



SHOP TESTED:
SHAPER
ORIGIN

p.28 **THE AMAZING**
LOCK MITRE
JOINT



p.42 **SHOP TOOLS:**
STRAIGHT
ROUTER BITS



p.54 **A CLOSE LOOK AT**
COLLETS



ISSUE #130
February/March 2021

CANADIAN Woodworking & HOME IMPROVEMENT

Master Your Router

TOP 10
Ways to Amp
Up Your
Router Game
p.10

- **Why You Need a Router Lift** p.56
- **10 Simple Improvements For Your Router** p.61

+ **2 ROUTER-HEAVY PROJECTS**

- **Build a Sapele Deck Box** p.32
- **Design and Build a Travelling Toolbox** p.18

SHOP PROJECT: **Make a Triple Router Table** p.14

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FEATURES

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If you thought a table with one router in it was handy, imagine how great a triple router table would be.

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Don't Be Afraid to Reach for the Router

Back Cover: Elynnd Benjamin, Craft Cabinet

All hail the router!

A router is a very simple tool, although when operated with knowledge and care it can accomplish an incredibly wide range of tasks in a small shop. It's essentially made up of a few basic parts: a motor with a collet to accept a bit that's attached to either a fixed or plunge base. The magic happens when you realize how many types of bits there are, and how the router's base can be attached to other jigs and fixtures. The combination of operations that can be performed is limited mostly by your imagination. Basic operations like adding an edge profile or machining a groove are easy, and routing a mortise or a sliding dovetail groove aren't much harder if you have simple jigs. Getting fancier, I've attached a router to a chain and created shallow bowl-like cavities in a workpiece, created hinge mortises in curved panels and inlaid contrasting wood of many shapes into table-tops and door panels. And honestly, I feel like I'm just getting started.

We can't share everything about what a router can do in this issue. Our main goal is to get you up to speed on some router basics to give you a solid foundation to work from. An introduction to collets, the basics regarding straight router bits and simple ways to enhance your router are just a few of the topics covered here. And if you want to see how top-level professional and hobby woodworkers use routers, we've included a few projects that take a deep dive into what a router is capable of. There's even a shop project to create a triple router table. If you thought a standard router table was a functional addition to your workspace, you've got to check out this shop workhorse.

If you want to create a hot-rod router table, you'll want to read about router lifts and how they'll help you work more efficiently. If strong and easy-to-assemble joinery is what you're after, maybe a lock mitre router bit is your answer. A lock mitre joint is not only strong, but also a lot easier to assemble than a typical mitre joint. And just think, this is but the tip of the router iceberg. Mesmerising jigs, a wide range of bit options and a host of other accessories are all waiting to be discovered. There's always something new to learn about your router. Just don't get too excited and forget about safe operation and PPE, as working wood at 20,000 RPM could nip you in the finger if done without care. As always, stay safe. I want you back here in two months, ready for more woodworking projects and techniques.

— Rob Brown



rbrown@canadianwoodworking.com

CANADIAN Woodworking & HOME IMPROVEMENT

Issue #130

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CANADIAN WOODWORKING & HOME IMPROVEMENT

One-year subscription (6 issues) \$24.95 + tax

Single-copy price: \$6.97

H.S.T. Reg. #878257302

ISSN 1921-6432 (PRINT)

ISSN 2371-9028 (ONLINE)

Canadian Woodworking & Home Improvement

is published by Inspiring Media Inc.

PO Box 808, Niagara on the Lake, Ontario L0S 1J0 Canada.

Telephone 519 449 1221

Facsimile 647 370 0864

Email publisher@canadianwoodworking.com

Website canadianwoodworking.com

Canada Post Publications Mail Agreement 40035186

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letters

Terrific Texture Video

I saw your video “6 Tips for Adding Texture to Wood” on your website, in the video section. About 4:50 minutes into the video you showed a grooved piece with a design I love. Can you tell me the tool and size required to get that effect?

Thanks,
Sherman G.
Via email

Hi Sherman,

That was made with a V-gouge (sometimes called a “parting tool”) that likely had a 60° angle. Most V-gouges will give essentially the same look, so the angle isn’t overly important if you’re just creating texture with the tool. Adding texture to wood is a lot of fun, and the results can be quite stunning. Let me know how it goes. — Rob Brown, Editor, CW&HI

Thanks for finishing rack idea

Hi Rob,

You wrote an article about a small-shop finishing rack a few years ago (“Build a Knock-Down Finishing Rack,” June/July 2017). I’m in the process of building a cupboard with 12 shelves for my daughter. When I trimmed the shelves, I had 24 lengths of 3/4" plywood strips to finish. I remembered seeing your article about a finishing rack. I’m now the proud owner of my very own finishing rack, and it works great. Thank you for doing the article.

Tony N.
Via email

Hi Tony,

I’m glad you enjoyed that article. I find my rack quite useful, and when I don’t need it, I keep it screwed to my ceiling, out of the way. I’m sure your daughter will appreciate the finished cupboard. Take care, and keep up the good work. — Rob Brown, Editor, CW&HI



Broadening Woodworker’s Horizons

I’m a woodworker/carver enjoying what both hobbies have to offer. I have periodically picked up issues of *CW&HI* magazine, depending on the projects featured. When I found the August/September issue devoted to carving spoons, I thought, “What an awesome find!” This has given me something else to carve that I hadn’t previously put much thought into. I was so impressed with this issue I took out a subscription to *CW&HI*. Keep up the vision of broadening the skills of Canadian woodworkers and carvers.

Regards,
Wayne R.
Stayner, Ontario

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Parksville, BC
has won a 20V Max
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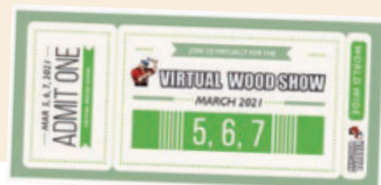
Events

Virtual Wood Show

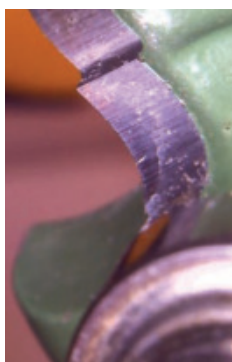
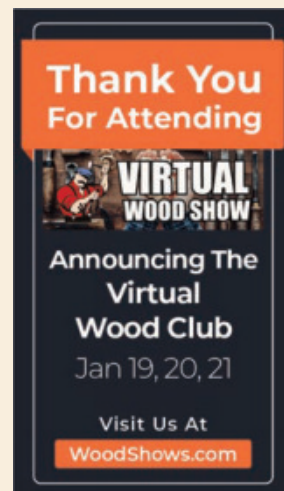
On November 6 to 8, 2020, the first Virtual Wood Show took place. The event was a huge success, bringing in a surprising number of first-time wood show attendees and allowing vendors and demonstrators to interact with woodworkers from all corners of the world in a COVID-19-safe experience.

The next project for the virtual show organizers is to

create a platform for woodworking, turning and carving clubs across Canada to safely interact with their members, and create a stronger sense of community. All Canadian clubs will be able to use this platform free of charge,



and will be given a private virtual meeting room in which to hold events. Woodshows.com will also take care of organizing free demonstrations and workshops for club members to enjoy. The free virtual fun kicks off January 19, 2021. Visit WoodShows.com for more information and to register your club. You can also learn about the Virtual Wood Show scheduled for March 2021 on their website.



Micro Mystery

Can you guess this object commonly found in most shops?

Follow us on Instagram and Facebook to see regular close-up photos of common workshop tools and objects.

We will post the answer to this one in our Apr/May issue.



Previous issue:
Adjustable
wrench roller



Best Build

Check out the **Turning** section of our forum for our latest "Best Build" thread – a collapsible table. This month's winner, Darrell LaRue, wins a **Veritas Dual Marking Gauge** from Lee Valley.



To find out more about this project, go to: forum.canadianwoodworking.com or simply go to CanadianWoodworking.com and click **FORUM**.

Free Plan

The Ultimate Router Table Revisited

Learn how the original was built and how to tweak a new build so it's virtually perfect.
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Video Links

canadianwoodworking.com/videos

Canadian Quotes –
Elynnd Benjamin



Dovetail Tips and Tricks



Forum Thread

Check out these home improvement threads and many others at forum.canadianwoodworking.com

- **Soundproof an interior door?** – If you're sleeping while another family member is up making noise, what are the ways to best keep the sound out? Our forum members have some great ideas.
- **Hardwood floor finishes** – There's a lot to consider when selecting a floor finish, especially if you want to avoid the finish changing colour too much. Read about what our forum members recommend.

Got a question? Join our forum so you can ask our skilled and experienced members any home improvement question you like. It's free, and is just a click away.

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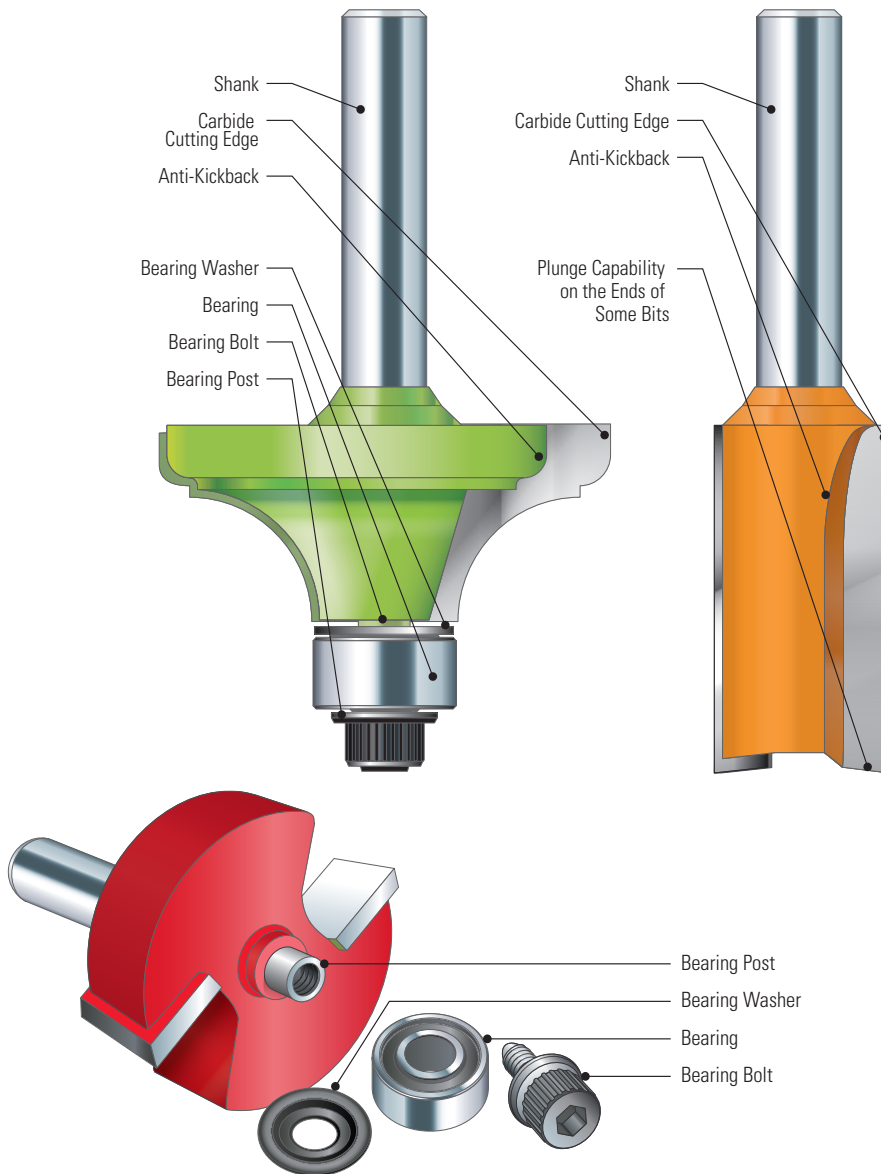
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Router Bits



Router bits can do so many things in a woodworking shop, and they're available in an assortment of general types. Straight bits are very common for cutting grooves, dadoes, rabbets and mortises. Flush trim bits have bearings and are used to copy shapes and flush surfaces to one another. Edge treatment bits usually have bearings, and add profiles to the edges of workpieces. Joinery bits create joints. Decorative bits embellish surfaces. Specialty bits do so many tasks. Most bits today have long-lasting carbide cutters, while HSS cutters are much less common. Different-sized bearings are sometimes interchangeable to expand the bit's function or the profile it leaves. Smaller bits have a 1/4" diameter shank, while larger or stronger bits have 1/2" shanks. A few bits are available in 3/8" or 8mm diameters for very specific purposes. Some router bits have cutters on their ends and sides so they can first plunge into the wood, then cut wood while being moved forward. Almost all bits can be re-sharpened. Purchasing a set of bits is often far more economical, though if you don't think you will use many of the bits in a set, it's likely better to buy bits individually as needed.

Price: \$10 to \$200

Shank Diameters: 1/4", 1/2" (8mm, 1/8" and 3/8" are far less common)

Bearing Outside Diameter: Ranges from 1/4" – 1-1/8"

Bearing Inside Diameter: Ranges from 1/8" – 1/2"

Get the Most Out of Your Router Bits

Protect Yourself

These high RPM bits will throw dust and chips into the air, and make lots of noise. Protection for eyes and ears is a must while routing.

Keep an Edge

A dull bit will burn the wood, creating extra work for the user, and leaves a poor joint. Sharp bits are a joy to use.

Remove Small Amounts

Router bits aren't made to hog off massive amounts of wood per pass. Multiple passes are safer, easier on the bit and leave a better surface.

Use Jigs

Jigs will help you be more accurate and safer while routing. They will also open up the possibilities of what can be accomplished.

Big Bits Are Different

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Ways to Amp Up Your Router Game



Routers are wonderful for profiling edges, but that's just the tip of the iceberg. Learn about what they can do, make a few jigs, purchase a few additional items and you'll be well on your way to increasing what you can do with these ultra-functional power tools.

BY ROB BROWN

1 Become familiar with all the things your router can do – Routers do much more than just edge profiling. Mortising, levelling, joinery, decoration and pattern making are just a few examples of the wonders awaiting you.

2 Get a router bit set – Without the right bit a router is pretty much useless. Buying bits one at a time is great if you only have the need for a few bits, but if you're looking to expand what can be done with your router, start with a large set of router bits. Sure, many may never be used, but the cost savings are still substantial. And some bits you don't know how to use now may be in regular rotation down the road.

3 Honing stone to sharpen bits – There are times when a bit needs to be properly and completely sharpened by a professional. There are, however, times when a few minutes spent with a small slip stone will add a bit of sharpness to a router's cutting edges. Only hone the flat portion of the carbide or steel.

4 Ear protection – Everyone knows to wear eye protection while routing, but some don't realize how important hearing protection is. Not only does it protect your hearing when the loud screeching is reduced, you'll be able to better focus on the operation you're undertaking, increasing safety and quality of cut.

5 Learn about different jigs – These may be the single quickest ways to expand the accuracy and functionality of what you can do with your router. Whether shop-made or purchased, jigs will turn your basic one-dimensional router into an ultra-functional workhorse that will do things you never thought possible.

6 Have jig parts around – Sometimes the biggest impediment to making a jig is not having the right jig parts around. Having hold-downs, handles, threaded inserts and many other jig-making parts ready for action will allow you to make a jig quickly and efficiently.

7 Consider a router table – Whether shop-made or purchased, a router table will instantly open up what you can do with your router, and also make operating it safer.

8 Buy template guides – Template guides are indispensable in so many routing operations. Having a few differently sized ones to choose from is handy, and they're really not that expensive.

9 Buy a trim router – A trim router isn't overly expensive (usually around \$100, sometimes much less) and will allow you to work more quickly and accurately. They take only 1/4" bits, and they won't be able to hog off material like a full-sized router, but they are easy to manipulate and get into areas a full-sized router sometimes can't.

10 Don't go big right away – Unless you have the money, there's no reason for your first router (or two) to be overly expensive. A plunge router kit can be had for a few hundred bucks. If down the road you feel the need for more functionality, you can always pick up another more powerful or capable router.



ROB BROWN

rbrown@canadianwoodworking.com



Go Online for More

RELATED ARTICLES: Router Bits (Apr/May 2015), Router Table Safety Tips (June/July 2016)

How Do You Create Unlimited Frame & Panel Possibilities?



Shaker Profile
(#99-762)

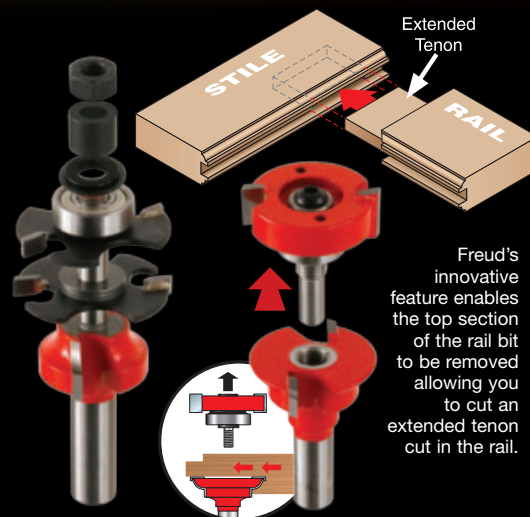


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Five profiles are available; Round Over (#99-760), Ogee (#99-761), Round Over Bead (#99-763), Bevel (#99-764) and Shaker (#99-762)

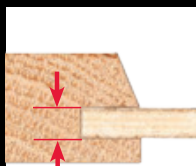


Freud's innovative feature enables the top section of the rail bit to be removed allowing you to cut an extended tenon cut in the rail.

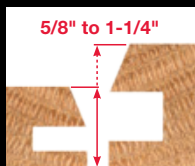
This System Offers Unmatched Versatility in Cabinet Door Making with:



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Red router bits are a registered trademark of Freud America, Inc.

Elynnyd Benjamin

...on glue-ups, mistakes and being a morning person.

BY ROB BROWN



Maple Table – Made for her mother, who needed a little drawer just big enough for a couple remote controls and something a bit taller than your average coffee table. Benjamin loves curvy lines and wanted the table to feel a bit like it was sprouting up from the ground.



Tell us a couple of interesting things about your personal life.

I love to mountain bike and teach my dog fun but useless tricks.

If you were not a furniture maker what would you be?

Maybe a welder because I could create with metal. I need to do something that keeps my hands busy.

In order, what are the three most important items in your shop apron?

Sharp pencil, 3" engineer's square, pocket rule.

Do you prefer hand tools or power tools?

They definitely both have their place, but hand tools are the most rewarding to work with.

Solid wood or veneer?

Although veneer has its place, definitely solid wood.

Figured wood or straight grain?

Depends on the figure, but I always find myself drawn to straight grain.

Flowing curves or geometric shapes?

Although my art is very geometric, I will always love curves the most.

Favourite wood?

This will forever be rotating, but currently Mukwa.

Least favourite wood?

Although I love cedar and use it for all my artwork, I also hate how toxic it is and wish I didn't need to wear a respirator every day.

Elynrd Benjamin, 33,
ESB Woodworks, elynyd.com
Studio – Nelson, B.C. (Small!)
Education – Fine Woodworking Program,
Selkirk College, Nelson B.C., 2012
Red Seal Carpenter since 2015

quotes



My space is bare bones, but it's a whole lot better than nothing! I share the garage with my partner and all of our bikes and gear, but I'm grateful to have a space at all. I'm pretty limited in what I can do at the moment as there's not much space for equipment.



I'm a morning person. I love the calm quiet and soft light. I'm most productive and make the least mistakes in the morning.



I listen to CBC radio in the morning, and a podcast, Spotify or CKUA in the afternoon.



I really love working with hand tools. There's just a level of satisfaction that can't be rivalled when you make perfect cuts without the use of power tools. I wish carving chisels spent more time in my hands.



I believe there are ideas floating around looking for the appropriate vessel to bring them to life. I guess I'm just a creative port importing ideas and exporting creations.



Pen and paper and Turbo CAD to design my work.



Put all your ideas on paper. The more you get down on paper and out of your

brain, you open up more space in your brain to bring in new ideas.



I'd be happy if I didn't see another epoxy river table.



I like commissions because you already have a buyer, but I love to create without parameters or expectations.



Word of mouth has been very kind to me, and Instagram is becoming a very useful tool.



For the past 13 years I've been doing carpentry work. It's in the last two that I decided to start working for myself and am slowly transitioning to doing more shop-based creative projects.



I really wanted to build a canoe and signed up for a course to learn how. The course got cancelled but in the process I decided to take an entry carpentry course and never really looked back.



Being creative and artistic is pretty important to me. I love to combine art with functionality.



Seeing your completed project is definitely the most exciting, but I actually really love

Elements Art Piece – This was a commission for a client in Revelstoke who wanted the four elements to be included in the pattern. I steam bent some thin strips to get the defined lines of the leaves for "Earth" and the wind for "Air". Benjamin incorporated a shou sugi finish on some of the pieces to add more texture to the piece.

just simply breaking out stock, truing up edges and thicknessing material. It's those very first steps where you're still wondering how the project is going to go, and taking rough material and cleaning it up to see the figure in the wood. Choosing which side of the piece has the figure you want to work with. It's like spring when the leaves are almost popping but the craziness of summer hasn't hit yet.



I'm currently part-time woodworking and part-time carpenter. I like the balance of doing both. Keeps my skills well rounded.



Don't let mistakes get you down. A good woodworker is just someone who is good at fixing their mistakes. We all make them and the more we try, the better we get.



Glue-ups are the most frustrating part of building.



I think in general there is a growing desire for quality handmade items. The Internet is making it easier to get your name and product out to a much larger crowd.



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SLIDESHOW: To view a slideshow of Elynrd's work visit the Videos section of our website.

BUILD A TRIPLE ROUTER TABLE

Router tables are useful tools to have around, but they don't always need to be big and fancy. This bare-bones router table is quick to set up and takes care of a few standard profiles often used in your shop.

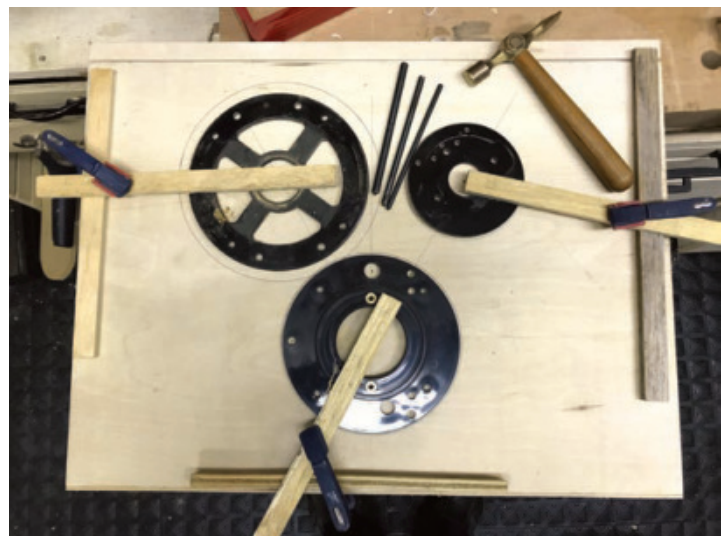
BY CHRIS WONG

I own eight electric routers and of those, three are less user-friendly than the others so they are largely unused. To make better use of those routers, I decided to set up a profile bit in each router and leave it set up that way so if I wanted to rout a 1/4" round-over, I could simply grab that router and rout the profile without having to install and precisely set the height. It didn't really work, because quite often the workpieces I needed to rout were small and more suited for a table-mounted router.

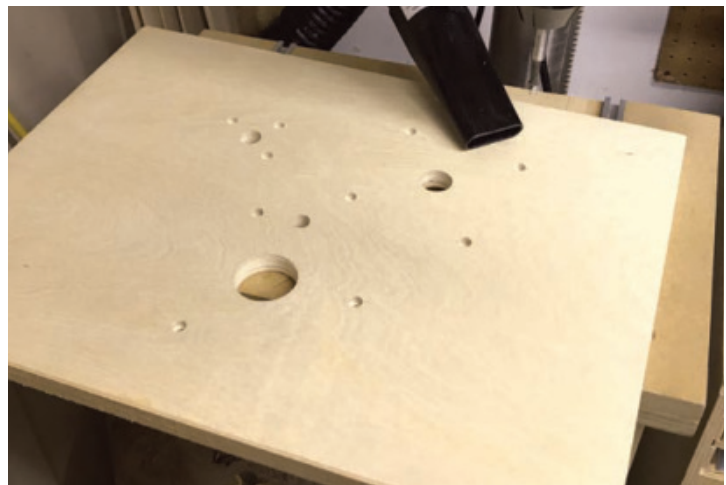
The design

To be space-efficient, I decided to crowd my three rarely used routers – a fixed-base D-handle Makita router, a table-friendly Freud kit router and a Porter Cable trim router – into one bench-top router table that I could pull out when needed and stow away afterwards. When selecting routers, keep in mind that ones with removable motors, or above-table bit change capability, make installing and removing bits easier without needing to unbolt the entire router from the table.

Each router was set up with a specific router bit – two round-over bits and a chamfer bit. I planned to install a chamfer bit in the kit router because it allows easy height adjustments so I can adjust between small and large chamfers. The 1/16" and 1/4" round-over



Careful Layout – If the routers are too close together, they may be hard to operate and use. But if they're too far away, this portable router table may become too large and unwieldy to easily set up and store.



Accurate Holes – To hold all the routers in place, Wong drilled bolt clearance holes and countersunk them. You will likely have to purchase longer bolts to hold your routers in place, which are easy to find at most hardware stores.



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Starter Pin – Wong made a wood starter pin to assist him with starting cuts. He can press the workpiece against the pin, then slowly rotate it into the spinning bit to start a cut.

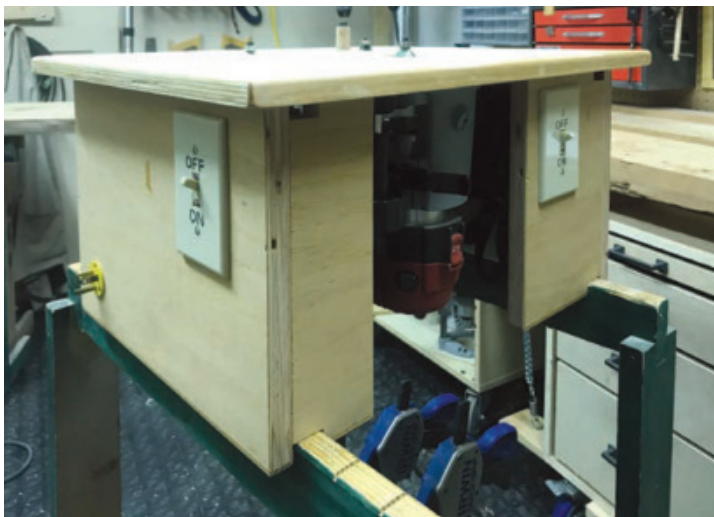
bits would be installed and precisely set in the other two routers, which are difficult to adjust when installed in a table. In use, I realized that a double-bearing flush trim bit was more useful to me than the chamfer bit. Everyone's situation is different, so make your choice depending on the type of work you do and what routing operations you often require.

You could use more trim routers for a more compact router table, or more routers that are easy to adjust or change bits for a more versatile, but less convenient, table. Using more routers requires a larger table and results in less room to maneuver around each bit.

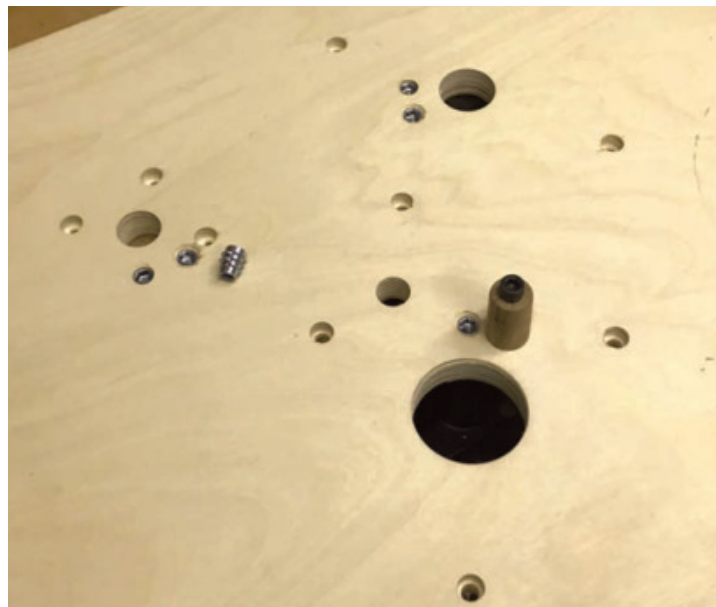
The table top

I started by figuring out what size to make the tabletop by crowding the three routers together, keeping in mind what adjustments and switches needed to be accessible. Then I estimated how much table space I wanted in front of and on either side of each router. I settled with a tabletop that was 20" × 16".

I selected a piece of 3/4" plywood for my top and carefully laid out the position of the bolt holes and drilled and counterbored them. The bolts that came with the routers were not long enough to go through the table but purchasing the sizes I needed wasn't hard.



Keep Things Steady – Although everyone must come up with an approach that will work for them, Wong cut notches into the underside of the base at the four corners. These four notches accepted the upper rails of his sawhorses and help keep the router table stable when in use.



Threaded Insert Nuts – Holes for threaded insert nuts were drilled near the location of each of the three router bits. Wong can easily and quickly move the starter pin to whichever location he wants to work on.

I also drilled a hole for the above-the-table-adjuster that the Freud router uses, and some 1/4"-20 threaded insert nuts to allow the addition of a starter pin.

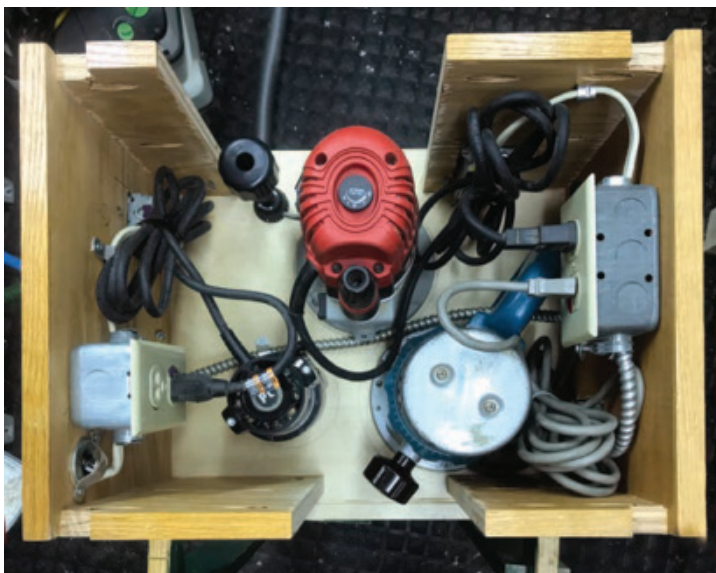
To break the edges, I installed a 1/4" round-over bit in my main router table for what may have been the last time.

I made the simple starter pin from a piece of scrap hardwood. First, I drilled a 1/4" hole in the centre and slid a bolt through. I tightened a nut on the opposite side, then clamped the threaded end of the bolt in a three-jaw chuck installed in my lathe and turned the wood round. Finally, I removed the nut and secured the wood on the bolt with a bit of cyanoacrylate glue (epoxy would also be a good choice). My starter pin is about 5/8" in diameter and it's easy to install and remove without tools.

The base and on/off switches

The base needed to be large enough to provide stability, but small enough to allow a secure grip on the edges of the table when carrying. It also needed to be tall enough to keep the router motors and their cords off the bench top. I lowered the router motors to their lowest position and added a half inch and made my base that tall, which ended up 10". My base consisted of two "U" shapes to allow access to the routers. I simply cut plywood to size and joined it with pocket screws. To permit safe, stable use, I cut 1" notches in the base to fit over the top beams of my sawhorses. I used three pocket screws to attach each side of the base to the top.

With multiple routers crammed under one table, a good system to get power to all and turn each on and off without confusion is vital. Heavy-duty power bars with individually switchable outlets are available, sold for DJ booths and computer server racks. If you use one of these, make sure you label the switches clearly so you know which router each switch operates. I elected to run separate switches for power outlets, with a switch in front of each router to avoid any confusion. Still, I labelled each switch and outlet pair with a different colour of paint for future reference. It might be a good idea to mark the router each switch operates on the tabletop as well.



Under the Hood – Although it's busy under the router table's top, Wong kept cords neat and tidy. Notice the simple pocket hole screw joinery at the insides of the four corners.

Once the routers were installed, I secured all the cords with cable ties so they were all contained within the router table. To further reduce cords, I recessed the male plug in the side of the router table base and simply bring an extension cord to it when I use the router table. In my shop, most portable power tools are

energized by the ceiling-mounted cable reel in the centre of the shop.

Finishing and details

To store the tool to adjust the Freud router from above the table, I installed a 1/4" diameter × 1/2" long rare earth magnet in the underside of the table next to the router.

For most shop projects, I usually skip any sort of finish, but since the router table top will see significant usage, I elected to apply a finish. Any film finish, or even paste wax, would be helpful. I chose to apply four coats of thin CA glue as a finish. I suspect that this finish will be plenty durable for the use it will see. Another good option would be plastic laminate.

Chris Wong is a sculptural woodworker who appreciates a good edge profile but is often too impatient to make test cuts to dial in a setting. He now has his optimal router setup... or so he thinks.



CHRIS WONG
chris@flairwoodworks.com



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Choosing a Router Table (June/July 2016)



A Spoon Carver's TOOLBOX

It's important to have a place to store your tools. While this toolbox was specifically designed to hold spoon-carving tools, there's no reason you couldn't design it to hold other tools, whether for travelling storage or for shop storage.

BY STEVEN DER-GARABEDIAN

I received a request to make this box specifically for spoon-making tools, however, with a bit of modification this design could fit other tools or even other applications. Although there are many ways woodworkers can machine different joints, I usually reach for the router, as it is multi-functional and does a good job machining the small joints associated with this fine toolbox.

My goal was to make this toolbox as light as possible, yet very sturdy. Intentional or not, it'll end up taking some abuse, as most toolboxes do. In order to accomplish the sturdiness, we'll need to glue the panels into their grooves. Solid wood won't work well because it moves with the seasons. While a piece of Baltic birch on its own would suffice, why not go a little further and jazz it up with veneer?

Photos by Steven Der-Garabedian (Illustration by Len Churchill)

Time to design

The box halves pivot open via four butt hinges. When travelling or, alternatively, not in use, they're held closed with a pair of draw latches. Since this toolbox will hit the road, I added rails and flip-stops to the internal dividers to make sure everything stays in their respective places. The right half also has a section behind a flip-down door to house sharpening stones, gloves, scrapers and more.

I like to have the hardware on hand before getting too deep into a project to make sure it fits my design. I ordered the hardware from Lee Valley Tools, including two pairs of brass butt hinges 00D0201 and a pair of round draw latches 00S5551. I chose case handle 00S6220. Finally, for the flip-down door I ordered Lee Valley Tools' hidden hinge pins 05H0201 in the 1/8" size.

Keeping things light, I chose 1/2" thick walls for the carcass, made the larger dividers 3/8" thick and the smaller tool dividers 1/4" thick. Joinery was kept simple, with slots and grooves cut on the router table. For the carcass joinery, I chose a pair of 4mm × 20mm Festool Dominos in each corner of the smaller left half and 6mm × 40mm Dominos for the bigger right side. Other joints, such as dowels or mortise and tenons, would work equally well on the box corners. Use the method that you're comfortable with and have the tools for.

Practical layout

It's much easier to design a box with a specific purpose by using the actual contents you plan to store to determine the size. Try different positions for tools or group the ones used together. When laying out the tools on your workbench, keep in mind that the back panels will need to be added to the overall depth. Take your time with this stage as the dimensions will be determined by this step. I grouped the thinner tools on the left side of the box and the bulkier, odd-shaped items on the right. For added accuracy, mill up pieces of scrap wood to size and confirm that everything fits. The final dimensions ended up being 13-1/4" wide × 20" long. The box is 2" deep on the left and 3-1/4" on the right.

Jazzing it up

The veneered panels will need to fully cure once out of the vacuum bag so we should start with them. I opted for 6mm Baltic birch cut oversized at 22" wide by 23" long. The outer faces got pressed with redwood stump/root burl that not only had beautiful grain but was the perfect size. For the inside I had some short pieces of cherry veneer that would complement the piece nicely. I needed to joint and join three pieces to make up the width, and this was easily accomplished with editor Rob Brown's veneer-cutting jig covered in the June/July 2020 issue.

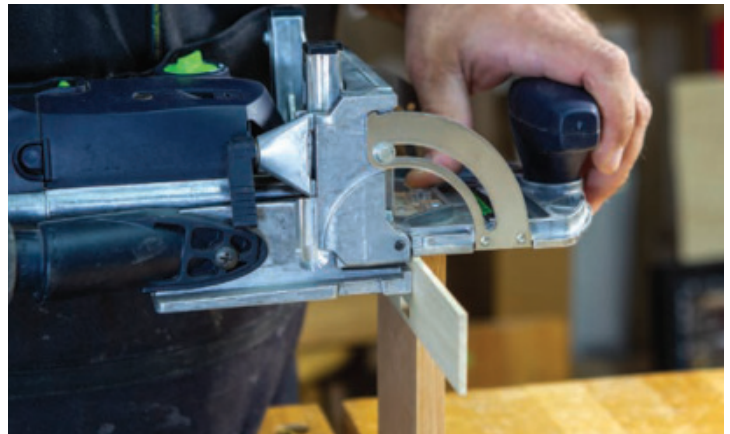
Using Roarocket's inexpensive vacuum-pressing kit, press the panels one at a time. Any PVA glue will work, but Titebond's Cold Press for Veneer adhesive is specifically made for this job. Press each panel for at least five hours, and once out of the bag, let the glue fully cure by propping up the panels overnight or longer. Don't lay them flat on a bench as this might cause them to warp or curl.

Creating the framework

I milled up pieces of cherry that were slightly thicker than the final 1/2" to allow for hand planing and sanding. Starting off with a roughly 6" wide plank, I ripped pieces that were 2" wide and 3-1/4" wide. If you keep track of the pieces as they're sliced off



Proper Layout – Determining where to locate each tool is an important step. Generally speaking, a project like this needs to be as small as possible, though it's just as important to be able to hold all the necessary tools in one toolbox. Der-Garabedian lays out the tools on a piece of material and records how much space is needed.

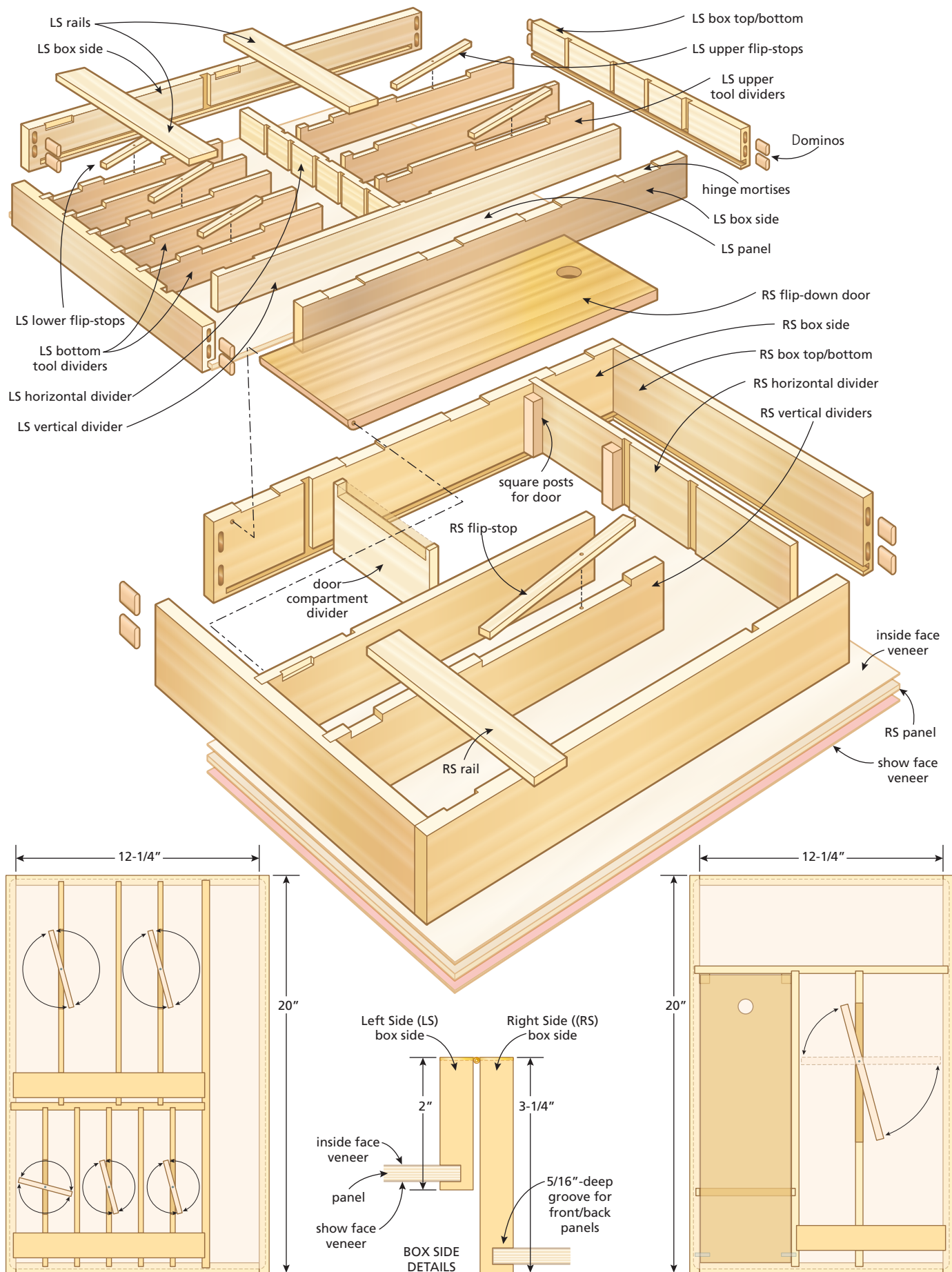


Dominos, with a Shim – Even on its shallowest setting, the Domino mortises would protrude out the other face of the workpiece. Der-Garabedian adds a shim between the cutter and the workpiece to save the day.

the plank you can create an attractive visual effect when the box is closed. Using a cross cut sled and a stop block, cut the sides of both halves to 20" and the tops and bottoms to 12-1/4" long.

If you're going to use Festool's DF 500 Domino joiner, there are a couple of considerations to take into account. I used the narrowest setting for the width of the mortises and slightly shaved the width of the Dominos with a block plane to allow for some lateral adjustment. The shortest depth for the 6mm Domino would almost have it poking through the side of the box. To work around this, I shimmed the unit away with a 1/8" thick piece of poplar. You'll also need to trim the Dominos shorter by at least 1/8" although 3/16" will give you a bit more wiggle room. While the smaller 4mm Dominos would work throughout, I wanted as large a Domino as would fit into the larger half.

Next, I milled up pieces of cherry that were 1/4" and 3/8" thick for the internal dividers. You'll need some widths that are roughly 2" and some 3-1/4" wide. This extra bit of material lets us trim off any tear-out from the router.



Materials List

Part	Qty	T	W	L	Material
LS Box sides	2	1/2	2	20	Cherry
LS Box Top & Bottom	2	1/2	2	12-1/4	Cherry
LS Rails	2	1/4	1-1/4	9-5/8	Cherry
LS Vertical Divider	1	3/8	1-1/2	19-1/2	Cherry
LS Horizontal Divider	1	3/8	1-1/2	9-3/4	Cherry
LS Bottom Tool Dividers	5	1/4	1-1/2	8	Cherry
LS Top Tool Dividers	3	1/4	1-1/2	11-1/4	Cherry
LS Upper Flip-Stops	2	1/4	1/4	4	Cherry
LS Lower Flip-Stops	3	1/4	1/4	2-3/4	Cherry
RS Box sides	2	1/2	3-1/4	20	Cherry
RS Box Top & Bottom	2	1/2	3-1/4	12-1/4	Cherry
RS Rail	1	1/4	1-1/4	7-1/2	Cherry
RS Vertical Dividers	2	3/8	2-3/4	14-7/8	Cherry
RS Horizontal Divider	1	3/8	2-3/4	12-3/4	Cherry
RS Door Compartment Divider	1	3/8	2-3/4	5	Cherry
RS Flip Stop	1	1/4	3/8	7	Cherry
Flip-Down Door	1	3/8	4-3/4	14-5/8	Black Limba
Square Posts for Door	2	1/2	1/2	2-3/8	Cherry
Front & back panels (rough size)	2	6mm	22	23	Baltic birch
Show face veneer (rough size)	2	1/40	22	23	Red stump/root burl
Inside face veneer (rough size)	2	1/40	22	23	Cherry veneer

LS = Left Side RS= Right Side

Hardware List

Name	Qty	Size	Details	Supplier
Rare-earth magnets	4	1/4 × 1/10	99K3101	Lee Valley Tools
Brass butt hinges	2 pair	2 × 1-1/8	00D0201	Lee Valley Tools
Plain brass round draw latches	2	1-5/16 × 2-1/8	00S5551	Lee Valley Tools
Small square case handle	1	5-1/8	00S6220	Lee Valley Tools
Hidden hinge pins	1 pair	1/8	05H0201	Lee Valley Tools

Getting groovy

We'll need to create a groove for the panels at the bottom of each half. A simple method I've been using for some time now is with a box slotting bit 16J8312 available from Lee Valley Tools. This bit cuts a 1/8" thick groove and comes with two bearings allowing for different depths of cut. Put the smaller of the two bearings on the bit for a 5/16" deep groove.

In order to size the slots we need to know the final thickness of our panels. Clean up both faces of the panels with sandpaper, keeping in mind we have only so much veneer to work with. I like to do

an initial pass with a random orbit sander at 180x, then switch to scraping and hand sanding to tackle any remaining spots.

Dry assemble the left half of your box using clamps, making sure everything is flush. Raise the bit so it will cut a groove 1/8" from the bottom. Get a scrap piece of wood and run a groove in it. We'll use this to hone in on the perfect fit. Next, set your box on the router table and run the bit counterclockwise along the inside. Raise the bit slightly and run the test piece against the bit. Try and fit the panel into this groove. Chances are it's still undersized. Run the box around the bit again. Go back and forth between the test piece,



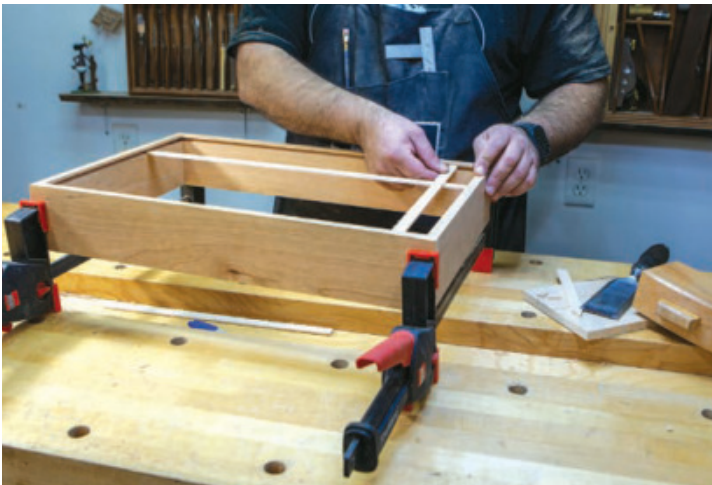
Slot Cutter – To cut the slots in the inside face of the carcass to accept the back panel, Der-Garabedian installs a slot-cutting bit in his router table and makes a few passes at different bit heights. Bearings of different diameters will give you some flexibility, as they all leave grooves of different depths.

the panel and the box until you get a nice fit. While a tight fit might be tempting, you don't want to risk breaking the lip and you'll need room for glue. Repeat these steps once more for the other half of the toolbox.

Use story sticks to measure the length and width of the panels directly. It's easy to make them from scraps of wood by re-sawing a 1/8" thick piece that's approximately 3/4" wide and longer than the box is wide. Using a chisel, put points on both ends and start fitting it into the groove. Trim a bit off of the points, going back and forth until the story stick is parallel to the



Nice Grooves – The router table provides a large, flat surface to support the dry-assembled carcass while the joinery to accept the back is machined. Multiple passes allow you to customize the grooves to accept any back thickness.



Direct Measurements – Thin strips of wood pared to length with a chisel will measure the distance between the bottom of the grooves. Der-Garabedian uses these strips to transfer the measurements directly to the table saw.

ends and fits in the groove. Repeat these steps for the length of the panel. Set up your cuts on the table saw using these sticks. Since the box slotting bit leaves rounded corners, we can either square the grooves or round the panel corners. I find the latter much easier, using a washer or an offset wheel gauge that matches the bit diameter along with a chisel and file.

Slots and more slots

Work on one half of the box and one section of each box at a time to avoid any confusion. Similar to a box slotting jig on the table saw, we will set up the router table to cut matching slots in our components. Some of these will be through cuts while others will need to be stopped. It's very important during this process to keep track of the orientation of the pieces. Using the following steps, we will cut the slots in our box frame and the thicker dividers. Position and space these to accommodate your tools.

Add an auxiliary fence to the mitre guide and make sure it is locked at 90°. Chuck in a 3/8" straight bit and, if you have it, a 3/8" onsrud up-cut spiral bit, which will work nicely to pull the waste down and out of the slot. Make yourself a non-slip, shop-made stop block by adhering sandpaper onto the back.

Raise the router bit to 1/4" and cut the slot in the auxiliary fence. Next, space and clamp the stop block the distance required for the pocket, in this case 2-1/2". We need to stop this slot at the groove for the panel. This is easily accomplished using a long piece of wood clamped to the left edge of the table, stopping us from sliding further into the bit than the groove. For the mating piece, we will need to put this long stop on the right side of the table. First, lower the bit below the table then pull the mitre gauge back against the stop. Raise the bit to the 1/4" height and push through once more. I found clamping the piece being cut to the auxiliary fence let me use a much more comfortable grip, rather than a white-knuckled approach.

Accurate Dadoes – Many of the dadoes needed to complete the joinery in this toolbox are stopped. Rather than free-handing it (and likely making a mistake), Der-Garabedian uses a stop block clamped to his router table either in front of the mitre gauge or behind it, depending on the situation.



Mock It Up – Sometimes you need to mockup the tool-holding cavities to get a better feel for how much space you really need. Der-Garabedian milled up some softwood scraps to determine the finished sizes of the parts.





Trim to Length – Der-Garabedian uses a hand plane and jig to ever so slightly trim the interior parts to length, one pass at a time. The benefit of using hand tools for this is that it's much easier to arrive at the correct length, and only very rarely do you end up with a workpiece that's cut too short.

Dry assemble the box and cut a length of the previously milled 3/8" cherry divider material just a bit longer than needed. Sneak up on the perfect fit using a shooting board to dial it in. Now we will divide the section to the left of this divider. Disassemble the box and head back to the router table. Using the steps above, create a stopped slot in the left side of the frame 1/4" deep at the appropriate location. Next, create a through slot in the freshly made divider, however, offset the distance by 1/4" as that's the amount it's inset into the frame.

To assist in accurate positioning of the dividers, use either a marking knife or pencil while the box is assembled. At the router table it's easy to position the piece by first unplugging the router, placing a square against the router bit and component, then spinning the bit by hand.

Using the steps above, continue to create slots in each part. Go back and forth between cutting the slots and fitting the dividers. Use stopped slots when working on the outer frame and through cuts on the internal pieces. When working on pieces that will get multiple slots, use an indexing pin and cut the components together. The top 3/8" horizontal divider on the right half along with the horizontal and 3/8" vertical divider on the left half get 1/4" deep slots cut for them. The remainder of the dividers are seated in slots 1/8" deep. Remember to take these offsets into account. There are a lot of intricate steps to completing this internal network. If you take your time, they will be accurate and the results will speak for themselves.

Flips and rails

Once all the dividers are completed, trim them down to their proper height, flush with the box frame, getting rid of any tear-out in the process. To hold the tools in their respective pockets we need to create a set of flip-stops and rails. The rails are located with a 1/4" space near the bottom. This ensures wood chips and shavings don't get trapped. The flip-stops sit atop alternating dividers, spanning the width of two pockets. To keep things simple, both rail and flip-stop mortises are 1/4" deep. Cut mortises in the top of the respective dividers with this in mind. The length of mortises for the rails will be 1-1/4". The length of the mortise for the flip-stops will



Where's the Cut? – In order to mark the edge of the spiral router bit, Der-Garabedian rotates the bit while placing a small square against the workpiece and bit. When the square moves to its furthest point away from the center of the bit, he knows that's the outer limit of the cutting circle, and he marks the location on the mitre gauge for future use.



Simple Spacing Jig – To make a jig to cut evenly spaced dados, make a notch in a piece of MDF with the bit you'll use for the dados, then glue a strip of solid wood into that slot that fits the notch snugly. Next, move the piece of MDF to one side by the width of gap you want, plus the width of the dado you're cutting.



Easy Alignment – You can make matching parts by routing a dado in two parts, then temporarily fixing them together with a strip that fits across both dados. The rest of the dados machined on these parts' faces will be aligned.



Looking Good – With the dividers in their slots and tools in their pockets, a final trim of their height can be completed while also removing any tear-out.

chisel to clean and square them up. Next, repeat the process for the flip-stops, removing any dividers that don't get them.

From leftover pieces of milled cherry, cut the flip-stop pieces to fit into their mortises. Centre them on the dividers by using a small clamp. Drill a pilot hole for a #4 $\times$ 3/4" screw. Next, drill a clearance hole through the flip-stop and finally countersink for the flat head screw.

be determined by the width of the two pockets it will span, minus approximately 1/8" for clearance.

Gang and tape like components together and cut the mortises for the rails with sacrificial pieces of MDF, or similar, on both sides. This will not only stop tear-out, but also help balance the router. A compact router with a straight bit is well suited for this. Come as close to your end points as you comfortably can, then use a sharp

chisel to clean and square them up. Next, repeat the process for the flip-stops, removing any dividers that don't get them.

Pivoting door

The door is made using a 3/8" thick piece of black Limba, trimmed to let it slip into its opening. To let the door sit flush, we'll need to remove 3/8" from the top of the divider. This is better done on a band saw or with a saw and chisel. A router would more than likely rip the small ears off the ends. Clean up any rough edges with a file and sandpaper and use a sharp chisel for

Balancing Act – Routing the rail and flip-stop slots in the top of dividers is easily accomplished with a hand-held router. Der-Garabedian adds thicker sacrificial pieces on both sides to aid not only in balancing, but also to prevent tear-out.





Snug But Not Tight – Der-Garabedian adds the flip-stops to the dividers by first drilling a pilot hole through the pair, then a clearance hole through the flip-stop and finally countersinking for a flat-head screw.



Finish Preparations – It's much easier to apply a finish if the dividers aren't in the box. Keeping track of where everything goes is just a matter of marking the bottoms of all the removable pieces.



Line Transfer – Once dividers are slotted and placed in position, a marking knife and the rail are used to transfer the location of the mortise to the box frame. Notice the small gap between the long edge of the strip and the case end. This allows any trapped sawdust to easily exit the cavity.



Door Relief – The band saw is a safe and simple way of relieving the top of the divider for the door compartment. Cleanup can be accomplished with a file and sandpaper.

the final fit. To keep the door shut we'll add a couple of square blocks at the top with magnets after the finish is applied. A knob would only get in the way so a 3/4" finger hole was drilled and chamfered near the top. To allow the door to pivot, a set of hidden hinge pins, mentioned above, was used. Follow the instructions that come with the set as they are well written and easy to follow.

Some assembly required

Applying a finish will be much easier if the whole box is still in pieces. Clean the interior of the box frame components with a hand plane or sander. Gather your parts and glue them up, keeping everything lined up as much as possible. Don't forget to apply glue into the grooves for the panels.

Once the glue has cured, remove the assemblies from the clamps and flush the corners as well as the tops and bottoms. A sharp block plane will work wonders on the ends and a jack or jointer plane will easily level any high or low spots. Test fit both halves to make sure they come together nice and flush.

At this point we can add our hinges and clasps. Clamp the two halves together, propping up the thinner half with scraps of wood.



Door Stops – Simple square blocks will stop the door from swinging further into its opening and, paired with magnets near the end, will firmly hold the door shut.

Using double-sided tape, stick the hinges at evenly spaced locations and use a marking knife to score their locations. Transfer these lines to the inside and outside faces and use a marking gauge set at the thickness of the hinges to complete the scoring. Re-clamp the two halves together and use a router freehand to mortise for the hinges, staying within the lines. Use a chisel to finish the fit.

Mount the hinges with matching screws, but use only one or two holes at this point. Make sure to use the right pilot size bit, as you don't want to break the head off the screw. Alternatively, using gimlets or a steel screw would aid in this step. We can also now locate and mount the draw latches. The screws that came with the latches were slightly too long so I substituted shorter ones.

Seeing the finish line

Assemble the toolbox one more time. You'll more than likely have to trim the dividers, as some material was removed when levelling the openings with the jack plane earlier. Mark up the bottoms of the rails and dividers to keep track of where they're located. Clean up any scratches that have popped up and tape off all edges that need to be glued during the final assembly.

I went with Osmo TopOil for the finish, as it will provide a durable finish and still let the grain shine through. I applied two coats, letting the first cure fully. I propped up the components on dowels to increase air circulation and allow the finish to cure. I also like to apply a fine furniture wax, like Clapham's Beeswax Polish, after the second application of the finish has fully cured.

Wrapping up

Once the finish has fully cured, remove any tape. Sand any spots the finish penetrated or, alternatively, touch up any spots you missed after gluing and assembling the toolbox one last time. Glue some 1/4" diameter rare-earth magnets onto the top of the square blocks for the flip-down door. Glue these on after adding another pair of magnets to the inside top of the door. Screw the flip-stops, hinges and draw latches into position. Finally, centre the handle between the latches. Some compartments were left a little larger than required, especially on the larger right half, to allow spoon blanks to be carried in this travelling toolbox.

Like with most things in woodworking, there are numerous ways to accomplish a task. Some methods and tools are better for certain operations, like the router in this case. The steps above count on a router table with a mitre slot. If you don't have this slot, you can create a sled to do the same work. Always use test pieces to check your bit height, especially if you don't have a height gauge. The router is truly a versatile tool and you will give it a good workout when building this project.

STEVEN DER-GARABEDIAN
info@blackwalnutstudio.ca



Close Shave – Final trimming of the door compartment divider is completed in place with a sharp chisel.



Hinged – Der-Garabedian mortises for the toolbox hinges after supporting the thinner half and clamping the pair together.



Finishing Touches – A durable finish will help keep this toolbox looking great for many years to come.



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Runner-Up:
Veritas 1-1/2" Pocket Layout Square



Runner-Up:
Gramercy Tools Spoonmaker's Drawknife



Winner:
Bessey Track Table Clamps



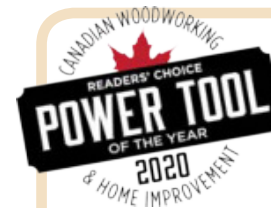
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Winner:
YETI SmartBench V1.2 Standard CNC Router



Runner-Up:
Supercell Mobile 14 Gal. High-Pressure Dust Collector



Runner-Up:
Arbortech Power Carving Unit



Winner:
DeWALT 20V MAX XR Brushless Cordless Compact Router



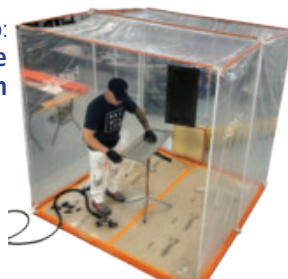
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Winner:
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Runner-Up:
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Runner-Up:
Festool Edge Sanding Guide





MAKING A LOCK MITRE JOINT

The main advantage of using a mitre joint is that it looks clean and simple. The downside is assembling it evenly so it doesn't look like a dog's breakfast. The lock mitre joint ensures the joint not only looks great when assembled, but that assembly is a snap.

Photos by Rich Keller (Lead Photo by Rob Brown)

Someone asked me recently what's new in the tool world. "Not much has changed since the electric motor was invented," I said. "And even then, it's still just a blade cutting wood. Now the blade just moves faster." That's a statement I will defend for a long time. Sure, every once in a while something comes along to cut wood in a new position, but at the end of the day it's still a spinning cutter with a motor. However, sometimes there are spinning cutters that you may not have tried before, and that can be exciting. One of those spinning cutters that I suspect not many people have tried is the lock mitre bit.

The first question you might ask yourself is "Why would I try a lock mitre bit?" That's a fair question. I expect the mitre joint isn't the most popular joint in the world. For one reason, they're tricky as anything to glue up. The angled face of the joint is almost never parallel to any clamp face and glue, of course, acts like a lubricant until it sets up. Pressure on the joint tends to make it slide out of alignment. On top of this, any imperfection when cutting the angle will make the joint out of square. For these reasons, I expect people avoid mitres in general. The lock mitre adds yet another degree of complexity to the joint, so I expect that scares some woodworkers even more.

The bottom line is that the lock mitre joint will make assembling a mitre joint much easier and will virtually always result in a mitre joint with two outer tips mating at the exact same point. This helps create an invisible joint between the two parts. The male and female portions of the joint that are routed into each piece fit into each other and lock the joint in place, hence the name of the joint.

Why even try?

I ventured to try the lock mitre bit more than 10 years ago, and although it was anything but new then, it was new to me. I believe it has (at least slightly) revolutionized my woodworking projects. I don't use it on every project, but when I do use it, I'm really excited with the results. Why use a lock mitre? I think it's easier to explain by example, so I'll describe the first project I used this bit for: a bookcase. I wanted to build a bookcase with doors to hide all of my stuff inside. For the design, I decided to use a face frame around the doors. However, if I just glued a frame onto the sides, I would see a glue line down the side of the cabinet, which is something I never like to see in furniture. The lock mitre bit allowed me to create a face frame cabinet that looks like it has 2" solid wood corners as opposed to two 3/4" pieces of stock glued together.



Invisible Joints – The glue line where the face joins the sides of this armoire is rather obvious, and not very pleasing to the eye. A lock mitre joint will remove this problem.

Easier than you think

Now that you can imagine the types of projects this bit can improve, let's look at how this bit is set up and used. I suspect most people avoid the lock mitre because they're afraid setup is tedious and difficult. Hopefully, I can show you how easy it can be.

The first step is to make sure all of the stock you plan to use is smooth, straight and, most importantly, even and accurately machined to a uniform thickness. The lock mitre bit will not work well with uneven boards. I like to thickness-sand my pieces before going to the router table as I find this gets my thickness even more consistent than the planer does. You should also prepare a few extra pieces of stock the exact same thickness to use when setting up the router bit. It's very important that all of your stock be the same thickness for the lock mitre to work properly, so you want to make sure that you prepare all your stock at the same setting on the planer or thickness sander and have a little extra just in case.

In terms of length or width of stock, any piece that can be routed safely will work. Smaller pieces can be done with push sticks or jigs to assist in holding the work. The length or width of board required will be the outside finished dimension of the piece you're building.

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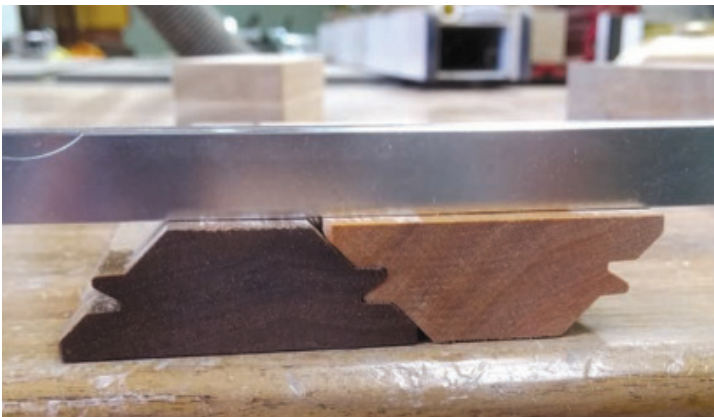
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Setting Bit Height – The router bit is not at the right height yet, as the boards do not line up in a flat plane. In this case, the router bit needs to be raised 1/2 the amount of the difference between the two boards. The board is about 1/16" off the bench on the right, so the router bit needs to go up 1/32". If raising the bit makes the problem worse, lower the bit two times the amount raised and try again.



Perfect Bit Height – Here the straight edge sits flat on top of the test pieces and no light shines through. The boards are in the same plane which means my height is set correctly. Next, I will move the fence back until the board comes to a sharp point on the 45° face.

You should also check the fence on your router table to make sure it's square to the top. Because one part of the joint is routed lying on the table, and the other part routed standing up against the fence, the squareness of the joint will be the same as the squareness of the fence to the table.



Set the Fence Location – The small flat on the left lets you know how close you are to having the fence location set up properly. In theory, having the flat reduced to nothing, while at the same time not cutting any material off the outer face of the workpiece, is the setup you are aiming for.

Start with bit height

Once you have installed the lock mitre bit, grab one of your set-up pieces of stock and lay it on the router table beside the bit. I like to adjust the lock groove by eye to be roughly in the middle of the stock to start, and then make a few test cuts to check it. I start with the fence revealing less of the bit than is required to make a complete cut. I will start by removing about 3/4 of the edge of the board, leaving a flat of about 1/4 of the width of the edge. The exact width of this flat is not critical. Rout an edge on two different test boards. For now, both boards should be routed with the piece lying face up on the table, not standing against the fence. Once done, flip one over to see if the boards go together in a flat plane. If the boards produce a perfectly flat joint, then the lock groove is perfectly centered and you can proceed to the next step. If the boards do not join flat, the bit must be adjusted up or down. Remember that the bit needs to move half the amount of the difference between the two boards. Move the bit up or down slightly less than half and try again. If the error is worse, the bit needs to move in the other direction.

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The Finished Joint – The finished joint is shown here with walnut and cherry. Different species were used for demonstration purposes. When the same wood is used the joint is invisible.

Set the fence depth

Once the height is correct, setting the fence is easy. Take a fresh test piece and rout the edge, then slowly move the fence back until the flat spot on the edge of the board disappears. It's important not to move the fence back too far or the piece will not contact the fence at all on the out feed side of the router bit, making it hard to keep the edge straight. If your router is not very powerful, you may want to rout a first pass before moving the fence to its final depth

setting. Remember, when you go to rout the good wood, one side of each joint needs to be routed lying down on the table, and the other side should be routed standing up against the fence. In both cases, the visible face of the wood will face towards you, away from the table or fence.

Time for glue

Gluing a lock mitre joint is relatively easy. I like to use a small brush to make sure I spread a thin, even coat of glue in the joint so that when clamped, the joint will tend to pull together rather than slide apart. You don't want to apply too much glue to the joint. The outside is easy enough to clean, but the inside corner can be difficult to access. If the inside is never to be seen, this is not a problem, but on a project where the inside is visible you will want minimal squeeze-out to clean up.

I hope this inspires you to give something new a try, and to take your woodworking projects to the next level.



RICH KELLER
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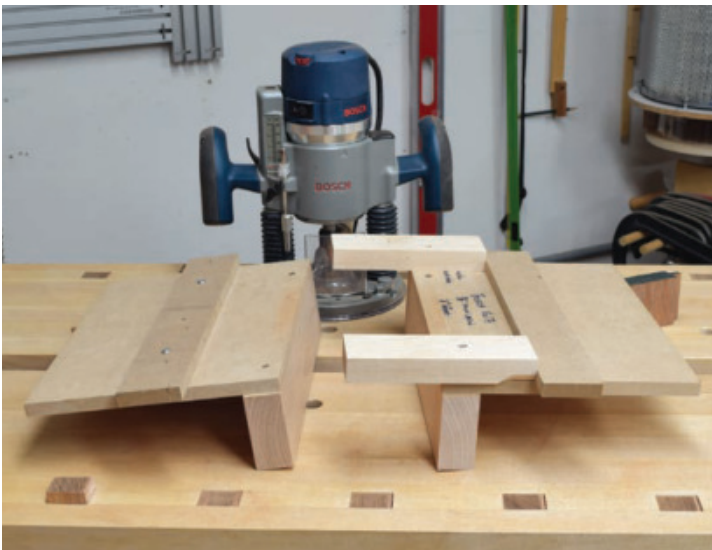
With routed mortises and other time-honoured joinery, this deck box is built to last so it will enhance the look of your outdoor space for years to come.

BY DAVID BEDROSIAN

This project is elegant and multi-functional, as it can be used as both a deck box and a bench. I used sapele, which looks great and is well suited for outdoor use. Other wood options include white oak, mahogany, ipe or cedar. The box would also work well as a toy chest or blanket chest indoors.

Rough mill all of the lumber

There are more than 60 workpieces in this project so take your time with the layout. As each piece is rough cut to length, mark the end so you don't lose track later. Many of the pieces are relatively short so I often doubled up the length to reduce the number of pieces I had to run through the jointer and the planer. I like



Simple Mortising Jig – The two vertical maple faces sandwich the workpiece while this mortising jig is in use. The router is guided by the two MDF strips that are screwed to the main MDF base parts. Those two MDF strips must be parallel with the maple faces or the mortises won't be parallel with the faces of the workpieces.

to mill the wood thicker than the final dimension and let it sit until I am ready to use it. If it twists, I can joint the board again before I take it down to its final thickness.

The frame of the box is made from 5/4 stock machined to a finished thickness of 1". The slats are milled from relatively flat 4/4 stock milled to a finished thickness of 7/8". This results in the frame being 1/8" proud of the slats, which adds some interesting shadow lines. If you can't quite get a full 7/8" thick from your 4/4 material, dressing it down a bit further isn't going to cause any problems as long as you adjust for that new thickness when machining the joinery.

The top of the box is milled from 4/4 stock, and I aimed for a finished thickness of about 7/8". If your 4/4 stock is not very flat, you may have to mill it thinner than 7/8" which is fine as long as all of the lid pieces are the same thickness.

Build a simple router mortising jig

The frame of this box is held together with mortise and tenon joinery. The rails connect to 3/8" wide mortises in the legs that are slightly deeper than 1-1/2". My longest 3/8" spiral router bit can rout that deep, but only if the router is sitting directly on the workpiece. If you're careful, you can rout the mortises using an edge guide, but I prefer a wider and more stable platform to keep the router flat on the edge of the workpiece.

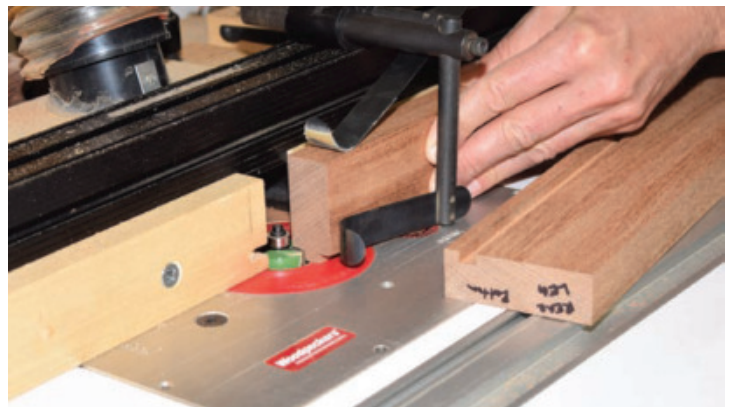
To make such a platform, I glued and screwed two pieces of MDF to some thick pieces of maple that I clamped on opposite faces of the workpiece. The router base sits on top of the MDF and slides against a wooden fence. The fence must be parallel with the front of the jig and offset so the mortise is 5/16" from the edge of the workpiece. Make one or more test cuts to dial in the fence position, noting the 5/16" offset is not critical as long as the mortise is parallel with the edge of the workpiece. For a little more stability, a second fence can be added to keep the router tight against the primary fence.



Ready for Action – Once set up, the mortise routing operation is easy. Take multiple passes as the router is guided between the two maple stops, limiting travel and determining the length of the mortise.



Keep the Corners Aligned – To ensure the two halves of each leg mate together perfectly, Bedrosian first machined a groove in the wider portion of each leg. This groove was positioned so it was at the center of the mating board. Next, he ran a pair of rabbets along the edges of the other leg portion, creating a tenon that fit into the groove. This kept the parts aligned during assembly.



Materials List

Part	Qty	T	W	L	Material
Legs - front and back sections	4	1	3	19	Sapele
Legs - end sections	4	1	2-1/4	19	Sapele
Upper Front / Back Rails	2	1	2-1/4	45	Sapele
Lower Front / Back Rails	2	1	2-3/4	45	Sapele
Upper End Rails	2	1	2-1/4	15-1/2	Sapele
Lower End Rails	2	1	2-3/4	15-1/2	Sapele
Vertical Dividers	4	1	2-1/4	15	Sapele
Wide Slats	8	7/8	5	13-3/8	Sapele
Narrow Slats	16	7/8	4-1/2	13-3/8	Sapele
Seat Front / Back Rails	2	7/8	3	45	Sapele
Seat Side Rails	2	7/8	3-1/2	19	Sapele
Seat Dividers	2	7/8	2-1/4	15-1/2	Sapele
Wide Seat Slats	3	7/8	5	13-7/8	Sapele
Narrow Seat Slats	6	7/8	4-1/2	13-7/8	Sapele
Bottom Cleats	2	7/8	1-1/4	To Fit	Sapele
Bottom Slats	To Fit	7/8	To Fit	To Fit	Sapele
Drawbored Pegs	24	7/32 dia		To Fit	Sapele

Hardware List

Name	Qty	Size	Details	Supplier
Hinges	3		01W9873	Lee Valley
Soft Close Lid Support	2			Misc

Machine the legs

Each leg consists of two pieces of 19" long stock joined with a 3/8" wide tongue and matching slot. This joint doesn't add any strength to the leg, but it keeps the two pieces aligned when the box is glued together. Rout the slot on the router table, locating it so the tongue will be centered on the mating piece. When the two pieces are joined, they should each be 3" across.

It's possible to join the two pieces that make up each of the four legs with bevel joints so the joint is less visible.

Lay the legs out to form a box using the 3" wide pieces (the ones with the routed slots) for the front and back of the box. Mark the top of each piece and lay out the mortises. The bottom mortise starts 1-3/4" from the bottom of the leg and is 2-1/4" long. The top mortise starts 1/2"



Rout a Slot – Once both sides of the leg assemblies have been mortised, and the groove and rabbet joint to secure the two parts together has been completed, it's time to rout the 1/4" wide slot to accept the panels. This slot is cut between the two mortises.

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Sneak Up to Perfection – With the help of a shoulder plane, Bedrosian shaves the tenon down to fit into its mating mortise. If the band saw setup was done carefully, this process won't take long.

Table Saw Tenons – First, Bedrosian machines the tenon shoulders on his table saw. The location of these cuts determines the length of the tenons, so keep your mortise depths in mind during this setup.



Ease the Edges – With the help of a small round-over bit, the edges of the tenons can be eased so they fit into the mortises nicely.



Cut the Cheeks – With the band saw set up to create a slightly oversized tenon, Bedrosian makes cuts on four sides of the workpiece, stopping at the table saw shoulder cuts.

from the top of the leg and is 1-1/2" long. Mark the inside face of each leg piece to use as the reference face for the joinery. This will ensure the slats are flush with the inside of the box and therefore recessed from the front. Rout all of the mortises to a depth of just over 1-1/2".

Set up your router table with a 1/4" slot cutting bit positioned so the bottom of the cutter is 5/16" above the surface of the table. Use a test piece to confirm the bit height and to adjust your fence to cut

a slot 1/2" deep. If possible, you will want to leave this router setup in place to rout all of the slots in the frame pieces as well as the slats. Start with the legs and rout a slot between the mortises. Be sure to have the inside face of each piece against the router table.

Drawbored mortise and tenons

The rails connect to the legs using 1-1/2" deep tenons that are drawbored for extra strength and to simplify the assembly. There are many ways to cut the tenons. I chose to use my table saw to form the shoulders and my band saw to cut the cheeks. Start by cutting the rails to length – 15-1/2" for the short rails and 45" for the long rails. Lower your blade to just over 5/16" and adjust your fence (and optionally a small stop block) so the left side of the blade will cut exactly 1-1/2" from the end of the wood. Start with a test piece and then cut all four faces which define the shoulders for the tenons. If your fence is not perpendicular to the table or is not parallel with your blade, the shoulders may not line up. If this happens, try referencing instead off a small 1-2-3 machinist block pushed against the fence. When you are satisfied with the setup, make the same four cuts on the end of each rail.

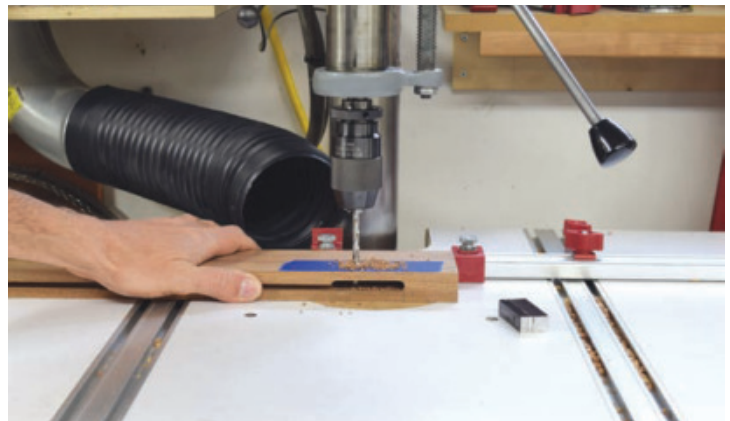
To cut the cheeks, move to your band saw. Set the fence to cut away the cheeks, leaving the tenons slightly thick so they can be



Chisel to the Rescue – Because the small round-over router bit can't quite reach the end of the mortise, Bedrosian uses a chisel to make quick work of the task.

cleaned up with a shoulder plane. Round-over the tenon to match the ends of the mortise. You'll need to fine-tune the fit with a chisel to ensure the joint seats properly and fully. Confirm that the shoulders are square to the rails so the frame will be square when the drawbored pegs are installed.

Use a 7/32" brad point bit to drill the holes for the drawbored pegs. Start with the legs and be sure to remove the rails since the tenons are marked and drilled in the next step. The bottom mortises have a pair of pegs and the narrower top mortises have a single peg.



Drawboring – The first step in creating a drawbored joint is to drill a hole directly through the mortise cavity. It should be centered across the depth of the mortise. The lower mortises receive two pegs, while the upper mortises receive one peg.

Dry fit the rails into the legs and pare the tenons as needed so the top rail is flush with the top of each leg and the bottom rail is 1-1/2" from the bottom of each leg. Use clamps if needed to ensure the tenons are fully seated in the mortises. Using the same 7/32" brad point bit, transfer the center of each hole to the tenon and then disassemble the frame. If you drilled holes through the tenons using these center points, you would have a pegged mortise and tenon joint. To drawbore the joint, you need to slightly offset the hole towards the shoulder of the tenon.

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Dry Assemble and Mark – Assemble a joint and use a Brad point drill bit the same size as the hole to mark the center of the hole on the mortise with a light tap of a hammer.



Slightly Offset – Bedrosian touches the marked center of the hole with a black marker for clarity, then he uses an awl to add a dimple that's offset from the original mark by about 1/32" to 1/16" before drilling the holes with the same Brad point bit.



Make the Drawbored Pegs – After ripping strips of wood slightly wider than the hole's diameter, he creates a taper on one end. Using a dowel former, Bedrosian hammers the strips of wood through the correct hole to create the pegs.

Complete the rails and dividers

The front and back of the deck box each have two vertical dividers that are mortised into the rails. The mortises are 1-1/2" long and slightly over 1-1/4" deep. Start by cutting the four dividers to a length of 15". Referencing the inside face of each piece, follow the same procedure as before to machine the mortises in the rails and matching tenons on the dividers. Use the slot cutter bit setup in your router table to cut 1/4" wide grooves on both sides of the dividers and the inside edges of the top and bottom rails.

The four bottom rails have a decorative cutout that's rough cut with the band saw and flush trimmed with a template and a pattern

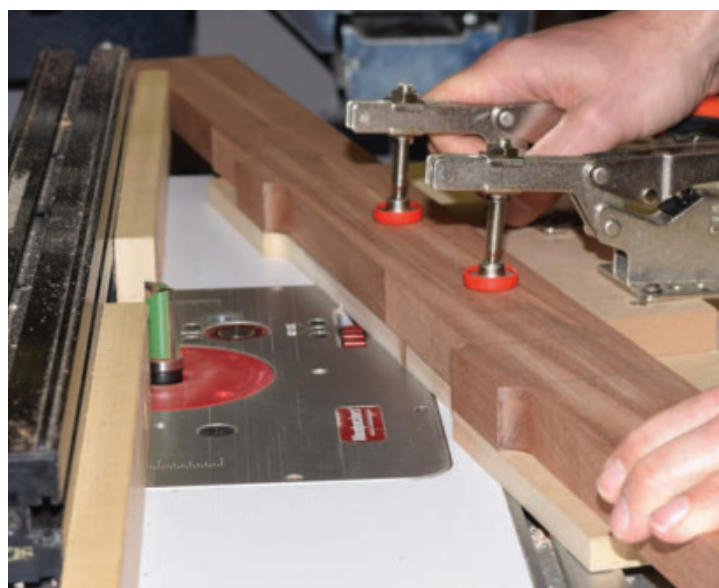
bit in your router table. The final step with the bottom rails is to machine a small chamfer where the slats meet the rail to promote water runoff. The chamfer runs the full length of the short rails and is stopped where the dividers join the bottom rail. You may want to defer these last two routing steps until the slats are completed, since they will use the same slot cutting bit setup as the frame pieces.

Tongue and groove slats

Each panel in the deck box consists of three slats joined with a tongue and groove on all four sides. To allow for seasonal



Vertical Dividers – Four vertical dividers are needed; two for the front and two for the back of the deck box. Tenons on their ends fit into mortises in the horizontal rails, while slots in their sides accept the solid wood parts that form the panels. The inside edges of the top and bottom rails will also need this same slot machined between the mortises that fix the vertical dividers in place.



Decorative Detail – The four bottom rails have a decorative detail routed into them with the help of a jig. Most of the waste is removed with a band saw, then the jig finishes the details



Tricky Tenons – The three slats that make up each section between the vertical rails all have stub tenons on both their ends to fit into the top and bottom rails. The slat in the center has a tenon on both sides, too. Two of the three slats have a tenon on only one side.

variations in the slat width, there is a 1/8" gap between the slats. No gap is needed on the top and bottom; the slats can butt tightly against the rails. Each slat is 4" wide, excluding the 1/2" wide tongue portion. One slat per panel has a tongue all the way around the perimeter so this board needs to be cut 5" wide. These are the center slats. The other two slats are cut 4-1/2" wide since they have a tongue on the top, bottom and only one side; the opposite side has a matching slot. The length of each slat should be about 7/8" more than the 12-1/2" distance between the rails. When the shoulders are cut, the slats should fit snugly between the rails.

Using the same slot cutter setup as before, rout the 1/2" deep



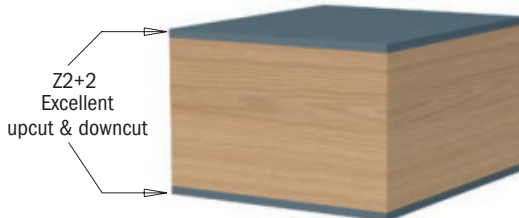
Sub-Assemblies – Because it's too difficult to assemble everything at once, Bedrosian started with the two end panels. He used spacers to help position the slats evenly until the glue dried. As always, being prepared for a glue-up is essential.

slots in one side of the 4-1/2" wide slats, keeping the inside face against the router table. To rout the tongues along the length of the slats, switch to a rabbeting bit and set the height so the top of the cutter is 5/16" above the table and the rabbet depth is 1/2" deep. Use a test piece the same thickness as the slats to dial in the fit. If the slats are not exactly 7/8" thick, or your slot cutter is not exactly 1/4" wide, you may need to remove different amounts of wood from opposite faces of the slats. You could raise and lower

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A Helping Hand – With the end assemblies complete, it was time to bring the front and rear panels together with the end assemblies. An extra set of hands is great to have nearby, but using square brackets to keep things not only together but square also works wonders.

the rabbeting bit when switching sides, but I find it easier to use a shim between the slat and the router table for the face that needs less wood removed. Use veneer or several layers of paper. Even a few strips of masking tape can quickly act as a shim. To get a clean cut, you may want to rout the rabbets in several passes to get the full 1/2" depth.

To machine the tongues on each end of the slats, use the same table saw and band saw setup when the tenons were cut. This will give a cleaner and more consistent shoulder. Follow up with the shoulder plane to clean up the face of the tongues so they fit in the grooves in the rails.

Glue up in stages

Be sure to use an exterior adhesive for the assembly of this project, as the elements will cause a non-exterior grade adhesive to fail. With all this careful machining, the last thing you want to do is watch your deck box fall apart over the span of a few months. A waterproof epoxy is the option I went with, though a Type-II or Type-III PVA adhesive would also work well outdoors. Every adhesive has its strengths and weaknesses, so make sure you know the characteristics of the adhesive you're using before assembling a project.

There are too many pieces to glue the deck box together at one time, so I glue it up in stages. I started with the end panels before moving on to the front and back. Dry fit the pieces so you can work out an even spacing between the slats. I used some thin offcuts and built up to the required spacer thickness with a few layers of blue tape. The slats are glued into the rails, but only use glue over the center inch to allow



Hinge Mortises – Although it depends on the type of hinge you use, many mortises can be marked to width with a marking knife, then routed to depth freehand. A sharp chisel can fine-tune the joint. An extra piece (or, in this case, two) of scrap wood clamped to the rail, flush with the top, will provide support for your router.



Outside the Box – Although it's a slightly unorthodox installation, it works like a charm. Bedrosian attached one hinge leaf to the back of the upper rail and the other leaf to the underside of the seat. He routed a notch in the upper edge of the top rail to allow clearance for the upper leaf when the seat is closed.



A Strong Stay – A stay will help keep the top from slamming shut, potentially hurting someone. It's also a nice touch to a beautiful project.

them to expand and contract with the seasons. No glue is used between the slats or where the slats join the legs or the dividers.

While the glue is drying, follow the same steps to make the top of the box. Adjust the mortise offset to account for the thinner stock. Rout the slots so the slats are flush with the top of the lid so it can be used as a seat.

Finishing touches

If the box is going to be used outdoors, I recommend using recessed / flush stainless-steel hinges such as item 01W9873 from Lee Valley Tools. One half of the hinge is screwed to the underside of the top with flat head screws. The other half has the counter-sunk holes against the back of the box, so it's fastened with round head screws, also in stainless steel. Rout small mortises in the upper edge of the upper back rail. This allows the leaf that's attached to the underside of the seat to have clearance when the seat is closed. The underside of the seat sits flush on the box.

Soft-close lid supports are required to keep this heavy lid from crashing down. Choose ones rated for the weight of the lid, which will depend on the wood species you choose. I added a block to the inner face of the end assembly in order to give me something to attach it to.

I used sapele for the slats that make up



Bottom Slats – Bedrosian glued a cleat to the inside face of the bottom rails, then cut slats to fit in place. The slats had a groove on both edges and a spline was inserted between each slat. Ample space was left between the slats for seasonal movement.

the box bottom. I glued a cleat along the inner faces of the front and rear lower rails to support the slats. I routed 1/2" deep grooves in their edges and joined the pieces with splines. I left a gap to allow for seasonal changes in the width of each board. A single stainless-steel screw in each end of the slats, driven from below through the cleats, secures the slats in place. A bottom made of a less expensive wood could also be used.

Most outdoor wood will fade to a silvery grey if left unfinished. If you want to maintain the colour, there are many suitable outdoor finishes to choose from. I used Cutek Extreme oil and applied two coats following the manufacturer's instructions. Once complete, take your box outside where your hard work can be admired.

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STRAIGHT ROUTER BITS – A PRIMER

Most of us know what a router bit is and have an idea of what it's used for, but knowing the details will help you choose the style of bit best suited for each individual application.



BY MARK SALUSBURY

Here I'll discuss the basic design, geometry and materials of straight and spiral bits used for trimming, shaping, and making dados and mortises. Adding a pilot bearing or two simply takes these basic designs to a new dimension.

Two designs

Basically, a rotary cutter fitted within the collet of a table-mounted or hand-held router, straight router bits come in two formats: straight fluted and spiral. Today's straight fluted bits generally have one or two tungsten carbide inserts brazed onto a supportive steel body. Straight spiral bits are available in either solid high speed steel (HSS) or solid tungsten

carbide. Straight fluted bits are more common than straight spiral bits.

HSS is formed from molten molybdenum, tungsten and chromium steel. Beginning as a liquid, it has a fine molecular structure capable of achieving and maintaining a very keen edge.

Tungsten carbide, on the other hand, is a chemical compound of tungsten and



Cutting Angle – When viewed from above, a router bit's cutting edges are set at an angle. This "cutting angle" is usually about 30° and is the proper cutting angle for the router bit's purpose.



Dish Angle – The outermost points of a straight router bit rotate slightly below the center of the bit. Otherwise, friction and heat would be increased, and a poorer bottom surface of the cut would be typical.

carbon particles compressed into "blank" shapes via a process called sintering. Twice as stiff and double the density of steel, tungsten carbide is less susceptible to normal wear and abrasion, offering a much longer useful life than HSS, but is comparatively brittle and unable to develop as keen an edge.

What's the angle?

While the cutting edge is the "business side" of a router bit, there's a lot more behind it. On closer inspection, the side edges of a **straight carbide-tipped bit** have a single "cutting angle" of +/- 30°. **Spiral router bits**, actually two flute machinists' endmill cutters with a "standard" 30° helix designed to mill aluminum or brass, have a primary cutter angle of 3° to 5°, supported by a secondary angle of a further 10° to 15°. These clearances behind the cutting edge reduce



Removable Bearings – Bearings can be removed if they need to be replaced. While using some router bits (both straight and non-straight types), you can use a bearing of a different diameter in order to obtain an alternate profile or cut. A good example is a rabbet bit, as the bearing adjusts the amount of material the bit removes with each pass.



Following a Pattern – Template bits (left) have a single bearing between the cutter and shank. Flush trim bits (center left), have a single bearing at the end of their cutter. A combination bit (center right) includes both bearings. Although less common for most woodworkers, the bit on the far right is mainly used for tracing a template while mortising for a shallow hinge, like an interior or exterior door. Choosing among the four is mainly a matter of function. If, for logistical reasons, the operation is best performed with a flush trim bit, that's what should be used, and vice versa. The combination bit is a great option, as it allows both approaches. A hinge mortising bit takes care of one main function.



Assorted Sizes – Bearings have different inside and outside diameters, and can sometimes be swapped out depending on the operation needed.



The Thicker, The Better – A thick tungsten carbide cutting edge hints at a well-made router bit. It also means the bit can be sharpened more often before it has to be retired.



Anti-Kickback – The material that protrudes from the center of some larger router bits is to limit the amount of material the bit will remove with one rotation. If a workpiece is advanced too quickly, the anti-kickback portion of the bit will press against the workpiece and slow the feed of the workpiece.



Carbide Spirals – Because it would be very expensive and exacting to attach spiral tungsten carbide edges to a spiral bit, the entire bit is made of tungsten carbide. Here are three up-cut bits from CMT and Freud in varying lengths and diameters. If used properly, they will provide you with a very long life.

the potential for friction and heat to develop as the severed wood fibres (a.k.a. “swarf”) make their way via the flutes to exit the bit as it repeats the process thousands of times per minute.

Don't forget the end

On the end of most router bits is also some form of edge with a relief or clearance angle. Behind it, the shape is dependent on whether the bit is designed to be simply “end cutting” or “bottom cleaning”. The ends of carbide-tipped bits have a relief angle of $\pm 15^\circ$. The ends of spiral bits, on the other hand, have a “primary cutter angle” of 7° to 10° supported by a secondary cutter (clearance) angle of a further 5° to 15° .

All straight bits, standard or spiral, will have a “dish angle” of 1° to 2° within the end, ensuring the bit contacts the workpiece primarily at its outermost tips with the centre in relief.

Pilots and bearings

A “pilot” or “guide bearing” allows router bits to smoothly follow a pattern or template so a shape or profile can be duplicated perfectly, in a controlled manner, as often as required. The less common option, the pilot is “plain”, simply a polished area of the bit’s shaft either above, below or on either side of the cutting edge. A “panel pilot” bit is a good example of this. More on these bits later. But in most cases, a ball bearing “guide” is fitted, reducing friction as the bit follows the pattern, thus extending each duty cycle.



Hone It Yourself – A simple diamond hone, like this credit card-sized version from Trend, is great for improving the keenness of a carbide edge without the bit leaving your shop.



Clean It Up – Bits accumulate pitch and resin, especially if you work with a lot of softwoods. Cleaning them will improve their performance.



Slippery Coatings – Many manufacturers apply proprietary non-stick coatings to their bits to decrease pitch buildup and keep their bits running properly for longer. Freud now uses its proprietary “Black ICE” (Industrial Cooling Element) coating on some of its bits, while other manufacturers have a slightly different version of a non-stick coating.

Continuing on my “straight bit” theme, bearing placement defines the bit’s intended use. Having the bearing at the end creates a “flush trimming bit”; having the bearing at the shank end, above the cutting edge, creates a “template” or “pattern bit”; and if there are bearings both above and below, the cutter produces a “trimming/template” or “combination bit”. In use, this variety allows us to select the best bit for each operation, assuring the fibres of the wood are being cut in the direction of the grain for the coolest, finest result while minimizing effort on our part. Available generally in 1/4" and 1/2" shanks, size the bit to the project, though a 1/2" shank is less prone to chatter. All can be used with either table-mounted or hand-held routers.

Shop-made patterns or templates can be crafted to best favour the grain direction of the individual part you’re going to shape,

secured to the piece being worked either above or below the part, or clamped to a jig using toggle hold-downs. Then, simply select the right bit to follow the profile.

Guide bearings also feature on “profile bits,” shaping a host of edges (coves, bullnoses, ogees) and joinery profiles. None of these bits are straight, so I won’t cover them in detail here.

Pilots/bearings are manufactured exactly flush with the tip of the cutting edge when the bit is first machined. Each time the bit is sharpened, its outer diameter (o.d.) becomes a few thousandths of an inch smaller, trimming less material during use, thus producing a shape slightly larger. In most cases this isn’t an issue. Also, it’s strongly recommended you remove ball bearing guides yourself before sending bits off for sharpening.

The grippy part

Router bit shanks, the part gripped within a router’s collet, are generally 1/2" and 1/4" in diameter. Most routers have interchangeable collets to allow the use of either, smaller handheld 1/4" “trim” routers being the exception. Given the choice, 1/2" bits are the best investment, offering the largest cutting-edge surface, heat dissipating mass and reduced vibration.

You get what you pay for

It’s hard to tell the quality of a bit by simply looking at it, but there are signs. Tungsten carbide comes in different grades and densities and appears much the same, regardless. On all straight fluted bits, you can look for the size and thickness of the insert, how uniformly it’s brazed to the body and the keenness of its edge. You can also tell a lot about a bit by its body mass. A larger mass will dampen vibration and dissipate heat better, plus often allow for the inclusion of an anti-kickback profile in the maker’s design to reduce the potential for the bit to take too deep a cut resulting in chatter, a catch or kickback. A quality bit will have an appropriate cost but will be well balanced and a solid investment that you can sharpen

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End of the Line – The ends of router bits speak to how they perform. End cutters that extend from the center of the bit to the outer edge of the bit will allow the bit to plunge into the material. The red Freud bit isn't made to plunge into wood, as the cutters on its end don't extend all the way between the center and the outer edge of the bit. The green Exchange-A-Blade bit has a series of cutters on its end that will allow it to plunge. One isn't better than the other; they are simply made to do a different task.



Different Plunging Approaches – Three examples of the different approaches manufacturers take to allow their bits to plunge cut into wood. In neither case do the main two carbide cutters extend all the way to the center of the bit. They all use a certain type of grind on their ends to accomplish the same function.

can be shaped and sharpened, affecting only the bit's length.

Typically, router bits are delivered sharpened with 600-800 diamond wheels for a fine cutting edge.

Speaking of damage

The enemies of router bits are the same as for any cutting tool: abrasion; impact; heat; and lack of cleanliness.

Making sure your wood is grit-free will minimize **abrasion**. Brush, scrape and vacuum the surface of materials you think may not be clean, and avoid using cheap particleboard, which is prone to having grit imbedded in the particles during manufacturing.

Impact is pretty obvious. Avoid dropping router bits, keep them protected from contacting each other by not storing them loose in drawers or tool bags, and inspect wood for elusive nails, screws, stones (odd but true), etc. before routing. Many bits are supplied with stands or holders to keep them separated on a shelf, or simply keep them in the display box they came with.

Allied with this is making sure the bit is firmly, fully seated within the router's collet. Make sure the collet and the tapered bore it sits within are each quite clean and mate well — no galling or damaged threads. Insert the bit fully, but not totally, and tighten the collet retainer firmly so it draws the bit in to seat fully. A bit that's loose or in a damaged or dirty collet rotating at several thousand



Mortise Makers – Straight end cutting bits, both spiral and standard, can be manufactured to machine clean and deep mortises. (Photo by Mark Salusbury)

again and again. Spiral bits come as solid HSS and solid tungsten carbide, with carbide bits more costly up front but offering comparable value long term if you take care of your tooling.

Sharpening

Most tooling retailers offer a precision sharpening service and the cost is quite reasonable vs buying a new bit, as long as the bit is simply dulled, not damaged. For straight fluted bits, including angled and/or profiled styles, sharpening is applied inside the cutting edge within the flute, reducing the outside diameter merely a few ten thousandths of an inch each time. If the bit's end requires sharpening, that may be applied outside the cutting edge along the primary and secondary bevel. For spiral bits, sharpening is again done inside the cutting edge within the flute and the end may be sharpened outside, as described above, if required.

Repairing a bit

If a straight carbide-tipped bit is damaged because it hit a nail in use or was accidentally dropped, a sharpener can remove and replace the damaged insert before resharpening the bit to return its balance. For a solid spiral bit, often the damage is near the end and that area can be cut off, and a fresh edge, gash, primary and secondary bevel



Look Carefully – Some straight bits are made to plunge (right), while others aren't (left). The small cutters in the center of the bit on the right remove material when they rotate, while the other bit has a hollow towards the center, and therefore doesn't remove material while rotating.

RPM can really mess up your day, not to mention all its contacts, if it comes free.

The usual sources of **heat** are overworking a bit, using a bit that's dull or forcing a bit that's bound with a film of resin or glue. It's always better to take several light passes, allowing the bit to do the work and the swarf to exit behind the cut rather than bind up within it. Making sure your bits are sharp rewards you with having to put less effort into the cut, minimizes edge-damaging heat and produces a smoother, burn-free result. Pitch and resins build up on bits, affecting the relief angle behind the cut and masking the face of the cutting edge within the flute, making the cutter effectively dull. Simply **cleaning** the bit using a citrus-based cutter-cleaning product is easy. These types of products are often sold where you buy your bits. Apply using an old toothbrush or a small square of abrasive-free, ultrafine (grey) or fine (maroon) "Scotchbrite" or equivalent microfibre hand pad. You'll add untold life to your bits. It's important to never use oven cleaner to clean your bits or saw blades. Its harsh chemicals harm the brazing that bonds the carbide inserts to the steel body and will damage or remove the anti-stick coating on the tool.

Manufacturers have also developed proprietary non-stick coatings for their bits, reducing pitch and sawdust buildup, which in turn reduces friction and heat.

Let the bit do the work for you

Feed speed, router RPM (variable speed routers rule!) and depth of cut are a balancing act we need to perform so the router bit can

deliver peak performance and not get overworked. All need to be tailored to the material being cut for a clean cut and effective swarf extraction. Sensitivity to how much material you're removing and whether you're routing resinous softwood, dense hardwoods, oily exotics, plywood or melamine-coated particleboard is important.

Choosing what bit to use

Router bits come in a huge range of styles but it's the presentation angle of the cutting edge that defines their ability to produce a good result. Realizing this, we can decide which cutter is best suited to any given material and for the finish we expect to produce. There are three basic cutting-edge styles: straight; slightly angled; and spiral.

Most **straight bits** today are tipped with a brazed-in insert of tungsten carbide that slices or scoops material as it cuts. Most are "end cutting" and capable of shallow plunge cuts while some offer "bottom cleaning" by having a cutting edge in some form extending across the full diameter of the bit's end.

Bits with **slightly angled** cutting edges are designed to be "finishing" bits. Because they shear as well as slice wood fibres, they produce a smoother finish. This design is typical on bits that shape final profiles, such as face edges, coves, bevels and ogees. Most often, these have bearing "pilots" for referencing a pattern as they cut.

Spiral bits, those that feature a helix running around the bit from tip to shank, are the ultimate for clean cutting and plunge routing. The continuous outer cutting edge along the bit's helix shears wood

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Slightly Angled – The cutting edge of some router bits is parallel to the shank, while others are manufactured on a slight angle, as shown here. An angled cutting edge leaves a slightly smoother edge, preferred for a finishing cut.

fibres exceptionally well, while generous flutes extract and direct the severed fibres as the cut is made so the edge is kept clean, friction is reduced and the bit remains comparably cool. Most spiral bits are “end cutting” and “bottom cleaning”, ideal for machining mortises, tenons, dados, rabbets, etc. They are available in both solid HSS for keenness and solid tungsten carbide for durability.

Up-cut vs. down-cut geometries

Spiral bits come in three styles: “up-cutting”; “down-cutting”; and “compression”. These feature up-cutting edges at the tip end and down-cutting edges at the shank end, overlapping in the bit’s central body.



Rake Angles – The CMT bit on the left is an end cutting bit, and has a negative rake angle. The Lee Valley bit on the right is for bottom cleaning, and has a positive rake angle. Also notice the bottom cleaning bit has plunge capabilities, as its cutters extend across the entire end of the bit. (Photo by Mark Salusbury)

Accepting that routers rotate in a clockwise or left-toward-right direction, hold a spiral up-cut bit in one hand and a down-cut bit in the other, and examine the direction of the flutes of each. The up-cut bit is designed to draw swarf from the tip upward toward the bit’s shank. On the other hand (pun intended), the down-cut bit extracts swarf from the bit’s shank end downward to exit at the tip end. An up and down cut or “compression” bit draws swarf from both ends towards the center of the bit.



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Spiral Bits – Up-cut bits (left) are great at clearing sawdust from a mortise cavity as their rotation naturally brings the dust upwards. Down-cut bits (left center) leave the outer edges of the cut clean, as the wood fibres are cleanly sheared off during the cut. A compression bit (center) includes a down-cut cutting edge near its shank and an up-cut cutting edge near its tip. It leaves both the upper and lower faces of the workpiece clean. The small diameter up-cut bit (center right) will produce a 1/4" diameter mortise, while even smaller is the 1/8" down-cut bit on the right. These specific spiral bits are made by Freud and CMT.



Panel Pilot Bit – A fairly specialized straight router bit, the panel pilot bit will plunge into material, allowing the user to run the flat portion of the bit on a template to create a specific shape. This is often used for sink cutouts and to deal with sheathing around the exterior of window openings.

Spiral bit applications

Because of its extremely good ability to extract swarf behind the cut, an **up-cut bit** is excellent for deeper **mortises**, when you want to extract a lot of fibre in a very controlled manner. However, it also draws wood fibres surrounding the cut upward, leaving a slightly frayed edge. In most cases, this isn't an issue as the mortise will be covered once the joint is assembled. This fraying effect can be minimized by taking a very shallow first cut to sever the surface fibres only.

A **down-cut bit** is well suited for forming **dadoes and shallow mortises** when you want to preserve a crisp edge surrounding the cut; perfect for crisp dadoes in veneered sheet goods. Its cutting action presses the wood fibres downward, away from the router, so it cuts very cleanly. In this case, the cut should be advanced slowly and with shallower depths of cuts so the swarf has a chance to be cut, ground and drawn away as dust rather than chips.

A "**compression**" bit or "**up and down cut spiral**" bit is well suited for applications where both the top and bottom surfaces of

wood or veneered sheet goods need to be left crisp, as it will draw cut fibres upward from below and downward from above, compressing the swarf to exit the cut from the center of the board face or panel thickness.

Panel pilot bit

A panel pilot bit is an aggressive cutter that does a smooth job of routing shapes within sheet goods like a countertop for a sink basin or house sheathing for windows or doors. The bit comprises a pointed tip; a smooth, plain pilot area; a single flute cutting area; and above that, the smooth shank. When chucked in a plunge router set so the bit's pilot area can follow a pattern, the pointed tip is plunged just inside the edge of the area to be removed, moved in a clockwise direction until the smooth pilot or shank contacts the guide surface, then slowly advanced within the cutting area as the pilot follows the guide/framing. A router with adequate grips and horsepower is recommended for this uniquely capable bit.

I'm guessing that now you'll never look at a straight router bit the same way again.

Many thanks to these companies for their assistance in my research for this article:

EAB Tool Company,
exchangeblade.com

Larry Electric, larry-
electric.ca

Lee Valley Tools,
leevalley.com



MARK SALUSBURY
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Reviews

Our staff writers review new tools and products on the market that are ideally suited to the woodworker and DIYer.

Shaper Origin

Shaping the future of routing technology

Veritas Compact Router Table

Small size. Big functionality

JessEm Mast-R-Fence III and Micro Adjust

Mastering the router fence



(Photo by Shaper)

Easy Bit Changes –

The router motor can be removed from the base to make bit changes quick and easy. Shaper controls the depth of cut through the onboard computer.

(Photos by Rich Keller)



Magic Tape – Keller set up the Origin to cut some simple text. The circle in the middle of the screen shows the limits of Origin's self-movement. In the background you can see the Domino tape that Origin's on-board camera uses to sense where it's moving and how far it has moved. If you want to rout a small piece, that's easy, too. Fasten the piece to your bench, then apply the Domino tape to the bench rather than the workpiece. Origin will still be able to figure out its movement.

Shaper Origin

BY RICH KELLER

I've been using a CNC in my shop for some time now. Before getting a chance to use the Shaper Origin, I noticed it online so I was very interested to get one in my hands and see what it was all about. For this review I initially thought I would compare the Origin to

a CNC to explain it. As I started playing with it, I thought maybe I would need to compare it with a conventional router to explain it. But I think neither of these comparisons would do justice to the tool. I will explain how the Origin is like both a CNC and a hand-held router, but I believe it is a class of tool on its own. It does have some unique features and benefits



and, of course, there are some limitations that we will also look at.

Shaper Origin is a hybrid CNC/hand-held router. Its size, shape and weight are similar to a hefty 3-1/4 HP plunge router, so it has a familiar feel in the hand. However, it has some extras you won't see on a regular hand-held router. For one thing, Origin has a screen mounted to the top. Origin is powered by a 1HP motor with a 1/4" collet. The motor can be moved in a limited range of motion by the onboard computer. There is about 1" of movement in the motor. The on-board screen allows the user to see and control this motion. Origin is able to follow a computer drawing within this range of motion much like a large CNC would move around a 4x8 sheet of plywood to cut out a kitchen cabinet. Origin is able to read line art drawings transferred to it either by WiFi or by a USB drive. Origin also has some onboard design capabilities to create a simple design right on the router.

So far, the benefit of this might not be readily apparent, but let me explain this better with a practical scenario where you could use Origin. Unlike a large CNC, which is completely self propelled, Origin works in harmony with the user to rout a design. So, while Origin's self-movement is around 1", it's not limited to routing things only 1" in size. If I wanted to make a bookcase and dado the shelves into the sides with a conventional router, I would need to use a straight edge. If I drew a line on my material, it would be impossible to follow freehand. However, if I did not care about the quality of my work, I could probably follow the line within, say, 3/8" or maybe 1/4" and rout the dado a bit wide and make everything work. It would save the time of setting up an edge guide. Obviously, no one would do this. But what if I had a router that could compensate for me being 1/4" off the line on one side or the other? This is exactly what Origin does. I provide the large motion, close to where the router needs to go, and the onboard computer brings the router bit exactly along the line I want to cut. I can also choose if I want to cut centered on top of a line, or along the left or right side of a line. The big advantage to Origin is that it can take away making patterns, templates, lines and jigs for anything I would typically rout with a hand-held router. It can save time routing complex "one offs" that would otherwise require a special jig or template to be made.

How does it work? Origin uses "shaper tape" placed in rows over the work surface to provide information to a small onboard camera. This tape is just a lightweight tape with random Dominos printed on it. There is no real science or specific placement required for the tape. Stick some rows down 6" to 8" apart and this allows the onboard camera to figure out how far and in what direction Origin is moving. Origin can also reference from the edges of a board and measure layout positions. Going back to my shelf dado example, I would not lay out a project like this on the work surface. Instead,

I would quickly lay out lines on the onboard computer screen, referencing from one end of the work. I am able to rout duplicate pieces this way, also, so the second, third, fourth, etc. piece will be routed exactly as the first. Origin will show me the layout lines on the screen, along with a "target circle". The target circle represents Origin's range of motion. As long as I keep the target circle at least partly over the layout line, Origin will do the rest to rout a perfect dado. Of course, Origin is not limited to dados. It can take any 1/4" shank router bit, so it's only limited by your imagination. It can be used to cut out intricate shapes from sheet goods, cut inlays, dados, letters for signs, and all sorts of other things that would be impossible to do completely freehand.

Origin really opens up new possibilities in the shop. One of the big advantages of Origin is that there is no size limit to the workpiece. Origin is ideal for large workpieces that would not be able to be cut on a CNC. Some of Origin's online literature shows a large, intricate inlay being installed in a hardwood floor. Origin could also be used just as well on other large surfaces, or on an assembled project where it would be impossible to put the project on a CNC. Origin is also self-contained, so there is no add-on software to buy as there is with a conventional CNC. And it's also very simple to learn. I was able to pull Origin out of the box and carve some simple text in a test piece in about 15 minutes without having used the tool before.

For all its advantages, Origin will not replace a CNC or a hand-held router. While Origin can do a lot, it still isn't the only router a shop would ever want. But to be fair, I don't believe the designers would suggest that. Origin does have its limits. It's not the tool to reach for if you want a simple round-over on an edge; a conventional router will be quicker for that. At 1HP, Origin has a smaller HP than a lot of hand-held routers. It's designed for detail work, not heavy material removal. Origin also has to be operated by someone, so unlike a CNC where I can start a project and walk away, I have to guide Origin close to where it needs to be to cut my project. Usually when I run something on my CNC, I start the machine and then do other tasks while it works away, so I feel like this makes me more efficient. Origin is also not able to do 3D carvings like a conventional CNC can. I don't think I would be dissuaded from buying Origin for these reasons, though. I believe it's a question of application rather than points of limitation. Origin is available at a price that is competitive with even a small CNC, yet has no limit to the size of workpiece it can be used on.

Shaper Origin

MSRP: \$3,599; Bundle (with workstation) \$4,099

Website: shapertools.com

Tester: Rich Keller

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(Photo by Lee Valley)

Veritas Compact Router Table

BY STEVEN DER-GARABEDIAN

Compact routers are so versatile that manufacturers have started to create a whole range of accessories to harness this usefulness. Once only thought of as laminate trimmers, they can accomplish so much more. Yes, they have less power and only a 1/4" collet, but their smaller size makes for a safer and more controllable experience.

Veritas has jumped onboard the accessory bandwagon making a table and various attachments that are just plain smart. The heart of the unit is the table and base. Attachments include an adjustable fence with a see-through guard and quick adjust flip-stops. Baseplates can be bought depending on the manufacturer of your router, and for those odd installations, a blank plate is also available. There are several other attachments for the baseplate alone. A pair of knobs will allow you to freehand rout comfortably. There is also a fence that lets you reference the edge of a workpiece, as well as a centering kit that allows you to cut circles or arcs.



Fully Equipped – The Veritas Compact Router Table comes fully equipped with a lot of standard equipment. (Photo by Steven Der-Garabedian)

The kit comes flat packed and can be assembled in no time at all. The unit's base is "C" shaped, making it a breeze to clamp to a larger surface. After removing your router's baseplate, you mount it to the Veritas see-through plate using the same hardware. There are levelling screws built into the top that ensure a flat and flush surface after seating and securing it with two more screws. If you're going to rout curves without the fence, one of these screws can be replaced with the included pivot post. The top and base are made out of 18mm Baltic birch plywood. The 15-1/2" x 11-1/2" top is covered with a durable, low-friction laminate.

If you opted for the fence, it rides in keyhole slots via a pair of T-bolts and knobs. The aluminum fence has a pair of sub-fences that are laminate-covered, like the top of the table, and can be slid closer in or farther out from the router bit being used. There are T-slots in the fence for attaching the flip-stops or your own shop-made jigs.

I like using my routers in tables, especially the larger varieties. I typically only use compact routers for freehand work as they're much easier to handle and balance. However, why should I limit what I can do with this very versatile tool? I made a small modification to my table. I found in use that I would rather have the micro-adjust and quick-release clip of my router facing the front. It makes for easier adjustments and bit changes. However, this put some stress on the power cord as it hit the back panel when raised to full height. The quick and simple remedy was to cut a small slot making sure the cord wouldn't kink. I think I'll also head to the hardware store and replace some of the hardware with Robertson drive bolts. I'd prefer to have one style of screwdriver instead of several when adjusting equipment.

Veritas has done a great job with this table. From its ease of assembly to its practicality, it's a smart way of extending the use of compact routers. The table and fence allow for the addition of shop-made jigs, and small details like the integral cord wrap proves a lot of thought went into its design. I'm not sure what else they could have done. Maybe offered it in the latest design colours coming out of Europe? Then again, maybe not.

Veritas Compact Router Table

MSRP: \$158

Website: leevalley.com

Tester: Steven Der-Garabedian



Small-Shop Ready – Perfect for not only a small-shop setting, but also for routing any small- to medium-sized projects and workpieces, this small router table is big on return. (Photo by Steven Der-Garabedian)

JessEm Mast-R-Fence III (04400) and Micro Adjust (04550)

BY RICH KELLER

I've had the opportunity to put together lots of JessEm router tables over the past 15 years for various schools and cabinet shops, so I was very interested to have a look at their new fence and see how it compares. A large part of the reason this fence is coming to market is to reduce JessEm's reliance on manufacturing overseas and the raw materials there. It also comes at a higher price than their 04010 fence made overseas. It's nice to see a Canadian-made product, but are we paying more for a flag, or is it actually a better product? After looking it over carefully, I believe that it's a better product and worth the price increase.

There are some substantial construction differences between this and the previous versions, which were made of a one-piece aluminum extrusion. This fence has a 3/4" thick phenolic base with an aluminum extrusion for the upright part. The base and the upright are held together with aluminum brackets. All of the hardware has been upgraded; there are no plastic knobs. The knobs for the guard are turned from stainless steel, and the knobs that lock the fence in place are solid aluminum and steel. The fence-locking knobs use a heavier thread than previous versions, and the nut the knob screws into has also increased in size quite a bit. This should definitely keep the fence in place when locked. The phenolic base is reinforced with an aluminum boss where the locking handle passes through. The fence is completed with maple sub-fences that are easy to adjust and easy to replace, if necessary. The fence is quite straight and square when all assembled, even though it's made up of a number of different parts. The guard has been upgraded, as well. As with previous versions of the fence, there are shims included to offset the out-feed side of the fence for various operations like jointing.

There's a micro adjuster available for the new fence, and this is a feature I think is long overdue. The micro adjuster moves 1/64th per revolution and has graduations down to 1/256", which gives lots of control over the movement of the fence. Like the fence, the micro adjuster is well made. Everything about it is beefy. The large dial is easy to read and turn. One downside to the micro adjuster is it can only be used on tables where the fence is mounted with the included hardware to the edges of the table. The fence itself can only be edge-mounted to a table that is 32" wide by using the included hardware, or it can be mounted using T-slots within the table. The T-slots need to be 17" apart in order to do that. The fence slides nicely and is easy to adjust.

Overall, I'm pleased with the quality of the fence. Everything about it looks and feels well made and should last the user a lifetime.

JessEm Mast-R-Fence III and Micro Adjust

MSRP: \$359.99 (Fence), \$119.99 (Micro Adjuster)

Website: JessEm.ca

Tester: Rich Keller



(Photos by JessEm)



Long Lasting – Quality parts, such as a solid wood fence face, knobs and components, will keep this router fence working properly for a very long time.



Router Collets

An essential component of any router, the collet is what holds the router bit in place as it rotates at over 20,000 RPM.

BY CHRIS WONG

The collet is a piece of precisely machined steel bored to match the shank of a router bit and tapered on the outside to slide into the hollow spindle of the router motor. The collet nut fits over the collet and as it is threaded onto the spindle it forces the collet into the spindle, causing the collet to compress and squeeze the router bit.

Although router collets have slits to allow them to expand and contract to enable them to clamp and release bits, the range of clamping is very limited. Only use a collet to clamp a round object of the specified diameter — doing otherwise can damage the collet. For example, router bits and collets in Europe are commonly 12 mm, which converts to 0.47". This is very close to 1/2", but not close enough to be compatible.

Photo by Chris Wong

Chucking a bit

To secure a router bit in a router motor, first insert the collet into the spindle and thread on the collet nut by hand until you feel resistance. Then slide in the bit. As a rule of thumb, a router bit shank should be inserted a distance of at least double the diameter of the shank. For example, a 1/4" shank bit should be inserted at least 1/2". Having said that, inserting the bit further is usually good practice. Finally, tighten the collet nut using the correct size wrench, immobilizing the spindle with either a second wrench or spindle lock.

Removing a bit

Removing a router bit can be a little trickier. In theory, you would simply reverse the procedure — immobilize the spindle and use a wrench to loosen the collet nut. The collet then opens up, releasing the bit and you remove it.

However, that doesn't always happen. Sometimes the router collet remains stuck in the spindle and doesn't open up and the bit is "frozen". Unfortunately, there is no sure-fire way to release the router bit. I have always been able to remove a frozen router bit by tapping it out with a small hammer and a block of wood to soften

the hammer blow. I have heard recommendations of using hot or cold to release the bit. This situation doesn't happen with all collets and routers.

Fortunately, most collets made nowadays can be described as self-releasing. This means that the collet is connected to the collet nut so the collet nut can be used to pull the collet out of the spindle. When removing a bit from a self-releasing collet, first immobilize the spindle and use the wrench to loosen the collet nut. Once loosened, the collet nut can be turned several times further by hand before it gets tight again. The wrench is required at this point to further loosen the collet nut and pull the collet out of the spindle. The bit should now slide out of the collet without difficulty.

Collets are fairly easy to maintain. Ensure they are kept clean and smooth, and free of rust or grease. Keeping collets in good working order is fundamental to safe and accurate machining.



CHRIS WONG
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WHAT ARE ROUTER LIFTS ALL ABOUT?

Router lifts aren't new to the market. Different companies have produced them for decades, in different styles and configurations. But what are they about and why are some so expensive? Is it really worth the dollars invested, especially for the home shop?

BY RICH KELLER

I think any woodworker who does much work at a router table understands the problem that a router lift solves. Routers are meant to be held by the operator while placed on the upper surface of a workpiece. Routers aren't really meant to be hung upside down in a table. While it does make it easier to perform some operations once set up, sometimes setting up a router upside down is quite awkward. Most of the controls are hard to reach upside down, and typically height adjustment is really difficult too, especially when trying to move in very small increments.

Back in the dark ages of the 1990s, when I

started woodworking, different router manufacturers came out with special knobs that could be installed on your plunge router to make it easier to change the height of the bit. I still have my special knob for my old Elu router sitting in a drawer. It did make it easy to change the height in the router table, but then when I took the router back out of the table, the special knob required about 400 turns to remove so the router could plunge freely again. Special knobs didn't solve all problems. Router tabletops are usually much thicker than the standard baseplate of a router, so it's hard to get the bit to come up as high as needed in a router table. And when you have to change a bit, you need to take the router out of the table.

Photos by Kreg

Secure the Motor – Here, the user has removed the motor from the router's base, then installed the motor in the router lift. Keller prefers this type of lift for a number of reasons.

Two main types of lifts

I think most woodworkers have heard rumours about how lifts solve all these problems and more. But how, exactly, do they do it? And how are they different from a router with a good depth adjustment system? First of all, there are two types of lifts. The first type of lift will take any router and move the whole router – base and motor – up and down. This type of lift usually features a “Swiss cheese” mounting plate that has holes that line up with virtually any router out there. This first type was put on the market because many people own a very nice (and expensive) 3-1/4 HP dedicated plunge router and think it's a shame not to put it in a table. Examples of this type of lift would be the JessEm Rout-R-Lift Prestige 02322 and Steel City SCM47032.

The limitation with this type of lift is that you can't bring the collet of the router above the table. Changing a bit is still quite awkward, although with this approach you do gain the benefit of above-table height adjustment. CMT offers a 1/2" Collet extender (CMT# 766.001.00), but I find this setup less than ideal. It places the bit farther away from the bearing and behind the router collet, so inevitably there will be



more runout and vibration in the cutter. There are limitations to what this type of lift can do for you. This type saves buying a new router, but typically these lifts are a bit more money than other lifts on the market because of their complexity. I would also group this type of lift with router kits like the Bosch 1617EVPK and Porter Cable 890 series, which have some adjustment function built into the base of the router, allowing a wrench to be put down through the tabletop to change the height of the bit. They're not poorly made products, they just don't have as much functionality as the second type of lift.

The second type of lift

The second type of lift, which is my preference, works only with some routers because it only holds the router's motor. These lifts don't utilize the base at all. To use this second type of lift, you need a router kit (as opposed to a one-piece router where the base doesn't detach from the motor) so the motor can be slid out of the base and installed in the lift. I believe this is a better choice of lift, even though it may require purchasing a new router. Because the motor is removed from the base, the lift can bring the collet up through the table to make bit changes much easier. And because the collet can be brought up so high, I don't

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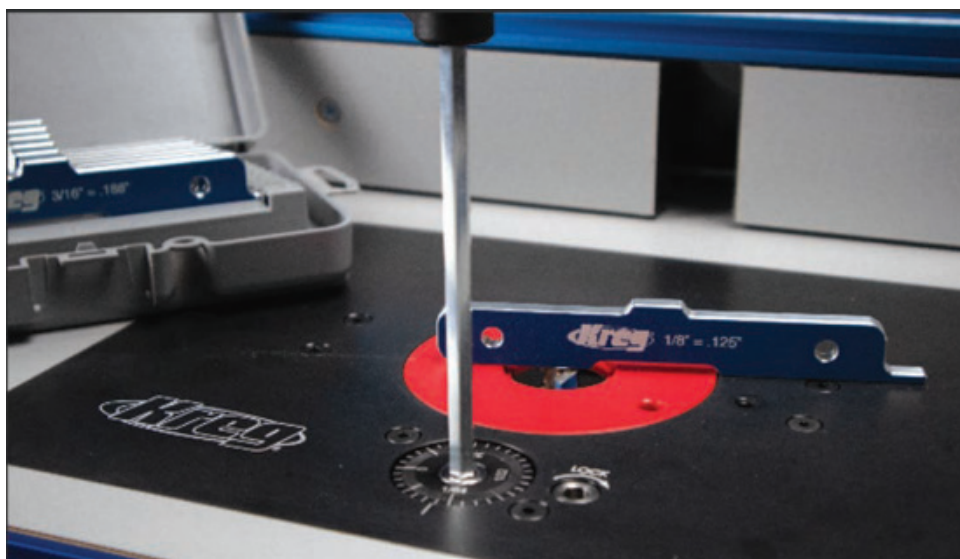
Above-Table Installation – When using a lift that accepts only the router's motor and not the entire router base, the user is able to bring the collet up above the table's surface for easier and quicker bit changes.

Up or Down...Quickly – One major advantage of using a router lift is that the bit height can be adjusted quickly and easily from above the table. This makes both macro and micro bit height adjustments simple.

have to worry about losing any depth of cut because of the extra thickness of my router table's top. I can also put the bit all the way into the collet rather than trying to "cheat" an extra 1/8" of length out of a bit and potentially not have the bit installed safely.

For this type of lift, there are a wide number of companies to choose from, but some of the brands are remarkably similar. King, SawStop and Steel City share a four-post design that's adjusted via a chain drive. This design is based on a design that was originally brought to market by General International under the Excalibur brand, and I suspect all three versions are now made by the same firm in Taiwan. This lift uses a system of plastic collars to accept motors of a limited number of different sizes into an aluminum clamp. Overall, these units are fairly heavy and well-constructed. Even though I suspect all three come from the same factory, they're not all identical. The SawStop version comes complete with all the sizes of adaptors for different motors, replacement table inserts and the top surface is also engraved with scales to position the fence. The King and Steel City lifts don't have these features.

The Grizzly T31638 is a nice price point option for a lift that can hold different sizes of routers. The construction of the lift is similar to the JessEm 02310, but rather than only work with one size of router motor, it



Two Types – The motors of the Freud and Festool routers on the left can't be detached from their bases. These two routers can't be used in a router lift. The Ridgid router is part of a kit. Its motor can be switched between a plunge and fixed base, and can also be used in a router lift. (Photo by Rob Brown)

can take three different sizes, 3.25", 3.5", and 4.2". The lift mechanism itself uses four guide rods, which should keep the motor very stable during use. Although this does not accept every size of router motor known, it will take the most popular choices from all the major power tool brands, making it easy to find a motor for this lift. This lift is priced slightly above the JessEm 02310, but does have the advantage of taking more than one motor size.

What are your options?

JessEm Tool produces two different lifts in this category, the 02310 and the 02120. The 02310 is one of the least expensive router lifts on the market. It's made to fit 3-1/2" diameter router motors. This includes Porter Cable 690 and 890 series,

Bosch 1617, and DeWalt 610, 616 and 618 motors, all of which are very popular. The good news is it won't be hard to find a router to fit in it. It's also manufactured in Canada, another plus. The 02120 is a beefier lift, much heavier in construction than the 02310. The feature I like most about this lift is the fact that the clamp that holds the motor in place is adjustable, and can hold just about any router motor without the purchase of additional parts.

The Rockler Router Lift FX is quite similar in design to the JessEm 02310 and takes the same common series of 3-1/2" router motors mentioned above. This lift doesn't have a lock for the height adjustment, something most lifts have. While there is some friction in the lift mechanism that should keep it stationary, it may drift in depth setting over long runs.



Chain Driven – The King Excelsior router lift is a four-post design that accepts the router's motor (far left). Height adjustment is aided and driven by a chain that moves the motor up and down evenly. Once installed into the router table (left), the lift's upper face sits flush with either a purchased or shop-made router table. (Photo by King Canada)

The Incra Mast-R-Lift II is made in Canada by JessEm and is a variation of JessEm's own 02120. This lift uses a different system of inserts than the JessEm lifts. The inserts for the Incra lift are held in place by magnets rather than the usual twist-lock system found in most lifts. This lift features the same adjustable motor clamp as the JessEm 02120 to fit pretty much any router motor out there.

The Incra PRL-V2 and Woodpeckers PRL-V2 have similar features, and the Incra version is made for them by Woodpeckers. The most notable feature of these lifts is that they use a spring-loaded, quick-adjust system to rapidly position the router close

to the desired setting, and then a thumb wheel to dial in the final setting. This allows the router collet to be brought up quickly for bit changes, and then put back in place quickly. The Incra lift uses their magnetic table inserts while the Woodpeckers version uses twist-lock inserts. This lift can also take a number of different router motors, though it's a shorter list than the JessEm 02120. Adaptor pads are required for some motors with these lifts. Also, when using the Porter Cable 690 and Bosch 1617 series motors with these lifts, you won't be able to bring the collet above the table. If you want to be able to change the bit above the table with

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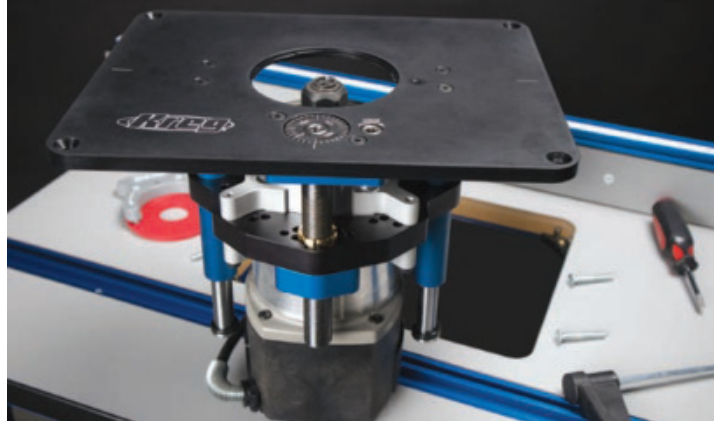


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Strong, Yet Flexible – JessEm's 02120 is a robust and well-made lift. The clamp that holds the router's motor in place is adjustable, so it can hold just about any router motor. (Photo by JessEm)



The Straight and Narrow – The inner workings of Kreg's router lift includes bearing-guided shafts that keep the lift working smoothly.



A Safe Start – During operation, it's common to press the workpiece against the starting pin immediately before starting the cut. This ensures the workpiece doesn't kick back or get caught as the bit comes into contact with the workpiece before the workpiece comes into contact with the router bit's bearing. The starting pin is seen here at the far end of the workpiece.

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these motors, you'll need to use a collet extension.

Kreg Tool also produces a router lift. This lift has an adjustable clamp for the motor, which I like. It can take pretty much any motor out there, and adjusts similarly to the JessEm 02120 lift. There are no extra parts to buy, which I like because it means no future purchases, even if you change routers. If you should ever need a new router motor, you're not limited in choice for what to buy. With this type of lift, you could also start off with a smaller router that you already own, then upgrade to something more powerful in the future.

I think a router lift is essential for any woodworker who spends much time at the router table. I prefer the second type of lifts I've mentioned here for one reason: above-the-table bit changes. Once you've done it once, you'll wonder why you didn't buy a lift sooner. It's easier than changing bits in a handheld router.

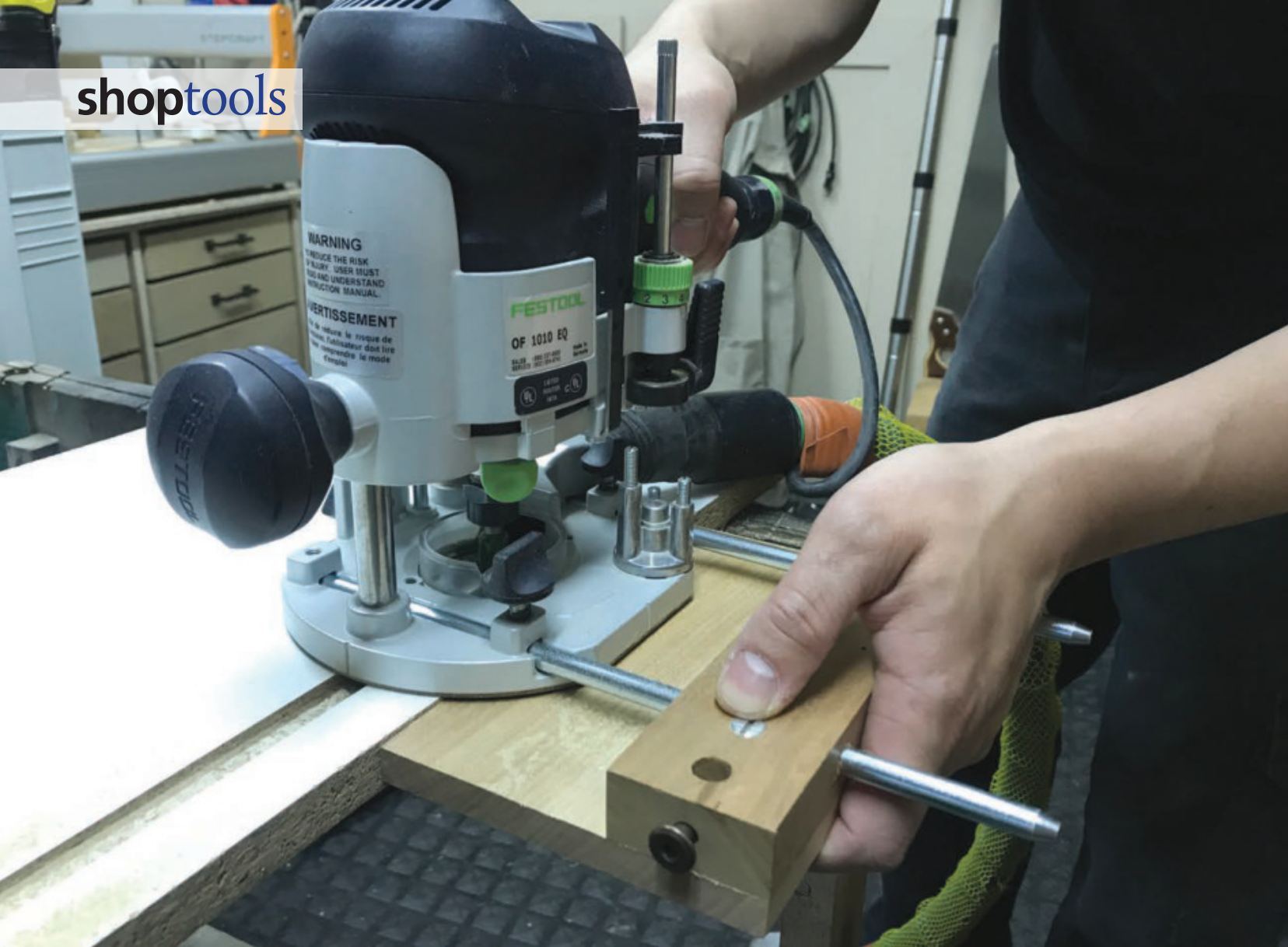


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The Ultimate Router Table Revisited (June/July 2016)



Simple Router Improvements

The router is a versatile tool. It's essentially a motor that spins whatever cutter you choose. The accessories you use with it determine how you can use the router, and what you can do. Here are some simple improvements you can make.

BY CHRIS WONG

Routers can take care of many tasks around the shop. Part of your journey as a woodworker is to learn how to use a power or hand tool to do more than just the most basic tasks. Before that happens, you should consider taking care of these basic upgrades, as they will make your time routing safer and more efficient.

Build an edge guide

Although most routers have a pair of holes for metal rods, few routers come with edge guides and, if they do, they're usually not sturdy or well-designed. Build your own with some scraps of hardwood or, better yet, build two so you can control the router along a narrow edge. Using two guides allows you to set the distance between the edges of the guides to the same as the workpiece, so you can then run the router on top of the workpiece.

Include features like a split fence, tall supports or dust collection if you like. It certainly doesn't need to be fancy, though. As long as the distance between the guide and bit is adjustable, it will come in handy in many situations.

Add a light

When using a handheld router, the bit is usually hidden in the shadows among swirling dust. To increase visibility so I can rout more precisely and confidently, I added lights to my router. The lights I chose are on flexible leads attached to a body housing the battery. The unit is intended to be worn around the neck when reading, but I found that by attaching the main body to the router motor with adhesive-backed Velcro, I was able to then position the lights on opposite sides of the bit to illuminate without the harsh shadows caused by a single light.

Make a better baseplate

Routers often come equipped with black baseplates with a hole large enough to accommodate most router bits. I have replaced most of these with shop-made baseplates that are more functional. My routers are equipped with a mix of baseplates. While some prefer routers with clear baseplates for improved visibility, I prefer using one with a large opening around the bit.

You might choose to make your baseplate clear, elliptical or compatible with standard brass guide bushings. Or all three.

Make an eccentric baseplate

If you frequently use the router with half of it hanging off the workpiece, such as when mortising for hinges or profiling edges, you'll immediately understand the benefits of an eccentric baseplate. The extended side of the baseplate provides greater registration on the workpiece and gives you increased stability. I mounted my eccentric baseplate to a fixed-base router with the extension directly below my left-hand grip. This allows excellent stability even when holding the router with my left hand.

Another version of the eccentric baseplate serves a different function. By carefully offsetting a polygon baseplate (square or otherwise), grooves of different sizes can be easily routed with a single bit. On my pentagon baseplate, with a 1/2" router bit

Edge Guide Construction

My two fences are each made from a 7-1/2 × 4-3/4 × 1/2" hardwood fence glued and screwed to a 7-1/2 × 1-3/4 × 3/4" hardwood body. Because the fence is 3" wider than the body, and the diameter of my router base is less than 6", a fence can be positioned underneath the router's base right up to the centre of the collet. The reduced thickness allows routing of thinner materials without needing to work over the edge of the bench. The fence can be reversed for larger offsets.

Two bolts passing through cross dowels in the body allow bolts to apply clamping pressure to immobilize the fence on the fence rods. If your router didn't come with metal rods, gauge the size required with drill bit shanks and order drill rod from your local metal supplier. Take measurements from your router base to find the spacing and height offset for these holes. Remember to add about 1/16" of height clearance so the fence doesn't bind under the router base.



installed in the collet, I can rout a 1/2" with one pass, and widen it by 1/32", 1/16", 3/32" or 1/8" with one additional pass.

Add an RPM chart

Most variable speed routers have a knob with a range of numbers like 1 to 6 that indicate the speed, rather than the RPM. You're left to check speed range on the motor plate to find the slowest and fastest the motor turns, then calculate what RPM speed #4 is. Make a line graph showing the speed setting and range of speeds and attach it to the router's motor so you know how fast the bit is turning.

Add an outrigger for better balance

Routing a profile along an edge is a common task, yet tricky to execute well – especially on outside corners where the router is least supported. An outrigger works with a pair of metal fence

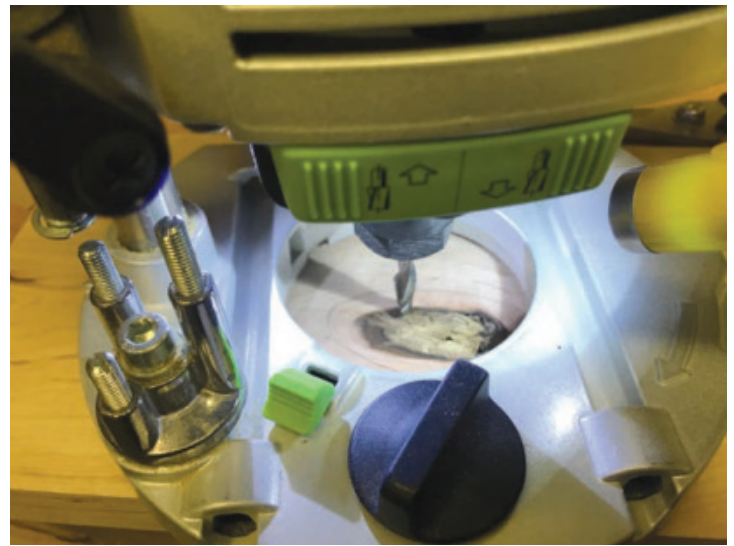


How Fast? – Printing off a simple chart showing bit RPM will help you choose the right speed for the many different operations a router will assist you with.

rods and provides a place to put weight on the workpiece to ensure the router doesn't tip like a catamaran.

Add dust collection

Removing dust at the source can increase visibility and reduce health and safety risks, too. Many manufacturers offer dust collection attachments for their routers, although they may not be included. Consider making a dust collection attachment that clamps or bolts to the router and positions suction right where it's needed.



Shed Some Light – Regular shop lighting is enough for most situations, but when working accurately and directly in the shadow of your router, a bit of extra light goes a long way to allowing you to see what you're doing.



Some Added Support – Wong added an eccentric base to one of his fixed-base routers to give him extra support while routing near the edge of a workpiece. It's easy to make an eccentric base with some 3/8" plywood or plastic.

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Keep it Perpendicular – Similar to the benefit an eccentric base provides, an outrigger will allow you to apply pressure to the router to keep it perfectly upright while working with the router partially off the workpiece.



Tiny Increments – Adding a bolt to the base of your depth stop rod will allow you to tweak the depth of the bit in small increments. The real magic comes when you learn how far the depth is adjusted with one complete rotation of the bolt so you can use that information to accurately fine-tune your bit depth.



Cut the Cord – Wong likes a short cord so there's no time wasted in regularly coiling up the cord. Storing power tools without cords is also simpler.

Put it in a table

A router table to a router is akin to what a table saw is to a circular saw. A router table offers a larger work surface for better support; larger, sturdier fence; increased visibility; and greater ease of manipulating all but the largest workpieces.

There are many options when it comes to design and style. Basic shop-built router tables can be built in an afternoon, while larger versions that offer more functionality will take more time and effort to build. You can also purchase a router table that's ready to accept your router so you can spend more time building furniture and less time on shop projects. This approach allows you to skip right to your next interior furniture project and skip the shop project.

Add a micro-adjust feature to the depth stop of the plunge base

Being able to micro-adjust the depth stop post on a plunge router is a great asset. If your router doesn't have this capability, add it yourself. You'll need a small coupling nut and epoxy (or a drill bit and thread tap), matching bolt and a nut.

My Milwaukee router didn't have a micro-adjustable depth stop, but when I removed the depth stop post, I found that the bottom was already drilled. I drilled the hole larger and taped threads before installing a bolt with nut to lock it in place. If you're unwilling to drill and tap threads, you could fix a coupling nut onto the end of the depth stop post with epoxy. Keep in mind that anything added to the end of the post reduces the maximum plunge depth the router is capable of, so you may wish to shorten the post as well.

To use, set the approximate depth required, then turn the bolt up or down the required amount and tighten the nut to lock it in place. Make a note of the bolt's thread pattern so you can make precise adjustments (for example, a 8-32 bolt requires 32 full turns to move an inch, so each rotation adjusts the depth of cut by 1/32").

Cut the cord

Consider shortening the cord and plugging an extension cord into the tool, rather than the tool into a wall socket. This saves the time to recoil the cord after use, and cuts down on the amount of space required to store the tool. Replacement plug ends are available at most home improvement stores and are easy to install. However, if you're not comfortable doing this type of work, contact an electrician.



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Don't be Afraid to Reach for the Router

A powerful and efficient tool in the workshop, the router can make quick work of some tedious tasks.



BY JAMES JACKSON

You never forget your first time using a router. The high-pitched whine of the motor as the bit reaches speeds of 20,000 RPM and the hypnotic spinning blade can make the tool a little bit intimidating.

My first experience was with my father's router table about 12 years ago while I was building my homemade cedar post lamp I wrote about in an earlier column. The base was made from a 1/2" thick piece of cherry and while I was content leaving the sharp angles of the wood intact, my dad suggested I round them over using the router.

I practised for a few minutes using a few scrap pieces and was amazed at how the tool effortlessly carved into the wood and created a beautiful finished edge. To this day, routers still fascinate me. They're such a useful and flexible tool capable of doing so much around the shop.

I do a lot of research and self-education via myriad talented (and not-so-talented) woodworkers and DIYers on YouTube, and they're always finding new ways to use routers. One of the most ingenious I've seen is using a router and wooden sled to flatten warped, twisted or misshapen pieces of wood instead of using a jointer. The router adds a little more precision to the process and often means less wastage compared to the larger, less flexible jointer.

My dad used this technique a few years ago to flatten the top of a piece of apple wood he turned into a serving tray. It also provided

a good reminder of just how dangerous the spinning blades can be when he accidentally sliced half an inch from the top of one of his pointer fingers while reaching for it.

Routers are also handy at making dado slots and rabbet joints. I've never tried this technique myself (and to be honest, not too long ago I thought they were called "rabbit" joints), but I can see how this powerful and accurate tool would make quick work of these projects.

Believe it or not, one of the best uses for a router I've seen is the simple yet effective flush trim bit.

As I wrote earlier this year, precision isn't exactly my strong suit when it comes to measuring or cutting wood in the shop. It's nice to know if I'm working on a project and the edges don't quite line up, I can fall back on this little trick to ensure a perfectly aligned edge.

Is it cheating? Maybe. I guess I could have used a hand plane and sandpaper to round-over the edges of my lamp or to flatten that piece of rough-sawn apple wood. And maybe I should learn to cut my dados or rabbets by hand first before moving on to the power tools.

No doubt there's an argument to be made for doing it the old-fashioned way, but with fewer people building handmade items these days, maybe reaching for the router is the lesser of two evils.

Just try to be careful when reaching for it.

JAMES JACKSON
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Illustration by Mike Del Rizzo



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Elynyd Benjamin

Craft Cabinet

Wanting a fun and playful piece for storing a wide range of crafting supplies, Benjamin built this cabinet. The main skill-builder was so she could practice her bent lamination techniques. Having said that, the hardest part of the build turned out to be the carved pieces that make up the panels in the door. Between fitting the parts to fit in the door frame, then carving all the beech sections, it was a challenge. Benjamin said after the build, “I would not have chosen beech for the panels had I known I was going to carve them!”

Turn to page 12 for more quotes.

