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ISSUE #136
FEBRUARY/MARCH 2022

CANADIAN Woodworking & HOME IMPROVEMENT

TOP 10
Ways to Add Value to Your Home
p.10

Craft a Mission-Style Night Table

3D PRINTERS p.45
Do They Have a Place in Your Workshop?

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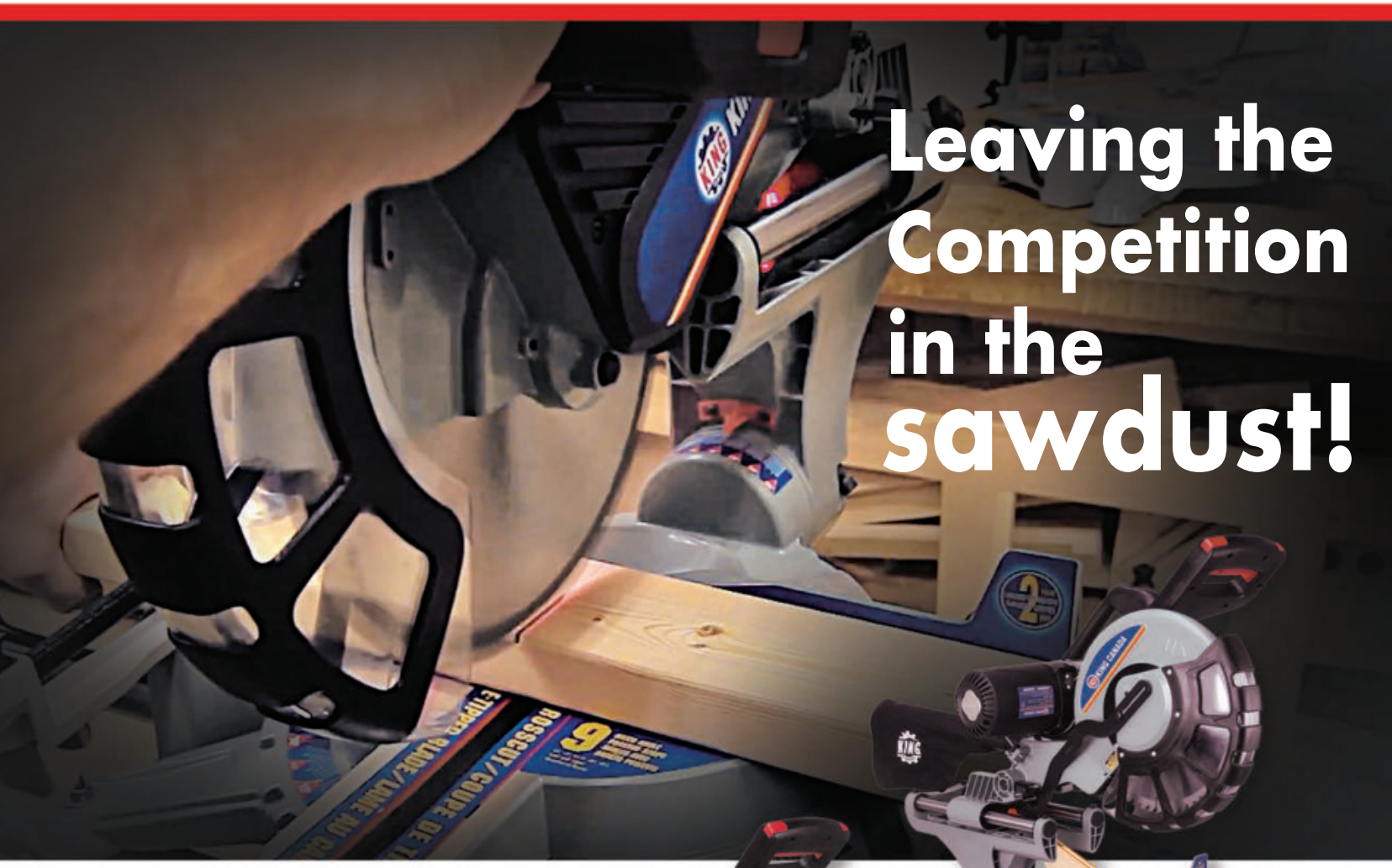

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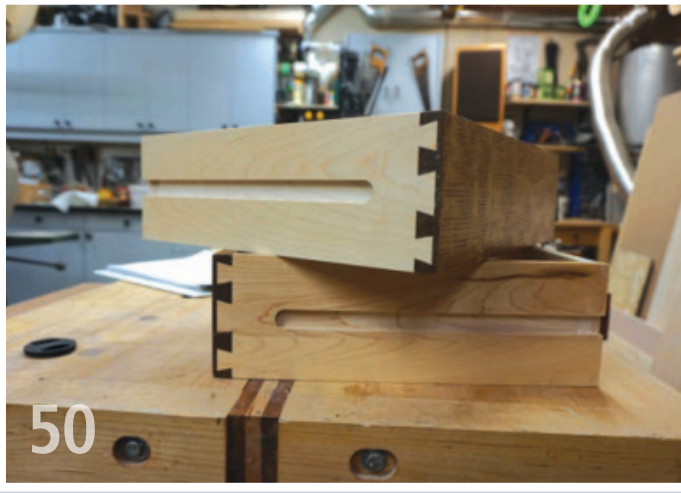
Cover photo by Randy Gillard



editor's letter

rbrown@canadianwoodworking.com

Over the past few issues, we've included a lot of relatively easy projects, dating from our Aug/Sept issue with simple projects for the summer months to our recent Dec/Jan issue with projects that would make great gifts. We haven't included many advanced projects, but this issue is going to change that. I have four projects lined up that aren't going to be made in one weekend: two interior furniture projects and two home improvement projects.

Our cover story is about making a Mission-style night table. It isn't a large project, yet it does have a lot of parts, and is great for enhancing your skills while working in a small shop. We have other Mission-style projects in our back catalogue, available online to subscribers, so if you like these night tables, be sure to check those out, too. The feature on the black cherry dining table is the opposite; the table doesn't have many parts, but physically it's a fairly large project. A table like this would be at home in just about any setting. On the home improvement side, the bathroom vanity we include has information on how it can be adapted to suit the space you have, so you can create a furniture-quality fixture for your home. Lastly, the interior door project will leave you with a custom look that will turn heads.

Even if you don't plan to build any of these projects, I'm sure reading through these articles will give you lots to think about in terms of construction techniques and inspiration. These projects include tips on working with curved parts and thick material, intricate angles and quarter sawn oak, to name a few. File these ideas away, as you can use these tips on other projects.

As always, don't be shy. I enjoy receiving photos of projects our readers make, especially if they're projects you read about in our magazine. They don't have to be works of art. Even if one of these projects is your very first try at woodworking, I'd love to see it.

— Rob Brown

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CANADIAN Woodworking & HOME IMPROVEMENT

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letters

Great back catalogue

Just read your article on sandpaper (Feb/Mar 2017) online and saw it was published prior to when I subscribed to your magazine. Having a subscription provides an example of the benefits of being able to access back issues. Thank you. While the summer is the time to enjoy working in my garage, the winter will be the time to sit at my desk, read, research, catch up on resource info and prepare for the following summer.

Thanks!
Ralph
Via email

Hi Ralph,
Thanks for your email. Once you read about proper sanding techniques, I'm sure you'll be considering what finish to apply. We have quite a few finishing articles in our digital library, and as a subscriber they're all available to you at any time for viewing or downloading — https://secure.canadianwoodworking.com/MyAccount/login. Finishing might not be the most enjoyable part of woodworking for many of us, but it's certainly one of the most crucial, and often overlooked, parts.

Happy woodworking! — Carl Duguay, Digital Editor

No "Kids' Corner" please

Please don't start "Kids' Corner" as floated in your "Editor's Letter" of the Jan/Dec issue. Adding articles by kids or for kids will displace the type of content I'm interested in. If I wanted ideas from kids, I would ask my kids or grandkids. My subscription, started during the pandemic, is hanging by a thread.

Mike B.
Ottawa, Ont.

Hi Mike,
Thanks for your message. It's always helpful to hear from readers, whether or not they like what we're doing.

I can appreciate your stance. I wish I had enough space to run this new column for kids, as well as at least one or two intermediate and advanced projects in each issue, and still have enough room for beginner projects, skill-building articles and all of our other columns. In fact, it's the more advanced projects that I like editing and including the most, but I can't always fit them in. We also adjust the types of projects we run in each issue, depending on the time of year. For example, the current Dec/Jan issue has projects that could be built as Christmas presents for friends and family. In our Aug/Sept issue we include many simpler projects, as many woodworkers are too busy with travel, cottages, etc. to get into more advanced projects. For this Feb/Mar issue we have a few large, serious projects, such as a black cherry dining table with an X-base and a set of Mission bedside tables in quarter sawn oak. Both of these projects are great for winter, when there's not much else going on.

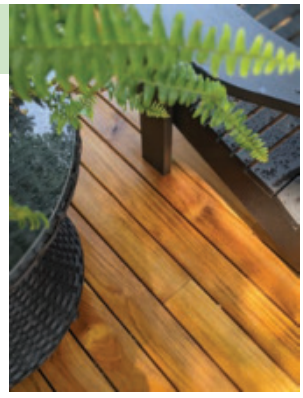
My current plan is to run a short "Kids' Corner" in every other issue or so. The first column was a fairly simple project, but other columns may also include projects that are a bit complex. We're trying to let young readers know there is a spot for them to work wood, and even write about it, in order to encourage them to take up this great hobby. I'm also hoping more experienced woodworkers can find the joy in making a simple project, as they can work quickly and smoothly, and have a great little project completed in a short amount of time.

I would encourage you to look at our back catalogue of projects on our website, as there are many intermediate- and advanced-level projects you could build if you don't see anything in our current issue.

It's always a tricky balancing act to make every subscriber happy with every issue, but I hope over the course of a year to provide every subscriber with at least a few projects they would like to build, as well as a host of other woodworking-related articles they can learn from. I hope you stick with us, as we hope to provide you with some great projects, as well as a Canadian perspective on woodworking.
— Rob Brown, Editor

shopnotes

Sustainable Teak By Mys-TEAK



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Tool Reviews

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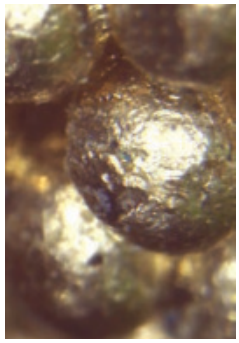
Product Watch

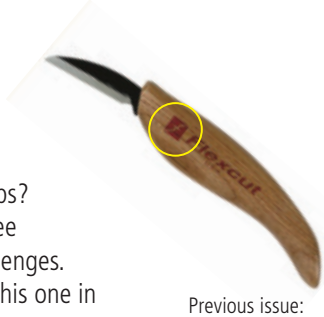
Double Taper Sanding Disc

This is a unique sanding accessory that recently caught our attention. It consists of a precision machined aircraft grade aluminum sanding disc with 2° tapers on both sides to which PSA backed sanding discs are applied. Installed on any table saw it creates perfect 90° edges (or any other angle) for your woodworking projects. It leaves a surface that will improve glue-ups and is ready for finishing. It sands off saw marks, jointer or planer ripples, and leaves a glassy smooth surface. It also helps reduce the visibility of glue lines when glueing boards together by creating a perfect 90° edge with no texture allowing the two pieces to mate closer together. Comes with two 80 grit and two 120 grit PSA backed sanding discs. **MikeFarrington.com**



Micro Mystery

Can you guess this object commonly found in most shops? Follow us on Instagram to see regular "Micro Mystery" challenges. We will post the answer to this one in our April/May issue.



Previous issue: Flexcut logo

Video Links

canadianwoodworking.com/**videos**

Canadian Quotes – Nick Barna

Rob Cosman's Dovetail Joint – 7 Mistakes to Avoid

Best Build

Check out the **Woodworking** section of our forum for our latest "Best Build" thread – a bookshelf. This month's winner, Craig Kosonen, wins a **Veritas Grinder Tool Rest** from Lee Valley.

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

Forum Thread

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

- **How To Enlarge Closet Door Opening (Structural Framing)?** – By taking a look in your attic and basement you can get clues as to how your house was made, and whether or not a wall is supporting weight, so you can modify it properly.
- **Cabinet Add-On – Material?** – One of our forum members wanted to add a few shelves under the overhang of a kitchen island, but wasn't sure what material would be best for the job. Our members gave him some good ideas.

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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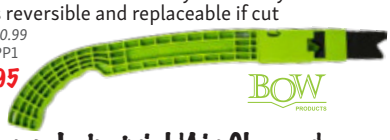

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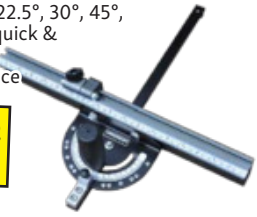

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Battery-Powered Generators

While portable battery-powered generators (BPGs) deliver less power than fuel-powered generators and for much shorter periods of time, they do have distinct advantages. They are more compact in size and lighter in weight than fuel-powered generators, don't produce noxious fumes and are super quiet when operated. They aren't an option when it comes to powering an entire house, but they are admirably suited when you need to keep the basics going during an emergency, or for off-grid events at the beach, cottage, camping or at the park. There is a bewildering array of BPGs on the market. Though most are quite compact, you can get models as small as smartphones that fit into a jacket pocket or backpack, and some as large as fuel-powered generators.

There are three important factors to consider when buying a BPG. Peak (surge or starting) watts is the wattage needed to get the appliance running, running watts is the wattage you need to keep it running, and watt hours is the total amount of energy available for you to use. The higher these rates are, the more expensive the generator is likely to be. Most BPGs can be charged three ways: plugged into a 110/120V wall outlet; plugged into a vehicle's 12V outlet; or connected to a solar panel. Expect any of these methods to take from half to a full day to fully charge your generator. Some BPGs have internal batteries, while others rely on external batteries that you may be able to use with other power tools.

Price: $100 to $7,400
Peak watts: 200 to 5,000
Running watts: 150 to 3,000
Watt hours: 72 to 6,000
Average (or common) run times: mini fridge (17 hrs); electric grill (50 mins); smartphone (50+ charges); coffee maker (88 minutes)
Battery: 18V to 56V
Weight: 1-1/2 to 100 pounds

Photos by Rob Brown Illustration by Len Churchill

Get the Most Out of Your **Generator**

Know what you need

Make sure the BPG you purchase meets your anticipated power needs. Most manufacturers provide a list of how long you can expect to power various devices. When in doubt, err on getting a more powerful battery, as you never know what the future will hold.

Charge up

Keep the batteries fully charged so you'll be ready to use the generator at a moment's notice. For extra convenience and security, keep a spare set of charged batteries on hand as well. A blackout can come at any time, and once it does it's too late to charge the battery.

Use it

Make sure you read the fine print. Some generators with internal batteries must be used and the batteries recharged on a specified basis (for example, once every six months) to preserve the lifespan of the battery packs. Even if you just run down the charge then recharge it, that might be enough to maintain proper performance.

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toptenTop 10

Ways to add Value to your Home

Simple renovations any DIYer can undertake to improve the resale value of their home and also make it more cozy, attractive and efficient to live in.

BY CARL DUGUAY

1 Give the outside of your home a facial and manicure – First impressions count. Making your home look attractive on the outside sets the initial feeling visitors and buyers will carry into the house. Power wash the exterior every spring and fall, including the driveway, walkways, deck and walls. Flush out the gutters, wash the windows and trim overgrown shrubs. Guests and potential buyers enter through the front door, so make sure it's clean, bright and attractive.

2 Make the outdoors inviting – You don't want the space around your home to look like a jungle (or a dump). To make it look inviting and complement the house, consider adding a small patio, firepit or barbecue center with table and seating. Install a simple fountain with recirculating pump or plant a flower garden using the convenient and inexpensive raised bed kits available from garden centers and hardware stores.

3 Insulate and seal – Top up the insulation in ceilings, crawl spaces, attics and basements. Apply an insulating sealant around the usual places – windows, doors, receptacles and plugs – as well as the less obvious places – plumbing vents, junction boxes, wiring access holes, behind knee walls, rim joists and attic access doors.

4 Give the inside some colour – One of the most repeated tips from realtors is to add a fresh coat of paint to the major rooms – kitchen, living room, dining room, bathroom and master bedroom. Choose contrasting colours for walls, ceiling and trim work that complement your furnishings and cabinetry.

5 Give tired kitchen cupboards a facelift – If you have older kitchen cabinets that are outdated or looking the worse for wear, consider replacing the cabinet doors and door handles, and repainting the cabinet sides and fronts. It's significantly less expensive than a full cabinet replacement.

Photo by Worx (40V Power Share Hydroshot Power Cleaner)

6 Spruce up the bathroom – Replace a stained toilet or sink. Install new towel racks and toilet paper holder. Replace an older incandescent light fixture with a newer LED unit. A common complaint made to real estate agents is loud bathroom exhaust fans, so choose one with a Sone (noise) rating of 1.5 or less.

7 Brighten up the kitchen – People spend a lot of time in the kitchen – make yours warm and inviting. Replace an old sink or leaky faucet. Update existing ceiling fixtures with energy-efficient, smart lights and add some under-cabinet LED tape lighting. Install a good quality peel-and-stick backsplash.

8 Replace faceplates and wall switch covers – If your electrical faceplates are cracked, stained or off-colour, replace them with more elegant wooden, ceramic or metal plates.

9 Embellish the garage or unfinished basement – You can spend a lot of money finishing a basement or garage. Or you can spruce it up with a few cosmetic enhancements. Install some inexpensive storage shelving. Paint the wall and floor or install square foam floor mats. If either room lacks lighting, add some by installing LED string lights. You can run several strings of lights from a single electrical receptacle.

10 Pare down – Paring down (decluttering) what you don't need is a cathartic (and in my experience quite enjoyable) process. If you're getting ready to sell your home, it's even more important; you want to showcase your home, not your belongings. Decluttering and cleaning were top-of-mind for every realtor I spoke to. Do it for every room and closet.

CARL DUGUAY
cduguay@canadianwoodworking.com

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Nick Barna

…on Scandinavian design, growing his business and being pragmatic.

BY ROB BROWN

NB Easy Chair – The back legs of this white ash chair are partially turned on the lathe, then steam bent and shaped on the router table. The seat and back are vacuum formed with veneers in two parts each. Fitting the arms to the angled and curved back legs was especially tricky with this piece.

How long have you been building furniture?
I started making very simple things for myself as soon as I had my own apartment. I didn't have any money for furniture. It wasn't until more than 10 years later, in 2009, that I started taking commissions from friends. I bought a table saw and combination jointer-planer and didn't look back.

What sort of furniture do you specialize in?
Clean, functional, modern wood furniture and fine cabinetry with a lot of solid wood details.

If you were not a furniture maker, what would you be?
A Buddhist hermit.

In order, what are the three most important items in your shop apron?
I think the three most indispensable items I always have in my apron are a Blackwing 602 pencil, my 6" Starrett square and a 16' tape measure.

Do you prefer hand tools or power tools?
I'm not an "either or" type of guy. I'm pragmatic. I like quality tools that do their job well. In my shop we have a MiniMax panel saw and Japanese hand planes. A wide range of tools gives you more options to get a particular task accomplished well.

Solid wood or veneer?
Again, each has a place in my shop. I do a lot of pieces in solid wood with traditional joinery and no fasteners. I also do pieces that rely on veneered parts to even be possible to construct in a lasting way.

Favourite wood?
I don't have a personal favourite. I do like certain woods for certain types of pieces: chairs in ash or oak; casework in walnut; tables in maple.

Photos by Nick Barna

Nick Barna, 42, AtelierNickBarna.com
Location & size of studio – Chelsea, Que., 1,600 square feet
Education – I have a BFA (Bachelor of Fine Arts) from the Maryland Institute College of Art, where I majored in fine art.

quotes

Harris Console Table – Grain graphics play a large role in this simple yet stylish white oak table. The drawer fronts are cut from a single piece of straight-grained wood and the grain of the base rail curves to follow the curve cut into its lower edge. Although you can't see it in the photo, the grain in the case is continuous.

In the past six months I have moved my shop from an 850 square-foot home studio to a 1,600 square-foot commercial space. I have also grown my staff from one craftsman and one part-time assistant to three full-time craftsmen. That means there is a lot of work going on in a space that size! We're a tight team and we help each other out a lot.

I have a special fondness for Japanese tools - especially the hand planes and saws. A panel saw is also an incredible tool that has made a big difference in my shop.

I'm a pretty decent craftsman, but my true passion is in design. I always get excited to design a new piece. I draw inspiration from everywhere. You never know what the stroke of inspiration or the small detail might be that can really bring a piece to life. Of course, there are certain styles and types that I often go back to: mid-century Scandinavian furniture (Hans Werner, Borge Mogensen, Alvo Aalto); Italian modernists (Carlo Mollino, Geo Ponti); the Japanese woodworking tradition; Shaker furniture; and even Chinese antique pieces all continue to inspire me.

I want every piece to be something to be proud of – from the making to the owning. That means each piece is well designed - pleasing and functional, well made from good materials, and durable enough to give a lifetime of happy use. I tell my clients, "These are the pieces of furniture that your children will want to inherit."

All my designs come from a certain need. Usually, it's a request from a client, but sometimes it's something I want to do for myself. I need for there to be that problem-solving aspect to it or I have a hard time figuring out what to do. Sometimes an idea comes right away, but some of the most interesting designs have come when the client doesn't like the first ideas. Sometimes it takes five or six drafts to get to that one that hits the mark. Most of the process is in my head. I will percolate on an idea for a few days and then draw it out in SketchUp. Then I figure out how to make it. Some pieces, like chairs, are more difficult and require full-size drawings, mock-ups and a lot of trial and error.

Don't be afraid to try new things. You have to go for it with ideas that you don't know how to make work to find something that is really outstanding.

I have no time or respect for copycats. It's a very real and sad problem in furniture making. I'm not talking about making a piece for yourself as a hobby but passing off other peoples' designs as your own work.

Woodworking can take a while for people to become proficient at. It's a skill that is so tied to patience.

I have been lucky to work in museums and get to see and handle some incredible pieces of furniture. I can remember seeing a few pieces by Jere Osgood that just blew my mind. The world is full of amazing pieces if you go looking for them.

In the world of woodworking, you have to do good work, be kind to people and learn how to do business, too.

Recently I had the opportunity to make a beautiful credenza – one of my very first designs – for the Canadian Mission to the United Nations in New York.

ROB BROWN
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INFO: DIFFICULTY – **3/5,** LENGTH/TIME – **3/5,** COST – **4/5**

Build an X-Base Dining Table

A dining table is the centerpiece for many great family moments. Building your own dining table can make those special moments even greater. This classic, refined design is a minimalistic approach to what can often be a complex project.

Photos by Rob Brown Illustration by Len Churchill

BY ROB BROWN

With its fairly simple lines, and little visual and physical clutter underneath to allow for plenty of legroom, this table has a simple, refined overall look. The black cherry's rich colour and grain are two of the table's strongest features.

X marks the spot (to start)

I drew a full-size layout on a large piece of paper so I could be sure of the angles and dimensions. The base sections each had to be wide enough to give the width of the table stability.

I began by milling the material for the leg sections to final thickness, then ripping the parts to final width. I left the main cross pieces long at this point, as I was just going to trim them to length after they were assembled.

Taking the angles from my drawing, I adjusted my miter gauge and installed a dado set in my table saw. After a few adjustments to dial in the half lap joint connecting the two cross pieces, I removed the waste from each joint. I was able to remove this material from all the cross pieces with the same miter gauge setup. I marked lines on the workpieces, and cut directly to those lines, checking frequently against the mating piece as I got close. To ensure gaps weren't created after the fact, I sanded the sides of the cross pieces before ensuring a perfect fit.

With the half lap joints dry assembled there was no movement between the pieces. I clamped them to a work surface with their upper ends overhanging the surface, then used a track saw to trim them to final length. I still left the bottom ends of the legs long at this point. I was now ready to fit the horizontal braces and cut the joinery to secure them in place.

Top rails and open-ended mortises

The first thing to do is to cut these two rails to size and miter their ends to fit perfectly against the top sides of the cross pieces. Ensure the upper edges of the top rails are flush with the ends of the cross pieces. With no gaps between the parts, it's time to create the mortises to accept the floating tenons.

There are several options for creating the mortises. A router, equipped with an edge guide and straight bit, could be used. A horizontal mortising machine is another option. Even a table saw and dado blade could be used, though the parts would have to be carefully secured during the cuts. I have a Festool Domino XL so I opted for that route. It created aligned mortises in all the parts with relative ease. Multiple cuts needed to be made to create the wide mortises, but that was an easy operation with the Domino.

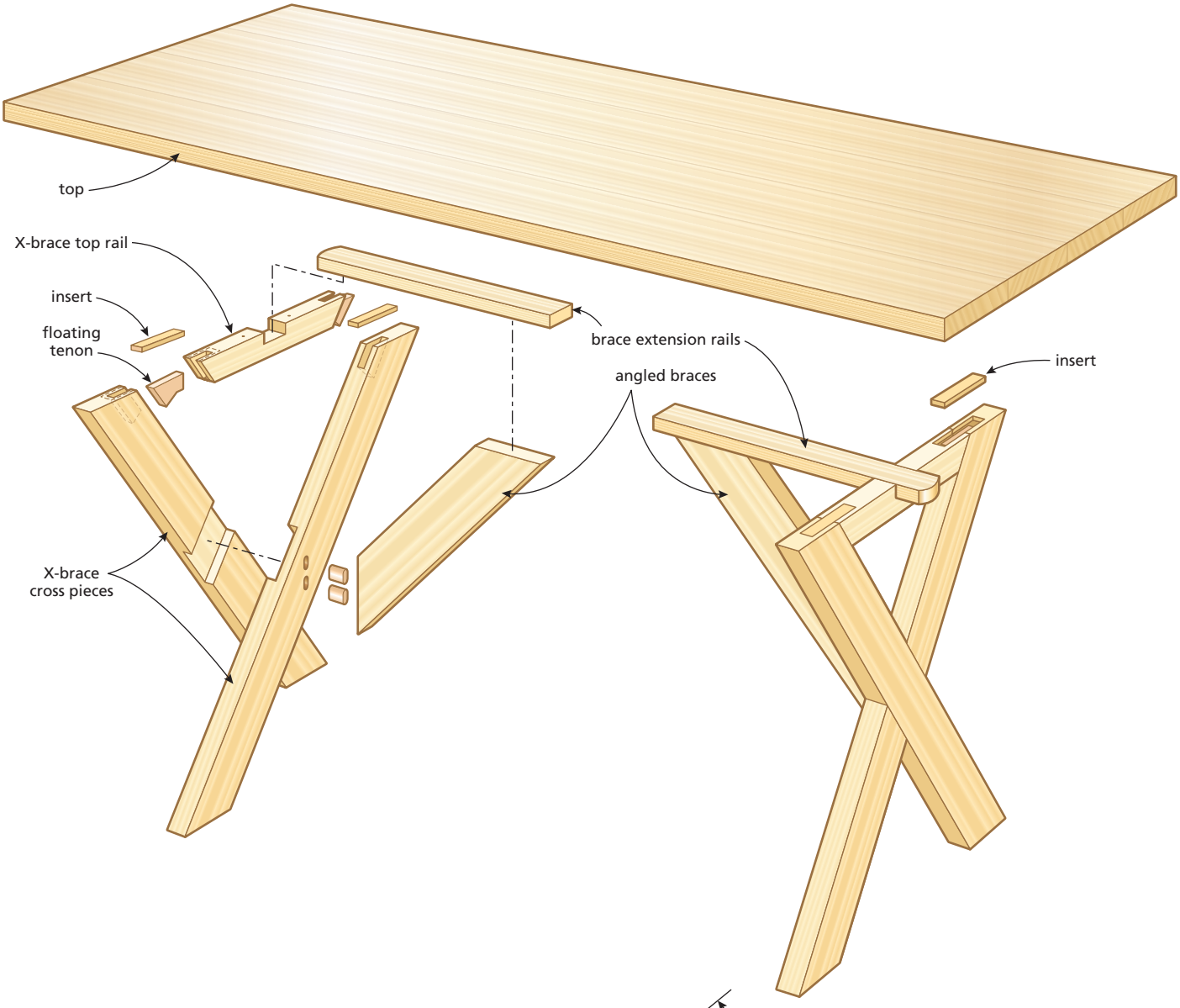
The tricky thing about the joints that secure the top rails to the cross pieces is that because the cross pieces go together with a half lap joint, there's no option for a standard closed mortise and tenon joint between the cross pieces and the top rails. You just won't be able to assemble it. This is why I used mortises that were open at the top of each base, sub-assembly.

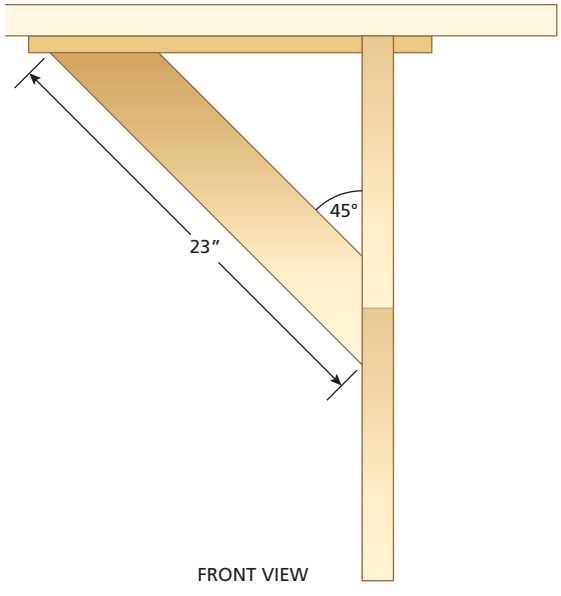
I lined the mating parts up, marked where the mortises needed to be positioned, then adjusted my Domino to make the plunge cuts. I ensured the mortises stayed about 1/4" away from the visible portion of the joint. When machining the mortises in the upper ends of the cross pieces I could only get the Domino cutter so close to the end of the workpiece without having it tilt during the operation. Instead of risking a loose joint I used the Domino as close to the

Full-Sized Drawing – When dealing with angles it's easier to have a full-size drawing to work toward. Here, Brown marks the half lap locations on one of the cross pieces and clearly marks the waste portion of the joint.

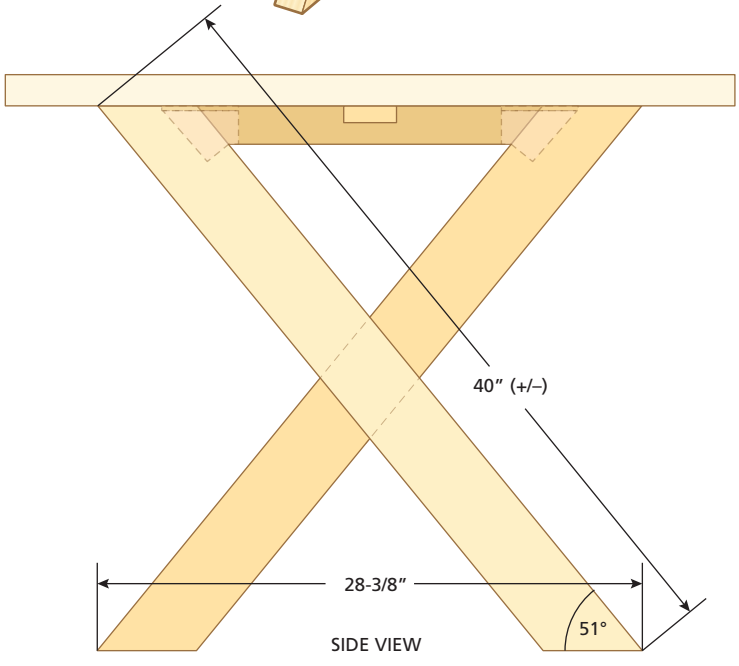
Remove the Waste – A dado blade removes wood quickly, but a standard width blade will also get the job done. Just be sure not to remove too much material or the resulting half lap joint will have gaps.

Dominos to the Rescue – There are many ways to cut this joint, but a Domino machine is one of the quickest. The remaining waste on the upper end of the cross pieces will be removed with a hand saw and chisel.





FRONT VIEW



SIDE VIEW

Materials List

Part	Qty	T	W	L	Material
Top	1	1-5/8	38	84	Black Cherry
X-Base Cross Pieces	4	1-5/8	4	~40	Black Cherry
X-Base Top Rails	2	1-5/8	2	To Fit	Black Cherry
Floating Tenons	4	5/8	To Fit	Mortises	Hardwood
Brace Extension Rails	2	7/8	2-3/4	To Fit	Black Cherry
Angled Brace	2	1-5/8	4	To Fit	Black Cherry
Inserts	4	1/4	3/4	7	Black Cherry
Table Top Cleats	4	1	1-1/4	2	Black Cherry

end as I thought was safe, then removed the remaining waste with a flush cut hand saw and chisel before using a chisel to ensure the faces of the mortises were smooth and even.

With the mortises complete I set my sights on the floating tenons, which were uniquely shaped to fit into each mortise. I dressed some solid cherry to the thickness of the mortise, then a bit of trial and error left me with a floating tenon to secure the joint. Although the thickness of these floating tenons needs to be accurately considered, the width and length don't need to fit perfectly to form a strong joint. Their strength comes from both of their faces, not their edges.

Unique Floating Tenons – Though typically straight, a floating tenon can be made to almost any shape to increase the surface area for gluing. The depths of the mortises need to be cut carefully so they're not seen on the visible side of the joint.

Each one of these joints, as well as the floating tenons, have been fine-tuned to mate with another specific part. Ensure you mark each joint so there are no problems during assembly. I added a letter to each mating part of the joint, but there are many other solutions to this challenge.

To finish off the top rails add two counter-bored screw holes to their undersides. Once assembled, the cross pieces will get in the way of being able to drill these holes. I used #12 screws to attach the top to the base sections.

Base assembly #1

Sand the edges of the parts, as you won't be able to easily gain access to them after assembly. Be sure you don't sand the edges of the half lap joint or gaps will be revealed.

With clamps and parts organized, apply glue to both faces of the half lap joints and bring the two cross pieces together with clamps. You could leave this joint to dry, then add the horizontal rail later, but if you go this route ensure the horizontal braces fit perfectly now. If the two cross pieces are glued together at even a fraction of a degree off, the top rails will not fit properly. I opted to continue with gluing the assembly, and added glue to the mortises and floating tenons, then brought the top rails into position and used light hammer taps to persuade the floating tenons into position. While doing this I ensured the top rails remained in their proper position, relative to the cross pieces, for a visually tight joint. When dry, I used my track saw to flush the upper edge of the sub-assembly, leaving the lower ends of the cross pieces long.

Create another triangle

As we know, the triangle is a strong shape, as it naturally resists racking. Although the two base sections would support a small vehicle, they would would offer little resistance to a racking force if someone leaned against the end of the table. My client wanted to keep the underside of the table as visually and physically clean as possible, so I opted for a simple angled brace attached to each base assembly.

To do this I needed to add two more parts to each base assembly. An angled brace would provide the racking protection, and a brace extension rail would keep the end of the

Dry Fit – Once the floating tenons are dry fit, mark them as well as the joint in general with a letter or number so you can be sure to assemble them the same way.

Bring It Together – Bring the half lap joint together first, then position the top rail in place and insert the floating tenons. A few clamps will tighten up the joints and ensure a bomb-proof base assembly.

Trim the Top – Take a small amount of material off in order to even out the upper edge of the base. A track saw makes the task easy, but either a router or circular saw, and a straightedge to guide it, are other options.

Remove Material – After laying out the joint and making a few kerfs with a hand saw followed by a few drilled holes, it's easy to remove most of the waste for the notch that will accept the top rail with a chisel and mallet.

Square Edges – To define one side of the notch Brown used a shop-made plywood square to guide his router. It was rotated in order to create the other side of the notch. After the edges were created, Brown removed the middle area by moving the router freehand.

Hidden Texture – Although it will rarely be seen, Brown shaped the end of the brace extension rails and added texture to it with a rotary tool.

angled brace in place for decades to come.

After marking out a notch in the top of the base assemblies (to accept the brace extension rail) I used a hand saw to make kerfs and allow me to quickly remove much of the waste. A router equipped with a straight bit was then used to machine the sides of the notch square and create a flat bottom so the brace extension rail could be glued directly to that surface. I used a simple shop-made plywood square to guide my router to produce the two sides of the notches.

I then machined the two brace extension rails to the exact size needed to fit into these notches. Although it didn't need it, I overhung the upper rail on the outer edge of each base assembly by 2", cut a visually pleasing curve onto their ends, then added texture to the end grain. This was strictly for aesthetics. At this point the brace extension rails were still oversized in length, even though one of their ends was complete.

The angled braces were then dressed to thickness and width, and a 45° miter was added to the ends that would be joined to the center of the X-base assemblies. A few Domino tenons were added to these joints to hold them in place. With Dominos inserted in the joint, and the miter on the angle bracket fitting snugly against the inside surface of the X-base assembly, I used a carpenter's square to determine where to cut the other miter on each of the cross braces so they would align properly with the brace extension rails. With the cross braces cut to size and dry fitted I could determine the length of the brace extension rails, cut them to length, add the curve and texture to their other ends and predrill a few screw holes through the brace extension rails, down into the angled brace and the X-base top rails. I also drilled screw clearance holes through the brace extension rails so screws could be driven into the underside of the table.

Prepare for final assembly

I used my table saw to trim the bottom ends of the legs to length. This could also be accomplished with a track saw, circular saw and guide, or router and guide. I also chamfered all the corners of the base with a trim router, leaving a flat surface about 3/16" wide. I finished the corners with a chisel, taking time to ensure an even look.

Next, I sanded all of the parts, as these surfaces would be hard or impossible to access once the base sections were assembled.

Base assembly #2

The final two parts of each base assembly were next to be secured into place. Thankfully, neither of the base assemblies are really that onerous. I started with gluing the Domino joints to fasten the angled brace to the cross piece assembly, then added the brace

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Invisible Joinery – Brown added two Domino tenons to secure the lower end of the angled brace to the cross piece assembly. By clamping a straightedge to the cross piece assembly and marking the joint locations on it, the mortises were created quickly and accurately. The next step involved laying out the joint on the end of the angled braces and using the Domino cutter to machine those two mortises.

Mark the Miter – With the angled brace in place, the corner of a carpenter's square was positioned at the lower edge of the notch in the base assembly. A line could then be added to the upper end of the angled brace and mitered to size.

extension rails with some glue and screws. Clamps brought everything together nicely. A 45° clamping caul temporarily clamped to the angled brace provided me with a surface for proper perpendicular clamping pressure.

Finishing the base sections

Although it was strictly for aesthetics, I wanted to add black cherry inserts on the upper edges of the base to hide any slight visual imperfections that resulted from gluing the loose tenons in place. You can skip this step if you'd like.

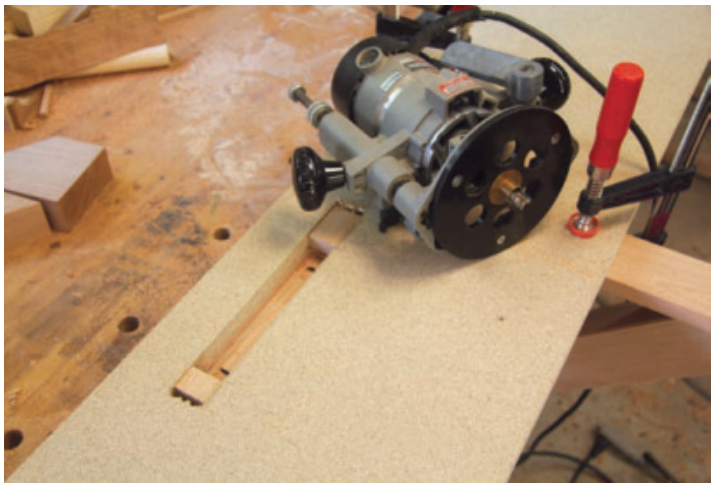
I first cut a template to act as a guide for a router equipped with template guides. With a straight bit in my router and the template guides in place, I routed two grooves into the upper edge of both base sections. After a bit of work cutting and fitting the solid inserts, I was ready to glue them in place. When dry, I used a plane to level the surface.

Nearly Ready – With the angled brace cut to size and the joinery fixing it to the cross piece assembly, the brace extension rail can be positioned in place and cut to length.

Chamfer the Edges – A router will chamfer the edges of the base before final assembly.

Take Care with the Corners – A router bit can only get so close to each of the corners, so a chisel is needed to remove the final bits of waste. Take time here to keep the chamfer lines as straight as possible, as mistakes will likely be easy to spot.

Final Assembly – The brace extension rail gets screwed in place at two locations, but the lower end of the angled brace needs to be clamped to the cross piece assembly. In order to do this, an angled caul needs to be clamped to the edge of the angled brace so clamping pressure can be applied perpendicular to the joint.



Routing Guide – Cutting a couple of kerfs in a piece of particleboard, followed by adding in two stop blocks to square up either end, makes a quick router guide to cut the shallow mortises for the inserts. The template guide attached to the base of the router follows the opening in the particleboard.

A Nice Fit – The solid inserts can be ripped to width and their four corners rounded so they fit nicely in the opening.

A Systematic Approach – First, Brown dressed the rough lumber flat and to rough thickness. He then glued up boards to make 10" wide panels and dressed them to final thickness. Here he is gluing a third 10" wide panel to the 20" wide section he initially glued up.

Solid tabletop

Making a 38" wide solid wood tabletop is easy if you have a 38" wide planer. If you're like me, and don't have that luxury, you'll need to glue up the top in stages by preparing narrower sections, then gluing them together to obtain the width you need.

I paid special attention to grain and colour when planning where the boards would go. I also alternated end grain growth ring patterns to minimize overall cupping of the finished top.

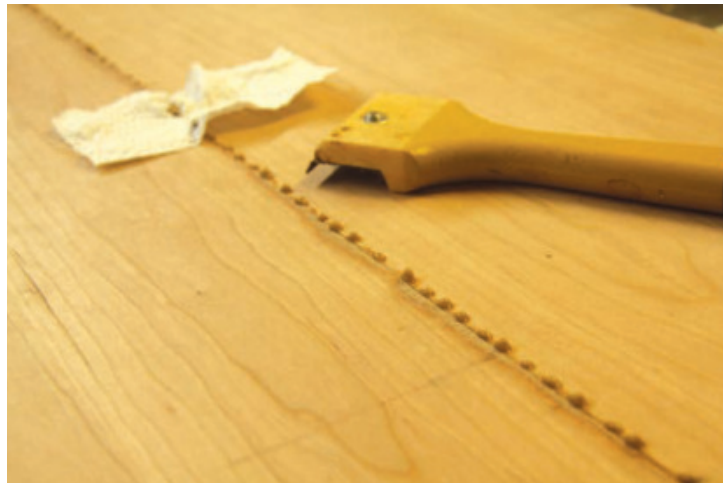
I have a 12" wide planer, so I dressed and glued lumber to form sections no more than 12" wide. When dry I was able to dress them to final thickness, true their edges for edge gluing and laminate these panels together. My approach included gluing two boards about 5" wide together, then gluing four of these sections together.

I jointed the rough lumber, dressed to within about 1/8" of the final thickness of the tabletop, ensured their edges were straight and glued them together. At this stage a perfectly aligned joint isn't mandatory, but it sure does make the process easier. The more evenly the mating boards meet, the better chance you have of success. I was able to manually align the two boards during glue-up, but adding a few dowels, biscuits, splines or Domino tenons along the length of the board will assist you during glue-up.

When the four laminations were dry, I planed them down to final thickness and straightened their edges. I glued the center two sections together, paying extra attention to keep the mating edges aligned. Cauls will help keep the dressed edges undamaged, as clamps can exert enough pressure to cause damage. I like to leave the panel to dry for just an hour or two before removing the clamps and scraping off the partially dried glue. Leaving glue squeeze-out to dry overnight makes it hard to remove cleanly.

Next, I tested the joint for the third panel, and made any necessary adjustments to ensure an even joint. Some glue on both edges of the joint and clamps meant the joint closed nicely. Once all four panels were assembled, I cut the top to size using a track saw. I then used a hand plane to remove any high spots, followed by a belt sander to leave a smooth surface.

I added a small chamfer on the top edge of the tabletop, and a low angle chamfer on the underside. There are many options for creating a pleasing edge on a tabletop, or the edge could also be left square.



Don't Wait Too Long – Leaving glue squeeze-out to only partially dry before scraping it off is a good approach. It comes off easier and cleaner when it hasn't fully cured. Waiting a couple of hours is a good timeline.

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Flatten the Top – Although he takes care to align the faces of the boards during glue-up as best as he can, Brown starts the levelling process with a hand plane, working across the grain. A belt sander with a 60-grit belt is next, followed by successively finer grits.

Attach the base

The two screw holes on each X-base top rail would house a screw that would attach the tabletop, but I wanted a bit more strength just in case. I cut a Domino mortise into the inside face of either end of both base assemblies. I made sure these mortises were in the X-base top rails of the base, rather than the top end of the leg, as the resulting short grain in the leg would have been too weak. I then made four cleats that would help fix the tabletop to each base section.

With the tabletop upside down, I positioned the base 15" in from either end of the tabletop and marked the screw locations for the

Turn it Over – Brown turns the table top upside down to secure the X-bases to the top.

Applying a Finish – There are many great options for finishing a tabletop, but Brown opted for a mixture of equal parts oil-based polyurethane, tung oil and boiled linseed oil. It provides a great mix of protection and grain enhancement, while it's also easy to apply.

#12 pan head screws. I was careful not to drill through the tabletop while boring the pilot holes. I then drilled pilot holes for the four cleats and screwed them in place.

To protect against rocking I installed a T-nut and leveller foot in the bottom of each of the four legs.

Finish it off

With the base sections removed from the tabletop, I made sure the entire piece was sanded and prepped for a finish. This included marking the base sections, four cleats and underside of the tabletop so I could put everything back in the same pilot holes.

When choosing a finish, weigh the pros and cons of each finish and put them up against the sort of usage the piece will get and the look you want for it. My clients didn't want a heavy film finish, but they did want a decent amount of protection from spills and wear. They also wanted to be able to still feel the grain when they ran their hand over the wood.

With this in mind, I opted for an oil / varnish mixture. Equal parts oil-based polyurethane, tung oil and boiled linseed oil were mixed and applied with a rag onto all surfaces of the table. After drying for almost two days, I gave the piece a light sand and applied another coat, and another one two days later. After each liberal application of finish, I used a clean rag to wipe all the excess off the wood's surface, leaving a light, yet protective, layer of finish. This is an easy finish to apply, and good results are almost guaranteed. Just make sure you test it on a piece of scrap wood of the same species before you commit to the entire table, as the look will be different for each species.

After a few days I used #0000 steel wool and wax to smooth the finish. I was happy with the smooth feel as well as the look.

ROB BROWN
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INFO: DIFFICULTY – **4/5,** LENGTH/TIME – **3/5,** COST – **3/5**

BUILD CUSTOM INTERIOR DOORS

Solid hardwood, coupled with a unique design and time-honoured joinery, makes for a stunning look.

Photos by Robert Zakarian Illustration by Len Churchill

BY ROBERT ZAKARIAN

Building custom doors is very rewarding. Stock interior doors are usually constructed from MDF and cardboard. Although these doors are cost efficient, they are boring in my opinion. Upgrading interior doors to solid wood not only adds value to your home but also allows you to design doors that fit the style of your home. This project will focus on a door I made for a linen closet. The door faces the staircase and provides an attractive look. This particular door is standard 80" × 18" × 1-3/8". The measurements in the materials' list are all final measurements. You would need to adjust the measurements to the size of doors you need. I'll go through the calculations which can then be extrapolated to the door size you need.

Wood selection

Poplar has a pleasing, simple wood grain, and is easy to work with, light yet durable, accepts paint well, and is cost effective. Moisture content of approximately 6% to 8% in kiln-dried poplar makes it a stable wood for this project

Choose the lumber and mark all stock for stiles and rails. Although you will increase the waste factor, it's safest to rough cut the parts long when dealing with tenons and other joints. Using the jointer and planer, work stock down to the final thickness of 1-3/8". You may be able to use 6/4 stock for this project if the stock is very straight, but just remember you will only have 1/8" extra thickness to work with. My wood mill didn't have any 6/4 so I had to use 8/4.

Once all parts have been planed down to exactly 1-3/8" thickness, cut all the stiles and rails to their final length and ensure they're square.

Rails need tenons

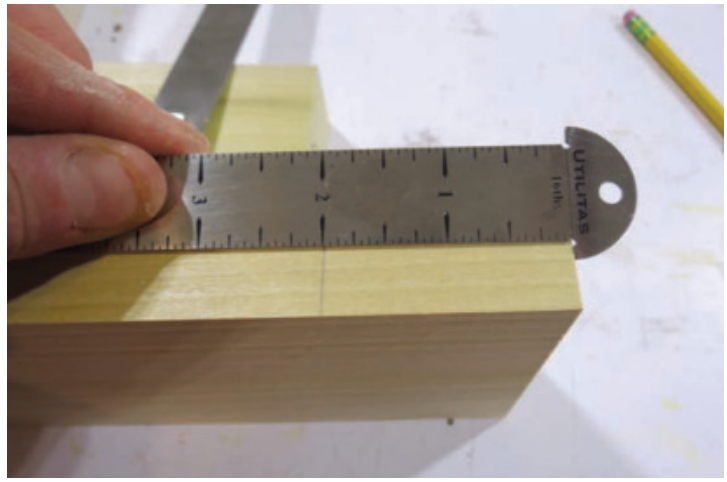
Let the fun begin. Once all the parts are cut to size, it's time to fabricate tenons on the rails. Label all parts of the door. These will be important references while machining the grooves, mortises and tenons.

I used the Freud door kit #99-268, though there are other options on the market. Freud has many door profile kits, but this particular one (Roman Ogee) is my favourite. Please follow all guidelines indicated from the manufacturer for this set and follow safety precautions for your router setup. Freud has extensive instructions that come with the set, but I will also explain some of the setup details here.

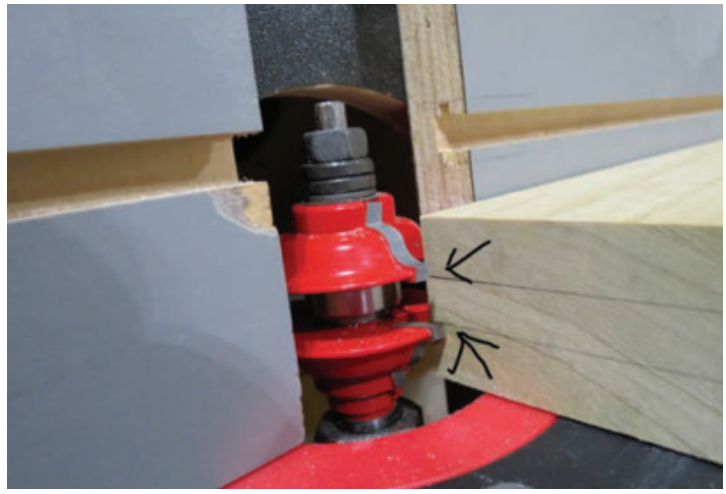
The measurements discussed here are for an 80" high × 18" wide door. Other cutters may have different dimensions, so the lengths of your rails may need to be different than mine to obtain the same dimension of door. I recommend drawing your door dimensions out full-size before starting to build it.

To determine the length of the rails, start by determining the length of the tenon for the outer rails. For strength, I want tenons half the width of the stiles, therefore 2" long. Given the door's final width is 18" and each stile is 4" wide, the formula is 18" minus 4" minus 4" equals 10". Next, add 4" (2" tenon length × 2 sides) to account for the two tenons on the ends of each rail.

The calculation to determine the lengths of the other rails (the rails other than the outer top and bottom rails) is as follows. The visible length of the short center rail is 4" and there are 1" long



Two Different Tenon Lengths – Zakarian marks the edges of the rails either 1" or 2" from their ends. These lines help him machine the tenons to the correct length. He stops moving his router table fence away from the blade when the router bit stops exactly at the pencil line. This tenon will be for one of the outer joints, as it will be 2" long.



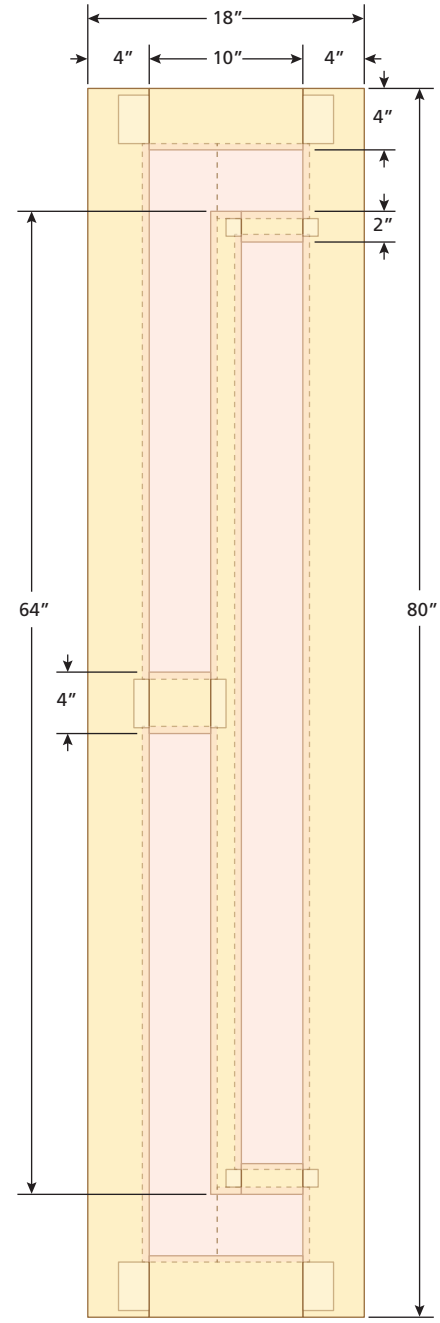
Center the Bit – The router bit to cut the tenons needs to be set up so it's centered on the stock.

tenons on each side of this rail. Therefore, 4" plus 1" plus 1" equals 6". You're probably wondering why I went with 1" tenons here, instead of 2" tenons. These parts are less structural than the outer two rails and stiles, so less strength is needed. The lengths of the two inner rails are calculated in the same way.

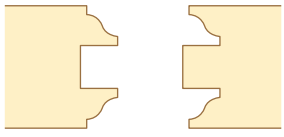
With all the rails cut to length, you can mark a tenon location line on the edges of the rails, near their ends. Add a mark 2" in from the ends of the two outer rails and 1" in from the ends of all the other rails. These lines will give you something to shoot for while machining the 1" and 2" long tenons.

Router bit setup for tenons

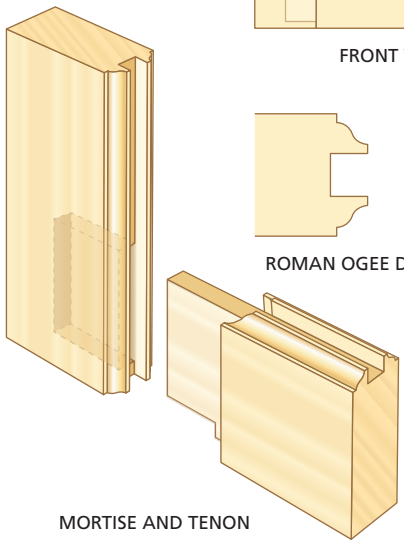
This step is the most important step in order for the tenons to fit perfectly in the mortises and for the parts to be the correct length and produce a door that's sized properly. First and foremost, make sure your stock is exactly 1-3/8" thick. Any deviation from this thickness will offset the bit and your pieces will not line up to have a tight joint. Take time and care to align everything properly



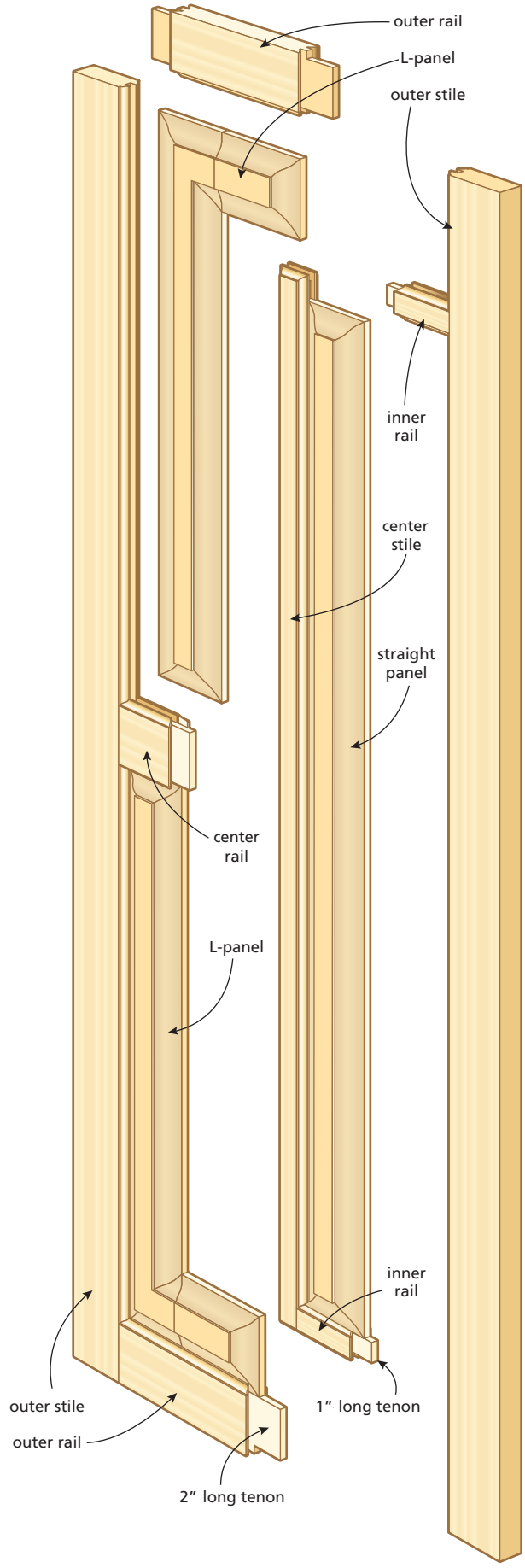
FRONT VIEW



ROMAN OGEE DOOR PROFILE



MORTISE AND TENON



Materials List

Part	Qty	T	W	L	Material
Outer Stiles	2	1-3/8	4	80	Poplar
Outer Rails	2	1-3/8	4	14	Poplar
Center Stile	1	1-3/8	2	64	Poplar
Center Rail	1	1-3/8	4	6	Poplar
Inner Rails	2	1-3/8	2	6	Poplar
Straight Panel	1	1-3/8	4-7/8	60-7/8	Poplar
L-Panels	2	1-3/8	10-7/8 / 4-7/8	34-7/8	Poplar

and use test pieces to test the cut before machining the actual rail.

Usually mortises are machined first, then the tenons are machined and fine-tuned to fit the mortises, but that's not how I made these doors. Because I used a hollow mortiser to create the mortises, the width of the mortise was set in stone. I made a test mortise so I could double check that the tenons I was making fit the mortise perfectly.

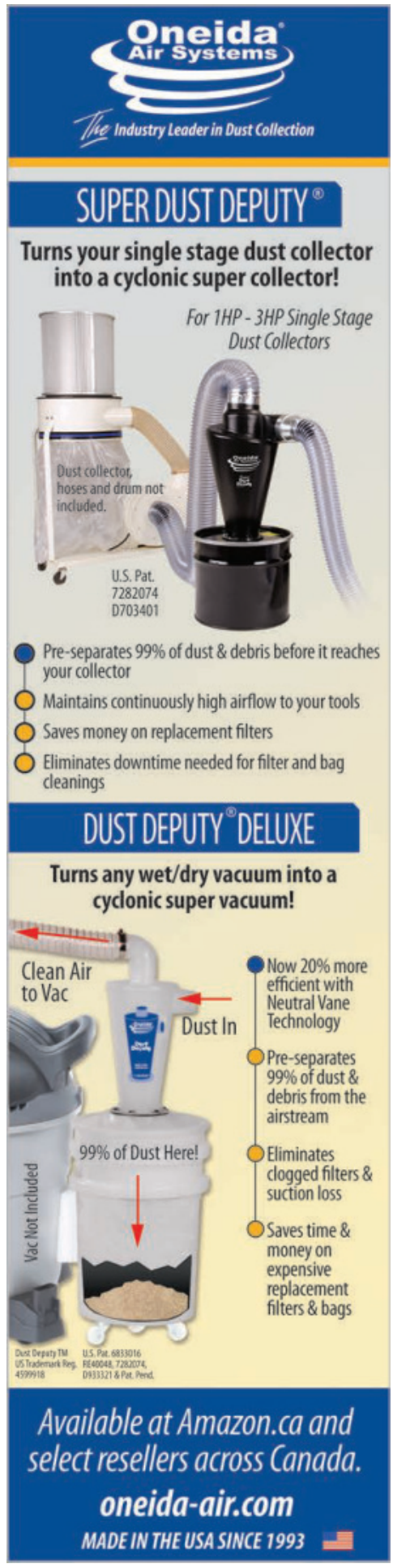
Start with some scrap

On the end grain of a piece of scrap wood, mark a line 1/2" from the top face and 1/2" from the bottom face. The material between these two lines is the thickness of the 3/8" thick tenon. Set up the tenon cutter from the kit #99-268 so the lower cutter is below the lower half of the 3/8" mark and the top above the top of the 3/8" line. If the stock is exactly 1-3/8" your tenon will be exactly dead center on that board. If the board is not exactly 1-3/8" you will need to adjust the cutter up or down to locate the tenon dead center.

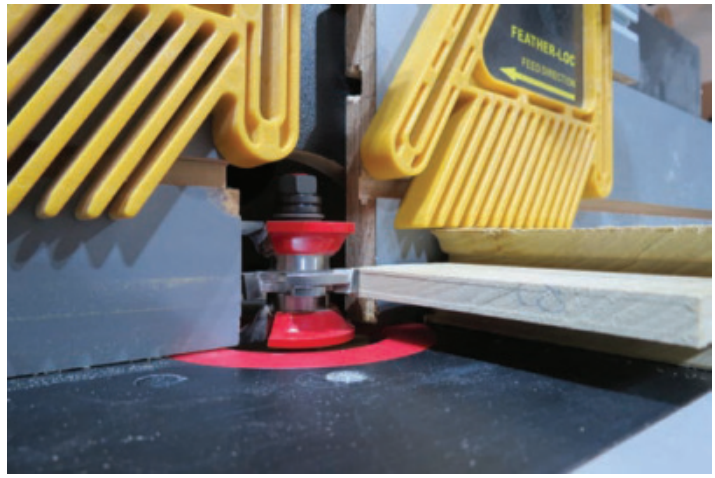
Set up your featherboard on your router table's fence, and run a piece of scrap through, making sure downward pressure is applied equally as the cut is made. After the test cut, ensure the tenon is centered on the stock. If there is a discrepancy, readjust your bit up or down to center the tenon. Keep your final scrap test piece, as this will be used to align your stile cutter later on.

Once you're satisfied with the adjustment, you can start to machine the tenons. They will all be controlled by a miter gauge while they pass over the rotating bit. To make both the 1" long and 2" long tenons, the top half of the cutter needs to be separated from the bottom half. Do not adjust the height. Move the fence away from the cutter and remove the top portion of the cutter as per the manufacturer's instructions. These cuts will be done in many small increments by moving the fence back

Test Cut – A test cut will help determine if the bit height is set properly. Zakarian is making a test cut now, but will remove the upper half of this cutter when making the tenon joints on his door.



Long Tenons – With the height set accurately, Zakarian removes the upper portion of the bit. This will allow him to move the fence away from the blade far enough so tenons of any length can be cut.



Set Up for Grooves – After switching to the grooving bit, Zakarian adjusts the height to match the groove dead center on the panel's edge.

about 3/16" to 1/4" until the tenon of the desired length is reached. This is where the lines you marked on the edges of the rails come into play, as the inner portion of the cut should stop exactly at the pencil line; the router bit should never cut beyond this line.

Make sure to keep the router fence parallel to the miter gauge track as you move the fence away from the bit. It's best to start with the shortest tenons, in this case the 1" tenons. Once the 1" tenons are completed, continue the passes in the same fashion until 2" tenons are cut. With the tenons complete, you can move to the second cutter in the kit which is for making the grooves to accept the panels.

Router bit setup for the panel grooves

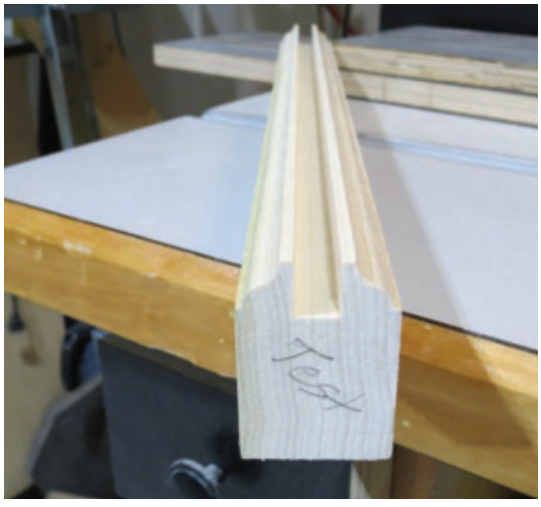
With all the tenons cut, install the groove cutter in the router. Aligning this cutter to the board is fairly simple. Align the top of the cutter with the top of the tenon and lock the router in place. Make a test cut and compare it to the tenon cuts to ensure a good fit. If the parts fit perfectly you can run all the stiles and inner portion of the rails while applying equal downward pressure while each workpiece is being machined.

Make sure to run both ends of the center stile, since it will mate with the upper and lower short rails and accept the panel at its end.

Mortise the stiles

For this step I used my hollow mortiser, however, you could also use a router equipped with a long straight router bit. Starting with the long stiles, mark where the mortises should be made.

For my door, the measurements are as follows: for the hinged stile, measure down 1/2" then mark for the width of the mortise. The 1/2" gives the tenon a shoulder to butt up against and prevents glue from dripping out. Mark the same measurement from the bottom of the stile. For the center mortise, center it on the stile. For the stile with the handle and latch, measure the same as above to



Ready for Action – With the height dialed in, the grooves to accept the panels can now be machined.

All Four Edges – Once the grooves are cut into the edges of the center stile, Zakarian machines the same groove on both of its ends. This is the only workpiece that receives a groove on its ends.

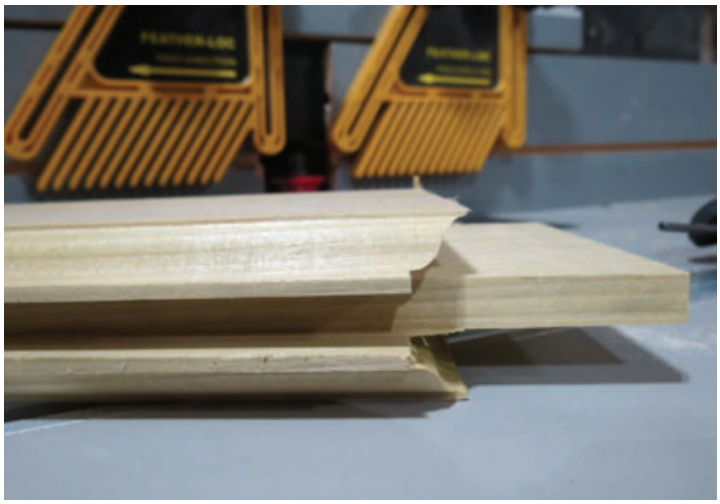
accept the upper and lower rails, then measure down 8-1/2" from the top and mark off for the mortise. Repeat this measurement for the bottom portion of the stile. For the center stile, one mortise is centered on its length, while on the other edge the two mortises are at the ends and will accept 2" wide rails.

Now that all the mortise locations are drawn out, set up the mortiser with a 3/8" chisel. Prior to hollowing out the mortise I like to predrill the mortises to remove some of the material. This technique puts less strain on the chisel and helps prevent binding. Set up the mortiser so the chisel is dead center on the board. First, center your chisel with the groove, then end-for-end the board and ensure the chisel lands in the exact same position. If it doesn't, you will need to adjust the fence front or back to get the chisel dead center. Proceed to hollow out the mortise, keeping in mind the mortises on each of the outer four corners are 2" deep, while the rest are only 1" deep.

Dry fit the frame and pre-sand

Before dry fitting the door, you will need to notch the tenons on

Coming Together – After being machined multiple times, this joint is about to be brought together for a test fit.



Freshly Grooved – With the 2" long tenons cut on both ends of this outer rail, and the groove machined into its inner edge, this workpiece is almost ready for assembly.

Remove Some Waste – To make it easier to mortise all the parts, Zakarian removes some of the waste with a drill bit.

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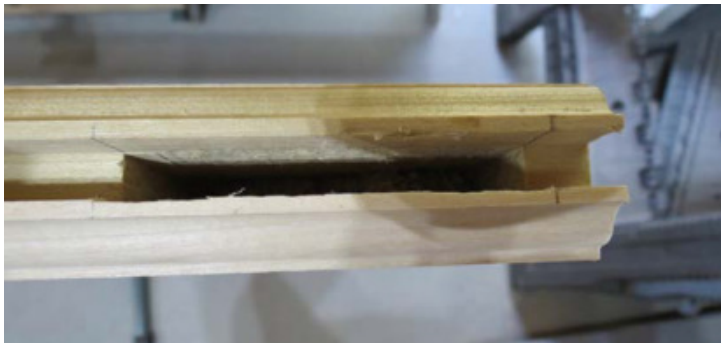
Cut Some Mortises – A hollow chisel mortiser is a good way to machine deep mortises in these workpieces, though a router or hand tools could also be used. The finished mortises are flush with the sides of the grooves.



either ends of the upper and lower outer rails because we left a 1/2" shoulder during the mortising step. On the bandsaw, cut 1/2" off the outer edge of each of the tenons. Now dry fit all the parts and tweak the mortises, if required. If prior steps were properly performed, these parts should fit together nicely with minimal force.

At this stage I usually sand with 120 grit, and make small repairs to imperfections in the wood.

Break out the panels

This door has three panel inserts. Two of them are L-shaped and one is straight. For the straight panel, cut your stock and square the panel to its final size of 4-7/8" wide by 34-7/8" long. There's a bit more work involved in the L-panels, as these parts can be a little trickier to get straight and true. Dress the main panels and the extensions to final thickness before cutting them to width and length.

There are two parts that come together to make the L-panels. Essentially, the main section is machined, then a small extension is added to one side of each of the main sections. The final dimension of the extension should be 10-7/8" wide × 4-7/8" long. For the vertical dimension (or the distance along the grain) of the extension, I crosscut the piece to its final dimension of 4-7/8" then glued this piece to the main portion. Just make sure the piece is wider than 10-7/8", as it can be trimmed to width after it's assembled. When gluing these parts together I flipped the two L-panels to face each other, making a rectangular frame. You can also add a few dowels or Dominos to assist with location. Another approach

Notched Tenons – In order for the tenons to fit around the 1/2" wide shoulder beside the mortises, you can use a bandsaw or hand saw to remove 1/2" of material on the edge of the 2" deep tenons.

to give you more flexibility if movement during glue-up occurs is to leave the main section long. That way, if the extension shifts at all during glue-up, the L-panel can still be trimmed to final size. Once the glue has set, cut the L-panels to the correct dimensions. Remember to dress and size the other rectangular panel as well.

Raise the panels

For this step I used the Freud raised panel router bit # 99-520. There are three raised panels to shape: two L-panels and the center rectangular panel. I set up the router for the center panel first. These panels are sized so a 3/8" deep tenon fits the grooves machined into the stiles and rails machined previously. Set the top of the cutter 1/2" above the table. Set up the fence so small amounts of material are removed at a time.

Using a test piece, make several passes until the bearing of the cutter is flush with the fence. Remember to alternate the passes, i.e. cut the top, then flip the board over and continue with the bottom, then move the fence back a bit. Make passes to all the straight sides on these panels first, including the external edges of the two L-panels.

Once all the straight sides are complete, remove the fence from the router table and insert a starting pin on your table. You can also clamp a piece of wood to the table to act as a starting pin if your router table doesn't accept one. This step is very important as it will allow you to slowly guide your piece into the cutter, providing support and preventing the wood from getting violently sucked into the cutter. Proceed with machining the remaining parts of the L-panels. If you're worried about removing a lot of waste with these passes you can lower the bit and make multiple passes, raising the bit each time. Just be sure to make the final pass with the bit at the proper height.

A third option to raise these panels is to first machine a few passes on the inner edges of the L-panels to remove some of the

Make Some Ls – Two of the three panels are L-shaped. Keeping them slightly oversized is a good approach, as the outer edges can be trimmed to size once the glue is dry.

material, then proceed to set the bit's final height. At that point you can machine all the straight edges, then remove the fence, install the starting pin and rout the inner edges of the L-panels.

Dry fit and adjust

Dry fit the panels in the grooves to make sure the panels fit nicely. If they're too tight you might have to repeat the

Perfect Match – Although not all the joints are glued, mating them while in the clamps can be easy.

Squared Off – The finished inside joint, ready to be sanded and assembled.

More Light Taps – A sharp chisel is mandatory for this step. After that, more light taps always trump fewer heavy taps with your mallet.

Final Assembly – After a dry fitting and sanding, it's time for some glue and clamps. Ensure the assembly is sitting flat while it dries.

process and apply a bit more downward pressure while feeding the panels through the cutters or raise the bit slightly.

The inner corner of the raised panel will need to be cleaned up using a chisel since the cutter will leave a rounded corner. To clean these four corners (two sides per panel), extend the lines and clean the waste out with hand tools. Score the lines with a chisel, then carefully cut away the excess, then clean up the corner with a scraper.

Dry fit panels and preassemble door

Sand all panels, then dry fit all parts of the door. If no adjustments are needed, glue all the rails and stiles and let them dry for 12 hours. Leave the panels free of glue, except for maybe a bit towards their centers, as this can keep the panels from shifting after assembly.

Finishing

Once the glue has set, machine the hinge mortises and the hole for the handle. Give the door a final sanding and break all the edges. I stained the door with a black water-based stain from Saman, then applied two coats of 5° water-based lacquer from Aqualux. The lacquer was sprayed using my HVLP.

The project took me about six days to complete, from start to finish. I have made many variations of this door, and although there are simpler ways to make doors, I really like the fact that these are unique and can be customized to the interior of any home. Proper layout, careful measuring and accurate machining are all good skills to have when making these doors.

ROBERT ZAKARIAN
robeben215@gmail.com

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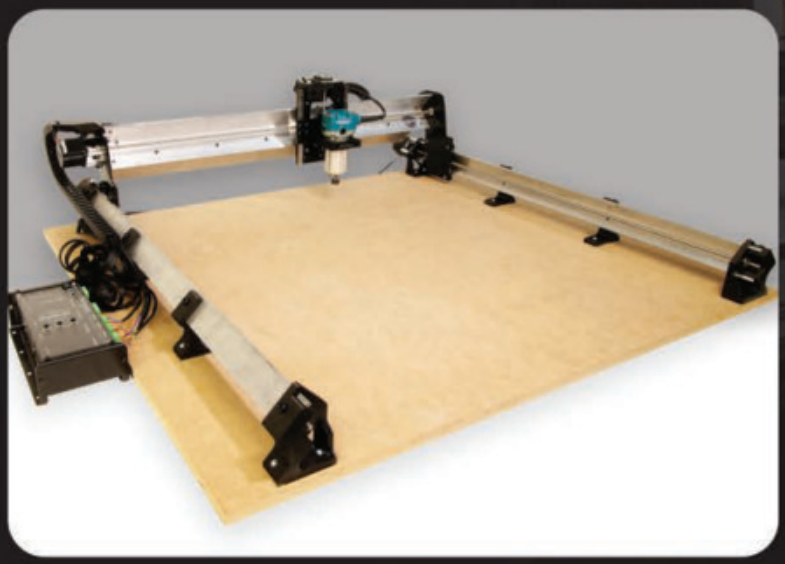

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MAKE A CUSTOM BATHROOM VANITY

Build a vanity for your bathroom that looks like a well-made piece of furniture.

Photos by Mark Salusbury Illustration by Len Churchill

BY MARK SALUSBURY

Styling cues often begin with a found object. The design for this vanity began with the basin, whose radiused corners I wanted to repeat by creating attractive, functional legs to support a furniture-like cabinet. I imagined a visual treat; best figure exposed, bookmatched panels, grain bridging across doors, and satisfying to the senses each time a door opened or drawer softly closed. Also, the counter's height, width and depth would be carefully chosen to suit the site and those who will use the sink daily.

My design makes frugal use of materials and assembles easily, creating a strong case in manageable steps. And don't let the rounded corners throw you; these are simply lathe turned. Square or chamfered corners would be simpler still and work just as well. Regardless, the legs are the foundation. I'm going to focus on a floor-standing vanity in this article, but will mention how a few adjustments can be made to create a smaller floating vanity at the end of the article.

Glue up the leg blank

To make the legs, I selected hardwood at least 2" thick, and milled four square sections long enough to trim to final length after selecting the best faces to orient outwards. If I'd designed a case with square legs, I'd move on to joinery here, but as I planned to turn the corners round, I went for a glue-up. With the two best faces of each chosen and marked, I glued the other two faces together fully along their lengths with strips of brown craft paper between, producing a square turning blank just over 4" in both dimensions. The brown paper makes it easy to separate the leg sections later.

Fully cured, a chop saw cuts the blanks' ends cleanly square. Using a compass, I drew a layout line on each end of the blank, marking the diameter I want to turn down to, then with my table saw set to rip at 45° I removed the corners tight to that line. A thin kerf blade with stabilizers not only cuts easily and smoothly, its narrow kerf maximizes useful cut-off material that will be used later.

At the lathe

A ring center will drive the blank and a cup center in the tailstock supports the blank. These circular centers ensure the blank won't be wedged apart during turning which might happen if spur and conical centers were used. Under compression, the ring center works well to drive the piece, plus if it slips, a twist of the tailstock handwheel increases compression to resume turning.

The blank gets centered on the lathe where the paper glue joints intersect. Its flat facets guide diameter and uniformity by turning and sanded only until all evidence of the facets are removed. The blank should finish uniformly with a +4" diameter end to end. Once split apart using a broad, sharp chisel tapped into the glue line from the ends, the glue and paper are carefully removed.

A note about accuracy

It's less confusing to take all measurements from one point. In the case of the corners, I reference layouts and machine setups from the inner corner of each leg. Regarding the vanity parts, all measurements are referenced from the floor elevation (bottom) of each panel.

A Few Pieces of Paper – Salusbury machined the four corner legs square, then glued them in a blank for turning with craft paper between their seams. This keeps them together while on the lathe, but makes them easy to get apart afterwards.

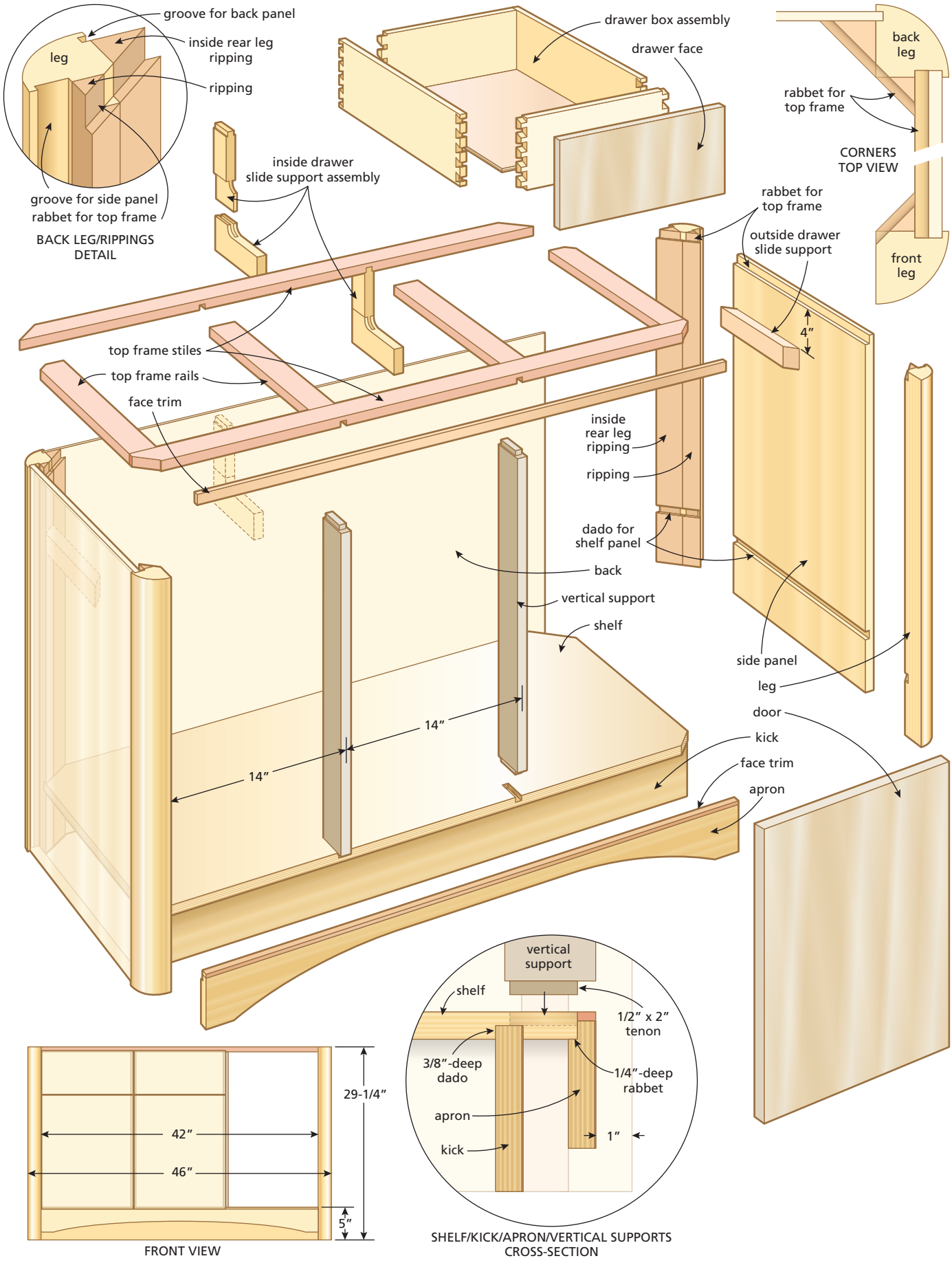
Waste Not, Want Not – Before the blank can be turned, rip each corner off and save the offcut. The offcuts can be used down the road to strengthen the leg-to-gable joint.

Grooves in the legs

Regardless whether legs are square or radiused as I've done here, the inner corner guided my next decision. Knowing the exact thickness of the plywood I'll be using for the sides and the back, and that I want a 1/4" reveal between those panels and the outer edge of their respective legs, I decide where to rout the grooves in each corner to receive the panels. At the router table, all cuts are referenced from the leg's inner corners. Ultimately, if there is any inconsistency in the plywood and/or the show faces of the legs that may need to be tweaked, doing so won't affect the accuracy of the structure.

Plywood is typically undersized; a 5/8" router bit in a table-mounted router and fence allows me to mill the +18mm grooves I need for my side panels.

At the table saw, a square profiled 1/8" thick saw blade rips the grooves for the 1/4" back panel. Off-cuts of both thicknesses of sheets goods are sanded to allow me to precisely size the width of grooves to fit the panels nicely.


groove for back panel
leg
inside rear leg ripping
ripping
groove for side panel
rabbet for top frame
BACK LEG/RIPPINGS DETAIL
drawer box assembly
drawer face
inside drawer slide support assembly
back leg
rabbet for top frame
CORNERS TOP VIEW
front leg
rabbet for top frame
outside drawer slide support
4″
top frame stiles
top frame rails
face trim
inside rear leg ripping
ripping
dado for shelf panel
back
vertical support
shelf
side panel
leg
door
kick
face trim
apron
14″
14″
29-1/4″
42″
46″
5″
FRONT VIEW
vertical support
shelf
1/2″ x 2″ tenon
3/8″-deep dado
1/4″-deep rabbet
apron
1″
kick
SHELF/KICK/APRON/VERTICAL SUPPORTS CROSS-SECTION

Materials List

Part	Qty	T	W	L	Material
Legs	4	2	2	29-1/4	Black Cherry
Rippings (triangular)	4	13/16	13/16	29-1/4	Black Cherry
Rippings (inside rear leg)	2	1-3/8	1-3/8	29-1/4	Black Cherry
Side Panels	2	3/4 or 18mm	18-3/8	29-1/4	Plywood
Back Panel	1	1/4	25	29-1/4	Plywood
Back Filler Blocks	2	1/4	1-9/16	4 1/4	Hardwood
Stiles for Top Frame	2	3/4	2	44-5/8	Hardwood
Rails for Top Frame	4	3/4	2	16	Hardwood
Bottom Shelf	1	3/4 or 18mm	20	44-5/8	Plywood
Vertical Supports	2	3/4	2-1/2	24-1/4	Black Cherry
Face Trim Strips (shelf / top frame)	2	3/4	15/32	42-1/4	Black Cherry
Apron	1	3/4 or 18mm	3-1/2	42-1/4	Plywood
Kick	1	3/4 or 18mm	4-9/16	44	Plywood
Doors	3	3/4 or 18mm	13-7/8	17-1/4	Plywood
Drawer Face	2	3/4 or 18mm	13-7/8	6-5/8	Plywood
False Front	1	3/4 or 18mm	13-7/8	6-5/8	Plywood
Inner Drawer Slide Support	4	3/4	2-3/4	6-3/4	Hardwood
Outer Drawer Slide Support	2	7/8	2	10-1/2	Hardwood
Drawer Front / Back	4	5/8	12-11/16	5-1/2	Hardwood
Drawer Sides	4	1/2	19-1/4	5-1/2	Hardwood
Drawer Bottoms	2	1/2	18-7/8	12	Plywood
Hinge Mounting Blocks	2	13/16	1-13/16	2-3/4	Hardwood

Solid Joint – The 45° rippings can be attached to the inner faces of the legs, directly beside where the gable will join the legs, offering a lot more glue surface area, and in turn a stronger joint.

Grooves milled, it's time to reapply the rippings I removed earlier, greatly increasing the glue area and simplifying construction later. These are applied perfectly flush with the inner edges of the grooves by dry fitting a prefinished (so glue won't adhere to it) scrap of the panel material within the groove and bonding each strip to the leg with a veneer of glue and a few brads, keeping the brads away from where joinery to receive the vanity's top frame and bottom shelf will be cut. Remove the groove-filler and repeat. The rippings fully cover the legs from the inner corner to the panel groove. As the grooves for the back panel are narrower than for the sides, I made two wider corner strips to achieve the same effect.

Titebond II Dark adhesive has a shorter cure time and yields a glue line that matches dark woods like the cherry I'm using.

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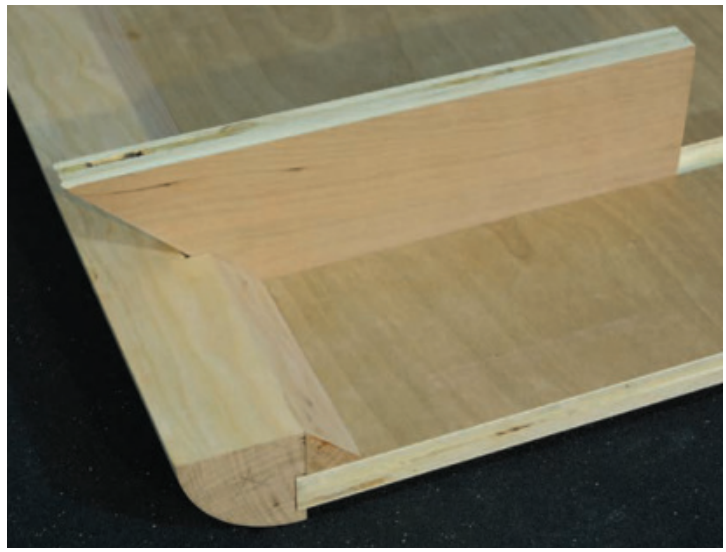
Different Legs – At left, a front leg with a freshly machined groove to accept the gable. Center, a front leg with the 45° ripping attached to it. Far right shows a rear leg with two 45° rippings glued to it.



Dadoes for the Shelf – With dadoes in the leg and gable to accept the shelf, the parts can be dry fitted. A spacer piece with a 45° angle cut into its end aligns the two workpieces.

Shelf dadoes

Cured fully, it's time to trim the legs to final length and friction-fit each leg to its respective panel. Back and sides come together for the first time…exciting! Satisfied, and taking all measurements from floor level, I mark on each part where to cut the dado for the bottom shelf and the rebate for the vanity's top. Both are the same width and easily cut at the table saw. The side panels are crosscut referencing the saw's rip fence; the legs are crosscut using a miter guide and stop block.

Top frame

Now, I reassemble the back and side parts as plumb, tight and square as possible to double-down on exact dimensions for the top frame and bottom shelf. Widths are measured from the base of the rebate and dado with a versatile shop-made bar gauge using a "Bar Gauge Head" (Lee Valley part No. 05N31.01). Depths are measured from inside the back panel to where the rebate and dado exit the inner front leg. Solid cherry trim will flesh out the leading edge of the top frame and shelf later.

At the table saw, the shelf receives its final length and width. At the miter saw, the 45° corners get removed to ease fully within the cutouts in the legs. After refinement, the shelf seats fully and snuggly within the dadoes. Nice!

Referencing the dimensions of the shelf, next make the top frame. Mill enough 3/4" × 2" stock to yield two long stiles to run the width of the case and four shorter rails to unite them front to back. I used my KREG 2000 pocket hole jig to join the parts. As the frame will be encased on three sides and covered with a solid surface counter and never subjected to stress, this is the perfect application for pocket screw joinery. The assembled frame gets trimmed and fit just like the shelf to fit snuggly within its rebate.

Glue up the legs and side panels

So far, all assembly has been dry fit for friction testing and alignment, but now it's time to glue up the legs and side panels. On a trusted perfectly flat surface, all parts get disassembled, sanded lightly, edges eased, labelled and tested again for final fit using only firm hand pressure. With a veneer of Titebond II glue applied within the leg grooves and over the applied "ripping," clamps easily draw the parts together the last millimetre while scraps of the shelf material align the shelf dado fore and aft. Once the side assemblies are cured, the back panel can be fully seated within its grooves, glued and pinned into place. Stand the assembly onto its feet to check squareness and let it cure.

The flexible back panel will easily allow the sides to splay apart when it's time to install the shelf.

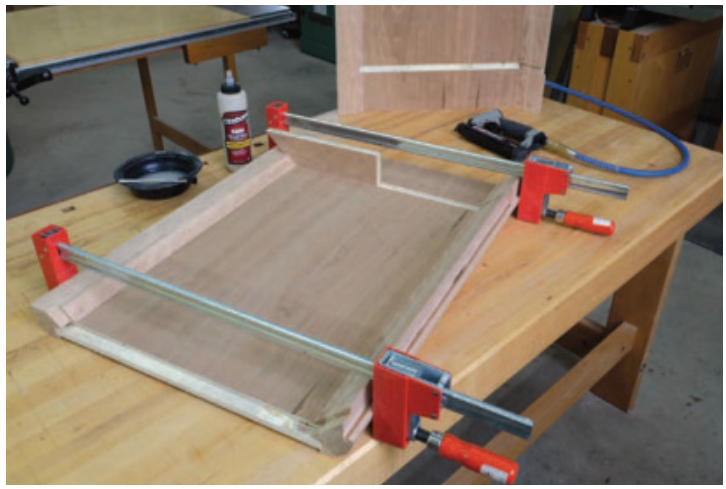
As the glue cures, cut a 3/8" deep groove to receive the kick under the bottom shelf, as well as 3/8" deep, 1/2" wide and 2" long dadoes to receive the vanity's vertical supports within the upper leading edge of the shelf. The verticals support the center of the vanity, the doors and drawer slide so strength and stability are paramount. Cut these dadoes into the shelf, but wait until the shelf is glued into place to transfer their locations and cut into the top frame to be certain the verticals will be perfectly plumb and square, and the door and drawer openings equal in width.

Install the shelf

On a perfectly flat surface, flip the case onto its back, apply glue within the side grooves and a thin bead across the bottom edge of the back panel. Deftly lower and guide the bottom shelf home. Raising the assembly up onto its feet, the top frame is simply dry fit for support and alignment during this glue-up. A few clamps front-to-back and side-to-side cinch the shelf into a snug fit as I quickly measure front and rear widths and check squareness between the shelf and sides, then the back and sides, bringing the case into square, and adjusting clamps if necessary.

With the shelf cured in place and next to the legs for greater accuracy, measure the distance between the top of the shelf and the underside of the top frame. After adding 3/4" for tenons, make the vertical dividers, forming 3/8" tenons at both ends. Stock that's 3/4" × 2-5/8" produces 1/8" side and rear tenon shoulders and a 1/2" shoulder to be located at the front. The vertical divider's faces should be flush with the leading edge of both the shelf and the top frame.

Left Assembly – This leg and gable assembly is for the left side of the vanity, as you can see the leg on the right is grooved to accept the back panel, and there's an extra 45° ripping attached to it.



Time to Assemble – While the legs and gable get brought together, the 45° piece is inserted into the dado for the shelf to ensure the parts stay in alignment. Be sure the legs mate with the gable properly, and the joint between the inner faces of the gable and leg are exactly 45°.

Using the completed vertical dividers, fit their lower tenons into the shelf's dadoes while the top frame is in place but slightly elevated in front. Using an accurate rafter square, make sure the vertical dividers are perfectly plumb and square with the shelf and then, with a sharp pencil, accurately mark where to cut the dadoes under the top frame. Removing and inverting the top frame, complete the layout for the front dadoes, then transfer those layout lines to the rear stile of the frame. Dadoes here will allow for alignment and installation of rear drawer slide support assembly later. Now, crosscut both pairs of dadoes into the top frame at the same time at the table saw.

To explain the rear drawer slide support assemblies just mentioned, the front of the drawer slides will attach to a leg on one side and a vertical divider on the other. At the rear, the slides will attach to a drawer slide block attached to the case on one side and a rear drawer slide support assembly suspended from the top frame on the other. These solid attachment points will keep the slides perfectly spaced and aligned.

The rear drawer slide support assemblies are cut from two pieces of solid wood, joined with a slip joint for strength. They essentially form a strong "L" that gets secured to the underside of the rear top rail with a tenon, and the back panel with glue and screws. These can be made now.

The two small blocks can also be cut and installed on the inner faces of the side panels.

Check the basin for clearances

As the vanity is designed to support a basin, before bonding the top frame into place it's a good idea to temporarily locate the basin over something the thickness of the planned countertop material to test for clearances while tweaks to the central rails of the top frame can still be easily made.

Now the top frame can be glued into place with clamps, followed by the vertical supports deftly within their dadoes.

Install the kick and apron

The vanity's kick is slipped within its dado beneath the shelf and secured to the sides with pocket screws installed from behind or bonded to inconspicuous glue blocks aligned behind the dado on the case sides.

Support Assemblies – To support the rear end of the inner drawer slides, a pair of rear drawer slide support assemblies are made. Salusbury joined two pieces with a slip joint, machined a tenon on one end of the pieces that fit into a dado in the underside of the top frame, and shaped assemblies on the bandsaw.

Keep It Simple – A simple piece of wood is attached to the inside of the gable to secure the rear end of the outer drawer slides.

Install the Apron – The curved apron has a rabbet cut into its upper, rear face. This rabbet fits over the front edge of the shelf. The front edge of the vertical dividers finish flush with the front face of the apron.

Optional Pullouts – Salusbury made pullout trays to assist with accessing all the items in the vanity.

Ahead of the kick, an apron introduces a softly curved arch and depth, giving the vanity the appearance of a piece of furniture rather than a plain installation. Trimmed with iron-on veneer along the bottom edges and shop-made solid wood trim along the top, it's rebated to align precisely with the top surface of the shelf and the front face of the vertical supports. A similar solid edging is made to trim the front face of the top frame, also flush with the face of the supports. The front face of the top and shelf should be 1" back from the leading edge of the legs so that when the drawers and doors are installed there will be a 1/4" reveal where they border the legs, just like the outer side panel union.

You'll have sensed that as it is with all projects, one stage leads to the next, becoming the reference for what's to follow. While drawings are made to refine thoughts, create material lists and guide construction, each stage requires fitting and refining, hence measurements change from the perfect view of a drawing. For me, the principals of cabinetmaking are patience, precision, problem solving and practice.

Drawer boxes

With the vanity case assembled, detailed and smoothly sanded, the next build is the drawer boxes. Their width is the opening between the legs and supports less the allowance for the slides. Their height is personal preference, guided by what's expected to be placed within. Depth is measured from the leading edge of the upper frame or bottom shelf, back to just shy of the rear leg. Dovetail joinery is strong, making glue-up stress free. A Leigh dovetail jig is a real asset, producing custom joints accurately and repeatedly. The 1/2" sides, 5/8" front and back panels, and 1/2" Baltic ply bottoms are rabbetted on three edges and slip within 1/4" × 1/4" grooves. The resulting boxes have a quality sound, feel and appearance.

Titebond III works well here, considering the intricate dovetail joinery and light wood tone. It has a long, stress-free working time, and cures waterproof to a light colour.

To fit the drawers to the vanity, invert the cabinet for easy access to the interior. Ensure the drawers are square and flush with the case and the slides located loosely. Check the fit and placement of the mounting blocks and drawer slide supports made earlier. To begin, the faces of the side support blocks should be in plane with the inner face of the front leg. After tuning the blocks and supports for perfect alignment, fasten the slide supports into the dadoes in the upper frame and screw them to the back panel from behind, then glue or screw the side support blocks into place. Next, fit the drawer to the supports and the drawer bottoms.

Flipping the case back onto its feet, insert the drawers into the case and slide and enjoy their fit for the first time. Only drawer fronts and doors need to be made and applied to complete the vanity.

I made pullout trays for behind the doors, though that option is

shopnotes

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up to you. I find they allow me easy access to all items, no matter how far back in the vanity they are located.

Doors and drawer fronts

Cutting the veneered plywood for the doors and drawer fronts requires consideration; these are visible parts. Grain direction and pattern must be oriented for optimum visual energy plus lateral placement on the sheet for optimum symmetry and vertical location of the parts for a flowing pattern from drawer fronts downward across doors. Remember, there's a left, center and right to the project with a saw kerf and applied trim separating the parts vertically and horizontally, so cut these parts accordingly.

Orient the plywood so the grain pattern adds visual lift, then look at the placement of the veneers used to skin the sheet, centering the middle door on that. With a thin kerf blade and stiffeners on the table saw, rip the panel into three equal-width strips, eliminating scrap strips on both sides. Next, calculate the height of the drawer fronts and doors, leaving a small margin above the drawers and below the doors for final sizing; these can be trimmed without affecting grain continuity later. Before cross-cutting plywood, I firmly cover the kerf top and bottom with blue painter's tape, minimizing potential tear-out.

Roughly sized and preferring a final space of 1/8" between the parts all around, and knowing the edging veneer is 0.020" thick, measure, mark and cut all parts to the final width and height and apply the fragile iron-on veneer edging. I let it cure several hours before sanding all edges and ends flush and applying finish to all the completed components.

I spray finished all components using my Fuji Mini-Mite 4 Platinum HVLP system, creating a smooth glossy surface for appearance and easy cleaning. Target Emtech EM2000wvx, an excellent finish with a faint amber hue when cured, warms wood's natural tones unlike most waterborne clear coats.

Next, drilling and assembly

A word about jigs: A thoughtfully designed, well-crafted precision jig made once will make everything it helps to produce thereafter a treat to complete. Plus, creating it allows the maker to think through the task it will be put to before lifting a finger.

Working from above the vanity, position and attach the vanity's central horizontal filler panel, visually anchoring the drawer fronts and doors beside and below. A pair of 0.100" shop-made shims jig uniform gaps between all panels. Another shop-made jig exactly locates the holes needed to attach the drawer and door pulls. All drilling is done at the drill press for accuracy and depth control.

Having previously drilled through the fronts of the drawer boxes, the shims are slipped on both sides of a drawer front, the front located perfectly, lightly clamped in place and the location of the screw holes in the drawer box transferred to the back of the front panel. At the drill press, drill all the holes for attaching the drawer front plus the pull. Next, attach the pull to the front and the front to the drawer box. Repeat for the second drawer.

Now the spacing above and on either side of each door can be set using the same shims so the location of the hinges can be marked. Within a couple minutes, another shop-made jig, based on dimensions supplied with the hinges, allows me to mark where the screws

and hinge mortises will go on all three doors and hinge frames, repeatably error-free. Holes for mounting the pulls can be located now, too, and drilled at the drill press.

With holes for hinge screws drilled in the legs and supports as required, the doors and hardware can come together and the door hinges fine-tuned.

Originally the plan was to use baskets resting on the bottom shelf for generous storage. Later, it was decided that removable bins on shallow sliding trays would be far more useful. Made to the same depth as the upper drawers but narrower, and just 2 1/8" tall to clear the door hinges, each tray rides on a center-mount slide (Lee Valley part 02K40.19). Made of poplar, joined with tenoned miters and finished like everything else, they've proven to be a user-friendly finale to complete the project.

Floating version

This design can be easily downsized to create a space-friendly floating vanity for a powder room. Without the countertop, the basin rests directly on the cabinet's top frame. By using dense 3/4" (+18mm) plywood for the back and dadoed into the rear corners like the sides, and by increasing the depth of the top frame and bottom shelf so they can be inset and glued within rabbets in the back panel, a case of exceptional rigidity is created. This then can be shimmed and lag-bolted, top and bottom, into a pair of studs within the wall. Just be sure to avoid any plumbing that might coincide with the lags.

Small Changes, Different Look – With a few tweaks in design and construction, this basic vanity can be turned into a smaller, floating version.

MARK SALUSBURY
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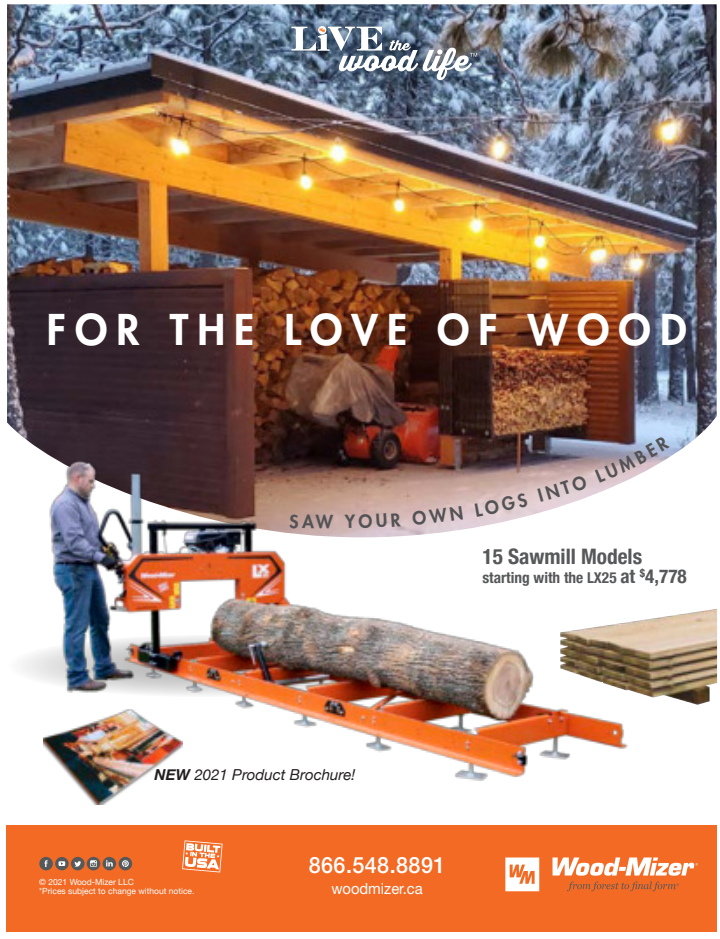


3D PRINTERS IN THE WORKSHOP

What are 3D printers and do they have a place in the workshop?

BY CHRIS TUCKER

The use of digital tools in the manufacturing industry is commonly referred to as "advanced manufacturing." In the industry there are two general approaches: subtractive manufacturing and additive manufacturing. Subtractive manufacturing is the approach that has traditionally been used in woodworking. We remove stock from pieces of material to form components that we then assemble to form larger projects. A CNC mill or lathe is an example of a subtractive manufacturing tool. Additive manufacturing, on the other hand, takes a raw material and reforms, or sculpts it, into a model or part. Three-dimensional (3D) printers represent the largest group of tools in additive manufacturing. In this article, we will explore what 3D printers are, how they work and how they can be utilized in your shop.

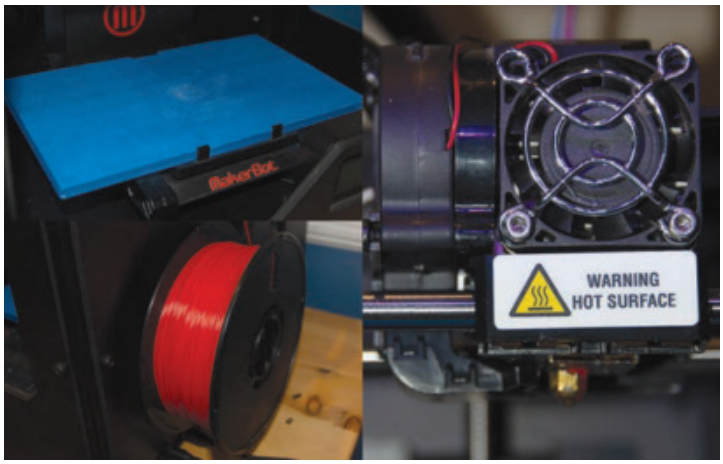
The concept of 3D printing is not new. The idea was discussed as early as the 1940s. However, devices capable of producing 3D printed material didn't arrive until the 1970s, with commercial machines really starting to expand in the '80s. Like most technologies, as they develop, their availability increases and cost decreases. Over the past 10 years, 3D printer options have exploded. There is now a wide range of styles of machines available at various price points that make it very easy to get into 3D printing. You can get a unit for as little as a few hundred dollars or up to hundreds of thousands of dollars for industrial machines.

To begin your journey into 3D printing, there are two factors that must be understood. The first is that 3D printing comprises a number of different processes, some of which are readily accessible to consumers, while others are limited to industry applications. The second factor is understanding the types of materials that can be used in each machine and their physical properties. We will first explore two of the most common forms of 3D printers available to consumers.

Types: Extrusion-based printers

The most common category of 3D printers is called extrusion-based printers. Fused deposition modelling (FDM) printers are the most common type in this category. These units are typically

Photos by Chris Tucker

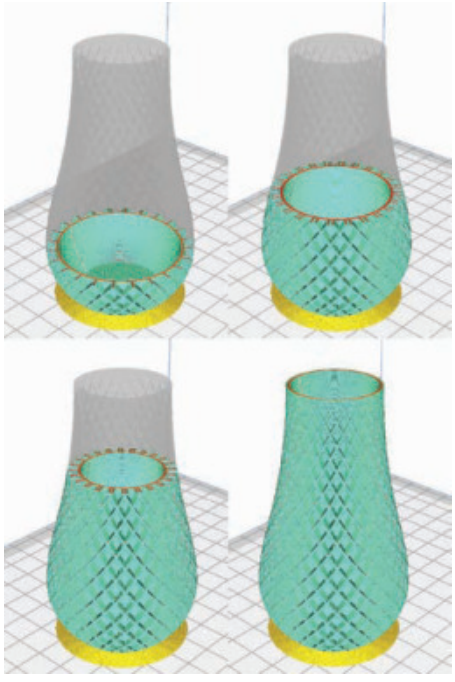


Parts of an FDM 3D Printer – Shown is a typical FDM 3D printer. Clockwise from top left: the build plate, extruder and filament spool.

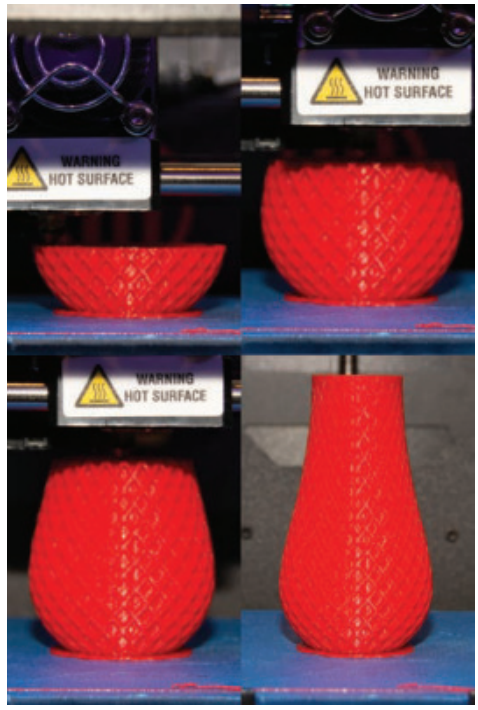
Post Print Finishing – A completed 3D print can be left as is or can be sanded, primed and painted to improve surface quality. (Photo by Makerbot).

desktop in size, and feature a build plate, a gantry with x, y and z axes, an extruder unit, and a roll of filament. The general principle of FDM printers is that a 3D model is broken, or "sliced," into layers along the x-y plane and then built up layer by layer. It's very similar to how masonry walls are laid, but instead of using bricks the extruder heats up the filament and extrudes it in a thin bead similar to how a hot glue gun works. The width of the bead depends on the resolution of the printer, but tolerances the size of human hair are common. As the model is built layer upon layer, the build plate lowers, allowing for the model to form. Once completed, it's generally good practice to allow the model to cool for a few minutes before removing it from the machine.

There are two common methods to remove the model. The first is to remove the model from the build plate either by hand or with the aid of a tool similar to a putty knife. The second method is removing the build plate and gently twisting the plate to free the model. Once freed from the build plate, a model is complete or can be sanded and painted to achieve your desired level of finish.



A Sliced 3D Model – Shown is a screen capture of a software tool that "slices" a 3D model so it can be printed.



FDM Printer in Action – Shown is a series of photos showing the progression of a 3D print: dimensions, 50 × 90 mm; material, PLA; 10% infill; three hours, seven minutes, print time; 38.17 g of material.

FDM printers have several advantages over other styles of 3D printers. They are inexpensive, compatible with a wide variety of materials, have an excellent number of resources available and are relatively safe. The main hazards consist primarily of potential burns if you come in contact with the extruder when it's hot, and pinch hazards if you get caught between any of the moving axes when in operation. These hazards are typically addressed by the manufacturer by providing a full enclosure around the machine. However, many FDM units are similar to CNC routers and are not fully enclosed.

One of the largest considerations when 3D printing a project is the material to be used. Material for FDM printers looks very similar to solid core wire. It comes in spools that usually hang off the rear or side of the printer or can sit on a stand next to it. Filament comes in two standard thicknesses: 1.75 mm and 2.85 mm. The filament can be made from a wide range of materials and can come in a dizzying array of colours.

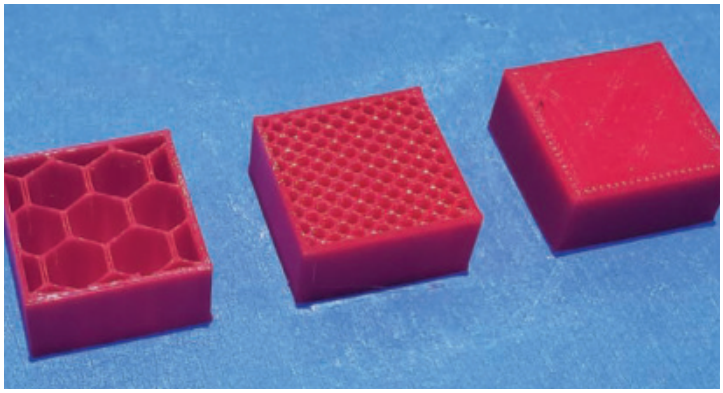
Not all 3D printers are capable of working with all of these materials. However, most entry-level machines will operate with PLA, ABS and PETG. Generally, the wider the range of material, the more advanced the machine. The majority of FDM printers only print a single material at a time, so prints tend to be monochromatic, based on the filament colour. Some units do have dual extruders which will allow for two colours to be loaded or potentially use two different materials, if available. However, most

Filament Comparison

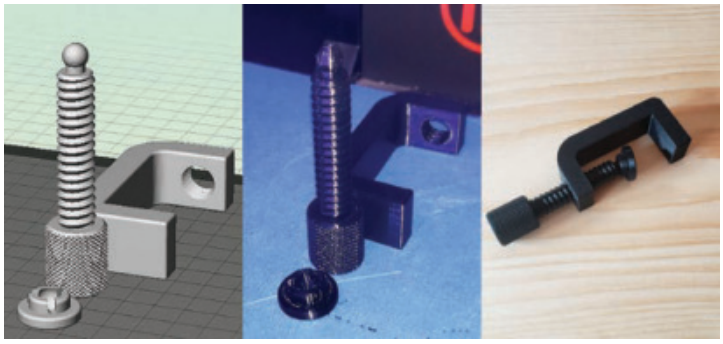
Name	Acronym	Working Temp	Ultimate Strength*	Flexibility	Durability	Printability	Unit Cost Per kg (sold by the roll)
polylactic acid**	PLA	180 - 230°	65 MPa	Low	Medium	High	$20 - 25
acrylonitrile butadiene styrene	ABS	210 - 250°	40 MPa	Medium	High	Medium	$20 - 25
polyethylene terephthalate glycol	PETG	230 - 250°	53 MPa	Medium	High	High	$20 - 25
polycarbonate	PC	260 - 310°	72 MPa	Medium	Very High	Medium	$40 - 120
nylon		240 - 260°	40-85 MPa	High	High	Medium	$65 - 95

*Ultimate Strength is the maximum stress that a material can resist by compression, tension or shear forces. Measured in megapascals (MPa)

**includes filled PLA such as wood (wood dust, cork, saw dust and other wood fibres) and metal (brass, bronze, copper, iron, stainless steel)



Infill – Shown are three prints with infill amounts from left to right of 10%, 40% and 100%. Different amounts of infill, which affect the amount of filament used, determine the strength of a part and length of a print.



Breaking a Model Up into Components – Larger prints may be broken up into individual components to go from one large print job to multiple shorter jobs. The print job shown took one hour, 38 minutes, and uses 16.26 g of material. This is less than $0.50 worth of material.

consumer units print only one extruder at a time. Due to the range of material, it's important for you to be aware of your machine's settings to ensure you select the proper parameters for the material you're working with. Also, due to the fact that most 3D printers have cooling fans attached to the extruders, there has been concern about nanoparticles becoming airborne. To address this, some units have complete enclosures with filtration built into the unit. Regardless, it's always advisable to work in a well-ventilated space and always follow the manufacturer's and supplier's instructions for operation.

The largest shortcoming of FDM printers is the time it takes to complete a print. Depending on the size of the model, you're looking at least an hour to complete a print, while some large jobs potentially take days, depending on the resolution and density of the model. There are factors that can be controlled to help make printing more efficient. Common strategies include:

- reducing the density of the part by using software that will fill voids with a lattice of material, thus reducing the amount of filament used, the weight of the part and the print time.
- altering the model orientation to reduce the use of support material or rafts.
- breaking large models up into components to reduce single, large run times.
- arranging multiple jobs in a single build to reduce the total number of runs needed.

Types: Vat photopolymerization

Vat photopolymerization printers are the second general category of 3D printers you'll likely encounter. Stereolithograph (SLA) printers, commonly referred to as resin printers, are the most common consumer type in this category. This type of process differs from FDM printing in that the print material is a light-reactive thermoset

Speed, Quality vs. Infill

Print duration (h:mm) **Filament used** (grams)		**Percentage Infill**		
		10%	40%	100%
Print Resolution	Low (0.3 mm)	0:14 4.47 g	0:18 7.61 g	0:36 16.58 g
	Medium (0.2 mm)	0:21 4.39 g	0:27 7.58 g	0:54 16.65 g
	High (0.1 mm)	0:43 5.29 g	0:55 7.73 g	01:47 16.65 g
To make a 25mm diameter × 25 mm high cylinder				

material, or simply a liquid that reacts to specific types of light, versus a solid spool of filament. These machines consist of a build plate, a resin reservoir and a laser. Essentially the process is similar to FDM printing in that a model is "sliced" and then built layer by layer. Where it is different is that the build plate is submerged in the resin tank and as the build plate is raised out of the resin, the laser cures the surface layer of material to the build plate. It appears that the models are emerging out of the resin (similar to how creatures emerge from the murky depths in movies). As a result of this process, models are generally built inverted.

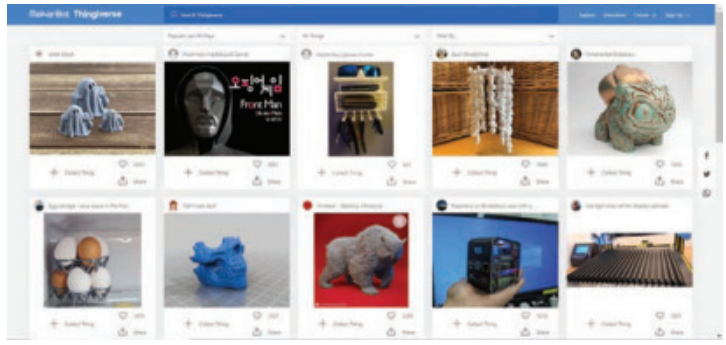
Resin models are generally monolithic, and do not have the same ridging characteristic as FDM models, which make them excellent for jobs that require a high degree of resolution. The print time for an SLA model is the most attractive characteristic of resin printers, with prints being completed in minutes instead of hours. There are two main downsides to SLA printers, however. They generally have a smaller build volume than FDM machines and, most importantly, the resin is highly toxic and should not be handled by inexperienced users. Cost is also a factor for SLA units, with an entry-level unit costing approximately $4,000.

Regardless of the type of 3D printer you choose, their application in the workshop is similar. The ability to design and fabricate components makes them an extremely versatile tool. I routinely use my 3D printer to create prototypes of projects, fabricate knobs for projects, jigs for simple tasks, containers for parts and custom tools to aid in those hard-to-reach places. There is also a huge online community of users who share their models in massive databases, with many offering free downloads. One of the largest communities is on thingiverse.com. You can browse the catalogue of models by keyword or user and find a variety of designs you can download to print or alter yourself if you want to customize them.

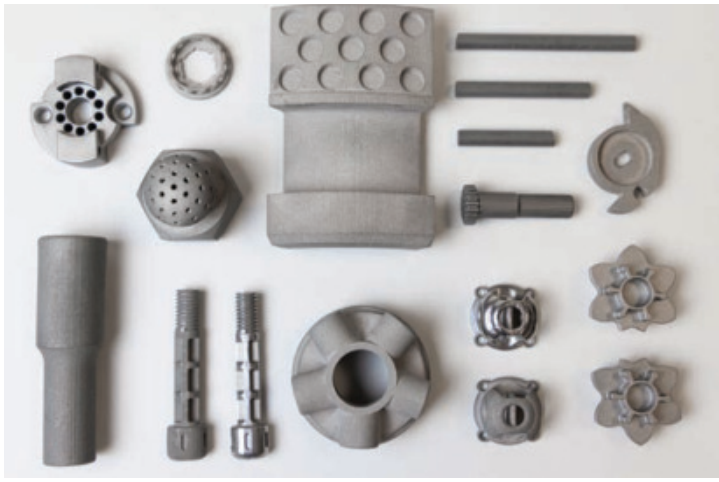
An Example of a "Resin" Printer – Resin printers are typically smaller than other forms of 3D printers and can be accommodated on desks or benchtops. (Photo by Formlabs)

A Resin Printer in Action – A resin printer prints objects upside down, and they appear to "emerge" from the resin. (Photo care of Envisiontec)

3D Printed Parts – Clockwise from top left: center finding jig; hold down clamps; finishing standoffs; corner clamp brackets; 1/4"-20 knobs; and vacuum adapter for a dust port.



Thingiverse.com – Shown here is a screen capture of the website thingiverse.com.



3D Printing in Powdered Metal – 3D metal printing offers a huge array of possibilities that can simplify the manufacturing process and reduce the need for precision machining. (Photo from Proto3000l)

New 3D Printing Wood Technologies – 3D printing technology has advanced to include the ability to print wood products and reproduce wood grain. (Photo from Forust/Desktop Metal)

Should you buy one?

Do you need to buy a 3D printer to explore the technology? Surprisingly and thankfully the answer is no. While owning a machine does make it easier for you to print jobs, if you don't want to invest in a machine, there are a variety of community resources that offer access to machines for free or for a nominal cost. Public libraries often have "makerspaces" equipped with 3D printers that you can access, and will often have trained staff to assist you with your learning and may even offer workshops. Commercial makerspaces are also a popular venue for accessing 3D printers. Most offer memberships or have drop-in hours allowing you to use their equipment. Most secondary schools and post-secondary institutions are now equipped with 3D printers, so while they may not be open to the public, if you have a child attending one, they may be able to print for you. There are even online services that will allow you to upload your file to them, specify the material and a few other parameters, and will print it for you and then ship you the completed part.

Perhaps one of the most exciting parts of 3D printing is the speed at which the technology is advancing. For example, in the past few years, technology in 3D printing has evolved to allow for 3D printing in metal for consumers. Also, processes have been developed to 3D print in wood-based material. While these types of innovations may not yet be available for your shop, these new ways of manufacturing can lead to more cost-effective and environmentally conscious solutions, which will allow us to continue to work in safe and productive manners. When examining technological innovations, I am always reminded of a quote from Albert Einstein: "Imagination is more important than knowledge."

Hopefully, you now have a bit more knowledge about 3D printers; it's up to you to do the rest.

Chris is a curriculum consultant with a background as a technology education teacher, an architectural technologist and a contractor. He is a CNC enthusiast using both additive and subtractive tools in his projects.

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Photos by Randy Gillard

Craft a Set of Mission Night Tables

Bring the simple, classic look of Mission-style furniture into your bedroom.

BY RANDY GILLARD

Like many woodworkers, I have always loved the clean lines of Mission-style furniture. After making a Mission bed for our guest room, I decided we needed a pair of matching night tables. Mission-style furniture involves a lot of clean horizontal and vertical lines, as well as simple, flat panels. Oak is the typical wood used in the construction of Mission furniture. It was usually quarter cut to reveal its large rays, which would be further accentuated by the finish.

INFO: DIFFICULTY – **4/5,** LENGTH/TIME – **4/5,** COST – **3/5**

Using quarter cut material

This is an aspect of the project where you can get as serious as you'd like. If the rays of quarter cut material are important to you, you'll have to either purchase quarter cut lumber or start with thicker material and break out the parts from the board at an angle so the workpiece's faces are quarter cut.

There's nothing wrong with using flat cut or rift sawn material for this project, although it won't give you the traditional ray fleck look Mission furniture is known for. A third option is to meet somewhere in the middle and use or saw quarter cut material for the more visible parts, while using flat or rift sawn material for the rest. No approach is wrong.

Construction approach

As with all furniture, there are many ways to produce strong joinery that will keep the piece functioning for years to come. Much of this depends on tooling available and the joinery preferences of the maker.

I use basic frame and panel construction for the gables and back, while the tops of these night tables also use a similar approach, but there are other options when it comes to joining the frame members. Mortise and tenon joints are a common approach, for example. I opted to use a mix of dowels in some joints and floating tenons in other joints, depending on a few details. Feel free to substitute another joint if you feel more comfortable making it.

Layout is important

I start the build by laying out the parts on the rough boards. I try to make the top and bottom rails from the same board so the grain and colour flow naturally around the piece.

Once the layout of the pieces is marked, I rough cut the lumber to length. Leave an inch of extra length to account for final trimming. Next, dimension the pieces on the jointer, planer and table saw.

Legs

The legs are made by laminating two or three pieces together and adding a 1/16" shop-sawn veneer on two of the faces to cover the glued edges. This allows the face grain to be displayed on all four sides. The corners will be slightly chamfered to hide the glue line between the veneer and the solid faces. If you don't apply quarter cut veneers to the edges of the legs, I recommend using straight-grained wood for these faces to keep the strong vertical lines of the legs simple.

Panels

The panels for the door, sides and back are re-sawn on the bandsaw. The two halves are bookmatched to present a mirror image on either side of the center divider. Since the panels are made of solid wood, they must be allowed to float within the frames. This is to prevent cracking from movement caused by seasonal changes in humidity. Since the panels are free to move slightly within the frames, they must be pre-finished so unfinished portions of the panels aren't seen near their edges as the panel moves.

Joinery, then sub-assemblies

Cut grooves for the panels, rails and stiles into the legs on the router table. Cut the grooves in the rear legs on two faces; one groove to accept the side rails and panels, and one groove to accept the parts that make up the back. These slots start from the top

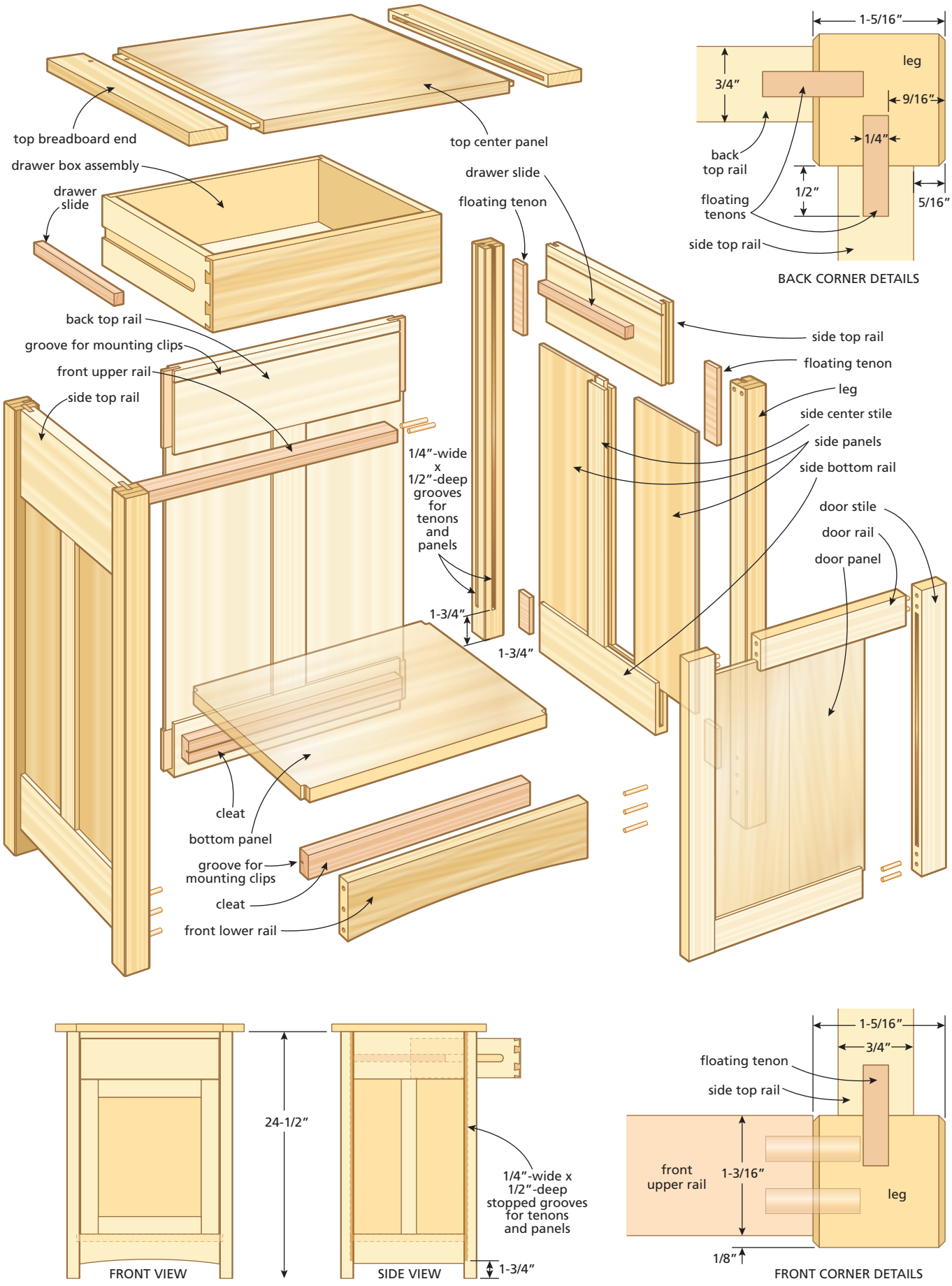
Bookmatching Looks Great – A bookmatched panel has great symmetry, which is a big part of what Mission-style furniture is all about. All the panels are bookmatched.

Lots of Grooves – Because Gillard used floating tenons to join many of the workpieces, grooves must be machined in the edges and ends of the stiles and rails.

Floating Tenons – When making floating tenons it's critical the grain is oriented correctly or the joints will be very weak. Notice how the grain of the tenon that's inserted in the rail is running parallel with the grain of the rail.

of the leg and are stopped 1-3/4" from the bottom so they don't extend below the bottom rails.

I used floating tenons to connect the rails to the legs. Therefore, a matching slot had to be routed into the ends of each rail. Make sure to orient the grain direction properly or the tenons will be very weak. Offcuts make good stock for creating the floating tenons.


top breadboard end
top center panel
drawer box assembly
drawer slide
drawer slide
floating tenon
back top rail
groove for mounting clips
front upper rail
side top rail
1/4"-wide x 1/2"-deep grooves for tenons and panels
1-3/4"
1-3/4"
cleat
bottom panel
groove for mounting clips
cleat
front lower rail
side top rail
floating tenon
leg
side center stile
side panels
side bottom rail
door stile
door rail
door panel
1-5/16"
leg
3/4"
9/16"
1/4"
back top rail
1/2"
floating tenons
5/16"
side top rail
BACK CORNER DETAILS
24-1/2"
FRONT VIEW
SIDE VIEW
1/4"-wide x 1/2"-deep stopped grooves for tenons and panels
1-3/4"
1-5/16"
3/4"
floating tenon
side top rail
front upper rail
1-3/16"
leg
1/8"
FRONT CORNER DETAILS

Materials List (for one table)

Part	Qty	T	W	L	Material
Legs	4	1-5/16	1-5/16	24-1/2	QSWO (Quarter Sawn White Oak)
Sides – Panels	4	1/4	5-5/16	16-1/8	QSWO
Sides – Center Stile	2	3/4	1-1/2	16-1/8	QSWO
Sides – Top Rail	2	3/4	4-3/4	10-7/8	QSWO
Sides – Bottom Rail	2	3/4	3	10-7/8	QSWO
Back – Panels	2	1/4	6-5/8	16-1/8	QSWO
Back – Center Stile	1	3/4	2	16-1/8	QSWO
Back – Top Rail	1	3/4	4-3/4	13-7/8	QSWO
Back – Bottom Rail	1	3/4	3	13-7/8	QSWO
Top - Center Panel	1	3/4	15	15-3/8	QSWO
Top - Breadboard Ends	2	3/4	2-1/16	15	QSWO
Top - Dowel	2	1/4	1/4	3/4	QSWO
Front Lower Rail	1	3/4	3	13-7/8	QSWO
Front Upper Rail	1	5/8	1-3/16	13-7/8	QSWO
Bottom Panel	1	3/4	11-3/8	14-3/8	QSWO
Cleat	2	3/4	1-1/4	13	Hardwood
Shelf (if desired)	1	3/4	To	Fit	QSWO
Door – Panel	1	1/4	10-7/8	12-5/8	QSWO
Door – Rails	2	3/4	1-3/4	10-1/4	QSWO
Door – Stiles	2	3/4	1-3/4	15-3/8	QSWO
Drawer Front	1	5/8	4	13-3/4	QSWO
Drawer Sides	2	1/2	4	12-3/16	Maple
Drawer Back	1	1/2	4	13-1/4	Maple
Drawer - Bottom	1	1/4	13-1/4	11-9/16	Maple Veneered MDF
Drawer Slides	2	To	Fit		Maple
Magnetic Catch Filler	1	To	Fit		QSWO

Hardware List

Name	Qty	Size	Details	Supplier
Hinges	2	2"	Part No. BP2050900	Richelieu
Knob	1	1 ¼ × 1"	Part No. 02G1621	Lee Valley Tools
Magnetic Catch	1		Part No. BP52090	Richelieu
Ring Pull	1	2 × 1-7/16"	Part No. APABP	Acorn Manufacturing
Tabletop Mounting Clamps	8		Part No. 13K0101	Lee Valley Tools

Stopped Grooves – A router table is a great way to accurately machine stopped grooves. The grooves in the legs start at the upper end but stop before exiting out their lower end.

Sub-Assemblies – With so many parts it would be impossible to assemble all of them at the same time. Creating gable sub-assemblies is the answer.

A slot in each rail

A slot is also required in each rail to accept the panel. The top will be held on using tabletop mounting clamps to allow for seasonal movement. Cut a slot along the top of the rails to accommodate the tabletop mounting clamps. These are cut on the table saw 5/8" from the top edge.

With all the pieces complete, the sides can be glued together to form the first sub-assemblies.

Back panel

With the sides complete it's time to start on the back. Once again, panels are re-sawn and bookmatched to provide a mirror effect across the center stile, and rails and stiles for the back panel are made, similar to how the sides were joined.

Stretchers

Before the back can be attached to the sides, cut the front top stretcher to size. The front bottom stretcher has a slight curve on the bottom edge. This is drawn with a marking bow, cut on the bandsaw, and can be smoothed out on the oscillating belt sander or with hand tools. Attach the front stretchers using 1/4" dowels. Either a dowel jig or dowel centers can help with locating the dowels.

Assembly

At this point a final dry fitting of the sub-assemblies and the remaining parts is in order.

If nothing else, it will allow you to practice the order of operations for these night tables. We all know that as soon as glue is applied Murphy's Law kicks in and throws us a curve ball, so being prepared is important. Collecting the necessary clamps, glue and any other little things like clamping cauls, glue brushes and the like is a great start. It's critical to check for square at this point and adjust if necessary.

Simple, Yet Strong – Dowel joints are simple to machine, yet offer more than enough strength to keep the rail-to-leg joints tight for a long time. Jigs are great, though dowel centers could be used.

Now the doors

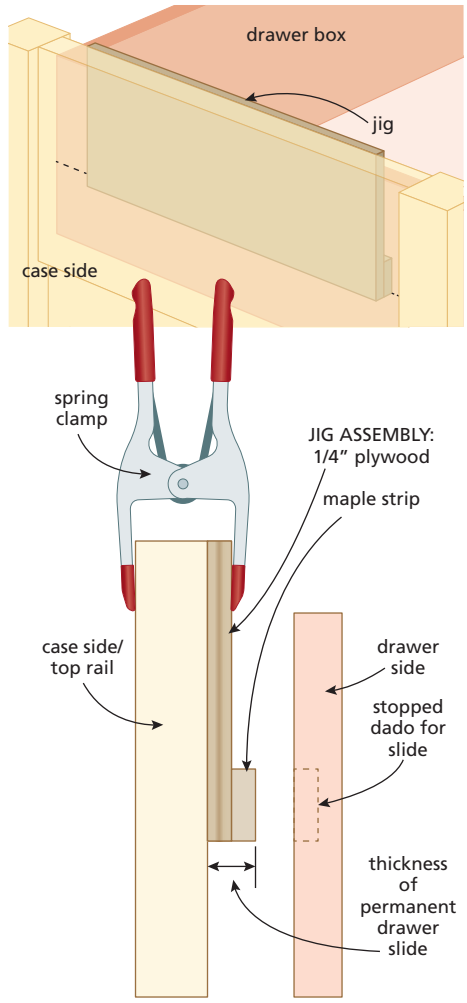
The door panel is made of a glue-up of two narrower panels, bookmatched at the center line. The doors follow similar construction as the sides with slots for the prefinished panels routed into the rails and stiles. One exception here is the use of dowels instead of tenons to connect the rails to the stiles. This avoids having the slot and tenons visible at the top of the door.

Top it off

The top comprises a center panel with breadboard ends. First, I glue up and flatten the center panel. Having a drum sander is a great luxury for this operation.

Next, a tenon is machined on each end of the panel on the table saw with a dado blade. This tenon will fit into a matching slot routed into the breadboard ends. The slot stops before the end of the board so it's not visible once everything is assembled in keeping with a typical Mission look.

Once again, we need to account for seasonal movement across the grain, so the end caps cannot be glued to the tenons along its entire length. Instead, they are glued for the first 2" at the front. At the back, it's pulled tight by drilling offset holes for a dowel pin. The hole in the tenon is elongated to allow the center panel to expand and contract without introducing undue stresses and potential for cracking. The hole in the tenon is offset by approximately 1/32" from the hole in the end cap. When drilling the holes in the end cap, insert some scrap in the slot to prevent blow-out inside the slot when the drill breaks through. When the dowel is hammered in, it



Check for Square – Once the main assembly has been completed, it's important to check for square and make any adjustments. This makes hanging the drawer and door much easier.

Top Tenon – A long tenon on the edge of the top panel is machined on the table saw. The ends of this tenon will be trimmed back a bit before it's fit into a groove on the breadboard ends.

Stopped Grooves – The breadboard ends have stopped grooves so the joint isn't visible.

draws the two pieces tightly together. When dry, the dowel is flush cut and sanded smooth.

I wanted to use dowels of the same material as the table, so I made my own. This is simply a piece of scrap steel with a 1/4" hole drilled in it. I cut some scrap stock slightly bigger than the hole, tapered the end, chamfered all four corners and hammered it through the hole. The result was a round dowel and a perfect fit.

Bottom panel

With the case dry-assembled, measure for the bottom panel which is a simple glue-up of several boards. The panel is notched at the corners to fit around the legs. I like to orient the grain front to back, especially on oak, as it makes it easier to slide things in and out of the cabinet without cross-grain friction.

To secure the bottom panel I used a pair of wood cleats attached to the lower front and back rails, and some tabletop mounting clamps. The cleats support the shelf, and a few tabletop mounting clamps fit into a table saw blade kerf in the cleats to keep the bottom panel in place. The top surface of the cleat is mounted 3/4" below the top of the front and rear rails, so when it's in place the bottom shelf is flush with the top of the rails. I found it easiest to fit the bottom panel, then remove it for finishing.

Drawer construction

With the main cabinet parts together, it's time to make some drawers. There are many ways to join and hang a drawer, but my approach was to machine a groove on the sides of the drawers and then install a wood drawer slide on the inner face of the side top rail that the drawer would run on. I came up with a way to position the drawer slides with a simple jig made up of 1/4" plywood and a narrow strip of wood. Essentially, if you build the drawer at least 1/2" narrower than the opening, then the jig will work. More about how the jig works later.

I milled the fronts, sides and backs to size and cut half-blind dovetail joints at the fronts. Less showy joints can be used at

Temporary Filler Strip – When drilling the hole for the peg, insert a filler piece in the groove so the wood doesn't blow out near the groove. Gillard used some extra floating tenon material he had.

Make Your Dowels – A 1/4" diameter hole in a piece of steel will allow you to pound some 1/4" wide strips through to create pegs in the same material as the rest of this project. Ease the end of the strip so it will be easier to start, and chamfer the edges so the hammering will be easier.

Lower Cleats – Two cleats, one on the inside of the lower front rail and one on the inside of the lower back rail, allow you to use tabletop mounting clamps to secure the bottom panel in place.

Notch the Bottom – Notch the bottom so it fits around the legs. Leaving a small gap will allow for changes in humidity.

Machine Dovetails – Dovetails are aesthetically pleasing and strong, and once a dovetail jig is set up it's easy and quick to machine the joints for the drawers.

Finish Before Assembly – Because Gillard wanted the drawer fronts to be a different colour than the drawer sides, he applied a finish to the fronts before assembly.

Drawer Hanging Jig – A piece of solid wood the same width as the drawer slides was attached flush with the edge of a piece of 1/4" plywood. The thickness of the solid wood combined with the plywood equals the finished thickness of the main drawer slide. The jigs are clamped to the inner face of the gables while the drawer is installed. The jig's location can be adjusted to position the drawer properly, then a line can be marked on the lower edge of the jig. The real drawer slide is aligned with that line.

Close Your Door – A small filler piece is attached to the gable so a magnetic catch can be used to keep the door closed

the back, though if you've already wrapped your mind around machine-cut dovetails to secure the fronts to the sides, it might be simple enough to use this same joint to secure the drawer back.

Because the drawer front is stained but not the sides, I must dry fit the drawer parts and sand everything perfectly flush. Then I stain the drawer front and apply a coat of polyurethane to all parts. Be careful not to get any poly in the sockets or on the back side of the tails. Doing so would compromise the glue joint. Once the finish has dried, I glue up the drawers.

Next, grooves are milled into the drawer sides to match up with the drawer slide that will be attached to the inside of the cabinet. These grooves are machined on the router table.

To hang the drawers square in the cabinet, I made a simple jig that positions a temporary slide within the drawer opening. Remember, I mentioned the fact that the drawer has to be at least 1/2" narrower than the drawer opening. This is because two layers

Flip-Stop – Secured loosely with a pan head screw, this flip-stop is usually in this position to stop the drawer from being pulled right out. If it's rotated down the drawer can be removed.

Bring It All Together – Tabletop mounting clamps bring the final few parts into position. Here, Gillard attaches the bottom panel.

Final Finishing Coat – Though the panels are already finished, once the piece is complete the rest of it has to be finished to match. Removing the bottom panel, top panel and drawer makes applying a finish easier.

of 1/4" thick plywood will need to temporarily fit between the drawer sides and the inside of the cabinet's gable. Thankfully, 1/4" plywood is slightly thinner than 1/4", so that gives us a small gap.

A temporary slide about 1/4" thinner than the real slides is attached to a piece of 1/4" plywood, and the piece of plywood is clamped to the inner cabinet sides through the top opening. By loosening the clamps and shifting the slide jig while the drawer is in position, the slides can be positioned perfectly. Once placement is finalized, I scribe a line on the inside on the cabinet, flush with the lower edge of the jig, and install the final slides flush with this line.

The final slides are sanded to 220 grit, and both the slides and drawer grooves are coated with paste wax for a smooth sliding action.

Add some details

The door is held shut by a magnetic catch screwed to a block glued to the back side of the front leg.

I added a flip-stop to prevent the drawer from coming all the way out. It's attached to the same block as the magnetic catch.

Adding an interior shelf, if that's a feature you'd like to have, is similar to making the bottom panel. It's held in place by the same type of clips. A small gap is left near the edges to allow for seasonal movement so the shelf doesn't press on the leg.

After bringing everything together for a test fit, it's time to finish staining and applying polyurethane. The finishing technique is quite basic but still produces a result that emulates the classic Mission look of fumed white oak. I used MinWax Early American oil-based stain and two coats of MinWax satin polyurethane applied with a foam brush. Sand the polyurethane lightly between coats to end up with a smooth finish, but just be careful after the first coat because you don't want to sand through the topcoat and leave scratches on the stained wood.

Randy has been making furniture since 1999. When not in his workshop, you'll most likely find him on the golf course or the ski hill. Originally from Newfoundland, Randy now lives in Calgary, Alberta.

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ShopTested

Reviews

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

King Canada Performance Plus Variable Speed Plunge Router / Trimmer Combo Kit

BY GORD GRAFF

Ask anyone who owns one and they'll tell you trim router combo kits are indispensable. With a fixed and plunge base and other accessories included in the kit, these pint-sized routers pack power and plenty of features, and the King 8366K is no exception. Because trim router combo kits are lightweight, compact and easy to maneuver, they're ideal for cutting hinge mortises, profiling edges, template routing, trimming plastic laminate, mortising inlays and a whole host of other tasks. First-time router buyers like them because of their versatility, value and ease of use.

At half the price of its competitors, the 8366K trim router combo kit certainly deserves a closer look. This variable speed, 1-1/4HP router kit with its 1/4" and 3/8" collet chuck capacity delivers performance in either the fixed base or plunge base configuration. The variable speed, 10,000 to 30,000 RPM, allows you to "dial in" the speed needed for different router bit sizes and materials being machined.

Photo 1 by King Canada, Photos 2, 3 and 4 by Gord Graff

A Plethora of Profiles – From roundovers to rabbets and coves to chamfers, this King trim router has what it takes to rout all sorts of edge profiles.

Flush It Up – On edge, the King trim router and fixed base make quick work of flushing up solid wood edging.

Plunge Action – When installed in its plunge base, the King trimmer can accurately make light- and medium-duty mortises.

Fixed base use

Changing bases is simple and easy. Release the quick-release clamp on the back of either the fixed or plunge base and slide the motor out. Next, slide the motor into the other base and lock the quick-release clamp and you're ready to rout.

Using the 8366K in its fixed base is a pleasure. It's well balanced, has an overmoulded grip to prevent your hand from slipping and includes a 1-1/2" dust port for efficient dust removal. The rack and pinion system used for raising and lowering the fixed base works effortlessly and a two-position spindle lock means you only need one wrench to remove and install router bits.

Balancing the 8366K on the edge of a 3/4" plywood drawer side to trim solid maple edging with a laminate trimming bit is a breeze. Because the 8366K is easy to control and well balanced, I found this to be a one-handed operation. With the fixed based installed, this router is way more than just a laminate trimmer; profiling an edge in 3/4" maple was quick and easy. Depending on the amount of material being removed, I found it necessary to make several passes, increasing the depth of cut with each pass, sneaking up on the final profile.

Plunge base use

The aluminum plunge base on the 8366K does not disappoint. It has a plunge travel of 1-1/2", three adjustable pre-set depth stops and plunges, and returns smoothly using firm but not stiff springs. There was no noticeable play between the base and the columns while plunging, and it plunged smoothly and accurately. This is key when plunging mortises. Any movement between the base and columns means an inaccurate mortise. Plunging 1/4" × 1" deep mortises into maple legs was smooth and accurate and the non-slip handles gave my hands plenty of grip while in use.

The supplied adjustable straightedge guide worked well to cut these mortises, but when cutting dadoes in the middle of a panel where the fence is too short to use, the plunge base on the 8366K has two flat sides that easily glide along a straight edge. Once again, multiple passes were used to cut a 3/4" wide dado.

The router kit comes with a trimmer roller guide, an accessory that isn't often used but it's nice to see it included with the kit for the times you can't do without it.

Final thoughts

The King Canada Performance Plus Variable Speed Plunge Router / Trimmer Combo Kit 8366K works well, within its limitations. It's well balanced, plunges smoothly, has variable speeds to accommodate different router bit sizes and materials, and it's a pleasure to use. And with the included accessories, what's not to like? Dust collection on the plunge base isn't included and would have been helpful, but the dust collection on the fixed base worked well. The kit doesn't include a template guide adapter for template routing, but the manufacturer recommends the purchase of a Makita Template Guide model 321492-3 for this task.

For light routing jobs, this router kit did not disappoint. In fact, I was very pleased by its ability to handle all the tasks I asked of it. The 8366K will never replace a 2-1/4 or 3-1/4HP router but it was never designed to. It's been designed and built to perform light routing tasks and it does so admirably.

King Canada Performance Plus Variable Speed Plunge Router / Trimmer Combo Kit

MSRP: $140
Website: KingCanada.com
Tester: Gord Graff

Milwaukee 2445-21 12V Cordless Jigsaw Kit

BY ROB BROWN

Cordless tools are great for their portability and maneuverability. Their only downside is when they're used for long periods of time, and you start to outrun your battery collection. Like many other hand-held power tools, a jigsaw is certainly one of those tools that I prefer using untethered, free to roam where I may, without the need for a cord. I say this for many reasons, but mainly because I use a jigsaw in many ways: right side up, upside down, inside cabinets, up high, down low and while making a lot of curved cuts. Battery power is a great advantage in these situations.

When the Milwaukee 2445-21 arrived, I was happy to put it to work. It's only a 12V tool, but that's more than enough power for any application I'll ever have. The run time is good, and it feels light, grippy and maneuverable in my hand. A larger battery would only needlessly increase its weight and tire my arm.

The variable speed trigger allows the user to easily and accurately control the speed of the blade. Tool-free bevel adjustment will have you quickly cutting between 0° and 45°, to the left and right. An LED will light up the work area in the interior of cabinets or other dark places.

Blade changes are fairly straightforward. Once a lever is rotated, a spring-loaded mechanism pops the blade out slightly. To insert a new blade, you press against the spring, which isn't too hard but does take some getting used to. Blade changes can be done quickly, with or without gloves.

I used this jigsaw on some 8/4 red oak, along with other materials, to test its limits. The saw cut well and didn't bog down or jump around at all. Obviously, blade selection is key for any saw, and this is especially true when pushing its limits, but with so many blade types on the market you can certainly find one for the task.

Removable Insert – The clear insert that comes with the jigsaw may help reduce splintering, though Brown found it was a lot easier to cut to a line without the insert in place.

Easy Switches – A lever is pressed in order to remove and install the blade. It's an easy task, whether you have gloves on or not.

The saw has a non-marring shoe that can easily be removed if needed. An anti-splintering insert also comes with the saw, but I found it obscured my vision of the line I was cutting to and reduced splintering only slightly. For me, this isn't a game changer; if the quality of cut on the upper surface is important I either use a reverse tooth blade or turn the saw upside down to ensure any splintering is on the other side of the workpiece. I found sight was good without the insert, and that's how I ended up using it. The insert also helps keep thin pieces of material from getting caught between the blade and the base plate.

To me, the overall benefits of using the Milwaukee 2445-21 are that it's lightweight, easy to maneuver, runs smoothly, has more than enough power for all but the most demanding commercial tasks and will easily go anywhere. Everything else it offers is icing on the cake.

Milwaukee 2445-21 12V Cordless Jigsaw Kit
MSRP: $249 (bare tool, battery, charger and case), $149 (bare tool)
Website: MilwaukeeTool.ca.com
Tester: Rob Brown

Photo 5 by Milwaukee, Photos 6 and 7 by Rob Brown

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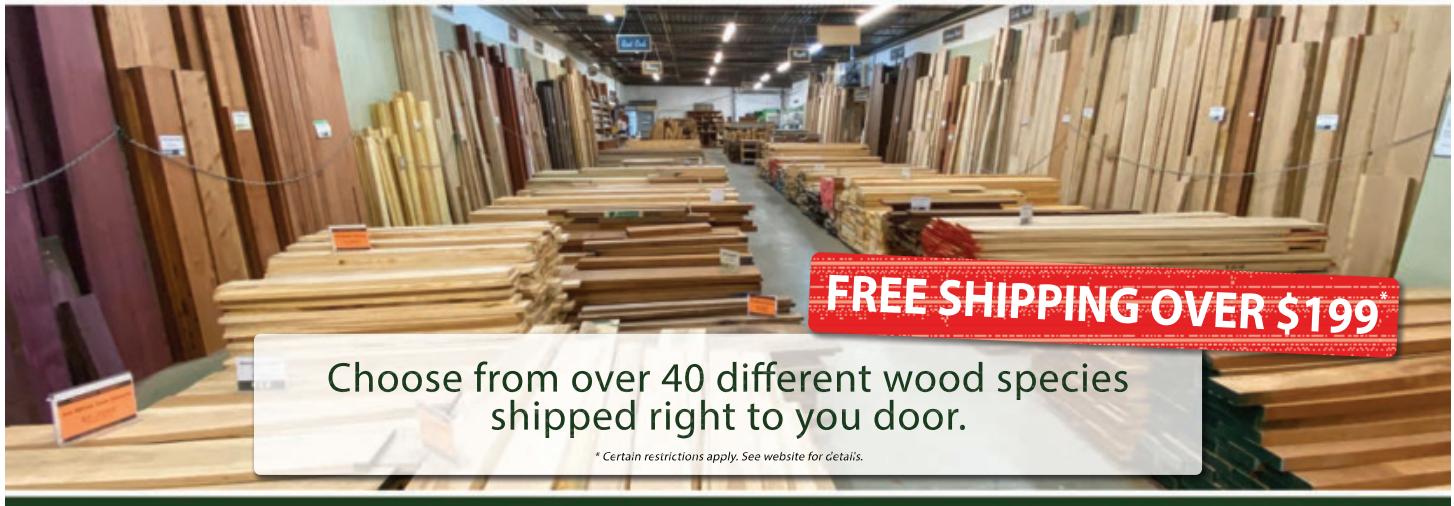

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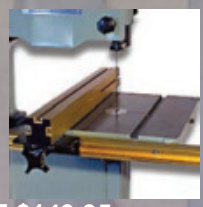

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Climbing the Ladder

I tried making a blanket ladder. See if you can tell where I went wrong.

BY JAMES JACKSON

Last summer I demolished the decades-old shed in my backyard to make way for a shiny new one. Most of the old wooden structure ended up in a dumpster, but I couldn't help but save about half a dozen 2×4 roof rafters from the same trash bin fate. The shed roof had been leaking for years, so the wood had some nice weathering and wear, but the pieces were also still plenty solid with just a bit of rot at the ends.

I knew I could build a nice, rustic project with the seven-foot long boards - I just needed the right idea.

After a year of sitting on a shelf inside the new shed, I finally had some inspiration just before Thanksgiving. I decided to build a simple blanket ladder for my wife, and maybe post the photos online to help spark some Christmas gift ideas among friends and family.

But I'll tell you right now, my initial attempt didn't work out; the ladder ended up out of square and didn't sit flush against the wall. Follow these steps, and see if you can pinpoint where I went wrong.

First, I had to sort through the lumber and find pieces that weren't too warped. I'd already discarded the ones that were rotted or extremely warped, so it was a fairly simple process.

Next, I pulled out the remaining nails that lined the 2" wide portion of the boards. I was excited about these old nails because they had left weathered rust spots along the wood, resembling old barn boards. My hope was to preserve this look with a gentle sanding.

I cut the boards to approximately 5' in length and put a 10° cut on the bottom, so the ladder would lean against the wall to support the blankets. I sanded the wood with 120 grit sandpaper to knock off the rough edges, and again with 320 grit to get it nice and smooth.

Next, I measured 12" up from the bottom and marked the middle of the 4" wide section of the board for the first dowel. I measured up another 12" and placed another mark. I did this for a total of four dowels.

The dowels were 1-1/8" in diameter and 18" long, since the thickness complemented the thickness of the 2×4 nicely. I drilled completely through the wood using my hand drill and a spade bit, being careful not to create too much splintering or chip-out.

It was a tight squeeze to get the dowels into the holes, and I hammered them into place by placing a chunk of scrap wood on top of the dowel so I wouldn't damage it with my hammer.

When I went to place the second 2×4 on top to finish the ladder, though, I ran into a problem. The dowel holes weren't straight, and it took a lot of force to get them into their corresponding holes. Once I managed to get them into place, the ladder was no longer square, and wouldn't lean properly. It wasn't off by much - probably just a few millimetres - but the impact was drastic.

Can you tell where I went wrong?

Cue the cinematic rewind sequence where we go through the entire process in reverse, and stop at the point when I started drilling the holes.

You may have guessed it already, but the problem is that I don't own a drill press, so I decided to try making the holes with my hand tools. Unfortunately, and despite my best efforts, the drill didn't go straight into the wood, and even the slightest angle meant my dowels wouldn't line up and the entire project would be out of square.

So, while this one project may be bound for the campfire scrap pile, I did learn some valuable lessons along the way. The first is I need the proper tools, like a drill press, if I want my projects to be good enough to sell.

Another is that aside from the problem with the dowels, the overall project looked pretty good and I'm confident people might actually want to buy these from me in the future.

JAMES JACKSON
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Illustration by Mike Del Rizzo

2021 Tool of the Year Award Winners

Woodworkers and DIYers from across Canada have chosen the best tools of 2021.

We are very pleased to announce the winners of our 6th Annual *Canadian Woodworking & Home Improvement* Tool of the Year Awards. The awards recognize the best woodworking products released during the year. Winning products were voted on by woodworkers and DIYers from across Canada, from a list of 10 candidates pre-selected by our contributing editors. You can learn more about each of these great new products by visiting: canadianwoodworking.com/TOY2021. Congratulations to all the winners and runners-up, and all the best for a great 2022.

Machinery of the Year 2021

Runner-Up: **Wood-Mizer MP160 Jointer / Planer**

Winner:
King Canada 12" Industrial Jointer/ Planer with Spiral Cutterhead

Runner-Up: **Makita 40V MAX XGT Brushless 10" Mitre Saw with Wireless Auto-Start**

Accessory of the Year 2021

Winner:
Kreg Pocket-Hole Jig 720

Runner-Up: **Woodpeckers Auto-Line Drill Guide**

Runner-Up: **ISOtunes Link Bluetooth Earmuffs**

Hand Tool of the Year 2021

Runner-Up:
WoodRiver Quick Twist Bar Clamp

Runner-Up: **Veritas Side-Clamping Honing Guide**

Winner:
Viking ARM Installation Tool

Power Tool of the Year 2021

Winner:
Festool Cordless Track Saw

Runner-Up: **DeWALT 12V 5-in-1 Drill/ Driver**

Runner-Up:
Milwaukee M12 23 Gauge Pin Nailer

Nick Barna

Jaqueline Desk

Barna loves desks with a light, streamlined look, but they aren't easy to design and build. He was able to support the dovetailed drawer box with the brass stretcher on one side and a leg assembly on the other.

Turn to page 12 for more quotes.
(Photo by Nick Barna)