanly sever the wood when cutting across the grain.

Western saws cut on the push stroke while Japanese saws cut on the pull stroke. Their smooth yet aggressive cutting has made Japanese saws a favourite among many woodworkers.

You can cut your sanding time more than in half by using a scraper. This tool smooths wood with a small burr, and when sharp, it develops shavings like a plane yet it doesn't tear the wood like a plane from time to time can.

A scratch stock is a profiled scraper used for shaping small moldings. This is another tool that will shape profiles that are difficult or impossible to shape with a router.

Chapter 36 Measuring and marking tools

The old adage “measure twice, cut once” is still good advice. Most woodworking venture begins with cautious measuring and marking, otherwise known as layout. Layout tools consist of rules, tapes, squares, dividers, and marking knives, to name a few.

The 6-ft.-folding-wood rule is still my favourite tool for measuring. This vintage style rule folds compactly to slip simply into a pocket. Steel tapes rapidly retract onto a spool for storage and are useful for measuring long lengths of rough lumber.

A reliable square is a tool that no shop should be without. My favourite is a 12-in. combination square. This multipurpose tool serves as an inside square, outside square, 45-degree square, depth gauge, and straightedge.

Get the machinist-quality square; those sold at home centers lack the quality and accuracy for fine work. The sliding-bevel gauge is used for laying out and checking angles other than 90 degrees.

The steel blade pivots and locks in place at virtually any angle. Dividers, trammel points, and compasses all mark a space between two points. Dividers are used to transfer measurements and step off linear dimensions.

The compass is similar to a divider, except a pencil is replaced for one of the points. The compass is the tool of choice for drawing small arcs and circles. Trammels are used for drawing large circles, such as a table top, that are beyond the reach of a compass.

Trammels come in a pair and clamp to a stick of any length. By adding a third trammel to the stick, you can draw an ellipse. A marking gauge and layout knife belong in every tool kit.

These tools incise the wood, unlike a pencil, and create a sharp guideline for chiselling and sawing. The finest marking gauges have a graduated beam that makes it easier to set the tool for a precise measurement.

While you can purchase expensive layout knives with rosewood handles, an X-Acto knife is inexpensive, and the thin blade reaches into areas that are inaccessible to larger knives. And when the blade dulls, you can toss it out and replace it with a new one.

Hammers and striking tools

Hammers, mallets, and other striking tools are used to deliver a precise impact. Hammers are used to drive nails and brads and feature a crowned, or convex, face that helps prevent marring of the wood surface.

Dead-blow mallets feature a shot-filled head that eliminates bouncing upon impact. For assembling joints and casework, a dead blow mallet is used for gently tapping parts into alignment.

Carving mallets are used to direct controlled force to a chisel or carving gouge. Some are made of dense tropical hardwood, while others feature a urethane head fitted to a wood handle.

When selecting hammers and mallets for woodworking, select the lighter ones, typically those that weigh under a pound. Greater force just simply isn't required for most woodworking, and heavy mallets are both tiring and awkward to use.

After you've acquired a solid mix of hand tools, keep them organized and within easy reach. Small tools, such as chisels, squares, and files, store simply in a rack. The rack can be wall-mounted or attached to the back of your bench.

It's difficult to develop high-quality work with inferior tools. But if you're on a budget, one way to extend your woodworking dollars is to shop for high-quality old tools.

A trip to a tool auction or flea market will yield planes, marking gauges, and bevels by Stanley. You'll also find squares, callipers, and dividers by aware names like Starrett or Lufkin.

Best of all, most of these tools can be added to your kit for a fraction of the cost of a new tool. Tools that show signs of use or need extensive cleaning and reworking are frequently passed up by collectors and can be a bargain for the woodworker. But there are things to avoid when buying old tools, too. Here's a list:

Tools with missing parts

- Avoid tools with broken, bent, or missing parts.

- Most parts are not standard hardware store items, and finding a replacement can be difficult or impossible.

Planes with cracked castings

- A plane with a cracked sole, even one with a good repair, may not ever function properly again.
- Besides, there are plenty of intact planes obtainable that need only light cleaning and tuning.

Heavy rust

- Most old tools have at least some rust.
- But those that have spent years in a wet basement or old barn may be encrusted with heavy rust.
- While you can clean it off, heavy rust will leave the surface pitted.
- If it's a chisel or other edge tool, the rust pits create a void at the tool's cutting edge.

Sharp Tools

- Sharp Tools are a pleasure to use, as they slice thin shavings and leave the surface of the wood glistening.
- Sharpness gives you much better control of the tool and enables you to do your finest, most precise work.
- Sharp tools slice and shear the wood cleanly while dull tools crush and tear.
- Stopping to sharpen a tool interrupts the work flow.
- But once you've learned the steps you'll soon be back to planing, dovetailing, and carving.
- You'll also have mastery of the tool, and your work will dramatically improve.

For larger tools, such as planes and saws, a cabinet works well for storage. I avoid storing tools in drawers, especially those tools I use often. Drawers simply become cluttered, and they hide their contents from view. So finding

the tool you need, can turn into a busy search. In contrast, cabinets and racks keep tools organized, sharp, and close at hand.

Sharpening Tools

While it is great to send router bits and circular saw blades out for sharpening, you'll want to sharpen your own hand tools. The steel in hand tools dulls rapidly compared to the carbide on bits and saw blades, and so it isn't practical to send these tools out for sharpening.

To keep your edge tools in top performance, you'll need a grinder and a set of bench stones. Grinders feature a coarse stone wheel and rests or supports to hold the tool at the appropriate angle.

Grinders are powerful tools that you can use to rapidly restore the bevel of a chisel or plane iron. Afterwards, bench stones are used to hone the edge, which sharpens it further.

Portable power tools

Portable power tools allow you to take the tool to the work piece. From time to time the work is too heavy or awkward to manoeuvre through a stationary power tool. That's when portable tools, such as drills and jigsaws take over.

Some portable power tools, such as routers and miter saws, can be mounted to a table or stand and used as stationary tools. Yet they cost much less and take up less space in your shop than large, heavy stationary tools.

These days, many portable power tools are cordless. They use powerful batteries that can be rapidly recharged. This allows you to work without dragging an extension cord around the room.

With their narrow reciprocating blade, jigsaws excel at cutting curves. While it won't replace the band saw for resawing, the jigsaw is a good option for cutting interior cuts or cutting curves on a work piece too large to handle at the band saw.

While biscuit joiners and sanders are not typically used for the finest work, these tools are great for rapidly joining and sanding shop and kitchen cabinets and other less demanding jobs.

Biscuit joiners use a small diameter saw blade to cut a circular slot. The slot is cut in two mating pieces and joined with a compressed-wood plate, or “biscuit.”

Portable sanders can efficiently level joints and smooth surfaces. Nevertheless, these tools cut very aggressively and are not known for creating flat surfaces, so their finest use is on inexpensive cabinetry.

To smooth your finest work, reach for your bench plane and scraper. Over the past few years, routers have dramatically changed woodworking.

Once tools for shaping the edge of a table top or a small molding, routers can now cut joints, mortise for hinges and locks, and even shape the edges of raised panels.

The transformation is due to the large selection of router bits, jigs, tables, and accessories that have been developed for this universal tool. While technically portable tools, routers frequently get the most use mounted in a table.

This in effect creates a mini-shaper. Like shapers, router tables have fences and miter gauges to support and guide the work piece. Best of all, mounting your router in a table allows you to use large bits that would be unsafe otherwise.

Fixed-base routers feature a motor that mounts in the router base and locks in place. Plunge routers are intended so that the motor and bit can be lowered into the work piece while running. Plunge routers are most useful for cutting mortises and other versions of joinery, using a jig to guide the cut.

Chapter 37 Assembling and gluing

Assembly is a critical time in the procedure of building a piece of furniture. You may have spent days or even weeks sizing stock, cutting and fitting joints, and shaping parts.

Then, in a rather short period of time, you've got to apply glue, assemble the various parts in the correct order, position clamps, and check for both alignment and squareness.

Also remember that glue-up is typically irreversible, so you must assemble it correctly the first time. The key to a smooth and stress-free assembly is to conduct a rehearsal of the procedure, frequently called a dry run.

The dry run is the time to check fit, alignment, and squareness and make any necessary adjustments. It's also the time to determine the number and position of clamps.

Read on to find out how to make your next assembly trouble-free. You'll find solid information on how to assemble your next venture and get an idea of the versions of clamps you'll need.

No discussion of assembling furniture would be complete without considering the various versions of adhesives obtainable today. A trip to the local home improvement center or woodworking store will yield a dizzying array of woodworking glues.

While some simply squeeze from the bottle ready for use, others require mixing two parts, and some, such as hot-melt and hide glue, even require heating.

As you perhaps suspect, each type of glue has different working qualities as well as characteristics. By having a basic knowledge of the most common versions, you'll be able to select the finest glue for the job at hand.

How to prepare surfaces for glue

Despite the technological advancement in adhesives during the past 80 years, there are no miracle glues. For glues to work as expected, the joints to which they are applied should be clean, dry, and well crafted.

More precisely, mating surfaces should touch; adhesives do a poor job of filling gaps. In fact, water-based glues, such as common yellow glue, shrink as the water in the glue evaporates, are dissolving any hopes of gap-filling properties.

While some glue, such as polyurethane, don't contract while curing, a thick glue line creates a weak bond. For glues to bond effectively, the surfaces must also be clean, dry, and smooth. The ideal surface is one in which the cells have been cleanly severed by a sharp plane or chisel.

A heavily textured, washboard surface created by feeding the stock too rapidly through a planer or jointer can limit full contact between the mating surfaces. For the finest bond, a sanded surface should be vacuumed or cleaned with compressed air to eliminate dust particles from the pores of the wood.

How to select the right glue

Glues vary widely in their working characteristics, strength, and temperature range. For example, in cooler temperatures some adhesives slow in their cure rate while others create a weak bond or don't work at all.

When using any adhesive I'm unaware with, I always cautiously read and follow the manufacturer's instructions. Let's take a closer look at some features to consider the next time you're choosing a glue.

Ease of Use

- Glues that can be squeezed from the bottle, spread onto the wood surface, and cleaned up with water top the list as easy to use.
- White and yellow glues are the most commonly used woodworking glues not only since they are user-friendly but they're strong, inexpensive, and emit no harmful fumes.

- Unfortunately, they also have little resistance to creepage and moisture, and they are not reversible.

Reversibility

- A glue's ability to be unglued is a vital characteristic for guitar makers and furniture restorers.
- Guitars ultimately need repairs since of the tremendous forces exerted by the strings.
- Repairs to antiques should be made using reversible glue to avoid spoiling the integrity of the piece.
- Nevertheless, for most woodworkers, reversibility is unvital; furniture that is well-crafted and cared for should last at least 100 years or more.
- The most common reversible glue is hide glue, so named since it is made from ground-up animal skin.
- Nevertheless, any glue that is a basic derivative of a natural product can usually be reversed and the parts disassembled.
- In contrast, modern synthetic glues are not reversible.

Creep Resistance

- Any glue line that is subject to excessive stress is subject to creepage.
- This phenomenon is manifested by a mismatched glue line.
- Examples include veneer over a solid wood substrate and layers of solid wood glued to create a heavy bedpost.
- When these broad surfaces move as an outcome of seasonal changes in humidity, the joints frequently become to some extent misaligned.
- Glues that have a tendency to creep are also subject to spring back if used for bent laminations.
- An excellent choice for creep resistance is urea resin glue.
- Polyvinyl acetate glues (PVAs), and white and yellow glues, have moderate creep resistance.
- Contact cement has very little creep resistance.

Water Resistance

- Nowadays, there are numerous adhesives that offer outstanding resistance to water.
- Be aware, nevertheless, that there are different levels of water resistance among adhesives.
- It's vital to cautiously read the label.
- For example, Type II yellow glue is water resistant but not waterproof, so it's suitable for outdoor furniture but not for boats.
- Resorcinol and epoxy are both waterproof and the finest choices for work that will be subjected to long periods of submersion.
- These adhesives come as two parts that must be measured and blended prior to application.

Toxicity

- In general, two-part glues that require mixing before use are the most toxic.
- These glues cure by compound reaction, and the compounds release harmful fumes.
- Read the manufacturer's label and take the necessary precautions to protect yourself.

Tools for spreading glue

When spreading glue, it certainly helps to have the right tool for the job; you'll get even coats of the right amount of glue in the right place. A paint roller works well for large jobs, such as when you laminate planks to make a bench top or spread glue on a substrate when veneering.

A short roller is usually large enough and will give you good control of the spread. For smaller applications, an old credit card or phone card works well. A very simple yet effective tool for glue application is a thin, tapered stick.

The stick will simply reach into mortises, and you can use it as a small paddle for coating the mortise walls. A flux brush also works well for

reaching into tight spots. Nevertheless, the bristles are too long for good control, so I trim the ends before putting it to use.

Inevitably you'll need to make a small repair, and a syringe will squeeze just the right amount of glue into any crack or crevice. The ones I use are obtainable at farm supply stores. The large needle will allow glues to flow through.

Gluings strategies

Gluings up is a high-risk venture, and there's definitely a lot at stake. Perhaps you've spent days or even weeks selecting, preparing, and joining stock. Now it's time for assembly.

Since glue is typically irreversible, you've got to get it right the first time. You've got only a few minutes to work before the glue sets up, and yet everything must be aligned and checked for square.

It sounds stressful, but it doesn't have to be. Glue-ups can be calm, and everything can go as planned. The key is to have a plan. I seldom glue anything without first performing a dry run.

Think of a dry run as a dress rehearsal. It's a time to practice the movements as you assemble the various parts and position the clamps. A dry run will also allow you to check all joints for fit and check the entire assembly for square.

If there are any issues, they will be apparent when it's easy to fix them. If there are no issues during the dry run, then you're ready to apply the glue. All the tools are in place, and the clamps are adjusted for the size of the work.

Here are some other criteria that are vital to a dry run, as well as to the glue-up itself. Stock for glue up should be flat, true, and square.

For example, if you're gluing boards edge to-edge to make a table top, the face of each board should be free of warp and the edges should be true (straight) and 90 degrees to the face. You can square the stock with a jointer and planer or with hand tools.

Complicated joints, such as the dovetail and mortise and-tenon, should fit with hand pressure or gentle coaxing with a mallet. Remember, the purpose

of clamps is to keep a joint closed until the glue sets, not to close poorly fitted joints.

Joints that require excessive clamp pressure to close will continually be under stress once the clamps are eliminated. Under these circumstances, the joints will ultimately fail.

Assuming that the joints are well-crafted, remember that most clamps can apply much more pressure than is required to keep a joint closed. Too much pressure can crush the wood fibres and rack an assembly out of square.

As you're tightening clamps, use only enough pressure to close the joint. It's much easier to glue up just a few parts at a time. Attempting to glue together an entire venture, even a small one, can be an invitation for failure.

It's difficult to spread glue on all the parts before the glue begins to "skin over." Also, the venture may buckle and distort under the weight and pressure of so many clamps.

Instead, glue together sub-assemblies, such as the left and right sections of a small table. Then, once the glue has dried, glue together the entire table. The dry run will make you aware of whether you're attempting to assemble too much at once.

Even though your joinery is flawless, it's still possible to glue a twist into a panelled door or dovetailed drawer if the work surface is distorted. I prefer to glue assemblies on the top of my bench since I know that it is flat.

I often use sawhorses when gluing large work, but I'll first make certain that the top of each sawhorse is positioned in the same plane. If necessary, I'll shim one leg of a sawhorse.

Before you disassemble the dry run, note the number and position of clamps. Gather tools that you'll need for the glue-up, such as squares, pinch rods, glue applicators, and a dead-blow mallet to gently coax parts into position.

Spread the glue evenly on all long-grain surfaces of a joint and technically assemble the parts in the same order that you used during the dry run. Once clamp pressure is applied, I like to see just a bit of glue squeeze out.

This is good insurance to let you know that the joint isn't glue-starved. I like to avoid excess squeeze-out, though; it makes a sticky mess and is

time-consuming to eliminate from the surfaces, corners, and crannies of the work.

It takes practice to know how much glue to apply, nevertheless. When you're first starting out, it's best to err on the side of too much. The best time to eliminate glue is after it has partially set up.

At this stage, the glue is no longer liquid but has a soft, plastic texture and will simply scrape away. Wiping the wet glue with a damp rag will push it into the surrounding pores and haunt you during finishing.

Allowing excess glue to harden is problematic, too. Hard, dried glue is tenacious; as you scrape it away, it will frequently chip out small areas of the wood surface.

From time to time assemblies that seem straightforward end up being difficult once you get the glue and clamps on. That's why a dry run with clamps is vital. Study the joint to determine where the pressure is required and use clamp blocks to direct the pressure.

For example, on a typical leg-and-rail assembly, the pressure is required behind the rail, not across the entire leg. Pressure applied to the entire leg will twist it out of square, yet a simple clamp block will distribute the pressure correctly.

Some joints, especially on corners that are not square, require a more customized clamp block. Dovetail joints require notched clamp blocks that direct clamp pressure to the tails.

Mortise and tenon framework

Mortise-and-tenon framework has broad applications in woodworking. The framework is commonly used as a face frame on casework. By adding a panel to the framework, you've created a door.

The long frame members are called stiles and are mortised to accept the tenons on the ends of the horizontal members called rails. My framework will be used as a base under a chest to attach the bracket feet.

It has extra length of the stiles, which is a solid, tried-and-true technique for building frames. The extra length, called "ears," is left intact until after assembly, at which time it is sawed off.

The ears serve numerous functions. They add strength to the stile when you're mortising, and they eliminate the need for absolutely perfect alignment during glue-up.

Instead, the ears are sawn flush with the rails. Also, when you're disassembling a panelled door after the dry fit, the ears provide a spot to tap open the joints without damaging the door.

Chapter 38 Sharpening Tools

Sharpening machine tooling, such as carbide-tipped saw blades and router bits, is best left to the experts. Occupational sharpening shops have both the tools and knowledge and will handle these maintenance chores for a modest fee.

Sharpening hand tools is another story. Possessing the skills to hone chisels, plane irons, and carving tools to a razor edge is an essential part of woodworking.

From time to time a chisel or other edge tool is inadvertently nicked as it comes into contact with a square or other tool lying on the bench top. Even under normal use, edge tools dull rather rapidly and require continual maintenance for the greatest control.

Fortunately, it's not difficult to develop sharpening skills. Sharpening is simply a gradual procedure of removing steel with abrasives. As increasingly finer abrasives are used the scratches in the steel become finer, the steel more polished, and the edge sharper.

There are many versions of tools and abrasives from which to select, from water stones to sandpaper, and the type you select is largely a matter of personal preference.

While the various stones and grinders have different working characteristics and costs, all will adequately sharpen steel. Let's take a closer look at what's obtainable.

Grinders

From time to time it is necessary to grind the steel to restore the edge of a chisel or plane iron. Perhaps the edge is nicked or worn from repeated honings. The most efficient way to restore the edge is with a grinder.

You can select between a common bench grinder or a more expensive wet grinder. Bench grinders require greater skill and a light touch to avoid overheating the steel and destroying the temper or hardness. Also, the tool rests on bench grinders are not well intended for supporting woodworking tools.

Nevertheless, if you construct tool supports, upgrade your bench grinder with cooler-running aluminum-oxide wheels, and frequently cool the tool edge by dipping it in water, a bench grinder can be an effective, inexpensive machine for restoring the edges of your planes, chisels, and other edge tools.

Nowadays there is a number of wet grinders obtainable featuring large-diameter, wide grinding wheels that run in a water bath. Wet grinders have numerous advantages over standard bench grinders.

The biggest advantage is that the continuous water bath over the wheel and tool edge makes it impossible to overheat the steel. Also, the wide wheel of a wet grinder is more effective for sharpening broad edges, such as the iron from a bench plane.

Since wet grinders are intended precisely for woodworking tools, the tool rests usually provide better support than those typically found on bench grinders.

The only real disadvantage to wet grinders is their higher price tag. Of course, grinding leaves a coarse surface, so it's vital to follow up by honing the tool edge with finer abrasives.

Bevel Angles

The first step in sharpening is to grind the bevel. I typically use a hollow bevel since it is faster and easier to hone than a flat bevel. Bevel angles usually range from 20 to 30 degrees, with 25 degrees being standard.

A shallow bevel is sharper and creates less cutting resistance but may fracture more simply. A steeper bevel is sturdier but has more resistance and provides less control.

I have numerous sets of chisels in my kit, and I grind them according to how I plan to use them. For example, I grind a steeper angle on the short chisels I use with a mallet, and a shallow bevel on paring chisels.

Also, from time to time it's necessary to adjust the bevel angle to some extent to compensate for the hardness of the steel. For example, if the edge fractures simply, try grinding a steeper bevel.

Edge profiles

Plane irons are ground either square or convex, depending on the type of plane and the work that you're producing. Planes for joinery, such as rabbet and shoulder planes, should be ground square.

The iron of a smooth plane works finest when ground to some extent convex. This profile prevents the corners of the plane iron from creating ridges in the board.

Bench planes used for flattening rough stock are called scrub planes. But any bench plane can be used as a scrub plane if you grind a pronounced convex profile on the iron.

Just remember to adjust the frog of the plane for a coarse shaving. Chisels are usually ground square to the edge, but skewed chisels are useful for many tasks, especially cutting dovetails. You can buy skewed chisels, but you can also regrind a skewed edge on an average chisel.

Chapter 39 Honing Tools

After the grinding to restore the bevel or eliminate a nick in the edge, the next step is honing. Honing is the procedure of abrading the edge of the tool over progressively finer abrasives. The back of the tool should be polished, too; it converges with the bevel to create the cutting edge.

Nevertheless, a great time to polish the back of the tool is after you first purchase it. Later on, each time you hone the tool, you can concentrate your efforts on the bevel. There are a number of tools obtainable for honing.

Man-made stones, such as synthetic water stones, tend to cut rapidly - but also wear rapidly. In contrast, natural stones, such as Arkansas stones, wear slowly but become clogged simply and are tediously slow-cutting. Let's take a closer look at what's obtainable so you can decide for yourself.

Until recently, most craftsmen honed their tools with Arkansas stones. These natural stones are still quarried, graded, ground flat and square, and boxed ready for use.

Natural Arkansas stones create a sharp, highly polished edge, and since they are hard, they retain their flatness for long periods of use. Nevertheless, Since Arkansas stones use oil as a lubricant, they tend to be messy. But their main drawback is that they cut so slowly.

Sharpening a chisel to a razor edge with Arkansas stones is time-consuming in comparison to newer alternatives, such as manmade water stones, so I retired my Arkansas stones years ago.

I remember back numerous years ago when ceramic sharpening stones debuted. They were heralded as hard and fast-cutting—great qualities for a sharpening stone. Additionally, since they were used dry, they were not as messy as other versions of stones.

When they became dirty with use, they could be simply cleaned with a mild household cleaner and water. Nevertheless, I soon became disappointed with these stones; after numerous cycles of cleaning and use, their cutting ability gradually diminished.

Another form of sharpening “stone” is actually diamond particles bonded to a hard plastic block or flat-ground steel plate. Diamond cuts rapidly, and

since of its hardness, it can retain its cutting ability for years.

A 600-grit diamond plate is great for flattening the back of edge tools and the soles of planes. Nevertheless, most diamond sharpening stones are too coarse for the final stages of honing. A great option, though, is to use diamond paste on a hardwood block for the ultimate in sharpness.

These days, many woodworkers prefer water stones for their fast-cutting features. First imported from Japan, water stones are obtainable in a wide diversity of grit sizes, and the finest stones will develop an incredibly sharp edge.

Since they use water as a lubricant, they are not as messy as stones that use oil. The only real downside to water stones is that they wear rapidly, so they must be reflattened often.

Norton Abrasives offers its own line of water stones, which also cut rapidly but wear slowly in comparison to traditional water stones. Still another choice for honing is sandpaper. You just need to back up the sandpaper with a truly flat surface, like plate glass.

The wet or dry abrasive sheets sold at auto paint stores are your finest choice; just moisten the paper and position it on the plate glass. As it wears, just toss it out and replace it with a fresh sheet.

Also, you'll never need to flatten it. This is a simple solution to sharpening that has become quite popular with a number of woodworkers. For the final polish of the edge, it's tough to beat a leather strop.

While you can purchase a strop from many woodworking tool catalogues, it's much less expensive to make your own. You can purchase a scrap of leather from your local shoe repair store and glue it to a block of hardwood.

Charge the strop with rouge, a very fine polishing abrasive in a wax stick. Slip stones feature thin, contoured surfaces for honing the curved edges of turning and carving tools. For the final polish after using slip stones, flex a small piece of leather to conform to the shape of the gouge.

Cabinet scrapers

The cabinet scraper is a great tool for smoothing wood and reducing sanding to a minimum. If you find it difficult to sharpen, you're not alone.

Scrapers cut with a tiny burr that is formed after honing.

The key to sharpening a scraper is to avoid rounding the edge while honing it. It's impossible to form a hook on a rounded edge. Scrapers are first sharpened, and then burnished to create a burr.

The angle of the scraper edge depends upon the type of scraper and how it will be used. The edge of a cabinet scraper is filed 90 degrees to the face. For scraper planes, an angle of 15 to 20 degrees works well.

After you polish the face and edge, a burnisher is used to draw the burr. Unlike other edge tools, scrapers cut with a tiny hook or burr. So after polishing a scraper, you'll need a burnisher to hook the edge.

The traditional burnisher is simply a hard, polished-steel rod equipped with a handle. Newer-style burnishers feature a small carbide rod mounted in a wooden or plastic block. The block serves as a jig to maintain the correct angle as the burr is created.

Chapter 40 How to sharpen chisels & scrapers

Sharpening a bench chisel is a good way to begin developing your skills. Remember that it always requires two surfaces to create an edge. When sharpening a chisel, you must polish both the beveled edge and the back.

Also, the back of a chisel should be absolutely flat. The back frequently guides or registers the cut; if the back is rounded, the accuracy of the cut will be lost. Sharpening is a two-step procedure.

First grind the bevel, then hone the edge. Remember, grinding rapidly eliminates a lot of steel. This is the finest option when the edge has been damaged or the hollow bevel has been worn away through repeated honing nevertheless, it's not always necessary to grind an edge.

In fact, in most cases, an edge can be honed back to sharpness in just a few minutes with bench stones. As you grind the edge, keep it cool to avoid annealing or softening the steel.

If you're using a dry grinder, dip the tool in water often. Also, check the bevel angle as you grind and adjust the tool rest if necessary. Next, examine the back of the cutting edge.

If the tool is a recent purchase, it may be necessary to eliminate grind marks, or, if it's an older tool, it may be marked by surface rust. Starting with a coarse stone, flatten and polish the back to a mirror finish.

You only need to polish about an inch or so back from the cutting edge. The next step is to hone the bevel. Be cautious not to become overzealous and hone too much.

An edge can usually be honed numerous times before it needs to be reground. Nevertheless, honing too much steel away initially shortens the life of the edge. To begin honing, position the bevel on a fine stone so that the edge and heel are both in contact.

You may find it helpful to rock the bevel until you feel the edge and heel make contact. Lock your wrist and glide the bevel across the surface of the stone with long, smooth strokes until you can feel a slight burr across the back of the edge.

You can also buy a simple guide wheel that holds the blade at a consistent angle for honing. Then stroke the back of the chisel across your finest stone to eliminate the burr.

The bevel should reveal a narrow shiny surface across the edge and heel. Finally, polish the edge further by passing it numerous times over a leather strop.

You can check the edge for sharpness by slicing a thin shaving from a soft wood, such as pine or poplar. When sharp, the tool will sever the end grain cleanly and reveal the cell structure of the wood. In contrast, a dull edge will crush the soft fibres.

How to sharpen a Cabinet Scraper

A sharp scraper will smooth the most difficult grain without producing tear out. The secret is in the burr. Before creating the burr, the edge must be sharp and highly polished.

Since cabinet scrapers are made from rather thin steel, it is easy to inadvertently round the edge during honing, making it impossible to form the burr.

Begin by filing the edge with a smooth mill file to eliminate the old burr and square the edge. To file the edge, use a technique called “draw filing”; hold the file perpendicular to both the face and the edge of the scraper and “draw” or pull it toward you.

Surprisingly, the scraper will cut quite well at this stage, while it leaves the surface of the wood fairly rough. For a cleaner cutting scraper, you’ll need to take the sharpening procedure further.

Next, hone the face and edge of the scraper with bench stone. To keep the edge square, flex the blade with your thumbs as you push it back and forth over the bench stones. Flexing the scraper effectively creates a broad footprint to prevent the scraper from tipping and rounding the edge.

The next step is burnishing. But first wipe away the stone residue from the surface of the scraper and apply a drop of oil to the edge. The oil will lubricate the burnisher to create a smoother edge.

Hold the burnisher at an angle of 5 to 10 degrees, and with moderate downward pressure, push it across the edge numerous times until you can feel a small burr. A burnishing jig will make the job easier and maintain a consistent angle.

Chapter 41 How to use the Respirator

1 - Installing the cartridges

- Wear a dual-cartridge respirator approved by the National Institute of Occupational Safety and Health whenever you spray lacquers or varnishes that comprise volatile organic solvents, or when you mix compound stains or work with ammonia.
- If you have a beard, you need a full face mask or hood.
- To install the cartridges on the model of respirator shown, screw them onto the inlet valves.
- Always buy cartridges in pairs, and keep track of the hours they have been used.

2 - Installing filters

- Use dust filters in conjunction with respirator cartridges if you are sanding compound treated wood or applying finishing materials such as shellac, lacquer or non-water-based stains.
- Select the appropriate filter for the task at hand, and then fit a filter into each retainer.
- Snap the retainer onto the cartridge.

3 - Testing the respirator

- Place the respirator on your face, with the top strap over the crown of your head.
- Pull on the side straps until the face piece of the respirator fits snugly.
- Test the device by blocking the outlet valve with your hand and exhaling gently.
- There should be no air leakage around the face piece.

Disposing of soiled rags

Immediately open all doors and windows, extinguish any sources of heat and turn off all electrical sources.

Wearing a rubber apron, rubber boots, heavy rubber gloves, safety goggles and a respirator, soak up the spill with rags or paper towels; then place them in a metal can double-lined with heavy-duty plastic garbage bags.

Add a small amount of water to prevent spontaneous combustion. You can also spread the rags outside and allow the solvent to evaporate before disposing of them. Clean up any residue with the appropriate solvent.

If the product is extremely flammable or poisonous and more than one gallon has been spilled, leave the work area and call the fire department. Otherwise, dispose of the soiled rags following the environmental regulations in effect on your community.

Chapter 42 How to get ready for a Compound Fire

To control small, contained fire, use a dry-compound fire extinguisher rated ABC. Position yourself safely away from the fire with your back to the nearest exit. Hold the extinguisher upright on a level surface, pull the lock pin out of the handle, and aim the nozzle at the base of the flames.

Squeeze the handle levers together and spray in a quick, side-to-side motion until the fire is extinguished. If the flames spread, leave the area immediately and call the fire department. Dispose of burned waste following the advice of the fire department.

Checking a smoke detector

A smoke detector is an essential safety feature in a finishing shop. Test the device once every month. First, press the test button. Then, blow out a lit match below a vent, letting smoke enter it, or hold a flame below it. Replace the battery if the alarm does not sound for both tests-or if it emits a chirping sound, indicating the battery is worn.

Choosing a safe finish

Finishing chemistry has changed radically in recent years. The most significant advance has been the development of water-based finishes in response to both the health risks posed by solvents and clean-air legislation that limits the percentage of VOCs, or volatile organic compounds, in solvent-based finishes.

Most of these regulations are mostly intended for furniture makers who use more than one gallon of finish per day. Inhalation is the most common way that solvents are absorbed into the bloodstream, but toxins can also be ingested from food and beverages left in the shop.

Others can be absorbed directly through the skin or even by swallowing vapours in saliva. In their most poisonous form, solvents can cause damage to the central nervous system and respiratory tract. Methylene chloride, for example, is suspected of being a carcinogen, while some glycol ethers have been linked to birth defects.

Keep in mind, nevertheless that the health hazards of any finishing product depend on a number of factors. Most merchandise on the market are actually benign when used only on occasion, and could only be considered poisonous if swallowed directly.

Some can even be made nontoxic; shellac is commonly used as an ingredient in confectioners glaze. When choosing a finishing product, be aware of the combination and concentration of organic solvents in its makeup, particularly if you intend to use the substance for extended periods of time; prolonged exposure may be hazardous. Always select the safest product for the job at hand.

How to prepare the surface

Old-time wood finishers smoothed wood with shark skin and filled its pores with plaster of paris and pulverized brick, colored it with materials such as iron filings and walnut shells, and completed it with secret combinations of oils and beeswax.

Modern finishing techniques are mundane by comparison, but the object is the same: to bring out the beauty of the wood. Whether this means a glassy film on the surface of the wood or a finish that softly glows from within depends on the type of protection the wood needs and the effect you wish to achieve.

Since taste is involved, there is no single right answer to every finishing question. But all occupational-quality finishes have one thing in common: careful surface preparation, which readies the wood to accept the finishing materials.

The amount of time you spend on surface preparation and the tools you use depend in large part on your work habits and your wood. Surfaces speckled with dried glue obviously require more work to smooth.

Loose knots, splits and other defects need repair prior to finishing; so does every dent and chisel nick. The wood perhaps has jointer and planer marks, which you can eliminate with shallow cuts using a smoothing plane.

The plane must be properly adjusted and sharp, so it cuts wood fibres rather than tearing them and roughening the surface. If the wood has an average

pattern, so you cannot avoid tearing the grain as it changes direction, substitute a cabinet scraper—a thin, flat piece of steel with a burred edge.

For ultimate smoothness of straight-grained wood, use both the smoothing plane and cabinet scraper. Cabinet scrapers take practice to sharpen and use, but once mastered they can substantially decrease your sanding time.

Beware of an improperly sharpened edge, nevertheless, which can scratch the wood as badly as coarse sandpaper. Sanding with successively finer grits completes the surface preparation.

For hand-sanding a fairly smooth surface, a typical progression is 150 grit, followed by 220 and then 280 grit. If you did not smooth the wood with a cabinet scraper, you might need to start with 80 or 120 grit.

Never skip an intermediate grit or you will leave scratches in the wood that the finish will magnify. With an orbital sander, use the same grit sequence; plan on hand-sanding with the final grit to eliminate any whorls.

After final sanding, you may wish to "raise the grain" and then resand, to eliminate the whiskery fibres that might otherwise pop up through the finish on the first humid day.

This step is essential when applying any material with a water, rather than solvent base. Whether or not you fill the pores of the wood is again a matter of taste.

If you like a natural-looking finish that allows you to "read the wood grain," do not use filler. Close-grained species such as pine and cherry do not require filling in any case, but if you want a glassy finish on an open-grained species, such as oak or mahogany, you must fill the wood.

A wash coat may be applied to the wood before or after staining—or not at all if you are applying a penetrating oil finish. A wash coat can be nothing more than a half-and-half solution of your final finish and the solvent recommended by its manufacturer, and for lacquer, use sanding sealer.

The point of using a wash coat is to prevent the wood from uneven or excessive absorption of finishing materials. When applied before the final finish, the wash coat keeps the wood from drinking up the finish, thereby reducing the number of coats required to build up the appropriate thickness.

Chapter 43 Additional tools

- Honing guide and angle jig: This is required for honing blades. The device holds blade at appropriate angle for honing a bevel, rotating the wheel on top of the jig sets angles between 15 and 35 degree.
- Smoothing plane: This is required for smoothing wood surfaces with the grain, usually prior to scraping and sanding. The blade must be sharpened and properly adjusted before use.
- Grinding jig: This is required for holding plane blades in alignment with grinding wheel during sharpening.
- Mill bastard file: This is required for squaring cutting edges of scrapers prior to honing and burnishing them.
- File Clamp: This holds file perpendicular to cutting edge of scraper during sharpening of scraper, ensuring straight and square edge.
- Tri-burnisher: This is used to form small burr, or hook, on cutting edges of scraper after honing, combines round, triangular and oval burnishers in one tool.
- Block plane: This is required for smoothing end grain and chamfered surfaces, usually used with one hand.
- Combination sharpening stone: This is required for sharpening plane blades. Coarse side eliminates metal rapidly, fine side creates smooth edge. Lubricated with water or oil depending on the type of stone.
- Hand scrapers: Rectangular scraper smooths flat surfaces, curved models work well on contoured surfaces, moldings and spindles.
- Abrasive Pads: An alternative to sandpaper for smoothing wood surfaces and abrading intermediate finish coats by hand; abrasive particles of aluminium oxide and silicon carbide are bonded to synthetic fibre pads. Last longer than sandpaper, and it can be washed and reused.
- Cabinet Scraper: This is required for smoothing wood surfaces, typically after planing; well suited for levelling knots and cutting away dried glue. Blade scrapes a paper-thin shaving from

surface: has twin handles for greater convenience and control than hand scraper.

- Belt sander: Tower sander used to eliminate stock and eliminate flaws from wood surfaces, and for smoothing. Sanding belts obtainable in grits from coarse to fine.
- Steel wool: Specially made woodworking steel wool is oil-free and features longer strands than standard varieties: less likely to leave deposits on wood.
- Random-orbit sander: Power sander used for fine smoothing and removing swirl marks left by belt or orbital sander; ideal for contoured surface
- Contoured sanding block: Holds sandpaper for smoothing curved and averagely fashioned surfaces by hand: features a narrow side for reaching into tight spots.
- Orbital palm sander: Power sander for smoothing surfaces that are difficult to reach with larger sander.
- Flat sanding block: Holds sandpaper to smooth flat surfaces by hand.
- Alcohol lamp and burn-in knife: Used to apply shellac stick to damaged areas on wood surfaces; flame from lamp heats knife, which in turn melts shellac, dripping it onto surface.
- Grinder: Sharpening wheel can be used to regrind bevels on plane blades.

Chapter 44 Planing Techniques

Choosing the finest way to smooth a wood surface is a matter of individual preference. There are no ordained steps or prescribed rules. Some woodworkers plane and then sand; others plane and scrape before sanding.

Whichever sequence you decide to follow, the object is to develop a surface that is as smooth as glass and just as flat. This section of the book explains the use of a smoothing plane to begin the procedure of preparing a wood surface to accept a finish.

A well-sharpened blade in a properly adjusted plane can shear off fine shavings of wood. You can make all the adjustments with only a screwdriver, despite the plane's apparently complicated design.

Plane blades require average sharpening. While you can hone a blade by hand, a grinder is the finest tool to bring a cutting edge to peak performance. For a nicked blade or an old out-of-square one you wish to salvage, square its end.

For a new blade or one that has had its bevel worn away, hone a new bevel on the cutting edge. To maintain a keen edge, hone the blade frequently on a sharpening stone.

Before using a plane, set the depth of cut to eliminate only a thin shaving on each stroke. Since an excessive depth setting may develop gouges in the work piece, you should test your setting first on a scrap board.

For a great outcome on a large surface use a long plane; a short one will be more likely to follow existing contours. Set a plane on its bottom when storing the tool to prevent the iron from getting nicked by other tools.

Infrequently rub a thin film of light machine oil on the blade to prevent rust. Once a year, or depending on the amount of use, take the tool apart for a general cleaning.

Sharpening with a machine

1 - Squaring the end of the blade

- Use a try square to check whether the cutting edge of the blade is square.
- If it is not, square it on a grinder with a rough wheel.
- With the guard properly positioned and the blade clear of the wheel, switch on the machine.
- Holding the blade between the index finger and thumb of your right hand, set it bevel up on the grinder's tool rest and advance it toward the wheel until your index finger contacts the tool rest.
- Slide the blade side-to-side across the wheel, pressing lightly while keeping your finger on the tool rest.
- The tip of the blade should stay perpendicular to the wheel throughout the operation.
- Dip the blade in water frequently to prevent it from overheating.
- Check the blade for square averagely.

2 – Creating a hollow-ground bevel

- Sharpening a plane blade involves three steps: creating a bevel on the blade's cutting edge, honing another bevel on part of the first one-called a micro bevel-then removing the burr that outcomes from the honing procedure.
- To create the first bevel, clamp the blade top face up in a commercial grinding jig set to create a 30 degree bevel.
- Run the cutting edge across the wheel as you would for squaring the blade; the jig will keep the blade square to the wheel.
- Check the cutting edge periodically and stop grinding when the bevel forms.
- As a rule of thumb, the bevel is correct when most of the sparks showering from the grinder fall on the top face of the blade, rather than below.

3 - Honing the micro bevel

- Place a combination sharpening stone fine side up on a work surface.
- Nail cleats to the table against the stone to keep it from moving.
- One of the cleats should be the same height as the stone and 4 to 5 inches long; this will allow you to use the full length of the abrasive surface.
- Clamp the blade in a commercial angle-setting honing guide with the bevel touching the stone.
- Saturate the stone with the appropriate Lubricant - either water or a light oil until it pools on the surface.
- Then, holding the honing guide, slide the blade back and forth from end to end along the stone, applying moderate pressure until a micro bevel forms.
- Continue until a burr-a thin ridge of metal-forms on the flat face of the blade. Then lap the burr as you would when sharpening a plane by hand.

Sharpening by hand

Clamp the blade in a commercial guide and grind a 30 degree bevel using the coarse side of the stone. Then reposition the blade in the guide and turn the stone over to hone the micro bevel.

To eliminate the burr from the blade-procedure woodworkers call "lapping" the burr-eliminate the blade from the honing guide and saturate the stone once again.

Holding the blade flush on the stone, bevel side up, move it in a circular pattern on the stone until the flat side of the cutting edge is smooth to the touch.

A few strokes should suffice to eliminate the burr. Test the sharpness of the cutting edge on a piece of paper; a sharp blade will slice a sliver from the edge. No matter how well it is adjusted, a dull or poorly sharpened plane blade will do a poor job of smoothing the wood surfaces of your furniture.

Moreover, its condition will only deteriorate if you persist in using it, losing its beveled cutting edge and possibly even going out-of-square. Such a blade would need to be squared and sharpened on a grinder.

A well-sharpened blade has a visible bevel and micro bevel, making it a razor-sharp cutting implement. This blade needs only an occasional honing on a sharpening stone.

Adjusting the plane:

1 - Positioning the cutting edge

- Loosen the lever cap screw and eliminate the blade assembly-including the lever cap, cap iron and blade-from the plane.
- Then loosen the cap iron screw and slide the cap iron on the face of the blade to leave a gap of about 1/16 inch between the end of the cap iron and the cutting edge of the blade.
- Tighten the cap iron screw.
- Next, place the blade assembly in position on the frog.
- The gap between the front edge of the blade and the front of the mouth should be about 1/16 inch.
- If not, loosen both frog setscrews about 1/4 turn, then turn the frog adjusting screw with a screwdriver to set the appropriate gap.
- Lock the blade assembly in position.

2 – Centering the blade

- Holding the plane, shift the lateral adjusting lever to one side or the other to center the cutting edge in the mouth.
- To set the cutting depth, turn the depth-of-cut adjustment knob so that no more than about 1/32 inch of the cutting edge protrudes from the mouth.
- Check the depth of cut by eye, and then confirm the setting by making a test cut on a scrap board.
- The shavings should be paper-thin; the finer the cut, the more transparent the shavings.
- Adjust the cutting depth, if necessary.

Using a smoothing plane

Guide a hand plane along a wood surface with smooth, even strokes. Always cut with the grain of the wood; planing against the grain will tear

the wood, rather than shaving it off cleanly.

If you cannot determine the orientation of the grain, lightly slide the plane parallel to an edge in one direction, then repeat in the opposite direction.

The cutting edge will chatter or catch on the wood fibres when it is cutting against the grain. If the grain orientation changes on the surface, switch the direction of your stroke to follow the grain.

To smooth a surface such as a table top, move the plane back and forth using a series of straight passes that slightly overlap. When pulling the plane back after each forward stroke, tilt the tool to one side to lift the cutting edge clear of the surface.

Smoothing a face

Secure the work piece face up on a work surface. Once you have oriented the plane with the wood grain, line up your shoulder and hip with the tool to help you maintain full control of the cut.

Gripping the plane with both hands, push the tool along the surface away from your body. Apply firm and sustained pressure during the stroke, pressing down on the front of the plane at the start of the pass.

Once the plane is completely on the surface, even out the pressure, shifting the pressure to the rear of the plane at the end of the stroke. Examine the shavings as you work and adjust the cutting depth if you want a finer cut. Keep planing until the surface becomes shiny and smooth to the touch.

Smoothing end grain

Use a block plane to smooth the ends of a work piece. There are two ways of planing end grain, both involving two steps calculated to avoid tear out at the edges. For either technique, secure the work piece end up.

In one technique, begin a stroke at one edge of the board, guiding the plane along the surface until the blade is about halfway across the end. Repeat the procedure from the opposite edge.

In the second technique, start by cutting a chamfer at one edge of the board, holding the plane at an angle to flatten the corner. Then make a pass across the entire end, beginning the stroke at the other edge.

Chapter 45 Scraping Techniques

Scraping wood surfaces is an intermediate step between planing and sanding. A sharp scraper can eliminate high spots, tear out and glue lines, smooth a surface, and clean up marks left by a plane.

The tool is inexpensive, easy to use and rather simple to sharpen. The commonly used versions are the hand scraper—a single blade of steel and the cabinet scraper, a blade mounted in a metal or wood body that resembles a spokes have.

This implement features winged handles for two-handed pushing or pulling. Scraper blades are made from thin sheets of spring steel and sharpened to form a cutting edge.

They are obtainable in different thicknesses, depending on the work you want them to perform. Thick scrapers are suitable for heavy cuts; light scrapers are used for finer work.

Unlike a plane blade, the scraper has a hook—a small flare along the length of the cutting edge. The hook's cutting action allows the scraper to be pulled or pushed in any direction, so you can reach corners and tight spots inaccessible to a plane.

A scraper's cutting edges dull rapidly and require average sharpening, which involves filing, honing and burnishing. The size of the scraper's shavings signal its condition: the duller the blade, the smaller the shavings, until finally the tool develops only sawdust.

Most new scrapers need to be filed smooth before use. It may help to apply a little lubricating oil on the cutting edge of the scraper before burnishing, but be cautious with the oil: if it gets on your hands or bench it could end up staining the work piece.

Apart from maintaining the cutting edges of a scraper, keep in mind that the tool will perform well only if you hold it at an angle to the wood surface and push or pull it while applying a fair amount of pressure close to the cutting edge.

If you hold the scraper almost perpendicular to the surface and apply heavy pressure, the tool will rapidly eliminate wood, but it may also gouge, dent

or scratch the surface.

Held at more of an angle, the scraper eliminates less wood, but develops a smoother surface. One technique of finding the right angle is to hold the tool almost parallel to the work surface; begin scraping while gradually raising the angle of the blade until it bites into the wood.

How to Sharpen the Scraper

1 - Filing the edges square

- To file off the existing hook on a scraper, clamp the tool in a vise with one long edge facing up.
- Holding a sharp mill bastard file firmly with both hands, make numerous passes back and forth along the edge of the scraper, exerting moderate downward pressure until the bun disappears and the edges are flat.
- To eliminate filings, periodically tap the file on a firm surface or use a file card.
- Turn the scraper over and repeat the procedure for the other edge.

2 - Honing the edges

- Secure a combination sharpening stone fine side up to a work surface with cleats and lubricate it as you would when honing a plane blade.
- Holding the scraper flat against the stone, rub the face on the stone with a circular motion.
- Apply moderate pressure and continue until any roughness developed by filing disappears.
- Turn the scraper over and repeat for the other face.
- To complete the honing, hold the scraper edge down and slide it back and forth diagonally across the stone until the edge is smooth with sharp corners.
- Repeat for the other edge.

3 - Burnishing the edges to start a hook

- Place the scraper flat on a work surface with the edge to be sharpened extending off the table.
- Holding a burnisher at a slight angle to the scraper, make numerous passes back and forth along the edge, applying strong downward pressure to start turning over the edge into a hook.

- Burnish the other cutting edge the same way; turn the scraper over and burnish the edges on the other face.

4 - Completing the hook

- Secure the scraper edge up in a vise Hold the burnisher almost perpendicular to the edge and run it along the edge in one direction until the edge swells to some extent, turning outward on one side.
- For the best outcome, apply moderate pressure.
- Then hold the burnisher so that the handle is at a 10 to 15 degree angle above the edge of the scraper and continue burnishing until the edge turns over.
- Repeat the procedure to form a hook on the other side of the edge, this time holding the handle with your other hand.
- The greater the pressure you apply, the larger the hook.
- Turn the scraper over and burnish the opposite edge.
- Test the cutting edges on the piece of scrap wood, burnishing them again, if necessary, until you have the hook you need for the job at hand.

Chapter 46 How to use a hand Scraper

Secure the stock to a work surface. Standing at one end of the work piece, curl your fingers around the front of the scraper and press on the back with your thumbs to make the tool bow a little outward.

Tilt the scraper forward about 20 degree from the vertical and scrape the surface in the direction that the bow is facing. If the cutting edge does not bite into the wood properly, adjust the angle of the tool to some extent.

Work at a slight angle to the grain, applying moderate pressure and making long, fluid, overlapping strokes. At the end of each stroke, lift the scraper off the surface before stopping. You can also pull with the scraper, but be sure to flex the bow toward you.

1 - Adjusting the blade

- Install the blade in the scraper with the hooked edge facing forward and protruding 1/32 inch from the sole of the scraper.
- Lock the blade in place by turning the two thumbscrews on the front of the scraper clockwise.
- Then bow it to some extent by turning the thumbscrew that presses against the center of the blade at the back of the scraper.

2 – Using the scraper

- Secure the work piece.
- Then, standing at one end of the stock and holding the scraper firmly with both hands with the hook facing away from you, push the tool with moderate pressure along the surface.
- At the end of each stroke, lift the scraper off the surface and turn the tool upside-down to dislodge the shavings and prevent the blade from clogging.

Chapter 47 Sanding Techniques

Sanding is the final stage in smoothing a piece of furniture and is also indispensable in eliminating any blemishes left by planes and scrapers. Both tools from time to time leave marks and ridges on wood surfaces.

They can also compress wood fibres and close the pores in the wood, inhibiting its capacity to properly accept a finish. Sanding as the final step opens closed pores, allowing the finish to penetrate the surface.

A wide diversity of natural and manmade sandpaper abrasives are obtainable for the woodworker, from natural materials such as flint, garnet and emery to artificial ones like aluminum oxide and silicon carbide.

For most applications, you need sandpaper with hard, sharp-edged particles that are not simply dislodged from their paper backing. Garnet, silicon carbide and aluminum oxide are the abrasives that best satisfy these criteria.

A typical sanding sequence begins with a 120 or 150-grit paper, depending on whether or not you used a scraper. You may first need an 80-grit abrasive to eliminate defects from a surface.

Continue sanding with a 220-grit paper, moving to increasingly finer abrasives to eliminate the scratches left by the preceding operation. For a surface that is to receive a glossy finish, you will need to use a paper at least as fine as 320 grit.

How high up the grit scale you climb depends on the finishing product you intend to apply and the effect you wish to achieve. Keep in mind, nevertheless, that polishing a surface to a high gloss with an ultra-fine paper may keep a stain from penetrating evenly.

Apart from selecting the appropriate grit, you also need to select between open- and closed-coat paper. The abrasive particles on closed-coat papers cover almost the entire surface of the backing, and are best suited to sanding hardwoods.

Open-coat papers have more widely dispersed particles, covering only 40% to 70% of the backing. These are your best bet for softwoods since they are less prone to clogging by more resinous wood.

Sanding can be equally well accomplished by hand or with power tools. While hand sanding is laborious, it allows you greater control over the procedure, especially when working on contoured surfaces or in corners and tight spots.

Whichever technique you select, you can judge whether the surface is smooth enough by pulling a piece of fine nylon fabric over the wood; the cloth will snag on rough spots. Then examine the wood under a beam of light played across the surface at a low angle. The light will expose any remaining imperfections.

How to use the belt sander for flat surfaces:

Clamp the work piece down and install a sanding belt of the appropriate grit on your belt sander. Holding the tool above the stock with both hands, switch it on and gently lower it flat onto the surface.

Guide the sander from one end of the work piece to the other in smooth and straight overlapping passes that follow the grain of the wood. Keep the sander flat and moving at all times until the surface is uniformly smooth.

Avoid leaving the tool on one spot while it is running; it can cut into the surface rapidly, leaving a gouge. Clean up the sanding particles before repeating with a finer-grit belt.

Hand sanding on flat surfaces:

Attach a piece of sandpaper of the appropriate grit to a sanding block. Grip the block firmly and sand the surface with straight, overlapping, back-and-forth strokes, applying moderate pressure and working with the grain of the wood.

Keep the block flat on the surface at all times, particularly when you reach an end or edge. To smooth a small or restricted surface, use a commercial sanding stick.

When buying sand paper, consider its composition. Aluminum oxide paper works best with a belt sander. Select silicon carbide paper in grits above 220 for finish sanding with an orbital sander.

To cut sheets of sandpaper rapidly and accurately, use a shop-made cutting board. Screw a hacksaw blade to a piece of plywood with a washer under

each end to raise it to some extent off the plywood.

To cut a sandpaper sheet in half, slide it under the blade. Hold one end down, and tear the other part of the sheet off. For a quarter sheet, mark a line parallel to the blade that is one-quarter of the width of a sheet from the teeth. Then align the end of the sheet with the line and tear.

Chapter 48 How to use a random-orbit sander on curved surfaces

With its compact and pliable sanding pad, the random-orbit sander is ideal for sanding contours such as a cabriole leg. Clamp down the work piece and fasten a sanding disk to the sander's pad.

With the tool clear of the stock, switch it on and lower the pad onto the surface. Applying moderate pressure, work along the length of the work piece in back-and forth passes until the surface is smooth.

Reposition the piece in the clamp as necessary to smooth adjacent surfaces. Smoothing contoured surfaces using only sandpaper risks creating blemishes on the wood or flattening out the curves with excessive pressure.

For a shop-made sanding pad that can follow contours without over sanding, wrap a sheet of sandpaper around a thick sponge that you can comfortably grip. Hold the paper around the sponge and sand along the length of the surface with firm pressure.

Secure the work piece and attach a piece of sandpaper to a commercial contour sanding block. For most contours, sand with the circular side of the block against the wood.

For crevices and other tight spots, wrap a sheet of sandpaper around the block, hold it in place and sand with the narrow side. Smoothing the contours of a piece of molding evenly without damaging its contours is a difficult task with only sandpaper or a conventional sanding block.

Nevertheless, you can use a short sample of the molding to shape your own sanding block that corresponds exactly to the surface of the work piece. Fashioning the block requires body filler or modelling rubber, used to make a mold of the profile.

To prepare the mold, nail together a small box to some extent longer and wider than the sample molding and about ¼ inch deeper than the thickest part of the molding.

Prepare the filler following the manufacturer's instructions, and then fill about half the box with it. Lay a single thickness of plastic wrap over the box. While the filler is still soft, press the molding sample into the box and clamp it firmly against the filler.

Let the filler harden, then cautiously eliminate the molding sample from the box. Saw off the ends of the box. To transform the box into a sanding block, stretch a piece of sandpaper abrasive side up across the molded side of the box.

Use the molding sample to press the paper against the hardened filler, and then staple the ends to the sides of the box. To use the block, clamp the work piece down and slide the block back and forth along the molding.

How to smooth grooves and turnings

To sand narrow grooves in turned pieces such as chair spindles, use commercial abrasive cord. Cut a piece of cord long enough to extend a few inches on each side and wrap it around the groove.

Pull one end and then the other repeatedly to sand half the circumference of the groove. Work from the opposite side to smooth the other half.

To sand turnings or larger grooves, use abrasive tape, which is wider than abrasive cord but handled identically. Smooth intricate turnings and moldings using steel wool or abrasive pads.

Smoothing a raised panel's edges

Some sanding jobs call for a certain degree of improvisation. For example, to smooth the beveled edges of a raised panel without rounding the square edges of the frame use a piece of sandpaper folded in thirds to about the width of the beveled section.

Hold the paper in a U shape and place one finger behind it; the folded paper cannot slip against your finger. Sand the edges, applying even pressure and working parallel to the wood grain.

How to eliminate sanding dust from a wood surface

Clean particles off wood surfaces after every stage of sanding before moving on to a finer grit abrasive or applying a finish.

Eliminate as much dust and grit as possible with a vacuum cleaner, rag or bench brush. Then wipe the surface clean with a tack cloth.

Sweep your hand across the surface to check for any remaining particles.
Wipe again with the tack cloth if necessary.

Chapter 49 How to repair damaged surface

Flaws on a wood surface can show through almost any finish. In fact, a clear finish like lacquer may magnify imperfections. Before you apply a finish to a piece of furniture, you need to find and mend any surface damage.

Most defects stick out, but you need to find and eliminate the less obvious blemishes as well. Try running a hand across the wood and feeling for them. You can also wash the surface with low angle light and look for them.

The finest approach to a repair and the materials required depend on the nature of the damage. A suitable repair for a dent, for example, is to lift it with steam.

Nevertheless, if the wood fibres are severed rather than simply crushed, steam will not work; a wood filler maybe the best remedy. For small blemishes, wax or shellac stick can develop a virtually invisible fix.

Both are obtainable in a diversity of colours to match many wood species. You can buy special burn-in kits for applying shellac sticks.

The typical package includes a burn-in knife with a gently bent, stainless steel blade; an alcohol lamp for heating the knife; and a special solution for soaking a felt block that levels the repair with the surrounding surface.

Larger blemishes are best concealed with wood filler. While many versions are pre-colored, you can tint filler yourself for a perfect match. Test the filler on a scrap of the target wood before committing yourself to a particular formulation.

In situations where filler is inappropriate - since the damaged area is too large or the filler would be conspicuous, you can mend the defect with a shop-made patch fashioned from a wood scrap of the same species.

Most modern patching compounds are formulated to be compound compatible with a diversity of finishes, but in cases where the two merchandises comprise the same solvent, the finish can dissolve the filler.

For all your fixes, whether lifting a dent or filling a gouge, lightly sand the repair once you are done to level it with the surrounding surface.

How to repair a dented surface

One way to fix a dent in wood is to swell crushed wood fibres to their original shape. Turn a household iron to its highest setting and allow it to heat up.

Meanwhile, soak a clean cloth in water, fold it over a few times and place it on the dent. Press the tip of the iron against the cloth over the dent, holding it in place until the cloth steams.

The steam will swell the wood fibres, lifting out the dent. Add water to the cloth as necessary and avoid leaving the iron on the cloth for too long, which may scorch the wood.

How to apply wood filler:

Select filler that is compatible with the ingredients and colour of the finish you will be applying. Use a putty knife to work the filler into the hole and overfill it to some extent.

Then scrape off the excess to level it with the surrounding surface. Avoid spreading filler onto undamaged areas, where it may cause uneven colouring if a stain is applied.

Select a shellac stick of the appropriate colour and set a soldering gun on Low. Holding the stick over the hole, melt it with the tip of the gun. Drip enough of the product to fill the hole.

While the filler is still soft, use a knife or a wood chisel to press it evenly into the damaged area. Work cautiously to avoid marring the surrounding area with the knife or chisel blade.

Allow the filler to cool. To level the filler with the surrounding surface, soak the bottom of a felt block with a small amount of commercial levelling solution and lightly rub the block back and forth across the repair. The slow acting solvent in the solution dissolves excess filler without harming the wood.

Light the alcohol torch and hold the burn-in knife over the wick for numerous seconds. With the shellac stick over the damaged area, press the knife against the stick so that enough filler melts and drops into the hole.

Reheat the knife as necessary until the hole is filled. Use the knife to spread the filler evenly. Finish the repair with levelling solution and a felt block.

Chapter 50 Patching Techniques

How to Patch a damaged corner

1 – Preparing the damaged area

- A damaged corner is best repaired with a patch.
- If the edges of the break are ragged or sharp, use a wood chisel to cut a shallow, oval-fashioned mortise with smooth edges around the damage.
- Hold the chisel with the bevel facing down and work with the grain of the wood.

2 - Installing the patch

- Cut a patch that roughly fits the mortise, and then shape it with sandpaper or a chisel until it fits perfectly.
- Spread some glue in the mortise and set the patch in position, aligning its grain with that of the work piece.
- Use masking tape to keep the patch in place while the glue dries.
- To level the patch with the surrounding surfaces, pare away the excess with the chisel.
- Cut with the grain, keeping the chisel bevel side up.

How to Patch a larger hole

1 - Making and outlining the patch

- An effective way to mend a larger hole on a wood surface is to cut a patch and a matching mortise over the hole, then glue the patch in place.
- Using a cut-off scrap from the work piece, or a piece of veneer with similar grain and colour, cut a patch that is a little larger than the hole.
- Give the patch a diamond shape, less conspicuous than a square or rectangular patch after the finish is applied.
- Use a wood chisel to bevel the edges of the bottom face of the patch, and then sand both faces.

- Place the patch over the hole, aligning its grain with the surface grain, and mark its outline with a sharp pencil.

2 – Chiseling the mortise

- Secure the work piece with a clamp if necessary.
- Select a wood chisel to some extent narrower than the sides of the mortise to cut along the outline.
- Tilt the tool with its bevel facing up to develop an angle correcting to that on the edges of the patch.
- Eliminate the remaining waste from the outline with the chisel bevel facing down.
- Periodically test-fit the patch in the mortise until the mortise is a little shallower than the patch is thick.

3 - Gluing down the patch

- Spread some glue in the mortise and set the patch in place.
- Lay a piece of wax paper over the patch, then position a wood block on top.
- The paper will keep the patch from adhering to the block.
- If the patch is located where you cannot clamp it directly, set a board atop the block and clamp the ends to focus the clamping pressure on the patch.
- Work rapidly to prevent the patch from absorbing moisture from the glue and swelling.

Chapter 51 Graining Techniques

Every phase of working with wood—from jointing and sawing boards to planing and scraping them—compresses the fibres on the surface. Exposure to water causes the fibres to stand up, roughening the surface.

If you intend to use a water-based finish, wet the surface to raise the grain before applying the finishing solution. Spray water on the surface, and then wipe off the excess with a clean cloth.

Allow the surface to dry, and then lightly scuff the wood with very fine 220-grit sandpaper. Avoid over sanding, which might expose fresh grain, making it necessary to repeat the procedure.

Raising the grain has other benefits, such as lifting shallow dents, exposing defects and helping a finish adhere. Filling the wood grain is the easiest way to achieve a high gloss, mirror like finish on open-grained species like ash, oak and mahogany.

Grain filler, also known as pore filler or paste wood filler, is not appropriate for every job, nevertheless. A closed-grain wood has no need for filler, and some woodworkers avoid fillers altogether in favour of a more natural look.

If you decide to fill the grain of your wood, you should understand the various options regarding when to apply the filler and exactly what type to use.

Filler is usually applied before stain; if you select to stain before filling you must be cautious not to damage the stain when removing the excess filler.

Yet another alternative is to apply the stain and filler together on the raw wood, while the outcome is frequently a flat, monochromatic appearance.

To bring out the character of a species like mahogany, try staining the wood, then sealing the stain with a wash coat, and finally applying filler with a contrasting colour.

Filler comes in numerous colours; select a shade a little deeper than the wood so it will match as the wood darkens with age. You can also buy untainted filler and colour it yourself. Before committing yourself to a

particular sequence of colour, apply the filler to pieces of scrap wood both before and after staining, and select the finest combination.

For best outcomes, ensure that the work piece is clean and dust-free. Then prepare the filler following the manufacturer's directions; it should have the consistency of thick cream.

Since grain filler can absorb a lot of finish, always apply a wash coat to a filled surface before staining or finishing it. The wash coat, consisting of the finish you plan to use diluted by the appropriate thinner, creates a barrier between the filler and the finish.

With some species like mahogany, a wash coat is advisable before filling, to prevent the filler from developing unsightly white spots numerous months after it is applied.

How to Apply the Filler

1- Brushing on the filler

- With the work piece face up on a work surface, pour some of the filler into a container.
- Apply the filler with a paintbrush or abrasive pads.
- Using back-and-forth, overlapping strokes cover the surface completely with the filler, working first with the grain, then across it.
- Examine the work piece under direct light to confirm that the surface is covered thoroughly.
- Apply more filler, if necessary.

2 – Wiping off excess filler

- Once the filler begins to dry, losing its shine and turning hazy, wipe it with a piece of clean burlap folded into a pad.
- Starting at one end of the work piece, work with a circular motion to pack the filler into the wood pores and eliminate the excess

3 - Cleaning up

- On a detailed work piece such as a raised panel, eliminate excess filler from hard-to-reach spots with a sharpened tongue depressor wrapped in a clean piece of burlap.
- Dab the pointed end into corners and along edges to eliminate excess filler.
- Allow the filler to dry, and then smooth the surface with 220 to 320-grit sandpaper.
- If a second coat is required, apply it the same way.

How to apply the wash coat

1 – Brushing on the wash coat

- Prepare a 50/50 solution of the finish you intend to use, diluted with the appropriate thinner.
- Brush along the wood grain to apply a light, even coat of the solution to the surface.

2 - Rubbing in the wash coat

- Use a clean, lint-free cloth to work the wash coat into the pores of the wood.
- Allow the wash coat to dry, and then smooth the surface with extra fine sandpaper.

Chapter 52 How to change the Wood colour

From the deep, clear and bright tones of dye-tinted stains to the dense richness of the pigment-tinted varieties, the materials used in colouring wood afford a great degree of latitude.

Stains allow you to make white woods colourful, light woods dark plain woods fancy and steaked woods uniform. Throughout the long history of furniture making, stains have been called upon to fool the eye.

They have helped common woods take on the appearance of more desirable ones, adding colour and figure where it was lacking. They have also developed colours and patterns that nature never imagined.

One trick involved inlaying mahogany surfaces with patterns of white holly. The challenge was to darken the surrounding wood without discolouring the inlay, and the solution lay in a wash of potassium permanganate or dichromate.

The wash reacted with the high tannin content in the mahogany, bringing out rich reds and browns, but it left the tannin-free holly unchanged. Modern stains fall into two broad categories: those containing dyes and those with pigments.

Dyes impart translucent colour to wood, altering nature's palette while leaving the intricate grain patterns visible. Pigment stains comprise opaque colorants that cling to the surface of the wood.

Pigments can be used to add patterns and contrast to the wood grain, or to bring definition and highlights to corners and carvings. Of course, not all wood cries out to be changed; some species are best left all natural.

It is hard to imagine improving on the rich patterns of rosewood Macassar ebony or Carpathian elm burl, just as it seems futile to alter the shocking intensity of Purple Heart, pad auk or Osage orange.

But for most woodworkers, opportunities to work with perfect specimens are rare. The typical venture involves making do with whatever materials are obtainable and affordable.

Stains help to make this feasible. Ebony-costly and difficult to work but strikingly beautiful, offers a prime example of the special effects that staining makes possible.

Even when the wood is obtainable, the small tree diameter makes it impossible to obtain wide boards and the natural instability of the wood virtually assures that a good-sized piece of ebony will crack sooner or later.

Fortunately, a widely used staining technique called "ebonizing" gives the appearance of ebony to more stable and affordable woods like mahogany and maple.

Perhaps more vital than mere fakery is the ability of stains to create new woods by adding unlikely colours to aware materials. But not all staining is so blatantly obvious.

A more subtle, but equally valuable use of stain is to add to furniture that most elusive of traits: age. More than one "antique" has come to market with adroitly applied mixtures of wax and rottenstone, or even shop dust and japan colours, hiding the fact that the piece only recently left its makers hands.

Along with an assortment of stains, pigments and dyes, there are a number of implements and accessories that every finisher needs. Changing the colour of wood involves as much art as science, but in some instances precise measuring is helpful.

For example, if you are attempting to match an earlier staining job, it helps to know the exact proportions in which the original ingredients were blended together.

Use graduated cylinders and cups to measure out liquids accurately, and a scale for determining precise weights of powders, crystals and other dry components.

Brushes, sponges, rags and pad applicators of varying sizes are the most common tools for applying stains and bleaches. Brushes are categorized by the nature of their bristles.

The brush you select for a particular venture will depend on the substances you need to apply. Solvent-based stains should be spread on with natural-fibre brushes; use synthetic brushes to apply water based merchandises.

An oil-based product, such as a pigmented wiping stain, can be applied with either type of brush.

All of the merchandises presented in this chapter are toxic to varying degrees. Whether mixing or applying a stain or bleach, wear safety goggles, neoprene rubber gloves and a dual-cartridge respirator.

Chapter 53 Bleaching Techniques

Bleaches are highly reactive compounds that break down the natural colorants in wood. For years, woodworkers have used bleach to lighten the colour of their stock. The effect can be startling.

Mahogany turns a tone of pale rose when bleached; walnut becomes creamy in colour. Bleaching has other applications, nevertheless, that go beyond simply washing out colour.

The procedure can be the first step in preparing a piece for a specific stain, such as a blond finish for mahogany; it is also used to ready a dark oak for liming.

In addition, bleaching is an effective way to suppress the colour variations between the sapwood and heartwood of a species like poplar and make them more uniform. It also rids wood of water and rust stains.

There are three common versions of wood bleach. Oxalic acid, sold in liquid form as "deck brightener," is your finest choice for removing stains from wood.

Sodium hypochlorite will do an excellent job of removing an aniline dye stain from a work piece. This product is obtainable as liquid laundry bleach. But the most effective all-purpose wood lightener is two-part A/B wood bleach.

Using this diversity of bleach involves combining lye and peroxide; the outcompeting effect is stronger than that of either ingredient on its own. Wood bleach can affect your tools as drastically as the wood.

Use a synthetic brush or sponge to apply bleach; a natural-bristle brush will ultimately disintegrate in the solution. Mix and store bleach in glass containers; the compounds may react with metal.

Bleaching leaves residues on wood that can become hazardous airborne irritants when the surface is sanded. The three main versions of bleach can all be washed away by rinsing the wood with water.

Bleach can be dangerous if handled improperly, so follow the manufacturer's instructions. Never mix bleach with another compound, and

always work with a fresh batch.

How to apply the bleach

Clean the work piece of any dirt or oil, and then ready the two-part bleach by pouring a quantity of each solution into separate glass bowls. Do not mix the two parts together; they will be applied in separate steps.

Spread a generous but even coat of Part A on the wood surface with a paintbrush or a rag. Let the product do its work for about 5 minutes, then apply Part B the same way.

Let the work piece sit for at least 4 hours, then rinse the surface with water or the neutralizer supplied with the bleach.

Allow the work piece to dry overnight before applying a stain or finish. Two-part bleach is usually strong enough so that one application is sufficient; nevertheless, to lighten the wood further, repeat the procedure.

Chapter 54 Wood Stains Variations

Staining was once key to the cabinetmaker's subtle art of forgery. Armed with natural dyes, compound mordants and secret recipes, cabinetmakers could imitate the look of prized, exotic woods, or give newly built chairs, chests and cabinets the patina that antiques acquire with the passage of time.

Nowadays, camouflaging and enhancing wood with stains are still vital aspects of woodworking. Whether a stain penetrates and dyes the fibres of the wood, or merely covers the surface with a thin layer of pigments, no other step in the finishing procedure brings about such a radical change.

Staining can highlight grain patterns, mask homely surfaces, add colour or impart a uniform hue to different woods within a single piece of furniture. All stains consist of a colouring agent blended in a liquid.

The two basic versions of colouring agents are dyes and pigments. Dye stains work much like the colouring agents used on cloth. Dissolved in water, oil or alcohol, they penetrate the surface and bond to the wood fibres.

Pigment stains comprise finely ground colored powders suspended in a liquid such as linseed oil. They work more like very thin paints. When applied to wood, the liquid dries, binding the pigment to the surface.

Dyes for staining wood are most commonly sold as aniline powders, which must be blended with a liquid before use. Their intense colours can be combined in varying proportions to provide a virtual rainbow of hues and tones.

Pigment stains are obtainable in the same wide range of colours, yet come in ready to-use liquid, gel or glaze form. Pigments can also be purchased in concentrated form as earth pigments or japan colours; the concentrate is added to a ready-to use stain for enhanced effects.

Both dyes and pigments can be blended with lacquer, varnish, wax or shellac to provide colored finishes. When choosing a stain, remember that most dye stains are brilliant and transparent, but generally not as lightfast, or impervious to fading, as pigment stains.

Dye stains are excellent for highlighting grain. Pigment stains are opaque and tend to cloud the grain. Some newer liquid stains comprise both dyes and pigments, providing the useful properties of both versions of colouring agents with added ease of application.

The most desirable liquid base for a stain depends on the effect you are seeking. The deeper the vehicle penetrates the wood, the darker and richer the outcompeting colour.

Since water penetrates deepest, water-soluble stains are generally the finest choice for hardwoods. One drawback of water, nevertheless, is that it raises the grain, necessitating further sanding of the surface.

Chapter 55 Dye Stains

Derived from plants, insects and animals, the wood dyes used in the 18th Century ranged from concoctions with exotic names such as dragon's blood, verdigris, madder root and cochineal to more earthy tints extracted from tea, urine, and vinegar and walnut husks.

A hundred years later, the first aniline dye was extracted from coal tar. Today, such dyes are the industry standard, usually blended with one of three solvents: water oil or alcohol.

Dyes not yet combined with a solvent are also obtainable in either powder or liquid form. Prepended stains are more convenient to use, but mixing them yourself gives you more flexibility when you need to develop a particular effect.

A fourth type of dye product, known as non-grain raising aka NGR stain, is only obtainable in liquid form. The dyes in NGR stains are dissolved in an anhydrous, or waterless, solution of organic hydrocarbons, such as petroleum.

Whichever type of dye stain you apply, the factor that will determine the eventual colour of the wood is the amount of dye in the solution, not the amount of solution applied.

Water-soluble saints are a good choice for emphasizing the grain of hardwoods. While a water-based stain will raise the grain, many woodworkers prefer to take care of that step before applying a stain, thereby saving a sanding step that might affect the final colour of the wood.

Alcohol-soluble dyes, aka spirit stains, do not raise the grain as much as water-based stains and they develop fairly brighter hues. Oil-soluble dyes are transparent and also non-grain-raising.

The drying times of these stains will vary, depending on the solvent used. Mineral spirit-based stains generally have a slow drying time, while stains containing toluene or xylene dry considerably faster.

The trade-off is that toluene and xylene are more toxic than mineral spirits. Another potential issue with oil-based stains is their tendency to bleed through a protective finish.

While this should only occur if the stain is still wet when the topcoat is applied, it is a good practice nonetheless to use a finish with a different solvent than your stain.

For the best outcome, NGR stains should be sprayed on wood. If you use a brush, you will need to add a retarder to the solution to extend its drying time. Choosing the right stain for a venture can involve experimentation.

Chapter 56 Pigment Stains

Any substance that can be decreased to a powder can become a pigment that will impart colour to wood. Minerals, ores, metallic oxides and many other naturally occurring earth compounds can all be ground into very fine particles.

Once they are suspended in a solvent such as oil, varnish, polyurethane or water, these powders become spreadable pigment stains.

Since the particles are suspended, rather than dissolved in the solution, pigment stains dry to a thin, paint-like coating on the surface of the wood. Whereas dye stains colour wood fibres and tend to accentuate the grain, pigment stains are opaque and hide the wood patterns.

As an outcome, pigment stains are frequently used for glazing, graining and other finishing techniques that compensate for the lack of distinct grain patterns in certain varieties of wood.

Today, pigments are developed synthetically, with binders and driers added to help them adhere to the wood as the solvent dries. Pigment stains come in different liquid and gel forms.

The most popular and best-known are pigmented wiping stains are ready-to-use finishing merchandises comprise finely ground pigment suspended in linseed oil, which doubles as solvent and binding agent.

Wiping stains are slow-drying, allowing plenty of time to spread them on or wipe off any excess. Either sprayed on or applied with a rag or a brush, they are particularly useful when the wood surface is made up of heartwood and contrasting sapwood.

Other popular pigment stains include japan colours, glazing stains and gel stains. Japan colours offer a more vibrant range of hues than wiping stains, but they need to be thinned before use.

They can be used to tint other stains when you are trying to match an existing surface. The main selling point of glazing stains is that they are heavier and denser than wiping stains-and thus useful for concealing grain.

Gel stains, meanwhile, are easy to apply and they set rapidly, reducing drips on vertical surfaces. Pigments are also obtainable in powdered or concentrated form.

Earth pigments, like siennas, umbers and ochres, are mined from the earth and procedures in deoxygenated conditions at high heat to bring out their bright colours.

Different pigment stains can be blended together or with powdered or concentrated varieties to develop unique colours and tones, provided the solvents are compatible an oil based stain cannot be blended with a water-based stain, for example.

Chapter 57 How to stain wood

Woodworkers are quite naturally disappointed when a cautious applied and apparently uniform coating of stain develops uneven outcomes on a piece of furniture. Unfortunately, different parts of the same board cannot be expected to absorb liquid evenly.

Unless exposed end grain is sealed, for example, it will usually take in more of a stain than faces or edges, making the ends appear darker. Sealing end grain is simply a matter of brushing on the appropriate sealer before you stain.

There are other preparations you should make at this stage. While grain filler can be applied either before or after staining, you need to raise the grain of the wood before applying a water-based stain.

Otherwise, the stain will lift the wood fibres; requiring sanding that may eliminate the stain. Many stains can be bought pre-blended and ready to use. Nevertheless, if you enjoy experimenting, you may also prefer to custom mix your colours.

A test strip can help you develop the right combination of ingredients and determine the number of applications you will need to make. From paintbrushes and rags to pad applicators and spray guns, there are alternatives in applying stains as well.

Whichever technique you select, wear safety goggles and rubber gloves. It is a good practice also to don a dual cartridge respirator to filter out toxic fumes developed as a stain evaporates.

How to prepare the stain

When working with dyes or pigments in powder form, use a wooden stick to mix some of the powder with the appropriate solvent in a glass container. Apply the stain to a sample strip of the wood that you will be colouring, allow the strip to dry.

To darken the colour of the stain, add a small amount of powder to the solution. To lighten the stain, mix in a little more solvent. Make another test

strip, adjusting the colour of the stain until you are satisfied with the outcomes.

Sealing end grain

Use a rag or paintbrush to apply a sealer to the end grain of your work piece. Make sure that the product you use for this task is compatible with the stain and finish you will be using.

Spread on shellac for water or oil based stains or finishes; for alcohol based merchandises, seal end grain with an oil-based wood conditioner. Avoid slopping the sealer onto the face or edge of the work piece; this could affect the even ness of the stain.

Brushing on stain

Dip a clean paintbrush into the stain, coating about half the bristle length. To minimize lap marks, flood the surface with stain and brush along the wood grain in light, even strokes.

Once the surface is completely covered, wipe it with a clean, dry, lint free cloth to even out the colour and soak up excess liquid. For uniform coverage with an alcohol-based stain, wipe the surface as soon as possible after brushing it on.

Wiping on the stain

Fold a clean, dry, lint-free cloth into a pad and soak it with stain, squeezing out the excess until the pad does not drip. Wipe the stain on the surface, working parallel to the grain. Rub off the excess with a clean cloth.

Using a pad applicator

Fill the well of a pad applicator tray half full of stain and pull the pad over the roller, loading it with the liquid. Draw the applicator along the work piece following the grain, wetting the surface liberally. Use a clean cloth to wipe away the excess.

Dipping a small work piece

To colour a work piece that is too small for brushing or wiping, dip it right into a container filled with the stain. Hold the piece over the can to let the excess liquid run off. Then hold the piece by the corners and wipe it with a clean cloth.

Spraying a stain

Prepare the spray gun following the manufacturer's instructions. To stain a piece of furniture, hold the gun about 6 to 10 inches from the surface with the nozzle perpendicular to the wood.

Starting at the top of the piece, squeeze the trigger to apply the stain, moving the gun from side to side in overlapping sweeps until you reach the bottom.

For more information on adjusting and using spray tools. Before spraying a stain, contact your local authorities to ensure that your spray area satisfies local safety regulations.

Chapter 58 How to pickle a wood surface

Pickling, or liming, refers to any one of a number of antiquing techniques intended to impart an aged and weathered look to light-colored wood. Traditionally, woodworkers have pickled furniture with such compounds as nitric acid, lye and lime.

Nevertheless, you can achieve comparable outcomes by applying a coat of white paint, pigmented white shellac or white glaze to the work piece.

The trick is to wipe off the bulk of the stain, leaving traces in moldings and corners. Once the pickled stain is dry it should be sealed with a light topcoat.

You can pickle either bare or stained wood surfaces, but if you have used a water-based dye on the wood, you will also need to seal it prior to applying a latex paint or glaze. Pickling can be attempted with any species, but the procedure works best with oak or pine.

1 – Applying the white stain

- Use a rag to spread white paint or stain on the surfaces.
- While the paint is still wet, wipe off the bulk of it with a burlap rag, leaving a whitish glaze on flat surfaces and streaks of white in crevices and carvings.
- Let the stain dry.
- If the effect is too pronounced, abrade the surface with 220-grit sandpaper until you obtain the look you want.

2 - Aging the surface

- To give the wood an antique appearance, use a rag to rub a mixture of rottenstone and paste wax over the surface.
- Wipe off the excess with a burlap rag, taking care to leave some residue in the crevices and carvings.

Chapter 59 How to Apply Compound Stain

Before the advent of synthetic dyes, staining wood was an art form that rivalled alchemy. With natural dyes derived from plants and insects, and compound mordants extracted from tin, iron, aluminum and chrome, staining required knowledge of botany and chemistry as well as involvement with wood.

Applied by themselves, natural dyes develop pleasant shades of red and brown on many species of wood. Tea, for example, is used infrequently on antique reproductions to develop a warm golden hue.

But in combination with compound mordants, natural dyes can bring out a rainbow of superb, brilliant colours. The term mordant comes from the French verb “mordre”, meaning “to bite.”

Mordants do two things for natural dyes: They change the colour of a dye through a compound reaction with either the dye or the wood. They also help a dye penetrate wood and bind with the fibres.

Some natural dyes are obtainable as powdered extracts, but others must be extracted from natural merchandises in the shop. Mordants come in crystal, powder or liquid form.

When preparing a compound stain, mix a 15% solution of the dry ingredients and distilled water. It is better to make the concentration too weak than too strong; it is easier to darken the wood than to lighten it.

Allow each coat to dry completely before applying the next; colour can be misleading when the stain is wet. Some natural dyes can cause allergic reactions, but most are rather benign.

Many compound mordants, nevertheless, are caustic and sometimes toxic. Prepare and apply these merchandises cautiously, wearing safety goggles, neoprene gloves and a rubber apron.

A dual-cartridge respirator is a must for a mixture producing toxic fumes. Do not spread a compound stain on bleached wood or you risk creating poisonous chlorine gas. To avoid splashes when diluting a mordant, add the compound to the water, a little at a time.

There are no hard and fast rules for applying compound stains. Typically, the dye solution is spread on the wood, and then the mordant is added while the dye is still wet.

The solutions should be blended separately and applied when cool. Experimentation is the key to good outcomes; keep a record of your recipes and the colours they develop.

Compound staining is becoming a dying art. Many types of merchandise can be found only at photography and compound supply houses. But if you are after striking and unique effects, they can be well worth the trouble of seeking them out.

How to mix the ingredients

In preparing a natural dye solution or a compound mordant, you will generally be following the directions supplied with the colouring agent. But it is vital to be precise when combining these ingredients. Measure out the dry ingredients with a scale and set them aside in a dish.

If your recipe calls for boiling or hot water, you can use a kettle to heat up the liquid. Fill a measuring cup with the volume of water you need, then pour it into a glass jar.

Add the dry ingredients to the water slowly stirring the solution with a wood stick until the powder dissolves. Apply the mixture to your work piece with a synthetic sponge, following the procedure for wiping on a stain with a cloth.

Chapter 60 How to use a fuming tent

One of the characteristics of ammonia is its tendency, to react with the tannin in wood. Exposed to a piece of furniture, this water-soluble liquid will darken the wood, giving it the classic look of an antique.

In oak and cherry, ammonia will bring out a diversity of hues ranging from light honey to dark brown. Depending on the amount of exposure, the compound will turn some species almost black.

Ammonia can be applied by either sponging or brushing the liquid or by sufficing the wood in ammonia vapour inside a shop-built tent. This second option, called fuming, has definite advantages.

The procedure colours exposed surfaces evenly without lap marks or streaks. And while the fumes penetrate the wood more deeply than brushed-on liquid ammonia, fuming does not raise the grain, since no liquid contacts the wood.

You can fume wood with average household ammonia, but aqueous ammonia obtainable from compound supply houses in a 28% solution, works much more rapidly.

Both merchandises are caustic and harmful to the eyes, skin and respiratory system; concentrated ammonia fumes can even be fatal if inhaled. If possible, fume wood outdoors; wear rubber gloves, safety goggles and a dual-cartridge respirator.

Using a fuming tent

Build a wood frame that is a little larger than your work piece. Use triangular brackets to reinforce the corners and a bar clamp to hold the corners square as you nail the frame together.

Eliminate any metal hardware from your work piece before placing it in the frame; otherwise, the ammonia will tarnish the metal. To complete the tent, drape a black plastic tarp over the frame. Use duct tape to seal any openings in the tarp and gather it tightly around the frame, leaving one flap open.

Fill numerous dishes with ammonia and set the containers in the tent. Seal the flap and let the fumes work for about 24 hours, checking on the work piece periodically and topping up the dishes with fresh ammonia.

Eliminate the piece when it has the colour you want, and keep in mind that it will darken a little more after it is exposed to the air.

Conclusion

Thank you for making it through to the end of this book. Hope it was useful and able to provide you with a good knowledge base you will need to achieve your goals 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?

The best thing is to learn new skills that can transfer over to many facets of life. Plus, woodworking is as timeless as we are. It has been around since the beginning and is still a privileged skill.

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.

This will help you hone in on a field or two to try out. Start with the basics, and slowly build your skill set with repetition. Don't expect to have a lavish and perfect table the first time you make one.

Instead have fun and try new techniques or tools whenever you can. Or sharpen a particular set of skills and become a master! Either way, take the first step and dive into woodworking! You won't regret learning this noble skill.

Lastly, if you found this book valuable in anyway, a review is always appreciated!

About The Author

Nils Johansson is a retired woodworking enthusiast and furniture maker since 1978. He has contributed to numerous woodworking ventures over the years throughout his career.

His unique woodworking knowledge known and trusted in the field of woodworking, but recently has decided to write books on woodworking related topics. His interest in furniture of the American woodworking tools have begun in the late 20th century.