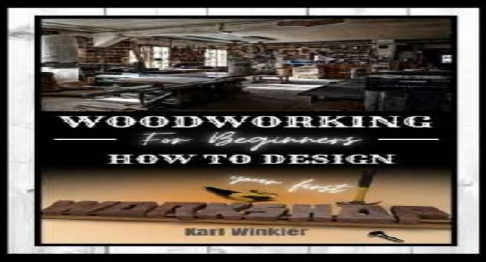
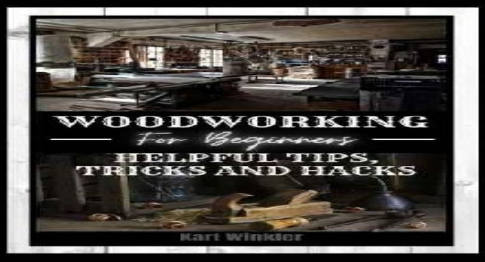
WOODWORKING

2 BOOKS IN 1





WORKSHOP DESIGN

AND

HELPFUL TIPS FOR BEGINNERS

Karl Winkler

Woodworking

Workshop Design and Helpful Tips for Beginners

2 Books in 1

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Disclaimer

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Introduction

Since workspaces vary so widely—from cavernous lofts in industrial buildings to the curves of basements and garages, down to hallways and closets - it’s hard to make definitive statements about shop layout. Just like having a workspace that is too hot, too cold, or too dark, a disorganized floor plan means woodworking won’t be as much fun. With too much fussing between every task, your frustration level will mount. Ever wonder why you are hesitating to head out to the shop? If it’s not plain laziness, it might be one of the culprits listed above. I can’t help with chronic lassitude, but I can give some advice on shop layout, with help from a few of my friends. While shop spaces range widely, most of us end up with a similar set of tools. Most also need some storage space for lumber, power tools, and other supplies; a router-table solution; and at least one other waist-high work exterior, aside from the workbench. In all cases the tablesaw and workbench were placed first, since they are used the most and require the most elbow room. But after that, these guys came up with a diversity of smart layout solutions. Also, space needs vary for hobbyists vs. professionals. That’s because time is money for the latter. The rest of us can live with a bit of shuffling to make things work. If you select to work with hand tools only, several of these rules don’t apply. Even if you make exclusions for a jointer and bandsaw to speed things up, you’ll be able to work comfortably in much less space, with only a workbench and tool cabinet to accommodate.

Book 1 begins with some workshop tips for basements and design tips for garage conversion. Then we are going to look at small workshop options, low-cost workshop options, how to wire your workshop, and tips for light improvements. Next, you will learn plenty of tips and techniques for Workbenches and storages, dust collectors, bench vises, sawhorses, cabinet installations, wall storages and how to build a wall cabinet. After that, you will learn woodworking safety practices, tips for dust protection, dust mask and respirators usage. Lastly, you will comprehend how to start planning your ventures and how to develop your own designs.

Book 2 begins with tips and techniques on how to shape wood, how to use bandsaw, Jigsaw and a handplane like a pro. Next, you will learn how to smooth wood, ripping techniques, how to apply crosscuts, how to break edges, and how to taper legs using tablesaw. Moving on, you will comprehend wood moulding techniques, how to fix mistakes, joinery and miter Joint tips. After that, we will cover how to cut mortises, how to fit tenons using handplanes, and additional mortise and tenon joinery techniques. Next, you will learn how to work with curves, how to peg wood joints, how to layout dovetails, and how to use Dovetails on the tablesaw. Lastly, you will comprehend how to miter your dovetails and how to implement moulded joints.

Book 1

Woodworking for Beginners

How to design your first Workshop

by

Karl Winkler

Chapter 1 Workshop tips for basements

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

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

illuminate storage zones. As with most woodworking workshops, a basement can get filled with tools fast. Yet basement areas can be small to start with, and often store stuff for everyone in the household, therefore storage for your lumber, tools, and accessories becomes even more of a contest. Numerous people recommended using narrow or oddly shaped areas, such as the space under stairs, to store lumber and scraps. Those with larger basements built separate storage rooms around their water heaters and furnaces. This resolution not only creates a neat storage selection, but it also separates the utilities from dust. Certain folks simply store most of their wood outside, bringing in stock as they require it. Other folks built wood stud walls over the concrete exteriors, making it easy to hang cabinets, lumber racks, or other storage systems. The bottom line: Use spaces smartly, and you'll stay well organized and avoid mixing your lumber scraps with the laundry. A basement may not be the ideal place to set up shop, but for numerous folks it's the best option. Instead of toiling in a dungeon, you can create a clean, well-lighted place. In the end, you'll be more comfortable and so will your housemates—a win-win for everyone.

Chapter 2 Design Tips for Garage Conversion

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

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

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

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

The ceiling posed a challenge. I like the looks and reflected light provided by an enclosed ceiling, but the bottom of my ceiling joists were now only 7 ½ ft. off my new plywood floor. The space felt more cramped and claustrophobic. My first thought was to spray insulation on the underside of the roof and leave the ceiling joists open. The insulation contractor said I’d still need to cover the insulation with plywood or drywall if the joists were left open, so I decided to look into raising the joists and enclosing the ceiling. I spoke to the local building department about my situation and an engineer in the department concluded I could raise the ceiling joists 2 ft. without creating structural issues. I had always thought of building inspectors as something best avoided on small home-improvement jobs, but on this venture, they were a big help. I’m a woodworker, so the idea of raising ceiling joists was a little scary. Fortunately, the actual procedure wasn’t that bad. I was able to reuse the existing joists by cutting them one at a time and nailing them in their new location. One smart thing I did was to rent a cordless Paslode framing nailer from my local home center. The final ceiling is a lofty 9 ft. While the floor plan didn’t grow, the shop now has a more spacious feel and by adding some ½-in oriented strand board on top of the ceiling joists, I have some

much-required storage above the ceiling. To access that space, I installed a fold-down attic ladder and wired a light in the attic. For insulation, I decided to spray the underside of the roof with open-cell foam insulation. Since my rafters are only 6 in. deep, I only was able to achieve an R20. But since foam practically eliminates air movement, which experts say is the real nemesis in heat loss, it should perform very well. When it came time to reinstall the lights, I decided on an upgrade. I substituted my three old 8-ft. two-bulb fixtures with nine 4-ft. four-bulb fixtures, effectively tripling the amount of light in the shop. With the addition of the white ceiling and walls, my shop now glows.

The walls of a typical frame-building garage are easy to insulate. But the walls of my shop are concrete block, so I used an insulation technique more suited to a basement shop, but with a modern twist. Rather than frame out the concrete wall in the typical fashion with studs on edge and the insulation in between, I took a different approach. I started by covering the masonry wall with a continuous layer of rigid insulation, wedging it between a top and bottom plate that I nailed to the block wall. Over that, I attached the studs flat against the insulation, nailing them to the plates. From there, I installed a second layer of insulation between the studs and completed with drywall. Installing the studs on edge would have created a thermal bridge from the block wall to the drywall, reducing the insulating appropriateties of the wall. The continuous layer of insulation between the block wall and studs acts as a thermal break and should outcome in lower heating bills. The completed wall is only 3 ½ in. thick but boasts an R-value over 20.

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

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

Chapter 3 Small workshop options

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

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

Chapter 4 Low-Cost workshop options

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

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

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

Chapter 5 How to wire your workshop

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

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

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

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

Think about how you work, and then plan to have ample power exactly where you need it. The right array of circuits, switches, and outlets makes the shop more pleasant to work in, and a few key accessories complete the picture. For general-use outlets, like the ones used for routers, hand sanders, and corded drills, it is a good idea to set up circuits based on the area served. For instance, you might set up a separate circuit for each wall. Or you may want a couple of 20-amp circuits to serve your workbench, where you might have three or four outlets on each circuit. A neat trick is to run two circuits along the wall and feed alternating receptacles from the two different circuits. Don't use a shared neutral circuit for this; you have to GFCI-protect the outlets, and keeping the two circuits completely separate makes this easier. A product called Plugmold is useful for providing workbench power. It is a steel channel with outlets spaced at intervals. Plugmold stands about 1¼ in. wide and above the exterior and is obtainable in various receptacle spacings (12 in. is best for shop use). Plugmold is much sturdier than a typical cord-connected "power strip" and is the right way to pack a lot of outlets along a wall. It's a good idea to place

wall outlets 50 in. above the floor. That way if you lean sheet goods against the wall, they won’t cover the outlets. And the outlets will be well above any benchtop or other work surface. Another nice setup is to set aside a shelf area for cordless-tool chargers, and put a 3-plus-ft. strip of Plugmold with 6-in. receptacle spacing on the wall behind the shelf. Put this on a separate 20-amp circuit, so you can leave it powered up while turning the other receptacle circuits off at the breakers for safety when you’re not in the shop.

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

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

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

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

Chapter 6 Tips for light improvements

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

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

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

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

1 - Choice your fixture

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

2 - Choice the bulbs

- One of the criticisms we often hear about fluorescent bulbs is that the light is unnatural and bluish.
- This was true, yet fluorescent bulbs are now obtainable in a wide variety of colors.
- Measured in kelvins, color temperatures generally range from 2000 K to 7500 K.
- Ideally, the lighting in the shop should be the same as the lighting inside your home, so your ventures look the same in both environments.
- Most likely you have warm incandescent lighting in your home, so you should select warm fluorescent bulbs with a 3000 K color temperature.
- This will help your completed ventures look the way you envisioned, and the cost difference compared to standard bulbs is insignificant.

3 - Plan your layout

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

Task Lighting

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

Chapter 7 - Workbenches and storage tips

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

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

How to make the top:

- First of all, when you hace to cut 4 x 8 sheets of medium density fiberboard aka MDF, and particleboard it's not an easy task.
- You can buy 1 sheet of each and then have your supplier rough them down to make each piece 1 in. larger at each direction.
- Next, you could utilise the particleboard offcuts to piece together the top's middle layer.
- If you do you plan your cuts watchfully, the middle layer will entail of 2 pieces with only 1 seam.
- Before you start the assembly, utilise a router or a tablesaw and straightedge to cut the top layer precisely to final extent.
- Next, you can cut the other layers about ¼ inch to 3/8 inch larger than this layer.
- Begin the glue-up with the top layer face down on the base.
- Roll yellow glue onto the exterior, then place the pieces of the middle layer on the waiting piece.
- Ensure that the middle layer extends beyond the top on all edges, and then screw them all together.
- You also need to ensure that you don't drive any screws where you plan to drill dog holes.
- After that, utilise a router and a flush-trimming bit to bring the middle layer flush with the top.
- Complete the glue-up by repeating the entire procedure to attach the bottom layer.
- Next, you should cut the stock for the solid-wood edging no more than ⅛ inch wider than the thickness of the top, with each piece about 1 inch longer than its completed extend.
- Once gluing the edging to the sides, utilise thick clamping cauls to distribute the pressure correspondingly.
- After completing gluing the edging in place and trimming the ends, utilise a router to flush-trim the protruding edging to the core, top and bottom.
- Then switch bits and round over all the edges.
- Now is also a great time to sand the benchtop.
- This bench has one vise, which acts a both an end vise and a front vise.
- You can utilise it to hold your work vertically for any sawing or chiseling task or you can use it in conjunction with benchdogs to simply hold a board flat on the benchtop.
- Before installing the vise, I utilise an inexpensive ¾ inch spade bit to drill a row of holes in the top for the bench-dogs.
- I start the row 5 inch from the vise end of the bench and space them about 4 in apart, yet the spacing can vary according to your requirements.
- What is vital is that the holes line up with the dog in the vise.
- To mount the vise, first you need to make a spacer to fit between the vise and the bottom of the benchtop.

- It should be rather wider and longer than the vise’s footprint, and thick enough to drop the cast iron jaws about ½ inch below the top.
- Hardwood jaw pads go on before fitting, and then get planed flush with the benchtop.
- Next, you need to glue and screw the block to the underside of the bench and then clamp the vise in its final place.
- Mark the location of the vise bolt holes on the bottom of the bench, then use an adjustable square to transfer the locations to the top.
- After drilling from the top, begin with a Forstner bit to counterbore each hole deep enough to completly recess the washer and bolt head.
- Utilise the center dimple left by the bit to drill the through-holes, and then bolt the vise in position.
- The last thing you need to do is attach the top to the base.
- I utilise 6 small angle irons obtainable from most stores and screw them in.
- For a tough, water-resistant finish, I utilise 4 coats of Minwax High Gloss Polyurethane on the bottom and top.
- The finish is durable, and can be renewed by scuff sanding with 220-grit sandpaper and brushing on a new coat.

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

How to build it

- The top looks like a bunch of 12/4 planks glued together, but it’s essentially three layers of 1-in.-thick boards. This design is very stable so it will stay flat, and it’s an economical way to use supplies.
- I used hard maple, yellow birch, and beech, dedicating the best of the maple to the top layer and the breadboard ends, and using narrower and rather lower-quality material for the middle and bottom layers.
- Glue up the top one section at a time.
- To make the job less stressful, I recommend Unibond 800, a slow-setting urea-formaldehyde glue typically used in vacuum veneering.
- Once you have the top glued together, use a circular saw to trim the benchtop to length.
- Clean up the edges with a scraper and a handplane, and flatten the top.
- When the top is flat, rout the rabbet for the till bottom on the back lower edge.
- The benchdog apron is laminated from two pieces.
- After gluing the pieces together, lay out and cut the mortise for the front vise hardware in the apron; depending on the vise, you may need to cut a hollow under the top to accommodate the hardware.
- Once that’s done, use a dado set to cut the dog holes.
- Attach the vise’s rear jaw to the apron and then set the piece aside as you start working on the breadboard ends.
- Cut the breadboard ends to width and thickness but leave them a bit long.
- Cut them to size after you lay out and cut the joinery to attach them to the benchtop.
- At the rear of each breadboard, rout the groove for the till bottom; it should align with the rabbet in the benchtop.
- Then drill holes for the lag screws that will help anchor the breadboards to the top.
- Lastly, lay out and cut the dovetails.
- Use a router and fence to cut the tenon cheeks on the ends of the top.
- Then lay out and cut the long tenons that will go deep into the breadboards.
- Clean up the inside curves with a chisel, and fine-tune the fit using handplanes.

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

How to build a smooth-working tail vise

- Building a smooth-working tail vise can take nearly as long as building the benchtop or base.
- The work is worthwhile because a tail vise is unmatched at holding work flat on the benchtop between dogs.
- Have the hardware in hand before you start and make a full-scale drawing of the whole assembly to make layout easier.
- Use a circular saw and hand tools to cut a notch in the benchtop for the vise, and tune the vertical exteriors square with the top.
- Rout the groove for the top plate a bit oversize to provide a little clearance and leave room for adjustment, if required.
- Now attach the vertical mounting plate to the bench (with only two screws so you can adjust it later if need be), aligned with the top-plate slot and perfectly parallel with the benchtop.
- The core of the vise accommodates the screw and nut, and is laminated from two pieces.
- Before gluing them together, hollow out the interior of one piece with a core-box bit and router.
- The other piece has a rectangular section eliminated with a saw.
- Glue these two pieces together and let them dry.
- Now make the dog-hole plank and dovetail it to the end cap.
- Cut two mortises in the end cap and mating tenons on the end of the core, for alignment and added strength.
- Also, cut the shallow mortise into the end cap and a tenon on the end of the top cover.
- Cut a shallow rabbet in the top edge for the top guide plate.
- Attach the top and bottom guide plates to the core and slide it onto the plate on the bench.
- There should be little wiggle when you lift the front edge, and the core should move parallel to the bench.
- If the guide plates grip the steel plate on the bench too firmly, the core movement will be stiff.
- Shim the bottom guide plate with a piece of veneer or a business card.
- If you have lots of wiggle, the plates need to be tighter together, so deepen the rabbet for the top guide into the core rather and retest.
- When the core moves smoothly, eliminate it from the bench.
- Now glue the dog-hole plank and end cap together and to the core.
- Mount the assembly to the benchtop, adding the last screws to the mounting plate.
- Thread in the lead screw and fasten the flange to the end cap and test the vise action.
- Lastly, install the top piece, which is tenoned into the end cap and glued to the top of the core.
- Now finish the exterior prep on the benchtop.
- Bring all exteriors flush and smooth using handplanes.
- I chamfered all edges with a block plane.
- Add the slide-up stop on the end of the bench, install the drawers, and make a couple of handles for your vises.
- Last, finish the top with two coats of boiled linseed oil.

Building a wired workbench

- In a modern workshop, many work gets done with power tools such as biscuit joiners, routers, or random orbit sanders aka ROS.
- Yet most of us utilise them on benches intended around handplaning.
- This means that each item from the height to the mass to the vises and benchdogs is geared toward hand tool usage.
- Power tools require electricity to run and they make a lots of dust.

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

Chapter 8 Dust Collector Tips

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

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

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

Chapter 9 Bench vise tips

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

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

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

Chapter 10 How to use the Bench Vise

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

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

Chapter 11 Tips for Sawhorses

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

How to make them

- The loveliness of these horses is their straightforwardness, and the materials and building imitate that.
- They will get knocked about and loaded severely, therefore select supplies in view of that.
- Avoid weaker woods like pine and poplar.
- Hardwoods will last much lengthier, yet these are only workhorses, therefore consider your wallet also.
- Red oak or hickory are cheap alternatives.
- Once milling the lumber, you should mark the upright mortises in the bases and then cut them utilising a plunge router.
- Cut the mortises in the uprights for the lower stretcher the same way, but utilise a backer board underneath to avert any blowout on the other side and to guard the exterior.
- This joint is wedged, consequently I flare the mortises with a rounded file to house the wedges.
- Next, cut the tenons on the bottom of the uprights and the ends of the lower stretcher.
- After that, cut the shoulders on the tablesaw utilising a stop on the crosscut sled, and then cut the cheeks with an over the fence tenoning jig.
- Then you can chisel and file the tenons round to equal the mortises.
- The notched top stretcher sits in corresponding notches in the uprights and gets screwed in place through the uprights, making it easy to replace when it gets worn.
- The distance between the inside shoulders of the notches should match the length of the lower stretcher from shoulder to shoulder.
- Next, you can cut the notches in the upper stretcher using a crosscut sled on the tablesaw.
- As there are only 4 narrow notches, you don't have to bother with a dado blade.
- I do the same for the uprights, utilising a tall fence on the sled.
- My bases have only an angled cut on each end and a shallow cutout with the similar angle on the bottom.
- Of any kind the shape, this cutout on the bottom is vital as it generates 4 feet instead of just 2 long planks that sit on the floor.
- Without the center area cut out, the horses are likely to wobble.
- Before glue-up, use a file or block plane to break the sharp edges, and use a handsaw to cut kerfs in the tenons that will hold the wedges.
- Drill and counter-bore the top of the upright for the screw that will secure the top stretcher.
- Now dry-fit the assembly.
- Mark and trim the through-tenons on the lower stretcher so they protrude about ⅛ in.
- Next, you can glue the uprights into the bases.
- Once they are dry, glue the lower stretcher into the two uprights.
- Once this assembly is in clamps, tap and glue the wedges into place before the glue sets up in the mortise.
- Afterward the glue dries, trim and file the wedge flush on the end of the tenon.
- You can screw the top stretcher in position, and you are ready to put the horses to work.

Chapter 12 Workshop Storage Tips

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

Cabinets Building techniques

- I especially like base cabinets in the shop because they provide horizontal work exteriors along with plenty of storage.
- For the Venture House shop, I made a set of fixed and rolling cabinets that occupy most of a long wall.
- The fixed units create 20 square feet of countertop in addition to nearly 50 cubic feet of storage in the spaces underneath.
- The top rank of shallow drawers works well for smaller items, while the deeper drawers underneath can hold routers, belt sanders, biscuit joiners, and other large tools.
- One open cabinet provides space for a shop vacuum, and an opening in the MDF top makes it easy to connect to any tool you roll into place.
- A backsplash prevents anything from falling behind the cabinet. I build shop furniture like this from ¾-in.
- You perhaps won't find this at your local home center, but it's worth seeking out at a plywood or lumber dealer because it is rigid, stable, and without voids.
- The cabinets are sized to be cut efficiently from standard 4x8 sheets.
- The boxes can be assembled simply with coarse-thread drywall screws.
- Be sure to drill pilot and clearance holes for each screw or you'll split the plywood and lose strength.
- With the exclusion of the MDF top, White built the cabinets excusively from Baltic-birch plywood.
- Basic butt joints, held with plenty of countersunk, coarse-thread drywall screws, make a sturdy box.
- For the fixed cabinets, White mounted the boxes on skids milled from kiln-dried 4x4s, with a ½-in. lag screw at each corner for leveling.
- The scrap is there to set the initial height.
- The rolling cabinets ride on heavy-duty casters.
- To the plywood subtop, White screwed a layer of ¾-in. MDF for a replaceable, low-friction exterior.
- Also had to create a large overhang in back to accommodate a protruding foundation wall, but you might not have to.

Chapter 13 Cabinet Installation Tips

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

Chapter 14 Wall Storage tips

- Cabinets are great for stowing tools and supplies that don’t see action every day.
- Tools used all the time should be closer at hand.
- This is especially true near the bench, where I keep chisels, saws, and layout tools in open racks on the wall.
- This makes them easy to find, retrieve, and stow.
- The same system works terrifically for clamps.
- A lot of woodworkers stow their clamps on a cart that rolls out of the way when not in use.
- For a smaller shop, it makes more sense to use open wall space.
- A fast and flexible way to create this storage is by covering the studs or wallboard with sheets of T-111 plywood.
- I like T-111 because, like any plywood, its strength means you can install tool racks anywhere, without searching for a wall stud.
- But I like the roughsawn look of T-111, and its exterior disguises abandoned screw holes.
- The plywood exterior makes it easy to attach an assortment of shelves and custom holders for a wide diversity of tools and clamps.
- And the arrangement is easy to reconfigure as your tools and needs change.
- White used T-111 plywood, an inexpensive exterior sheathing product, as a base for mounting tools and clamps.
- Battens screwed to the wall provide more attachment points for the siding and eliminate the worry of aligning seams with stud locations.
- Near the bench, White mounted an array of holders for hand tools of all kinds.
- For chisels, you can route dadoes of differing widths in a long board, and then added strips on the front side to keep the chisels in place.
- The tool walls make it easy to find, retrieve, and stow the items you need most often.
- Because they are heavy and hard to handle, the most efficient place to store sheet goods is near the entrance where you bring them into the shop.
- In this shop, I placed the plywood rack right next to the twin carriage doors.
- And, because the tablesaw is only a couple of steps away, there won’t be any trouble maneuvering through the shop with a cumbersome 4x8 sheet.
- The rack holds the sheets between the wall and a support arm that can mount to a wall or a ceiling joist.
- The support arm stops the travel of the sheet tops; this lets the user flip the sheets forward to view and retrieve a sheet from anywhere in the pile.
- The bottom ends of the sheets rest on a rather raised platform covered with melamine particleboard with a UHMW plastic strip on the open end for easy sliding in and out of the rack.
- The restraining bars lift out of the way for loading.
- A lipped platform secures the sheets at the bottom.
- Lastly, some folks say that a shop is only as good as its lumber stash.
- But how good is that, really, if the stash is disorganized?
- The solution is to get your lumber up on a good sturdy rack.
- It’s not much more expensive to buy one than build one, so we bought one.
- I put the rack along the shop’s back wall, with long stock below the window and shorter boards higher up, between the back door and the back window.

Chapter 15 Building a Wall Cabinet

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

Design considerations

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

How to build it

- I think a tool cabinet deserves some extra attention.
- For me, that means a solid-wood case with dovetails at the curves, and frame-and-panel doors mounted with mortised butt hinges.
- Still, I made good use of Baltic-birch plywood in the back and door panels as well as in the interior of the case. It provides a solid exterior for mounting tool holders and its thin, void-free plies mean that the exposed edges look nice.
- You could certainly build the whole cabinet from plywood or go to the other extreme by adding veneer or marquetry.
- It's a great place to show some flair and dress up your shop, or you can keep it straightforward.
- I cut the dovetails on the tablesaw.
- Then I cut the pins with a handsaw, hogging out the waste between pins with a router and paring to the line with chisels.
- To give the case more rigidity, I joined the fixed shelf to the sides with through-tenons.
- Typically I start by cutting the mortises, but in this case it was easier to transfer the tenon layout to the mortises rather than vice-versa.
- First I cut the tenon shoulders using the tablesaw.
- I formed the cheeks by cutting a shallow rabbet, with the blade buried in a sacrificial fence.
- The rabbet has three benefits.
- First, it provides a consistent shoulder line to pare to when removing waste between the tenons.
- Second, it obscures any gap at the mortise.
- And Lastly, I can give a shelf a final handplaning without affecting the thickness of the tenons.
- For the mortises, I started by marking the shelf location on the back edges of the sides and then carried those lines across the faces.
- Next, I stood the shelf on each case side to mark the mortises on the inside and outside faces. I roughed out the mortises on the drill press and squared them up with a chisel.
- Once the joinery was completed, I dry-fitted the case, making sure the assembly was square.
- I also lightly chamfered the ends of the dovetails and through-tenons with a block plane because I planned to leave them proud instead of trimming them flush after glue-up.
- After gluing up the case, I made and installed the plywood back panel.
- I cut it and the lower French cleat from the same piece, beveling their mating edges at 45°.
- The bevel cut is hidden by the fixed shelf and centered in its thickness.
- Then I assembled the doors and the door boxes

Building the storage components

- With the case complete, it was time to work on the storage components.
- I started at the heart of the cabinet with the plane till and the gallery, intended to hold my collection of handplanes.
- The till not only displays the larger planes nicely but it also makes them simply accessible because it tilts back at 30°.
- Triangular cleats screwed to the case sides support the till.
- The planes are separated by a series of dividers screwed to the till.
- I used the actual planes and a ¼-in.-wide spacer strip to locate the dividers.
- At the bottom of the cabinet I created a gallery that also embraces a couple of drawers, useful for each item from drill bits to tape measures.
- The whole section slides in and out as a unit and is screwed to the base of the cabinet at the back.
- The gallery is narrower at the top than at the bottom, and the dividers are curved.
- This allows easier access to the handplanes.
- The ¼-in.-thick plywood dividers slide into dadoes in the ½-in.- thick top and bottom.
- I added horizontal dividers to two of the partitions to double-up block plane storage, gluing in stops to keep the smaller planes from sliding in too far.
- At the top of the cabinet, just above the plane till, I added cleats to the cabinet sides.
- These not only support a small shelf but also act as a place to attach a pair of swing-out plywood panels made from ½-in.-thick Baltic-birch plywood.
- I relieved the bottoms of each panel so they wouldn’t block access to the planes below.
- I also added swing-out panels to the inside of each cabinet door.
- The panels give me another robust exterior to attach tool holders, helping the cabinet pack in even more storage in a shallow space.

Chapter 16 Storing handplanes

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

How to build it

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

How to fit the interior frame

- Start by making the top and bottom pieces of the frame.
- Cut them to length, and then bevel one edge 5° so that the inward facing edge is at a right angle to the back panel.
- That means you bevel the top edge of the top piece and the bottom edge of the bottom piece.
- Next, cut the dadoes for the vertical frame pieces in the top and bottom of the frame.
- Fit the vertical pieces, and then cut the dadoes in them for the short horizontal frame pieces.
- After cutting and fitting the shorter pieces, drill ¼-in.-dia. holes in them for the lower bootlace hooks.
- Now glue the interior frame into the case.
- These tight-fitting parts require only spring clamps to hold them while the glue cures.
- After the interior frame has been installed, drill holes through the top of the case for the top bootlace hooks.
- Clamp a backer board to the opposite side to prevent tearout.
- Cut the top and bottom grooves for the back panel with a tilted dado blade.
- Then use a plunge router and angled fence to make the grooves in the sides.
- Cut the grooves in the top and the horizontal divider at 5°.
- With the case dry-assembled, use offcuts from the back-panel stock to lay out the side grooves.
- Place these blocks in the top and bottom grooves and scribe around them with a knife.
- Clamp a fence aligned with the scribe marks, and use a plunge router and ½-in. pattern bit.
- Assemble the carcase first.
- Once that's done, make the french cleat, then cut and assemble the interior frame.
- The plywood back panel is glued into its grooves, making the cabinet rigid.
- Install the top and bottom frame pieces first, and then attach the vertical pieces.
- You can glue them to the back panel without clamps, but the joinery must be tight.
- Drill the bootlace holes in the short horizontal pieces before gluing them in.
- Once the case is glued up, drill holes through the top piece for the bootlace hooks.
- Clamp a backer board underneath to prevent tearout.

- Make a loop using a square knot and thread it through its hole.
- Experiment to get the right-length loop for each plane.
- I completed the rack with three coats of Danish Oil, which brings out the beauty of the wood, protects it from grime, and touches up simply if required.
- Once the finish is dry, make the bootlace hooks.
- It will take some tries to get the right-length loop for each compartment.
- As long as you can hook the knob of the plane through the loop and the plane sits in its compartment, you’re good to go.
- Singe the ends of the loops to prevent fraying.
- It won’t take long to get the hang of this rack.
- Soon you’ll be removing and replacing the planes with just one hand.

Chapter 17 Woodworking safety practices

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

Handling Cuts

1 - Soap and Water

- The rival of healing is infection.
- The germs that live on lumber and tools generally do not cause disease; all the risk is from bacteria you already carry on your skin.
- A wound allows those skin germs to reach the more vulnerable tissue beneath the skin.
- The issue gets worse in case there is sawdust, dirt, dead tissue and debris goes into the wound.
- The most effective way of handling all wounds is instant washing with soap and clean tap water.
- You could skip this in case you need to go to the emergency room (ER), because they can and will clean it there.
- Washing drastically decreases the number of germs, and takes away dirt and debris in which bacteria could hide and multiply.
- The best way to clean a wound is to hold the cut under running water for several minutes.
- If you have no soap around, plain tapwater will do a great job.
- Wash every wound, even if you can see contamination or not.
- Waterless hand cleaners and antiseptic solutions may be better than nothing, yet they are not a proven substitute.
- If you are able to wash the wound successfully, you don't need these supplies.
- Doctors and first-aid manuals in the past have routinely recommended the usage of an antibiotic ointment, yet recent research proves that clean wounds need no antibiotic if they are washed properly and closed quickly.
- Furthermore, the ointment preparation discourages the formation of a scab, which is the most effective wound closure obtainable.
- Skip any antibiotic ointment unless dirt and debris were driven into the wound and cannot be washed out.
- Wash both hands vigorously enough to generate lots of lather under a robust stream of warm running water for several minutes.
- While washing, hold the cut open and flush the wound for at least a minute.
- Ignore any bleeding this may cause.
- Dry both hands on a clean paper towel.

Weak areas of the hand

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

2 – Using 5 minutes pressure

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

Using a glove

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

3 - Close the Wound

- When you get cut, keeping the two edges of the wound firmly closed will help it heal rapidly.
- Cuts from sharp tools penetrate cleanly, which makes them easier to close and faster to heal.
- Wounds with frayed or crushed edges take a bit longer to heal. In either case, you want to wash and close the wound to pull the sliced skin back together.
- Standard adhesive bandages cover the wound but don’t securely close it.
- As soon as you start using your hands, skin movement will reopen the cut.
- Hospitals often utilise a specialized tape product called Steri-Strips, which you could buy without a prescription in most drugstores or online.
- It is likewise possible to glue wounds closed with ordinary cyanoacrylate glue.
- Both practices work better in case you have a helper to either hold the wound closed or to apply the Steril or glue.
- Dry the skin around the wound, then cut the strips to length.
- Eliminate the paper backing, and apply.
- Adhere the strip to one side of the cut, push the wound edges together so they just meet, and stick the strip down on the other side.
- Cyanoacrylate glue works for closing a wound.
- But the job is not like butting two boards together.
- Do not apply glue inside the wound. Instead, push the skin edges together and spread a thin layer of glue across the top of the skin, interrupting the glue at short intervals to preserve flexibility.
- Don’t utilise the activator spray that comes with some glues.

4 - Smarter Bandages

- In case you go to an emergency room with a hand injury, you’ll come home with a huge bandage that will attract many sympathy.
- Emergency rooms often use gauze as the main element of bandaging.
- Gauze is light as air, extremely flexible, and breathes like it wasn’t there at all.
- Nevertheless, you cannot work wood while wearing gauze.
- Woodworkers need bandages that are flexible, thin, and tough.
- It is likewise convenient to have bandages that shed water, sawdust, and glue, and yet breathe so the skin stays dry.
- Here are two bandages that you could utilise after you’ve closed the wound or after you’ve come home from the ER.
- The first option is to cover the area with a Tegaderm dressing.
- Tegaderm is a transparent medical dressing that’s flexible, tough, and stretchy.
- It is great for hand wounds because it could be conformed to a number of shapes and is so smooth that it won’t catch on any sharp edges.
- This product is obtainable with and without a non-stick, absorbent pad in the center.
- Numerous wounds will seep a small amount of serum in the first few hours after bandaging, and the absorbent pads are useful then.
- Later, they may be unnecessary.

- In case you have to handle rough lumber, or do work that applies a lot of friction or abrasion to your hands, consider wearing leather or fabric gloves to protect the dressing.
- Injuries that involve the palm or the webs between the fingers are very hard to bandage.
- Once closing the wound with a Steri-Strip, apply a Tegaderm bandage.
- Put on the bandage and then peel off the paper frame.
- In case you need to cut the bandage to a smaller size, do it while all the backing paper is still in place.
- The bandage is thin and flexible, allowing nearly full knuckle movement
- It's hard to keep a bandage in place on the palm of your hand, thus wrap the dressing with Coban tape.
- First you have to take a couple of wraps around the wrist.
- This serves to anchor the whole bandage.
- Then continue with several wraps around the palm.
- Lastly, end the Coban on the back of the hand or wrist, where it will receive the least rubbing.

Punctures treatment

- Punctures from clean, sharp tools like narrow chisels, scratch awls, and marking knives should pose very little hazard and require very little treatment.
- The wounds tend to close themselves.
- Wash thoroughly and apply a small bandage until bleeding stops.
- If you have a puncture wound caused by a dull tool, you have an increased chance of infection.
- First wash the area thoroughly.
- As you wash, flush out the wound with water using a squeeze bottle or glue syringe.
- Apply Tegaderm with an absorbent pad.
- If the wound becomes more puffy and painful over a period of several days, have it seen by a doctor.
- Puncture wounds carry a very small risk of tetanus.
- You were immunized against tetanus in childhood, but your immunity needs a booster every 10 years.
- Keep this up to date.
- As you wash, open the wound as much as possible, and squirt water in with a squeeze bottle or a glue syringe.
- Don't be bashful about the amount of water.
- You want to flush the wound vigorously enough to get rid of any debris at the bottom of the puncture.
- Punctures from dull tools like screwdrivers leave more crushed and damaged cells, and the dull edge often pushes the skin, dirt, and debris back into the wound, creating more chance for exterior skin bacteria to be lodged in underlying tissue.
- These wounds really need to be flushed out.

Splinters

- Everyone who works with wood has had splinters in their skin, and virtually everyone has struggled to eliminate them.
- If you have trouble seeing the splinter, use magnifying glasses, whether it's a pair of inexpensive reading glasses or visor-type magnifiers that you can wear over eyeglasses.
- These magnifiers may come in handy for other shop uses, too, like working with small parts or chiseling to a line in tight spaces between dovetails.
- Typically you can pull out the splinter with a pair of tweezers.
- Nevertheless, if a splinter has tunneled a long distance under your skin, you'll have to gently slice the skin to reach it using a No. 11 blade in either a disposable scalpel or an X-Acto knife.
- After slicing, pull out the splinter with tweezers.
- Be sure to wash your hands and the blade thoroughly before you probe around in the skin.
- Sterility is not necessary, but cleanliness is very vital.
- Typically no dressing is required; but if you had to dig so deeply that the wound bleeds significantly, and then dress this as you would a cut.
- To reach long slivers that tunnel through the skin, use an X-Acto knife with a No. 11 blade.
- First wash your hand and the blade. Insert the back of the blade along the top of the splinter, and gently slice open the skin with the tip of the blade.
- Slice along the splinter's length to expose it as much as possible, and then pull it out with tweezers.

Looking after your eyes

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

On your way to the Hospital

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

Chapter 18 Tips for Dust Protection

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

Should you have an exhaust valve

- An exhaust valve is an indispensable feature on a dust mask.
- In fact, we recommend you steer clear of any dust mask that doesn't have one.
- Exhaust valves clear the warm air you exhale, prevent safety glasses from fogging, and help keep your face cooler.
- You also should look for a mask that is made from face-friendly material.
- The interior of the 3M 8511, For instance, is soft and fleece-like.
- An adjustable nosepiece is vital, because it allows the mask to form a tighter seal against your face and allows you to customize the mask to the shape of your nose.
- Adjustable straps are a big plus, because they make for a tighter fit.
- Testers liked the adjustability of the straps on allow you to hang the mask comfortably around your neck.
- Some features don't reveal themselves until you have a mask on.
- You don't want a mask that interferes with your vision or safety glasses, prevents you from speaking audibly, or interferes with hearing protection.
- Because they have nearly all of these features, two masks really stood out from the rest: the Willson Saf-T-Fit.
- Respirators are harder to peg than dust masks, but there are a few key features to look for.
- The weight and balance of the helmet, For instance, are vital.
- If a respirator doesn't sit well on your head, you'll take it off very rapidly.
- And the face shield shouldn't distort or interfere with your vision.
- You also should be able to wear some kind of hearing protection with the respirator on.
- Of the respirators we tested, the Airshield Pro differentiated themselves for comfort, clarity of vision, and overall user-friendliness.
- Dust masks don't last forever.
- Replace yours when it becomes hard to breathe through, when the mask no longer seals appropriately, or when it is damaged.
- If you use a respirator, ensure that you confirm its airflow regularly.
- When it doesn't move enough clean air, it's time to replace the batteries, the filter, or both.

Chapter 19 Dust Mask and Respirators Tips

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

Reusable Masks as an alternative

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

Powered Respirators tips

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

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

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

I would love to trade up for a cyclone collector, but I recently exhausted my marital capital on a larger band-saw and a planer/jointer with a segmented cutter head. So I have the same setup you perhaps have:

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

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

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

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

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

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

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

If you can afford it, get one of the new compact cyclones, with a filter that has been rated by a reputable third party. We found a few manufacturers with certified, state-of the art filters called Oneida, Penn State and Grizzly. And filters from those companies can be purchased as accessories and retrofit onto an existing cyclone. But other manufacturers are upgrading all the time, so confirm websites for current

stats and testing info. If a single-stage collector is a better fit for your budget, or if you already own one, consider the upgraded filters coming from Oneida and Grizzly.

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

Bottom line about Filtration

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

Chapter 20 How to start planning your ventures

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

1 - Plan the work

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

2 – Do not hurry

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

3 – Get ready for mistakes

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

4 - Keep your tools where they should be

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

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

5 – Use the power of Hand Tools

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

6 - Document each stage as you progress

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

7 – Ensure that you keep your tools sharpened

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

Chapter 21 Supplementary tips for beginners

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

- If you are a hobbyist, don't put yourself on a deadline.
- Leave those for your day job.
- Take a breath, clear your mind, and let that quiet voice guide you.
- It will warn you about every shortcut, and you'll be surprised at what you can accomplish.
- When I was starting out, I couldn't wait to begin cutting and building, so I intended pieces without much fore-thought.
- As a outcome, my work wound up with proportions, moldings, and other elements that I didn't like.
- I keep my first bookcase well hidden in a basement playroom.
- If you're creating a design from scratch, you'll need to iron out the particulars before you buy lumber.
- The best approach is to make scale models and mock-ups.
- After the bookcase, I built a cradle from a plan in a book.
- That one came out great, and sits proudly in my daughter's bedroom.
- We all get sticker shock at the lumberyard, but it's not worth the savings to buy subpar wood, or just enough to cover your cut list.
- The trade-off comes when you are forced to accept defects in the completed piece, or make the long drive to get more wood later.
- You won't regret buying 10% or 20% extra.
- You can cut around defects, reject a board that warps severely or looks worse than you thought it would, or replace one if you make mistakes.
- Before you open your wallet, though, take care at the lumberyard to find the right board for each part.
- Look for matching color and great grain where it counts most.
- Then use a lumber crayon to mark each board for the parts it will yield.
- Also, if you buy your wood already surfaced, take extra care to ensure that each board is straight, flat, and smooth before putting it in the take-home pile.
- You need patience and attention to detail when cutting pieces to rough length and width, then jointing and planing them to achieve flat, parallel faces and square curves.
- These tasks are crucial, but dull, and it's too easy to treat them like a speed bump on the road to building your venture.
- You might decide, for instance, to skip the step of milling your stock rather oversize and letting it acclimate for a few days before bringing it to final dimension.
- You might select not to bother marking which faces you've already milled, and end up with lumber that is not straight or square.
- Attention to these particulars will make you much happier when the work is done.
- It's also worth recalling to mill extra pieces as replacements or test parts.
- If I don't sharpen my hand tools at the beginning of a venture, I tend to avoid it when I'm in the thick of things later.
- So I try to make do with dull tools, swearing when they dive too deep or tear at the wood.
- I end up with torn-up exteriors and joints that don't fit well. I've learned to commit to a sharpening session early on.
- At a minimum, I hit my block plane, smoothing plane, and scraper.
- If there are any mortises and tenons, I also sharpen my shoulder plane and chisels.
- If you don't know how to sharpen blades well, read about it, buy the gear you need, and learn to use it.
- I recommend a high-quality honing guide and waterstones, getting the final polish on an 8,000-grit stone.
- Once you use a truly sharp tool, you'll know what all those hand-tool nuts have been crowing about.
- Confirm the bits and blades on your power tools, too.
- They should be free of gunk and sharp to the touch.
- Cutting joinery is another place where I sometimes have tempted fate.
- In a rush and overconfident, I sometimes try to make the first cut on my actual workpieces.
- That's where extra lumber can come in handy.

- Mill an extra part here and there to dial in your setups for perfect outcomes.
- Another trap I sometimes fall into is trying to work around the fact that I don’t have the right tool or jig for the job.
- For instance, I used to struggle to cut tenons with my sloppy shopmade tablesaw jig until I Lastly made a second one—cautiously.
- Sometimes you need a certain tool for best outcomes.
- I use spiral upcutting bits for mortising.
- Until I got serious and bought a few of these pricey bits in different sizes, I struggled with straight bits that wouldn’t clear chips, stopping every five seconds to blow them out.
- Once all the joinery is cut, I can’t wait to get the whole thing glued up.
- At that point, two huge temptations arise: avoiding a bunch of sanding and scraping, and not doing a dry-fit to test the clamping setup.
- Skip either, and you’ll be sorry.
- Some beginners try to skip exterior prep—either in part or exclusively—leaving behind jointer, planer, and tablesaw marks that become painfully obvious once a finish is applied.
- Once the exteriors are prepped, don’t rush into a glue-up.
- Stop to do a real dry-fit, and you won’t have any surprises once the glue is spread and the clock is ticking.
- You don’t want to be caught scrambling around the shop for a missing clamp or caul, or be forced to pull apart a whole assembly that doesn’t fit right.
- By now the exterior should be mostly prepped, with just a bit of touch-up to do after the clamps come off and the squeeze-out is scraped away, but you still need to apply a nice finish.
- Once again, you’ll be tempted to dive right in, slapping finish on the real piece.
- Stop, take a breath, and make a test panel.
- A test panel is simply a piece or two of extra venture wood, used to test the finish.
- Even if you are using a finish you’ve already mastered, you shouldn’t skip this step, because each board can respond differently to a finish.
- You should try out most or all of any procedure, coat by coat, on some scrap.
- If you are unsure of your exterior-prep technique, try that out too.
- Drawings are vital in any furniture venture, but they don’t tell you where to start building.
- The choice is an vital one.
- Building in the right order helps ensure that parts fit appropriately, and it gives you the flexibility to work around the small variations that are bound to occur.
- Select poorly and the venture can get a lot more complex.
- This approach goes hand in hand with another vital idea, which is to avoid precutting all of your parts to final dimension. Instead, leave them rather oversize.
- That way, you can cut them to fit the piece perfectly as it comes together.
- So how do you select where to start?
- The clearest general rule is to build the case first.
- Doing so lets you start with a single assembly that will control the dimensions of just about every other part in the venture.
- Even in pieces that aren’t case pieces, this underlying idea still applies: Look for the assembly with the most control over other parts, and start there.
- Practice this and you’ll find that for any piece of furniture, there’s a sequence that will make the task straightforward.
- Here are four basic furniture types, with time-tested advice on what to build first, next, and last.
- If you understand these, you should be able to handle almost each item else.

Bonus Chapter How to develop your own designs

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

1 - Identify and analyse

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

2 - Set the objective

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

3 - Generate ideas

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

4 – Select

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

5 – Build

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

6 – Document

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

7 - Evaluate

- When you've built the piece, always review the steps you took and look for ways to make the procedure more enjoyable and productive.
- Next time you design, revisit the files for successful pieces to see how their designs advanced.

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

Drawing plans

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

Supplies:

Cardboard

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

Foamcore

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

Wood

- Material can come from the shop scrap barrel, typically ⅛-in. or ¼-in. resawing offcuts or other scraps.
- Working in small scale makes parts easier to handle and the design easier to see.
- Wood scraps can be cut with saws and joined with a diversity of glues.

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

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

Procedure:

- First, decide on scale.
- Are your questions about the design mostly about the rightness of its basic proportions?
- Do you need to transport the model and show it to clients?
- A small-scale model will perhaps answer.
- Or do you need to live with the piece for a while, to see how it casts shadows and fits into its intended space?
- If so, full-scale is perhaps your best bet.
- When I built library tables, I made a ⅛-scale model for several reasons.
- One was to impress the selection jury with my design, giving them something tangible to see and discuss.
- I built the model in cherry, the same as the tables would be, but I sketched in the inlay particulars with a pen.
- The other advantage?
- It forced me to walk through the stages of building the piece and led me to resolve key questions about building.
- Which parts would I put together first?
- What steps had to be completed before moving to the next phase?
- Would this design hold up over time, or did I need to modify the structure?
- For my Greene table, I worked full-scale with cardboard.
- I made up hollow table legs that were 1 ½ in. thick by 2 ½ in. wide by slicing up parts on the saw and hot-gluing them into elongated boxes.
- Having a leg that doesn't collapse when you walk by is great.
- I cut apron pieces to length and made up a top with drawn-in breadboard ends.
- I made straightforward mortise-and-tenon joints and used corner blocks on the inside curves for strength.
- Now here was something to walk around and examine.
- At this point in the procedure, you can congratulate yourself for building the model, but then let it rest for a couple of days.
- Let it sit in a corner of your shop or in the place where the completed piece will
- Then come back to it and see how it feels.
- Your gut will tell you a lot about whether you got it right.
- If it's not, then you'll need to start figuring out where to cut and where to add.
- I tell my students that planning at this stage may feel like it's slowing you down, but in the end it can save you time as you build with confidence, knowing you have a design that works, fits the space, and looks great.

Working Small

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

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

Working Big

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

Book 2

Woodworking for Beginners

Helpful Tips, Tricks and Hacks

by

Karl Winkler

Chapter 1 How to shape wood

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

Milling procedure

- To make the milling procedure as easy as possible, begin thinking about flat, straight, and square stock when you're selecting the wood, no matter if it has been planed already or is still rough-sawn.
- Circumvent badly warped stock.
- You'll have to remove far too much material from a board with a big bend or a substantial twist to get it flat, straight, and square.
- And even if the boards look good, buy them somewhat denser, wider, and longer than the final dimensions you need.
- That way, when you do mill away some extra material to remove whatever warp is there, you'll have enough stock remaining to provide the right-sized board.
- As a general rule, I begin by cutting each board to a manageable length and width.
- I cut the board about an inch longer than its approximate final length.
- Then I utilize a bandsaw to rip the boards to their approximate final width.
- The bandsaw is safer than the tablesaw when cutting warped stock.
- Depending on the width, I allow an extra ¼ in. to ½ in. of stock during this initial cut.
- Keep in mind, though, that the maximum width is limited by the size of your jointer.
- If you need to end up with a 10- in.-wide board and you have a 6-in. jointer, you'll want to rip two pieces of stock to about 5-½ in. wide and edge-glue them after they've been milled.
- The next step is to flatten one face of each board.
- The jointer gets that job. For safety, always utilise push blocks when planing a face surface.
- I generally take light cuts, no more than 1 /32 in.
- If I have a lot of material to remove, I might increase the next couple of cuts by a supplementary 1 /64 in., but rarely do I remove more than a fat 1 /32 in. with a single pass.
- A cut that's too heavy requires you to exert more pushing force on the board and is likely to develop tearout or splintering.
- To plane the face, place the board on the infeed table with one edge against the fence.
- Using a push block in each hand, feed the board into the knives.
- Once the knives begin cutting, I utilise the push block in my left hand to apply downward pressure to the lead end of the board, pressing it against the outfeed table while pushing it forward.
- As soon as I get 12 in. or so of the board on the outfeed table, the push-block in my right hand joins the one in my left at the outfeed table.
- Then, with both hands in line on the board, and situated toward the front of the outfeed table, I push the boards forward.
- At this point, all the downward and forward pressure from the push block is over the outfeed table, just past the knives.
- To keep the board moving, I pick up my lead hand and place it behind the other one and keep repeating the procedure until the board has cleared the knives.
- Use extra care as the board exits the infeed table because, for an instant, the guard doesn't cover the spinning knives.
- Keep making passes until the entire exterior is planed.
- At that point, your stock is perfectly flat on one face.
- Now, utilise the jointer to straighten and smooth one edge of the board, making it square to the face you just planed.
- The planed face goes against the fence. If the edge has a front-to-back bend, be sure to place the concave edge against the jointer table.
- This ensures that the board won't rock because two points are always in contact with the table.
- For safety's sake, I never push with my fingers over the blade area.
- Continue making passes until the board is planed along its entire length.

Working on the remaining face

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

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

Procedure:

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

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

Chapter 2 Bandsaw and Jigsaw tips

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

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

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

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

close to either end. If the dimensions exceed the 1-to-5 rule, then I trim to final width on the tablesaw. Because so little waste material is left, this cut is often exposed on the waste side, cutting away just 1 /16 in. or so. I essentially favour this because it avoids creating narrow strips of waste that can fall into the throat plate and cause issues. The last step is to cut the ends. If the pieces are too long to handle with a tablesaw's crosscut sled, cut them on the chopsaw.

Procedure:

1 - Cut to Rough Length with a Jigsaw

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

2 - Snap a line or Add a Guide

- A carpenter's chalk line produces a bright, straight line on stock that's too long for marking with a straight edge.
- A better path to a straight rip is to attach a piece of edge-jointed stock, nailing into the waste area of the rough board.
- The jig's jointed edge rides the bandsaw fence and guides the stock in a straight path through the blade.
- On the bandsaw, it's easy to "correct" grain that runs out of parallel to the edge of roughsawn stock.
- Just make your first cut follow the grain.

3 - Cut a Straight edge on the Bandsaw

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

4 - Rip to Rough Width

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

5 - Joint a Face and Square an Edge

- Joint with the cupped side down.
- Take light passes until the face is flat.
- To decrease tearout, review the rotation of the cutterhead and the direction of the grain when deciding which way to feed a board.
- You can mark your jointer near the cutterhead for easy reference.
- The diagonal lines represent appropriate grain orientation.
- Register the freshly jointed face against the fence and again take light passes until the edge is flat.
- If the fence is set at 90 degree to the jointer table, the two jointed surfaces should now be square to one another.

6 - Saw and Plane to Thickness

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

7 - Trim to Final Width

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

8 - Cut to Final Length

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

Chapter 3 How to handplane like a pro

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

Procedure:

- Begin with a No. 5 jack plane or a No. 4 smoothing plane.
- If the edge of the plane iron is perfectly straight, the curves of the iron will score the work as you plane.
- You can circumvent this by sharpening the iron with a very slight convex edge. This is especially useful when planing edges.
- I get a convex edge by bringing the iron across a grinding wheel at a slight arc.
- You likewise can utilise a coarse stone and apply greater downward pressure at the curves of the iron.
- For a smoothing plane, aim for a difference of about 1 /64 in. between the crown’s peak and the edges of the iron.
- For a jack plane, aim for 1 /32 in.
- Begin with a piece of stock roughly 1 in. thick, 8 in. wide, and 10 in. long.
- Lay a straightedge across one of the broad surfaces from end to end, edge to edge, and diagonally across the curves.
- Note the high and low spots.
- Begin taking strokes to bring the high spots in line with the lowest point on the surface.
- If the board is somewhat twisted, with one or two high curves, take diagonal passes from high corner to high corner, working enough of the exterior to bring the high areas down to the low spots.
- A board that is somewhat cupped across its width can be worked with the convex face either up or down.
- With the convex side down, make straight cuts along both edges to lower the high curves, or make strokes across the board from edge to edge with the plane in a skewed position, working your way down the length to remove the high curves.
- Use the same technique if the board is tapered, removing thickness at one end.
- If the board is cupped and the convex side is up, plane straight down the middle until you have flattened the high center.
- Check your progress often with the straight-edge.
- When the board is nearly flat, finish with a series of straight smoothing cuts along the board’s length and in the same direction as the grain.
- For the first pass, align the center of the blade—the peak of its crown—with the left- or right-hand edge of the board.
- The cut will be deepest at the board’s edge.
- Overlap each stroke by about half the blade’s width.
- This will put the blade’s crown into the shallowest part of the previous cut, minimizing exterior undulations.
- Check your work again.
- You’ll know the exterior is flat when no light can be seen under the straightedge in any direction.
- Mark the flattened exterior for utilise as a reference face in laying out subsequent cuts.
- The next step is to plane one long edge straight and flat so that it is square to the reference exterior you just flattened.
- Beginners often want to correct an angled edge by tilting the plane’s body to compensate.
- This would be required if the iron were ground and honed straight.
- With a crowned iron, it’s unnecessary. Instead, set the sole in full contact with the edge, aligned so the blade’s crown cuts on the high side of the angle.
- As you make cuts to remove the angle, shift the plane with each cut until the blade is centered on the edge, bringing the high side down and into square.
- To remove a convex exterior on an edge, simply make short strokes in the center of the edge and lengthen each consecutive cut until the edge is straight.
- For an edge that is twisted or high at opposite curves, move the plane laterally from one edge to the other, starting with the plane off to one side as though you were addressing an out-of-square edge.
- As the cut progresses, the plane will shift so that it is making a cut with the crown in the center, at the square point of the twist, and then gradually will shift to have the opposite side of the crown cutting to remove the opposite angle of the twist.

- Use a straightedge to check that the edge is straight and flat.
- Use a square, with the head registered against the reference face, to check that the edge is square.
- Once the edge is straight and square, mark it, too, as a reference edge.
- You'll utilise it to check that the ends are square and that the opposite edge is parallel.
- Next, utilise the edge-planing practices to plane the ends of the board so that each is square to both reference exterior and edge.
- With the iron adjusted to make a finer cut, utilise deliberate strokes, working in from both edges and stopping short of the curves to circumvent chipping out.

Last touches:

- Set the head of the square against the reference edge and utilise the square's blade to scribe a reference line indicating the board's completed width.
- Plane the opposite edge to this width, checking with the square against the reference face for squareness, and using the head of the square and the blade to check for parallel.
- Lastly, plane the remaining exterior to bring the stock to completed thickness.
- Use a cutting gauge to scribe a line indicating the final thickness.
- Working off the reference face, scribe the line all the way around the piece of stock.
- This line will be parallel to the original reference face.
- Work to bring the high spots in line with the low point on the surface.
- As you approach the scribe line, you'll begin to create a feather edge just above it that falls away as you reach final thickness.
- This feather edge provides great visual evidence that you are getting the exterior flat and parallel.
- If the feathering develops equally on all four edges, you're on the right track.
- If you've reached the scribe line and still don't have a parallel surface, strike another line and keep going.
- Don't get discouraged.
- By the time some of my students have completed this exercise, their original 1-in.-thick workpiece is no more than ½ in. or ⅛ in. thick.

Chapter 4 How to smooth wood

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

Procedure:

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

Working with a glued-up panel

- A glued-up panel, whether for a door or a tabletop, typically has high spots where the boards didn't align perfectly.
- A wide-belt sander will develop a flat surface, but these machines cost thousands of dollars yet still leave a lot of hand-sanding to be done.
- The most precise way to level and clean up those surfaces is with handplanes.
- Secure the panel to the bench between benchdogs in the tail vise and benchtop.
- Mark surfaces with a pencil to show high and low spots.
- Make passes diagonally across the exterior with the jack plane to bring each item into alignment.
- Work corner to corner, using overlapping passes.
- Next, plane with the grain from end to end, starting at one edge and working to the other using overlapping passes.
- Repeat the procedure until all remnants of the diagonal passes are eliminated.
- Complete the exterior preparation with a smoothing plane, working with the grain.
- After finishing the top and bottom, clean up the end grain and edges.
- End grain is prone to tearout and chatter.
- But you need to clean it up if the edges are to be exposed, as they often are on a tabletop.
- The smoothing plane, set for a very light cut, deftly handles the challenge.
- Be sure to skew the plane throughout the cut.
- This not only makes the work easier but likewise produces a high-quality surface.
- Avoid chipout at the end of the cut by clamping a backer block to the far end.
- If required, lubricate the end grain with paint thinner, which makes the ends slick and supple, reducing chatter and extending blade life.
- Use the sawmarks on the board end as a reference, planing until the marks just disappear.
- The last step is to plane the edges.
- A smoother may be enough here, but if there's any damage from clamping, I'd recommend

starting with a jack to handle the heavy planing.

Working with glued-up door frames

- Glued-up door frames often have issues with misalignment of parts, such as a rail that’s proud of a stile, and often have blemishes and scars from glue squeeze-out and clamps.
- Handplanes are the cure-all for these issues.
- With the door secured to the benchtop, visually identify any high spots.
- If the rail or stile is high on one end and low on the other, utilise a tapering approach.
- Take the first couple of passes with a jack plane in the vicinity of the high spots.
- Gradually extend the length of each successive stroke toward the flush end until both ends are flush with the mating parts.
- If the rail or stile is offset equally on both ends, simply plane uniformly with the jack plane until each item is flush.
- Lastly, take a few final passes with a smoothing plane, starting with the rails.
- Be sure to skew the plane to decrease the chances of tearout across the grain of the stile.
- If you get a few catches, don’t worry, you’ll clean up the stiles in the next step.
- Also, lift the plane on the return strokes so that its heel doesn’t accidentally bruise the stile.
- When the rails are smooth and blemish-free, plane the stiles.
- Once you have the exterior of the door planed smooth and even, utilise handplanes to dial in the reveal, or gap, around the door.

How to level face frame parts

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

Finishing touches

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

Chapter 5 Ripping techniques

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

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

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

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

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

Chapter 6 – Resawing using Bandsaw

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

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

Preparing for resawing:

- A narrow, coarse hook-tooth blade will clear sawdust out of the kerf simply, and a positive rake angle will make it easy to feed a board through with a light touch.
- A straightforward technique is to set the tension one mark higher on the tension scale of your bandsaw.
- You likewise can check the tension by pressing your finger against the side of the blade; if it deflects more than ¼ in., crank up the tension.
- With the blade tension set, make sure that the table is square to the blade.
- Next, position the guide blocks and thrust bearing about 0.002 in. to 0.003 in. from the blade.
- Be sure that the guide blocks do not contact the teeth.
- Then, adjust the upper guides so that they're no more than ⅛ in. above the workpiece.
- Place a square against the side of the blade, and adjust the table until the sawblade is flush against the blade of the square.
- Guides should be 0.002 in. to 0.003 in. from the blade and should not touch the teeth.
- You have the right spacing if you can just slide a slip of paper between the guides and the blade.
- The same goes for the thrust bearing, which shouldn't spin until you begin to feed stock into the blade
- If you're sawing just a few drawer parts from inexpensive stock, you can utilise the fence that came with your bandsaw.
- But for precise, uniform cuts, it's better to build a taller auxiliary fence.
- Before resawing, it's vital to determine and adjust for blade drift, the tendency of the thin blade to begin cutting out of parallel with the fence.
- One way to decrease drift is to track the blade so that it's in the exact center of the tire, which can be hard to do with the flat tires on numerous European bandsaws.
- I find it easier to adjust the fence for drift
- A tall auxiliary fence made from ¾-in.-thick plywood or medium-density fiberboard (MDF) helps support wide stock for resawing, ensuring cuts that are true and smooth.

- Raise the guides and cut along a scribed line freehand.
- Stop midway through the cut, hold the test piece in place, and clamp the auxiliary fence against it.
- This ensures that the blade won't wander during the cut.
- To ensure a true cut, utilise one hand to push the board and the other to hold it flat against the fence throughout the cut.
- Before the board starts to fall off the table on the back side, walk around to the other side of the saw and pull the board through.
- Support the board with one hand while using the other to hold it flat against the fence.
- This technique likewise keeps your hands away from the blade.
- As you near the end of the cut, push the stock through with a push stick to keep your fingers clear of the blade.
- Run the just-cut face of the workpiece lightly over the jointer before slicing the next sheet.

The procedure of resawing

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

Chapter 7 How to apply crosscuts

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

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

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

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

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

Chapter 8 How to break edges

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

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

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

A quick and effective technique:

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

Chapter 9 How to taper legs using tablesaw

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

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

An easy technique for construction

- To make the jig, begin with a piece of hardwood, roughly ⅞ in. thick by 2 in. wide by 38 in. long, rip off a ⅜-in.-wide strip, and cut it to 33 in. long.
- This strip will ride against the rip fence, so you want it just proud of the edge of the sled.
- To achieve this, place a piece of masking tape along the edge of the sled, place the strip and the sled base against the rip fence, and then glue and either screw or staple the strip to the sled.
- Peel off the tape, and you’re all set.
- The two long sides of the sled must be parallel, so with the sled riding against the rip fence, trim the opposite side.
- But before you do that, attach the stop block, so it gets trimmed flush, too.
- Afterward, attach the sled’s adjustable fence, push handle, and toggle clamp.
- An L-guide locks the jig parallel to the fence yet lets it to glide smoothly with no slop.
- To make the guide, glue and nail or staple a 2-in.-wide by 38-in.-long strip of ½-in.-thick plywood to the remaining piece of hardwood that you ripped earlier.
- Place the side of the base with the maple strip adjacent to the saw’s fence and clamp the guide to the fence.
- Check to see if the sled slides back and forth.
- If it is too tight, simply add a strip or two of blue painter’s tape to the hardwood side of the guide before re-clamping it and testing the movement again.

On traditional furniture across a range of styles, there is a rudimentary rule for which faces of a leg to taper: If it falls under the aprons, it gets tapered. A tapered leg lends a piece the lightness and grace mentioned earlier, plus gives it a stable-looking stance without making it look splay-legged. On a typical four-legged table with a rectangular top, or even variations such as a bow or serpentine front, the two inside faces of the legs are tapered. To describe how the jig works, I’ll cut one of these legs. First, cut any joinery on the leg. It is much easier while the blank has straight sides. Layout, or more precisely the lack of it, is another advantage to this jig. A line marking the begin of the taper and another on the bottom of the foot are all you need. The taper typically starts where the bottom of the apron or rail intersects the leg. I utilise a combination square to set the lines on the top, being cautious to mark only the sides to be cut. Too many lines leads to mistakes! If the taper has a completed dimension of, say ⅛ in. at the bottom, I cut a piece of stock that thick, line up the blanks, and mark the bottoms with one swipe of the pencil. I rotate each leg 90° and make a second mark. Lastly, I utilise a wax crayon to highlight the faces to be tapered. When using the sled, the thin end of the tapered leg should always be closest to the operator. This way not only are you cutting “downhill” with the grain, but the action of the blade helps push the blank onto the sled. You likewise want to rotate the leg clockwise after the first cut, so the leg is resting flat on a non-tapered face during the second cut.

Procedure:

- Adjust the jig and cut the first taper.
- There is no need to adjust any setting; just reposition the leg while the blade is spinning and clamp it down.
- With the first taper facing up, make the second tapering cut
- To position the leg in the sled, align the mark on the bottom of the foot with the edge of the sled and push the foot into the tip of the screw protruding from the stop block.
- Now align the begin of the taper with the edge of the sled and set the adjustable fence against the leg.
- Lastly, deploy the toggle clamp.
- Leave a little extra material to handplane and sand by setting the saw fence so that the side of the sled is about 1 /32 in. from the blade.
- Make the cut, using the handle to push the sled so that your fingers come nowhere near the blade.
- Pull the jig back to the front of the saw, loosen the clamp, rotate the leg 90° clockwise, and secure it again.
- Cut the second taper.
- When cleaning up the saw marks, don’t remove any wood above the taper because this will leave a gap between the leg and the apron.
- To sneak up on the line, I mark the area below the line with a crayon, and then plane up the marked area, stopping just before the line.
- A final light sanding completes the job.
- To circumvent extending the taper too far, mark the exterior of the leg a few inches below the layout mark with a wax crayon.
- This makes it easier to measure your progress and to stop before you reach the line.
- You need to set up the sled only once to cut tapers on two adjacent sides, but lay out each leg to keep track of your cuts.
- Line up the layout mark with the edge of the sled and stop block, and push the leg gently against the screw in the block.
- You need only a small tick mark at the begin of the taper.
- Line it up with the edge of the sled, and then slide the adjustable fence against the back of the leg blank.
- You want the edge of the sled to be about 1 /32 in. away from the blade.
- In this way the taper is cut somewhat proud to leave room for handplaning and sanding.

On a round or oval period table with corresponding shaped aprons, the legs can be tapered on three or four faces. Further, on contemporary furniture, it is common to find legs tapered on four sides, often extending all the way to the top, or even inverted with the wider part at the base of the leg. Never fear, this jig can handle all of these tapers and then some. For instance, with four-sided tapers, cut the first two adjacent sides. To cut the last two sides, first adjust the sled’s fence to take into account the tapered side of the leg that will now be against it. After cutting the third taper, you may need to place an offcut under the blank to support it during the fourth cut.

Chapter 10 Wood moulding techniques

A crisp molding lends the same touch of elegance to a well-made cabinet that a silk tie bestows on a sharp-dressed man. But in order for their magic to work, neckties and moldings both must be treated with care. A molding with torn-out grain or fuzzy edges will spoil the effect—like a soup stain in the middle of your chest. I don't have to fuss with a necktie very often, but my students and I do run plenty of molding. I've adopted several practices for making sure the results fit well and look their best. Creating molding safely and cleanly requires cautious attention in three areas: cutting profiles, cleaning them up, and lastly, ripping the individual molding strips. The suggestions here touch on all of these areas.

How to eliminate tearout

- To eliminate tearout, I like to bury the bit in a wooden fence, creating a zero-clearance cavity that lets the fence serve as a chipbreaker.
- There are two types of this fence that I make most often; both begin with a great scrap of wide 2x stock with a jointed face and edge.
- The first is a very straightforward fence that I make by using the bit itself to cut the zero-clearance cavity.
- Clamp one end, bury the bit a little deeper than you need, then bring the fence back to the appropriate setting and clamp the free end.
- If you are raising the bit into the fence, go only as high as essential.
- Creating a cavity taller than your final bit height decreases the chipbreaking effectiveness.
- For complex bits or those that can't cut their way into the fence, such as bearing-guided bits, I drill the fence opening with a Forstner bit.
- This likewise makes it easier for me to joint the infeed side if I need an offset fence.
- I likewise cut a channel in the back of the fence for chip removal.
- To avoid chipout in heavily figured stock, I reorient this fence so that the bit is literally buried in the infeed side.
- To do this safely, clamp a straight backer board behind the fence.
- Loosen the clamps that hold the fence and, with the router running, slide the infeed side of the fence into the bit.
- The movement is very controlled because the rotation of the bit pushes the fence against the backer board.
- After setting the fence, reclamp and continue running the molding.
- Another advantage of any sacrificial wooden fence: I can rapidly screw guards or hold-downs in place.
- A great table and router are likewise important.
- Reinforce an MDF top with angle iron or C-channel, if need be, to avoid sag.
- As for routers, I recommend a fixed-base model with at least a 1½-hp motor.

How to cut moulding on a wide bank

- Choose a piece of stock that is wide enough to run a profile on each edge while leaving a few inches in the middle.
- A larger workpiece means less vibration and better results.
- It likewise lets you run the molding much more safely, keeping your hands well clear of the spinning bit while controlling the stock.
- It's likewise much easier to clean up moldings while they are part of a wider piece that can be clamped simply while the profile is scraped or sanded.
- Pay close attention to the feed rate.
- Too fast leads to chipping; too slow can cause burns.
- Wax the table and fence to keep resistance to a minimum.
- After the molding is done, rip it away on the tablesaw.

How to glue up your own stock

- When you want to cut a wide molding in figured wood like bird's-eye maple, you might not find stock thick enough.
- I do this by ripping a thinner board into strips a little wider than the thickness I want.
- Stand these strips on edge and laminate them face-to-face to create a glued-up board with enough thickness for the desired moldings.
- Glue up the blank with a piece of scrap stock as a backer board.
- This lets you cut multiple molding strips in the reoriented face grain while keeping your hands safely away from the bit.

- Assemble the blank so that each glue joint falls in a tablesaw kerf when the moldings are ripped.
- You'll need to account for the kerf width, the amount of stock removed in cutting the profile, and the thickness of the completed molding.

How to decrease chipout

- Sometimes a straightforward profile requires multiple passes of the same bit.
- Because I don't have a specific bit that cuts the proportions I need, I run this molding with multiple passes using a core-box bit.
- In this situation, I find that I can decrease chipout dramatically by making the first pass with the bit set at the point farthest from the fence.
- I then raise the bit and move the fence toward the workpiece with each successive pass.
- In this way, the chipout created by each pass is removed by the subsequent passes.
- For the final run, I make sure the bit is buried in the fence, reducing the likelihood of any chipout.
- This technique likewise helps when cutting complex profiles using a combination of different bits.
- This is sometimes essential because numerous complex-profile bits don't quite fit specific design requirements.
- By combining cutters, you can match older moldings or create original designs.
- The delicate crown molding at right—for a small chest—is made by combining three cutters: an oversize beading bit from Eagle America, a core-box bit, and a straight bit.
- Begin by cutting a sample section of the profile to utilise as a setup piece.
- Creating this piece likewise brings to light any unforeseen issues in the procedure.
- If you create the molding often, hang the sample on the wall for future use.

Procedure when using multiple bit profile:

- Sequence the profiles to eliminate tearout, starting at the bottom and inside on the molding.
- Running this bit first will cause some tearout at its top edge.
- This line of tearout will be eliminated when the core-box bit establishes the cove
- Raise the bit a little each time.
- Any chipout along the outside edge will be eliminated when the fillet is cut.
- Use a straight bit buried in a fresh fence to avoid tearout.

How to utilise an offset fence

- Profiling an entire edge is very much like jointing the edge of a board: the entire original exterior is eliminated to create the profile.
- With a standard setup, this means the profiled workpiece won't ride against the outfeed fence.
- For appropriate support, the outfeed fence should be set flush with the cutter while the infeed fence steps in about 1 /32 in.
- Make passes on a scrap piece to dial in the offset.
- While this might sound a little complex, it's essentially quite straightforward to set up.
- Take a jointed piece of 2x stock and drill an opening for the bit.

Clean up procedure before ripping

- Moldings generally need some cleanup, especially if the profile was generated by a combination of bits.
- Still, if the milling was executed appropriately, that cleanup should require minimal effort.
- A diversity of tools come into play for taking off tearout, tool marks, chatter, or burn marks.
- The list includes scrapers, a shoulder plane, files, and various sanding blocks.
- Scrape first, using scrapers produced to a diversity of profiles to fit the need.
- Shape cutoffs from card scrapers into an assortment of beads and rounds.
- For moldings like bracket feet, grind a scraper close to the profile.
- Don't go for an exact match because you'll need to attack from various angles.
- Detail files work well for small radii and leave marks small enough to be eliminated rapidly with sandpaper.

- Sanding, nevertheless, should always be kept to the essential minimum.
- I tell my students that after just a few minutes of sanding, the only thing they are really sanding away is their grade.
- I tend to utilise aluminum-oxide paper ranging in grit from P150 to P220.
- Most times, I utilise a sanding block or a piece of dowel stock for an appropriate curve.
- Contour sanding grips are obtainable, but these seem like one more thing I don’t really need to accomplish a rudimentary task.

How to rip between the blade and fence

- When cutting molding from a blank, standard safety practice calls for setting the tablesaw fence so that the ripped molding falls to the outside of the blade.
- The fence is then reset and the procedure repeated for the molding on the other edge.
- But repeatedly resetting the fence can lead to variations in the thickness of the different pieces.
- This issue can make it harder to fit the molding appropriately.
- To circumvent this, I rip off the molding between the blade and the fence.
- The distance between the fence and the blade never changes, so the thicknesses are far more consistent.
- And because you’re not resetting the fence after each cut, the work likewise goes more rapidly.
- But this technique demands extra precautions.
- Use a splitter to avoid the molding from curling into the back of the blade and causing kickback.
- Stub splitters stay out of the way but get the job done.
- Push sticks and hold-downs are likewise important.
- A small bandsaw cut in the end of the molding stock lets you hook a narrow push stick into it.
- A hold-down clamped to the fence keeps the stock from lifting off the table.

Chapter 11 How to fix mistakes

The difference between a professional and an amateur is that the pro knows how to cover up his mistakes. We all make mistakes, so it is nearly certain that the hole you find yourself in has been previously occupied, and that a former occupant found a successful way out. I've divided the issues into defects and flaws in the wood, miscut joinery, and undersize parts, but there are some tips that apply to every mistake and every venture. There was a student who once had nearly completed a violin. He was applying a French polish when his pad stuck to the surface, leaving a blemish in the otherwise flawless finish. In a rage, the student smashed the violin to pieces. Too bad he didn't take an advice and sleep on the issue. More often than not inspiration will strike, either in the early hours or the next morning when you are no longer angry at yourself. In the case of the violin, rubbing the spot with an alcohol-dampened pad would have eliminated the error in minutes! As a common tip; you should hang onto every piece of scrap until a venture has left the workshop. It's much easier to get a great grain and color match for a patch if you still have part of the board left over.

How to create an invisible patch

- Take a deep carving gouge that is somewhat wider than the damage, in this case 8/10mm, and carve out a shallow depression around the hole.
- Practice on some scrap first.
- After dry-fitting the patch, glue it and clamp it in place with plenty of pressure.
- Waxed paper prevents the caul from sticking to any squeeze-out.

How to substitute a loose knot

- A loose knot doesn't add character; it detracts from the wood's beauty.
- Instead of scrapping a nice board or cutting it in two.
- Draw the outline of the loose knot on a piece of clear plastic, such as a three-ring file divider.
- Use the transparent pattern to find a nice, tight knot of similar size on a piece of scrap and resaw it to about 3 /16 in. thick.
- Draw a similar outline and cut it out on a scrollsaw.
- Place the patch so that it covers the whole knot and draw around it with a very sharp pencil.
- Use a small plunge router or a rotary tool in a plunge base to excavate to a depth of about ⅛ in.
- After that, work up to the layout lines with a small chisel or gouge.

How to repair moulding

- Sometimes tearout just happens, particularly on curly wood.
- If it occurs while profiling the edge of a tabletop, you may not be able to simply trim that edge and re-rout, as that will affect the overhang.
- Instead, I will describe how to add a strip and conceal the joint in the profile.
- Saw in line with the fillet of the profile to leave the center of the tabletop untouched.
- Find a piece of scrap that closely matches the rest of the top in color and figure and glue it on.
- After trimming the strip to leave the table top approximately 3 /32 in. wider than the desired final width, re-rout the profile.
- Measure how far the fillet of the profile is from the glueline of the repair.
- Set the tablesaw to rip off this exact amount, leaving a flat edge.
- Make one final pass on the router table to bring the fillet of the molding in line with the joint for a nearly invisible repair

How to hide an incorrect mortise

- The secret to numerous repairs is to circumvent straight lines.
- They aren't found in nature and they will attract the eye.
- Glue a piece of tracing paper over the damaged area, then glue the patch to the paper over the hole.
- When the glue is dry, mark around the patch with a knife.
- Then break off the patch at the paper line.
- Adjust the size and shape of the patch using sandpaper until it fits seamlessly.
- The curved shape of the patch helps it blend into the background.
- Now just rip away the waste, leaving 1 /16 in. glued to the damaged face.

- Trim the strip to match the leg’s taper, then break its edges to conceal the seam.

How to eliminate a groove

- It’s a common mistake to cut a groove for the drawer bottom on the incorrect side of a drawer side.
- Instead of cutting all those dovetails again, I will describe how to rapidly substitute the miscut section only.
- This goes rapidly compared to dovetailing a brand-new side completely

Chapter 12 Rudimentary Joinery techniques

Most students always find it more satisfying to perfect their joinery by creating a piece of furniture rather than by adding to the kindling in the scrap bin. The dado and the rabbet are fundamental woodworking joints found in all kinds of furniture, from bookcases to highboys. Building this organizer, which either can be hung on a wall or stood on a table, lets you to practice these joints while creating a useful piece of furniture. This piece features dadoes that run the width of the sides to support the shelves, and stopped dadoes in the upper shelf and the underside of the top to receive the partitions. Rabbets in the cabinet include those at the top of each side piece and partition as well as in the drawer construction. Both joints provide precise alignment of the parts, load-bearing cap capability, and increased glue surface. They can be cut precisely on the tablesaw, with or without a dado set, and with a router using various fences and jigs.

I chose red oak as the primary wood for this venture and pine for the drawer boxes and the back slats. If you can find 11-in.-wide oak boards, you will be spared the step of gluing up panels, but glue-up is not a big procedure for a venture this size. The oak for the partitions needs to be thicknessed to ½ in., and most of the pine needs to be ⅜ in. thick; this is best done with a planer rather trying to resaw denser stock. You will need about 18 ft. of 8-in.-wide oak boards, and 7 ft. of pine, which includes an extra 20% to be on the safe side.

How to cut dadoes and rubbets using tablesaw

- Most of the dadoes and rabbets for this venture can be cut on the tablesaw using a set of dado blades.
- There are two types of dado blades: stackable blades, which consist of two outside blades to cut the sides of the joint and multiple chipper blades to eliminate the waste in the middle, and adjustable blades, likewise known as wobble blades.
- I favour the stackable dado set because it makes a cleaner cut.
- Install a throat insert made for a dado set.
- Mount the two outside blades and sufficient chippers to make a cut just under ¾ in. wide.
- Using a piece of surplus oak as a gauge to make test cuts, fine-tune the width by adding or removing shims between the blades until you achieve a snug fit.
- Each side piece gets a pair of dadoes for the shelves, and the top and bottom shelves each receives one narrow dado for the drawer divider.
- Dadoes shallower than ¼ in. deep can be cut in one pass, but feed the workpiece slowly to achieve a clean cut and circumvent straining the motor.
- Use the rip fence to guide the location of each dado, making the same cut on both side pieces before adjusting the fence for the next dado.
- Apply firm downward pressure on the workpiece to ensure that the depth of each dado is consistent throughout its length.
- Even though the cut for the rabbets on the top of each side piece is ⅜ in. square, there is no need to reset the width of the dado set.
- Instead, clamp a piece of ¾-in.-thick plywood or medium-density fiberboard (MDF) to the rip fence, locate the fence for the cut, and gradually raise the blade so that it eats into this sacrificial fence.
- The final cuts with the dado blade are ⅛-in.-deep by 3 /16 -in.-wide rabbets on both sides of each end of the three partitions, and 3 /16 -in.-deep by ¼-in.-wide rabbets on overlapping sides of the pine back slats.
- Known as a shiplap joint, this lets the boards to move seasonally without creating a gap between them.
- While you have the router out, now’s a great time to profile the edge of the top.
- Though this venture has a cove on the underside of the front and sides of the top piece, you may favour the look of a chamfer.
- Regardless, utilise a bearing-guided bit running along the edge of the workpiece.
- For a clean cut with minimal tearout or burning, make the cut in two stages with the second cut at the final depth removing only a small amount of wood.

Procedure:

- The outside cutters of a stackable set of blades are placed on the arbor first and last, with chipper blades between them.
- The width of the cut is fine-tuned by placing metal or paper shims between the blades.
- Adjustable blades, likewise called wobble blades, can be adjusted to width by rotating a dial on the side of the blade.
- The depth of the dado should equal about a third of the wood’s thickness.
- Apply continuous pressure both against the fence and downward to ensure that the cut is

consistent in depth across the piece.

- With narrow workpieces, utilise a miter gauge for guidance and support.
- After cutting the dadoes for the shelves, flip the board and cut the rabbet on the top of each side, creating a narrow tongue that will enter the top.
- To circumvent damage to the rip fence, clamp on a sacrificial plywood fence.
- On this venture the partitions are secured in stopped dadoes in the upper shelf and the top.
- The stopped dadoes must be cut in identical positions on the top shelf and the underside of the top piece.
- To achieve this I utilise a rub collar in conjunction with a template.
- The collar has a tubelike piece of metal that surrounds the router bit and guides it by means of a template placed on the workpiece.
- When laying out the job and making the router template, the difference between the outer diameter of the rub collar and the router bit must be taken into account.
- Blocks of wood glued to the underside of the template act as stops to ensure precise placement on both of the pieces to be cut.
- I likewise utilise the router to cut ⅜-in.-square stopped dadoes on the sides for the back slats and on the underside of the top for the sides.
- Because these cuts are near the edges of the workpiece, a fence attached to the router and guided by these edges works well.
- You will need to stop the router just before the end of each cut and square up the end with a chisel.
- Due to the drawers have false fronts and are fitted with guides, it is safe to make up the drawer boxes before the carcase is assembled.
- The front, back, and sides of the boxes are connected by dado and rabbet joints cut on the tablesaw:
- First cut two dadoes on each side piece; the distance from the end is determined by the thickness of the front and back pieces.
- Because the next cut is made with only a thin section of wood in contact with the tablesaw, fit a zero-clearance insert around the sawblade to avoid the workpiece from getting wedged between the table and the blade.
- In two cuts you can make rabbets on the ends of the drawer back and sides to create a tongue that connects with the dadoes on the drawer sides.
- Before assembling the boxes, cut grooves on the inside of the front and sides, and cut away the back of the drawers so that the bottom can be slid in.
- The drawer partition simply is a ¾-in.-thick piece of pine that is joined to the two shelves with ¼- in. dadoes.
- These can be cut on the tablesaw with two passes over a conventional blade.
- To circumvent having end grain exposed on the front of the cabinet, utilise a tongue-and-groove joint to attach a thin facing piece of oak.

Completion:

- You will find that the assembly of this venture will be much easier to do on a pair of sawhorses, because the gap between the horses lets more room for clamping.
- Glue the shelves to the cabinet sides and slide in the drawer divider from the front.
- When these joints are dry, slide in the back slats, glue in the three partitions, and then glue on the top.
- Screw the center of each back slat to the sides.
- Before fitting the drawers, mill some rabbeted drawer guides from pine and set them in place with glue.
- The rabbet along the bottom and the fact that they are 1½ in. short allow them to be trimmed in place with a block plane.
- Once you have achieved a snug fit for each drawer box, mark its location on the back of each false drawer front.
- Transfer the location of the holes on the drawer box and drill pilot holes in the false front to circumvent splitting the wood with the screws.
- The last pieces to add are a valance that is set just in from the sides and glued to the lower shelf, and a two-part French cleat if you are going to hang the organizer on a wall.
- Before assembly you should sand the interior sections with 100, 150, and 220-grit paper.
- With the piece assembled, plane all of the joints flush and repeat the sanding sequence on the outside.
- Wiping the wood with denatured alcohol will reveal any glue that has squeezed out.
- Sand these areas again with 220-grit paper.
- Finish the wood with three coats of an oil-varnish mixture, such as Waterlox, sanding between the first two coats with 220-grit paper.
- When the finish has cured, rub the cabinet with 0000 steel wool, and wax and buff the wood for a smooth, satin finish.

Chapter 13 Miter Joint techniques

The attraction of a miter joint is easy to see. It is an elegant and straightforward technique for joining parts that meet at an angle without showing any end grain. Whether you are building the frame for a veneered panel, applying wrap-around molding or constructing a straightforward picture frame, a miter joint will serve your needs. But as the saying goes, the devil is in the particulars. The very visibility of the miter joint means that errors in machining or assembly are hard to conceal. Nevertheless, with a little patience and lots of practice cutting and assembling miters, you too can master the joint. Generally used for right-angle curves between two boards of equal thickness and width, miters are made with matching cuts. These cuts are at 45 degree so no end grain is visible. But the miter joint isn't reliable solely as a glue joint for most constructions. Where any real tenacity is required, strengthening with biscuits, splines or keys is always the prudent choice. In short, to get perfect miters requires perfectly mating joints, a slip-proof gluing system and at least one form of strengthening.

Procedure:

- It doesn't matter what type of saw you cut miters with, utilise a sharp, clean blade.
- Generally the more teeth to a blade, the smoother the cut, but no blade will cut well if it's dull or covered with pitch.
- Every cut is made in two directions: at 45 degree across the width of a board and at 90 degree across its face.
- For a miter to close up well, both angles need to be cut exactly.
- Make rough adjustments using a plastic 45 degree drafting triangle, then take several practice cuts, checking the results with a combination square.
- A chopsaw works great at cutting miters.
- Just make sure the fence is flat and straight.
- If essential, add an auxiliary fence and shim it to make it square to the table.
- Frame parts can lie flat on the chopsaw table.
- Angle the blade 45 degree to the fence to make the cuts.
- Clamp stops onto the auxiliary fence to index matching cuts.
- When cutting miters on a tablesaw, you'll get the best results using a jig that holds your work to move it past the blade.
- The miter gauge is, of course, the standard jig used for cutting miters.
- Be sure to check your settings for the angle of cut.
- Attach an auxiliary fence to the miter gauge to support the workpiece near the blade.
- When cutting frame miters, angle the gauge down and away from the blade.
- This way, if the workpiece slips, it will slide away from the blade, not into it.
- A piece of sandpaper glued to the fence will help avoid slipping.
- Make certain that your gauge is cutting a true 45 degree angle, and then cut one end of each matching part.
- Measure and mark off the required length and clamp a stop onto the auxiliary fence to index the cut so matching parts are the same length.
- A picture frame jig has four parts: a flat base, two runners, a fence and clamping blocks. The base can be made of any flat 1½-in.-thick sheet stock.
- Make the runners, which attach to the bottom of the base, out of quartersawn hardwood, so seasonal movement won't affect their fit.
- The fence of the jig is ¾-in.-thick plywood.
- Cut the corner of the fence at a right angle, and then screw it to the base.
- It won't matter if it's mounted a little off a true 45 degree angle as long as you always cut one piece of the miter joint on the left side of the fence and the other on the right side.
- The cuts will always be complementary and mate perfectly.
- Put on the clamping blocks last.
- You can clamp a stop block to these blocks to make cuts of uniform length.
- After cutting the miters, do yourself a favor and take some time to prepare them for gluing.
- First check your cuts to see how well your saw performed.
- There are several ways to remedy a cut that is less than smooth.
- Trim the miter with a low-angle block plane, tuned up with a freshly sharpened blade.
- Put the workpiece in a vise and take a few light passes off each mating face, but don't change the angle.
- Check your results with a combination square.
- A disc sander outfitted with a miter-gauge jig can likewise be used to fine-tune miters.
- This jig rides in the slot in the sander table and has a plate on it cut at 90 degree but situated 45 degree to the sanding disc.
- Work on both sides of this fence to ensure that mating pieces get complementary cuts, but always work on the left side of the moving disc.
- In this way your work will always get pushed down into the supporting table.

- Take only light passes, and try to move the work past the disc so you don't burn the wood or load up the disc in one spot.
- Before starting, double-check that the sander's table is exactly 90 degree to the disc.
- A third technique of trimming is to utilise a shooting board.
- A stop angled 45 degree on both sides is screwed to the base.
- When used with a square-sided plane, this jig will trim the miter at 45 degree across its width and at 90 degree to its face.

Wood is made up like a bundle of straws. Crosscut or miter the end of a board, and you expose the ends of those straws, which suck up glue and starve a joint, weakening it. The faces of a miter joint should be sized by precoating them with a light wash of glue to fill the pores. Scrape off any excess glue before it dries. Despite the normal warning not to apply glue to an already glued surface, in this case sizing will strengthen the glue joint. Dry-fit and clamp each item before the final glue-up, and you'll thank yourself later for your calm demeanor and slow heart rate. Band clamps fit around a box or a picture frame to apply even pressure to the miter joints. Practice locating and tightening the band clamp in place right over the joint. Utilise several clamps for wider glue-ups, and stagger the clamp heads so they're not in each other's way. You can put clamping curves over the joint to help spread the pressure. Some band clamps come with self-adjusting curves suitable for any angle; you can likewise buy aftermarket types. Again, practice with these systems before gluing. When gluing up miters with splines or keys that would interfere with a band clamp, I utilise shopmade clamping blocks clamped right onto the frame side. These blocks have a notch cut right into them where you can place another clamp to apply pressure directly across the joint. If your clamping blocks slip too much, glue a piece of sandpaper to them on the side that rests against the workpiece.

Splined miters in frames

- Reinforce miter joints by using splines or biscuits, which are inserted before the joint is glued up, or keys, which are added after glue-up.
- Which technique you utilise is determined by several factors, the most vital being aesthetic considerations.
- Do you want to conceal the strengthening for a seamless look, as with a gilded picture frame, or do you favour to emphasize it, as with face-frame keys?
- The second factor is the hardy and length of time involved.
- Through spline cuts are made along the length of the miter.
- They're most simply made on the tablesaw.
- Use a spline-cutting jig to support the workpiece at a 45 degree angle to the blade.
- Make this jig out of a straight piece of ¾-in.-thick plywood and a support piece glued and screwed on at a 45 degree angle.
- Make certain that your fasteners are higher than the tablesaw blade at its highest setting.
- With your frame piece in the jig, set the fence so that the sawkerf is centered in the thickness of the stock.
- If it's not, the faces of your frame members will not be flush.
- One way to avoid this is by having a miter jig with two fences on it for each side of the miter.
- The jig is rotated 90° to cut the spline in the adjoining workpiece.
- Set the blade height for a ¼-in.- to ⅜-in.-deep cut, but no deeper.
- Because the grain direction of a spline in a solid-wood frame has to run in the same direction as the frame members, too deep a spline cut makes for a wide and fragile spline.
- Hold or clamp the work firmly in the jig.
- Place your hands cautiously out of harm's way and make a pass.
- Use a flat-grind blade to put a flat bottom on the cut.
- Mill up the spline material out of a contrasting wood to set off the joint.
- Using a tenoning jig, hold the board vertically and run it past the blade to trim your spline to thickness.
- Then cut the spline to length.
- If your spline doesn't quite fit, utilise a block plane to trim it to thickness.
- Be cautious not to snap the short grain of the spline as you plane.
- You're looking for a snug fit, not one that's overly tight.
- Fit one side of the spline and check to see that it will let the joint close up nicely.
- Trim its end grain with a block plane, if required.
- Size the end grain of the miter, then put glue in one of the spline cuts with a thin piece of wood.
- Set the spline in place all the way down to the bottom of the groove.
- Then put glue on the rest of the joint and clamp it up.
- If the fit is a bit loose, clamp across the face of the joint as well.
- You can likewise pin this spline in place with dowels for extra strength and an supplementary design detail.

- You can likewise strengthen a miter with a biscuit joint.
- Mark the frame members across their faces with a pencil at the center of the joint or closer toward the inside corner of the joint so that the cut won’t show at the curves.
- Center the joiner in the thickness of the stock.
- Support or clamp the frame members securely, and hold the joiner tight to the miter as you cut.
- Mitered frames may likewise be reinforced after glue-up using exposed keys.
- These keys are inserted into mitered curves from the outside after cutting the appropriately sized slots.
- Slots may be cut on a tablesaw or on a router table

A keyed miter jig works great for holding a glued-up frame in place while you pass it through the sawblade. Set the blade height for the full depth of cut, and utilise a flat-grind blade if you have one. Cut each corner, holding the same face of the frame to the jig. Mill up key stock wider than the depth of the key cut. Trim the stock to thickness on the tablesaw. You should utilise a thin push stick to help you move the work safely past the blade. Utilise a handplane to trim the key exactly to thickness, then cut it longer than essential.

Fit keys in their cuts so that they’re snug and only require a light tap to position them. Make sure when gluing that they fit all the way down in the key cut at both its sides. Once the keys are dry, clean them up on the bandsaw. Sight along the edge of your frame as you make the cut so you don’t cut into the piece. Then handplane away from the corner in each direction to trim the key flush. If you plane toward the corner, you will tear out the tip of the key.

Face-keyed miters for frames perhaps originated when someone made a straight key cut in the incorrect spot. It was a pretty mistake. Make these cuts using the keyed miter jig on the tablesaw. Place the cut just on the outside edge of each corner on both faces of the frame. Make up key stock as before, but this time just make it conveniently thick. When gluing, make sure the keys fit down to the bottom of the cut on both sides of the joint. Put clamps across the keys to hold them in place. The final step is to plane the keys flush with the face of the frame, being cautious of the contrasting grain directions.

Chapter 14 How to cut mortises

Numerous woodworking professionals cut mortises by drilling away much of the waste with a drill press, then cleaning up what remains using a bench chisel. The technique is prevalent because it doesn't require a special machine or jig. It's a challenge, though, mainly because the chiseling procedure is slow and simply goes awry. I've been building furniture full time for more than 30 years, and I still utilise drilling and chiseling to make numerous of my mortises. But I've managed to refine the procedure to just a few steps. The tools are straightforward. After removing most of the waste using the drill press, I utilise a mortising chisel to square an end and lever away, in one shot, most of the waste. A bench chisel rapidly cleans up what's left. This technique delivers clean, precise mortises, and rapidly. Including the drill-press work, I can finish a ⅜-in.-thick by 1½-in.-wide by 1½-in.-deep mortise in about 5 to 8 minutes. As a side note, if you don't have a drill press, utilise a doweling jig and handheld drill to eliminate the waste precisely.

How to apply the bench chisel

- A bench chisel is ideal for a lot of applications, but it's not the best choice to clean up the waste after drilling a mortise.
- When driving a bench chisel with a mallet to square the end of the mortise, the chisel tends to twist.
- That's because the blade is rather thin and the edges are beveled, so there is little side support.
- Typically, you'll need to begin and stop the cut several times to keep it on track.
- And chances are it won't be as clean a cut as you'd like.
- It's likewise challenging to keep a bench chisel square when cleaning up the sides.
- So the mortise may not end up straight and smooth.
- Plus, compared to my technique, it's slow.
- The solution is a mortise chisel.
- They come in two rudimentary types: One has a blade with a rectangular cross-section, and the other has a blade with a trapezoidal cross-section.
- You want the rectangular one.
- A rectangular mortising chisel won't twist simply as you bang it with a mallet to square the end of the mortise.
- And because the curves of the chisel meet at sharp right angles, you get a shearing cut when you lever it forward.
- That means much of the sidewall waste can be eliminated in one quick motion.
- In addition, while bench chisels are typically sharpened to 25 degree, most mortising chisels are sharpened to 30 degree.
- That means the sharpened edge is less likely to fracture when levered.
- Last, mortising chisels are denser and longer than bench chisels.
- That adds stiffness and leverage, making them better suited to the forceful levering action.
- It takes just four steps to cut any mortise.
- But first, make sure your chisels are sharp.
- Keep in mind that this technique requires that the mortise and the mortising chisel are the same width.
- That means if you want a ⅜-in.-wide mortise, you need a ⅜-in.-wide mortising chisel.
- I find that three different chisel widths ¼ in., ⅜ in., and ½ in., cover nearly any mortise I need.

Layout technique

- Begin by cautiously laying out and marking the length and width of the mortise.
- Use a sharp pencil to mark the ends.
- Then utilise a marking gauge to cut the two scribe lines for the sides.
- Now, with a square and a marking knife, cut scribe lines at the mortise ends.
- The cut lines are important: When you slip the sharpened edge of the chisel into them, they align it perfectly for the beginning of the cut.

How to eliminate the waste wood

- You could eliminate all the waste with the mortise chisel, but it's a lot faster to eliminate most of it by drilling a series of holes.
- Also, drilling makes it easier to maintain a consistent depth along the length of the mortise.
- I put the drill press to work here.

- Either a brad-point or Forstner bit works fine.
- Both of these bits let you drill overlapping holes to eliminate the maximum waste from the mortise.
- Just be sure that the bit diameter is the same as the mortise width, and position the fence cautiously so that all the holes are bored dead-center into the mortise.
- Begin by drilling the first hole at one end of the mortise, and then do the same at the other end.
- After that, drill as numerous non-overlapping holes as possible.
- Then cut overlapping holes as required to eliminate most of the remaining waste.
- With most of the waste drilled out, mark the depth of the mortise on the chisel blade.
- Place the tip of the cutting edge into the scribe line on one end with the bevel facing away from the end.
- Make sure the chisel is plumb.
- Also, with thin stock, it's a great idea to clamp the sides of the stock at the mortise so it won't split.
- Now, utilise the mallet to pound the chisel to the full depth.
- Keep the chisel plumb as you go.
- Once you reach the full depth, lever the chisel forward, toward the opposite end of the mortise.
- This is where the rectangular chisel pays big dividends.
- Because the chisel sides are parallel, their leading edges slice away, in one quick motion, a great portion of the waste at one end.
- Repeat the cut-and-lever technique on the opposite end.
- If the wood is hard, utilise both hands and lean into the chisel a bit.

You now have only a small triangular section of waste in the middle of the mortise. Since this is mainly a paring operation, utilise a normal, bevel-edged bench chisel. Simply begin at the top of the waste triangle and cautiously pare down to the bottom. Utilise the mortise chisel to clean up what remains.

Procedure:

- Keep the mortise at least ¾ in. away from the end of the workpiece.
- Otherwise the end-grain at the end of the mortise could blow out when you drive in the chisel.
- After marking the location with a pencil, utilise a marking gauge to scribe each side of the mortise, stopping at the pencil lines.
- To complete the layout, utilise a knife to scribe a cut line at each end of the mortise.
- With an ink marker and a square, mark the mortise depth on the blade of the chisel.
- Place the tip of the chisel into the cut line on one end of the mortise, and then utilise a mallet to drive it to the full mortise depth.
- Use a bit that matches the mortise width.
- Clamp a fence to the table to ensure that the bit drills into the center of the piece.
- After drilling a single hole in the test piece, utilise a dial caliper to make sure the hole is centered.
- With the stock against the fence, drill a hole at each end of the mortise.
- In between, drill as numerous non-overlapping holes as possible, leaving ⅛ in. between holes.
- Then drill overlapping holes, anchoring the center spur in the material between each hole to help keep the bit from drifting.
- Lever the chisel toward the opposite end of the mortise.
- As you do, the square curves of the mortise chisel shave a great part of the waste stock.
- Repeat from the other end.
- The levering trick eliminates all but a small triangle of waste.
- Bench chisel eliminates the remaining triangle.
- Elapsed chiseling time for both the mortise and bench chisels: one to two minutes.
- If keeping the chisel plumb is a issue, clamp a block of wood to the workpiece.
- Hold the blade against the block and you can drive the chisel knowing it's aligned perfectly.

Chapter 15 How to fit tenons using handplanes

Numerous woodworking professionals select to cut tenons with a tablesaw, thinking it will be fast and dead-on, only to get frustrated when their precise setup results in ill-fitting cheeks or misaligned shoulders. Truth is, it's hard to cut perfect-fitting tenons using just machinery, whether a tablesaw, a router, or a bandsaw. A better approach is to cut the tenon close and dial in the fit using hand tools. But is there one that's best for the job? To find the answer, I compared shoulder planes, rabbet block planes, fillister planes, and bullnose planes to see which one is best for trimming tenon shoulders and cheeks. All are essentially planes intended to cut into curves, leaving crisp, square edges and removing material systematically in a way that power tools cannot.

For a plane to be effective at trimming tenon cheeks and shoulders, it must have some rudimentary characteristics. First, it must be adept at cross-grain and end-grain cuts, so it should have a low cutting angle. Precision manufacturing likewise is critical, and the way the blade aligns with the body is vital for peak performance. The blade should silhouette the body precisely, projecting somewhat beyond each side and parallel with the sole to achieve the desired amount of cut. If the blade ventures excessively from the side of the plane, it will dig into and mark the joint's side. If it doesn't venture enough, the plane is pushed away from the corner and produces a sloping or wandering cut. The sole of the plane should be flat and the plane sides should be perfectly square to the sole. The blade should hold up to the rigors of end-grain planing. As with any handplane, the depth and lateral adjustments should be easy and should hold. Lastly, since these planes may be used in multiple positions, the body should be comfortable to grip with one or two hands.

I used all of the planes on tablesawn tenons to fine-tune the shoulders and cheeks, a job that involves tricky end-grain and cross-grain work. The stock was cherry, and the tenons were ¼ in. thick by 4 in. wide by 1¼ in. long. I judged the planes based on the test, as well as on their fit and finish and ergonomics. After all the testing, bullnose and fillister planes fell out of contention while shoulder and block rabbet planes rose to the fore. With their low cutting angle, both of these planes handle end-grain and cross-grain cuts. And they're made for utilise with one or two hands, so you can hold them in a number of positions to handle any trimming job. I'd recommend buying a shoulder plane first, and adding a rabbet block plane later.

You may be tempted to file, sand, or chisel your way to perfect tenons. But these practices are inconsistent. Files and sandpaper tend to round over the work, especially in the corner, and it's hard to control a chisel over a longer exterior without creating a taper. The key to achieving a piston fit is working logically. Cut the tenon on the tablesaw, and then cautiously trim the shoulders and cheeks with a shoulder plane and rabbet block plane. Shoulder planes and rabbet block planes reach into curves and eliminate material systematically in a way that power tools cannot, and they're more precise than files, sandpaper, or chisels. With each one, the blade should venture somewhat beyond the side for best performance. If it doesn't venture enough, the plane is pushed away from the corner and won't eliminate stock equally. Bullnose and fillister planes are not intended to trim tenon cheeks and shoulders. The bullnose plane has too short of a nose and does not register appropriately to begin a cut. The fillister is really a joint making tool, made for cutting rabbets and raised panels. It's not intended to be used on its side for trimming shoulders, and it's too long to utilise with one hand, a essential trait for trimming tenons with the workpiece supported on a bench hook.

With its tall body, a shoulder plane is ideal for trimming tenon shoulders, offering great control while keeping your hands away from the work. It likewise can be used to trim tenon cheeks. Buy the biggest one you can, which can handle any size shoulder and any tenon cheek. The issue with a shoulder plane, even a large one, is that it's not the most efficient tool for cheeks, requiring multiple overlapping passes to tackle long tenons, which could result in a tapered tenon if you're not cautious. That job is best handled by a rabbet block plane, which has a wider blade. Though it can be used on a shoulder, its short body is a bit harder to hold on its side. Out of both, the first one I'd recommend is the large shoulder plane, because it can do both shoulders and tenons pretty simply. Ideally, though, if you can afford it, add a rabbet block plane for cheeks. With both tools you'll be set up to trim tenons perfectly every time, rapidly and efficiently.

Chapter 16 Mortise and Tenon Joinery techniques

It’s hard to hide mistakes in through mortise-and-tenon joints. Both the tenon and the mortise are there for anyone to see. I found it tough to get crisp, chip-free mortises that were uniform and had clean, square curves. Then, recently, I came across a drawing of a straightforward bench made from 1 x 12 stock. I wanted to build several of them, but the joint that held the bench together was a wedged through mortise and tenon. The bench was an incentive. I worked on my technique and experimented with prototypes until I could cut this joint rapidly and precisely. In a through mortise and tenon, the tenon goes all the way through its mating piece and shows on the other side. Wedges are often added to spread the end of the tenon and lock the joint together. It’s a robust, eye-catching joint. I can cut the mortises by hand, but when I’m faced with making a lot of them, I like to utilise a machine. In my shop, that means using either the drill press or the router. I favour using the drill press because it’s quiet and setup is fast and precise. I can simply see the cut in progress. When I’m boring holes for a through mortise, I try to minimize tearout where the bit exits the stock. If possible, I’ll select the side where tearout will be the least noticeable; then I’ll lay out and cut the mortise from the opposite side. If tearout is unacceptable on either side, then I’ll utilise a router and a jig. For this bench, though, I decided I could live with some minor tearout on the back side because this area is fairly well-hidden.

The usual approach is to build from the inside out. Meaning, cut the tenons first, and then utilise the tenons as a template to mark the mortise locations. The issue is that you drill the mortises from the back, which virtually guarantees some tearout on the face of the piece, no matter how cautious you are. I favour the outside-in approach-cut the mortises first by drilling from the face side, and then mark the tenon locations from the mortises. To do it this way, I set up my drill press with a Forstner bit and a fence to register the workpiece. Forstner bits are best for this operation because they make such clean cuts. Just Recall that the bit diameter should be equal to or somewhat smaller than the tenon thickness. You can always enlarge a mortise that’s too narrow. To minimize tearout, I set the drill-press depth stop so that the bit just goes through the workpiece or leaves a paper-thin layer of material on the bottom of the mortise. It’s best to back up the workpiece with a clean piece of scrap. I drill the first hole at one end of the mortise. Then I nibble away the remaining waste by sliding the work face down on the fence and drilling successive holes every ¼ in. or so until I reach the other end. Toward the bottom of each hole, I slow down and utilise light pressure on the drill-press arm.

After roughing out the mortise on the drill press, I trim up those little waves on the sides and any remaining waste on the bottom of the mortise with a sharp chisel. This can be done by eye, but you’ll get better results if you clamp a straight piece of ¾-in.-thick scrap across the workpiece to serve as a guide. You can utilise the guide to square up the curves by working toward the corner from one direction and then swinging the guide 90 degree and working in from the other. If you utilise a chisel to square up the curves, be sure to work in from both sides of the workpiece, or you’ll tear out some really nasty chipping on the back side. The way I square up the curves is to saw them out with a small, stiff saw. I made my saw by filing teeth into the back of a carbon-steel paring knife. But you could likewise modify a wallboard saw by hammering the teeth flat, filling the sides of the blade to eliminate all set and the filing the teeth straight across like a rip saw. I lay the saw against the wooden guide clamped to the workpiece and saw to the corner of the mortise. I utilise the saw as a rough me to square out the curves.

I mark the tenon directly from the mortise using a small knife or pencil sharpened to a chisel point. Because the tenon thickness is the full stock thickness, only the width must be marked. I utilise a square to extend this line down the face of the stock and a marking gauge to scribe the tenon length. The tenon should extend completely through the mortised stock with an extra 1 /32 in. or so. This will be trimmed flush later, after the wedges have been glued in place. I bandsaw the tenons using the cutting sequence. If all goes well, the tenons will fit snugly into the mortises on the first try. This never happens for me, though, so some fitting is typically required. Filing either the mortise or the tenon typically will take care of a too tight fit. If you have some gaps, don’t worry. Small shims cut from the same stock will hide them

After fitting the mortises and tenons, I cut the wedge slots in the tenons. A thin-kerf cutoff blade in a tablesaw will develop a clean slot that’s about the right width. Depending on the size of the tenon and its direction in the mating stock, I utilise one or two wedges to spread the tenon and create a tight joint. Wedges should always exert pressure against the end grain of the mortise to keep the workpiece from splitting. I locate the slots. I saw the wedge material by ripping the stock, on edge, on the tablesaw. I angle the blade at 30, and adjust the fence until the point of the wedge will just fit into the kerfs I’ve sawed into the tenons. I cut the wedge material to length, and now I’m ready to assemble the joint. After clamping each item together, I drive the wedges home with a bit of glue on the leading edge.

Procedure:

- Back up workpiece with clean scrap; utilise a Forstner bit to eliminate most of the waste. Set depth stop so bit just cuts through stock.
- Guide chisel with a straight piece of scrap, and pare remaining waste from walls of the mortise.
- A shop made saw used like a rough file squares the curves.
- Cautiously work the saw into the corner.
- Transfer the mortise location to tenon stock.
- Use a knife or sharp pencil to mark out the tenon width.
- Extend tenon layout lines down the face of the stock with a square
- Mark the length of the tenons with a marking gauge or knife, and then cut to the line on a bandsaw.
- Wedges spread the tenon and lock the joints together.
- The wedge should exert pressure against the end grain of the mortise so it won’t split the stock.
- Set the tablesaw blade tilt to 3°, and elevate blade to about 1 in.
- Set the rip fence so the wedge tip just fits the kerf in the tenon.
- The end grain of the stock should sit on the saw table.

Chapter 17 How to work with curves

My first saw was a bandsaw, so from the very beginning of my woodworking career, I found myself working with curves. If you've only been a straight-shooter until now, you'll find that curves not only open up a world of design possibilities, but they likewise offer plenty of chances to expand your repertoire of woodworking skills: from laying out eye-pleasing shapes to cutting and smoothing those shapes, or even bending them. What stops most people, nevertheless, is the prospect of cutting and fitting joinery on these curved parts. I'll describe you three practices that I've used over the years with great success. There's nothing exotic or hard about them, and once you see them in action, you'll soon be adding graceful curves to your own work.

In summary:

- Create a subtle flat as an easier landing spot.
- Make the flat stand out for a curved transition.
- For inside curves, scribe the tenon shoulders.

Procedure:

- A straightforward way to join two pieces when one of them is curved is by leaving or creating a flat area on the curved work where the mortise is to be cut.
- If you are cutting the curved piece out of square stock, it's easiest to locate and cut the mortise while the workpiece is still square.
- Then you can leave the area around the joint flat when cutting the curve.
- The tenon on the mating rail can then be cut and fitted just as for any other mortise-and-tenon joint.
- When creating the flat, be sure to extend it ⅛ in. or so beyond the rail both above and below the joint to accommodate any expansion across the width of the rail.
- When the piece is glued up, you can sand lightly to ease the transition from flat to curve, leaving about 1 /16 in. flat.
- Things get more challenging if you're cutting several identical parts from square stock.
- If you want to minimize waste, you'll need to nest the layout of the parts and cut them all out before doing anything else.
- This means you'll then have to create the flat, and cut the mortise, in an already curved part.
- To do this, I make a straightforward jig that holds the work while I create the flat spot and then cut the mortise.
- Clamp the curved piece into the jig so that the area to be flattened ventures above the jig's fence.
- Now you can create the flat spot, using a handplane to eliminate the projecting material and bring the part flush with the top of the fence.
- To utilise the jig with a router, screw on a top plate to support the router.
- Use a spiral upcut bit or a straight bit, set to cut flush with the top of the jig's fence.
- The first cut should be a clockwise pass around the area to be flattened; this is a climb cut to circumvent tearout.
- To mortise with the same setup, equip a plunge router with a fence that will ride along the back of the jig.
- Adjust the fence to locate the mortise on the thickness of the workpiece.
- Rout between the layout lines in shallow passes until you reach the desired depth.

Some designs call for seamless curves that flow from one part to the next, regardless of whether the parts themselves are curved. In these cases, don't shape the curve, or much of it anyway, on the end of the tenoned piece. The outer tips of the curved ends will consist of very fragile short-grained stock. Instead, leave a raised area on the mortised part, and form the transitional curves there. Just rough them in, and then refine the transitions after gluing the joint together. A well-known example of this technique can be seen on the leg-to-rocker joints of a rocking chair. As a side note, another excellent solution to this issue is the gunstock joint used in hall table. Here's a final point to review when using this type of joinery: It makes a lot of sense to utilise quartersawn wood for the rail. This is because, after the joint has been smoothed to seamlessly flow together, seasonal expansion and contraction of the rail across its width could create minor misalignment between the parts. Quartersawn stock, which moves less across its width than flatsawn material, will minimize this issue.

When you're joining a tenoned part like a chair's crest rail or a table apron to a concave section of curve, it won't work to create a flat spot on the curve. A straightforward approach is to scribe the tenon

shoulders on one piece to exactly match the curve of the adjoining piece. As a side note, this is another instance where a quartersawn rail is a great idea. Excessive wood movement can cause gaps to appear in a scribed joint, because expansion or contraction will essentially change the curvature of the shoulder.

How to cut the mortise and tenon

- You can utilise the jig again to cut the mortise, while you may need to utilise a curved offcut as a brace between the jig and the workpiece to help hold the work squarely when clamping.
- The real trick in this technique lies in shaping the tenon shoulders to firmly hug the curve of the mating part and create a gap-free joint.
- This procedure will be straightforwardr if, when cutting the tenon, you angle the tenon shoulder so that it generally follows the direction of the curve to which you'll be scribing.
- You can do this with a tablesaw tenoning jig, clamping the workpiece in the jig against a precut wedge.
- Cut the tenon to normal length to fit in the mortise.
- Begin the scribing procedure by inserting the tenon fully into the mortise.
- Next, utilise a marking knife to ride along the curved workpiece and scribe a line into the shoulder of the mating part.
- It's ideal if the scribed line is made with a single-bevel knife so that the straight side of the cut is toward the shoulder, this will leave a very crisp edge to pare toward.
- Facing the knife that way often will create the offset you need to transfer the full curve to the shoulder, while ultimately shortening the tenoned part as little as possible.
- But you can utilise a shim of some kind to increase the scribing offset for deeper curves.
- The paring requires a very sharp chisel with a flat back.
- Nibble a little bit away at a time, until you are just one or two paring cuts away from the scribe line.
- Now put the chisel's edge right in the scribed line and pare down.
- The easiest way to keep the cut perfectly on your line is to make each cut after the first one with only the leading quarter of the chisel, registering the rest of the chisel against the existing shoulder.
- A gentle twist of the chisel, applying a little extra force against the existing shoulder, should keep you from inadvertently crossing the line. It likewise helps to undercut the shoulder a little.
- Just be cautious not to do that at the curves, where undercutting from one side will leave unsightly gaps on the adjacent face.
- As you trim back the shoulders, you might likewise need to trim the tenon length back so the final depth is about 1 /32 in. less than the depth of the mortise.
- This leaves room for excess glue.

Chapter 18 How to peg wood joints

I rarely cut mortises and tenons, whether in doors, leg-to-apron joints, or on breadboard ends, without pegging the joints. Driving a wood peg through a mortise and tenon not only strengthens the joint, but it likewise adds a decorative element that I've come to depend on in most of my designs. Because I lean toward joinery that is honest and exposed, using pegs makes the construction procedure transparent. If you see pegs, you can bet that they're more than ornamental, and you can tell at a glance how the piece is held together. Reinforcing a joint in this manner involves driving a hardwood peg through the mortise and tenon. Structurally, the peg strengthens the mechanical connection between mortise and tenon, often to the extent that glue isn't essential. Visually, the peg can add a subtle or bold detail to your work. Most of the time, I drive pegs into a mortise-and-tenon joint that has already been assembled. But with appropriate planning, pegs likewise can be integral to the assembly procedure, exerting their own clamping pressure. This technique, called drawbored pegging, calls for some drilling and layout work before assembly. Both practices make for bombproof joints, and the practices are rather straightforward.

Pegs can be intended to suit most furniture styles. For starters, you can make them round, square, flush, or even proud and faceted. Then there is the species of wood. Because the end grain of the pegs is exposed and will darken with an applied finish, they will offer contrast in some form. For a more subtle appearance, cut the pegs from the same primary wood you're using on the venture. To pump up the contrast, select pegs of a darker or lighter species. I often utilise walnut to add a darker accent to cherry designs. Ebony is dense and robust, and the near-black color offsets mahogany or walnut well. On occasion, especially if I want a more contemporary look, I'll utilise pegs of a lighter color: holly pegs in a mahogany door, for instance. Regardless of your design, select a dense and robust hardwood peg that is as robust as, or faster than, the material you are pegging. On a few occasions, I have pegged joints with a softer wood, but in these cases the pegs are simply a design element—not a means of strengthening the joinery.

There's more to pegging a joint than the appearance. It's likewise vital to get as robust a mechanical connection as possible. A few factors come into play here: the size, placement, and number of the pegs. Without calling in the engineers, you can determine the size of the peg by reviewing the joint you're reinforcing and the desired effect. In general, I utilise pegs between 3 /16 in. and ⅜ in. dia. That said, even smaller decorative pegs of ⅛ in. dia. would not be out of place on a delicate box, and ½- in. pegs might work better on a beefy trestle base. Position pegs so that neither the mortised nor the tenoned stock splits as the peg is driven home. You likewise may utilise multiple pegs to secure wide mortises and tenons, such as those on table apron-to leg joints. In these cases, double pegs help strengthen the joint and lend the design a more balanced appearance.

Whether you're installing round or square pegs, begin by choosing a bit that closely matches the peg size. Just make sure the bit isn't much larger than the peg stock. If you're drilling into softer stock, you can make the hole about 1/32 in. smaller than the peg stock because the primary wood will offer a little give. But you may need to whittle the bottom two-thirds of the peg to get it to fit the hole. Shoot for a snug fit, but not so tight that the peg could split either the mortised or tenoned stock. Different woods react differently, so test the fit on scrap pieces. Before gluing the mortise-and-tenon joint, transfer the mortise/tenon location around to the face of the stock and then mark out the center point of the peg locations. If you are pegging an exposed mortise and tenon, such as a bridle joint, you can mark the locations after glue-up. Simply drill at the center points all the way through the tenon and about ⅛ in. to ¼ in. beyond. On thinner stock, common on door frames, ¼ in. is not always possible. In these cases, simply drill about a third or half of the way into the opposite wall of the mortise, just make sure the back wall of the door stock isn't thinner than about ⅛ in. utilise a piece of tape attached to the bit to control the depth, and keep the drill perpendicular to the workpiece. On smaller workpieces, using a drill press guarantees perpendicular holes. If your design calls for square pegs, you'll need to square up the top third of the hole using a chisel.

Both round and square pegs need a little prep work before you drive them home. After cutting the pegs to length, they should be about ⅜ in. longer than the depth of the hole, ease the edges on the bottom of the pegs using sandpaper, a chisel, or a small knife. Doing so lets you to drive the peg into the hole without splitting or damaging any parts, and gives excess glue a place to go when you drive the pegs home. Once both hole and peg are prepped, place a small drop of glue in the hole and apply a thin layer to the lower third of the peg. To drive the peg home, utilise a small metal finishing hammer. Its light weight won't stress the stock you're pounding, and the tone of the metal hammer will deepen as the peg bottoms out in the hole. Once the peg bottoms out, stop hammering or you'll risk cracking the stock.

You can trim pegs flush, but leaving them proud of the exterior they're driven into is a great way to accentuate the joinery even more. I often leave small pegs about 1 /16 in. proud of the surface, larger ones a little more. After installation, the exposed end of the peg can be softened with sandpaper, chamfered with a chisel or plane, or, my favorite, faceted. The first few times I tried to utilise faceted pegs, I made it a lot more hard than essential.

Simply drive the peg into place as usual, and then wait for the glue to dry. To cut the pegs to a consistent

size, utilise a shim whose thickness matches the desired ventureion of the peg, and register the saw against it as you trim the pegs to length. To cut the facets, utilise a chisel that's wider than the peg, and hold it bevel-side down against the exterior adjacent to the peg. Working in from one side at a time, utilise the bevel as a lever to angle the blade upward as you cut toward the center. To avoid denting or scarring the exterior you're bearing against, place a thin shim between the chisel's bevel and the exterior of the wood. You'll have the best luck if you cut each facet in a single sweep of the chisel, every time you stop to realign the chisel, you're left with a small ridge on the peg's pyramid top that will have to be cleaned up. Before working on a venture, practice the technique on a scrap peg and joint.

Procedure:

- Driving wood pegs into mortise-and-tenon joints adds strength and visual appeal to furniture.
- Typically, the joint is glued up before pegs are installed, but you don't have to wait for the glue to dry before adding pegs.
- You might want to leave the clamps on, though.
- Draw the outline of the tenon on the mortised stock.
- Locate the pegs' center points, and then define them with an awl so that the drill bit won't wander.
- You can buy dowel stock for pegs, but you'll have more design options if you make your own from hardwood scraps in your shop or from purchased pen blanks, which come in a diversity of exotic species.
- Begin with a ¾-in.-sq. blank.
- Set the tablesaw fence and the blade height based on the size of the pegs you're cutting.
- If you're making 3 /16 -in. pegs, set the fence to 3 /16 in. but leave the blade height just shy of 3 /16 in.
- Using a push stick at the end of each cut, rip along each corner of the blank, adjusting the blade height until only a sliver holds each corner together.
- Ultimately, you'll be able to peel away the strips.
- To make round pegs, place the square strip in a V-grooved trough and plane away equal amounts of stock at the curves.
- The pegs will go in easier if you chamfer the bottom edges.
- Use a metal hammer to drive in the pegs.
- Stop when the hammer tone deepens; it means the peg has bottomed out.
- Attach a tape "flag" to the drill bit, and stop drilling when the flag knocks the chips away.
- Drill perpendicular to the workpiece to circumvent tearout.
- Set the fence to match the peg width and set the blade height to just under that measurement.
- Use a push stick at the end of each cut, and raise the blade until only a sliver of material holds the peg stock to the blank.
- Then peel away the strips.
- With the blank set in a V-grooved trough, utilise a block plane to eliminate the curves, rotating the blank as you go.
- Use a handsaw to trim the peg nearly flush.
- Place a shim under the saw to protect the workpiece.
- Dampen the peg with water, then mash it a few times with a hammer, causing the head to mushroom somewhat.
- The water softens the fibers and mashing helps spread the peg to fill any gaps.
- Pare the peg flush using a chisel.
- Rest the chisel flat on the work-surface.
- Slowly work your way around the outside of the peg and toward the middle to circumvent tearout as you finish the cut.
- Pegging the breadboard ends of a tabletop is a great way to reinforce that joint.
- But you must allow for wood movement by elongating the outermost peg holes.
- With the breadboard ends clamped to the tabletop, drill the holes for the pegs at their marked locations.
- Again, flag the bit to gauge the drilling depth.
- Eliminate the breadboard end, utilise the drill to elongate the holes in the outer tenon, and then clean up the holes with a chisel.
- Glue the breadboard ends to the tabletop, being sure the holes in the breadboards align with the holes in the tenons.
- Clamp them in place, and tap the pegs home.
- By drilling the tenon peg holes somewhat toward the shoulder, the mortised joint will be drawn tight as the peg is driven in.
- Go through one side and partway into the other.
- Use a Forstner bit for a clean cut
- Use a combination square and a knife to offset the hole 1 /32 in. to 1 /16 in., depending on the hardness of the supplies.

- With the joint re assembled and clamped together, mark the center point of the hole.
- An easy way to do this is to insert a Forstner bit into the hole and tap lightly.
- Drill through the tenon.
- Align the tip of the Forstner bit so that it engages the offset line.
- If you need to drill multiple holes, using a fence helps ensure consistency.

Chapter 19 How to layout Dovetails

Striking a perfect blend of form and function, dovetail joints add great interest and detail while enhancing the structural integrity of a case, box, or drawer. Cutting dovetails can become second nature after plenty of practice with saw and chisel. Dovetail layout, on the other hand, is where I see students get frustrated. Here are the key steps in laying out a rudimentary through-dovetail joint, with tips on creating an eye-catching joint that is sturdy enough to last generations.

Several factors go into the design of a dovetail joint. These include the size and spacing of the tails and pins, and the slope of the tails. Most dovetail joints begin and end with a half-pin on the outside, with the rest of the space subdivided into multiple pins and tails. This creates plenty of long-grain glue surfaces as well as mechanical strength to tie the elements together. A common practice is to span the joint with pins and tails of equal proportions. While it's structurally very sound and typical of machine-cut dovetails, this joint has little design appeal. A better technique is to span the joint with tails that are larger than the pins. This is a common practice with hand-cut dovetails and likewise can be done on the bandsaw or tablesaw, as well as with the better machine-dovetail systems. I recommend sizing the half-pins on the outer edges from ¼ in. to ⅜ in. at their narrow end. Interior pins range from ⅛ in. to ¼ in. wide and can be spaced anywhere from ¾ in. to 2 in. on center, depending on the application. Last, it's vital to select an appropriate slope, or angle, for the tails. That slope is what draws the pin board up tight during assembly. More slope pulls the joint together efficiently; too little slope may require clamps or other aids to pull the joint together, much like a box or finger joint requires clamping pressure in two directions. Partly a matter of preference, the traditional ratio is 1:6 for softwoods and 1:8 for hardwoods; the reason being that the fibers of softwoods can compress more simply and therefore require a bit more angle to ensure that the pins are drawn tight to the tail board.

Layout procedure

- When laying out dovetails, utilise as few steps as possible.
- Begin by marking out the orientation of the pin and tail boards: inside and outside faces, top and bottom, front and back.
- Recall that tail boards generally make up the sides of drawers and cases, and the fronts and backs of chests; pin boards are typically the fronts and backs of drawers, tops and bottoms of cases, and ends of chests.
- With the orientation of the tail board and the pin board established, scribe the baselines on both using a marking gauge.
- Set the gauge to the exact thickness of the pin board and scribe the tail board on both faces and edges.
- Setting the gauge to the pin board's exact thickness means there are no proud pins to interfere with clamping and leaves little to trim flush after glue-up.
- After scribing the tail board, scribe the inside and outside faces of the pin board in the same way.

While some woodworking professionals will argue that it's best to lay out and cut the pins first, I favour to work the tails first for a few reasons. First, I can lay out and cut more than one tail board at a time. Second, I find it easier to align, hold, and transfer the tails to the pin board because the pin board can be held securely in a vise and the tail board can lay horizontally, simply registering on the pin-board ends. Last, any adjustments or fine-tuning during assembly will be done to the pins, and it is much easier to trim and fit the open, right-angled pins than the tight, angular confines of the tails. Clamp both tail boards in a shoulder vise so that they are 2 in. to 3 in. above the benchtop and square to it. Measure and mark the half-pins across the ends of the boards and perpendicular to the faces.

Now divide the tails based on the number that you want and the pin sizes between them. For instance, say you want four tails with 3 /16 -in.-wide pins and two ⅜-in. half-pins. Lay out the half-pins ⅜ in. from both edges, then make a mark on the end of the tail board 3 /16 in. past the half-pin mark on the right side. Then measure from that mark to the half-pin mark on the left side. Say that distance equals 6½ in. Because you want four tails, divide the 6½ in. by 4, which equals 1⅝ in. Now adjust a set of dividers with the points 1⅝ in. apart. Lay one point of the divider on the right half-pin and walk it across the board end until you pass the half-pin on the left. If your math has been done correctly, the divider should be 3 /16 in. past this mark. Now put one of the divider points on the left half-pin mark and walk back across the board end to the right.

How to mark out the tails

- The divider technique will leave a series of impressions spaced appropriately, in this case 3 /16 in. apart.
- Place a sharp pencil in each impression, slide a square up to the pencil, and square a line across the ends of the boards.
- Next, set a bevel gauge to the appropriate slope and mark the face of the tail board.
- A dovetail saddle marker can be handy here because it lets you to draw the two lines across the top and down the face rapidly and without misalignment.
- Dovetail saddle markers generally come with one of two slope ratios, 1:6 or 1:8, and are obtainable from a number of sources.
- Now you're ready to cut the tails and eliminate the waste.
- The end-grain cuts must be absolutely perpendicular to each face of the board.
- Otherwise, during the next step the information transferred from inside the boards will not match the outside, causing issues.
- With the tails laid out, cut, and pared, secure the pin board in the shoulder vise, with its outside facing you and its end 2½ in. to 3 in. above the benchtop.
- Place the tail board with the outside face up on the end of the pin board.
- Use a spacer to keep the tail board level.
- Line up the baseline of the tail board with the inside edge of the pin board.
- If the tail's baseline overlaps the pin board's inner edge, the tails will be too tight.
- If the baseline is proud of the pin board's inner face, the pins will be too small, resulting in a loose joint.
- Holding the tail board securely, utilise clamps if required-knife in the tails clearly on the pin board.
- Extend the marks perpendicularly down the pin board's face to the baseline.
- Now you are ready to cut the pins and complete the joint.

Chapter 20 Using Dovetails on the tablesaw

It takes an awful lot of practice to cut dovetails by hand and to do it well. Your sawcuts should be straight, at a consistent angle, and square to the board's face. And you can't cut into the baseline. Later, when you're paring and attempting to make up for bad sawcuts, you can make things much worse. There are ways to cut dovetails that bypass those challenges. With a router and jig, you'll get straight and square tails and pins that have consistent angles. Unluckily, they won't look as nice as hand-cut dovetails. It's hard to redevelop the wide tails and narrow pins that make the hand-cut version so appealing. Nevertheless, there is one power tool in your shop that excels at cutting straight and square, and can simply maintain the same angled cut for both tails and pins: the tablesaw. What's more, because tablesaw blades are no more than ⅛ in. thick, you can redevelop hand-cut dovetail spacing, too. Of course, because both the tails and the pins are cut at the tablesaw, you're limited to through dovetails. That's great for case joints and the back joints on a drawer, but what about the half-blind dovetails we all utilise to join the drawer front to the sides? No issue. I have a trick that turns a through-dovetail into a half-blind, with added benefits you can't get the traditional way. But let's begin with the basics.

To cut dovetails this way, you need only your stock miter gauge and a blade. I utilise a rip blade because these are ripcuts and because it has a flat-top grind, which leaves a flat shoulder when I cut the pins, with no paring required. Nevertheless, any standard blade will leave a bit of material between tails, so you'll still have some paring to do. If you're going to cut dovetails this way all the time, get a blade with the teeth ground to match the dovetails'slope. Any saw-sharpening service can do it. Utilise it for the tails and you won't have any paring to do in the curves, either. You likewise need two L-shaped fences for the miter gauge—one for the tails and one for the pins. They should be at least twice as long as the drawer sides are wide, so the sides always have support as you move them to cut the pins and tails. After the fence is attached to the gauge and a kerf is cut into it, it's easy to align layout lines with the kerf so the blade cuts exactly where you want it to.

Procedure:

- To take advantage of the tablesaw's accuracy, you need to set it up precisely.
- Mark the tails, setting the gauge at your favorite dovetail angle.
- Then utilise the same bevelgauge setting to angle the blade to cut the tails.
- With the blade at 90°, angle the miter gauge for the pins.
- Don't change the setting on the bevel gauge, and the pins are sure to match the tails.
- The tablesaw locks in the cutting angle and a stop block lets you to make eight cuts from a single layout line.
- So all you need to do is lay out the tails at one end of one board.
- Scribe all the boards, wrapping the marks around the edges on the tail boards.
- You can space the dovetails any way you want, but they should be symmetrical around the centerline.
- Make sure the bevel gauge's setting hasn't changed and that it's flat against the blade's plate, coming up in a gullet between teeth.
- Flip the board to make two mirror-image cuts, then rotate it end for end to make the same two cuts on the opposite end.
- When you've done the same with the second tail board, you've made eight cuts without moving the stop block.
- As you work across the board, moving the board to a new layout line and making all four cuts each time, you naturally begin to cut the second side of every tail.
- A few eyeballed cuts knock off most of the waste at the ends
- After defining all of the tails at the tablesaw, cleanup goes rapidly.
- Work to your scribe lines.
- Move the blade back to 90 degree.
- One side of every pin is cut with the miter gauge angled in one direction.
- Angle it in the other direction to cut the second side.
- Do this on all your boards.
- You can utilise a 0.5mm mechanical pencil because of its very fine line.
- You can't see the end grain when the board is standing on the auxiliary fence, so you'll need these lines to align the board for cutting.
- Use the bevel gauge, still set to the angle used for the tails.
- You can attach a new auxiliary fence so that the kerf for this cut doesn't overlap the one used for the tails.
- You can't flip the board this time to make a mirror-image cut on the same end, but you can invert it. Keep the same face out.
- If you do, the pin will be too narrow and you'll have gaps in the joint.
- Take advantage of the zero-clearance kerf, aligning the board so that the pencil line is right next to the kerf, but not in it.
- You can utilise through-dovetails in lots of places, but typically not drawer fronts.

- There, you want half-blind dovetails.
- But you can still utilise this dovetailing technique by gluing a thin board (⅛ in. to ¼ in. thick) to the front of the drawer box after it's glued together.
- That lets you to utilise through-dovetails for all of the joints, but still get the half-blind look.
- You get more mileage from your best lumber, which you can resaw to get book- and slip-matched fronts.
- Resawing from a denser board lets you spread a beautiful board over several drawers.
- You can utilise a caul made from melamine-covered particleboard to protect the front and help spread the pressure over the entire surface.
- Cut them off short and they'll stick into the front and avoid it from creeping under clamping pressure.
- Routing is faster than a handplane and makes it easier to keep the edge square to the face.
- Do the ends before the long edges, and utilise a pin in your router table to help you enter the cut safely.
- There's no way around it to cut the second side of the pins.
- Be sure the bevel gauge is still locked into its original setting.
- This is just like cutting the first side of the pins, apart from the board goes through the blade at a different angle.
- Most of the waste can be cut out with the fence at the second setting, but you'll need to move it back to the first setting to get all of the waste.
- After cleaning up the baseline of the pin board with a file, the joint should come together square, without gaps, and without much persuasion.

Chapter 21 How to Miter your Dovetails

Among my favorite things about making this small dresser mirror is the joinery—two different combinations of dovetails and miters that are robust, look great, and allow me to cut molded profiles on the edges and faces of the piece.

On the case, the lap of the half-blind dovetails enables me to cut a continuous ovolo edge detail around the top. The miter at the front of the joint likewise lets me cut a molded profile on the front of the case. I wanted the same molding particulars on the edge and face of the mirror frame, and I wanted its joinery to visually echo the dovetails on the case. The joint I utilise a dovetailed through-tenon with a miter in front and a half-lap in back, is challenging but fun to execute, and the results speak for themselves. The interlocking nature of a dovetail adds strength to the miter. The square shoulders of the half-lap make it easy to square the frame and avoid the miters from slipping during glue-up.

Procedure:

- Use a marking gauge to scribe the width of each piece onto both edges of its mate. Then utilise a bevel gauge to lay out the angles on the front faces.
- Use the bevel gauge to mark the angled socket cheeks on the edge of the piece.
- For the pin, the straight lines are on the edge and the angles go on the end grain.
- For easier layout on narrow stock, you can make an adjustable jig by fitting Plexiglas into a kerf in a hardwood block and adding screws.
- A cleat on the end helps locate the jig.
- The front cheek is cut at an angle with the saw stopping just before the outside corner of the miter.
- The rear cheek is cut to the baseline.
- Clamp the stock horizontally to cut away the waste.
- Cut on the waste side of the line and pare with a chisel.
- A pair of angled cuts establishes the socket walls.
- Cautiously saw to the waste sides of your marks, and then utilise a bandsaw or coping saw to hog out the majority of the socket.
- The remaining waste can then be cleared with a coping saw and chisel.
- With a router and fence, eliminate the extra material.
- Use a chisel to square up the tab, which will form one half of the mitered front.
- Its rear face likewise captures the half-pin behind the miter.
- Scribe a line for the tail length using a gauge setting picked up from the pin board.
- You can scribe the underside of the top all the way across, but scribe the show face only between your angled pencil lines.
- To pare the waste from the narrow sockets, you can utilise a chisel that ground to 1 /16 in. wide.
- Scribe the socket shoulders with a knife, then flip the piece in the vise and mark the vertical portion of the pins with a pencil.
- After sawing to the lines and hogging away the waste with a router, you can do a cautious final cleanup with a chisel.
- Adjust the sliding bevel to the angle between the top’s outside corner and the scribe line for the tails on the underside.
- Trim the miter.
- After sawing tight to the line with a fine saw, the paring required should be minimal.
- If all is well, you should now be able to tap the top and sides together, and you should have a tightfitting miter at the front.
- The dovetails for the case are, ordinary half-blinds.
- Nevertheless, the mitered front complicates the layout and joinery somewhat.
- To begin with, you’ll need to dimension the top piece so that it is the full length of the case, to allow for the miter at the front.
- And before laying out for the tails, you’ll need to eliminate a narrow band of stock so that the tails will come up short of the end of the case.
- On this case, the top and sides were likewise of different thicknesses.
- This meant the miter wasn’t 45 degree, requiring different bevel-gauge settings to create the mating angles.

Chapter 22 Biscuit Joint Techniques

It will never match the beauty of a dovetail or the strength of a mortise-and-tenon, but for speed, accuracy, and ease of use, it's hard to beat the biscuit joint. Biscuit joints can be used on all wood merchandises: solid wood, plywood, medium-density fiberboard (MDF), and particleboard. For this reason, they are great for cabinetry, which typically involves a mix of solid wood and sheet goods. Biscuits are a great way to join a plywood carcase and attach an assembled face frame. They likewise help keep things aligned when gluing solid-wood edging to plywood or assembling solid boards into a wide panel.

A dedicated tool and an oddly shaped tenon combine to create a biscuit joint. At the heart of the procedure is a power tool called a biscuit joiner or a plate joiner. To make a joint, utilise the tool to cut a shallow slot in each of the mating parts. Then, after adding glue to each slot, insert a thin, football shaped biscuit into one slot. A little more than half the biscuit's width goes into the slot; the other half sticks out. To complete the joint, just slip the mating slot onto the tenon and clamp the parts together. The biscuit joiner has just four main parts: a motor, a blade that cuts the slot, an adjustable fence that aligns some types of cut, and a base that houses the blade and likewise can align cuts. The 4-in.-dia. blade looks like a miniature tablesaw blade. Unlike a tablesaw blade, nevertheless, the biscuit-joiner blade cuts horizontally. The kerf it creates, commonly called the slot, measures about ⅛ in., just wide enough to accept standard-thickness biscuits. Thanks to a spring-loaded sliding way that connects the base and motor, you can butt the front of the base against a workpiece, begin the motor, and push it forward. The spinning blade emerges from the front of the tool to cut a shallow arc-shaped slot in the workpiece. Release the forward pressure, and the springs push the motor back to retract the spinning blade safely into the base.

The second element in this joint is the biscuit. Made from beechwood or white birch that has been thoroughly dried, biscuits are compressed by machine to a standard thickness. For maximum all-around strength, the biscuits are cut so the grain runs diagonally. When a biscuit comes into contact with moisture, it swells. So when you insert a biscuit into a gluelined slot, the biscuit expands, creating a snug fit and a tight joint. It is vital to utilise only water-based glues such as common yellow PVA glue. Biscuits won't work with epoxy, cyanoacrylate super glue, or polyurethane glues. Biscuits come in three standard sizes, No. 0, No. 10, and No. 20. The biscuit joiner has preset depth stops that match these sizes.

When using a biscuit joiner, you have two ways; the fence or the base, to register the slot in the workpiece. Each has advantages. For extra flexibility, the adjustable fence lets you position the slot anywhere between 3 /16 in. and 1 in. from the fence. Also, you can set the fence to cut slots in angled joints. Nevertheless, if all you want to do is center a slot on ¾-in.-thick stock, it's easier to register off the base. This is because the center of the kerf is located ⅜ in. from the bottom of the base. To create a slot in ⅜-in.-thick stock, place the base and the stock on the same flat exterior and make the cut. It's OK if the slot isn't exactly centered; just recall not to flip the parts when it comes time to glue them.

How to cut and assemble a biscuit joint

- With a biscuit joiner in hand, it takes just four steps to join a pair of ¾-in.-thick boards end to edge.
- This joint is useful for making light-duty door frames, especially when the panel is plywood or MDF.
- That's because plywood and MDF don't expand and contract with changes in humidity, so they can be glued in place to add strength to the frame.

Step 1:

- Align the boards as you want to see them joined, and utilise a single line to mark the biscuit centerline on the top face of both parts.

Step 2:

- Based on the width of the board, select the largest biscuit that it can accept.
- For the 3-in.-wide stock, No. 20 biscuits are a great choice.

Step 3:

- Cut the slots—Clamp one of the workpieces in place.
- Set the depth-adjustment knob for the No. 20 biscuit.
- Align the center-registration mark on the biscuit joiner with the biscuit-centerline mark made

in step one.

- Begin the motor and, with one hand on the top handle and one hand on the motor housing, push the motor toward the stock.
- Continue cutting until you reach the stop, and then allow the spring action to return the motor to the starting point.
- Repeat the procedure to cut a slot in the second piece.

Step 4:

- Use a small brush to apply a generous coat of glue to each slot.
- Be sure to coat the sides of the slots, that’s where a lot of the glue strength comes from.
- Add glue to the biscuit and insert it into one of the slots, then attach the other piece and clamp them together.
- Don’t answer the phone after the biscuit has been inserted into the first slot.
- By the time you come back, it will already have swelled enough that you won’t be able to insert it in the second part of the joint.
- The only thing you can do then is let the glue dry, saw away the protruding part of the biscuit, and recut the slot.

Biscuit joinery is useful in a wide range of applications, from aligning edge-glued boards to securing shelves to assembling and attaching frames, miters, and more.

Chapter 23 Joints using Dowels

In all of woodworking, no joint is as undervalued or underused as the one held together by the lowly dowel. Why? The answer lies in a mountain of broken chairs and cabinets. Decades of bad factory-made furniture have given the sturdy little peg a rickety reputation. But pros know better. Dowel joints offer a straightforward, robust way to make fine furniture, and they often succeed where other joints can't. Dowels are easy to utilise in part because they are cylindrical, meaning you can rapidly create precise holes for them using a handheld drill. As to strength, our recent joint test showed that appropriately executed dowel joints are robust enough for all but the most demanding applications. This strength means you only have to make straightforward butt joints before drilling holes. And the best news, especially for beginning woodworking professionals, is that all you need is that drill, a couple of great drill bits, and an inexpensive jig. Here are my favorite ways to utilise dowels.

Woodworking professionals often edge-glue several boards into a panel for a wide part like a door or tabletop. Dowels work well to keep the boards aligned so their surfaces stay flush. To mark out for the joinery, draw tick marks across the joints, about 6 in. or 8 in. apart. Utilise these marks to align the doweling jig for drilling. This joint's strength comes from the long, edge-grain glue surface, so the dowels don't need to be several or large. I typically utilise ⅜-in.-dia. dowels, unless the panel is less than ⅝ in. thick. Be sure to drill 1 /16 in. or so deeper than required to hold excess glue when the joint goes together. Also, when gluing any dowel joints, don't put glue on the dowel itself; the hole will scrape it off and create a mess. Instead, put glue in each hole and spread it with a small brush or stick.

Nearly any joint that calls for a mortise-and-tenon, table bases, door frames or face frames, is a candidate for dowel joinery. Because this joint relies exclusively on the dowels for strength, you need longer dowels, and more of them. A great rule for dowel size here is one-half the thickness of the workpiece, with ¾ in. or more extending into each hole. A ⅜-in.-dia., 2-in.-long dowel works great in most situations. To ensure that the holes in the mating pieces line up precisely, begin with the jig referenced along a common edge. In this case, utilise the top edge of the rail and the top of the leg, which will be flush when the pieces are assembled. Also, don't apply glue to the mating surfaces. The end grain won't add much strength and you'll get excess squeeze-out, which is best avoided.

A great dowel joint depends on a snug fit between dowel and hole. Hardware-store dowels won't do, but good, inexpensive dowels are obtainable from online woodworking suppliers. To drill precise holes, utilise a brad-point bit. Its center spur prevents the bit from wandering and enlarging the hole. To keep mating holes aligned and ensure that the holes are square to the surface, you'll need a doweling jig. Low-cost models work with dowels of ⅜-in. diameter, a great all-purpose size. For places where the jig can't go, a set of dowel centers is a smart accessory. These metal plugs fit a hole precisely and transfer its location to the mating piece.

How to hide a joint

- Furniture makers often draft an overall design for a piece first and sort out the joinery afterward.
- This lets creative freedom but can lead to situations where traditional joinery won't work.
- One example is the lower shelf on this table.
- Rest it on stretchers or cleats and it will look clunky.
- Traditional joinery would be hard to execute or visually distracting.
- Dowels offer a clean solution.
- You can utilise the jig to drill the dowel holes in the table legs, but the jig won't work on the small notched curves of the shelf.
- Instead, dry-fit the legs to the aprons, and clamp a support block to each leg so that its top is level with the shelf bottom.
- Then insert a dowel center into each hole and rest the shelf on the blocks.
- A light mallet tap on the outside of each leg will press the dowel center's point into the shelf edge, marking for the mating hole.
- Now drill the dowel hole in the shelf edge.
- Again, place glue only in the dowel holes.

Bonus Chapter How to implement moulded joints

Most commonly found on drop-leaf tables, the rule joint lets the outside leaves to be lifted to create a large, useful surface, or folded down to save space. The beauty of this molded joint is that it looks eye-catching whether open or closed, and it keeps the hinges hidden. You need to understand the mechanics of this joint in order to lay it out and cut it precisely, and blogs rarely go into enough detail. A rule joint consists of a board with a bead and a board with a cove, or cope. When the joint is closed, the two boards meet firmly and on an even plane. As the leaf is lowered, the cove rolls equally around the bead. Two or more hinges support the leaf. The secret is to place the center of the hinge barrel in line with the center of the bead. While you can create this joint with matching molding planes or shaper knives, the technique I'll explain uses two widely obtainable router bits. And construction is easy when divided into three main steps: Cut the bead, cut the matching cove, and lastly, fit the hinges.

Procedure:

- It is vital to the smooth operation of the rule joint that the boards remain flat and true, so rough-mill the boards a little oversize and allow them to rest in your shop for a week or so to make sure they are stable and don't cup or twist.
- Then mill them to final thickness, in this case ¾ in.
- I always mill a sample board to the same thickness as the tabletop and utilise it for layout and test cuts all the way through the procedure to ensure the rule joint fits appropriately.
- This makes me confident that each item will work when I begin cutting my valuable tabletop.
- The rule joint revolves around the barrel of the hinge, so begin laying out the joint by setting a marking gauge to the distance from the flat side of a drop-leaf hinge to the center of its barrel.
- The grain of the tabletop and the drop leaf runs parallel to the rule joint, so the layout is done on the end grain.
- Scribe a line along the end grain of the sample board, registering off the bottom edge of the board.
- Make sure you lay out the end of the board that will contact the router bit first on the router table.
- I used a ⅜-in. radius half-round or bullnose bit to cut the bead, so I set a compass to this distance.
- Put one point of the compass on the scribe line and the other where this line reaches the edge of the board.
- Now draw an arc of about 180° whose apex just touches the edge of the board.
- Use a knife and a square to mark a line perpendicular to the scribed line at the location of the compass point away from the edge of the board.
- You now have established the location of the hinge and the profile of the bead.
- I utilise a full half-round bit rather than a quarter-round beading bit because the half-round bit will cut a return past the centerline.
- If this is not cut, the bottom edge will bind as the leaf drops and the cope of the drop leaf will not roll equally.
- You'll likewise need a ¾-in. diameter core-box or round-nose bit, which should nest perfectly with the half-round bit.
- With the half-round bit mounted in a router table, utilise the sample board to set the correct height of the bit and then gradually move the fence back to sneak up on the exact line of the bead.
- Once set, clamp a hold-down board to the fence, and make the cut to both sides of the fixed part of the tabletop.
- With a sharp bit, you can do this simply in one pass.
- Depending on the thickness of the board, you may be left with a thin strip of wood attached to the fillet.
- Cut this away on the tablesaw and clean up the edge with sandpaper wrapped around a block, using a light touch.
- With the bead side complete, the next step is to cut the matching coves on the leaves.
- To get the approximate location of the cove, I butt the beaded board against the uncut side of the sample board and trace the bead onto the end of the board.
- Eliminate the bulk of the waste with a ¼-in.-wide dado blade on the tablesaw, staying away from the traced line.
- This will avoid the core-box bit from having to make too large of a cut in a single pass.
- Set up the router table with the ¾-in.-dia. core-box bit.
- Use your sample board to make a trial cut just below the outline you drew.
- Now check the fit of cove to bead, and raise the height of the bit accordingly.
- The cut should develop a cove that perfectly matches the bead when the boards are mated on a flat surface.

- When set up, I take a secondary fence and align it parallel to the primary fence with the sample board as a spacer.
- This fence acts like a featherboard to keep the leaf tight to the fence, ensuring a smooth, consistent cut.
- With the beads and coves cut, you can move on to the hinges.

How to locate and fit the hinges

- Locating and installing the hinges is the most critical part of the procedure.
- The first step is to determine the number of hinges.
- For smaller pieces such as a Pembroke table, I utilise two hinges.
- For large tables or a dining-room table, I would utilise up to four.
- Set a marking gauge to the width from the edge of the bead to the vertical line you drew during layout.
- Now take the actual tabletop, and scribe a line along the underside of the bead to mark the centerline of the hinges.
- Clamp the top and a leaf together, face down.
- Now place the hinge upside down with the barrel in line with the scribe mark.
- Using a knife, outline the location of the hinge across both boards.
- Set up a router with a ¼-in. straight bit and adjust the depth of cut to the thickness of the hinge leaf.
- Separate the boards and rout away the waste, staying away from the knifed line.
- Then clean up the walls with a chisel.
- To make room for the hinge barrel, I utilise an 8 carving gouge to create a round-bottomed trench.
- You likewise could utilise chisels to create a straight-sided recess.
- Set the hinge in the mortise to check that no part of the hinge ventures above the bottom exterior of either board.
- Fasten the hinge with appropriate screws and swing the leaf to check the fit.
- You may have to sand the surfaces very lightly, but that should be the limit to your fine-tuning.
- While this joint takes patience, you'll see the reward on your next table, whether the leaves are open or closed.

Procedure:

- The joint revolves around the barrel of a special drop-leaf hinge.
- When the leaf is raised, it should be flush with the tabletop.
- When lowered, there should be no gap between the parts.
- For the two halves of the rule joint to meet without a gap, it is critical that the radii of these two router bits match exactly.
- Because the joint revolves around the center of the hinge's barrel, you need to mark this location.
- Set a marking gauge to the distance from the flat side of the hinge to the center of the barrel, and scratch a line on the end of the sample board that will enter the router bit first.
- Set a compass to equal the radius of the half-round bit you'll be using, in this case ⅜ in.
- Place one point on the edge of the board and the other on the center-point line created in step one.
- Draw an arc of about 180°.
- Drop a line at right-angles to the center point.
- This gives the location of the fillet, or straight section above the bead.
- The shaded area is eliminated on the router table to leave the beaded half.
- Using the layout on the end of the sample board, set the half-round bit to the correct height.
- Make the first pass with the fence somewhat forward, and then ease it back until the bead is cut perfectly
- Now that the router has been set up using the sample board, clamp a hold-down board to the fence of the router table and cut the bead on both sides of the fixed tabletop.
- Because only a small amount of wood is being eliminated, you can cut each bead in one pass.
- If a thin strip of wood is left attached to the top of the fillet, cut it off on the tablesaw and cautiously sand it flush.
- Butt the tabletop to a fresh edge of the sample board with the fillet in line with that uncut edge.
- Transfer the outline of the bead.
- Use dado blades to cut away the bulk of the waste in what will become the cove.
- Align the sample board with the round-nose bit, but make the first cut with the bit somewhat too low
- After the first cut, the bead and cove should nest perfectly, but the coved sample board

should still sit a little higher than the beaded board.

- Sneak up on the cut until the two boards are level.
- Once the sample board is right, clamp a second fence to the router table so that the wide leaves won’t wobble as they pass the router bit
- A regular hinge with its barrel in the middle won’t work for this type of joint. Instead you need a drop-leaf hinge with sides of different lengths.
- The short side is attached to the beaded board, while the longer side is attached to the drop leaf so that the underside swings under the beaded board.
- Set a marking gauge to the distance from the edge of the bead to the vertical line below the fillet.
- This marks the center of the hinge barrel.
- Scratch a line where the hinges will be centered.
- Then clamp the drop leaf to the tabletop, and locate the hinge upside down straddling the joint, with the barrel centered on the scribed line.
- Mark the outline deeply with a knife.
- The drop-leaf hinge should sit flat with the barrel facing up.
- If the leaves rise up as they approach the barrel, the hinge may not work appropriately.
- Set the depth of a straight bit to match the thickness of a hinge’s leaf.
- Clean up the recess alter routing away the bulk of the waste.
- Use a chisel to square up the sides of the hinge recess.
- Hold one leaf firmly in a vise and utilise a block of wood and a hammer to gently straighten the leaf.
- Use a carving gouge or a chisel to cut a trench for the barrel of the hinge.
- Use full-threaded screws to attach the hinge to the tabletop and the drop leaf.
- Check that the two surfaces of the rule joint remain parallel throughout the movement with no binding or unsightly gaps.
- A bit of sanding smooths out the action.

Conclusion

Thank you for finishing this book. Hope it was useful and able to provide you with a great knowledge base you will need to achieve your objectives whatever they may be.

Woodworking can be an extremely satisfying and possibly even life-changing interest! Producing artwork with wood can lead to skills you never knew you could have and maybe even fatten your wallet, and who wouldn't love that?

Woodworking has been around since the beginning and is still a privileged skill. The best thing is to learn new skills that can transfer over to several facets of life. Plus, woodworking is as timeless as we are. The next step is to pick out a field you may want to try out. Contemplate the time you have to spend per venture, the amount of funds you have to commit, and the work space you have or can build. Begin with the basics, and slowly build your skill set with repetition. Have fun and try new practices or tools whenever you can. You won't regret learning this noble skill.

Lastly, if you found this book valuable in anyway, a review is always appreciated!