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JANUARY-FEBRUARY 2019
ISSUE 82

**TIME TO GO
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**HOW TO BUILD AN
OFFSET SMOKER**

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Talkin' 'bout a revolution

Because I do a fair bit of cooking, people say to me, “You like cooking, don’t you”? To which I reply, “No, I like eating.”

Most of us love eating, of course, but I need to know what goes into my food. I like to cook and eat simple, tasty, unprocessed, fresh food, with no added extra anything. That’s why I cook a lot — control. So barbecuing suits me right down to the ground — good-quality meats, cooked just as I like them by me, with fresh salads and veg for balance.

But like so many of us now, when we barbecue at home, it’s mostly on the kettle where you can easily add great smoky flavours and, if you have the skills, cook low and slow to get a mega feast of flavours from your efforts.

However, for the past few years there has been a new way of barbecuing that has been sweeping our nation, and it’s cooking low and slow, using an offset smoker.

Our cover story this issue is selfishly as much for me as it is for you. I want to know more about this low and slow way of cooking, and how to make a smoker myself without having to attack the meagre funds in my piggy bank to buy a tailor-made one. The small amount of this low and slow I have done on our kettle has been very rewarding. Amazing flavours and extremely tender meats that pull apart with ease and melt in your mouth while exploding with juicy, amazing flavours. Are you getting hungry yet?

This issue we feature three ways of building an offset smoker from the ‘Mate, that’ll never work’ to the ‘I used whatever I found in the scrap bin at work to build it

during smoko’ approach — magic — is that a sheddie or what?

We also hope we have given you the complete guide to this fantastic way of cooking in this article, with recipes, wood types, cuts, and much more. Summer is here. Get building, get cooking, get eating, and enjoy all that sharing that this time of year brings.

Just one final thought — at this time of year make sure you have a good rest. For many of us life is made busy with pressures we never experienced when we were younger. Social-media demands, texts, email, chores, work, family, hobbies, money, exercise, etc. It’s a busy old life.

Don’t underestimate the pressures you are under and there’s no shame in asking for help if things get too much. Not only is there no shame, it’s a must!

I have a good friend who has had nine, *nine*, friends or acquaintances attempt or succeed in taking their lives these past few years. All men, and all in their 30s and 40s. So, as the saying goes: ‘Houston, we have a problem.’

So fellas, rest up, relax, take a break, and ensure that you spend time with people you care about and who care about you, and maybe share your shed time with your partner, kids, or mates. It’s not a place you have to be on your own all the time.

Have a great Christmas holiday, a bloody good break, and look after yourself.

Greg Vincent
Publishing Editor
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THE WHERE DREAMS ARE MADE REAL
Shed

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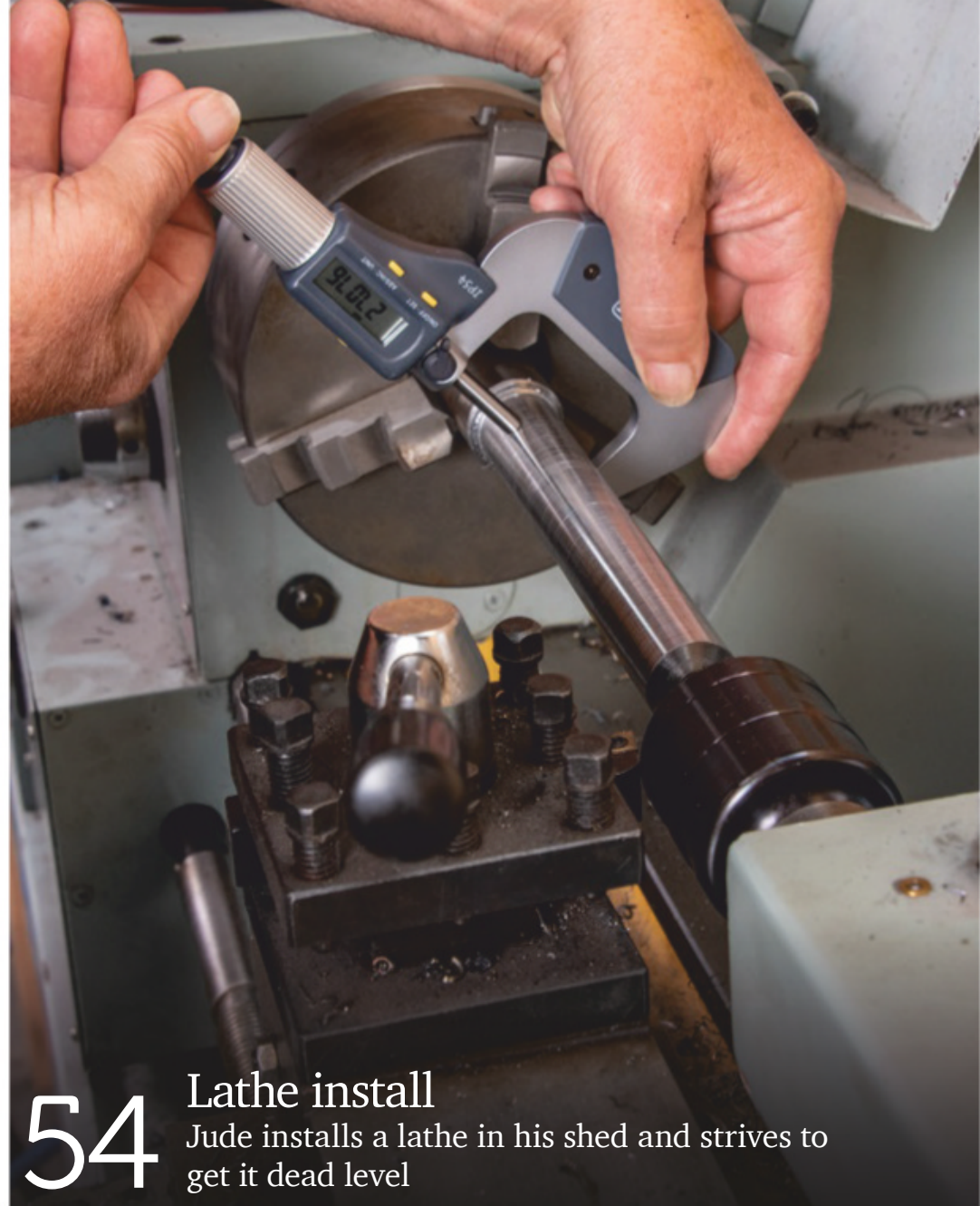
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Make your own low and slow barbecue



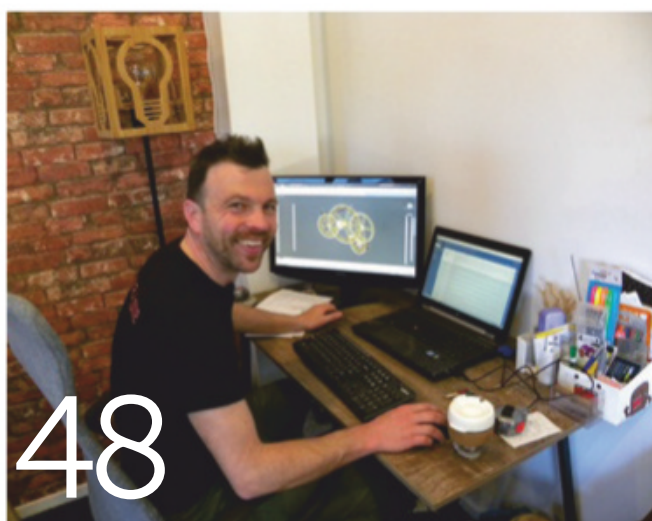
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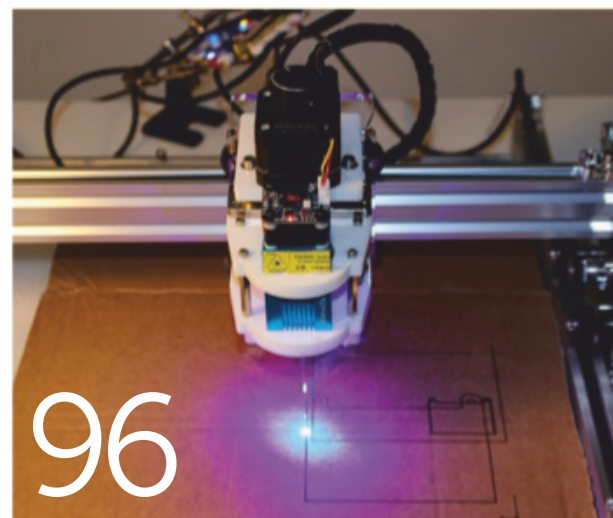
Make this stand for your lightweight modern TV with ease and little skill required



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Off the grid

Our new regular column by Murray Grimwood on a sheddie making his own way

Smoke without fire?



By Ian Parkes

*Photographs: Todd Wylie,
Ray Salisbury, Matthew Lett,
Maurice O'Brien, Roman Taylor*



BARBECUING IN NEW ZEALAND IS ON THE CUSP OF A REVOLUTION. THE SUDDEN APPEARANCE EVERYWHERE OF DELICIOUS PULLED PORK, RIBS, BRISKET, ETC., IS FUELLING THE DRIVE TO A MORE AUTHENTIC LOW AND SLOW STYLE OF BARBECUE COOKING AND SMOKING. TIME TO BUILD YOURSELF AN OFFSET SMOKER AND GET COOKING.

Until now most of us have just been scratching the surface of the art of the barbecue, chucking steaks, sausage, chicken, and fish onto the grill. We might get a bit of additional flavour from the flame or smoke from fat dripping through, but not much. Maybe we use a marinade — but that's still just grilling food. And sometimes we cook on the hot plate — that's just frying food outdoors.

This direct-heat method is still great for small cuts of meat, cooking them at high temperature to caramelize the outside before the inside gets too dry, but the barbecue lid is basically used just to keep the weather off.

Bigger cuts of meat or carcasses naturally need to be cooked for longer and at lower temperatures to ensure that the outside doesn't burn before the inside is cooked.

Real barbecuing has much more in common with a hangi or slowly roasting larger chunks of meat over an open fire.

Target temperatures for the low and slow style of barbecuing are around 100°C–150°C (212°F–302°F).



The best way to get smoke without too much heat is via an indirect method, hence the need to build a separate closed smoker.

Cooking with smoke

Smoking is a different type of cooking. It takes longer, as smoke is much cooler in temperature than direct heat, but it also imparts those delicious flavours that we learned to love over thousands of years of roasting meat over open wood fires.

You need an hour per kilo, but longer for thicker cuts of meat. Some smoking processes can take 20 hours or more. Lean cuts of meat will dry out after this time, but cheaper, fattier cuts of meat just get more delicious. The best cuts are pork shoulder, brisket, beef cheeks, beef short ribs, and pork baby-back ribs.

Slow cooking also allows enough time to dissolve the fat and connective tissue in the meat so that the meat actually falls off the bone. It's the collagen in this extra tissue that breaks down, turns into sugars, and makes the meat moist and juicy.

If you are starting out, go for a small pork shoulder roast like a Boston butt or a picnic roast. You probably won't find these on supermarket shelves. Go and see a specialist butcher. They are cheaper per kilo, which gives you headroom for experimenting with different types of wood, temperature, and time.

Then you can move on to larger and more difficult cuts, like a brisket or ribs, and refine your recipes.

The best kind of second-hand smoke

This desire for smoke without fire gave rise to the offset smoker barbecue, placing the firebox in a separate chamber, as in larger commercial smokehouses. The heat and smoke are funnelled into a large, closed smoking chamber that does the cooking, and then out the chimney on the other side. Maintaining the temperature and getting the right amount of smoke takes practice. You have to manipulate vents, flaps, and fuel, and move the meat around as the end closest to the fire gets more heat than the other end. Some people won't give up the hands-on involvement that this requires, while others add baffles or diffusers inside the smoker to spread the heat and smoke more evenly.

A 'reverse-smoker' variation directs heat and smoke down to the far end of the smoker under the food then back over it to a chimney at the firebox end.

You can back out of workload entirely by buying a pellet smoker. They are direct-heat barbecues with the addition of a reservoir of compressed wood pellets. A small auger pushes the pellets into a little fire pot where an electric igniter rod sets them on fire, and a fan blows smoke into the barbecue.

You could also pop down to the hardware superstore or barbecue retailer and pick up a new but traditional offset smoker from around \$1K to \$7K or more, but that's not the sheddie way, is it?

So let's see how to build a traditional offset smoker in the time-honoured do-it-yourself way. ►

Build a bargain offset smoker —
version one:

More than a hint of oak



Maurice was told by many that his barrel offset smoker would never work. Well, we guess they got that wrong.

Barbecue smokers have to handle lots of heat for a long time, which is why most of them are made from industrial-grade steel — and that’s why Maurice O’Brien made his smoker out of wood.

Industrial Revolution chic is the aesthetic of most offset smokers. The default look is big, black, and brutish steel barrels and boxes. Some of them do their darndest to look like vintage steam trains with tall chimneys and steel wagon wheels.

Maurice O’Brien decided to go another way. He wondered about making one out of a wine barrel, evoking a rustic vibe, which is much more convivial than the Industrial Revolution.

“I just wanted to do something different,” says Maurice.

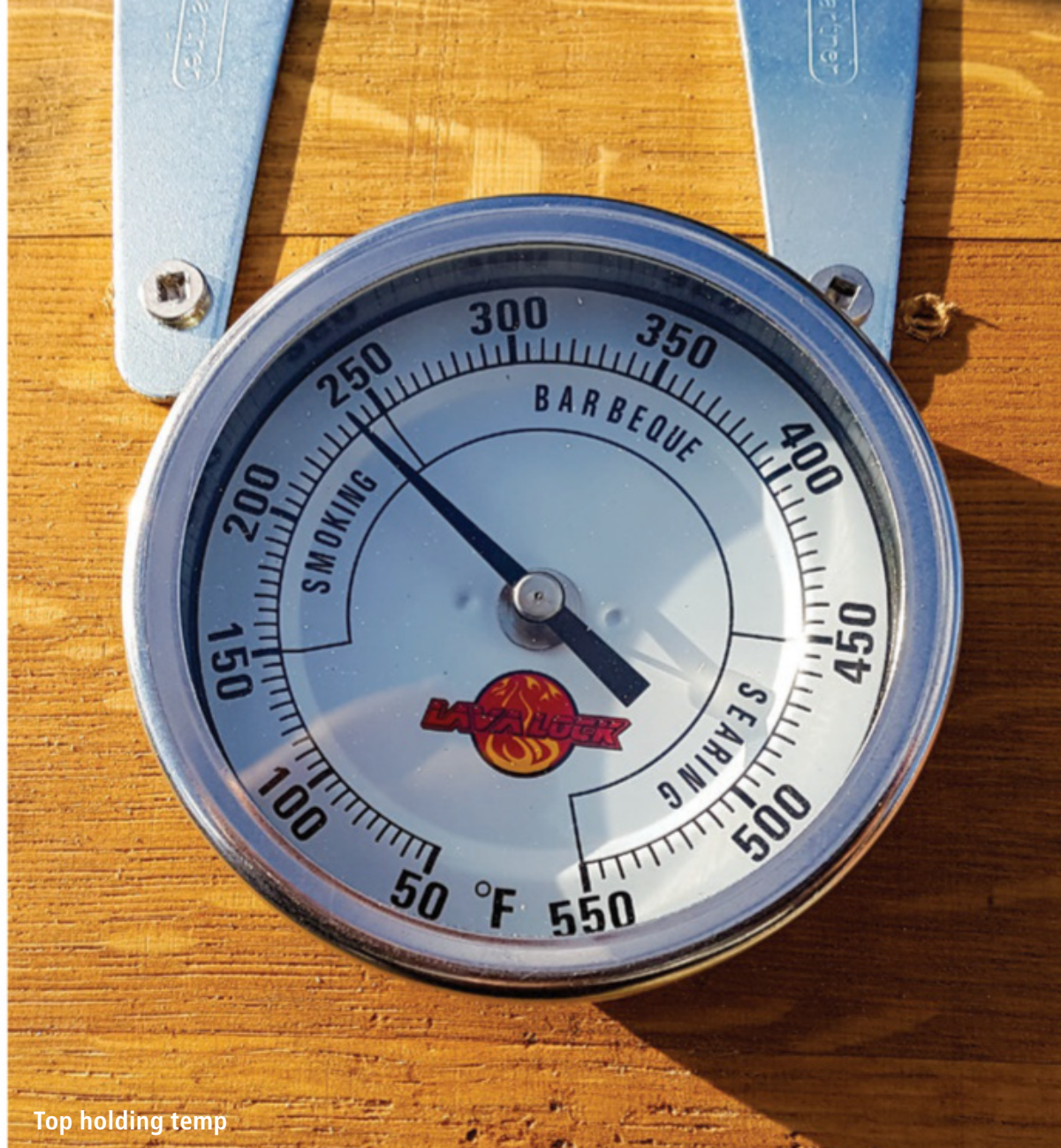
As you don’t set the fire in the barrel — you cook with hot air and smoke — he reasoned that a wine barrel should work. It was the right shape, it was certainly big enough, and it might actually be a bit more fuel efficient — it wouldn’t radiate as much heat as a metal smoker. And the clincher: he wasn’t a welder, but this was a smoker he could still build himself.

That’ll never work, mate

Maurice says that everyone told him it wouldn’t work, which was just the incentive that he needed to buy a barrel of wine, empty it, and then try to build a smoker the same day. Fortunately, that wasn’t the route he chose. He bought an empty barrel, then set about deciding how to prevent it all going up in smoke.

He reasoned that it could handle the temperature of the hot air and smoke inside. The issue would be the connection to the firebox, which would come through the base of the barrel lying on its side in a cradle. Those parts would be steel, and over the extended hours of a cook it would soak a lot of heat over to the wood.

But first he had to get into the barrel, and going in through the side rather than the end posed a problem. The staves are all held in place by the bands. Cutting through them could set off a catastrophic collapse. Maurice decided that he’d have to pin everything in place first. People had also warned him that the wood would open and close as it heated and cooled. He



Top holding temp



The finishing touch to every barbecue

Wine-barrel offset smoker

Builder: Maurice O’Brien, Porirua

Build time: Around 20 hours

Cost: \$1100 — big-ticket items were the engineering/welding, and a diffuser plate that he doesn’t use

wasn’t convinced about that but screwing it together would surely help.

He drilled 300 holes in the bands, two in every stave, then inserted dome-headed screws. “That took the longest of everything,” says Maurice.

Then it was safe to cut across the bands and into the barrel. He decided to use a multitool after realizing that holes drilled for a jigsaw blade would let smoke out. It also made a narrower cut than a jigsaw, which meant that the lid would remain close-fitting. Before he popped it out he fixed a couple of hinges close together at the top. The curved shape of the barrel meant that they couldn’t be too far apart or they would fight each other.

Maurice used boiled linseed oil and turps to oil the barrel — first coat: a 50:50 ratio of oil to turps, second coat: 70:30 oil to turps, third coat: 100 per cent oil. ►



Are they ready yet?



The build is coming together

A few tips



- Slather the meat in the rubs the night before. Most low-and-slow-cooking fans in New Zealand swear by applying them at least 30 minutes before (apart from brisket, which is overnight) so that the salt can help tenderize the meat. They can cook in as little as two hours.
- Spritz your meat often with apple cider vinegar and water to retain moisture.
- Resting your meat also adds to its flavour and tenderness, usually two hours plus for big cuts — wrap the meat in towels and put it in a chilly bin.
- For real success in getting it cooked just right, use a temperature probe for meat — midrange is Thermopro and top-of-the-range Fireboard: fireboard.com/shop/fireboard-fbx11-thermometer/.

“He needed to buy a barrel of wine, empty it, and then try to build a smoker the same day”



Extra bracing on the inside



The funnel template is ready



Wow, the smell of wine from the barrel is magic

Maurice designed and built his own trolley and naturally that had to be wood too, to keep with the rustic theme. Big lumps of macrocarpa came at the right price but Maurice says that it's not ideal, as it splits easily. So he got busy with the screwdriver again. “You can't see the splits,” he says.

What about the firebox?

There's no escaping a steel firebox though, so non-welder Maurice hot-footed it down to a big-shed hardware shop and bought one. It's part of an offset smoker

kit but you can buy bits individually. Maurice just needed the firebox.

It came with a blanking plate to fit over the oval-shaped smoke hole for those using it as a stand-alone barbecue. Maurice used this as a template to mark the cut-out on his barrel. Then he got a local engineering company to make an adapter plate, basically a pipe with a flange on it, to bridge the gap between the holes in the firebox and the barrel. It has to clear the lip of the barrel, which is higher than the top (or end of the barrel, as it's now on its side). This

adapter is welded to the firebox and bolted around the hole in the barrel.

At this point the inside edge of the barrel was still exposed to heat so the engineers also made a kind of funnel device to pop into the hole. It protrudes a couple of centimetres into the barrel, directing the heat further into the barrel and away from the wall.

Maurice fired it up and gave it a test run. “I stoked it up really hot, hotter than I'd run it in a real cook, to see what happened. Once it had all cooled down I pulled it apart again,” says Maurice.



One bag of charcoal along with some fruit wood has lasted Maurice six cooks



Parts for this build came from an offset smoker kit



All fired up ... looking good

“It wasn’t good. There was some scorching where it touched.”

He needed some insulation between the adapter plate and the barrel. Maurice works in a home-improvement shop and he spotted some fibrous cement panelling used in wet areas or to protect walls around wood burners. Ideal really.

He bought some fibreboard, which he shaped and fitted like a gasket between the adapter and the barrel. It was all bolted back together for another test. He dismantled it again to check and ... success! No more charring, except where he wants it — on the meat.

“I fired it up again last weekend for a 12-hour smoke and it worked fine. It’s still going strong,” he says.

Fine-tuning

Friends at work persuaded him to fit a diffuser plate under the racks to spread the heat and smoke more evenly. Maurice went back to the engineering shop and had a plate made but after installing it he felt it robbed too much heat. He not only found the food cooked better without it, but he also used less charcoal and wood. The smoker is definitely hotter towards the firebox end but he finds that useful. ►



Which type of wood should you use?

Manuka

Flavour: Strong

Good for: Pork, beef, turkey

Peach

Flavour: Mild

Good for: Pork and poultry

Apple

Flavour: Light

Good for: Pork, beef, seafood, poultry

Cherry

Flavour: Light

Good for: Pork, seafood, poultry

Hickory

Flavour: Strong

Good for: Pork, beef, turkey

Oak

Flavour: Strong

Good for: Beef

Guava

Flavour: Mild

Good for: Pork and poultry

Maple

Flavour: Mild

Good for: Pork and poultry



If looking, you're not cooking

He's fitted three racks inside the smoker — a rack on the stand, a shelf under the door, and he's added a kind of spice rack under that for rubs and marinades and the other stuff you need to hand in the heat of a cook.

Maurice's temporary method for dealing with fat dripping down might get changed, or it might not. He lays tinfoil in the bottom and chucks it out after, which he says works just fine.

He's taken to placing a tray of water in the smoker too — an accepted trick to help prevent meat drying out.

Now the real fun begins

He says he's "rolled out the barrel" about half a dozen times, cooking for between 10 and 16 hours at no more than 75°C. In that time he'll get through a bag of charcoal and half a bag of apple wood. Fruit woods are supposed to add their own special flavour.

So far, Maurice has cooked a brisket, sides of pork ribs and beef ribs, and pork strips, experimenting all the time with rubs, marinades, injections, and sauces. While the barrel may have contributed hints of oak to wine, Maurice hasn't

noticed the reverse process — hints of wine in the cook — but then slow-roasted meat is so rich in flavour that he didn't expect it to.

He set out on the low and slow route cooking St Louis ribs on his Weber. The trick there is to line up charcoal briquettes in a circle and light just one of them. They burn through one at a time. After a few goes with that he was hooked.

"It's like golf — one good hole and

it brings you back again and again," he says.

Maurice says that he is just starting out and is a long way yet from claiming he's a 'pitmaster'.

"I don't think you can claim to be a pitmaster until you have mastered a brisket," he says. It's a cheap cut of meat, sinewy and fat, but those are the elements that render and break down in slow cooking and make it so delicious. ►



The bend test — they're done!



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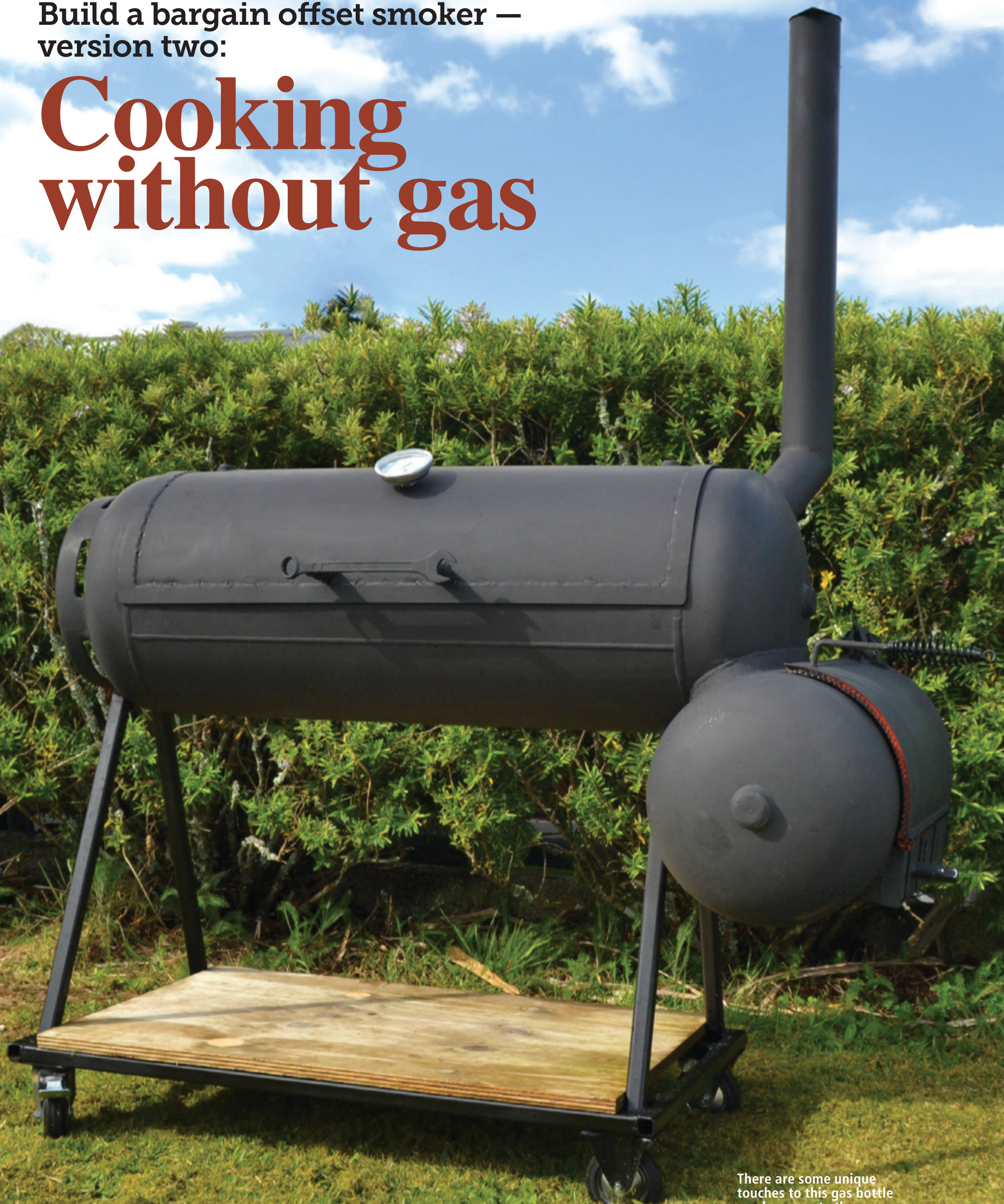
Unless you are a world class athlete like Tom Walsh, who can lift 250kg, health and safety recommendations are that two people are required when lifting a 40kg bag of cement.

Tom Walsh

New IAAF World Champion,
Olympian, NZ record holder,
qualified builder, NZCB member
and ITAB graduate.

Build a bargain offset smoker —
version two:

Cooking without gas



There are some unique touches to this gas bottle smoker — note the chipping-hammer handle keeping things cool



Nice lines and a nice finish

*‘Give a man a fish,
and you feed him for
a day. Teach a man
to build an offset
smoker barbecue,
and you feed him for
a lifetime’ – ancient
shed proverb*

LPG special

Builder: Matthew Lett, Rotorua

Build time: 25–30 hours (not including thinking time)

Cost: \$250 including box-section steel, wheels, and consumables



Keeping wood handy is a good idea

It's elegant, original, and short enough to fit in a confined space. Matthew Lett made a smoker like no other using gas bottles.

The elegant curves in Matthew Lett's offset smoker make it look like a stylish factory product, or maybe part of a Cold War-era submarine, but then the builder's signature touches catch the eye — the spanners sacrificed for handles and hinges; the spark-plug socket handle on the vent; and, above all, the wacky way that the firebox door opens and hangs in space, which is also reminiscent of a submarine hatch.

Matthew, like Maurice, likes to do things his own way. He's not the first to build a barbecue out of LPG bottles but he celebrates the challenge they presented. Most people cut off the curved ends to have nice flat surfaces

to work with. That makes it easier to mount the bottles end to end, and to cut a vent into the end of the firebox.

Too easy, reckoned Matthew. He decided to mount them crosswise, primarily to make the unit as short as possible. US builders generally don't need to worry about space but Matthew's had to fit on the deck of a Rotorua townhouse.

A lot of curves to contend with

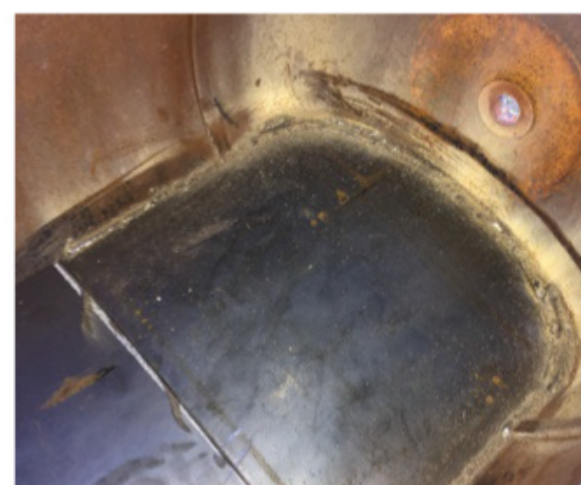
That gave him quite a headache working out how to get all those curved surfaces to mate up. He eventually sorted out a template and made the cuts, letting the firebox vent into the smoker. It nearly worked, too, but he did have to add a flat bar band around the join to cover up some of the welds and filling. ►



Matthew used what he had around to cut build costs to great effect



Basically the whole build was done with an angle grinder and a welder. The only real costs were for the box-section steel and the castor wheels



There's the rub

Building your offset barbecue is only half the fun. Just as there are no rules for building one, there are no rules for how to cook in one, but a few traditions might give you some pointers.

The US has a number of regional styles. The South is famous for its sweet barbecue sauces because molasses and tomatoes were easy to come by there. Pork is the traditional meat. Cattle farming in the West led to Texas barbecue using beef with a dry rub including some Mexican spiciness, and the local mesquite scrub wood added its own flavour. Sauce is added just before serving.

Carolina-style barbecue is known for tart cider vinegar, mustard-based sauces from European cooking, and basting the meat — a technique picked up from the Caribbean. Kansas City has its

own barbecue culture, which applied Southern-style sweet and spicy barbecue



sauces to beef, merging the Southern and Western styles.

Rubs can be as basic as salt, pepper, and garlic powder, or a sweeter option — brown sugar, salt, pepper, and paprika, filled out with ground fennel seeds, coriander seeds and star anise. A quick google offers up a mouthwatering array of recipes, some noting that pork rubs need less sugar than beef.

Or you can buy commercial rubs and sauces. They have tried and tested the flavour profile and chosen a winning formula. Choosing something with broad appeal is sensible, as you probably won't just be cooking for yourself, and not everyone will share your passion for eyeball-melting hot chilli. You will have plenty of other things to experiment with when you start out.



There were a few challenges with angles and curves to overcome

“US builders generally don’t need to worry about space but Matthew’s had to fit on the deck of his Rotorua townhouse”



Matthew’s chimney is at the firebox end

The vent system also provoked deep thought. A simple flap or rotary disc on a flat end would work but that was out of the question. “I had sleepless nights over that,” says Matthew. “I can’t stop thinking about things until they’re finished. I probably spent four or five weeks thinking about that dampener. I just wanted to build it once. Mind you, I had an idea that worked and then halfway through building it, I changed it. If it can be done differently, I’ll do it differently.”

All up, \$250!

He started with two LPG cylinders that he got from the dump. As they cost money to be cut open safely before scrapping, he got them free. But he still had to open them. He took them to a farm, removed the valve, and washed them out with soapy water. Then he filled them with water before cutting into them with an angle grinder. “It had to be safe but it was still pretty nerve-wracking,” he recalls.

Announcing our own great Kiwi barbecue sensation



The Aussies have their shrimps and pineapple, the South Africans their braai, and Argentina has its own *asado* barbecue style. We Kiwis now have a chance to develop a distinctive low and slow barbecue style based on our own iconic ingredient: sheep! Lamb shanks are already well known as a low and slow delight. So the cuts that also work for pork and beef will also work for lamb. But forget lamb — let’s go the whole hogget and use mutton. Mutton has much more flavour — and that’s what barbecue is all about. So, ask your butcher about mutton shoulder, and start experimenting. Here’s a few options: Greek-style herb rubs will work well — oregano, marjoram, and bay, served with Greek salad and tzatziki; or you could go more Moroccan or Tunisian (merguez) with coriander, cumin, and chilli, served with minted yoghurt; or to really bring out the flavour, you could use garlic, rosemary, and anchovy (the secret ingredient is Worcestershire sauce). Come on New Zealand, start your smokers.

Matthew says that he did everything with an angle grinder or a welder. His only material costs were for the box-section steel and the castor wheels, giving him a total cost of about \$250. The grate he swapped for a litre of home-made gin. Yes, he also makes damson-plum gin.

Spanners were a no-cost option. He was a diesel mechanic and had no problem sacrificing cheap, old imperial spanners that he wouldn’t rely on anyway. ►

A man with a full brown beard and sunglasses is leaning his arm on the lid of a large, black, offset smoker. He is wearing a red, white, and black plaid shirt. The background is a red brick wall. The smoker has a diamond-plate metal handle on the left side.

Build a bargain offset smoker —
version three:

Taylor-made smoker

Roman works in an
engineering business so his
only real expense was paint



Roman used a pressurized water tank for his smoker's main body and used Feldon's BBQ Pit/Smoker Build Calculator for critical dimension advice

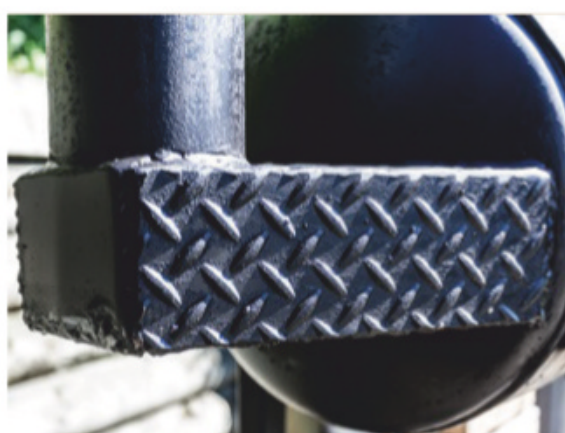


The Iron Maiden

Builder: Roman Taylor, Nelson

Build time: A month of every second smoko at work

Cost: \$141.20. The biggest expense was the paint



You can't go wrong if you follow Roman Taylor's recipe for a rub — and for building a smoker to cook it in. This is the most traditional design and the cheapest.

Roman, of Nelson, works at an engineering business and he's pleased with his design. After putting seven cooks through the smoker in the three weeks since he finished it, he's thinking of going into business making more of them. He's already got a few on order from his mates. A bit unnecessary, perhaps, as at the rate

He's already got a few on order from his mates

he's cooking, they won't be running out of barbecued meat any time soon.

Roman started with a pressurized water tank that he saw advertised, similar

to an air-compressor tank, which was used to distribute water around a farm to drinking troughs.

It measured 1400mm long by 500mm wide, a handy size for the smoke chamber. But they are not all the same and if you find a tank with different dimensions Roman says that you need to consult the barbecue bible, Feldon's BBQ Pit/Smoker Build Calculator; just look it up online. It will give you critical dimensions for the firebox and chimney to suit your smoke chamber. ►



Wet or dry rub?

Some meats are marinated in sauce and then grilled and basted. Others like beef brisket and pork are covered in a dry rub and left to cook until the rub forms a crust, or bark. In the US, both versions are then sauced afterwards as well.

Dry rubs are favoured for ribs. They can be mostly salt and pepper with some spices but brown sugar is also commonly added. Make sure you remove the membrane — see weber.com/US/en/grill-skills/mastering-pork/ribs/removing-the-membrane-from-baby-back-ribs/weber-34589.html.

A wet rub can be the same as just mentioned but with the addition of oil, or it can start out as a sauce. They can be mustard based, with added vinegar, or tomato and molasses based. The tomato can be slathered on to create a glaze, or thinned with more vinegar, which penetrates the meat.

Or you can make a nice marinade, such as finely chopped rosemary, garlic, olive oil, and red wine vinegar. Baste the meat with it and steep it overnight.

Some rub recipes



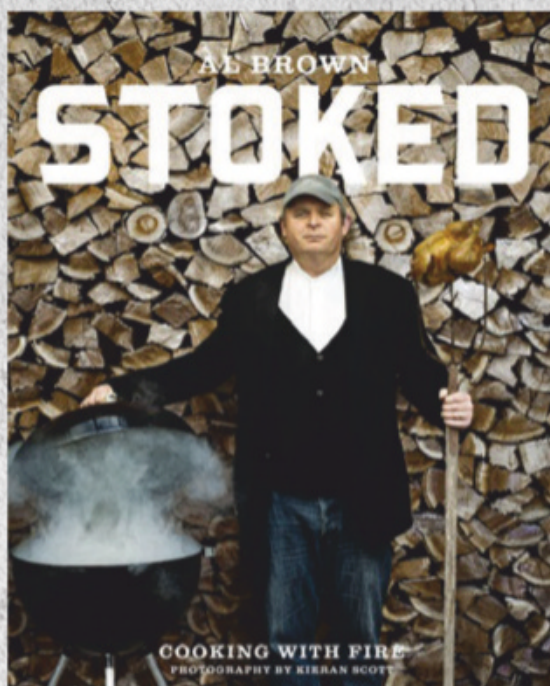
Elspeth's dry rub

1tsp fennel seeds
2½tsp flaky salt
6tsp brown sugar
2tsp sweet paprika
2tsp smoked paprika
2tsp ground chilli
2tsp garlic powder
1tsp ground cumin
½tsp ground nutmeg
Toast the fennel seeds in a dry frying pan until fragrant, then grind to a powder using a mortar and pestle. Add the flaky salt to the mortar and give a light bash to break down some of the larger crystals. Transfer the fennel and salt to a mixing bowl and add the remaining ingredients. Mix well, ensuring that there are no lumps of sugar. Store your rub in an airtight jar away from direct sunlight. This rub works well with pork ribs, beef short ribs, and chicken. Rub a generous amount onto your chosen meat 12–24 hours prior to cooking, if time allows, but it will also work well as a last-minute seasoning.

Al Brown's Carolina spice rub

2tbsp Spanish smoked sweet paprika
2tbsp ordinary paprika
2tbsp salt
2tsp freshly ground black pepper
2tsp cayenne pepper
A little sweet, a little spicy and a little heat.
Mix all the ingredients together in a bowl and store in an airtight container. Great for brisket.

Our thanks to *Stoked* by Al Brown, published by Random House New Zealand, RRP\$70
Photograph: Kieran Scott



A square chimney

Sticking with Roman's plan, his chimney is 1400mm of 150mm pipe. He welded that to a triangular box (with the point cut off and welded shut) that he made out of tread plate. It is about 10mm from each side of the tank where it is welded to the smoker and 100mm deep.

The chimney is cut off at an angle inside it. Some smokers' chimneys are welded straight onto the side of the smoker. Roman went to the effort of building this square funnel to make sure the chimney drew the smoke evenly across the width of the smoker, and it adds a bit of balance to the design.

The lid

He welded a length of 15mm bore pipe, just short of the same width he wanted for the lid, along the top of the cylinder to provide a mount for the hinge. Then he took two lengths of 12mm rod, bent 50mm of them at right angles, and inserted the short sections into the pipe. Next he heated the rods with a gas torch, bent them down to follow the curve of the cylinder, and welded them in place. Roman says that no matter what kind of hinge you intend to fit, it's best to fasten them in place before you cut out the lid.

"You know it's going to work and it's just much easier than trying to hold loose parts in place while you fasten them up," he says.

Then he cut out the lid with a plasma cutter. That left a gap all around the lid. The solution is to weld 20x2mm flat bar around the edge of the lid, which provides an overlap and closes the gap.

To create a handle he slipped a length of the same 15mm bore pipe over some more 12mm rod and welded this in between the two 60mm lengths of 40x5mm flat bar. Then he welded the flat bar onto the front of the lid. This gave enough room to get his hand on the handle with a decent clearance to the lid. Roman says that the loose fit of the tube over the handle keeps it cool enough, and it rotates nicely, maintaining a comfortable grip when you lift the lid.

The firebox

This is simply a 480mm length of thick-walled (12mm) pipe — the thickest he could find to avoid losing heat. It's also ►



Being a welder by trade means that Roman's smoker is built tough and sturdy. Once the build was completed, oil was painted on the insides and a fire made as hot as possible to season the metal, close any pores, and prevent rust



Cooking Roman style



Roman describes himself as an old-fashioned Texas barbecue man, which means that rubs don't need to be any more complicated than salt, pepper, and garlic powder. Texans also tend to go for sweet sauces but Roman isn't such a fan of these.

Asked about temperature, he said that it varies depending on how much meat you are cooking but he sticks at 250°–275° — that's Fahrenheit. "Oh, that's the number-one rule of barbecuing," says Roman. "Never talk in anything other than Fahrenheit. You will find yourself run off discussion forums for mentioning the word 'Celsius'. It's very, very important. Never use the 'C-word'." Interestingly, he used a thermometer for the first couple of cooks and was a bit disappointed. Now he just uses the two-second rule: if he can hold his hand on the smoker lid for more than two seconds, it's too cool; if he burns his hand, it's too hot.

"I just do it by feel. I'm old-fashioned all the way," says Roman, aged 30.

"That's part of barbecuing. That's where it started, with slaves cooking cheap cuts of meat and just learning how to do it by feel. Sure you can get thermostats and fans, and fan controllers, but for me it's about charcoal, fire, and wood smoke, and without that it's not traditional."

Texan barbecues use the local mesquite wood and oak. Roman uses oak and what he can get locally — manuka for stronger-tasting meats but he says that it can overpower chicken. He likes apple, cherry, and especially plum — "It's a very sweet, mild smoke."

He's right behind the move to barbecuing mutton, or actually ... "Way ahead of you. Mutton is great," he says. While it's not as well known as beef and pork in US barbecuing, Kansas has a mutton barbecue tradition, says Roman. "I like herb rubs — not overly spicy and nothing sweet. You don't want to cut into the savoury flavour."

Roman says a barbecue is very therapeutic, watching the smoke with a drink in hand, but it's more than that, as it provides an all-day feast for friends.

"As Anthony Bourdain said, a barbecue isn't the road to world peace but it's a start." Roman also grew up reading the pages of *The Shed* and for him being featured in the magazine — and he used these words — "is a real honour".

Roman gets deeply involved in what he does, so it's no surprise what he has named his smoker.

"I work in heavy metal, I listen to heavy metal, and my new favourite toy is made of heavy metal, so it just had to be called 'The Iron Maiden'."



Roman Taylor — Texas barbecue man

480mm in diameter. He welded a 10mm plate onto the end that butts up against the smoker cylinder, leaving just a small gap for the smoke to pass from the firebox to the smoker — about one-eighth of the area of the end plate.

The firebox door is a circle of 5mm tread plate, also cut with a plasma cutter. The hinge arrangement is essentially the same as for the smoker lid with one complication. The straight, vertical tube for the hinge has to be attached to the curved side of the firebox. A short length of 40mm angle iron had enough depth to take that shape, so that was cut and welded to the side of the firebox, and the tube was welded to the return. Hinge rods, 12mm again, were inserted and welded to the front of the plate. The hinge rods were given a slight kink to sit the plate flat against the end of the firebox.

The vertical handle on the firebox door

is slightly different from the smoker-lid handle, in that the offsets from the door were also made from 40mm angle iron this time, just because he found the right-size offcuts in the scrap bin at work.

Careful planning is key

Here comes the tricky bit, but it's not all that tricky. Roman simply held up the firebox to the end of the cylinder and drew around it with a Vivid marker to mark the cut on the smoker cylinder. Then he cut up vertically from the bottom of the smoker to the line, and cut along the line. It worked well enough to be able to weld the firebox straight in.

Roman made the stand from 40x40mm box-section steel. He added a shelf of 5mm aluminium tread plate for firewood storage, and the castors were salvaged from a stand at a previous employer's, when its wheels were replaced.

“Never talk in anything other than Fahrenheit. You will find yourself run off discussion forums for mentioning the word ‘Celsius’. It’s very, very important. Never use the ‘C-word’.”

Inside the smoker, he welded two sections of angle iron for the cooking grill to rest on. It partially covers the hole from the firebox, where it also does a good job of keeping flames from licking through and burning the food. The remaining hole is only about 30mm high.

The cooking shelf is cut from elongated steel mesh and he used the same mesh in the firebox. No need for angle-iron supports this time as it just finds its own support on the curved sides of the firebox. It’s not fixed, making it easier to take out and clean.

The next step was to spray or brush the inside of the smoker and firebox with oil and stoke the fire as hot as he could get it to season the metal, prevent rust, and close any ‘pores’ in the steel.

Best of all, thanks to Roman’s careful planning, it worked. He says that he can happily leave the smoker for a couple of hours without it needing attention.

As Roman works at an engineering business, he has a policy of checking everything that goes into the scrap bin. Almost all of his smoker parts came out of it.

Roman says he owes boss Brendon Smith at Metalcraft, Tahunanui, a big vote of thanks. The smoker took up workshop space at a busy time but at least he had the wheels on it quickly so he could move it out of the way.

And he thanks Dan and the team at the Mad Butcher in Stoke, who source the cuts of meat that you won’t find on most packaged-meat shelves.

Smoking times and temperatures



Converting from Celsius to Fahrenheit, just multiply the temperature by 1.8 and then add 32.

Smoking item	Smoking temp	Smoking time	Internal temp
Brisket	225°F–250°F	1.5 hours per 500g	185°F–195°F
Brisket, pulled	225°F–250°F	1.5 hours per 500g	205°F
Chuck roast	225°F–250°F	1.5 hours per 500g	125°F–185°F
Chuck roast, pulled	225°F–250°F	1–1.5 hours per 500g	195°F
Filet mignon	Cold smoke then 250°F	Until done	Until done
Hamburgers	225–250°F	30–40 minutes	Until done
Prime rib	225°F–250°F	12–20 minutes per 500g	125°F–145°F
Sirloin tip roast	225°F–250°F	8 hours	Until done
Whole ribeye loin	225°F–250°F	20–30 minutes per 500g	125°F–145°F
Rump roast	225°F–250°F	30 minutes per 500g	145°F
Beef short ribs	225°F–250°F	8 hours	Until done
Beef tenderloin	225°F–250°F	1.4 hours	120°F–160°F
Chicken breast	275°F–350°F	1–2 hours	170°F
Chicken thighs	275°F–350°F	1.5 hours	170°F
Chicken wings	275°F–350°F	1.25 hours	170°F
Turkey	275°F–350°F	2–3 hours	170°F
Lamb	225°F–250°F	4–8 hours	135°F–165°F
Lamb shanks	225°F–250°F	4 hours	Until tender
Belly/Butt bacon	less than 100°F	6 hours	140°F
Pork butt	225°F–250°F	1.5 hours per 500g	170°F
Pork chops	225°F–250°F	1.5 hours per 500g	160°F
Ham (bone in)	225°F–250°F	1.5 hours per 500g	160°F
Pork crown roast	225°F–250°F	1.5 hours per 500g	155°F–165°F
Pork loin	225°F–250°F	4–6 hours	160°F
Pork sausage	225°F–250°F	1.3 hours	165°F
Ribs (baby back)	225°F–250°F	5 hours	Pulls back from bones
Ribs (spare ribs)	225°F–250°F	5–7 hours	Pulls back from bones
Pork shoulder (sliced)	225°F–250°F	5–8 hours	175°F
Pork tenderloin	225°F–250°F	2.5–3 hours	160°F
Whole pig up to 45kg	225°F–250°F	16–18 hours	205°F
Fish whole	225°F–240°F	3.5–4 hours	Until flaky
Fish fillets	225°F–240°F	1.5–2 hours	Until flaky
Salmon (cold smoked)	70°F–80°F	2–4 hours	Until done
Salmon (hot smoked)	200°F–225°F	3–4 hours	Until done
Crayfish (steamed)	200°F–225°F	15 minutes per 500g	To taste
Scallops	190°F	1–1.5 minutes per 500g	To taste
Duck (whole)	225°F–250°F	3–4 hours	170°F
Venison roast	200°F–225°F	1–1.5 hours per 500g	160°F
Venison tenderloin	225°F–250°F	1–1.5 hours per 500g	160°F



You soon learn to use heat-resistant gloves constantly



2018 Auckland Blade Show

NEW EVENT FOR KNIFE ENTHUSIASTS SETS HIGH STANDARD

By Brent Sandow

Just on 300 people came through the doors on 6–7 October for the first Auckland Blade Show, held at the historic Parnell Community Centre.

To say the standard was high is an understatement, and this certainly bodes well for the future of New Zealand knife making. Feedback from both exhibitors and the public was extremely positive, with many knives going to new homes.

What was interesting is that most makers had their own style and take, so there was a great variety of different knives available. Whether you were after a hunter, a filleter, or a kitchen knife it was there. That's before we even get to the collectables made from Damascus steel with exotic handles ranging from fossilized walrus ivory to highly figured exotic woods. On both mornings before the show opened, it was great to see the makers connecting and sharing knife-making ideas.

Gameco, the knife-making supplies company, had six tables and did a great trade selling supplies to existing makers and newbies alike. They had quite a range of products for sale at the show, including blade steel, handle material, leather sewing



machines, belt grinders, and a host of other supplies and tools.

Also at the event we had collector Vincent Saunders on hand displaying part of his Randall collection, and what a treat that was. Knife dealer Terry Finney, from Knives of Africa, was also in attendance, representing the fine line of knives from various South African makers that he sells, as well as Matt James from Damascus NZ with his Damascus billets and knives. Last but not least show sponsor *The Shed* was on hand to promote its products.

The good news for knife fans is that planning for next year's show is already underway. Keep an eye out for more details.

Best of Show awards

Best Hunter: Leif Haseltine

Best Bowie: Jerry McClure

Best Historic: Richard van Dijk

Best New Maker: Guy and Carter Fearon

Best Table Display: Shea and Lena Stackhouse

Best Folder: Jerry McClure

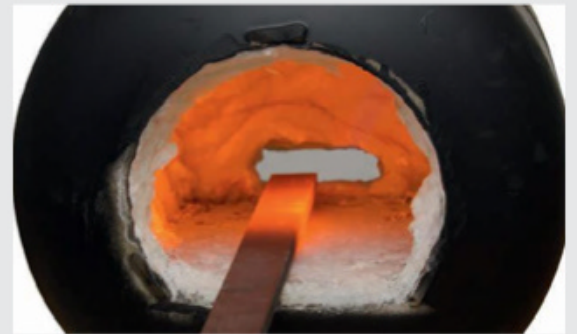
Best Kitchen: John Worthington

The Shed online

What's happening online at theshedmag.co.nz?

Every week we upload new content on *The Shed* website joining the 100s of articles and videos already on the site for readers to discover, learn from and enjoy. The past two month's new uploads include:

- how to build your own workshop forge from a gas bottle



- how to make this stylish chair using recycled native timbers to have it last many years of harsh New Zealand weather



- Des Thomson demonstrating the easy-build metal sweeper from *The Shed* Issue No. 81



- our bunk makers from *The Shed* Issue 81 and learn more about one of New Zealand's largest Men's Shed.



These are just some of the new uploads to our website in the past two months. Visit theshedmag.co.nz to enjoy even more.

The Shed is now on Instagram:  search 'theshedmag'.



New name and a new direction for major power tools brand

Popular power tools brand Hitachi has rebranded to 'HiKOKI'. The name change reflects the innovative new direction the company is taking. While maintaining the quality it's known for, HiKOKI is revolutionizing the power-tool landscape with its new Multi Volt platform.

HiKOKI's aim with Multi Volt is to free users from power cords and conventional battery platforms. The company has drawn on its 70 years of Japanese design and the latest advances to make larger tools — those that have traditionally relied on mains power — cordless. The new platform automatically switches voltage between 18V and 36V, delivering what the company says are previously unseen levels of performance and reliability.

The main change for the business is

the increased focus on technological advances. Under the HiKOKI brand, the aim is to push technological limits further, bringing greater innovation to the end user.

For existing lines, the change is simply a different label. The company will continue to manufacture in the same factories to the same quality. In New Zealand, HiKOKI will continue to be distributed by Accent Tools Ltd, which has seen success in the industry over the last 30 years.

There's also good news for those who already own some of the Hitachi range: Multi Volt technology is fully compatible with both Hitachi and HiKOKI 18V cordless tools and HiKOKI's new 36V Multi Volt power tools. More information can be found at hikoki.co.nz.

Coregas' new Trade N Go Gas system

Coregas is set to revolutionize the gas-buying game in New Zealand with its Trade N Go Gas system.

The company has been around since 1974, supplying gas to the Australian and New Zealand markets. Priding itself on its excellent customer service and safe and cost-effective products, Coregas spotted a weakness in the market and set out to create what is essentially a 'swappa' system for your gas bottles.

Until now, DIYers and commercial users who only use small quantities of gas have had to pay rental fees for their cylinders in order to have them on hand and ready to use. The answer, according to Coregas, is to offer a trade-and-go system similar to what is currently offered for LPG gas across the country.

The Trade N Go Gas system includes your most commonly used gases: acetylene, oxygen, argon, and MIG shielding gas. Users simply pay a fully refundable deposit for a D-size cylinder plus the cost of the gas. There is the option to either return the cylinder for a full refund of the deposit, or trade it for another on the spot.

Coregas' nationwide network is continuously expanding, and includes participating Bunnings and NZ Safety Blackwoods stores, as well as its own service centres. Visit tradengogas.co.nz to see the full list of participating stores and to find out more.





Engine volunteer Graeme Murray at work cleaning the cylinder block of the Witte swing-arm log saw

Time machines

KAURI MUSEUM VOLUNTEERS RESTORE OLD MACHINES THAT TELL OF OUR HISTORY

By Deb Clapperton

Photographs: Stephen Davies

The Matakohe Kauri Museum, which opened on 29 January in 1962, stands on a small knoll overlooking green pasture, an historic totara house, and then out to the Kaipara Harbour.

As the last remnants of mist uncoil from the placid waters a trusty band of volunteers makes its way to the rear shed door. It is Wednesday: volunteer day. Today there are only four: Kerry Bonham, Bill Poyner, Ralph Paulger, and Graham Murray. Other volunteers, past and present, include

John Cooper, Max Wallis, Lloyd Eager, and Ian Cullen, with their years of volunteering ranging from 30 years to three months.

Year after year, the work of reassembling rediscovered or donated machinery, and the ongoing maintenance, has been the focus of this committed team of volunteers.

Dedicated volunteers

The museum tells the story of the early European settlers, mainly through their relationships with the ancient kauri and its

gum. It preserves our past but also sees its role in conserving the mighty trees' future. Visitors are able to see, hear, and touch the machines and devices that were used in the kauri industry. It is thanks to the skill and expertise of these men in their shed that this equipment is, or is about to be, in working order.

The working sawmill draws much visitor attention. John Cooper, Max Wallis, Ian Cullen, and Everard Judd were responsible for much of its restoration, although Graham Murray has been involved with the maintenance more recently. He comments that the saw doctor was paid more than a medical doctor. The sawmill steam engine (today a cleverly disguised electric motor) drives most of the machinery in the sawmill — namely, a vertical breakdown saw, docking saw, cant saw, and breast bench saw.

The models that are positioned working in the pit are so lifelike that in low lighting they seem about to break into speech at any moment. At times it is hard to differentiate between the living volunteers and the models!

Constant maintenance and restoration

The vertical breakdown saw used to cut huge kauri logs in half was still in use in the Matakohe sawmill until 1991. Built by Alfred Leaf in 1917, it was moved to Parahi, then in 1928 to Hukatere. Originally driven by a 9hp (7kW) Tangye engine, it was then driven by a Fordson Major Tractor, and later in 1954 in the Weber's Matakohe sawmill, a 10hp (7.5kW) electric motor.

Graham Murray, Kerry Bonham, Bill Poyner, and Ralph Paulger are currently working on making and fitting new steel mounts for the electric drive motor. The hidden electric motor and gearbox are a more modern addition, driving the saw up and down via wheelbarrow wheels on the end of the motor, turning a four-foot-diameter wheel, which then drives a flat belt, changing the thrust from circular to vertical.

The team of volunteers has also hauled out the Witte swing-arm log-saw engine and is starting the painstaking process of repairing and reassembling this machine. Stored for some years in the toilet block in the Matakohe Cemetery — no one seems to

know who stored it, why, or where it came from — nevertheless, it is going to be fixed!

Restored to its former glory

Graham Murray remembers that Darcy Sterling, one of the founder's sons, thinks the engine arrived very early in 1962, although Roger Mulvay (a former director) remembers it coming in 1999. In pieces now, the engine, crankshaft, piston, cylinder head, and con rod will soon be pieced together and restored to working order. The date for this type of log saw seems to be post 1925; however some of the volunteers debate this and place its age even earlier. Apparently, there are several videos on YouTube showing the exact machine, but dating it as 1922. American made, it was the first portable power saw available. Volunteer Graham Murray says brute force was required in its partial disassembly, and a mallet had to be employed to free up the seized piston. Volunteers are currently engaged in making or finding various parts to replace the linkages that have rusted away. Suitable pieces of steel are heated with a welding torch in the process of reshaping. The magneto is either to be repaired or simply replaced, as the skill set is too sophisticated for the volunteers at this stage. Notes have been taken of the flakes of original paint, and she will be restored to her former glory very soon.

Not a restoration for the faint-hearted

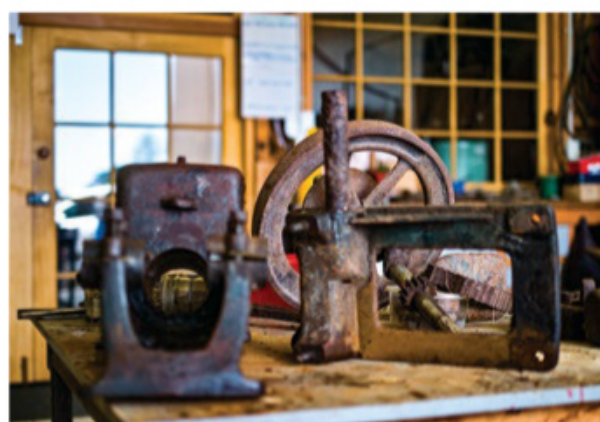
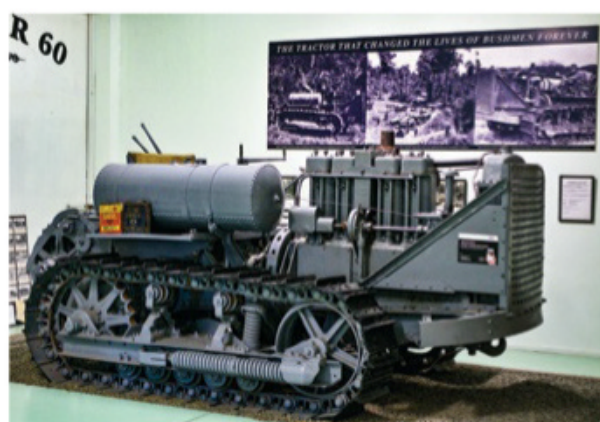
Another project that requires low level but constant attention is the Caterpillar Sixty built by the Caterpillar Co. in the US and used for dragging out logs in the bush. First used in the 1930s, it replaced the equivalent of 112 bullocks (between eight and 14 were used in a team), drivers, and jackers. She runs at 60hp (45kW) at 640rpm and weighs 9.3 tonnes.

Costing £2K, it landed in Auckland circa 1929, imported by AS Paterson & Co. Ltd. The petrol tank holds 44 gallons (167 litres) and uses 5½ gallons (21 litres) per hour. Measuring nine feet high (3m) and 15 feet long (5m), the Caterpillar carries a winch that can haul 25 tons (23 tonnes), and its winch drum holds 341m of wire.

Although there is an instruction panel on the machine's side, Graham Murray says that these are more for the operator than



Engine volunteer Ian Powell inspecting parts of the plough that he has been restoring



the mechanic, and he is guided by common sense and prior practical knowledge and experience. Interesting to note is that one of the tracks has been installed back to front because of excessive wear, a cost-cutting exercise apparently.

The Cat is started up quite often and this is a job for the younger members of the team. With luck, it will take only eight turns of the crank, but it has been known to take 18–25. It's a dangerous task as someone must stand on the tracks to rotate the flywheel. Care has to be taken to check that her radiator is full and that the exhaust manifold repair is holding up. That old standby, exhaust sealer, is applied, as recasting the manifold is simply too expensive.

Legwork

As a side note, some of the volunteers tell the story of the dangers of working on these monsters. Norman Shaw was chief



Above: Engine volunteer Ralph Paulger in the bowels of the vertical breakdown saw where he has been servicing the drive mechanism

Left: The Kauri Museum's Caterpillar Sixty on display

Below left: The disassembled Witte swing-arm log saw in the engineering workshop at the Kauri Museum

Below: Engine volunteers Graeme Murray and Ralph Paulger cleaning the dismantled Witte swing-arm log saw

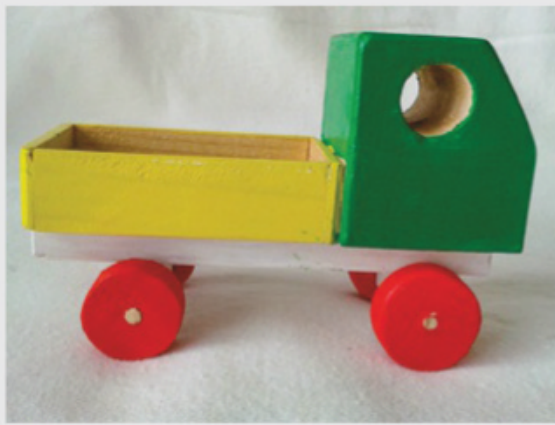


mechanic for Lovatt Sawmills in Whangarei and was sent into the bush to fix the Cat. Bashing away at a rusted-up nut, a piece of metal sheared off and flew into his six-year-old daughter's leg. At 82 years old now, she still carries a piece of the machine.

The work of the volunteers is valued beyond price by the museum and ensures that these historic pieces of machinery continue to tell their part of Northland's kauri story. The museum is open seven days a week and is an entrancing step back into our past. Come and visit or investigate in more depth by visiting kaurimuseum.com.

**Matakohe
Kauri Museum**

5 Church Road
Highway 12, Matakohe, Northland
09 431 7417
kaurimuseum.com



Toy story

Thank you for your interest in the toys, Greg. I have been making them for about eight or 10 years.

The designs are my own and the inspiration to make them resulted from a friend who commented, “Some kids never get a Xmas present.”

I had recently had been discharged from hospital and thought of kids in hospital at Xmas time. Making toys would give me something else to do, I had the equipment, and a source of free, untreated pine.

In the past, I have donated the toys to Middlemore’s Kidz First, Starship, Salvation Army, and Barnardos, but I shall be 87 in a week or so and have decided to supply only Starship and Middlemore; age is only a number but maybe it is time to slow down a bit.



I had thoughts of publishing a book; titled something like Toys You Can Make but I have never ventured into that field. Preparing the drawings would be no big deal and it would be great to see other people making the toys for their own children, and maybe a few extra for kids in hospitals.

I have the garage here set up as a workshop. This is a great place to live but one must have something to do. Thanks again for your interest,

Bert Toomey, Warkworth

Driving a locomotive

I liked the article All Aboard about the battery train built for Xavier and Ryder Brown in the last issue of your good publication [*The Shed*, Issue No. 81].

Will you please advise the boys that if they present themselves at the Rimutaka Incline Railway, adjacent to Maymorn Station, Upper Hutt, we will at our expense show them how to drive our shunting locomotive TR 189 on which their engine was based?

Our operating days are the second Sunday of each month but the boys would be welcome then or any Saturday, which is our main work day.

Our railway operates on three-foot-six-inch gauge as does Kiwi Rail’s.

Bruce Gillanders, of Rimutaka Incline Railway

Ps. We were pleased to see you used our photo of our locomotive TR 189; crediting of the photo to Rimutaka Incline Railway Heritage Trust would be appreciated.



Cricket mix-up

Did your Clifford the Cricket in Issue No. 81 work OK? I did notice on the cover picture, the picture on page 3, and very clearly on the top-right-hand-corner picture on page 101 that the cathode and anode are the wrong way round on Diode 1. Just an observation.

Brad Wards

(New subscriber to The Shed)

[via email]

Mark Beckett replies: You are correct, D1 is incorrectly mounted, and yes it does work, although the LEDs flickered even when the sound was off. I did my usual trick of bending the components and then stuffing them in, and followed the shape on the PCB. (<https://girtby.net/archives/2009/01/11/they-dont-call-it-hardware-for-nothing/>) So well spotted and thanks for pointing it out.

3D-printer grumble

I have been getting your wonderful magazine for a number of years. It is good that a publication brings together the skills and experience of sheddies.

However, I must point out to your readers if there is erroneous information. There is. I often look back to the April/May (2018?) edition and the article about 3D printers. I must point out that 3D printers do not make your designs into the real (meaningful) thing (paragraph 19). And what is meant by the “digital world” (paragraph 20)? As far as I know, digital processes have been around for decades. And no, making games, recording music, robotics, and 3D printing (paragraph 20) are not really the same thing as making things in your shed.

So let’s get back to what sheddies need most in a library — newspapers, magazines, and books — not 3D printers.

Sue Ember,

Denver, Colorado, US

[via email]

Thank you for your letter, Sue, and sorry to see you don’t share our admiration for 3D printers. I have to disagree with you, I am afraid, I believe these printers have helped sheddies a great deal since their arrival. To be able to create or replicate parts yourself is a great advantage. Some parts are just too expensive to purchase or no longer available and the 3D printer’s ability to solve those issues is a real bonus for sheddies everywhere.

So sorry, Sue, we will have to agree to disagree on this one — Editor

Make a stand for engineering

I wish to bring to the attention of readers of *The Shed*, and indeed, members of the wider community with engineering in their hearts, a piece of devastating news. It concerns the wanton destruction of one of the totems of our engineering heritage: the deliberate incineration of the substantial bulk of the Auckland University's [AU] Engineering library: radionz.co.nz/news/national/354765/library-closures-prompt-fears-university-of-auckland-will-burn-books.

Those readers of *The Shed* who have never seen that precious 135-year-old collection will be at a disadvantage, but for those who have I am sure that you will be gasping in disbelief that a supposed 'administrator' would order this outrage, much less even contemplate it. Sadly, it's true.

In the Western world it is unheard of for a country's leading educational institution to destroy a faculty library. Indeed, for the closest parallel you are forced to reach back into 20th-century history — Khmer Rouge 'Year Zero', Maoist Cultural Revolution, and of course, the one everyone thinks of first: Nazis burning books. Perhaps not far from the truth in this case! This deliberate carnage cannot go

unremarked or not responded to.

Even as I pen these words right now the UK government have declared '2018, Year of Engineering' as their boldly stated slogan — yearofengineering.gov.uk/ — and in America they have even declared their two MESTA 50K ton forging presses national treasures commanding a heritage protection order! (youtube.com/watch?v=hpgK51w6uhk.)

Yet here we are on the other side of the world in the year of 2018 destroying one of the key planks that underpins an engineering education — a bold embarrassment and a national disgrace moreover, at a time when the engineering trades are in decline and manufacturing on a descending spiral. Shame on us for doing nothing about it.

AU is only nominally a private institution. The inconvenient truth is that for most of its existence it has been taxpayer funded and therefore those books are the common property of all New Zealanders and they, mere custodians. Unfortunately, apart from spitting in the face of all engineers it reflects a 'New Age' attitude I see as the clean-hands mentality, where everyone thinks that all you have to do is twiddle on a keyboard and a magic

fairy delivers the goods to your door without having to lift a finger to make anything. Engineering is viewed as a flea-ridden, mangy dog that should be kept outside and ignored. These technically illiterate ignoramuses are in need of re-education: it is engineers who make the world. It underpins our economy and provides our national infrastructure, not to mention jobs both for us and our children. The act of burning that library is a symbolic representation of the antithesis of what we stand for and for the love of our hobby.

If this attitude is to change then we need a counter-reaction to this dark deed, for if we stay silent then we are as guilty as those who perpetrated the act. The necessary response cannot be a solo effort on the part of one person; it will require a coordinated team approach. For this reason I am forming an action group to undertake some form of judicial response to this and am appealing to readers to prove to me that not all Kiwis have turned into spineless jellyfish incapable of standing up for things that are important and worth fighting for. So please, contact me and volunteer your commitment for the cause: pyralog@yahoo.co.nz

Andre Rosseau, Auckland

Letter of the month prize

Every issue our Letter of the Month winner will win a copy of *Best of The Shed* worth \$19.95. This hefty 180-page special edition has all the best projects from the first 10 years of *The Shed*.

Letters should be emailed to editor@theshedmag.co.nz, or posted to Editor, *The Shed*, PO Box 46020, Herne Bay, Auckland 1147.



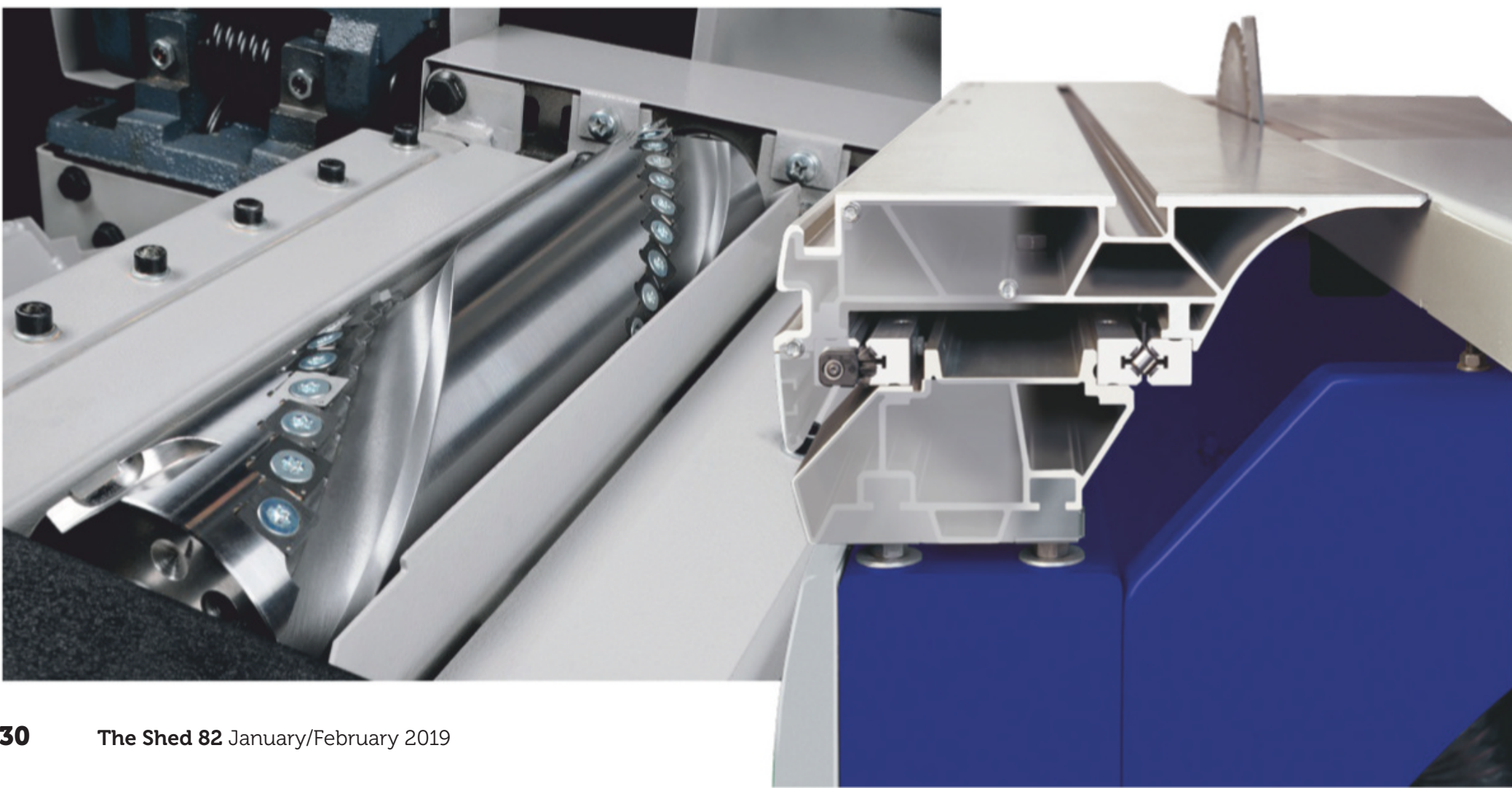
Combination woodworking machines

In this magazine, we're always looking for ways to make sheddies' lives easier — whether that's giving expert advice or displaying inspiring new projects — but let's not forget that central to the sheddie's existence are the tools and machines that they use. In this section,

we take a product and consider different options so you can make an informed choice about what best suits you.

This time around, we're looking at combination woodworking machines made by Felder. Felder has been in the business of quality woodworking machinery

since its founding in a garden shed in 1956. Based in Tyrol, Austria, today the company manufactures the full range of woodworking machinery, but its range of combination machines is as popular now as it was in the early days. Here, we look at three of Felder's most popular machines.



Hammer C3 31

The Hammer C3 31 is considered entry level, but it's no lightweight! The 610kg machine is made up of solid cast-iron machining tables, strong ribbed aluminium sliding tables, and powerful European motors, meaning stability and reliability. It's not unusual to see these machines in light-commercial workshops, and they're also ideal for use in residential areas. This is because of Felder's patented SilentPower spiral cutter-block on the planer/thicknesser, which produces a silky-smooth finish and reduces noise by half. Changeover time between functions is less than 15 seconds, and the ability to switch out the spindle moulder shaft for a router spindle is a massive bonus to home hobbyists. Pricing starts from \$15,200.



Felder CF 531

The Felder CF 531 is the C3 31's big brother, with similar capabilities but executed to a higher degree. The sliding table guidance has been upgraded to the Felder patented X-Roll system — on which Felder offers a 10-year guarantee — which evenly distributes the load of the table on all sides, keeping wear to a minimum and giving long-lasting precise guidance through the lifetime of the machine. In addition, the spindle moulder tilts to 45 degrees, giving limitless possibilities for profiling. Priced between \$20K and \$25K depending on specifications.



Felder CF 741

Felder's flagship model is the CF 741, considered the Rolls-Royce of combi machines. With a weight of 1100kg, there's no compromise on build quality. Electronic control and displays of key functions such as speed, height, and tilt make it the most ergonomic and accurate combi available. Double-sided cast-iron supports with a synthetic insert normally used in the aerospace industry allow extremely smooth tilting and precision without the need for any lubrication. There's also a huge number of bells and whistles to satisfy every potential use or user, and pricing is correspondingly varied, from \$28K to \$40K.





Great place to be



REVVING UP, *island style*

**A GREAT BARRIER ISLAND SHEDDIE
DOESN'T LET ISOLATION GET IN THE WAY OF
RESTORING BIKES TO THEIR ORIGINAL CONDITION**

By Bob Hulme

Photographs: Bob Hulme



Beer-crate gramophone



Gramophone under restoration



Gramophone work in progress

As you can imagine, on Great Barrier Island the population is likely to have more than its share of characters given its remote location. Part of the charm is its lack of power supply and absence of a supermarket. If something breaks there's not likely to be a spare part sitting on a shelf anywhere on the island, so if you don't want to wait or to pay hefty freight charges on top of the cost of the part, you make one or use real No. 8-wire ingenuity. Even though it is New Zealand's fourth-largest island (after the North, South, and Stewart Islands) and is only a half-hour flight from Auckland, it's like a different world and that's why the locals love it.

Survival on the Barrier is dependent on knowing who has the required skills and the right gear when something needs fixing

From hippy to sheddie

One of the characters who give the Barrier its flavour is Artie Laven. He's a proper sheddie who moved here 47 years ago. He says he was a hippy when he arrived, so we guess it has been the island way of life and the need to fix things that has turned him

into a sheddie. He built his own house back then and did part-time work in Auckland in the refrigeration industry to fund the build. Once the house was finished he was able to set up his own business servicing fridges, mostly on board visiting yachts, as well as around the Barrier. Generator servicing became part of his speciality too. When it became obvious that solar-power systems were the future he obtained an agency to sell and install them on the island.

The locals here each have their own skills, and survival on the Barrier is dependent on knowing who has the required skills and the right gear when something needs fixing or building.



Above: Clever folding table
Left: Preparing to fire up the Lister
Right: Artie at work in the radio-station studio



Artie's shed/s

Nowadays, Artie says that he is retired, but he still does pump and generator servicing for a few clients and friends. Artie's shed is more a collection of sheds in reality. The main workshop is housed in an old bus. With electricity not on tap, generation is a necessity and he has a robust-looking Lister engine driving a generator. It was not in working order when first acquired, so he spent many hours getting it running and has set it up so that it can run on a 70 per cent used-

vegetable-oil mix. Fuel prices are much higher on the Barrier, which has been exacerbated by the Auckland Council tax which the locals are fighting.

The Lister diesel drives a 1500W generator, which isn't lot of power from such a big unit, so Artie has another, more modern, smaller unit that has more grunt. The generator that the Lister powers is a motor/generator, meaning that it can be used as an electric motor to start the Lister diesel. On one of the sheds he has only solar panels that top

up a bank of batteries. These drive AC tools via an inverter.

Tools and interests

The bus is home to a couple of lathes as well as other tools essential for an island sheddie, such as welders, bench grinders, hand power tools, and of course all manner of spanners, files, etc. One lathe is an old flat-bed Boxford. How many of those are there still in use around New Zealand? Probably loads! They seem to last forever. Various ►



Lathes in the bus workshop



We think someone has already let the bus go!



Setting up the Manx Norton for a run-up

materials are kept on hand and nothing is thrown away, as sourcing steel or other metals is not so convenient in this remote place.

One of Artie's interests is restoring antique 78rpm record players. These are the ones powered by a spring that needs to be wound up with a crank in the side. No electronic amplifier in these babies, just a sound-amplifying metal horn. The

sound is pretty good and Artie likes to play records from his collection. In fact he has a bit of an ear for music and even has a show on the island radio station every Wednesday afternoon. It runs on three different frequencies around the Barrier — Aotea Radio broadcasts on 94.6 at Claris (where the airfield is), 104 at Fitzroy, and 107 at Whangaparapara. Radio has history here, as Radio Hauraki

started as a pirate station broadcasting from a boat in the waters off the Barrier.

Mad for motorbikes

While it was a love of sailing that influenced Artie's move to the Barrier, he has never given up his enthusiasm for motorcycles, and in particular the racing Nortons. Regular readers will remember him from our report on the annual classic motorcycle race festival at Pukekohe in *The Shed* Issue No. 78. He has only missed competing in one of those race meetings since it began 39 years ago due to illness.

The Barrier does seem to be a strange place to live if you are into fast bikes. The roads are mostly sealed now but are narrow and windy so not at all ideal for giving a bike its legs. There is probably no likelihood that the Barrier will become New Zealand's Isle of Man any time soon, but who knows? Waiheke Island was once quite primitive before it was transformed into the domain of glitzy vineyards and luxury retreats and, believe it or not, back in the early 1900s the New Zealand Tourist Trophy (NZTT) motorcycle championship races were held on Waiheke.



BSA winged-wheel bike



Not an e-bike



Puch moped



Above: Morning-tea break, island style
Right: Triumph Daytona



*He always restores his bikes
using (or creating) parts
that are period correct*

Artie's pride and joy

The bike that is Artie's pride and joy is the Norton Manx that legendary Kiwi Len Perry rode in the Isle of Man Tourist Trophy (TT) back in 1951 to ninth place and highest-placed 'colonial'. Artie bought the bare frame, front forks, front mudguard, rear suspension units, and swing arms in 1967. The original wheels were tracked down and bought shortly after. After fitting a Norton International motor, Artie got it into race trim. (He actually bought a complete bike so that he could get its International motor.)

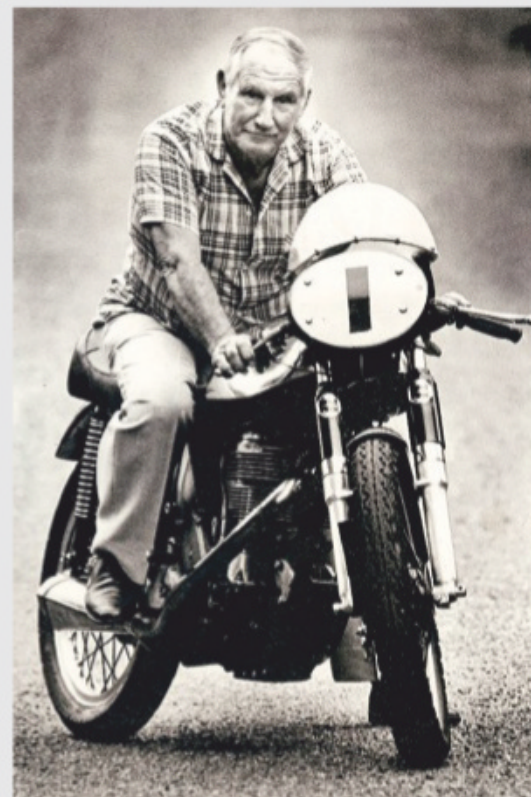
It was not until this century that he located the original motor, but the owner didn't want to sell. Instead he wanted to buy Artie's bike. So there was a stalemate for a while until it was resolved with what Artie said was a substantial payment to the engine's owner. Now he has the complete bike in its historically original condition. The shed where this bike is kept has original posters and photos on the walls of Len Perry and the Isle of Man circuit. It's a fine line between a shed and a shrine! ►

Len Perry, 1912–2002

Len started motorcycle racing at the age of 15 on a speedway bike at Henning's Speedway, which was at Mangere. He won 42 national titles over the course of his career, including in speedway, grass track, hill climbing, and road racing. This included five senior NZTT titles and three junior NZTT titles that were raced on Waiheke Island.

He was the captain of the New Zealand team that went to the Isle of Man races in 1951. Other team members were Rod Coleman and Ken Mudford. Len finished in ninth place and the team scored second place. He raced two motorcycles supplied by the Norton factory — a 500cc featherbed Norton Manx and a smaller-engined 350cc bike for races limited to the smaller capacity. He raced the bikes in Europe also that year and came first in the 350cc Belgium International De Mon and second in the 500cc race at the same meeting. (First place went to fellow Kiwi Rod Coleman.)

Business and family interests kept Len from serious competition from 1954 (which was the first of several times that he retired from racing), and yet he managed to win the New Zealand 250cc championship in 1959. He often turned up at classic race meetings and



even rode at one such event in 1999. In 2001 he took part riding parade laps.

The 1951 Isle of Man wasn't the first time he had gone over to race there. He tackled the tortuous course in 1939, but after a crash in practice that cost him his third finger, he was unable to take part in the race.

These days we recognize names such as Graeme Crosby and Aaron Slight as Kiwi international racers, but Len was certainly one of the top New Zealand internationals in his day.



It's a sparsely populated place

It's like a different world and that's why the locals love it

Keeping the bikes period correct

His efforts are not focused on just the one bike or even on one make, although there is a definite bias towards Nortons. He always restores his bikes using (or creating) parts that are period correct. Sure, improvements could be made to bring a bike up to later specs and use changes that the manufacturer made to subsequent models, but that is not Artie's way. He wants his bikes to be as close as possible to when first manufactured. The oldest complete original bike is a 1937 War Model 16H side-valve Norton. An earlier 1931 Norton 22 motor sits in an ex-Len Perry speedway sidecar outfit frame. The 22 motor is a 500cc overhead valve with twin exhausts — ahead of its time back then.

Even older is a Norton motor on its

own — 1930 DT that is distinctive because of its through-bolted design. The cylinder head bolts go right down to the crankcase and hold the barrel in place as well as the head. It is reportedly one of only two that came to New Zealand.

More trips to Puke

The shed line-up includes an apparently out-of-place 1979 1000cc Moto Guzzi Le Mans-frame bike. It features innovations like a foot brake that works on both wheels and the shaft drive makes it a very smooth tourer. Artie would not have looked for one of these particularly and only ended up with this one as payment for restoration work done on a customer's motorcycle. It's possible this one could be sold to fund more trips to Pukekohe in the future, he says.

Four-wheeled vehicles have also featured in Artie's past. He has the dashboard panel with the speedo off one of the two Hudson Terraplane cars that he once owned. He absolutely loved them and this memento helps to keep those memories fresh.

It will be useful one day

With so much water in every direction here it is no surprise that boating is

something nearly everyone is into, so it's also no surprise to see Artie's row of outboard motors. He tells us that only two are in working order and the rest are kept for parts. People don't like to throw things away over here.

In another location are some items that carry on the two-wheeled theme. One of these is a Puch moped. These were very popular in New Zealand and Artie has a story about this model. He came to New Zealand as a 14-year-old with his family from the Netherlands as government-assisted immigrants. Part of the deal was a restriction on how much cargo they could bring with them and it was not easy to cut back on belongings to fit the maximum weight. However Artie's dad just loved his Puch moped and insisted that it came with the family. This one is not that actual one, but it is identical.

A couple of motorized bicycles here are a fascinating — a BSA winged-wheel bike, and what was a normal bicycle that has been fitted with a 50cc BSA motor. Absolute gems.

For more information on Great Barrier Island go to aucklandcouncil.govt.nz, doc.govt.nz, and greatbarrier.co.nz. 

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A woman with short grey hair, wearing safety glasses and large yellow earmuffs, is seated at a workbench. She is wearing a green cardigan over a grey t-shirt and blue jeans. She is using a hammer to work on a piece of metal held in a red bench vice. The workbench is made of a large, thick wooden log. In the background, there is a wooden shelf with various tools and a window looking out onto a rocky landscape. The text "ANTIQUES OF THE FUTURE" is overlaid on the bottom right of the image.

ANTIQUES OF THE FUTURE



Above: Nicola made the medieval-look goblets, which are encrusted with paua pearls and 18-carat gold balls, for husband Justin's 60th birthday. The wine-bottle coaster has a carved pounamu base. Justin made the rosewood handles for the water jug and Aladdin's lamp-style teapot

Right: Nicola's silver rose bowl, titled *Heliamphoria Exappendiculata Aquaticus*, was named after and inspired by the carnivorous pitcher plant. Crafted for the annual Flaxmere *Art in a Garden* exhibition, it features removable stem holders, weighs 3.5kg and measures 270x270mm

Bottom: An elaborate pitcher-plant sculpture, a segment of which is seen here, is an example of complex anticlastic raisings



A SILVERSMITH USES ANCIENT TECHNIQUES TO CREATE EXQUISITE PIECES FOR PRESENT GENERATIONS TO TREASURE

By Sue Allison

Photographs: Juliet Nicholas

A few people are lucky enough to have lightbulb moments in their lives. Nicola Roake's happened 30 years ago on the other side of the world with a hammer in her hand. Nicola was in Oxford, England, with three small children and a husband who was furthering his medical studies when she decided to extend her interest in arts and crafts by joining a group of silversmiths. "When I started whacking that first piece of silver I was over the moon. I was so excited," she says.

That passion hasn't waned, and Nicola is now one of New Zealand's foremost silversmiths, hammering out antiques of



the future in her home workshop high on the hill above Christchurch's seaside suburb of Sumner.

"I'm a traditional silversmith," says Nicola. "It's a craft that's been around for at least 400 years and it's still pretty much done in the same way. I've seen engravings from the 16th century where they are using exactly the same tools."

While Nicola has no formal art training, she has always enjoyed crafts, from embroidery and weaving to creating jewellery out of beads and copper to sell at the markets in her early days. The mother and now grandmother loves being a 'homemaker' so it was a bonus finding ►



Nicola's workshop is a well-set-up bunker that was integral to the design of the Roakes' house when they built on the hill 10 years ago. "It's lovely having a purpose-built workshop after making do at the end of the garage. I've now got room for all my gear, plenty of power points, water on tap, and good lighting," she says.

The long room, which has both internal access and a door to a sunny garden terrace, has a custom-made workbench at one end and a gas-fired hearth and polishing machine at the other. The centrepiece is a large gum stump, carefully selected and carted to the workshop, where husband Justin carved bowl-shaped hollows in its flat top for 'sinking' the silver.

"Once I get in my workshop I don't want to do anything else," says Nicola, who spends about 20 hours a week in her studio, and more if she has a commission. "I've been known to be up at 2am finishing a piece."

Glossary



The process of turning a flat piece of silver into a three-dimensional object is an age-old one and the terms associated with silversmithing are equally archaic.

Sinking: Hammering the metal into a depression to create a concave hemispherical shape.

Raising: Shaping the form by hammering it over a stake.

Planishing: Using highly polished hammers to refine the surface.

Chasing: Placing decorative indentations into the surface of silver.

Repoussé: Design imprinted from the back that forms a raised design on the surface.

Annealing: Heating the metal to make it soft again after the silver has become work-hardened by hammering and shaping. If the silver isn't annealed throughout the process, it will crack and weaken.



"I found something I could do at home. That was the great thing for me"



a vocation that didn't interfere with that role. "I found something I could do at home. That was the great thing for me," she says.

Gathering more skills

While in the UK for nine years in the 1990s, Nicola made the most of her association with The Jewellery and Silversmiths Society of Oxford and even became chairman of the group. She also exhibited widely, including at London's Goldsmiths' Hall. "I like to get involved if I do something," she says. "While over there, I learned as much as I could."

Once back in New Zealand, she continued her involvement as a member

of the Silversmiths Guild of Canterbury, also teaching and furthering her skills by attending a workshop in Maine, US, where she learned the complex art of anticlastic raising under the tutelage of Michael Good, the master of the modern discipline.

In a nutshell, 'synclastic raising' involves making a shape, such as a bowl, in which the dominant curves move in the same direction. 'Anticlastic raising' is the creation of saddle shapes, in which the two dominant axes curve in opposite directions. "You are bending metal in directions it doesn't really want to go," says Nicola, who is one of a small band of silversmiths in the world accomplished in the technique.

"I love making a three-dimensional form out of a flat piece of silver," she says. "It's a beautiful metal to work with."

Nicola exhibits around New Zealand and her works are held in private collections throughout the world. Her husband, Justin, a keen woodworker, contributes to her mixed-media works, making wooden handles for jugs and creating bases for

sculptural pieces as well as doing any gold-plating.

Given the intrinsic value of the metal and time-consuming process, silver pieces are expensive and most of Nicola's works are commissioned. Her goal is to produce exquisite pieces that far outweigh the worth of the raw material and will be treasured for centuries to come.

"People admire things that are old, but my works will be antiques in 100 or 200 years too," she says. "We need to have people making things that last more than five minutes." ►

Blacksmith v. silversmith

While there are similarities in their crafts, silversmiths and blacksmiths work with very different metals in different manners. Silver, being soft and ductile, is worked at room temperature. Iron and steel only become soft and malleable under extreme heat.

"Blacksmiths work everything hot, while I do everything cold except for soldering," says Nicola.

Blacksmiths call their shaping tools 'anvils'; silversmiths call theirs 'stakes'. A blacksmith's furnace is a 'foundry'; a silversmith's is a 'hearth'. Traditionally silversmiths used charcoal- or coke-fired forges. Modern silversmiths generally use gas torches or sometimes laser-beam welders.



The inside of Nicola's goblets are gold plated

Hammering tools



Nicola has built up an arsenal of shaping tools over the years, many of them homemade or repurposed from unexpected sources. Alongside more conventional smithing tools are stainless-steel hip-replacement joints and heavy nails picked up when cycling the Otago Central Rail Trail. "I filed off the rust and polished them up," says Nicola, who admits that they made for a heavy bike-load.

"It's not high-tech. You need a

range of hooks, knobs, and domes for getting the subtleties of shape, and the weighting of hammers is important."

All the hammers and shaping tools are highly polished. "You have to keep everything very clean, as the tiniest bit of grit will mark the silver," she explains.

Nicola is conscientious about wearing earmuffs and also an elastic wrist strap to avoid damage from repetitive hammering.



Different shaped tools for planishing and forming, with those for anticlastic raising on the middle shelf



A range of hammers

Making a bowl



Nicola starts with a flat sheet of 1.1mm thick silver. She marks out a 150mm diameter circle using a compass, taking care to highlight the centre point for future reference. She then cuts out the disk using a fine piercing saw lubricated with wax (Image 1). Silver is shaped not stretched, so the surface area doesn't change.

Work now begins to shape the two-dimensional sheet into a three-dimensional form. This begins with sinking, by which the sheet is hammered carefully, round and round, into a hollow in the wooden stump taking care to keep the thickness even (2 and 3).

"It's very physical. When I'm doing big

objects, I can only work for about four hours at a time," says Nicola, who wears leather gloves to protect her hands from the sharp edges.

The silver hardens with hammering so must be regularly annealed throughout the process to prevent it becoming weak or cracking. Nicola paints the surface with Argotect to protect it from fire scale (4) before using a gas torch to heat the bowl to a dull red colour (it's important not to overheat it), the heat realigning the particles in the metal (5). Once quenched (6), it is put in a 10:1 solution of sulphuric acid for about 10 minutes, before the hammering process is resumed.



She then uses a compass to mark concentric circles as a guide for raising the sides (7). Once the silver sheet has been hammered into a basic shape, the form is raised by hammering it over a raising stake. "It's important to apply enough pressure but not so much that it stretches," says Nicola. "Inexperienced people will often get crinkles and potential splits." Once the silver has been shaped into a bowl, it is planished to smooth out irregularities and refine the surface. Nicola fits a four-armed planishing stake into her vice. The tips of the starfish-like device give eight options for the finishing touches, from flat to rounded or hooked forms (8 and 9).

Decorating, or 'chasing', is done by supporting the form with 'pitch' (10), which is made from tar and wax bulked out with plaster of Paris for volume. It is stored in a cast-iron pitch bowl. The pitch is warmed to make it more malleable, then the bowl pushed over it and left to cool. "The pitch holds it firmly so it keeps its shape while you are making decorative marks and lines," says Nicola. To decorate goblets, she fills them with pitch and inserts a stick into the mixture while still warm. "It's like a toffee apple. You put the stick in the vice and turn it around to chase the sides. 'Chasing' is decorating from the outside while 'repoussé' refers to a raised design on ►





“We need to have people making things that last more than five minutes”



the surface that is created by hammering from inside the item.

Nicola forges her own chasing tools and stores them in sealed plastic containers to keep them dust-free. She draws her design with a fine-tipped marker pen then taps fine steel tools along the lines with a repoussé hammer, forming indentations. “I liken it to drawing with my tools. It’s delicate work. You need a steady hand and good eyesight,” says Nicola, who also uses fine Dremel dental tools for texture and detail. “They are good for getting into tricky places and it is helpful to clean off scratches and fire scale.”

If the bowl has a base, it is soldered on before polishing. Nicola dons an apron and gloves for the polishing process (11 and 12). She first uses Tripoli black nugget to cut out any scratches and fire scale, then washes the piece and moves on to the second polisher, where a fine rouge is applied to the spinning mops to give a highly polished finish (13).

It takes Nicola 10–12 hours to make a small bowl such as the one pictured here. To view more of Nicola’s silverware and see a video of her at work, check out roakesilver.com.





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Bevan (left) and Andrew (right)

LEADING CHANGE WITH BAMBOO



Frontal Lobe's Sydenham premises



Frontal Lobe's first product — bamboo-ply bicycles called 'Plykes'



Custom shelving system

COMPANY TAKES ADVANTAGE OF INNOVATION IN DESIGNING ITS RANGE OF NEW PRODUCTS

By Ritchie Wilson

Photographs: Ritchie Wilson

Bevan Whiting and Andrew Veitch jointly own the newly established Christchurch design and manufacturing business Frontal Lobe, which produces items made from ethically sourced timber — principally bamboo.

They aim to produce homeware for sale in shops and also bespoke items for one-off jobs such as shop fit-outs.

The two men have contrasting backgrounds. Andrew has worked in retail since leaving school, working his way up to management, first at Kathmandu in Christchurch, then in Melbourne after the Christchurch earthquakes. He then worked at T-shirt companies Cotton On and T-Bar, managing 12 stores, and finally at Topshop, where he was responsible for hundreds of staff. He returned to New Zealand after five years in Australia, looking for a job with a more personal connection to customers than fashion clothing and with a sustainable footprint. ►



A large lighting fixture destined for a architecturally designed house on the Cashmere Hills. Note the enviable tool board in the background — including (of course) a Frisbee

The Router Bros. truck



The decal on the side of the tin-plate truck that holds the cutters for the router was designed on screen. The logo was then inkjet printed onto Testor's Decal Paper. This comes in two varieties — clear or white background — and is available as boxes of six A5- sized sheets from model shops.

A layer of protective finish was sprayed over the printed surface. The printed paper was immersed in water until the water-soluble adhesive loosened and the top layer floated free. There was sufficient adhesive remaining for the decal to stick to the toy truck. The decal was then smoothed out and left to dry.



Bevan working on the on-screen design for the bamboo clock

He took a temporary job with local engineering company Pandeck, which makes low-rise elevators, and met Bevan there.

Looking for that perfect job

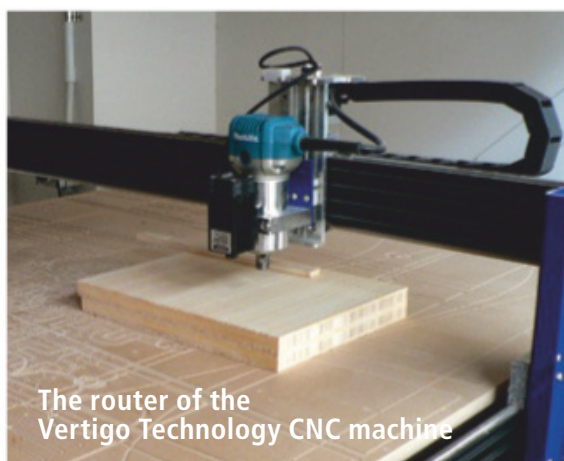
Bevan was always interested in design and over many years had seen his father Ray successfully design and build TQ midgets for speedway racing. Having worked in his father's workshop since his early days, he wanted a job that combined manual and design skills. So he completed an apprenticeship in carpentry, worked as a designer for a number of years, and then ran a heritage renovation company for four years, but was frustrated by the lack of input that he had into the design of the projects he was working on.

His father had built up his engineering company and moved into the production of the Pandeck elevators. Bevan worked on a new, higher reach device in his father's shed, where Andrew was sent to assist him in the making of a prototype. Encouraged by Bevan's father, who had recognized Andrew's abilities, the two explored the possibility of going into business together, running a company that made something.

They often have passers-by and nearby workers visiting and they try to help other embryonic enterprises



The bamboo clock being assembled



The router of the Vertigo Technology CNC machine



Multi-component, glued bamboo corners for joining aluminium extrusions

It started with a bamboo bike

The first projects were the original 'Plyke' — a bicycle made out of bamboo ply — and a gear-driven, expanding dining table, again in bamboo, which they assembled in Bevan's father's barn.

They almost immediately started looking for premises in dynamic south Christchurch and a year ago were offered their present premises at an attractive rental price because the sitting

tenant wanted to move to a larger space. This had the advantage that it offered much greater interaction with the public and got them out from under Bevan's father's feet.

This interaction with clients and potential clients and being part of a community are two of the things that Andrew wanted as a business owner, as well as wanting to be proud of what the business does. They are actively involved in their community and within





Frontal Lobe gets its bamboo and bamboo ply from Wellington's Plantation Bamboo and Pahiatua's Woven Bamboo, each of which the company again has an excellent relationship. Both suppliers source their wood from ethical, sustainable sources that are certified by the Forest Stewardship Council (FSC). The FSC is a credible international organization, based in Germany, which since 1993 has set rigid standards of sustainability and eco-friendliness for forest products. It is an independent, non-profit regulatory organization that certifies wood as originating from sustainable forests. Bamboo is unrivalled in the speed with which it grows and the efficiency with which it converts carbon dioxide into timber. In an overpopulated world,

with more and more people joining the middle class worldwide, bamboo is one of the few natural materials that can be produced in sufficient amounts to meet the demands of the future.

A close look at many items on sale today will reveal that they are made from bamboo. As Bevan says, "It's everywhere!" Bamboo is tough, long-lasting, hard, and attractive looking. From flooring and furniture to fabric, we are in the bamboo age. It takes finishes very well and is a beautiful material. There are 2000 different types of bamboo. The types used by Frontal Lobe take only six to 10 months to grow to their full height and can be harvested after three years. The extra time is needed for the stem to harden. After harvesting, the bamboo is processed into sheets of ply or solid timber.



Lampshade in thin bamboo



Bamboo lamp

the bounds set by Worksafe New Zealand they try to adopt an open-door policy. They often have passers-by and nearby workers visiting and they try to help other embryonic enterprises with, for instance, their computer expertise.

Kiwi router a key business tool

The cornerstone of their business is the 1200x1200mm CNC router, which cuts bamboo ply accurately to within fraction of a millimetre. It is a product of Westport company Vertigo Technologies (see *The Shed* Issue No. 80, September/October 2018) with which they have built up a very close relationship. Updates introduced by the manufacturer are routinely incorporated into Frontal Lobe's device. Current projects include a very large lighting fixture and an oversize clock based on various-sized cogs cut by the router from bamboo ply. For the Christmas retail market, they have designed a lamp with a large hanging bulb, which, because the lamp looks like a penguin with its small feet at 90 degrees from each other, they have named 'Gentoo', after the penguin of the same name.

Bevan and Andrew aim to spend about equal amounts of time on one-off designs and on objects produced in larger numbers for sale in high-street shops. The process starts with a concept that Bevan will work up on screen using Autocad software to get an optimal design. He then uses Makercam software to generate G-code, which directs the router. Makercam is

shareware, which has the very attractive feature for a start-up business of being free. Bevan, as with so many on-screen designers, taught himself to use both these design programmes.

Slick finishing

Vertigo Technology recommends using the Autodesk Company's Fusion software, which has the advantage that the sequence from on-screen drawing, to three-dimensional modelling, to the G-code, which the router responds to, is seamless. Bevan thinks that as the business grows he will use the more efficient Fusion.

The bamboo is fastened to the router bed, the sound-reducing door is shut, and the computer-controlled machine goes into action making accurately sized components. The items produced require only the minimum of sanding before they are assembled, or perhaps glued together, and are then protected with a vegetable-based finishing oil called 'Woca'. This is made by a Scandinavian company and is a very pleasant material to use, having no volatile organic solvents and not requiring special safety precautions. It also produces a most attractive finish and is available in clear and several colours, such as whitewash and black.



The immaculate assembly area. The tall object to the right is a coat stand, which can have multiple moveable coat hooks on all four sides

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I found this set-up using a mirror saved my legs a bit



Welding the nuts in place for the levelling bolts

ON THE LEVEL

LEVELLING A LATHE MAY BE A BIT TEDIOUS BUT IT'S A VITAL TASK

By Jude Woodside

Photographs: Jude Woodside

Since I built the stand and the drawers for my lathe I haven't got around to using it. Of course, before I can I will need to level it.

I designed this new stand to make levelling it a bit easier — it has adjustable feet. To level a lathe you need a machinist's level. It's not strictly necessary and I have seen it done with a plumb bob, but as it happens I do have a level. It's a fairly cheap one, but it seems to work and claims to be accurate to .02mm/metre. I haven't used the level since I first set up this lathe, a couple of years ago.

Calibrating your level

It's a good idea to calibrate the level again. Calibration is usually done on a surface plate. I have a small surface plate but it has needed a stand for some time. I wanted to get it on a stand so that it wasn't constantly under my feet. The block of ground granite weighs a substantial 50kg even though it's only 460mm square. I had a spare stand that would just about fit it perfectly.

I needed a means of levelling the stand so I welded M10 nuts to the base to take four M10 bolts and nuts. The top would also need three mounting pins. Surface plates usually have holes where the plate has been fitted to a polishing machine to be surface ground. Mine doesn't have the holes but I planned to sit it on three points set up as Bessel points.



Boring the holes for the Bessel points that will support the block

I haven't used the level since I first set up this lathe a couple of years ago

Bessel points

It's not strictly necessary for a small plate like mine but surface plates are usually balanced on either Bessel or Airy points. Both serve to provide the best possible support against gravity. Surface plates have one important characteristic — their flatness. To maintain that precision flatness they must be balanced on points that will minimize the deflection caused by gravity. Even 100mm thick granite blocks will suffer from some sag over time due to gravity.

It might be barely noticeable without high-precision equipment but it will be measurable. Airy points ensure that there will be no slope on the ends and Bessel points ensure that a beam will not change in length. That will also minimize any distortion to the surface, so they are ideal for surface plates, although both types are used. Bessel points are calculated by multiplying the length of the block by .557 and this number is subtracted from the length and the result divided by 2 to arrive at the location of the points from



Tapping the Bessel point holes



Welding the angle iron to contain the granite block



Lowering the block in place



Fixing the Bessel-point bolts. Screwing them all the way in at first allowed me to retrieve the stops



The finished block on its dedicated stand



Calibrating the machinist's level

each end of the block. However, there are only three points and that makes it easier to level the block.

The third point is placed midway along the opposite side to the Bessel points. I put the points about 20mm from the edge. To fit the Bessel points I drilled and tapped through the supports and fitted three high-tensile 60mm M10 bolts. I also welded some thin angle iron around the edge to contain the block. The angle iron was welded to the base using plug welds that were ground flat.

Lifting

After a quick paint job the unit was ready for the block. At 50kg I wasn't going

Then I adjusted the whole unit for level using the levelling feet and the Bessel points

to attempt to lift that on my own. So I enlisted the engine crane that has proved to be so valuable in my workshop. With the block in place I fitted the Bessel points and lifted them high enough to free up the strops. Then I adjusted the whole unit for level using the levelling feet and the

Bessel points.

To calibrate a machinist's level you must first find a level spot on the block. On any roughly level block there will be a line that is level. Move the level about until the bubble shows level. Levels are self-proving, so turning it by 180 degrees should show the same level again.

To do this accurately I usually add something heavy enough that will sit without moving too easily and butt the level to it on the level line. If you turn the level and it doesn't quite look level you can adjust it with a small screw usually marked on the level. Simply adjust the level to about half of the error. Test it again until it is accurate. ►



Cleaning the ways



The level in place across the ways



The view through the mirror



*It is a tedious business and very tiresome,
especially on your own*

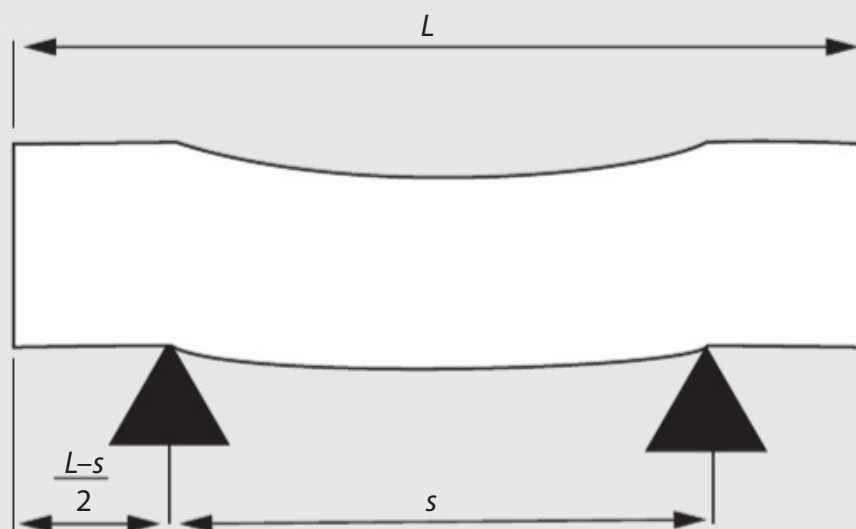


Airy points and Bessel points

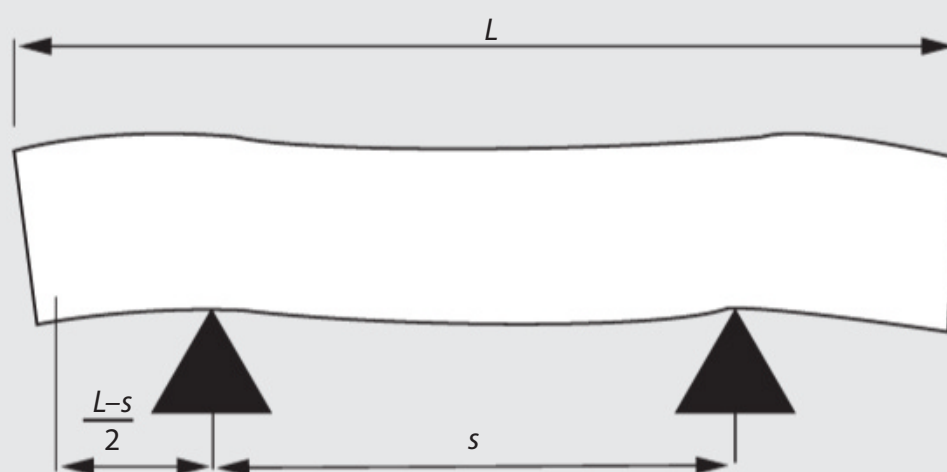


Airy points are named after Sir George Airy who developed them. They represent points on a beam where gravity will not cause the ends to deflect if the beam sags from gravity. Or, in engineering speak, they induce zero slope at the ends. They are often used to support standard measures like a standard metre rule used for calibration. Surface plates, which are large and very dense blocks of granite or steel that are intended to be perfectly flat, also need precise support, and Airy points are often used. Airy points are intended to keep the ends perpendicular and square. They will also keep the edges square and flat.

Bessel points are named after Friedrich Bessel and do something similar, but they will enable a beam to maintain its length. This is a better option for surface plates in that Bessel points will ensure that the surface stays relatively flat, which is the preferable condition. In practice there is very little between them and either will do. The diagrams show a very exaggerated version of the effects. The change in flatness due to gravity is more pronounced the larger the plate, and the effects are only measurable with some high-precision equipment. Professional surface plates are regularly checked and lapped if necessary to maintain their flatness.



Airy points maintain parallel sides



Bessel points maintain length and resist gravitational sag



Above: Checking the diameter
Right: Not perfect, but not too bad



It's not exactly precision, but it's not bad for a small lathe, and overall I'm happy

Levelling the lathe

I set up the lathe by cleaning the ways with acetone and inspecting them. There should be no significant divots or projections — if there are, it's a good idea to use a stone on them to get them flat. Ideally, it's best to level something using just three points.

Put a jack under the midpoint of the tailstock end and then just balance the thing from the headstock end where all the weight is. I didn't have anything small enough to do that as the best jack I have is too big to fit under, so I tried using a lifting jack that I have, but it tended to lift the end too far to be useful. Usually I select three points across the ways to find level — under the chuck, in the middle, and against the tailstock.

I set all the feet at their lowest point so they were all more or less even. Then I began the business of adjusting one foot at a time until I could get the level flat. It is a tedious business and very tiresome, especially on your own. My thigh muscles haven't quite recovered. I

did eventually resort to using a mirror to save the constant moving up and down. Eventually you will get all three points roughly in line and then it's just a matter of fine-tuning. You can rarely get it perfect. To double check I also put the level on the carriage, since this is the operative bit. It's recommended to do the longitudinal level first. The longitudinal level is the least important but it gives you a base to start from. The most important level is the latitudinal one across the ways. This is where twist will manifest and that will cause you the most issues.

Testing

Once you are happy, or when you get to the point that you can't get it any closer, it's time to check the effect. Lock all the feet. Put a test bar in the chuck and skim the end off. Bore a centre hole for the

live centre. After making a quick skim cut, make a cut at each end of the bar, enough that you can measure with a micrometer. Measure both cuts and see how they compare. With luck they will be perfect; in practice they're likely to be out by a greater or lesser degree.

If there is still significant variation, check that the tailstock is aligned properly. Check the amount of variance and move the tailstock by half the difference. If the taper starts at the tailstock end then move the tailstock away from you; if it's the other way round then move it towards you.

Mine still has a small variation of .001mm over 300mm. It's not exactly precision but it's not bad for a small lathe, and overall I'm happy. Once the lathe is level it pays to check it regularly, but it's always easier to level the second time around.



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WHIRLIGIGS ARE A FUN PROJECT
THAT GENERATE A LOT OF INTEREST AND
ALSO REQUIRE A BIT OF LATERAL THINKING TO
BE EFFECTIVE

By Coen Smit

Photographs: Coen Smit



Goosing into the sunset



The basic parts of the whirligig

Whirligigs are one of those small garden-art projects ideal for accumulating brownie points with any sheddie's spouse. Relatively simple and inexpensive to make, they provide an interesting, whimsical counterpoint in a garden, balcony corner, or on the eaves of a building.

The central feature of all whirligigs is the wind-driven wings, arms, or paddles that provide the sense of movement, as well as the pivot that enables it to position itself at the appropriate angle to the wind so that it will initiate that movement. There is a huge range of designs and themes that can be made into whirligigs and many can be found on the internet to give you inspiration. I particularly like the shape of a flying goose because of its streamlined shape, which lends itself ideally to a whirligig, and its wing action in a reasonable wind is delightful to see. Its long neck stretched out ahead of it and wings windmilling furiously in a good breeze results in a great display of movement and activity as it pivots back and forth to maintain its position in relation to the wind direction, looking like it is making every effort to get motoring!

Choose your whirligig design

Other good whirligigs include an old sea dog in a rowing boat — the harder the wind blows, the more frantically he rows. Alternatively, a small propeller-driven aircraft, reminiscent of a Cessna, will look like it's taxiing ready for take-off. However, there are also plenty of other designs to suit your tastes and construction abilities.

As mentioned, the driving propellers — disguised as part of the overall



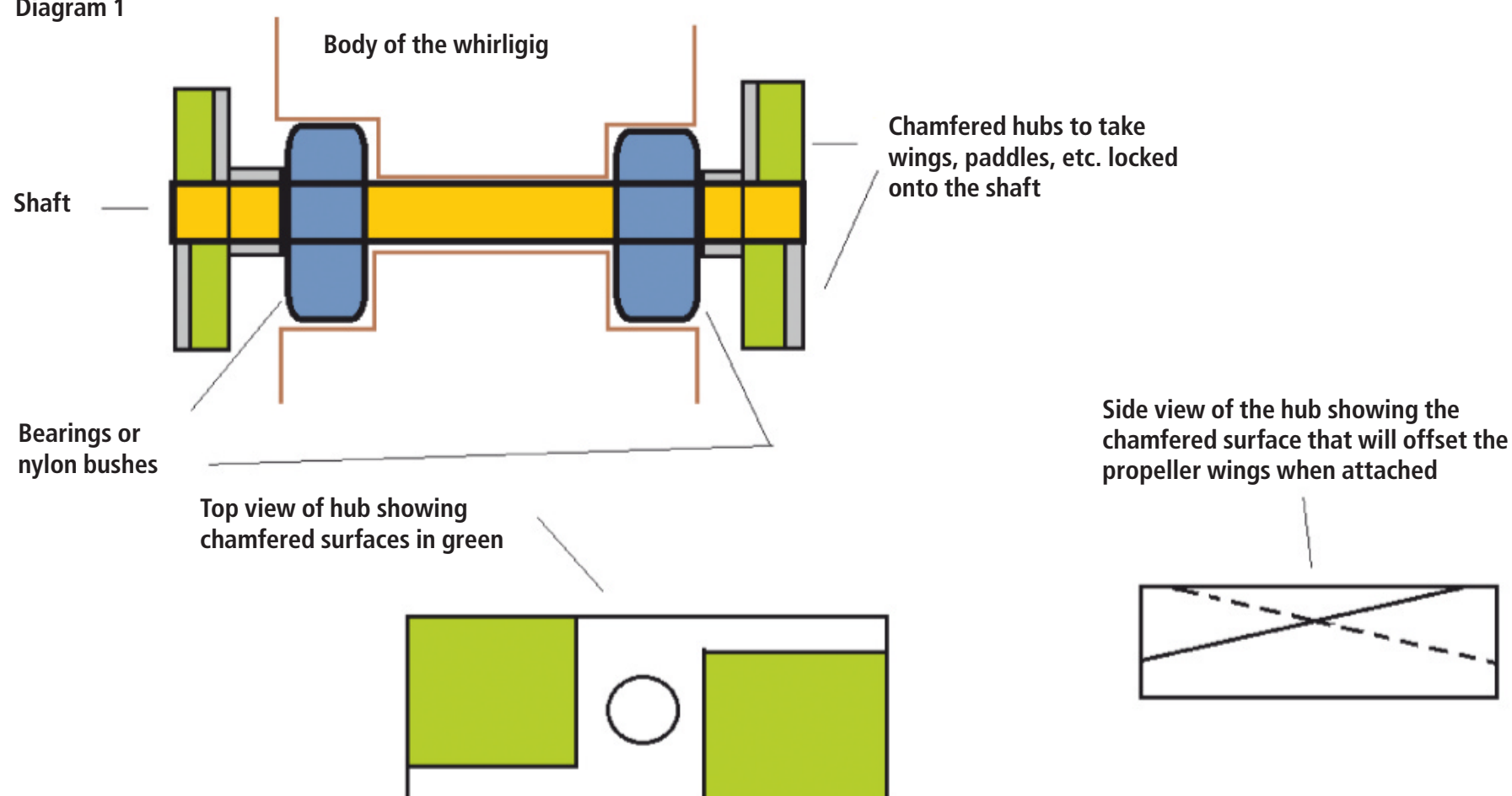
*Its streamlined shape
... and its wing action
in a reasonable wind
is delightful to see*

whirligig — are the heart of any successful whirligig, as well as ensuring its longevity. A central shaft positioned through the body of the whirligig on bearings, or nylon bushes with a hub at either end, provides the wind-driven spinning movement. If you decide on a symmetrical wing either side, set them at 90 degrees to each other so that at any moment the wind is acting on one or other of the blades (see Diagram 2). If you opt for an asymmetric propeller, such as with a rowing-boat figure, set each paddle at 180 degrees to the other (see the Indian canoe figure on following page).

Hub design

The second critical aspect for an effective whirligig is in the design of the hubs that carry the rotating portion of the item. One option is to construct the wing as a single piece where each blade of the wing is offset to enable it to attack the wind. This incorporates the hub into the wing shape and will give it extra strength to cope with high wind loads. The second option is to construct separate hubs, build the offset into the hub, and then attach the blades. This is a simpler method of construction and makes it somewhat easier to build interesting wing shapes to complement the whirligig. (See Diagram 1.) ►

Diagram 1



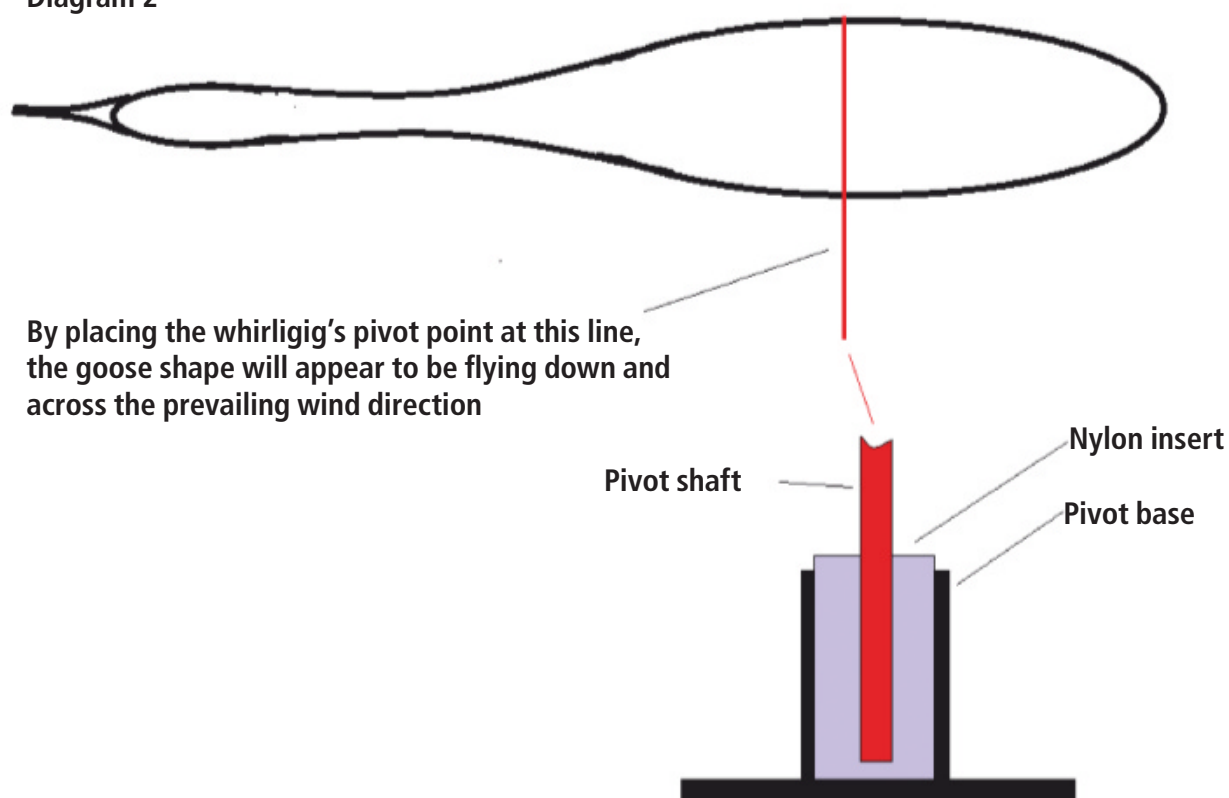
Whichever way you choose to build, remember that it is important to offset the wings so that wind pressure on their surface induces a rotating movement. Each wing blade must be offset in the opposite direction of the other, otherwise wind pressure on each will cancel the rotating effect (see Diagram 1).

Balance is critical

When you construct an asymmetric propeller, as for the rowing-boat whirligig, the same offset rules apply as if the two paddles were one propeller. When building this section of your whirligig, be as precise as possible and bear in mind that imbalance in the wings or paddles will cause vibration and result in premature wear and tear. It may also mean that higher wind speeds will be required for the whirligig to work.

This also applies when deciding on the size of the wings or propellers. The greater the mass, the higher the wind speed will have to be to overcome the inherent friction and inertia of the wings or propellers. When determining their size and shape, take into account the average wind speeds the whirligig is likely to be subjected to. For example, if the site is prone to strong winds, it could tear itself to pieces, as happened to one of the first examples I built years ago.

Diagram 2



The pivot point can alter movement

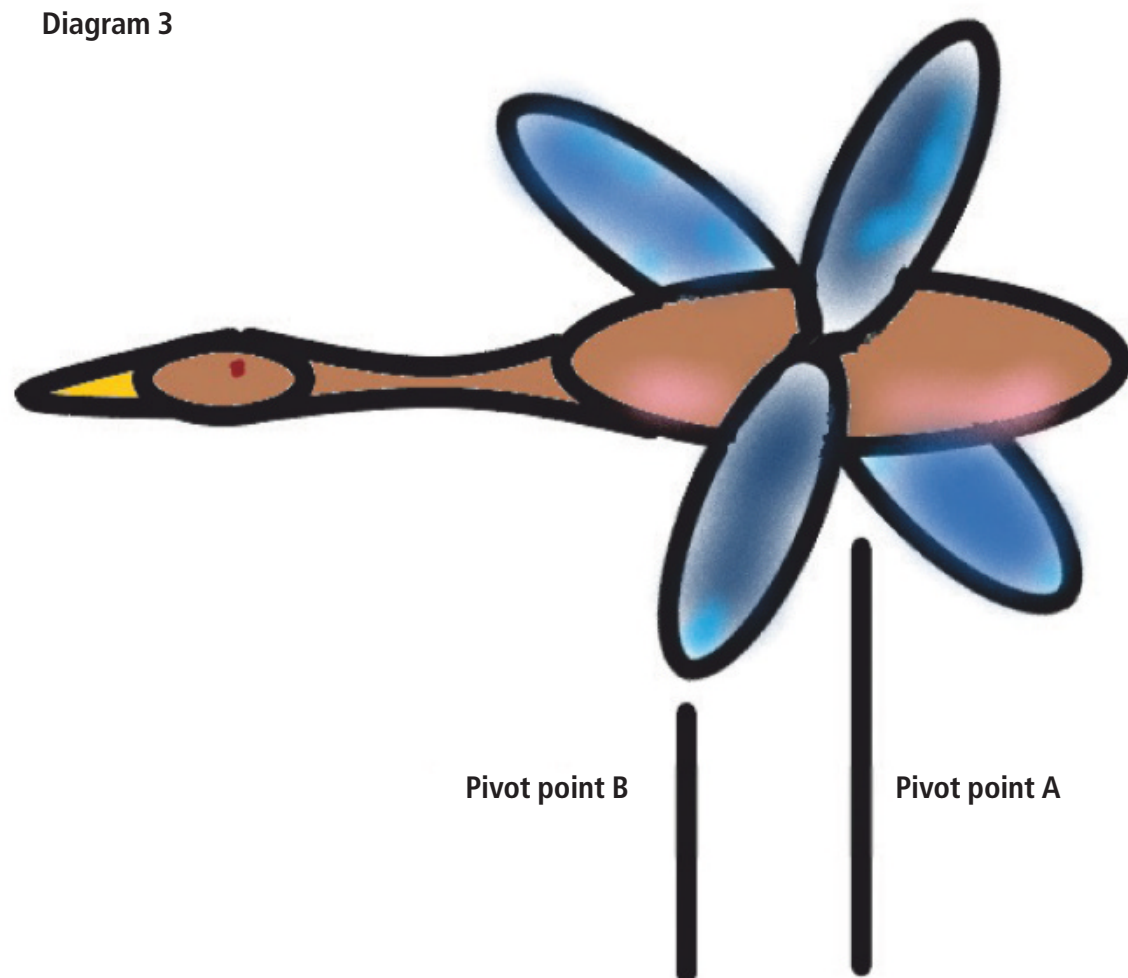
As a general rule, the pivot should be placed so that wind pressure on the body of the whirligig will bring the propeller into the wind (see Diagram 2).

Depending on where the pivot point is situated on the body of the goose in the example here, it can be made to appear to be beating furiously against the wind or frantically scurrying before it (see Diagram 3).

Avoid putting the pivot point where

it is evenly balanced in terms of wind pressure, as then the goose will be continually changing direction and the wind pressure to activate the wings will be inconsistent, resulting in intermittent movement of the wings. The direction that the whirligig will face is determined by the surface area contacting the wind either side of the pivot point. Don't be tempted to move this point too far one way or the other, because that will adversely affect the ability of the whirligig to overcome the

Diagram 3



friction of the pivot itself and reduce its ability to turn according to the wind direction. Placement of the pivot point should be a trade-off between allowing the whirligig to turn easily and still maintain a sufficient differential in the surface areas presented to the wind.

Simple two-dimensional object

An uncomplicated whirligig is basically a two-dimensional object. Using the goose as an example, its body can be cut from a wide plank or a piece of marine ply, 20mm or so thick, and painted in

a way that pays homage to the real thing. The wings can either be made from a thicker length of timber in one piece, using a bandsaw, or from thinner material and hubs cut out, as shown in Diagram 1.

Nylon blocks are fixed either side of the body with a single shaft running through them to which the wings are attached. Select an appropriately sized section of nylon to offset each wing and ensure that there is sufficient clearance between the body and the wings as they spin. Countersink the screws holding the nylon blocks to the

body, and use some large washers to take up any excess clearance between the hub of the wings and the blocks. This will reduce wobbling in the wings and enable the whirligig to run fairly silently. Similarly, when drilling the mounting blocks to take the shaft, keep the clearance to a minimum. Over time there will inevitably be some wear in the nylon blocks, which will become evident in strong winds as a rattling noise; however the blocks are easily replaced. Or, you can opt to use a pair of roller bearings and faceplates in place of the nylon blocks if this is going to be a concern.

A tough goose is called for

In the example I use to illustrate this article, I used a 10mm shaft to carry the wings that I threaded at each end. In turn I threaded each hub and glued them in the correct position in case the wings moved on the shaft thread. Take the time to secure the wings adequately. An earlier, similar flying goose's wings actually self-destructed in a heavy wind and were found a considerable distance away after the weather eventually cleared. (I live in the Roaring Forties, which might help to explain the incredible force exerted on the wings in strong winds.) ►

This is a simpler method of construction and makes it somewhat easier to build



An Indian canoe whirligig with asymmetric paddles

“The possibilities are limited only by your imagination”



A model puffin whirligig made from contrasting timbers

The pivot post consists of a 10–12mm section of round bar sufficiently long enough that the wings will be clear of the base on which the whirligig is mounted, in whichever direction it faces. The round bar is threaded and inserted into a matching thread in the body of the goose, then locked in with an appropriate glue such as Araldite. The second part of the pivot post consists of a tube with a nylon block in which the pivot post can turn freely, and a suitable footing to secure it to the selected base. In this instance I used the upturned leg of a discarded steel table with two small nylon blocks drilled out to carry the round bar. Two holes drilled into the side of the upturned table leg secures it to the fence post.

Simple is best in strong winds

The simple two-dimensional design has the added advantage that in really strong winds it will face almost directly into the wind, thereby relieving the

strain on the pivot post considerably. I have built a similar goose in a steampunk vein using a wooden body clad in aluminium, copper, and stainless steel. I used two small roller bearings to run the wing shaft and then built the wings out of stainless steel. The finished whirligig looks quite good, although I have noticed that it generates considerable noise in strong winds, which suggests it is best placed on an outbuilding well away from the house.

As I mentioned, there are many designs that can make delightful

whirligigs, such as a man chopping firewood or starting a car with a crank handle, a lady milking a cow or beating her husband with a broom, a plane endlessly taxiing for take-off, and a Pegasus forever flying through the sky. The possibilities are limited only by your imagination. Bear in mind, however, that the more elaborate the whirligig is, and the more moving parts the wings have to drive, the more difficult it will be to align all the bits and pieces accurately so that the wind activates it. 📦

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To make the scenery look better and to cover the exposed wires and moving parts, I glued some fake dry leaves here and there on the surface

MAKING BIRDS DANCE IN A SPECIAL CLOUD

A POPULAR GAME LEADS TO AN EXPERIMENT THAT INVOLVES COMPLEX TASKS TO ACHIEVE THE DESIRED EFFECTS

By Enrico Miglino

Photographs: Enrico Miglino

The experiment in this issue aims to demonstrate that birds are not always angry, but can also do something else! Am I joking? Sure, but I should admit that I was inspired to make this project by the popular game *Angry Birds*.

This fourth article in our series on practical, educational BBC Micro Bit experiments is a little more complex than the others. We will see how the Micro Bit can connect to control another microcontroller, while we send commands through Bluetooth via a smartphone.

Technology principle

As in all the other projects based on the Micro Bit, we will investigate and experiment with a principle, as well as show the methodology can be applied to your own personal projects.

The Dancing Birds project is an example of stacking two microcontroller boards to create a small cloud to execute some complex tasks.

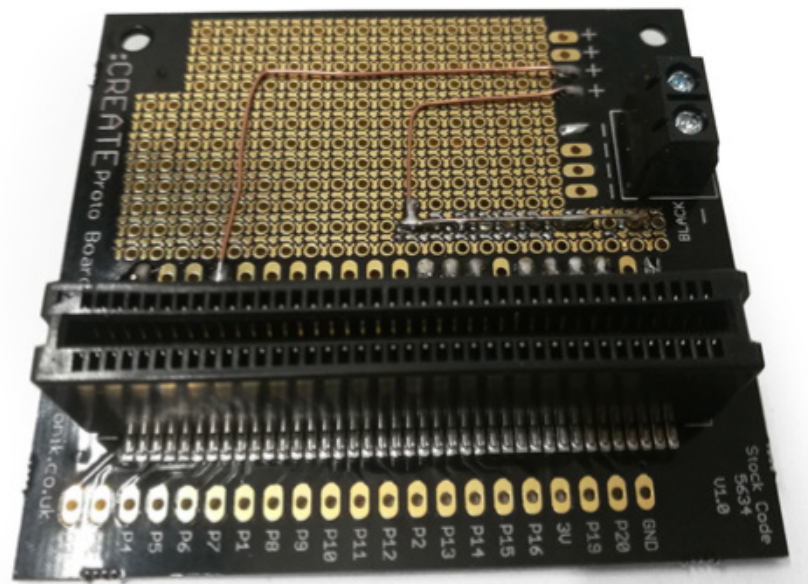
The BBC Micro Bit is based on a fast and powerful microcontroller, which natively includes several useful sensors and features. Unfortunately, the relatively

reduced number of available general-purpose input/output (GPIO) pins could mean an issue with driving the many servo motors that we need to make this project.

I decided to use an Arduino Mega 2560 to help the Micro Bit with controlling the hardware. The Arduino Mega has a lot of available GPIO pins, so it was the ideal solution to manage the motors, servos, and more, even if it is a bit slower and has a less powerful processor. I faced some interesting challenges stacking these two microcontrollers but, finally, things worked out and the birds danced.



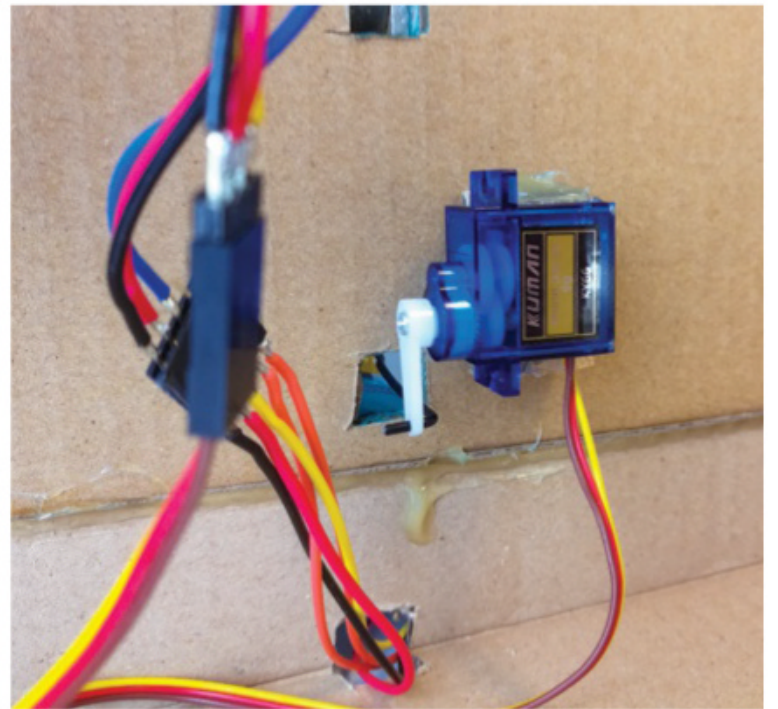
Left: While the Arduino Mega controlling the servos fits inside the box, the control wires are connected to the Micro Bit board, exposed so that the display feedback can be seen and it can be reset and paired with the smartphone via the Bluetooth connection



Right: The Kitronik proto board with the soldered wires to connect the control signals between the Arduino Mega and the BBC Micro Bit



Left: The internal servo presses the monkey's belly button with a mechanical action



Right: Internal view of the two servos connected to the actuators: the monkey belly lever and the birds' floating base

Making and moving

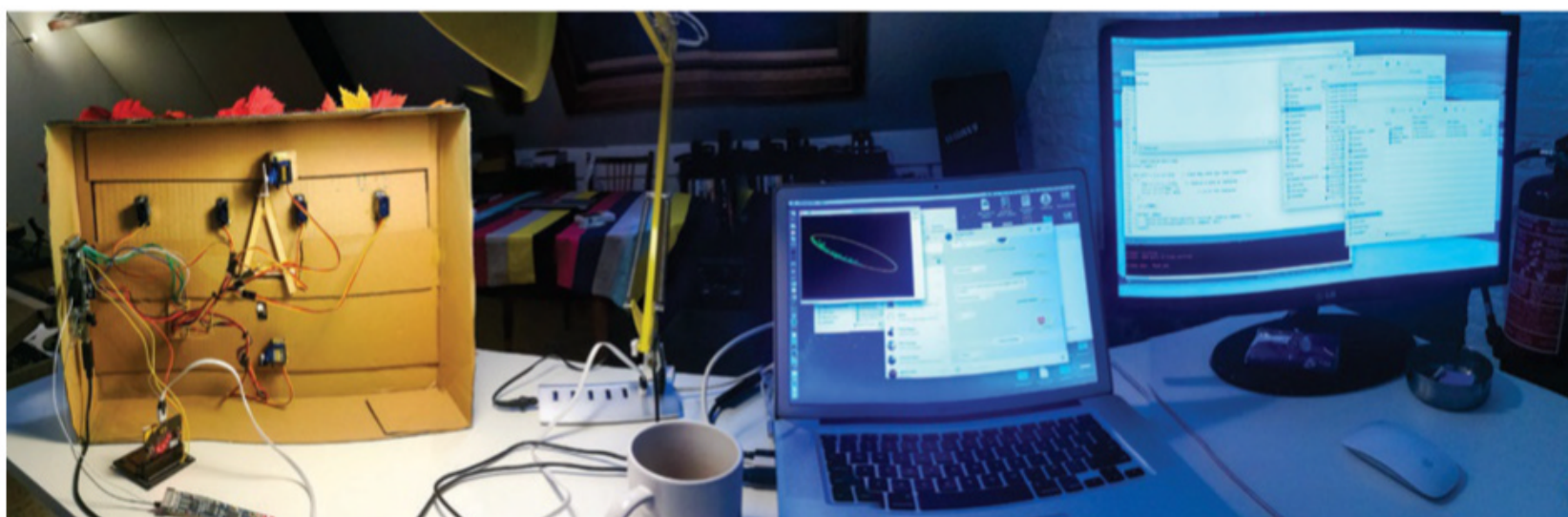
The moving parts are controlled by six micro-servos, a small investment from a pack of 10 bought on Amazon. It's better not to buy the cheapest ones — I have already made this mistake once — as they tend to be unstable in several angular positions. As the motion of the dancing birds is quite complex, I opted for US\$2 servos. You can find US\$3 packs for five or more servos on Amazon, but I recommend you don't buy these, as you

The Dancing Birds project is an example of stacking two microcontroller boards to create a small cloud to execute some complex tasks

need a reasonable positioning response.

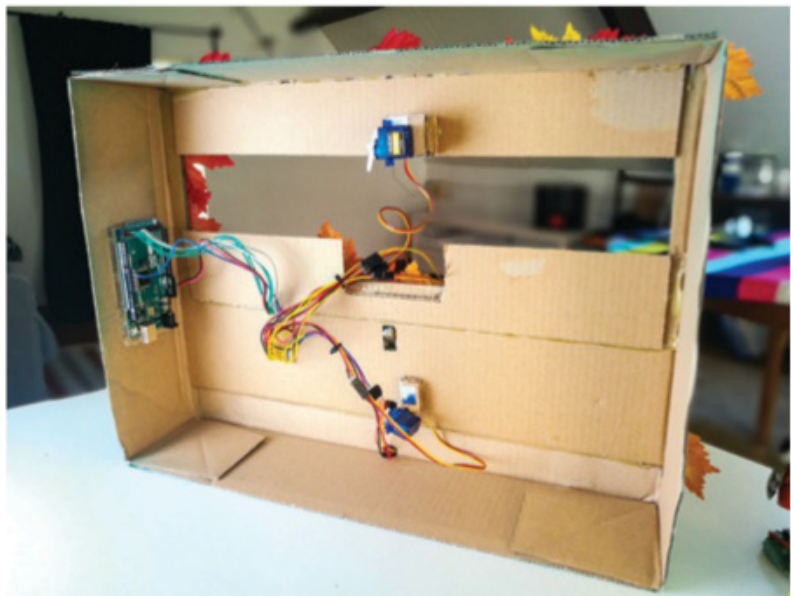
The Arduino Mega 2560 is perfect to control the motion as it has many pins, good speed, and sufficient programming space. The servo-control software has been developed in C-language using the well-known Arduino IDE. You can write your own version of the code sketch, or as a starting point refer to one available on GitHub: <https://github.com/alice-mirror/DancingBirds/blob/master/DancingBirds.ino>. ►

A panorama of the interior of The Dancing Birds stage (with servos and Arduino Mega inside), and the computers for programming and testing. The most difficult part of the final set-up of the programme was the servo calibration for the right-angle rotation to position the birds on the rotating platforms and the two levers for jumping the base and pressing the button on the belly of the monkey toy



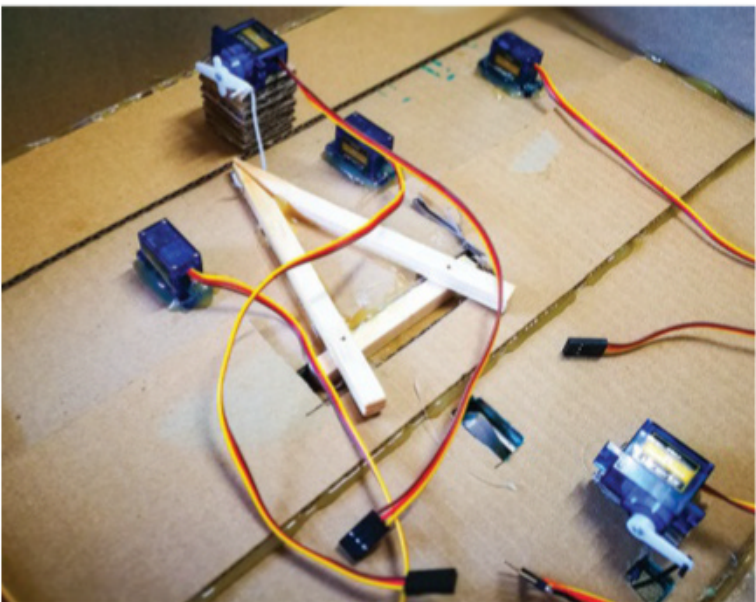


The birds' floating base in the open position. As the birds' legs are soldered to their bodies with a spring, a small motion of the platform is all that is required to create a nice effect



Left: Internal view of the cardboard stage in assembly phases

Right: The servos hot-glued in place ready to be connected to the Arduino board



The Arduino Mega 2560 controls the servos, acting as the bare executor of some external commands.

This is the point at which the Micro Bit comes into play.

The BBC Micro Bit board is one of the most complete and versatile microcontroller boards around, with the bonus of also being one of the better solutions for educational purposes. But the board has its limits too — one of which made me crazy for days trying to develop this project.

Best-laid plans

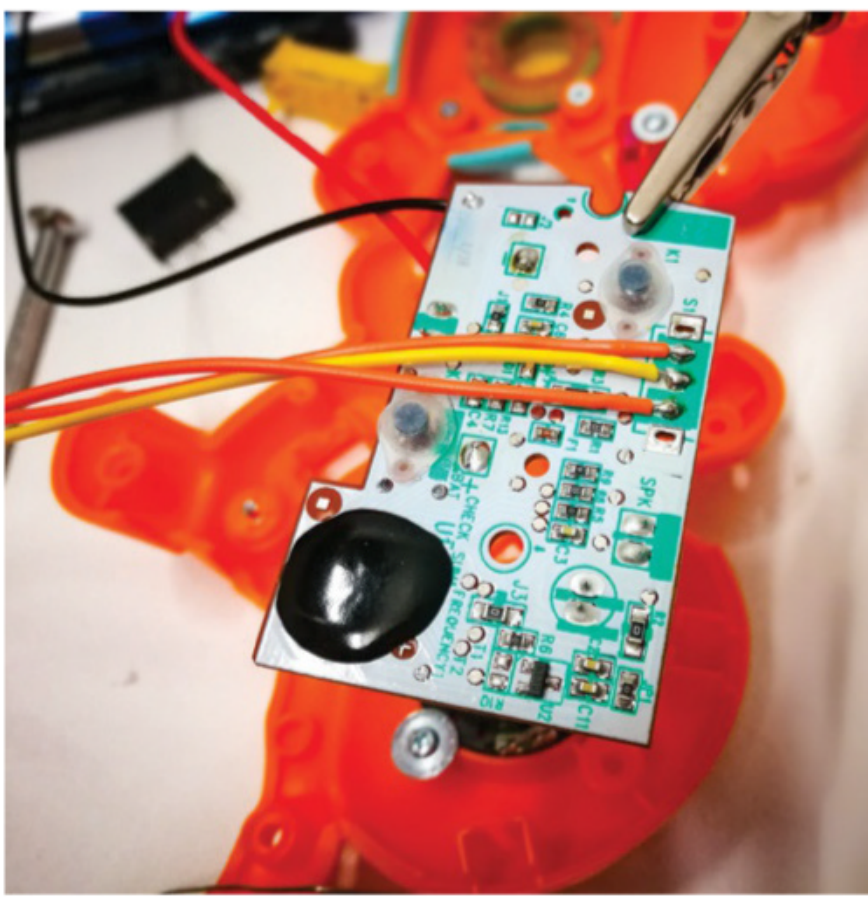
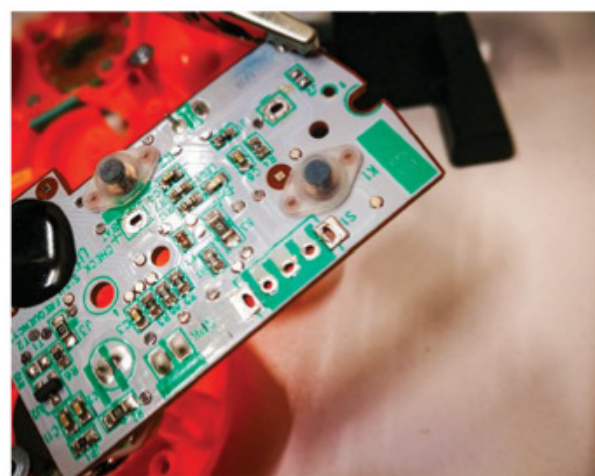
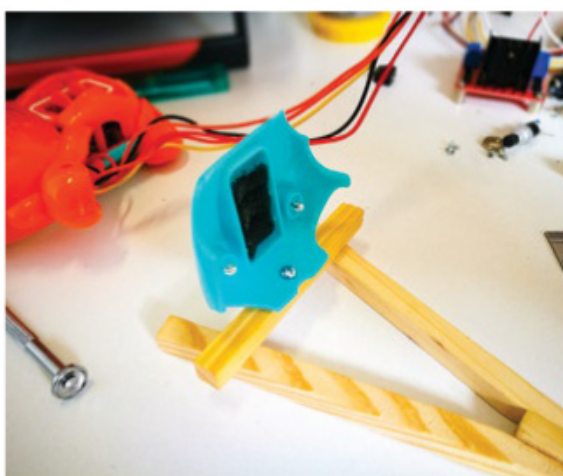
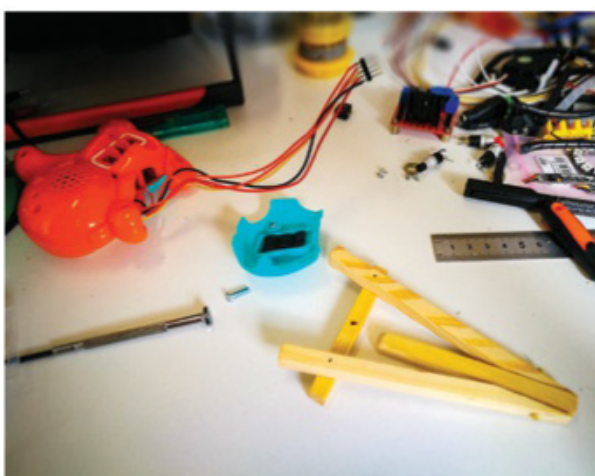
My original plan was to control the Arduino board with a Micro Bit through the I²C protocol; apparently, on both the boards it is easy to implement and easy to programme, with plenty of well-documented examples.

I spent many days trying to set up a good strategy to make the two boards communicate with this two-wire protocol until I had to give up and find some sort of plan B.

The most probable reason why it would

not work is that not all the Micro Bit features will work well if used together. In my case, it seems that the I²C fails to communicate with the Arduino if I also set up the Bluetooth library on the Micro Bit, due to some internal firmware issue that makes the I²C incredibly unstable when Bluetooth is active.

Fortunately, it was not too hard to find an alternative solution. Many unused GPIO pins on the Arduino Mega were still available, so I decided to create my own communication protocol. Using



Above and left: Four steps in the hack of the baby's toy. After removing the battery power, I connected a separate power line (coming from the Arduino Mega), while the power button would be actuated by a digital signal coming from the Arduino. The use of the belly button to change the music was a nice effect, so I decided to leave this function intact and activate it with a servo-controlled actuator

Kitronik's protoboard edge connector for the Micro Bit, I wired the two boards together through six digital pins corresponding to the six servos controlled by the Arduino. I was also able to power the Micro Bit directly with the 3.3V output from the Arduino.

At this point, all the parts worked well, including the Bluetooth connection.

In our stacked set of microcontrollers the Micro Bit board will be controlled by a user. Just download the Kitronik app on your smartphone (available for free on Android and iOS marketplaces) to make the birds dance with a Bluetooth pad.

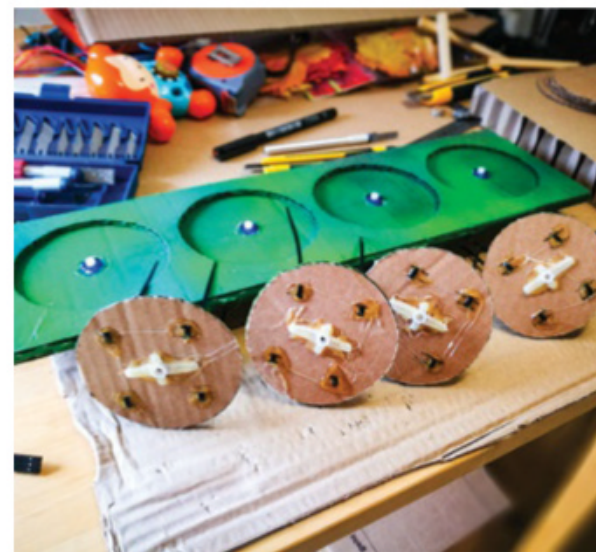
Once all the prototyping tests have been completed, it's time to assemble the dance stage and place the birds. ►



The birds fixed on the cardboard rotating platform and placed on the floating base



Above: Three steps in the creation of the rotating platforms for the birds, with the servo lever glued with its axis centred to the bottom of the platform



Assembling the structure

Dance needs music. I searched for something suitable for some nice, small birds. A baby game monkey with lights and sound was perfect to make them happy.

After disassembling and removing the unneeded components I was able to power it with the Arduino, while I left the belly button of the toy, which changes the played sound, to preserve the integrity of the monkey. One of the servos presses the button just like a baby does, with a pleasant scenic effect. The six servos are hidden on the dancing platform executing different synchronized tasks depending on the Micro Bit commands. Among them, one servo changes the music (the monkey belly button), and one makes the birds jump on their platform.

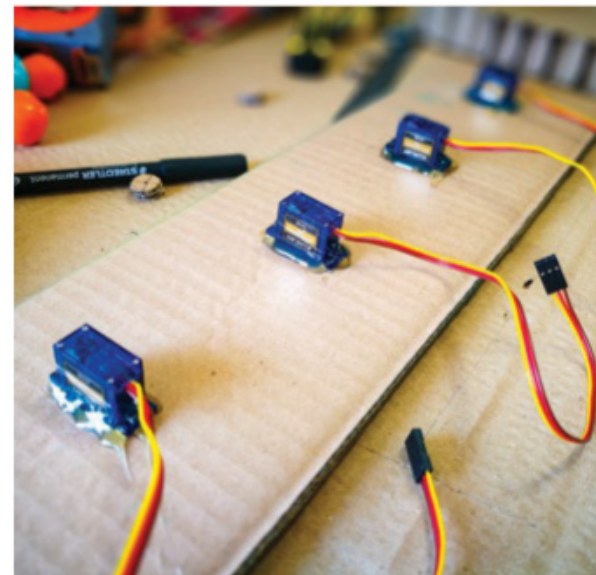
After preparing the wires to control the monkey from the Arduino, it was reassembled and screwed on a small wooden support, with a moving part to press the music-changer belly button. The birds' servos have been glued inside the bird-support platform that can jump through another hidden servo.

The Micro Bit software is also available on our GitHub platform: <https://alicemirror.github.io/DancingBirds/>.

Note that by default the Micro Bit development environment is set up to use radio functions. As we use the same component on the board for the Bluetooth connection, we should load the Bluetooth library instead and exclude the radio library. 

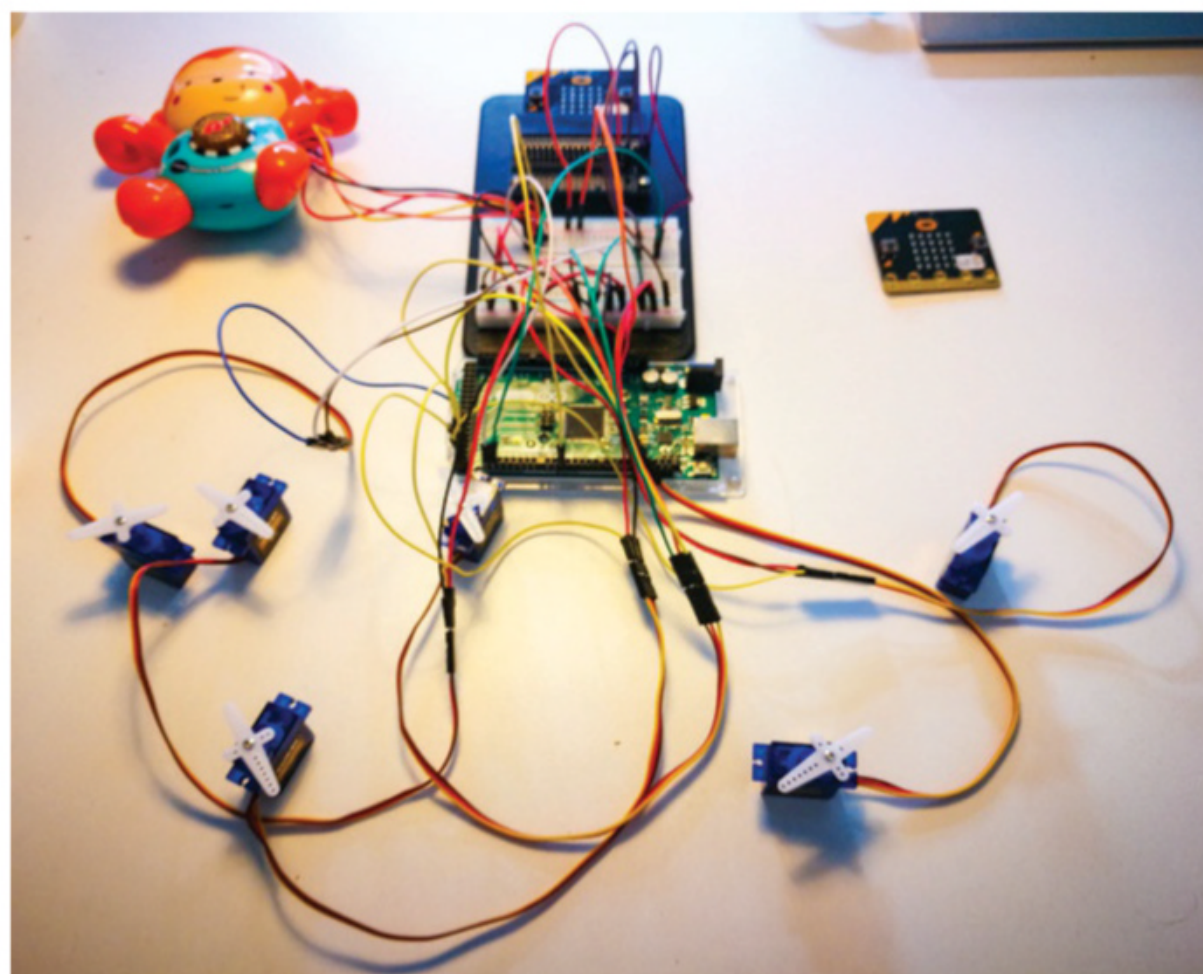
Handy tip

To save sources from the Micro Bit online Blocks programmes: when viewing the software written with the graphic Blocks at <https://makecode.microbit.org/>, you can press the JavaScript button at the top of the page to switch between the Blocks view and the JavaScript source code. Then you can select the text and just save the source to your local computer.



Above and left: How the floating base was built. To create the space for the four rotating platforms I used multiple layers of cardboard glued together

Below: The Arduino Mega wired to test the connections and signals. This temporary setting was used to develop the control software on the Arduino side





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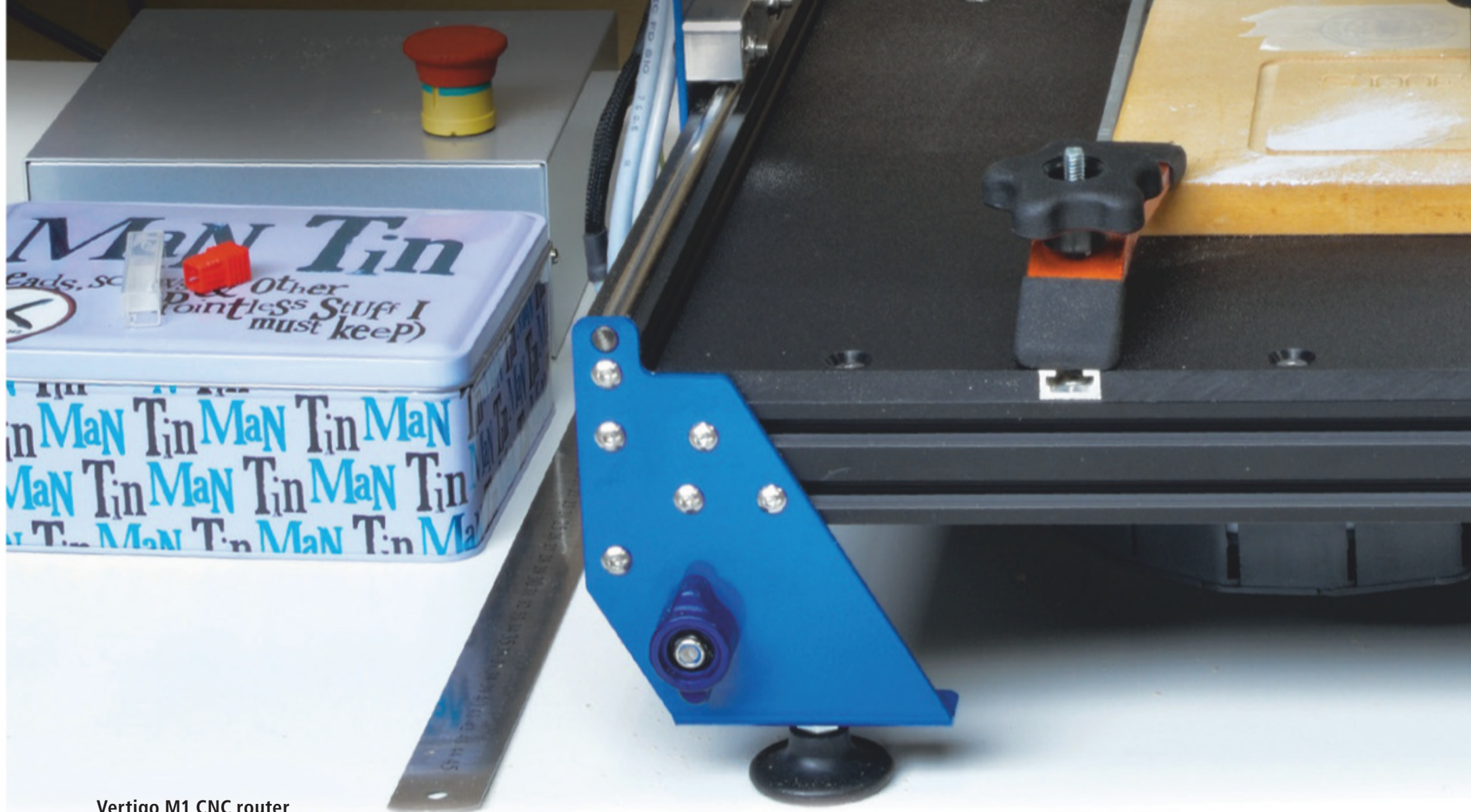
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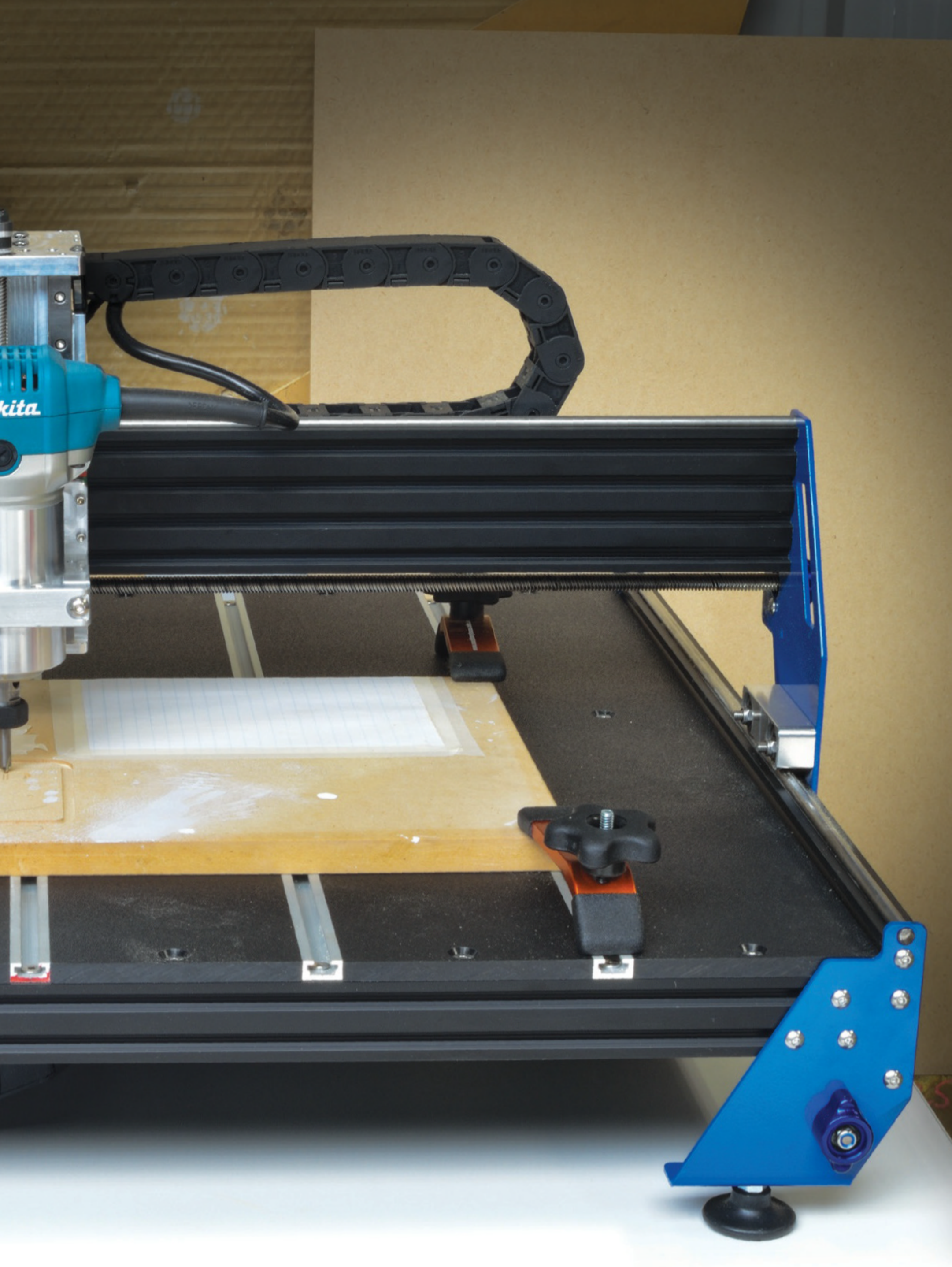
IN PART TWO OF OUR SERIES ON CNC ROUTERS WE EXPLAIN THE BASIC PRINCIPLES TO GET YOU GOING

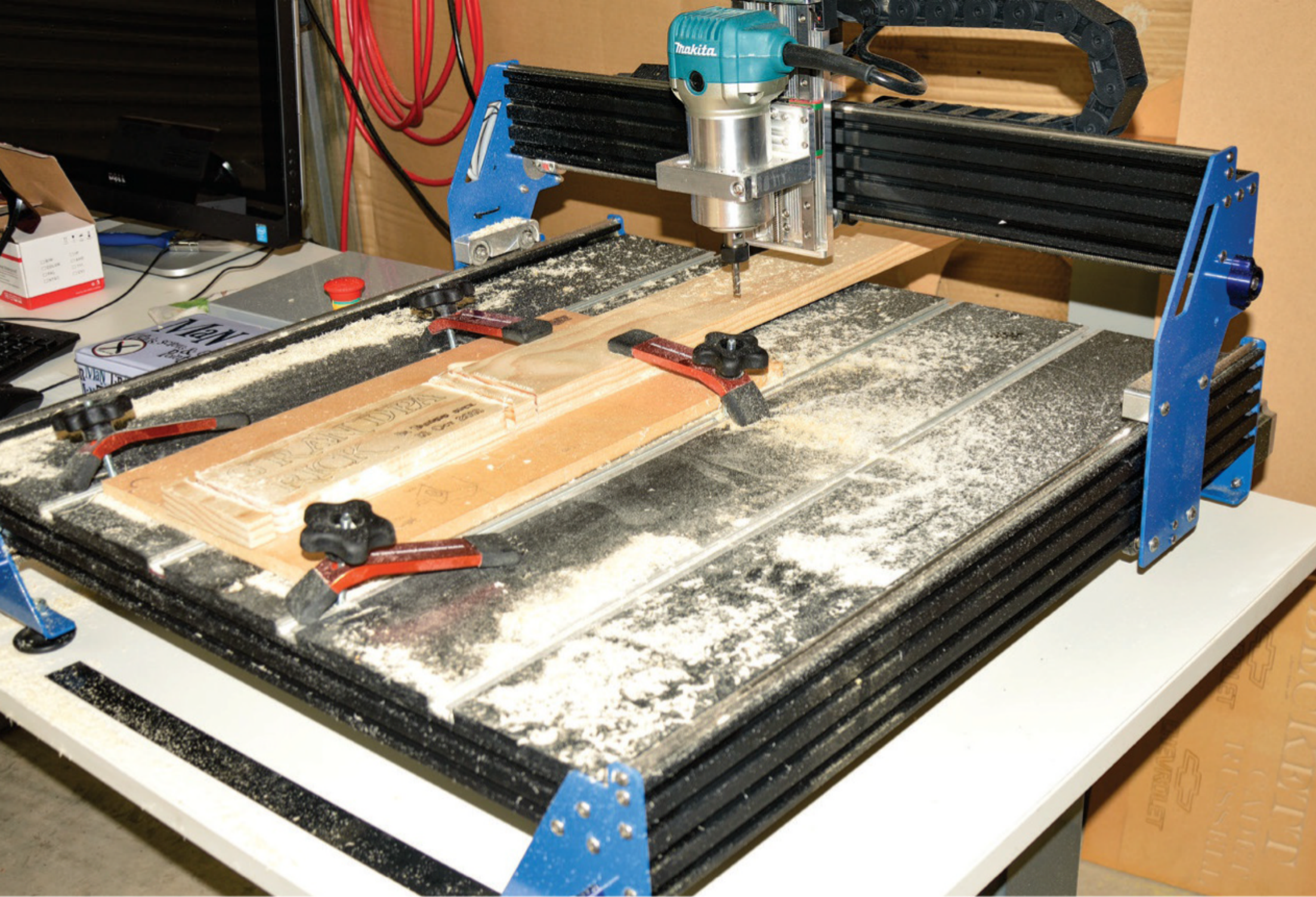
By Mark Beckett

Photographs: Mark Beckett



Vertigo M1 CNC router





Regular readers will recall that in *The Shed* September/October 2018, Issue No. 80, I wrote about purchasing a Vertigo M1 CNC router from the guys and gals in Westport.

Buying it was easy ... well, except for the bank transfer.

I took the invoice down to my bank and said, "I'd like to pay this please." With all this online banking stuff, you'd think that the bank would tap a few keys and transfer from my account to this other one ... *no* ... apparently not when the other account is at another bank. They offered

me two options: cash or online banking.

Since Mrs Finance does not trust me with online banking, cash it was. I waited while they counted it out, put it in an envelope and then I walked 50m into the other bank.

At the other bank they counted it, tapped a few buttons, and — hey presto — it was done.

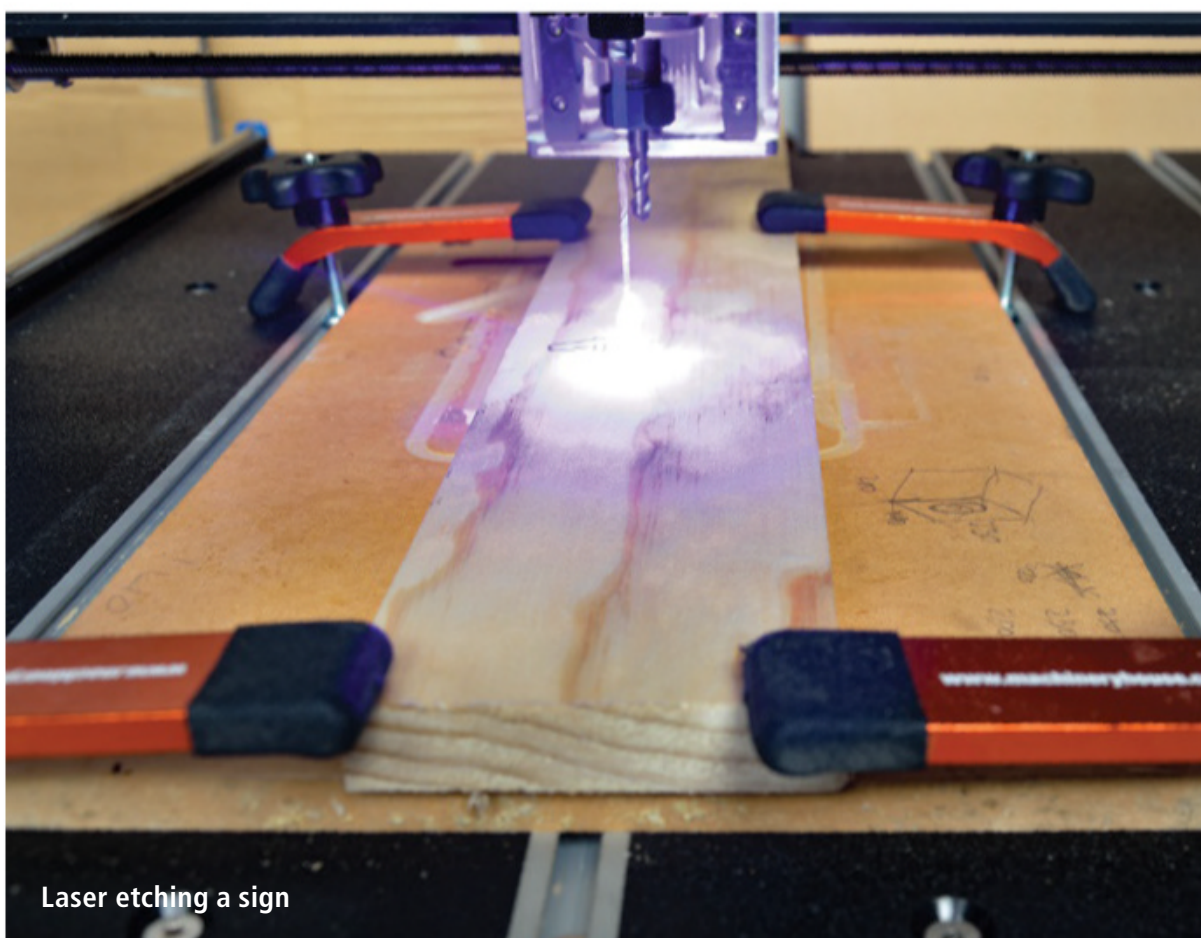
So much for a sophisticated modern banking system.

I had been putting off buying a CNC router because I have enough other projects to keep me busy, and the time to upskill was going to eat into these, but now that I've bought one, it's time to get my head around the terms and other bits to make it do stuff. I'm sure I'm not alone, so this article will hopefully assist anyone contemplating making that step.

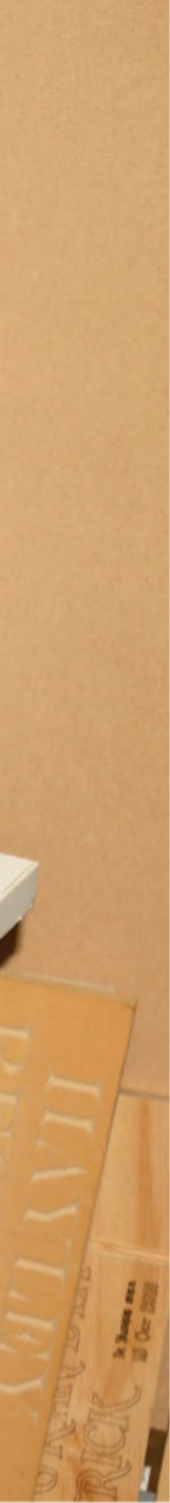
What software to use

There are various software packages available. Some do just one part, but others like Autodesk Fusion 360 can do both CAD and CAM (the first two processes).

I chose to use Fusion 360 because CNC



Laser etching a sign



Left: Good vacuum required — a dust shoe has been ordered to reduce the spread and catch 80–90 per cent of the dust



Right: Router contour

and 3D users are familiar with it, so assistance when you get stuck is much easier and more appropriate to the issue you're having.

The third part of the software equation is the bit that takes the NC (numeric code) and provides something the hardware can use. CNCJs is the preference here and will run on a wide

variety of platforms. You use this to set the zero point, work height, and view the process.

Because I elected to add a 2.4W laser to my router, the recommended software is Laserweb. This controls the machine and the laser power, but there are other software packages that offer different effects. I've also managed to use Fusion 360 with manipulation of a sample laser cutter.

What hardware do I need?

The links to the software are on the Vertigo website (<https://vertigotech.co.nz/pages/downloads-vertigo-technologies-ltd>). You can download them elsewhere, but for Fusion it pays to go via the New Zealand website.

Fusion 360 will run on Windows or Macs with at least 8GB of memory, but it does require a 64-bit machine, and, while it will optimize your graphics card, a good card will improve the performance, so you don't need a lot of computing power.

Fusion 360 is a cloud-based application, but you can run it offline as well. I've

I had been putting off buying a CNC router because I have enough other projects to keep me busy, and the time to upskill was going to eat into these, but now that I've bought one, it's time to get my head around the terms and other bits to make it do stuff

Glossary



CNC

CNC stands for 'computer numerical control', which means it works on numbers in a proper sequence. There is a good description here: autodesk.com/industry/manufacturing/resources/manufacturing-engineer/g-code. For the absolute novice, you just need to make sure the file and the controller board match.

In reality it takes three software processes to make something.

CAD

'Computer-aided design' software has been around for a while, and comes in various forms and features. I'll be sticking with Autodesk Fusion 360, but more on why later.

CAM

'Computer-aided manufacturing' is the process to make the part. It uses the settings to work out the best path for the tool to make that part. You may have different speeds for a certain section, or a depth limit that the cutter or machine can handle, and the idea is that this bit of software works all that out. This works out the tool path in order to achieve it.

Post processor

This translates the tool path into the code specific for the machine to make the part.

2D, 2.5D, and 3D

I always knew what '2D' was. Put simply, line drawings are '2D' — they use the X and Y axes only.

'3D' adds height and for this you use the Z-axis.

'2.5D' was a mystery, but luckily a bit of searching filled in the blanks. If you wanted to make something with a height change as a step (rather than smooth), then it is 2.5D. I read a few other bits and it seems that if the Z-axis (the height) stays fixed while the X and Y move, then it's considered 2.5D.

In years gone by, 2.5D machines were sold as a cheaper way into CNC, or as retrofits, because it was easier to do.

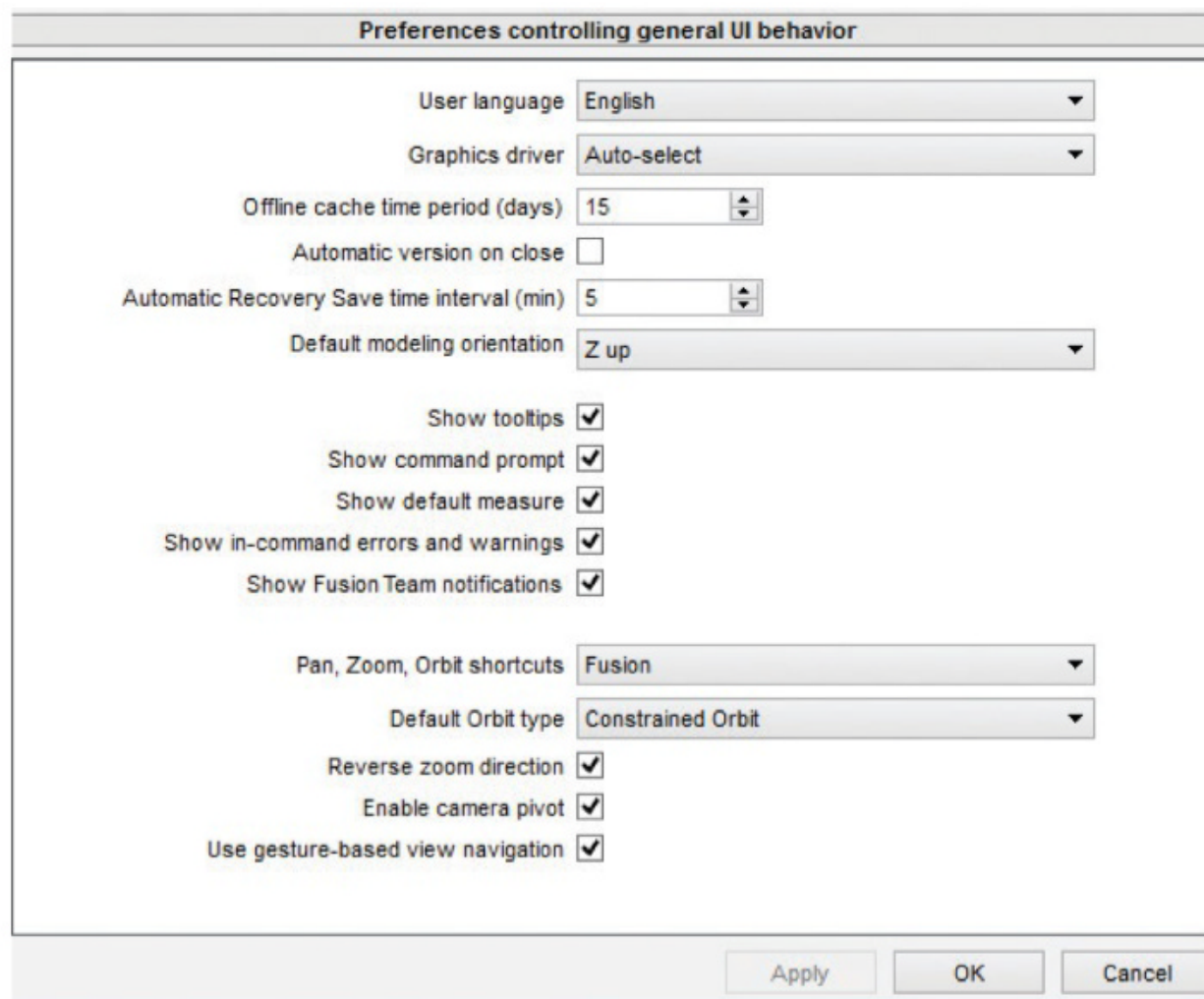
found it very handy that I can do my creations inside on the computer, and then go out to the cold garage, fire up the computer out there, and my designs are available to tweak and save again. So while I have reservations about cloud-based software, this has been an advantage to me.

You need to register Fusion but it's free for makers and students, and very affordable for anyone using it commercially. This video by Scott Moyse from Cadpro Systems explains it very well: [youtube.com/watch?v=7cvNAYFBgE0&t=0s](https://www.youtube.com/watch?v=7cvNAYFBgE0&t=0s).

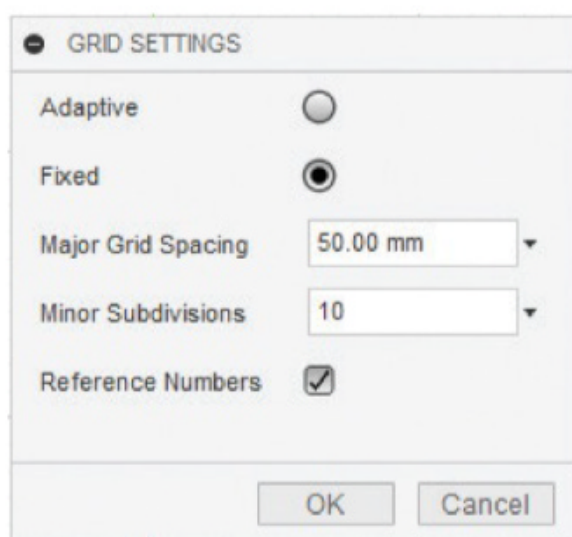
He also has some very useful tutorials: cadpro.co.nz/products/fusion-360-vertigo/.

Fusion 360 set-up

I did make a few tweaks. By default Fusion swaps the Z and Y axes, so go into Preferences, under the General settings, scroll down to Default Modelling



Fusion 360 Preferences window



Fusion 360 Grid settings

Orientation and choose Z Up. This means that any new drawings you create will have the correct orientation.

I selected Reverse Zoom Direction, as it seemed more natural to scroll forward and have the image get bigger.

You can set the default units (inches or millimetres) and while we are metric, it is entirely your preference.

I also set my grid at 10mm by selecting the Grid and Snaps in the lower right of the Fusion 360 screen,

and chose Grid Settings and 50mm for Major Grid Spacing and 10mm for Minor Subdivisions.

The software likes to create a workspace in the Users folder and, while it might be a pain, it means that you have visibility across a network, so I chose to leave this option on. However, I did decide to point the Output files to a dedicated place.

There are other tweaks related to background and other settings that you can adjust further down the track.

First steps

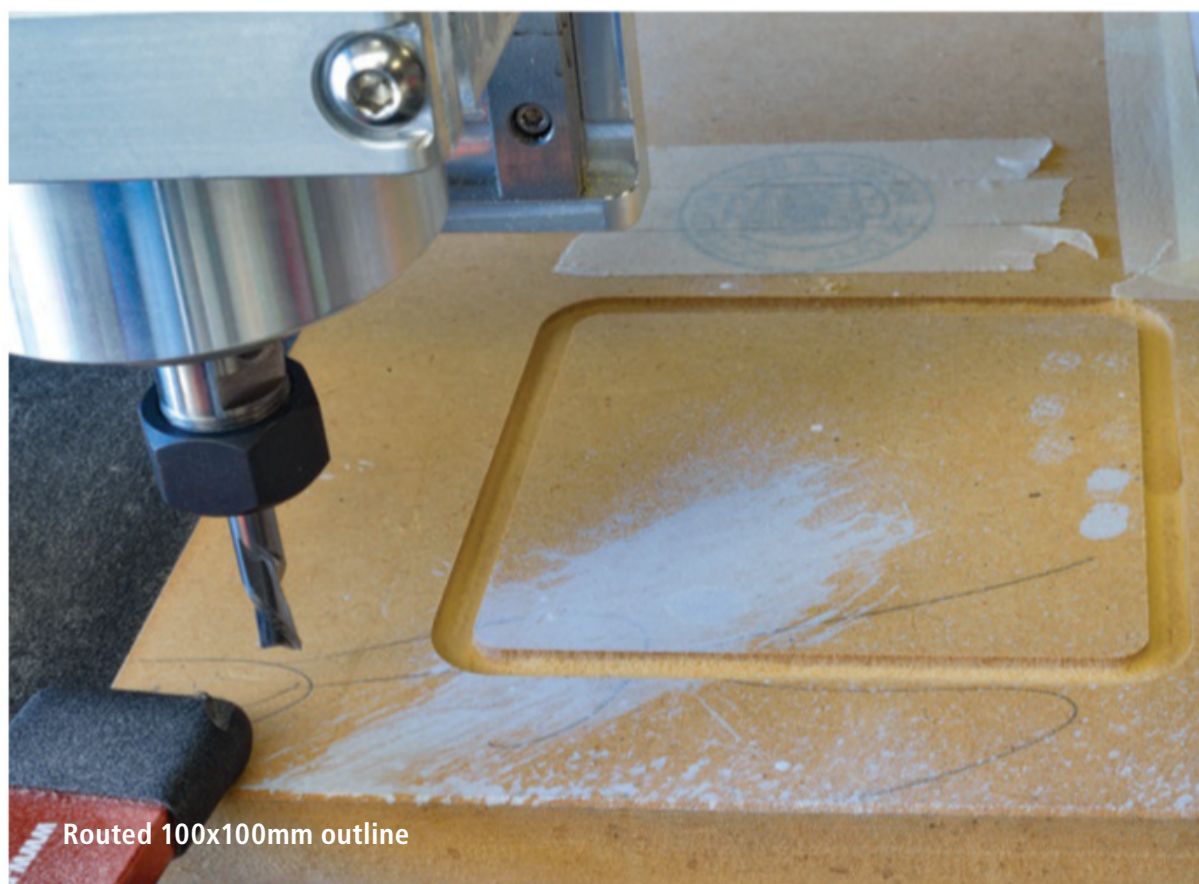
This is a good starting point for new users and covers various topics: <https://f360ap.autodesk.com/courses/#getting-started-for-absolute-beginners>.

For this article I decided to show how to cut out something, and engrave something.

My theory is that once you've been helped to take the first step, you're less apprehensive about taking the next step on your own.

This example is a 140x140mm piece with two rounded-corner rectangles inside to give a few machining options.

Start Fusion 360 and hover the mouse over the Sketch icon and Create a new Sketch. It wants you to select a plane and



Routed 100x100mm outline

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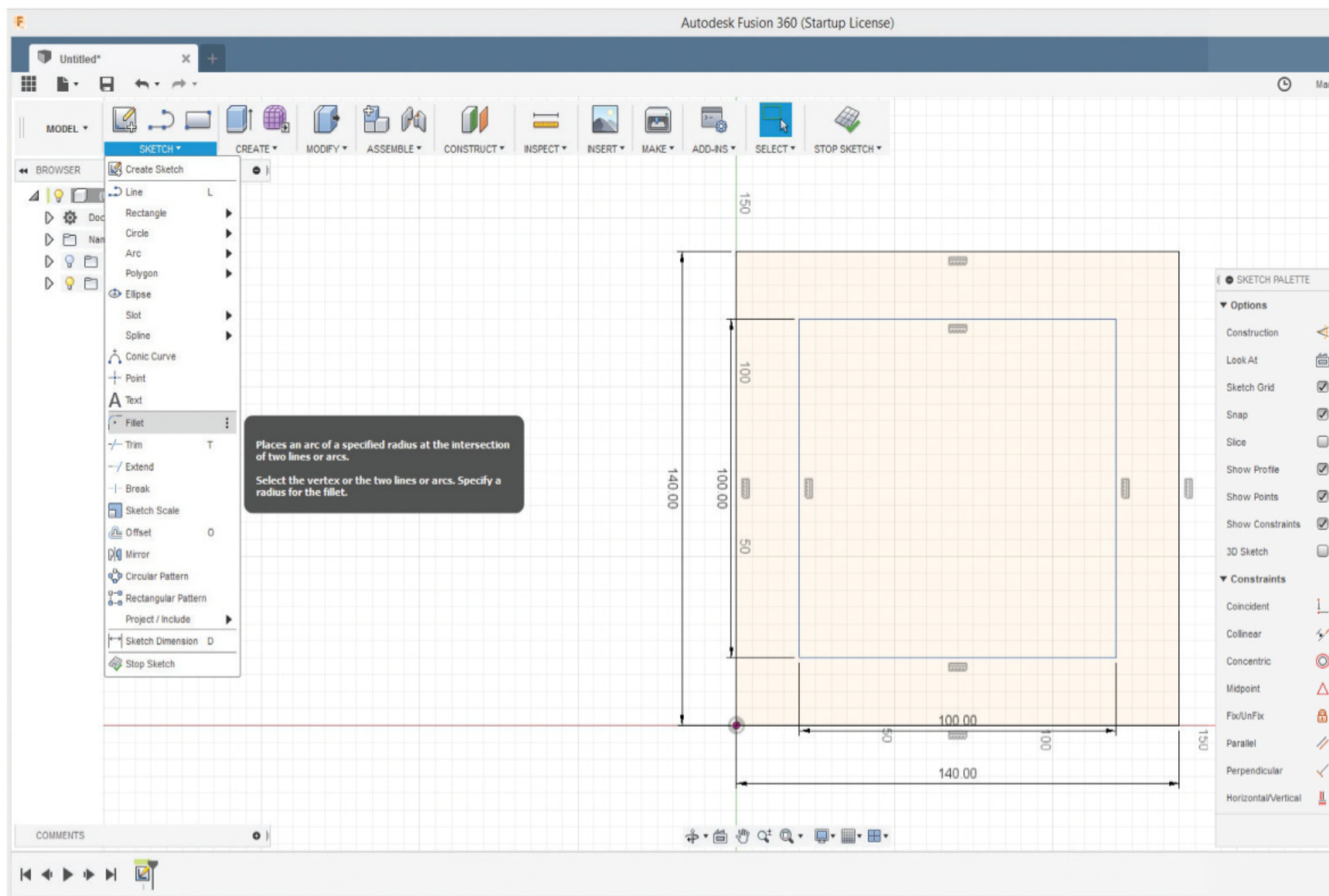


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Fusion 360 Sketch and Fillet command

rather than chase around, click on the top of the 3D box in the upper right. Click anywhere and it will shift the centre to the middle of the page.

To draw the rectangle there is a rectangle symbol on the right of the Sketch icon. Place the first corner on the XY centre (it changes to a box when you're over it) and then move the mouse outwards to the right until the X-axis shows 140, or simply type 140, press the Tab key, and repeat for the other axis. Press Enter and you have a rectangle 140x140mm.

Repeat the exercise again, this time starting 40 up and 40 across (if you have set Snap to Grid it is easier), and draw a 100x100mm rectangle.

You can zoom in/out with the mouse scroll wheel/button, or press and hold the scroll button, and then drag to shift the whole drawing.

We need to put a 6mm fillet (round) the corners. To do this, select Sketch and then Fillet. Select the first line of the 100mm

My theory is that once you've been helped to take the first step, you're less apprehensive about taking the next step on your own

rectangle, then select the other line of the corner. You can set the fillet radius by either dragging or typing '6'. Repeat for the three other corners. It should use the same 6mm fillet setting ... unless you pressed Enter, which stops the Fillet command; if you did, select Sketch and Fillet again.

By now, you should have a square with rounded corners. Don't worry about the symbols or the warning about a constraint.

To mill this out and give us some options, we need to add 6mm to each side of the

square by selecting Sketch and Offset.

It wants you to select the plane or geometry, so click the square, then hover the mouse over the 100x100mm rectangle (the whole outside edge should be blue), and then click to select. Type '6' into the dialogue and press Enter. You'll see a red copy but 12mm larger.

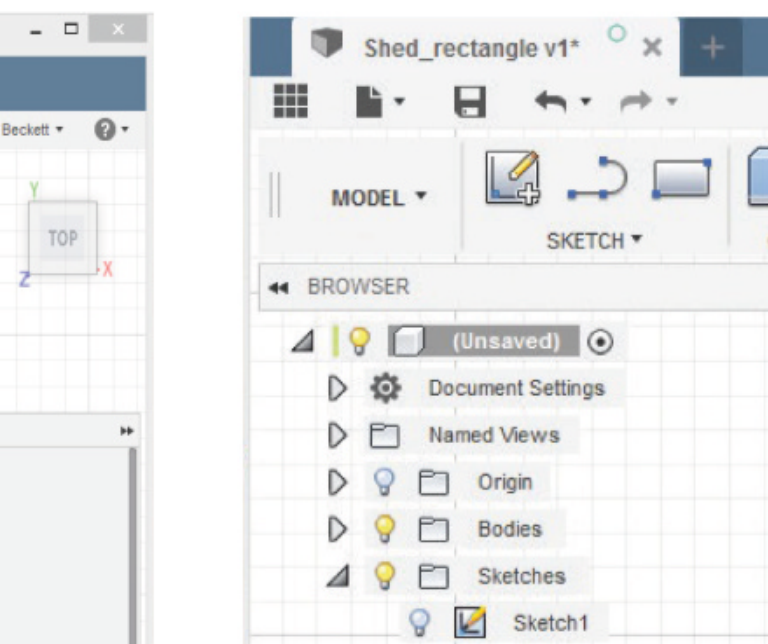
I prefer to save designs at various points of the process. That way, if I make a major blunder I can return to a known point, but Fusion 360 will autosave and has a history timeline.

To save your design, select the Disk icon, select Save, and give your design a name. Choose a folder you want to use and then press Save.

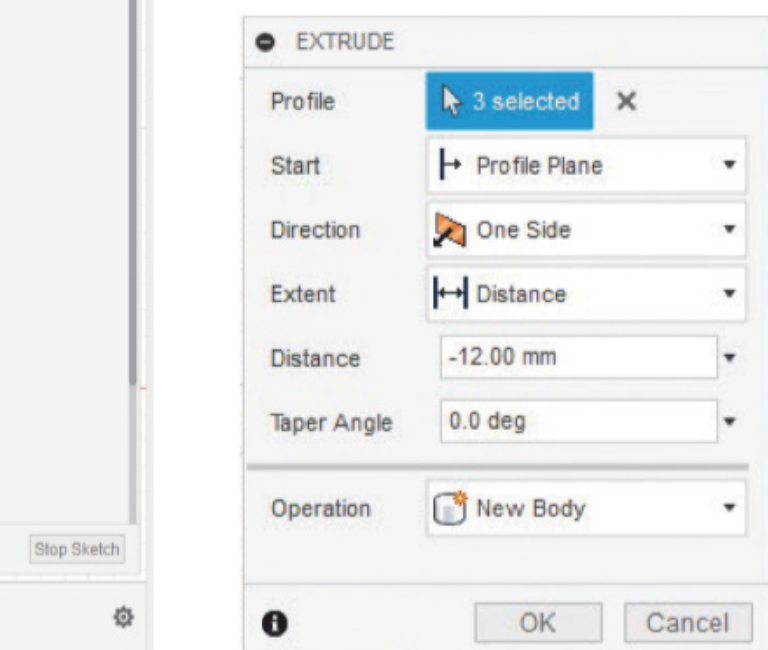
Third dimension

At this point you have a two-dimensional drawing, and we need to set some depths for our router.

Left click and drag the mouse over the whole drawing, select Create, then



Show sketch by clicking on light bulb



Extrude options to give the third dimension

Extrude, and set the distance as -12 to simulate a piece of material (stock) from which we machine out our shape.

Fusion defaults to working with the three new 'bodies' you created, so you need to 'show' the sketch by clicking on the light bulb next to Sketch.

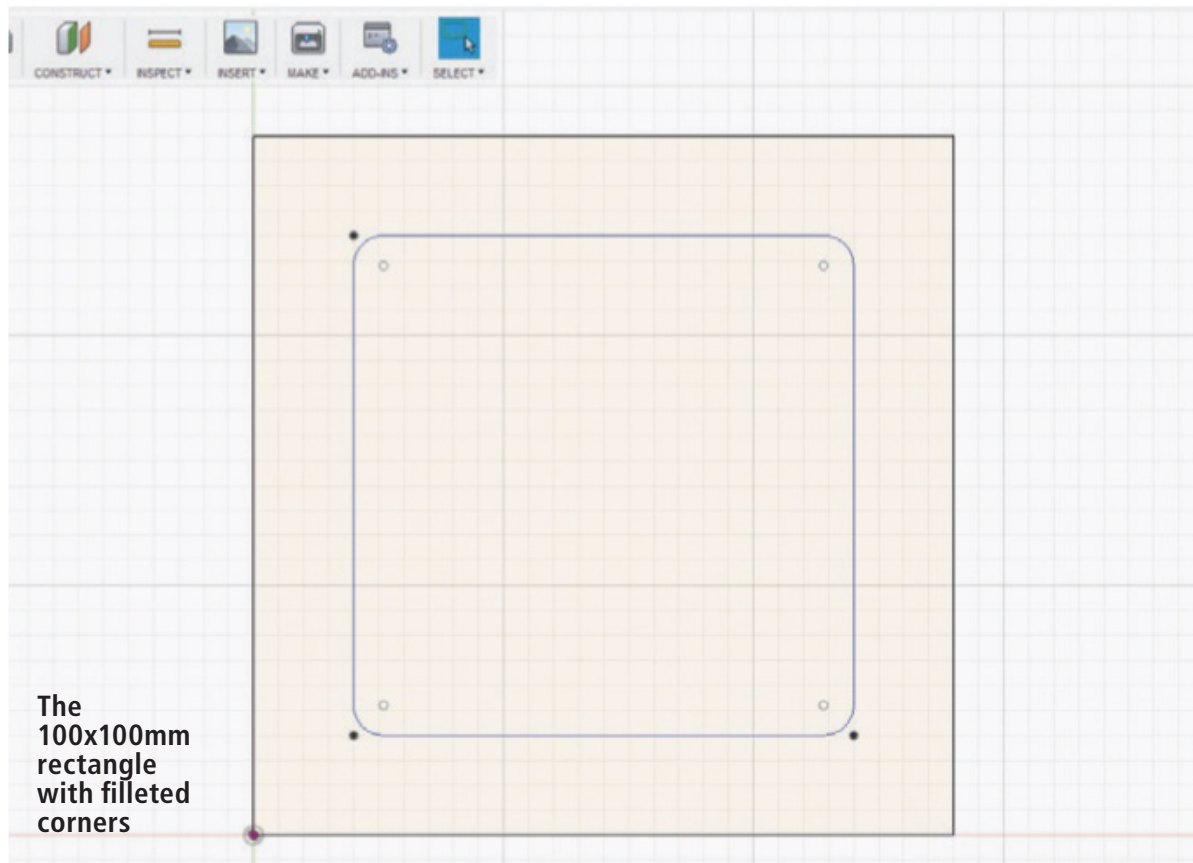
Select the area between the 100mm and 112mm rectangles and then select Create and Extrude. Set the distance to -3. Your drawing should show a 3mm deep trough around the inner rectangle.

Save the sketch for the future.

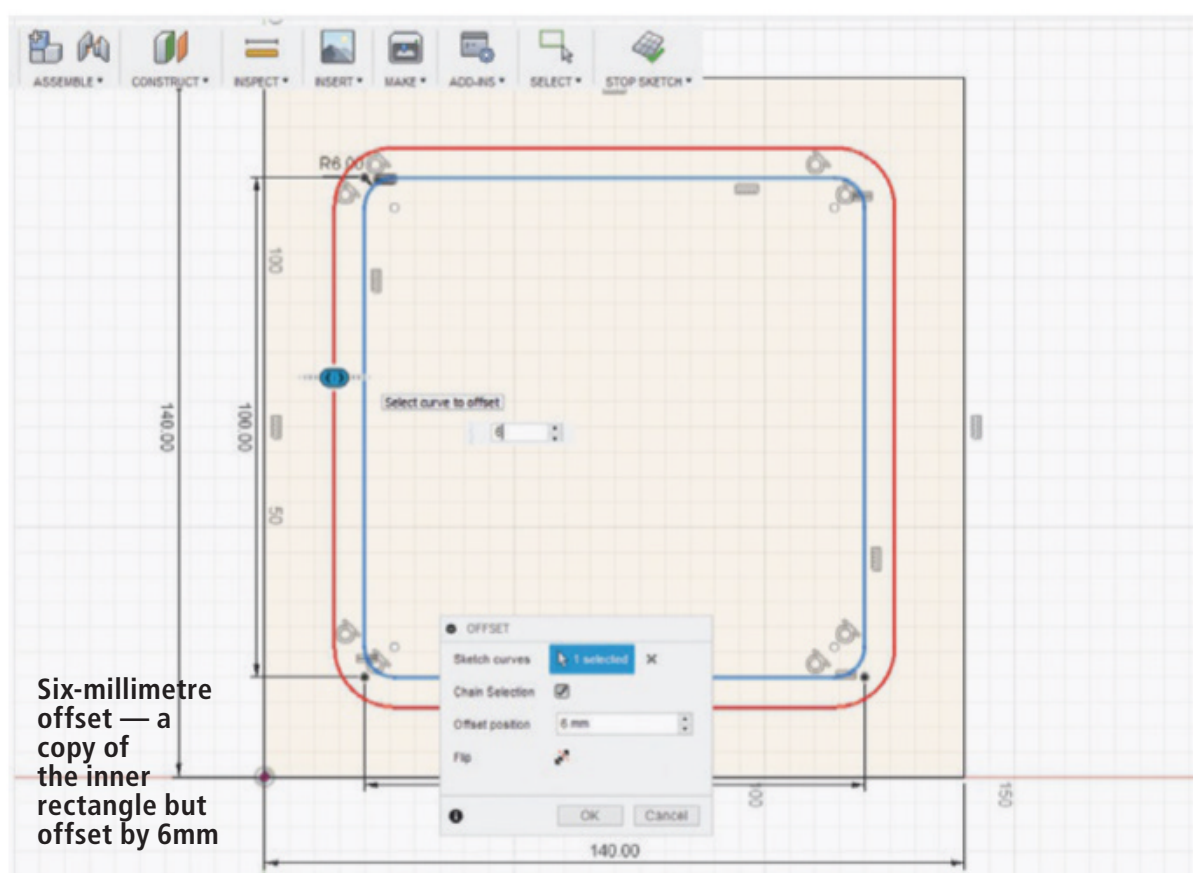
CAM

Now that we have a sketch (CAD), we have to give the machine instructions on what to do. On the right change the Model to CAM and you'll notice the menu icons change to various machining processes.

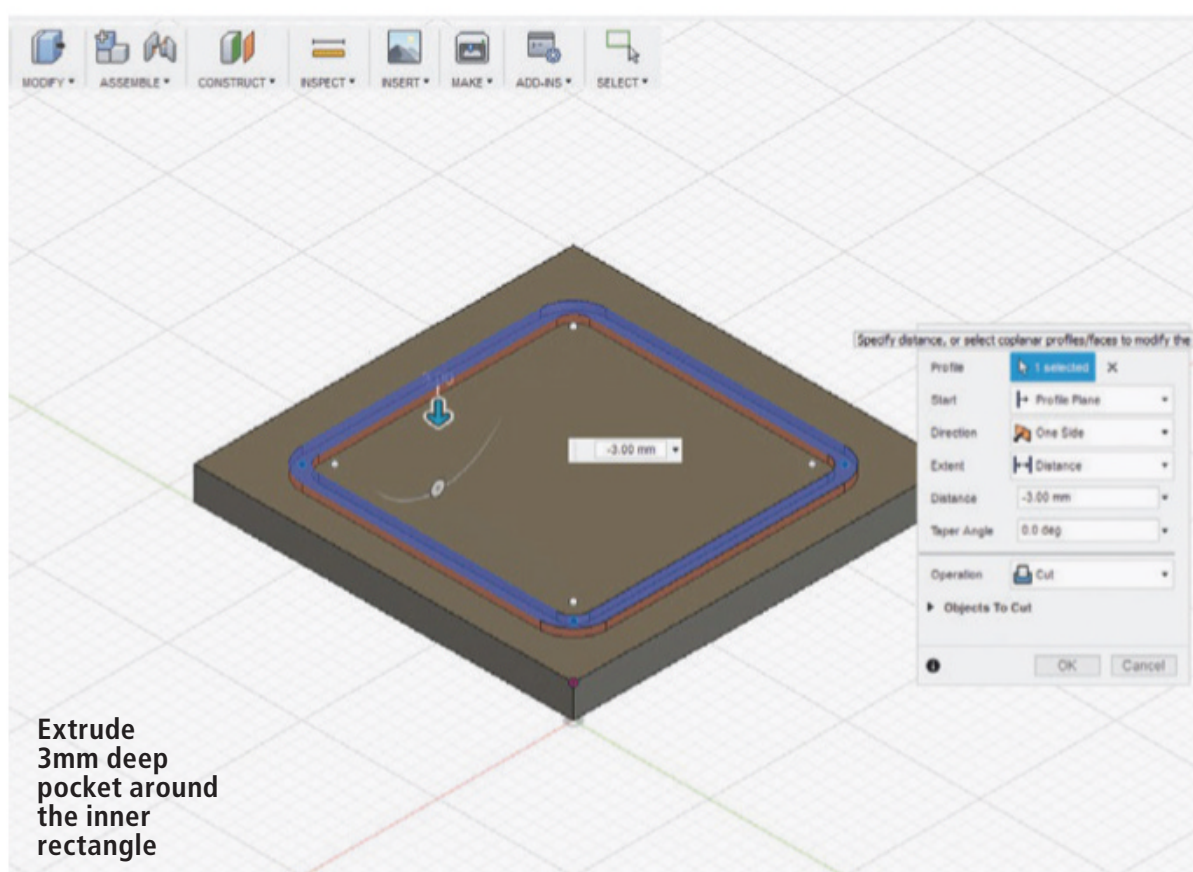
Under Manage you can add or modify the Tool Library. This provides information to the CAM process about the tool bit so that it can work out the angle, depth, and feed rates to use for



The 100x100mm rectangle with filleted corners



Six-millimetre offset — a copy of the inner rectangle but offset by 6mm



Extrude 3mm deep pocket around the inner rectangle



Above: Routing contour — finish is such that there is no sanding required apart from to the edge



Zeroing the Z-axis using paper to detect when it touches

“There are various software packages available. Some do just one part, but others like Autodesk Fusion 360 can do both CAD and CAM (the first two processes)”



*Congratulations, you now have a created your
first CNC-machined item*



that bit. ChipX has provided a library for its tools and this can be downloaded at <https://chipx.co.nz/product-category/cutting-tools/chipx-tools/router-bits/>.

Under 2D, select 2D Contour and select the bottom of the inner rectangle. Ensure that the red arrow is on the outside of the line. The arrow specifies which side of the line the tool will work to.

Select the Tool tab in the 2D Contours dialogue and choose a 6mm cutter.

The third tab allows heights to be set and tells the machine where the top surface is, and how much to retract (to clear obstacles).

Thanks to some help from Scott, I've learnt that you select Stock Top for the Top Height and Selected Contour(s) for the Bottom Height.

Under Linking we need to turn off Lead-In and Lead-Out. This provides a means of getting the tool into some machining operations.

For this exercise, under Passes select Multiple Depths and set the Maximum Roughing Passes to 1mm. Our cutter

will easily handle a 3mm deep cut, so this is just to show how to do it. You can also use the Ramping settings to allow a controlled depth change.

Under the Tool tab you can adjust the tool's default speeds or rate. In the case of the Vertigo CNC router, the rpm is manually adjusted on the Makita trimmer, but the others relate to how fast the machine moves.

As a suggestion — standard plywood, or hardwood: 2000mm/min cutting feed rate, 250mm/min plunge feed rate with a 6mm diameter router bit, and speed 3 on the router.

The Ramp Feed Rate is used with Ramping where you progress deeper with each pass. A slow cut rate will result in dust rather than chips and excessive tool wear, while if it is too fast you will load the machine, so it depends on the material you are machining. Until you get used to it, err on the slower side.

Click on Okay and you'll see 2D Contour calculate the tool path. The sketch will show a number of blue paths that hopefully run around the outside of the 100mm rectangle.

So now we've set the tooling operation, we need to tell the process where to start. Right click on the Setup and click Origin, then select Selected Point from the drop-down menu and click the upper bottom left point of the object.

Select the Stock tab and change the Stock Top Offset to 0mm, then click Okay.

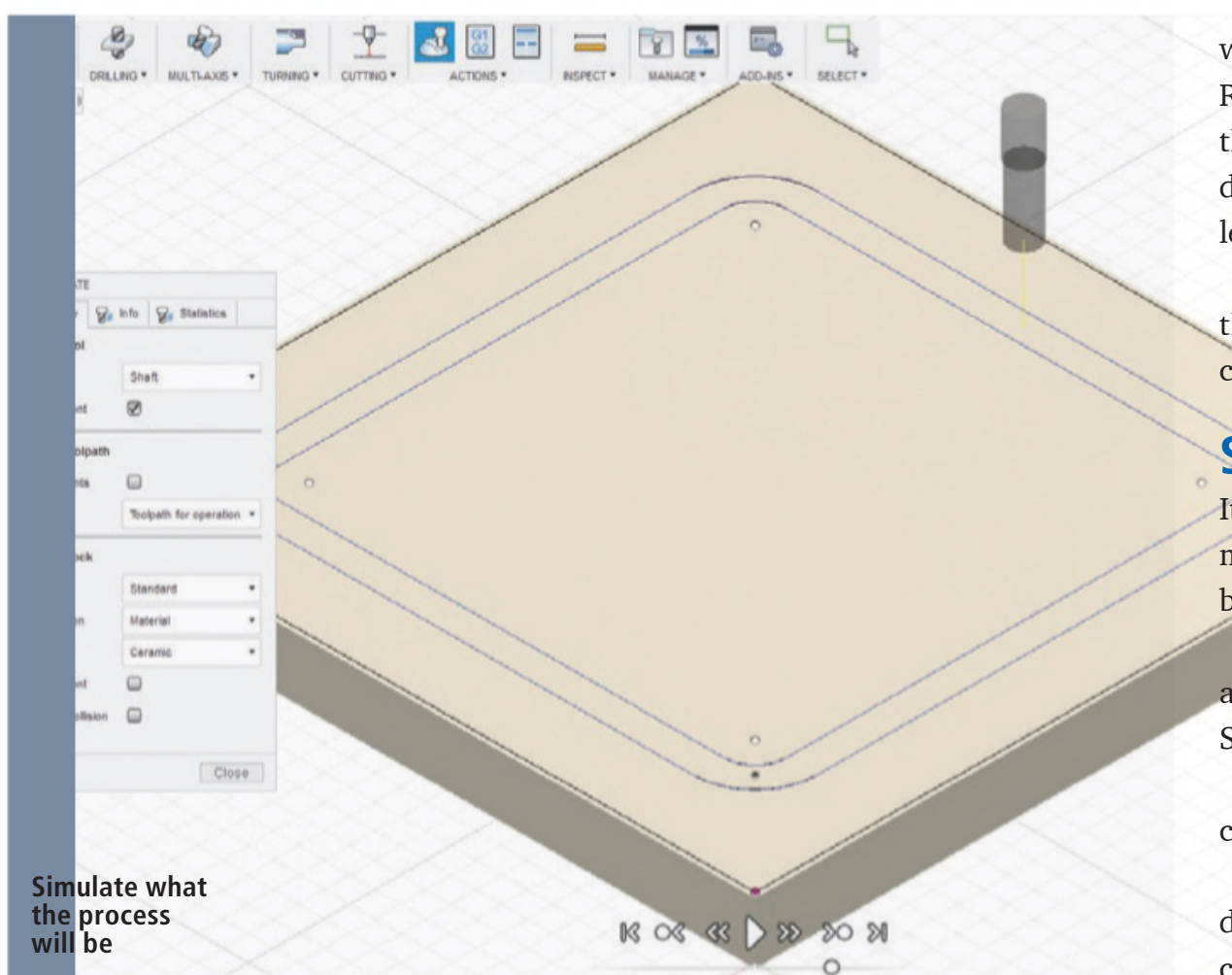
Simulate

It is essential that you simulate the machining process to spot any errors before letting loose and doing damage.

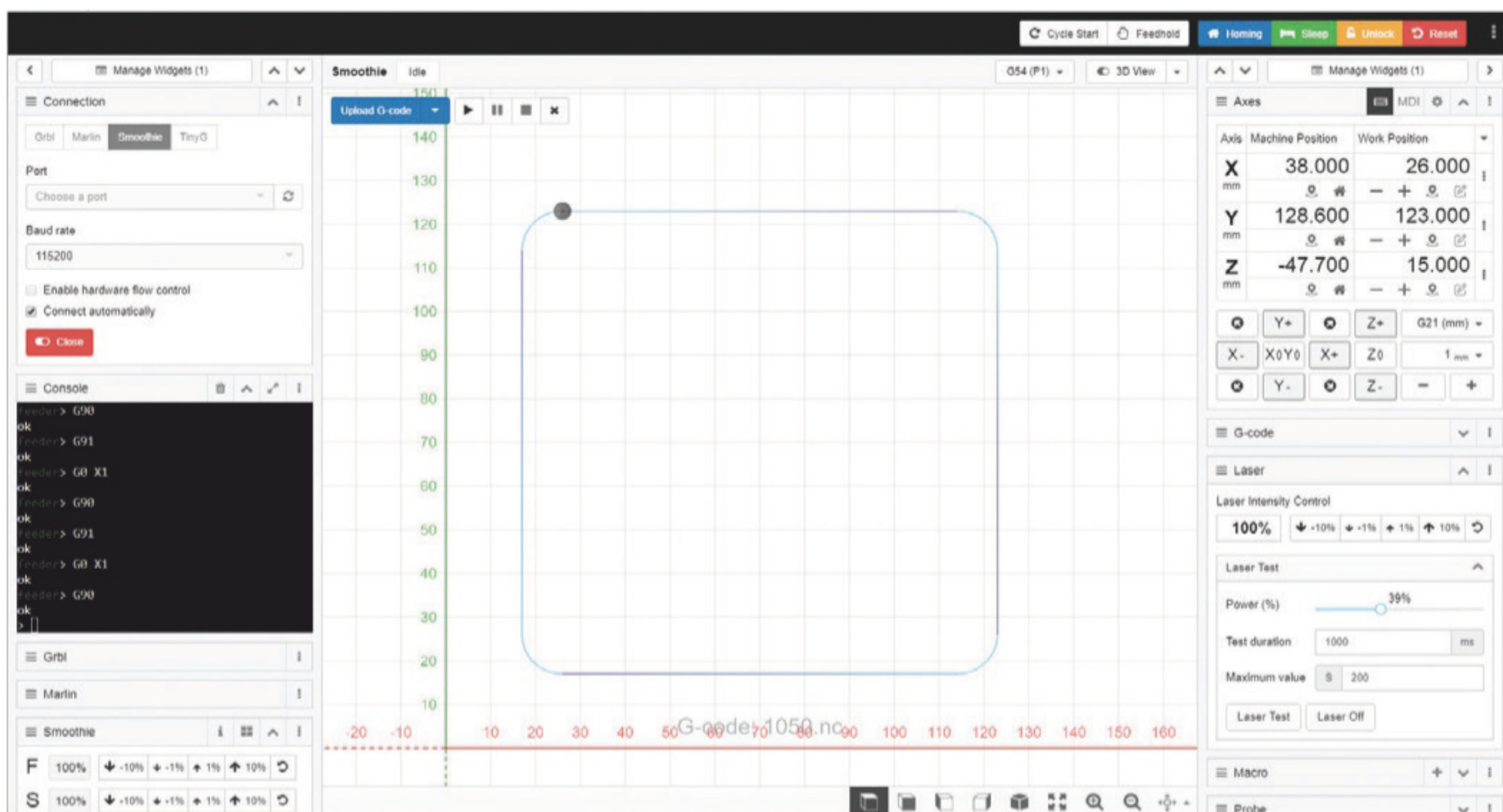
Click on the 2D Contour you created and under Display change the Tool to Shaft, and tick the Transparent option.

Select Stock and under Material choose Ceramic.

Press Play and you'll see the tool come down and start removing material. You can change the simulation speed with



Simulate what
the process
will be



Check Fit by manually moving router to the line using keyboard

the slider underneath, move and rotate it just as you did with the sketch, and pause it at any point.

The Simulate Info tab allows you to see the Z-axis, which changes as it steps down. Operation will give the total time, which should be around 1.30min.

Once you're happy, close the simulation and then right click on 2D Contour and select Post Process.

The file created is a plain text file consisting of a letter and number, and for Fusion 360 it has an .nc extension. You need to check that the controller type is set to Smoothie Mill/Laser; choose the drop-down menu just above the Output folder to check.

Change the Program name to your next number available, and add a description — for instance, 'Shed Example'.

Select Post and it will point to the folder you selected and the filename you chose.

The real thing

We've created the file, simulated it, and now it's time to actually make wood chips.

I'm assuming you have followed this helpful guide: <https://vertigotech.co.nz/pages/machine-operation>.

CNCJs has settings for the movement for each click or press of the arrows, and I left mine at 1mm. Holding the Alt

I can't possibly make you into a CNC guru, but hopefully I've shown that the machining process is no different than using a hand router

button down divides it by 10 to allow fine movement and holding the Shift button multiplies this by 10 — *but* be careful you don't do too many and go outside the working area.

Add a piece of scrap MDF to the router and clamp it down. Move the router to the lower left start point. In CNCJs, set the Z-axis carefully and then set the zero point by selecting the drop-down menu next to Work Zero and choosing Zero Out Work Offsets. As a precaution, move the Z-axis back up to protect the bit.

Click on Upload G-Code and it will show the tool path built by the CAM process.

You can move the machine with the keyboard to ensure that it can be machined out of the stock, and more important, ensure that it won't strike a clamp. Leave the height set well above

the stock and press the X0Y0 button/icon on the right side and it will move directly from where it is to the zero point.

If you press Play on the G-Code, it will ask you to confirm. Set the router speed to 3 and switch the router on. Press Play again and it will start moving.

You can follow it on screen, but be ready to hit the E-Stop on the router if anything goes wrong. E-Stop simply stops power to the machine steppers, so switch off the router, and be ready to manually shift and reset the zero point.

You should start seeing a 6mm wide groove being machined out of the stock and it will show the progress on screen. Once finished, it will retract and return to the zero point. I prefer to turn off the router as soon as it retracts.

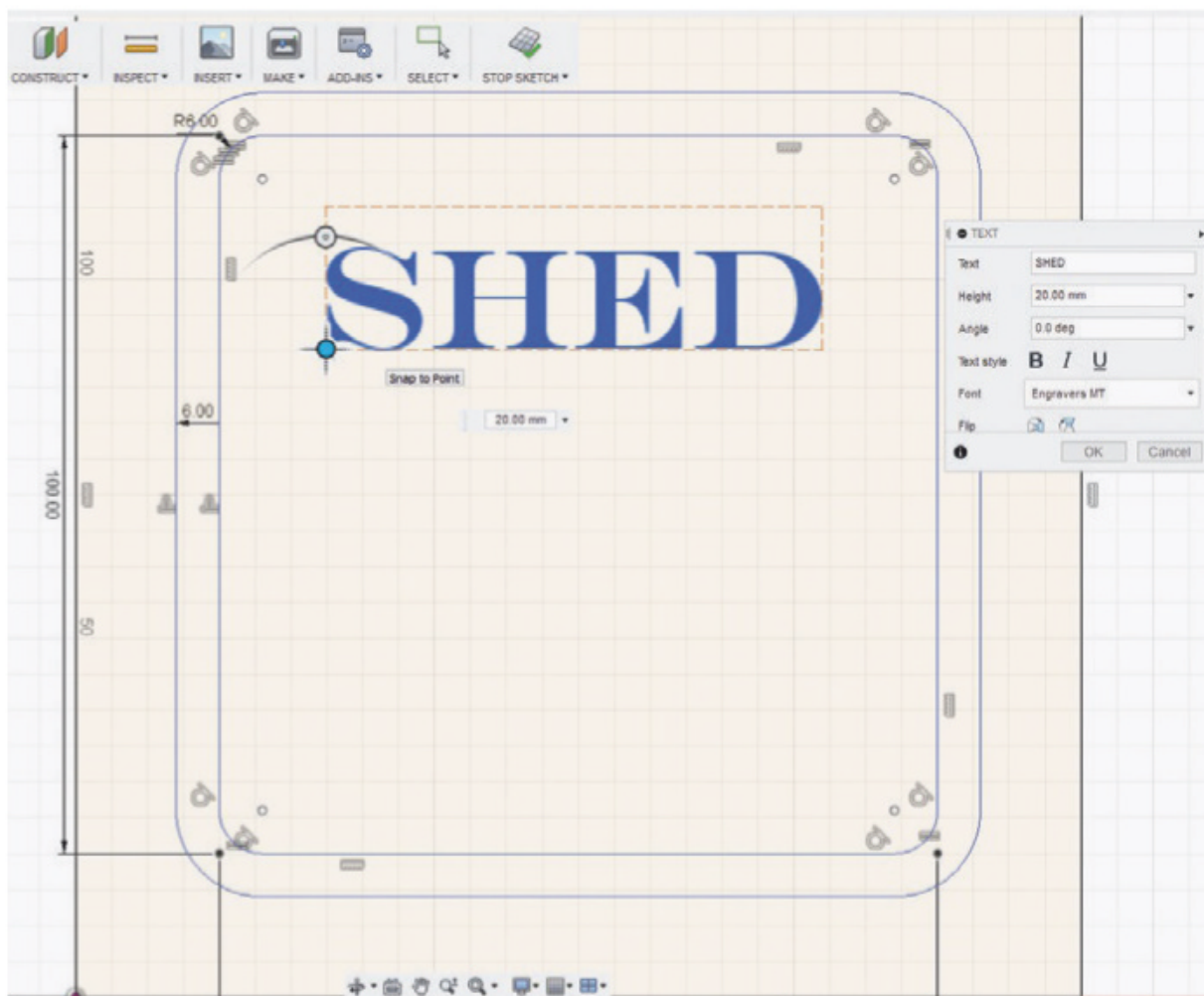
Congratulations, you now have a created your first CNC-machined item.

What now

You can choose to clear the inner rectangle with 2D Pocket or 2D Adaptive clearing.

You need to select the inner rectangle as the contour and click on the red arrow to change from outside to inside for machining.

Set the depths as we did earlier, turn off Multiple Depths, Stock to Leave, Lead-In, and Lead-Out. It will automatically set a



Adding text

Ramp and should default to Helix.

You will note that the tool stays as selected initially because it assumes that you're just doing another set in the process, but feel free to select a different tool if you wish.

Run Simulate and note the difference between the two styles.

Engrave

The process of engraving is basically the same, but the tool bit is tapered. ChipX have a 15-degree and a 45-degree engraver, but you can add others.

Depending on the depth, the tool path varies and the results do as well.

For a shallow depth it simply traces the outline, while a very deep cut will try to remove everything between the lines.

Engraving is a single pass, so be careful not to exceed the cutter depth, as the shaft will not remove material.

On your sketch, return to Model and then from Sketch choose Text.

I added 'SHED' and used Engravers MT font and made the height 20mm.

Place it somewhere in the inner rectangle.

Return to CAM and under 2D select Engrave, then select the text that you've previously entered.

Set the Top Height, but this time set the Bottom Height Offset at -0.5mm.

Because you are engraving, Fusion 360 knows the 6mm flat cutter is wrong and asks you to choose a new tool bit.

Run Simulate, and note that it traces the outside of each letter.

If you edit it and choose a -3mm Bottom Height Offset you will see the difference as it removes the material between the lines by varying the depth.

The Post Process is exactly the same — choose a number for the file, add a description, save it, then load it into CNCJs.

XY zero remains the same but the Z-axis zero will have changed. Lower the bit until it touches the surface, then click the edit pencil on the Z-axis and enter '0'. Click the tick and retract the bit to prevent accidents.

When you run this it will vary the depth to form the letters as shown in the photo.

Conclusions

Hopefully this has given you a quick insight into the CNC router's abilities and how easy it is to use.

I can't possibly make you into a CNC guru, but hopefully I've shown that the machining process is no different than using a hand router, where you plan what material you will remove and what bits are used to do each step.

If it looks wrong in simulation, it will be the same in the real world.

I've been stuck a couple of times, but a quick internet search has provided the answer.

Vertigo has a Makers Group on Facebook (Makers Group for Vertigo CNC), and from my observations, is both knowledgeable and helpful, so make sure you join and don't be scared to ask.

Commercial users can benefit from training courses run by Cadpro. [📄](#)



Engraving text



The completed project

Create a classy TV stand

A STYLISH YET SIMPLE TELEVISION STAND CAN BE MADE WITH MINIMAL TOOLS AND MODEST SKILLS

By David Blackwell

Photographs:

David Blackwell

This television stand has been designed for a modern 32-inch LED?LCD television and has also been designed to be made with minimal tools, enabling the weekend warrior/hobbyist to make it in not much more than a day. You certainly do not need advanced skills to make it. To complete it in a day, the gluing up of the timber will need to be done the day before and obviously the stain and varnish will need to be done over several days.

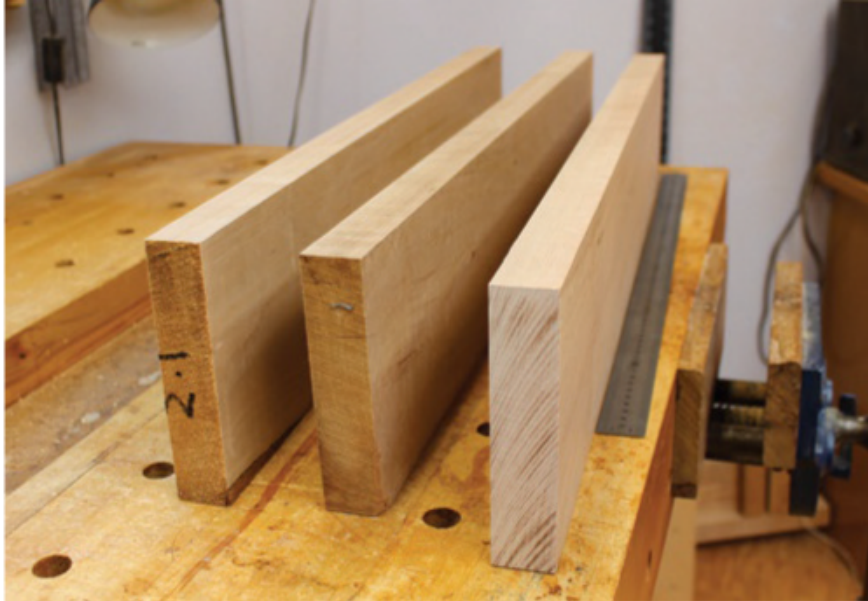
While I have the equipment in my home workshop to machine the timber, I want to stress that this television stand could be made in the home workshop or garage with little in the way of tools. For example, you could ask the timber yard to dress the timber for you (you might even find the sizes you require already dressed at the big-shed DIY stores),

and all the cutting could be done with a handsaw.

Enjoying the design process

I enjoy the design process and often mull the concept over in my mind for several days, sometimes much longer. I also look around furniture stores for similar products, although in this instance I was unable to find anything remotely similar.

My stand has one shelf for the Sky box, but if you had a second box you might add another shelf or place it on the base. The woodworking purists might not like how I have designed this product by relying on screws to hold it together but I believe they are adequately strong enough for the modern light-weight televisions,



Above: Machined timber ready for the biscuit slots
Left: A biscuit in place, minus the glue



The shelf ready for gluing



Cutting the biscuit slots

particularly the 32-inch size or smaller, but, much more important, it makes it a very simple project for the hobbyist with only modest woodworking skills.

I decided to make the stand out of beech, as it is a wood I use often and I know it could have the finish I was looking for — a black stain and a satin varnish, similar to a lamp stand I made several years ago (see *The Shed*, Issue No. 59). Almost any sort of timber would work well, including pine, or even recycled timber. I get all my new timber, as opposed to recycled timber, from Halswell Timber in Christchurch as they let me scratch around selecting the pieces I require without standing over my shoulder.

Plans and sizes

I started the process on my drawing board, drawing it out at 50 per cent

If you do not have a biscuit slotter you might consider using dowels

scale, and this allowed me to work out what I thought was about right aesthetically. As I am a visual person I then made a full-size mock-up using some offcuts of pine that I had left over from a previous project. After making the mock-up I decided to change the angle of the uprights slightly before starting on the main project.

The finished base is 620x370x30mm thick. There are no required

measurements and you can change the sizes a little to suit the type and size of timber you can buy. Avoid the end grain facing the front for aesthetic reasons.

I purchased 150x40mm rough-sawn timber, machined it, and glued three pieces together to get the desired width before trimming. As I said earlier, I machined the rough-sawn timber myself, but you could ask the timber yard to machine it for you or alternatively buy pre-machined timber.

The shelf is 330x280x23mm (trim to length partway through the assembly process to ensure that the length is correct), while the top is 580x230x19mm, the front strip along the top is 580x24x3mm, and the uprights are 65mmx28mm rough-cut to 500mm long before cutting the angles. ►



The base all glued up



Bench Cookies are great for holding the work for sanding

Jointing options

To glue the pieces together you will need clamps to lock the timber in place while the glue dries. I have about half a dozen of these clamps and if I need more I can always borrow them from my neighbour, as he does from me from time to time. My clamps, mostly, are not high-quality, expensive ones but they certainly do the job.

I have inserted biscuits to the joints when gluing the timber together. This adds strength to the joint but, in my view, certainly the base and the centre shelf are thick enough to allow good strength by gluing them together without the biscuits. If you do not have a biscuit slotter you might consider using dowels. The holes for dowels should be carefully marked out and drilled.

Take a little time with the glue-ups to ensure that you have at least one surface at which the three pieces all line up. This saves a lot of additional planing or sanding when finishing the base. I usually place greased cooking paper on the clamp where the timber sits to avoid the water in the glue causing a chemical reaction with the steel of the clamp and leaving a black mark on the timber.



Sanding after the glue-ups is not the most pleasant task. Mask removed for the photo

Once the glue is dry, trim the base to the required size.

The shelf and the top

The centre shelf is 280mm wide so I started with two pieces of 150x40mm, machined them to size, and glued them together — the same process as used for the base using biscuits.

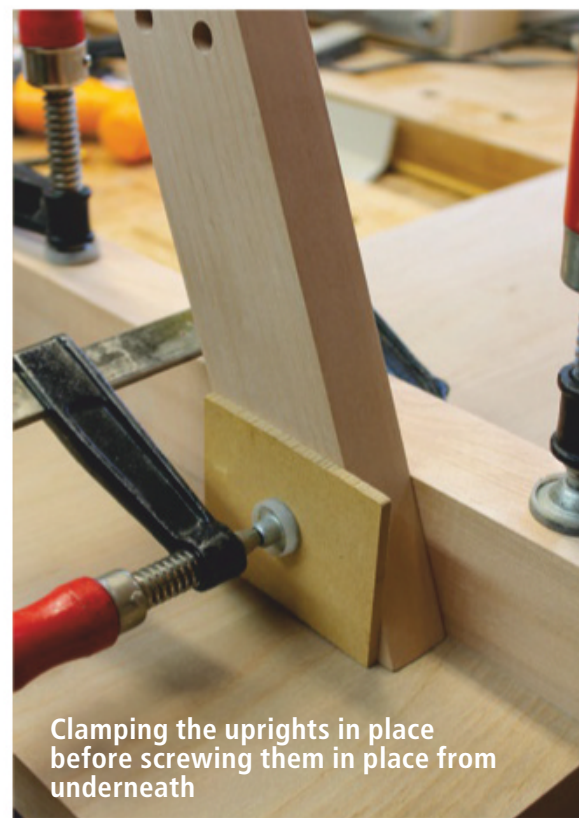
The top is 230x19mm and while I might have been able to find some timber that width I decided to glue two narrower pieces together to try to alleviate the risk of it bowing due to the ever-changing climate conditions. With this timber only being 19mm thick, it is more desirable to use biscuits or dowels to give the joint that additional strength. Again not a



Timber glued and sanded ready for trimming to size. Remember to cut the length of the shelf once the uprights are screwed in place.



Cutting the angles on the uprights on the sawbench



Clamping the uprights in place before screwing them in place from underneath

The timber



Base: 620x370x29mm
Shelf: 330x280x23mm
Top: 580x230x19mm
Front strip: 580x24x3mm
Uprights: 65x28mm, rough-cut to 500mm long

necessity, but it certainly gives a little more peace of mind.

At this stage, with the components all trimmed to size, it is time to sand them all to the desired finish. I do not find this a pleasant task but it is necessary to make a quality product. Holding the components while you are sanding them can be a little difficult but I have found that Bench Cookies are ideal and really do hold the pieces while you sand them. They are relatively inexpensive to buy in a packet of four from a specialist shop like Carbatec. I use my orbital sander, as I find it best, but you could easily use a flat-sheet sander or, if you are really keen, sandpaper and a sanding block. This can be a messy job and you should use safety equipment like a mask and ear muffs (I use ear plugs).

Cut the angles on the uprights, making sure you cut them the correct way around. I was able to cut these on my bench saw but they can easily be cut by hand. Using 185mm MDF spacers, I worked out and marked the place for the screw holes in the uprights. Remember though, the 185mm spacers are the bottom of the shelf so the holes are marked already, and drill about 10mm above that.



Clamping the shelf in place before inserting the screws

Assembly

I started the assembly process by marking out exactly where on the base I wanted to place the base of the uprights and drilled the holes for the four screws. When assembling I used a scrap piece to clamp to the base, knowing the upright was at the correct angle, and then did the same with the second upright. Just in case I was a millimetre or so out with the width of the uprights I did the final trimming to length of the shelf after the uprights were screwed in place.

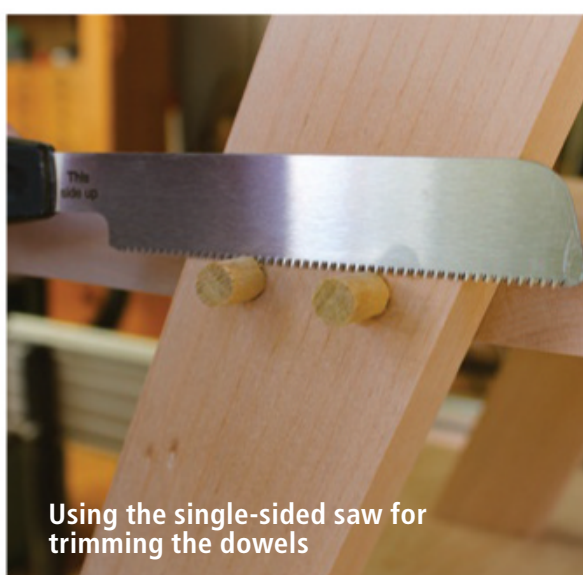
With the bottom of the middle shelf 185mm up from the base, the spacers held the shelf parallel while I inserted the screws. I did use a clamp to avoid anything moving. ►



Assembled with dowels glued in the 10mm holes



Dowels ready for cutting flush



Using the single-sided saw for trimming the dowels



The discs ready for screwing on under the base

Earlier in the design process I did consider leaving the heads of all the screws visible but decided I should make it look a little more classy than that. The screw holes holding the shelf in place were plugged with a dowel glued in place and then sanded smooth level with the surface. I drilled a 10mm hole about 10mm deep before drilling the holes for the screws and, once everything was assembled, I glued in a short length of 10mm dowel, cutting it off and sanding

it smooth when the glue was dry.

I have a small, inexpensive, single-sided saw for cutting off plugs that does not leave a mark on the wood, but you could use any smaller ordinary saw by placing thin cardboard next to the wood to avoid the unwelcome marking of the wood.

Fitting the top and finishing

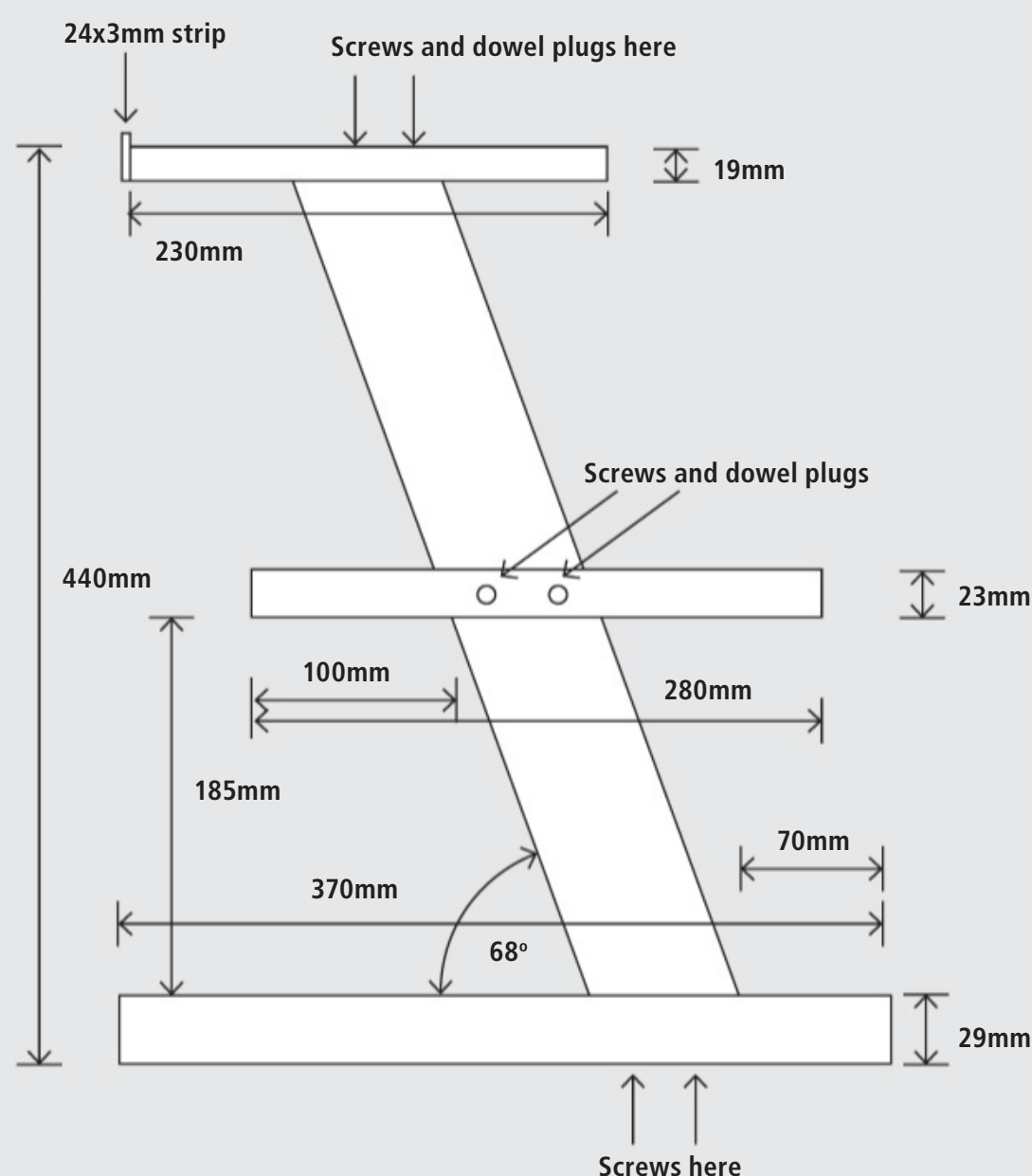
To screw the top in place I carefully marked out where it was to go and then drilled the four holes, first for the dowel plugs and then for the screws. I then attached the top.

Under the base I considered fitting four small rollers but finally decided on four round discs about 75mm in diameter by about 20mm thick. I cut these on my bandsaw but they could easily be cut by hand. I screwed them in place about 10mm from the edges. I used a small dab of glue before I finally screwed each disc in place.

The finishing, like the sanding, is not one of my favourite tasks but it still needs to be done well. I put on two coats of black Briwax water-based wood dye, and then two coats of clear satin varnish. I would suggest you always apply these sorts of finishes onto offcuts first to ensure that you get the finish you require. My favourite finish for beech is Danish oil but this was not suitable for this project.

The top where the television sits is a flat surface, so to avoid the television vibrating forward I placed a 3mm thick strip along the front, upstanding from the base by 5mm. I attached this with four small brads and glue. I punched the brads below the surface and filled the holes with a wood filler.

TV Stand schematic



Safety warning

If you have or are likely to have babies or toddlers in your house, you should consider tying the television to the top with simple generic clips available from a hardware shop, or perhaps drilling several 1mm holes and using clear nylon fishing line to hold things in place should there ever be an earthquake. Sadly, a very young child perished when a television fell during the Christchurch earthquakes.

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Time for a milling machine?

THE FIRST IN A SERIES ON THE MILLING MACHINE FOR YOUR WORKSHOP

By Peter Woodford

Photographs: Geoff Osborne

Vertical machine centre (VMC) turret milling machine. Note the riser block (bright green section) fitted into the pillar to gain more Z-axis height. The 440mm bed-to-spindle height now includes the 100mm riser block

“So, once you have made the case for buying a vertical milling machine, new or second hand, what you should be looking for?”

In a typical home-engineering workshop progression, you buy a bench vice, some hand tools, and possibly a bench grinder. After you buy a small pillar drill then comes a big leap — buying a centre lathe.

Along the way you acquire more small tooling, drills, turning tools, etc. You make many useful items and produce a fair bit of scrap.

But then you find that the lovely pieces you are turning out on your lathe require other features, especially holes more accurately positioned than you can mark out and drill on your pillar drill. As good as you have become with a file, that flat section needed on the shaft really needs to be machined. And how are you going to make a slot for that keyway?

Milling machine

Another even bigger leap is now required — a milling machine. With this, you will be able to accurately pitch out holes, machine flat, machine slots, machine angles, square-up edges, and maybe start that model steam loco you promised yourself.

This leap often seems to be very daunting and it actually may be, in part due to the different milling-machine types — all centre lathes are basically the same layout and just vary in size.

There are two main, basic milling-machine configurations, horizontal and vertical (referring to how the spindle of the machine is mounted), with a few that are both.

In this first article of our introduction to milling, we will look at the most useful type for the home workshop: the vertical milling machine. So, once you have made the case for buying a vertical milling machine, new or second hand, what you should be looking for?

Size

Whatever you plan to make, don't forget that when friends find out about your purchase, they will always have car and boat parts for repair or modification. So, unless you are going to be a clockmaker, you may want a machine big enough to cope with some of the typical sizes of car or boat parts. However, no matter what size machine you buy, you can be sure that the first jobs you are asked to do will be too big for your new purchase.

Unless you have lots of space and money,



Pete Woodford shows the quill lever lowering the spindle towards the table

When you have a typically small job to do, a very large machine can be very ungainly to use

though, don't get carried away with size. When you have a typically small job to do, a very large machine can be very ungainly to use. The working footprint of a milling machine is also generally larger than its base size, so don't forget that when you plan the machine spot in the workshop, you need to allow space for table movements and the possibility of a workpiece overhanging the table.

Power

Do you have single- or three-phase power available? Single phase makes things easier as you can plug in and go. But check the current required, as a 10A supply may not be suitable and you may need to upgrade the wiring. If you have three phase, this will open up your options with the possibility of using ex-industrial equipment.

You get better starting torque from three phase than from single phase and three phase is much easier to run in reverse. This is very useful in some processes, for example, reversing the spindle to wind out a tap if you have been tapping under power.

Converting ex-industrial equipment to single-phase motors is not always an

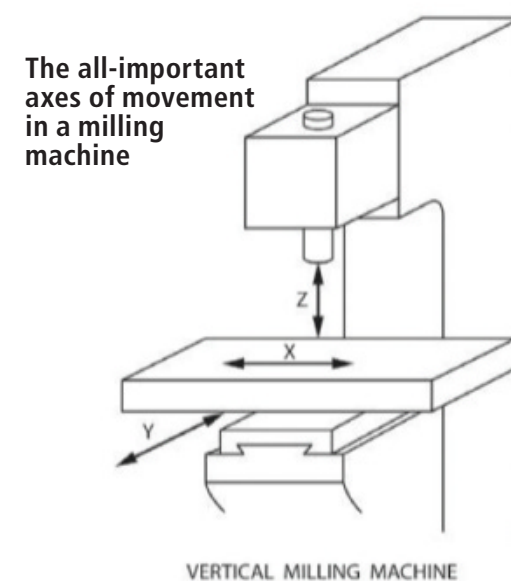
option due to space limitations, as single-phase motors are usually larger than their three-phase equivalents. But the use of a single-to-three-phase converter may be an option, as most smaller machines tend to be single phase. If you buy new, you may be able to choose single or three phase.

New or second hand?

Is the well-used Bridgeport mill at that price as good as a new, imported machine with a warranty?

There are some very good second-hand machines out there, but worn out is worn out, no matter what the name on the side. The latest machines coming out of Asia are now well worth considering. You may also be able to do a deal on a starting tooling package with your new machine.

When looking at a machine, be it new or second hand, find yourself a friendly toolmaker, miller, or model engineer to help you assess the suitability of your prospective purchase. ►



The all-important axes of movement in a milling machine

VERTICAL MILLING MACHINE

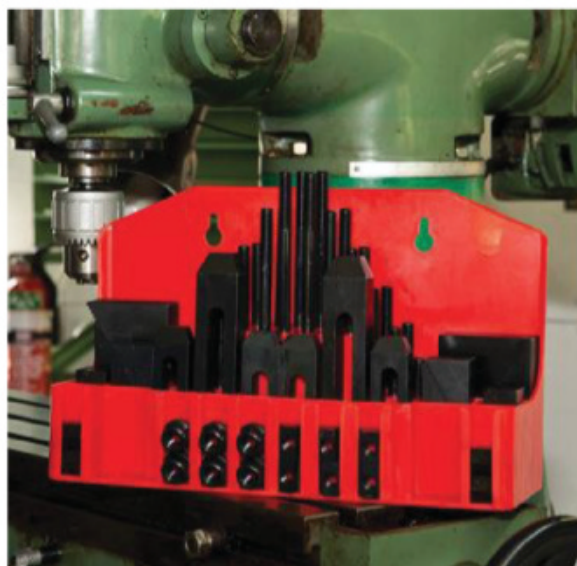


Above: Pete's machine is belt driven

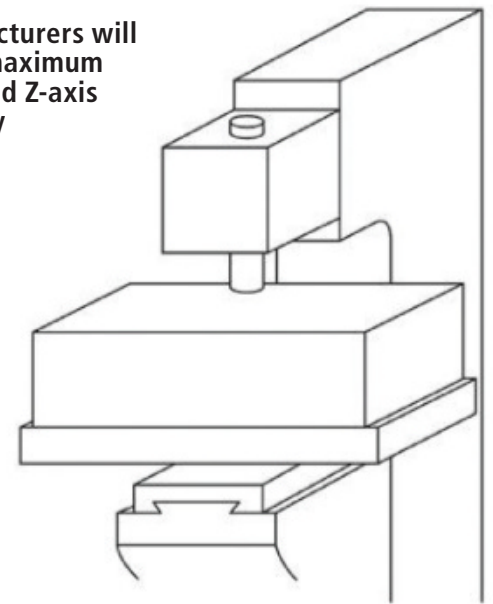
Below: Milling a slot



Below: Typical tooling package of studs, tee-nuts, nuts, connector nuts, finger clamps, and stepped heel-blocks



Manufacturers will quote maximum X-, Y-, and Z-axis capacity



rigidity and saving important height in the Z-axis.

The 30-, 40- and 50-series tapers are the most common industry-standard tapers. The bigger the number, the larger the holder, so you are most likely to find 30- or 40-series tapers in the small-/medium-sized machines. Very small machines may have other, less common spindle tapers.

These R8, and 30- and 40-series tapers are preferred for milling. All R8 tapers have a common drawbar thread — $\frac{7}{16}$ UNF — but 30- and 40-series tapers do vary, with manual-machine and CNC-machine types having different drawbar threads. Check carefully as differences are not immediately obvious to the untrained eye.

Axis size — the Z-factor

The axes of movement lengthways (X), sideways (Y), and up-and-down (Z) — the X-Y-Z sizes — will be quoted as the capacity of the machine. To overcome the limitations of the X-axis moving in a plane in one direction, and the Y-axis moving in a plane at right angles, you can always reposition the workpiece on the table and drill or machine in several operations. A little inconvenient, but possible.

But with the Z-axis, don't forget you have to allow for the combined height of the tool holder or drill chuck, plus the tool held over the table. This can greatly reduce the maximum height of the component you can drill or machine on the table. When buying a milling machine, pay close attention to the dimension of the Z-axis. You could possibly gain more Z-height with a riser block fitted into the pillar, but this is not possible with all machine designs.

I have inserted a riser block in my

machine (the bright green section visible on the machine in the photos), which is a Warco milling machine with a bed that is 760x180mm, and axis-movement maximums of: X, 560mm; Y, 200mm; and Z, 440mm, bed to spindle, which includes the 100mm riser block added.

Spindle-taper types

A spindle taper is the way the tool holder is held in the machine, with the spindle usually held in place by a drawbar. There are several common types of spindle taper.

The Morse taper is common on smaller machines and mill/drills, especially in New Zealand, and is good for drilling. But this type of holding taper is not preferred for milling. The Morse taper is not designed for the side loading that occurs when milling.

The R8 taper is also a common taper found on small- to medium-sized machines. It is relatively cheap and designed with milling in mind. It has the advantage that the tool is held very close to the spindle nose, increasing

Quill

Most vertical milling machines of the size suitable for the home engineer will have a quill-type spindle, ideal for drilling holes, boring holes, reaming, and assisting in setting a workpiece. This quill is operated by a lever driving a rack and pinion. It may have a fine feed option using a hand-turned wheel and is sometimes gear driven from the spindle.

Tooling

The tooling package that you need can be very daunting. It is possible to spend as much money as you have just paid for your machine (or more) on tool holders, cutters, and component-holding equipment (vices, clamp sets). A second-hand machine may already have an assortment of tooling. You will need a basic set of tooling to get you started and the rest can be built up over time.

With tool holding, the R8 system holds the tooling directly and comes in metric and imperial sizes. These are relatively

cheap but several will be needed to cover the different tool sizes to be held. Collet chucks are available for the R8 series but this reduces Z-height. The 30- and 40-series tapers have collet chucks of different types, including Autolock and the now more common ER series.

Tee-nut clamping sets consist of varying lengths of studs, tee-nuts, nuts, connector nuts, finger clamps, and stepped heel-blocks, usually in a purpose-designed holder.

Starter milling packages are often available from tool suppliers and if a new machine does not come with one, ask what deal they might do. A typical package might include a machine vice, tee-slot clamping set, tool holder and collets, and a face mill.

Machine vices

A machine vice is a must. That vice you use on your drill press is probably not going to be suitable for holding a component to be milled as the side-loading pressure will need to be contained in a solid machine vice. These come in many sizes, often available with a swivel base to allow angle-setting for machining.

A swivel base will steal some of your Z-height, so check that the vice can be removed from the base and used without it if necessary. If you were to have one machine vice, the type with a removable swivel base offers you both basic and angle-setting options. However, a tilting-and-swivel-base vice cannot usually be removed from its base and used as a simple vice, so does not have that variety. ►



5

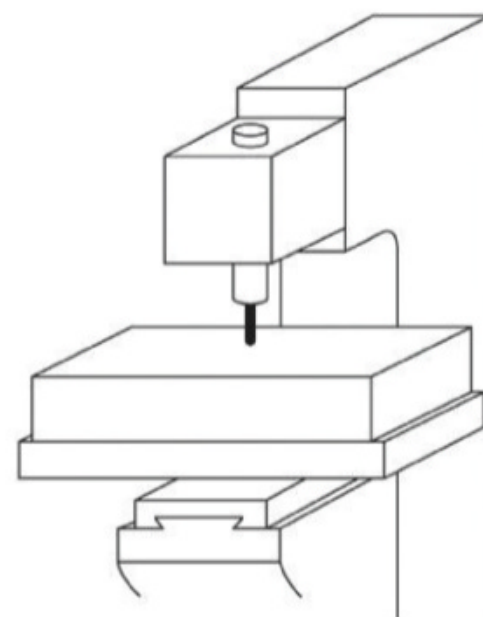
Two machine vices: a tilting-and-swivel-base vice and removable swivel-base vice

It is possible to spend as much money as you have just paid for your machine (or more) on tool holders, cutters, etc



Left: End milling of a box-section workpiece

Below: Allow for cutting tool and holder in the Z-axis





Replacing drill bit



The mill adjusts in three axes

Belt or gear-driven?

You may not have a choice whether you get a belt-driven or gear-driven spindle. A gear-driven option is a positive drive that will probably have a larger number of speeds available but will be noisier than a belt. The quieter belt drive may be an advantage, depending where your machine will operate. If you jam the spindle, the belt drive may slip and save more serious damage. Stripping the gears is painful and expensive.

A variable-speed drive works either through expanding or contracting pulleys. Motor-speed control also gives full variable spindle speed within a set range.

If you have a direct-drive, motor-speed control, check that there is enough spindle torque at slow speeds. Milling machines are often very compromised at slow speed, making it easy to stall the spindle when you are using larger drills or cutters.

Digital read-out

It's great if your milling machine comes with a digital read-out (DRO). If not, or your budget can't stretch to this option, check whether the machine can be easily retrofitted. Once you have used a DRO on a machine you will wonder how you ever got by without it.

Looking at a clear DRO rather than

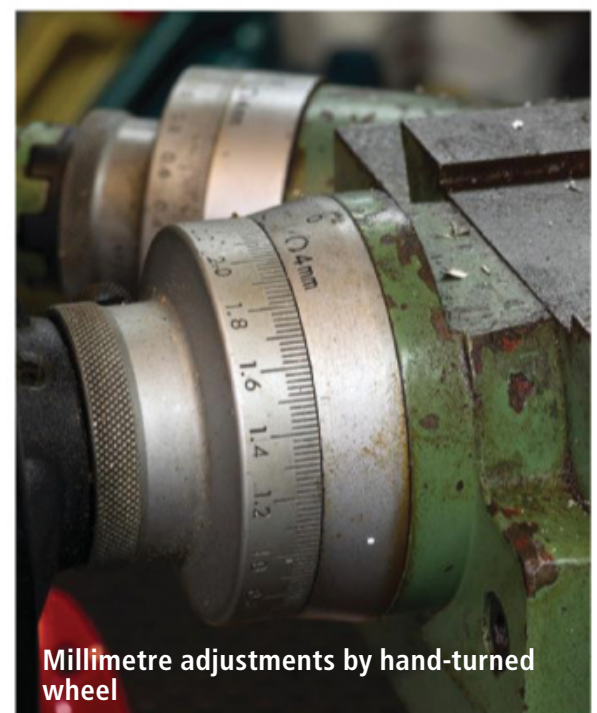
battered, engraved marks on the hand wheel has many advantages when you are setting up, pitching out holes, moving longer distances, or having to count how many turns of the hand wheel to get to the next position.

Power feed

Power feed is not absolutely necessary for the home engineer, as we do not have production pressures on us. The smaller machines are unlikely to have power feed, but bigger machines might have a power feed on the X-axis. If not, check if a power feed could be retrofitted, as this may prove desirable as your ability improves and funds become available.



Tooling showing (from right) a two-flute slot drill, three-flute end mill, four-flute end mill, and four-flute centre-cutting end mill



Millimetre adjustments by hand-turned wheel

Tilting machine head

A tilting machine head will allow you to machine a feature on an angle, or drill a hole into the angled face of a component. It's very useful if the component cannot be held at the required angle.

But look at how rigid the machine is and how well the head is clamped in position. Every tilt option can reduce the rigidity of the machine. The more rigid and solid your machine and the better you clamp your workpiece (without distorting or damaging it), the less chance there is of the dreaded cutter chatter when you are machining.

Mill/Drills

The round-column mill/drills should really be called 'drill/mills'. These make good drilling machines but are very compromised mills. There is some great work being produced on some of these machines and several members of the Auckland Society of Model Engineers (ASME) have mill/drills producing first-class components. But I feel, as mills, these machine have several big drawbacks.

Most have a three Morse taper spindle held in place with a drawbar. The Morse taper was never designed for the side loads induced during milling, so only light milling should be attempted.

The quill has to be lowered to move the cutting tool down to take a cut. This increases the overhang of the spindle from the machine's head, reducing rigidity and increasing the likelihood of chatter. When you are cutting, this will get worse the further the quill is extended from the head of the machine.

Probably the biggest flaw is the round column. There is a problem if you have to move the head up for more clearance in the Z-axis, or down to reduce the quill overhang and increase rigidity to stop the chatter of the cutter. As soon as you loosen the head to move up or down, you will also lose position in your X and Y axes, as it will move around the column, even if only slightly. This will mean that you have to some way find your position accurately on the workpiece.

I have seen many different ways to overcome this problem, including a laser bounced off a mirror across the workshop and back to a point on the machine head to aid accurate repositioning, or stop blocks attached to the column.

My recommendation is that unless one falls in your lap or is very cheap, be warned: you will probably end up very frustrated with it and will give up on milling (hopefully not), or will have to try to sell it on to someone — at a much reduced price if they have read this article. There are some dovetail-column mill/drills on the market now but for some reason they seem to be only available with three Morse taper spindles. This is a shame, as

a R8 or 30-series taper would make these worthy of serious consideration.

Level

Your new (or second-hand) milling machine is purchased, delivered, and positioned in your workshop. All machines must be mounted on a substantial base. Now, do not waste any time but level the machine as soon as possible, even if it is with a builder's spirit level (engineers call these 'approximate'). Make sure all the milling machine's levelling feet are loaded with the weight of the machine.

The machine is a big lump of iron, but even so there is an engineering term called 'creep', meaning that all engineering materials will move over time if a load is applied.

If you do not ensure that all the feet are carrying the load of the machine, you are effectively applying an uneven load that over time will distort your machine. The bigger and more solid the machine, the longer it will take, but it will distort. Then at a convenient time, find a friendly engineer who will lend you an engineer's level to level the machine — accurately.

Next issue: clamping your work. 



The most common spindle shanks that you will find on home workshop machines (left to right): Posilock tool holder three Morse taper shank, R8 shank tool holder, ER tool holder 30 taper shank, and 40 taper shank



Cutting tools typically used on a milling machine. These will be covered in a later article



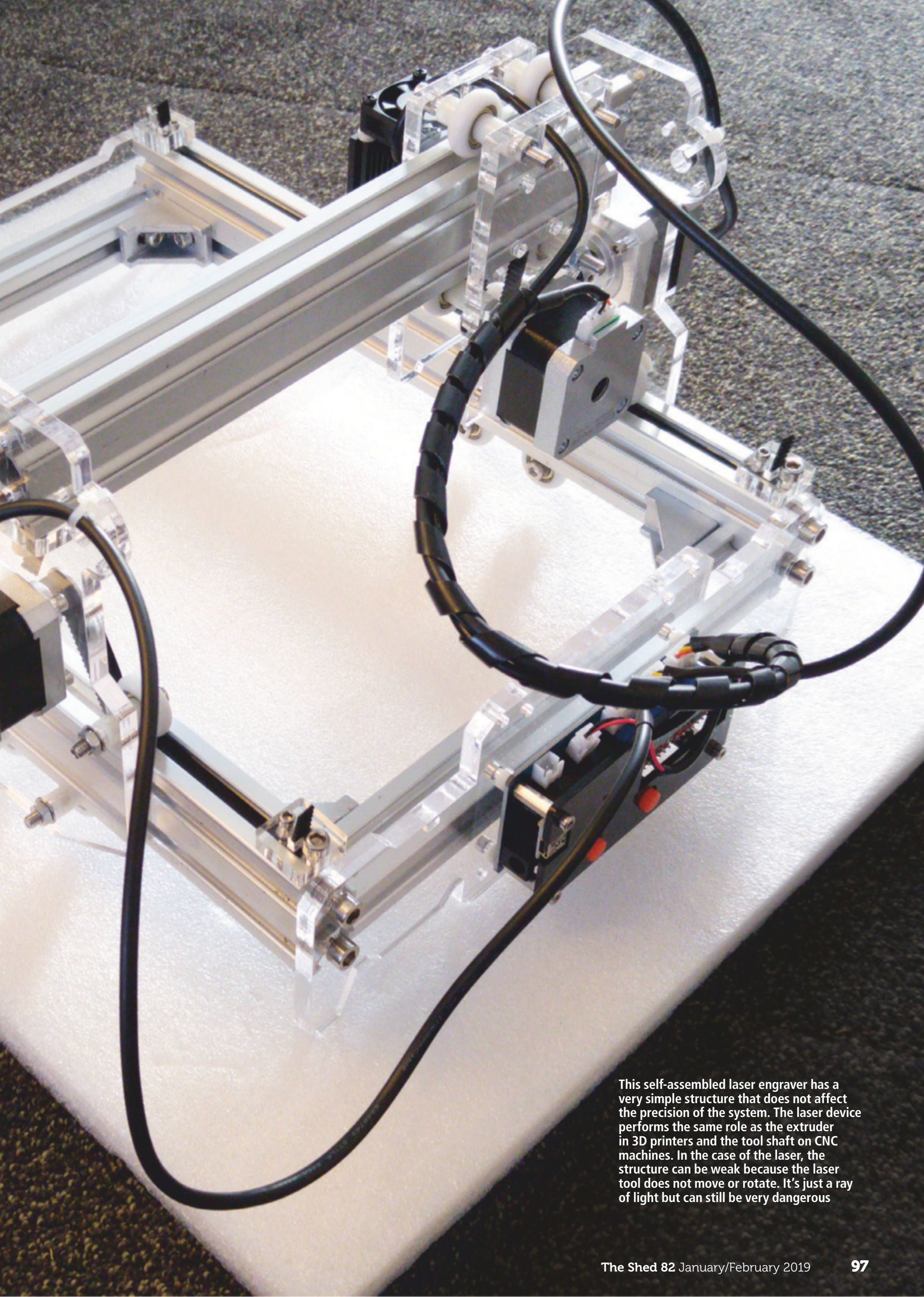
The ER-series holders are the most popular system in general use now. Pictured on the left is a Clarkson Autolock 40 taper shank with collet and ER tool holder, and on the right, a 40 taper shank with ER collets

NEW ADVANCES AND DIY
KITS PUT LASER CUTTERS AND
ENGRAVERS WITHIN THE REACH
OF HOBBYISTS

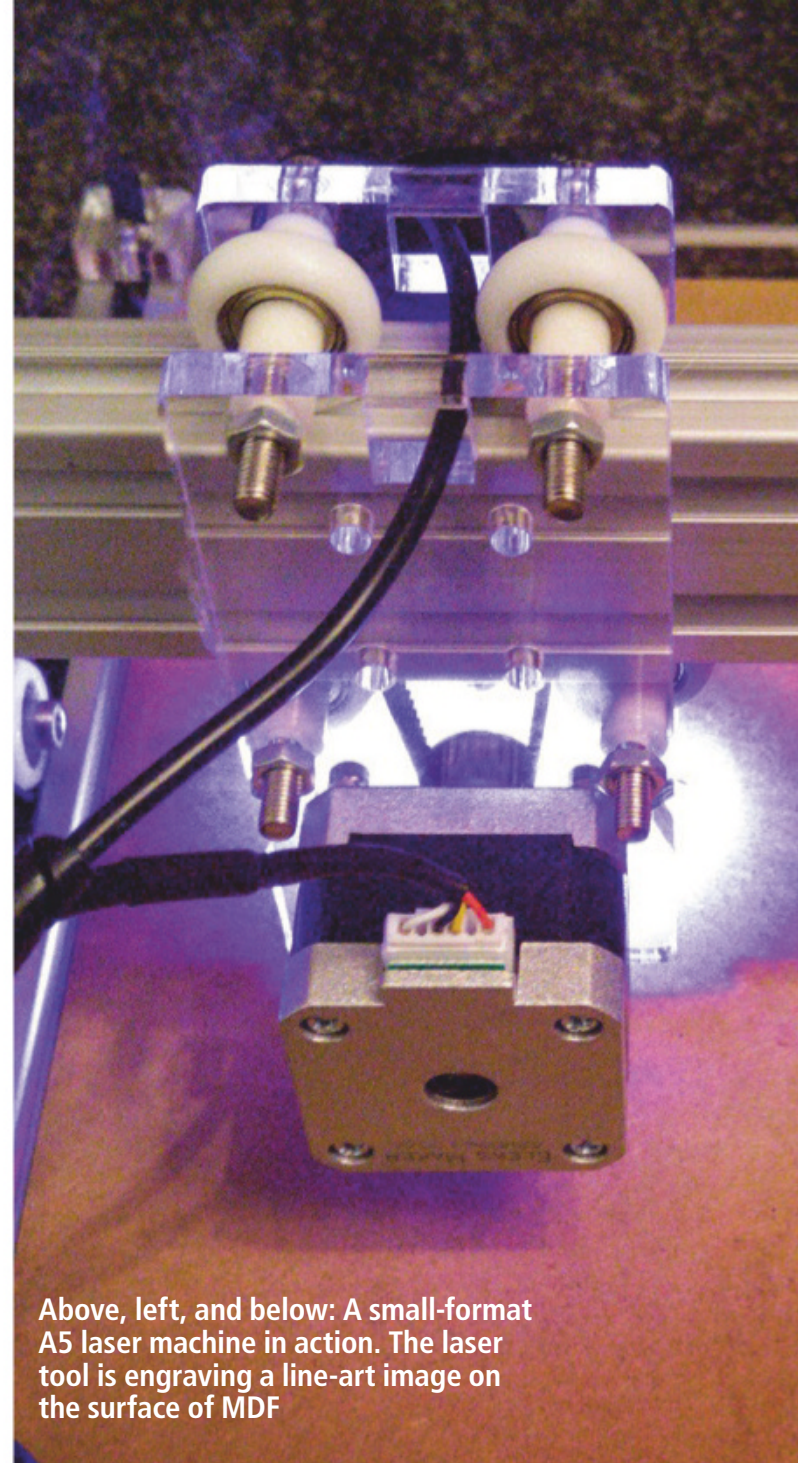
GETTING TO GRIPS WITH LASER CUTTERS AND ENGRAVERS

By Enrico Miglino

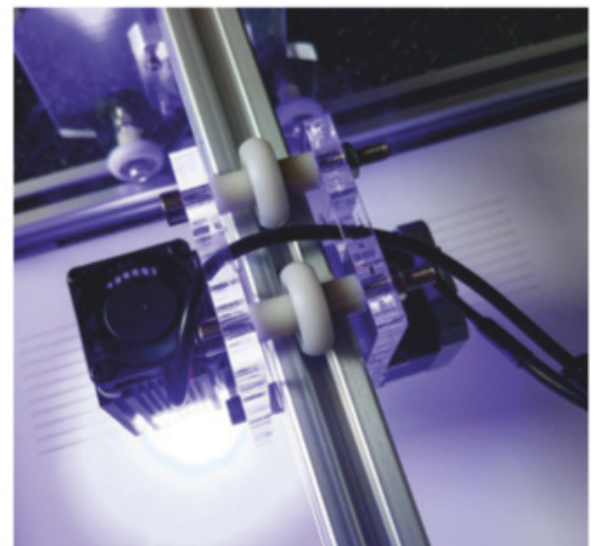
Photographs: Enrico Miglino



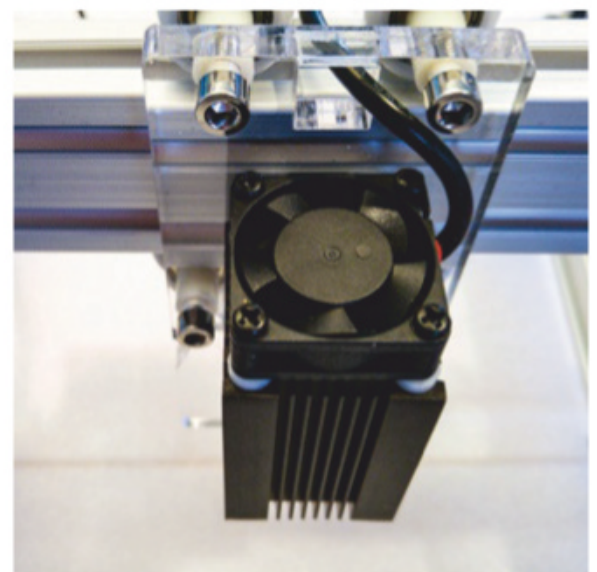
This self-assembled laser engraver has a very simple structure that does not affect the precision of the system. The laser device performs the same role as the extruder in 3D printers and the tool shaft on CNC machines. In the case of the laser, the structure can be weak because the laser tool does not move or rotate. It's just a ray of light but can still be very dangerous



Above, left, and below: A small-format A5 laser machine in action. The laser tool is engraving a line-art image on the surface of MDF



Below: Top view of the laser tool. As can be seen, it is lightweight, small, and easily driven by a thick aluminium structure. The top-side of the laser tool shows the cooling fan, which is automatically activated when the laser is in use



Nowadays we all know what a laser is. It is widely used in a lot of devices, such CD and DVD readers and writers. The laser is used to transmit very fast signals through fibre optics. Lesser known is the meaning of the acronym 'LASER': light amplification by stimulated emission of radiation.

The term 'laser' is associated with a coherent light beam but visible-light lasers are only one of the applications of this technology. Until the early '60s, there was no technology that produced a pure, monochromatic light source to build efficient laser devices.

Today we have small and powerful lasers on a single chip — the LED lasers used to read and write DVDs — as well as more powerful ones able to produce high-energy light beams (red, blue, and green are the most common) used for a number of applications from military and automotive to biomedical.

Lasers for the people

Until a few years ago powerful lasers for cutting and engraving materials were used exclusively for industrial applications. A cheap industrial laser cutter cost more than US\$5K. The current availability of

laser engraving machines costing less than US\$300 makes these tools a very interesting option for hobbyists.

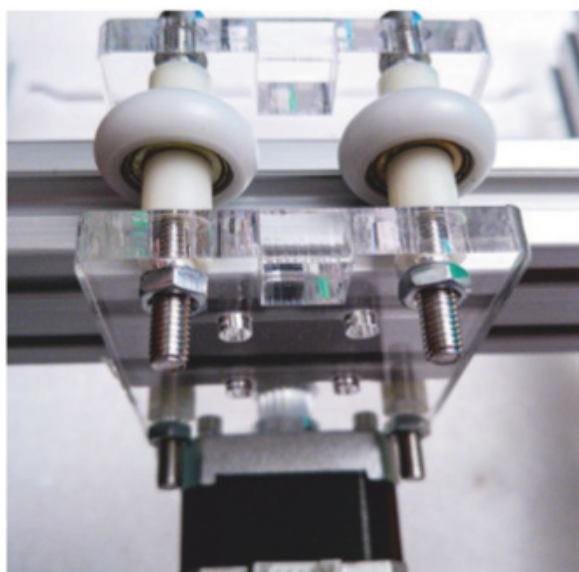
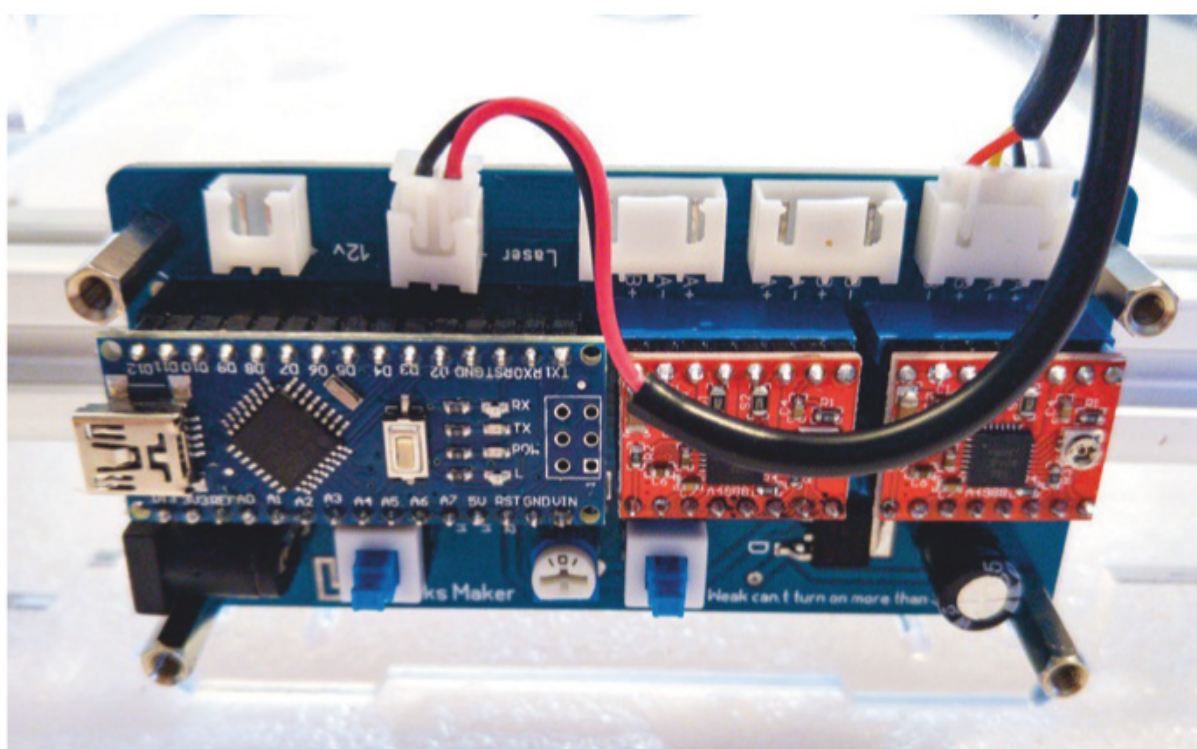
This series of articles will focus on the most important aspects of laser cutting and engraving machines, as well as software workflow, best practices, and tips for using these tools.

Then there's always the question of what the best choice for a specific project might be — CNC router, 3D printer, or laser?

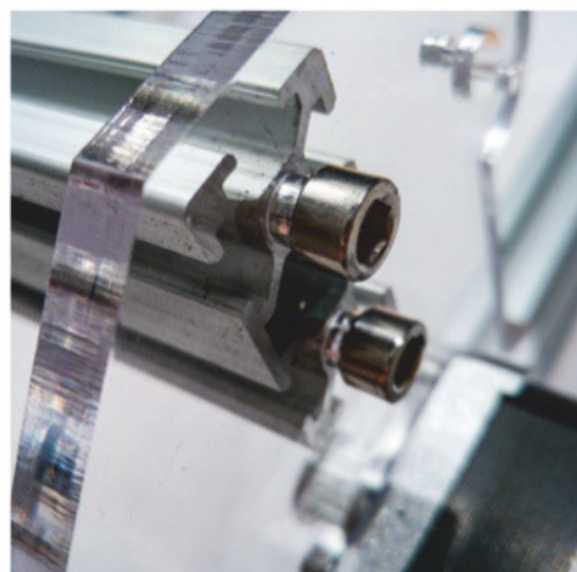
There is not a definitive answer to this question. It mostly depends on the kind of materials being used and projects that we are working on. We know that CNC routers are based on a technology that removes material from a solid block, and 3D printers and laser CNC routers are definitely the best solution for many types of materials, but they do have some limitations.

There are some designs that can't be machined with a CNC router, but they are well suited to 3D printing, like solids with complex internal shapes. CNC routing is more precise than (most) of the 3D printers that seem to be the most versatile devices. One of the bigger limitations of 3D printers is the narrow range of materials

Right: The EleksMaker Mana controller board, one of the most diffused laser controllers based on Arduino Nano. The circuit is very simple — together with the Arduino Nano microcontroller (the small blue board plugged on the base), you can see the stepper motor controllers: one for the X-axis and one for the Y-axis. Note that the Y-axis uses two stepper motors that are synchronized, both connected to the same motor controller (the small red boards plugged on top of the blue printed circuit board [PCB]). The base board connects the Arduino to the motor controller's signals, providing the right power supply to the circuit (5V) and the laser tool (12V), the leftmost top connector on the base PCB. As this version of the controller board is very simple, the laser is just powered when needed, as the board does not provide any signal to control the power of the laser tool



Detail of the stepper motor (bottom) and the transparent two-side support for the laser tool that will be fixed on the front side. The entire block head moves over an aluminium rail supported by two sets of coupled bearings. The heaviest component of the head block is the stepper motor, which is about three times the weight of the laser tool



Due to the low mechanical stress applied to the moving parts, joints, and enclosures of the laser engraver, they work well and are stable without the need for heavy screws and fixings



Detail of the bottom side of the laser tool with the focus lens. As the laser is in a fixed vertical position the engraving plane height can be adjusted to focus the laser lens

In this introductory article, I have tried to show a range of the possibilities offered by these devices

used — almost exclusively plastic filament or resin. The 3D-printing technology that is available and affordable for personal use is based on filament fusion and extrusion. A considerable investment is needed for 3D printing using more recent technologies like liquid resin or powder. CNC routers and 3D printers can build solid, 3D objects, but laser machines work essentially on surfaces.

On the flip side, there are some machining jobs that are impossible to do with a 3D printer but are dead easy to do with a cheap laser engraver.

A CNC router can be replaced with a 3D printer if you're willing to make some compromises, and a laser cutter and engraver tool is complementary

to a 3D printer. The perfect solution for a hobbyist's workshop would be to include both.

Home laser engravers (and cutters)

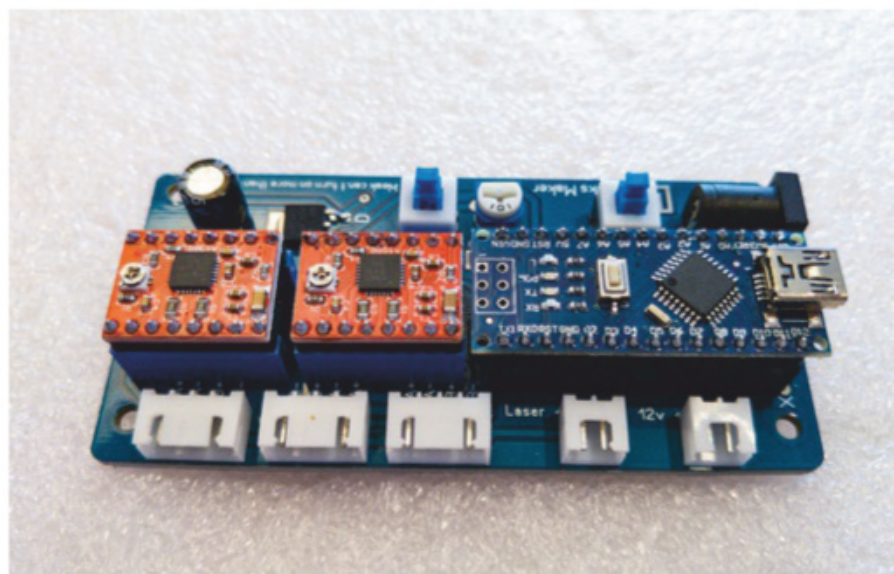
In this article, I have tried to show a range of the possibilities offered by these devices through the photographs — a sort of visual index showing the most important aspects we should consider when choosing which kind of device to buy. In following articles, we will see in detail how they perform, and how to get the best results from various configurations.

Excluding very small laser engraving machines sold preassembled, a DIY tool may be the right solution. Assembling a

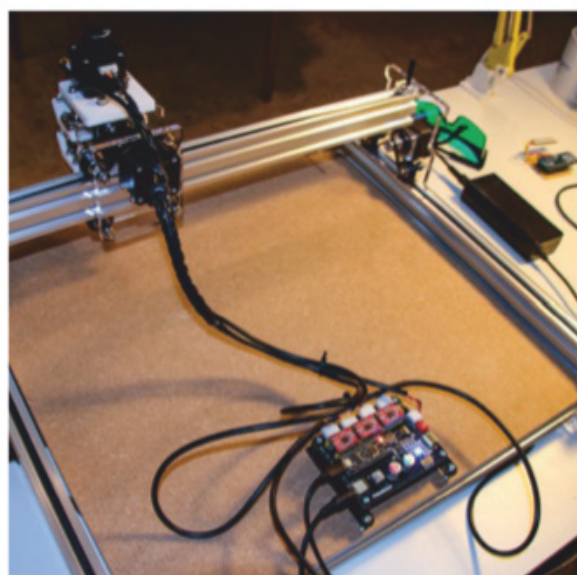
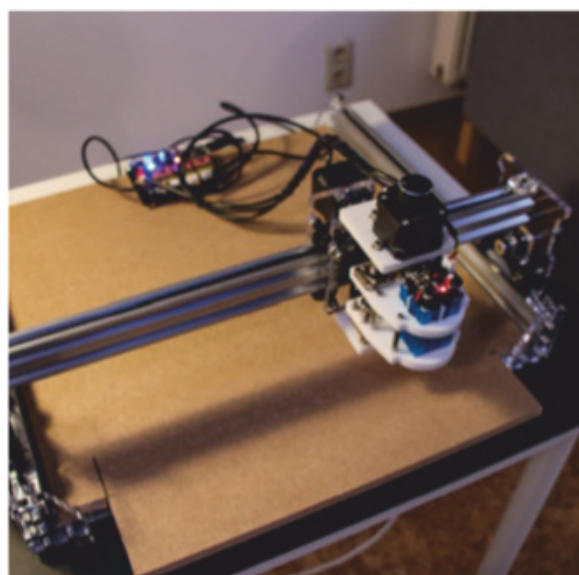
home laser engraver kit is very easy and doesn't take more than a couple of hours, and the precision and performance are really worth the effort.

Here I have used a set of three different configurations of the popular EleksMaker laser cutter and engraver. I am not sponsored by this company and the brand is a popular DIY design. I find that EleksMaker devices have the advantage of an extremely simple structure, are easy to maintain and manage, and are user-friendly when it comes to hacking and upgrading.

While the 3D-printing world is a stable market with a wide range of good options, laser-engraving technology for hobby and personal use is still in the pioneering ►



Above, left, and below: These images show what you should expect to find in your DIY laser box. The few components and the easy-to-assemble design require only a few hours to put together before you have a ready-to-start sheddie laser engraver



Above: Two views of a laser cutter and engraver equipped with an extra motor for the Z-axis, so it can cut thick material. While the machine design is the same as the smaller ones, the cutting surface is wider, with a working surface of 300x250mm. By adding the Z-axis motor and support, the available working surface is reduced, so it is better to use a large frame

If you can afford the cost of the best choice — a 5500mW laser — go ahead and buy it. I recommend that a 2500mW laser tool is the minimum you should consider

technologies — like the CO₂ laser cutters used for metal sheets — and are available for industrial applications only.

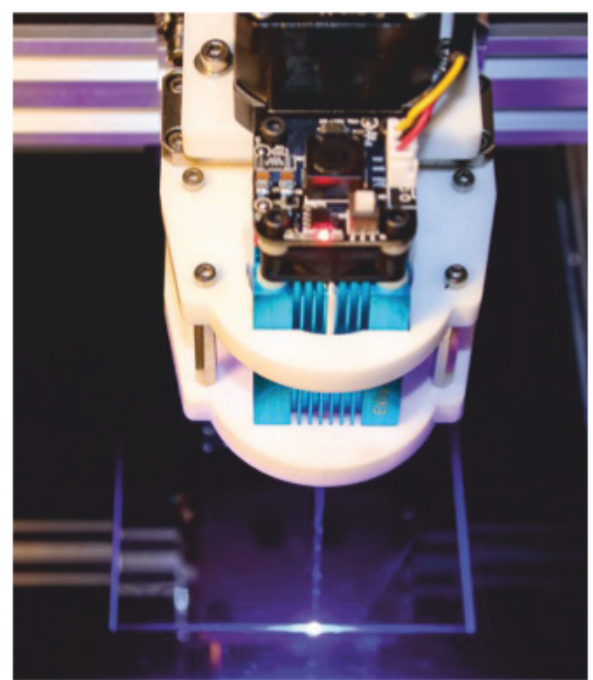
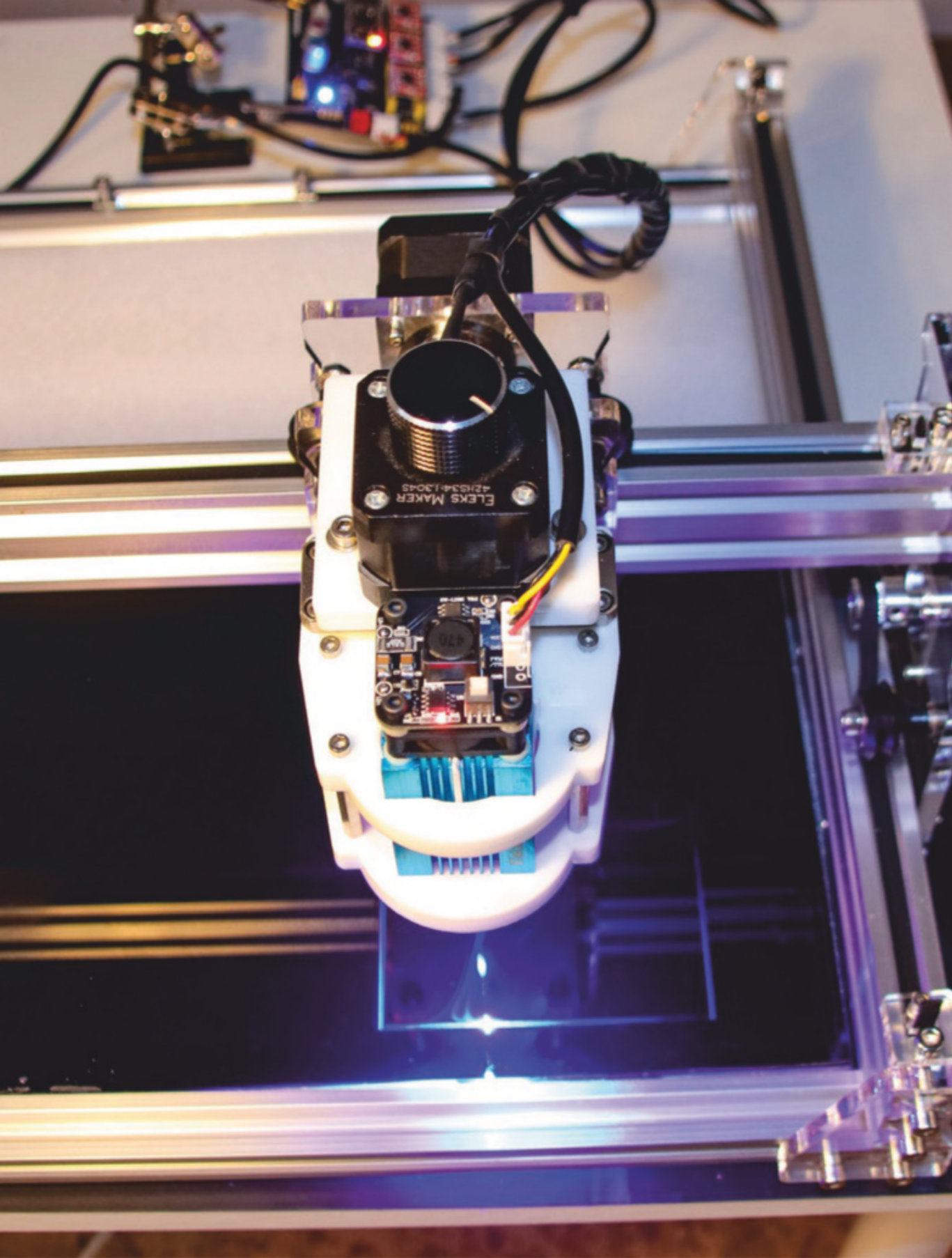
The most diffused materials for laser engraving are wood surfaces, plywood, robust cardboard, MDF, some of the opaque metals (e.g., copper and aluminium), and many types of plastic and acrylic, excluding most of the transparent ones. Some transparent plastics can be engraved, but testing is

necessary beforehand.

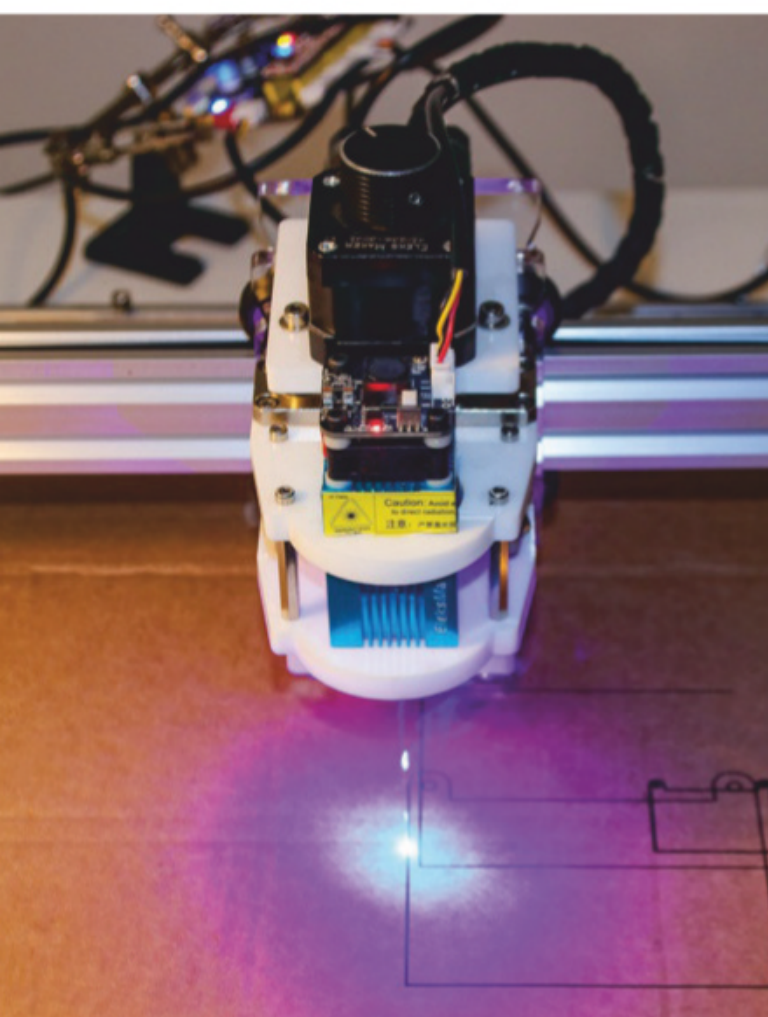
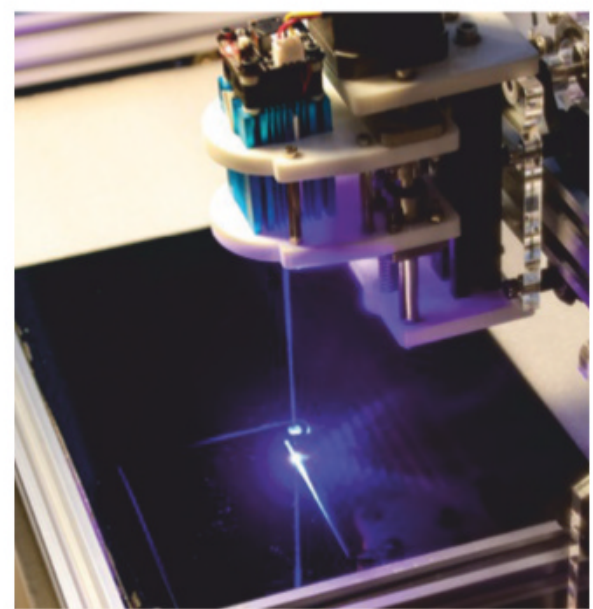
Most of the parts of DIY robots, games, 3D-printer supports, and parts of the laser machines that you can see in the photographs in this article are 5mm laser-cut pieces. The maximum thickness that I recommend you work with on a homemade laser is 3mm.

It is important to take into account that there is no direct relationship between the power of the laser and the

materials that we can cut or engrave. In some cases, certain kinds of surfaces can't be scratched at all, like plastics of the same color as the laser beam. In theory, we can do the same jobs with a relatively low-power laser as we can with a higher-powered one — we just need to do multiple passes over the same path. However, this is not always true, and power is the most important factor in deciding what laser device to buy. ►



A 2500mW laser head cutting a 3mm Kitronik Perspex sheet. To cut relatively thick material (e.g., this 3mm thick acrylic), we can programme the software to repeat the same path more times. To avoid the laser point going out of focus while the cut goes deeper, we can add a Z-axis head to support the laser tool. At every pass the Z-value will decrease (typically .55mm) until the sheet has been completely cut



Left and below: To cut thick acrylic with a relatively low-powered laser device — about 1500mW — many passes are needed over the same path. As shown, to avoid wasting time and material it is good practice to try cutting a test material beforehand to make machining easier. In this example, I made the same piece with thick cardboard, and cut it in a few minutes before proceeding with the acrylic

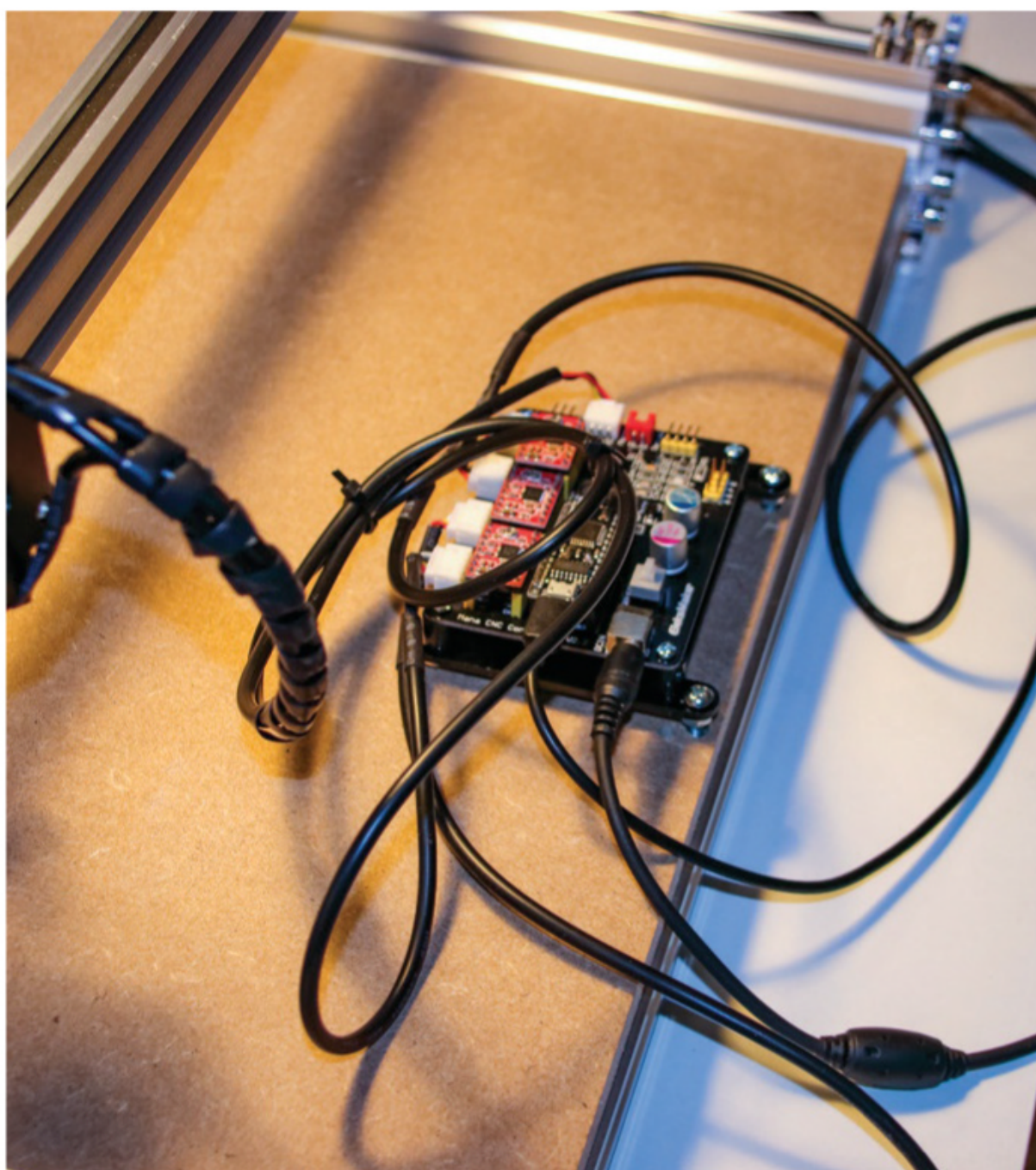


phase. This brings a lot of possibilities to building your own personalized device, tailored to your personal needs

With most of the 3D-printer brands an Arduino-based control board is standard, and this is also the case with laser engravers. The range of available laser tools you can buy will vary between 500mW and 5500mW. The laser is the most important component of an engraver set-up and also the component that has the biggest price range; with the example shown here, the engraver structure itself only contributed US\$80 to the overall cost.

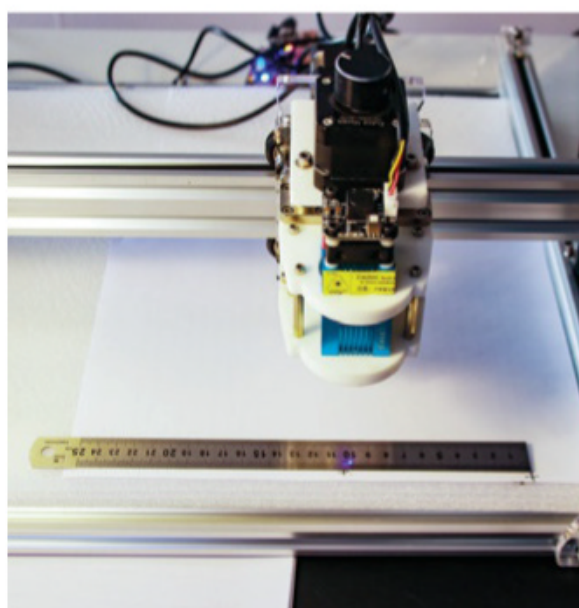
Materials

Regardless of the power of the laser, there are some kinds of material that can't be managed by a laser cutter and engraver, like glass. These materials can be cut using lasers based on different



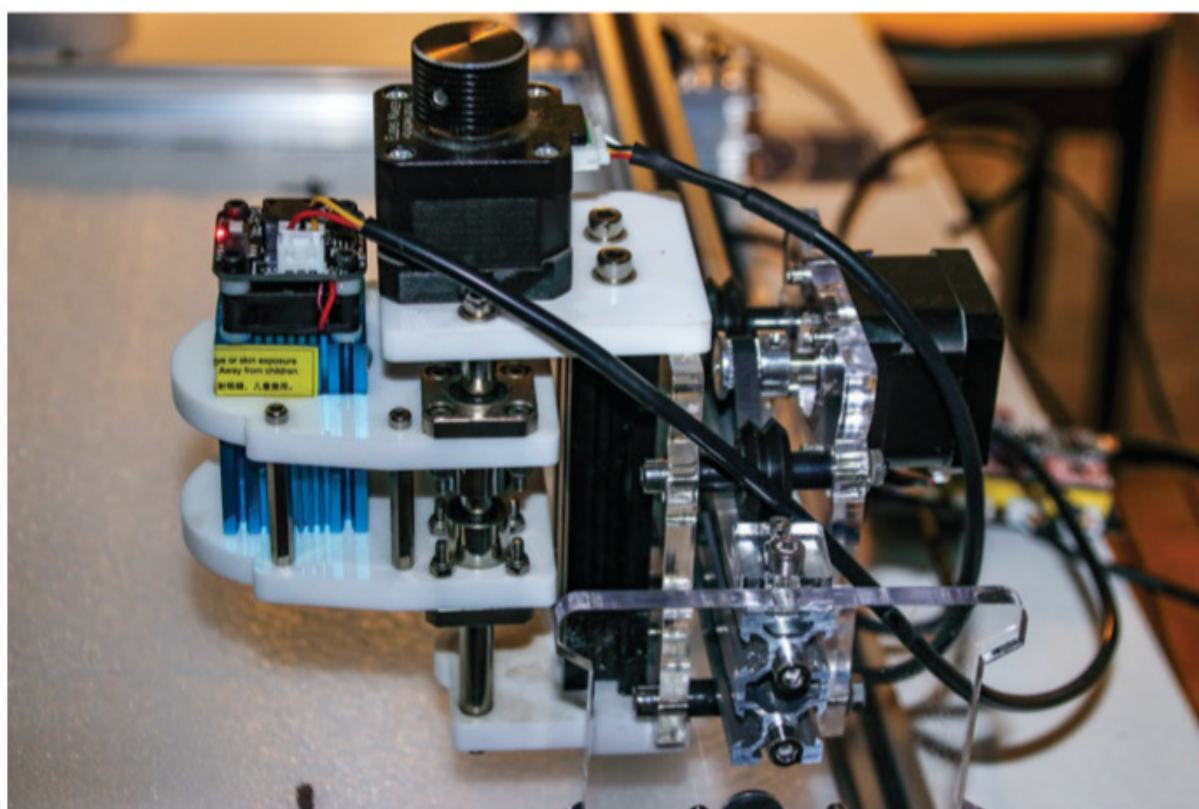
“There is a number of options for managing the workflow of a laser cutter and engraver, from the design up to the finished job”

Left: The three-axis laser is controlled by a board very similar to the Mana used in the smaller machine. In this case, I have used a Mama SE, a model including a third motor controller (the three small red boards), while the laser tool is controlled with a pulse-width modulation (PWM) signal instead of the direct power connection. Using PWM makes it possible to set the laser power in a range between zero and 1000. The combination of these two improvements makes the machine more flexible, with a lot more options for working on a wider range of different materials and thicknesses



Right: Detailed view of the Z-axis mechanism with the laser tool installed and replacing the bare laser head

Above: It's an easy procedure to empirically detect the working surface and axis motion calibration. With the laser set to low power level, manually move the axis with the jogging functions of the software and mark the four extreme corners of the working area, then set up the programme configuration to the detected values as well. To verify the correctness of the axes motion, just position the laser, place a ruler, then move the laser head in the X- or Y-direction at a fixed distance (e.g., 100mm). After moving, the laser should point the same distance on the ruler. If not, the motor stepping parameters should be updated on the software configuration. Repeat the same operation for each of the axes



If you can afford the cost of the best choice — a 5500mW laser — go ahead and buy it. I recommend that a 2500mW laser tool is the minimum you should consider. As a simple comparison, to cut a 10x10cm rectangle out of 3mm thick plywood with a 2500mW laser, we need about five passes at a speed of 50mm/min. The same cut with a 500mW laser needs 20 passes at a speed of 5mm/min.

The software

There is a number of options for managing the workflow of a laser cutter and engraver, from the design up to the finished job. It is possible to use open-source software applications, as well as a good low-cost application. This is one of the most important factors that affects the results of working with laser devices and we will look at this in our next article. 📄

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TARANAKI TREASURE

By Bob Hulme

Photographs: Bob Hulme

A SPECIAL MUSEUM IS STAFFED BY PASSIONATE VOLUNTEERS

Taranaki is a region with no shortage of museums; in fact they seem to be there in epidemic numbers, so it's a great place to visit to view a good range of nostalgic gear.

The Taranaki Regional Council even has a booklet listing museums and galleries in the district. It lists 29 in total. I'm not sure why this region has so many well-preserved examples of equipment that reminds us of how people lived ages ago. Perhaps they were a canny lot of early settlers who never threw anything away, or perhaps farming was so lucrative that new stuff was bought before the old stuff wore out. Who knows? What I do know is that there is a good chance that you can see a collection on display of whatever is your interest in this lovely part of the country.

Sheddie delights

One that stood out for me on a recent visit was the Taranaki Aviation Transport and Technology Museum (TATATM). While the name suggests lots of machinery, there

is far more to it as there are displays of household appliances, radios, and medical apparatus too.

What stood out for us the most was the enthusiasm of the volunteers who man the museum each day — always helpful, and ready to answer any questions about exhibits. They are keen for visitors to

interact with the exhibits and like to keep as many items in full working order as they can.

I was fortunate to meet several of the volunteers as I spent four days there — not wandering around the displays all that time, you understand, but as members of the New Zealand Motor Caravan



Loading matai weatherboards into the workshop



Above: Enthusiastic volunteers Neville Worsley (left) and Graham Loveridge
Left: Linotype machines

*Perhaps they were
a canny lot of early
settlers who never
threw anything away*



Dredge suction engine

Association (NZMCA) my wife and I were able to stay overnight on the grounds in our caravan for a very reasonable charge. Run by the TATATM Society, the museum has operated from its current location on Kent Road, just off State Highway 3 and close to Egmont Village, for nearly 40 years. Its only source of income is from museum-entry and camping fees (NZMCA members only).

Amazing volunteers

The society has leased the present location from the Department of Conservation since December 1979 and gradually obtained various buildings to house all the exhibits. It made the move there in 1980 after shifting around four temporary locations since 1975. The land was originally occupied by a school from 1875 to 1926 and left as grazing until 1952, when it was used first by the Taranaki Go Kart Club and then by the Taranaki Car Club, before reverting to grazing again in 1965.

While we were there, a truckload of old

P51 Mustang



On 22 December 1953, two of these aircraft crashed on their way to Auckland to perform a fly-past for the visit of the Queen and Prince Philip. Both crashed due to bad weather within a short distance of each other and both pilots were killed. The P51 Mustangs were RNZAF serial numbers NZ2404 and NZ2411. One crashed at the mouth of the Waipungau Stream, and the other across the Tongaporutu River.

Years later, Roger Jordan, one of the founders of the museum, recovered what interesting pieces of wreckage he could find. Most pieces were pretty small, but from down a 5m hole he recovered an undercarriage leg, .5-inch calibre Browning machine guns, and a Packard Merlin engine. It's believed that the engine was probably going full noise when the plane hit the ground.



Post-office display

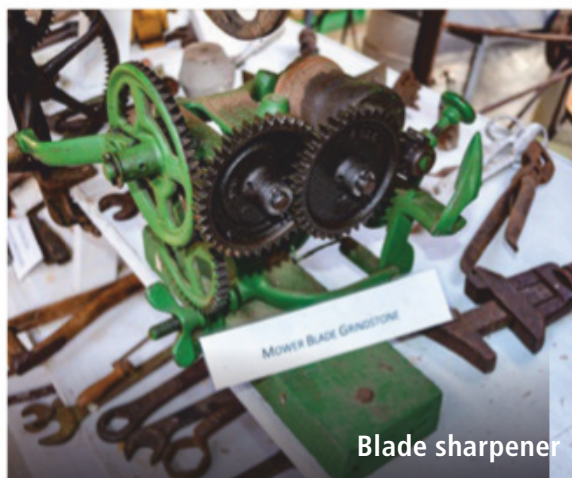
Airspeed Oxford



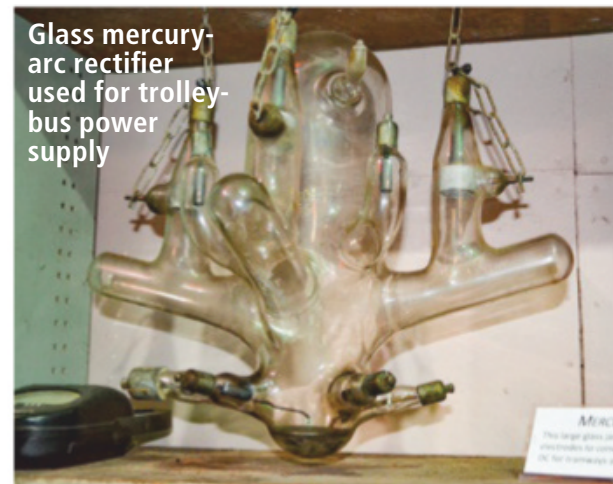
This plane is one that failed to return to its base at New Plymouth from a navigation training mission in October 1942. It was lost and not found until a goat hunter stumbled across the wreckage in the North Egmont area. He was trying to keep up with his dogs and tripped over, finding himself face to face with the wreckage and the remains of the four people who had been on board!

Roger Jordan heard about the discovery and called MOTAT in Auckland to see if it was interested. MOTAT was and asked him to act on its behalf. The RNZAF assisted by lifting the two engines out using an Iroquois helicopter. Plenty of volunteer manpower was on hand to recover other parts. The people at MOTAT then put it to Roger that the items recovered could be used to form a basis for a local museum.

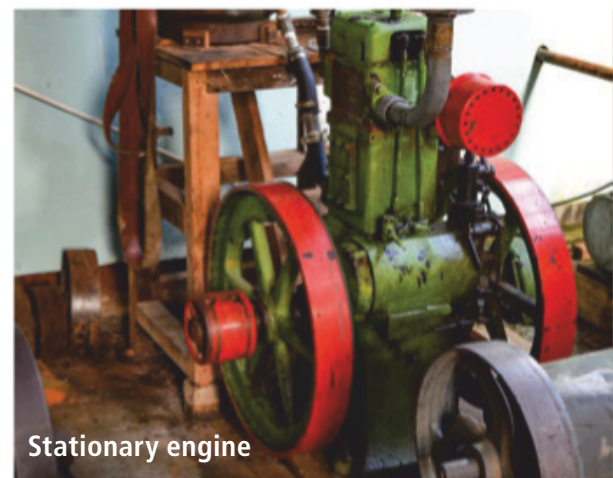
The devotion and passion of these guys is great to see



Blade sharpener



Glass mercury-arc rectifier used for trolley-bus power supply



Stationary engine

weatherboards arrived that the museum had tracked down and purchased to maintain one of the buildings there. I was told it was lucky to find some that matched the original ones. They looked like matai timber and in not bad condition. Volunteers with a digger turned up to unload and stash them away in their workshop area where a lot of restoration work is done. The devotion and passion of these guys is great to see.

Heaps of local history

In 1978 the Taranaki Harbours Board donated items from its steam dredge that was being scrapped. The suction-pump motor looked big enough to be the vessel's main engine and society members had to build a special shed for this, which could only be completed after the engine was craned in. Other dredge items include the rudder gear and a Ruston diesel auxiliary engine.



Above: Manual switchboard
Left: Very early Fordson



The first building after the entry houses the collection of agricultural and logging machinery. Most of the equipment here is in working order and often used in displays and parades in the district. The next and largest building has several printing presses with the old typesetting machines for making lead printing plates. Radio and sound-recording equipment follows, before there is a post office set up as it would have been in the 1950s, complete with a manual telephone exchange.

Kiwi-designed quad bikes

If you want to study the Motunui Methanol Plant, no problem — there is a full-scale model of it here.

The aviation section is not vast, but there are some really special finds on display with unique background stories. How a complete Harvard trainer aircraft was fitted in there I can only imagine.

Transport items include a 1938 Ford fire engine, complete with uniforms of the era, and a 1950s Ford Marmon-Herrington crash-tender. But what took my eye was one of the smaller vehicles — a Gnat.

These were a New Zealand-designed

three-wheeled farm vehicle that proved popular until farm bikes and quad bikes caught on. Simple and effective, but not many examples seem to be around anymore. Probably all rusted out due to cow dung!

New members of the society are welcome, but beware — the passion and spirit of these people is infectious.

If you plan to visit the Naki, make sure you call in to visit the enthusiasts at TATATM. 



Gnat farm vehicle

MAKING IT UP AS HE GOES

A CREATIVE MIND AND AN EYE FOR INNOVATION
RESULT IN SOME SURPRISING SCULPTURES

*By Helen Frances
Photographs: Tracey Grant*



Ray Woodhouse in his compact workshop



The finished Blind Finch *Light Burger*



Blind Finch Hamburgeria owner Derek Allomes grilling ingredients in the engine room of the burger bar



Using Nemo's boathook to lower shutters



Among the many projects Raetihi sheddie Ray Woodhouse has on the go, the beginnings of a gourmet steam-punk hamburger make a mind-watering statement on his workbench. The burger filling, tucked inside a 300mm high copper shell, features a brass and copper patty, frilly lettuce, mushrooms, olives, bird feathers, brass feet, and other metallic goodies. An LED bulb will light up the filling.

When it's ready, the burger is destined, on spec, for The Blind Finch gourmet burger bar in Ohakune. Ray also made a copper fireplace surround, brass hooks to hang his menu boards on the wall, the copper drinking-fountain dish, and a Captain Nemo boathook for the burger bar. The boathook is for raising and lowering the shutters over the food counter that also has brass hooks he made to hold them open when food is being served.

Award-winning creations

But the burger is just an appetizer. Ray specializes in strange and fantastical

“I had it sitting there for a while and thought, what can I do with it?”

creatures and plant forms that serve both as sculptural pieces and lampstands. His insect-like lamp and companion dimmer, titled *Light Flight*, won the Waimarino Art Awards 2017. He created it from an antique bowling ball made from *Lignum vitae*, one of the hardest woods known, that he found at Trash Palace in Porirua.

“I had it sitting there for a while and thought, what can I do with it? I’ll put some wings on it. And it grew from there. If it has wings it’s got to have feet, and so on.”

Another that he calls *Buggly* sits at present on his dining-room table. He made it incrementally as he does a lot

of his pieces, starting with a rough idea and then adding features as further inspiration arrives.

“I called it *Buggly* because he has dreadlocks. It was based on a prehistoric trilobite — a giant slater — hence the shape of the head. I used some Tasmanian blackwood for the body, then it was a matter of figuring out how to attach it all. I decided to put legs on it, and then it needed fins.”

Antennae and a little mouth with a light bulb followed, and finally a baby *Buggly* to house the dimmer switch, operated by twisting its nose.

“I like using found objects but I also like going outside the square. In this little lamp, everything is made; nothing is recycled, except for the tips of the antennae, which are from old brass drawer handles. Everything else, including the dimmer housing, I made from scratch.”

On another part of his workbench sprouts clusters of brass and copper mushrooms, toadstools, and other fungal forms. He silver solders the mushrooms

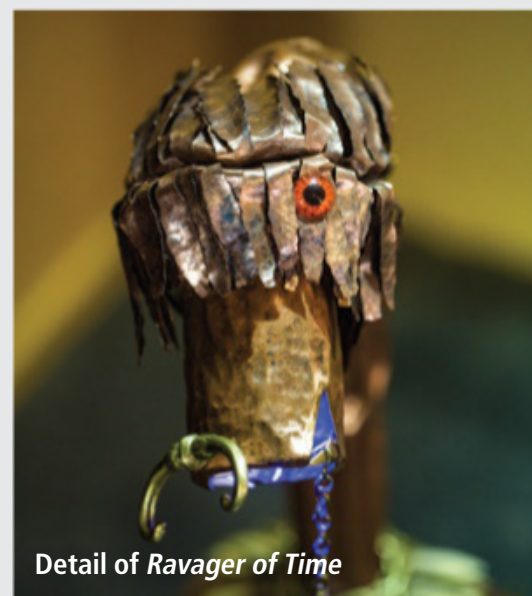


Ravager of Time

Waimarino Awards 2018 entry

Ravager of Time, 17kg and 900mm high, is based on the concept of 'the ravages of time'. Ray invented a motley prehistoric creature — a bird-dinosaur that sports cast-iron-bathtub claws, which he sand blasted and painted; copper feathers; brass tail feathers; real feathers around its neck; dinosaur arms; and brass fangs. The creature is ripping an antique clock apart.

"It evolved as I was making it. I like things that denote decay and try to capture that in my photography as well," says the artist. "I found an antique clock at the tip and made up a story to go with it that would show what a ravager of time might look like. I also like making things that illustrate a pun, like 'a mental block' or 'tongue-in-cheek'."



Detail of Ravager of Time

and uses a gadget that fly fishers use for making flies to hold the mushrooms while he fires the gas torch. He plans to mount clumps of the fungi on pieces of native timber, as small items sell more quickly than large works.

Some of Ray's larger pieces are displayed at Whanganui's Expressions gallery. The *Neuralyzer* (as in brain connections) lampstand features two massive copper flower forms facing each other with large bulbs in the centre of each flower. The flowers are mounted on an antique lawn-roller handle, attached upside down to an iron plate used for

sharpening shearing combs. The dimmer-switch housing stands on Tasmanian blackwood feet, inlaid with rivulets of copper.

"I use a very fine router bit to cut grooves, then inlay copper wire and glue it in. I then sand and polish it to its final finish," he says.

Running Light has multiple brass feet around a circular timber base and a matching dimmer.

He has combined his work and his wife May's exquisite beadwork in two pieces — *Wired Flower* (jewellery using de-spiked barbed wire), and *Lite Butterfly* lamp.

Functional sculptures

These lamps each have a short story with them, that Ray describes as "flights of fantasy", which explains their origins, such as very remote parts of the volcanic plateau where Ray and May have tramped extensively on photographic expeditions.

"The idea is to make functional sculptural pieces that can stand alone as art works, which take on another dimension at night. *Lite Butterfly* carries this concept further with a wearable necklace and earrings.

Ray keeps an artist's visual diary but doesn't make drawings or plans. ►



Running Light



Neuralyzer

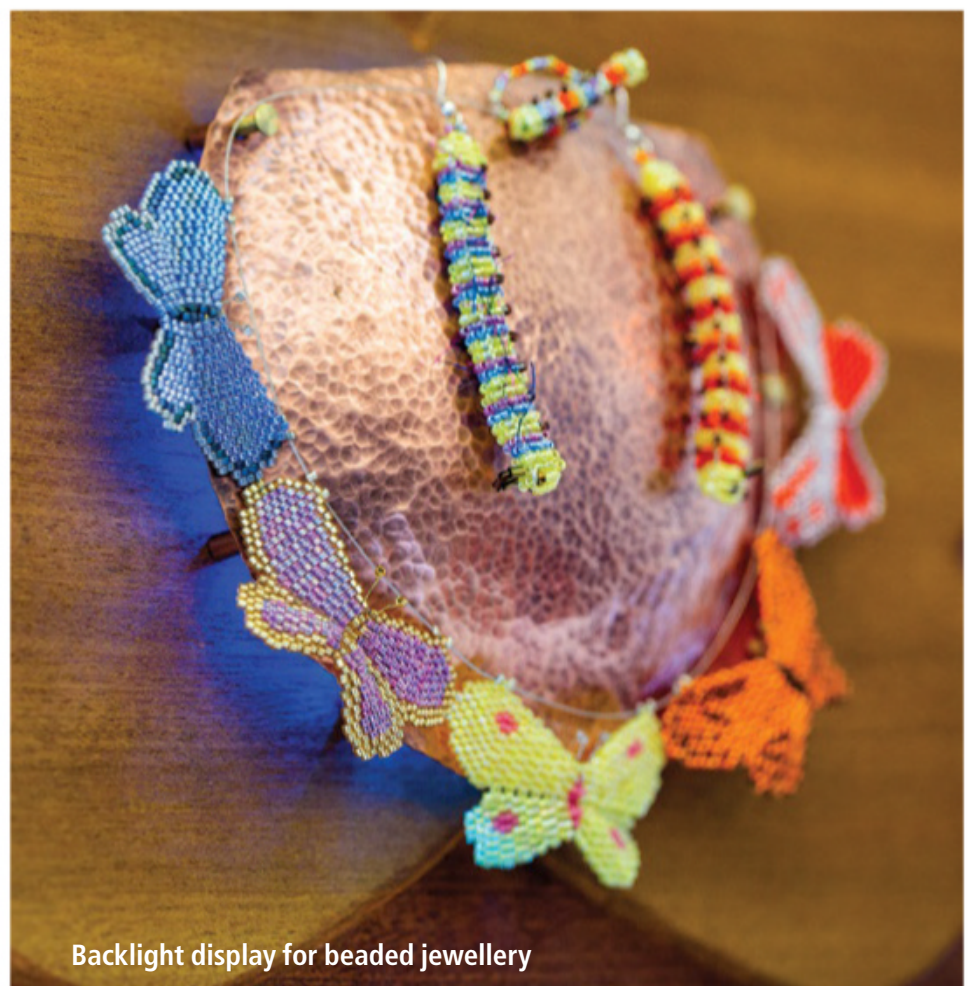


Neuralyzer detail

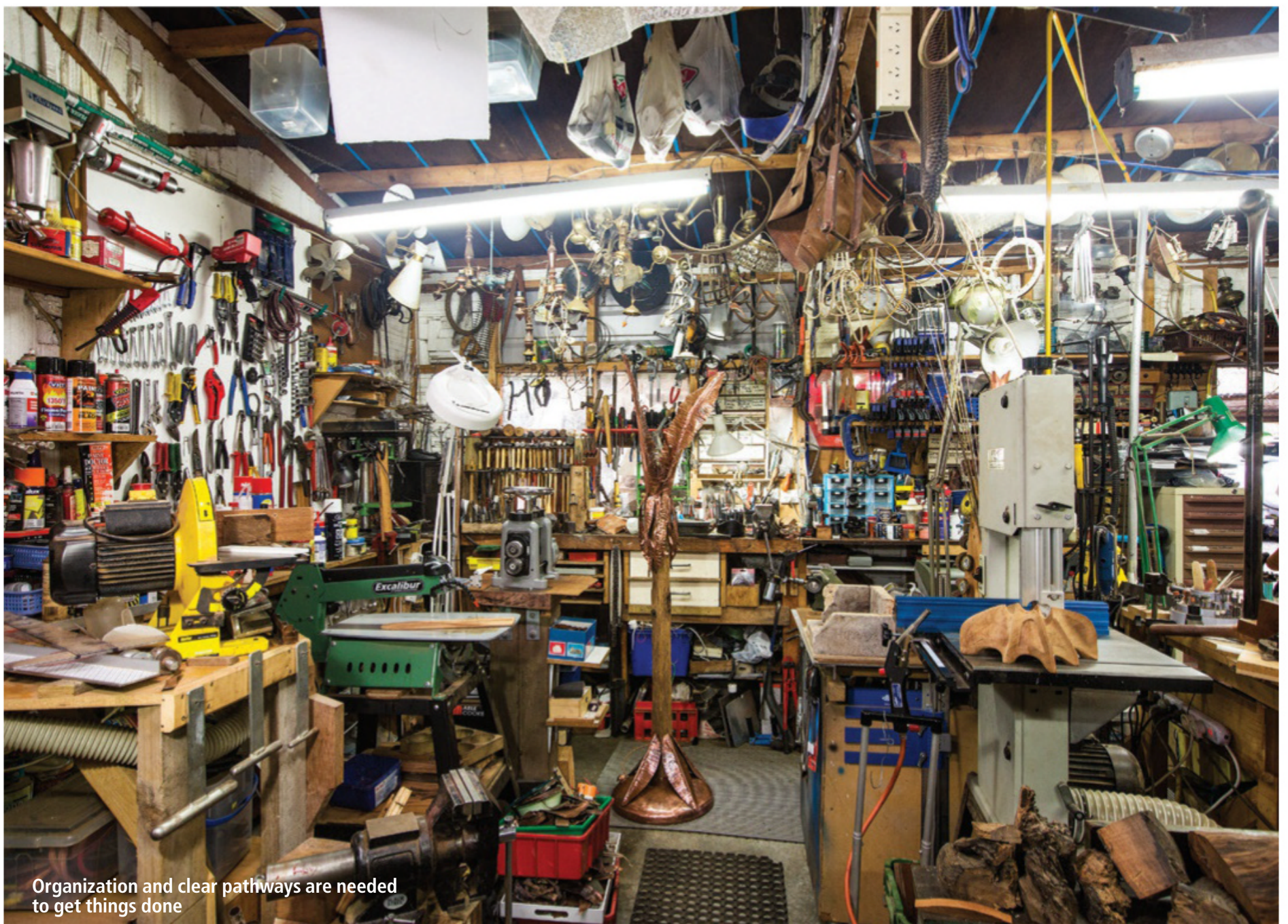
“You get a creative idea, write it down, make a few rough sketches, otherwise you wouldn’t remember it”



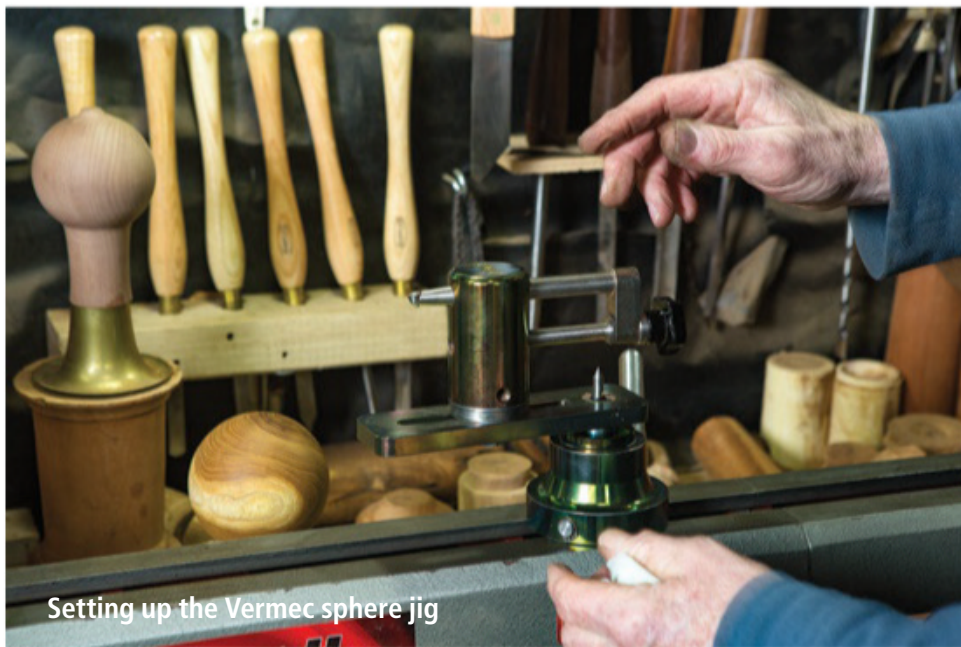
Engraving the ID tag for Ravager



Backlight display for beaded jewellery



Organization and clear pathways are needed to get things done



Setting up the Vermec sphere jig

“I just try things out and discover things as I go. I’m not bound by any rules or traditions”



Covered-in area for messy jobs



Using the Foredom drill press ...



... for very small work

Fold-forming copper — from the internet

‘Fold-forming’ is a technique of metalworking whereby metal is folded, repeatedly forged and annealed, and unfolded, at which stage it generally has a dramatic new three-dimensional form.

The technique was invented in the late 1980s by Charles Lewton-Brain. Charles’ work has been recognized by the British Museum research lab, and a 1991 Rolex Award, and in 2012 he was the recipient of the Governor General Award for his contribution to Canadian arts. He is associate professor, jewellery in the School of Craft and Emerging Media at the Alberta College of Art and Design. See [youtube.com/watch?v=OBRnJp8gKys](https://www.youtube.com/watch?v=OBRnJp8gKys).

“You get a creative idea, write it down, make a few rough sketches, otherwise you wouldn’t remember it. It’s a very simplistic idea of what I might do, but it won’t necessarily turn out exactly like that,” says Ray.

His ideas are stimulated by diverse sources, such as 1970s LP album artwork (he used to work for Festival Records), Leonardo da Vinci’s designs, and Polish surrealist artist Jacek Yerka’s paintings. “Other stuff is just purely out of my head.”

Ray is also an experienced landscape photographer, specializing in black-and-white and colour infra-red film, and says that he has developed an eye for what works: “You look at a scene, distil it, and break it down. You remove things; whereas a painter adds things, photography subtracts. So you’ve got a very basic image and it works. It’s a similar process when making things.”

Ray’s magic shed

Ray’s shed is a sprawling, rustic treasure trove of materials and machinery, set among two acres (.4ha) of fruiting trees and bushes.

Ray says that his shed activities took off after 2000 but before then he was doing all his own photograph framing, making the mouldings and invisible joins.

“I found framers expensive and they



Sitting on a traditional shaving horse to shape a bowl base with a drawknife

weren’t as meticulous as I am. I’m very finicky. I used acid-free foam-core backing boards of various thicknesses, archival matt boards, and museum glass so that a hung print will last a long time. They were very expensive productions.”

A combination of back trouble and digital technology saturating the market with images propelled him to reinvent himself. He had plenty of equipment and masses of materials that he had collected — glass, metal, beautiful native timbers.

“When you are doing stuff like this people get to know about it and they give you things,” he explains.

He became interested in metalsmithing, making pendants, bracelets, and earrings.

“I thought, if you can do that on a small scale then you can extrapolate that into a bigger scale. Then on the Internet I discovered influential artists overseas, and a Canadian goldsmith, Charles Lewton-Brain, who pioneered

fold-forming copper,” he says.

Through experimenting with his tools and machines Ray developed a ripple technique for metal, heating, beating, and folding it, which he discovered by intentional accident.

“With the right machinery you can do all sorts of things with metal,” Ray says.

All the gear

His tools and machinery are stationed around the shed, which at first glance looks very full. But everything he needs is close at hand. A dust extractor controls that particular by-product of shed activity and he has non-stop stereo music pumped out by quality equipment that he found at the local dump, thanks to chalet owners upgrading or selling their secondary residences.

Ray likes particular brands and buys the best-quality equipment as he says cheap gear lets you down. He sings the praises of “a great little bandsaw by

Strange tastes



While Ray makes surreal lamps and creatures in the shed, wife May cooks up unusual things in the kitchen. Consulting ancient recipes for wild berries, wine, and weeds, May has made herby-flavoured gorse-flower fritters and broom-flower conserve, which accompanies wild meat and was traditionally served at Balmoral Castle during the game season. Other recipes on the menu include elderflower pancakes, bramble chutney, and broom vinegar.

Proxxon”, which is water cooled and cuts metal, wood, and glass.

“I’ve got different bands — diamond bands and metal-cutting bands. You can cut different metals and slice up glass. Proxxon has a range of stuff for people who make serious models such as mini steam engines. They have some really good quality mini lathes,” he says.

Ray’s equipment includes buffing gear, a mini belt sander, a little metal drop saw, and a bench polisher/grinder; a flexible drive by Foredom, which makes a range of motors and supplies equipment to jewellers and metalsmiths, and inflatable sanders from King Arthur’s Tools. “If you are furniture making the drums make sanding so fast that it becomes enjoyable,” says Ray.

He uses a mini drill press for doing very small work and is in the process of restoring a watchmaker’s lathe. A rolling mill is handy for brass bangles and embossing patterns on copper, and he also uses it for fold-forming copper.

A Nova Comet midi lathe and jigs enable him to make componentry for his lamps, wooden balls, knobs for gearshifts, hubs for spoked wheels, and more. He uses a scroll saw to decorate items such as native-timber cupboard doors. He has a thicknesser, an air hammer, a drill press, a linishing machine, and filing cabinets full of tools.

An SCM Systems air-powered engraving tool has a ceramic bearing and air turbine and runs at 400,000rpm.

“It’s like drawing with a pencil — you can draw on glass, stone, anything, and engrave pictures.”



Figuring out stuff

Ray sharpens all his own tools with a Tormek water-cooled sharpening machine and has jigs for sharpening every kind of cutting blade. “I do it myself because no-one else in the area can do it,” he says.

“If you’ve got an idea and you want to create something you have got to have the tools to do it. But because I never went through any formal schooling [in art and the use of machines and tools] I just try things out and discover things as I go. I’m not bound by any rules or traditions. So you never know quite what you’re going to end up with. But it’s also about paying attention to the detail to get a really nice finish.”

The ‘make it up as he goes along’ approach goes hand in hand with his innovative mindset.

“Just about everything I make I’ve never made before,” he says. “So you find yourself at four in the morning trying to work out a technical problem — How do

I do this, how do I design it to make this work? — It’s good for insomniacs; you can lie there planning the next design.”

Across the yard in a small open shed, Ray keeps larger woodworking gear and dries out chunks of wood. There’s some Tasmanian blackwood and a massive piece of macrocarpa; a hunk of kowhai is destined for an outdoor sculpture of a morel mushroom.

In this wood-prep shed Ray uses a traditional shaving horse, for which he got the design from a UK wooden-bowl carver, David Fisher. Ray says that sheddies can find free plans for the shaving horse on David’s website, and says, “It’s a brilliant way of holding a piece of wood while using your drawknife to shape it, and the rhythmical back and forth is very therapeutic.”

Ray has plenty of materials and ideas waiting to be realized; it’s just a matter of getting around to doing them all.

You can contact Ray about his work on 027 3705 618.



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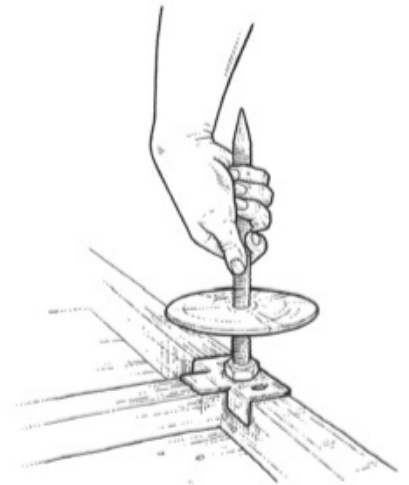
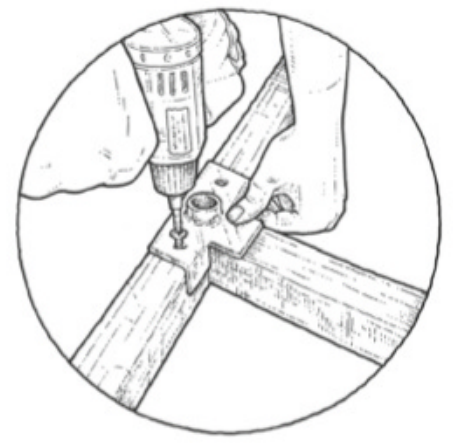
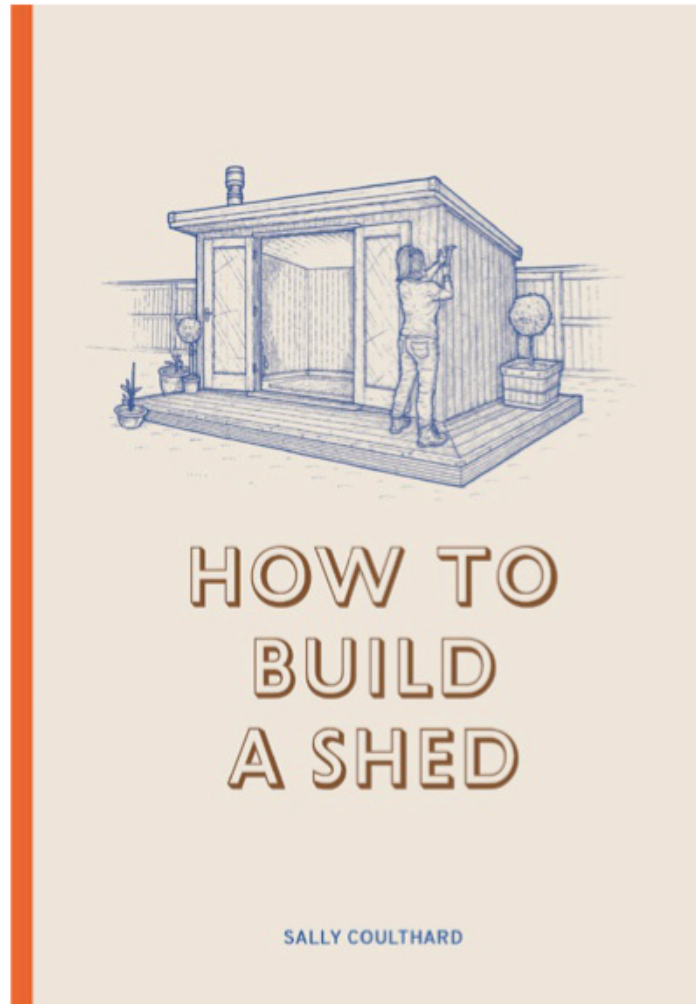
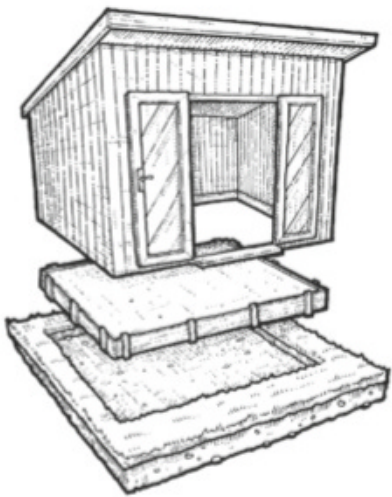
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HOW TO BUILD A SHED

BY
SALLY COULTHARD

Review by Ritchie Wilson

£14.99

Hardback
144 pages

250 illustrations

Size: 220x155mm

ISBN: 9781786272829

Published: 22 October 2018

Published by Laurence King, available at
laurenceking.com

This very nicely bound 144-page book does exactly what it says on the blurb — it describes how to build a 2.4x3.6m (8.64m²) outbuilding.

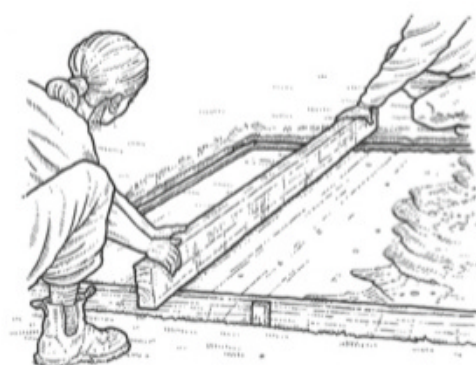
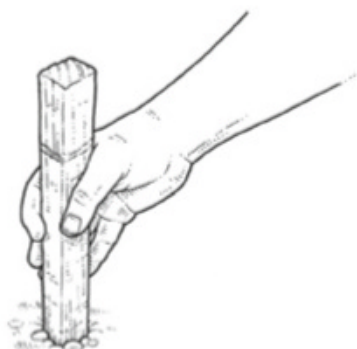
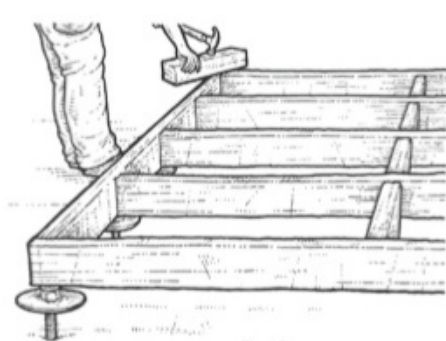
Sally Coulthard, who is a British designer and writer, uses her shed to write in, but it would be suitable for numerous purposes. She assumes that her readers have absolutely no experience of construction and gives detailed instructions for even the most basic aspects of the process, which she refers to as “the build”.

Most readers of *The Shed* would know how to drive a nail, but if they didn't section 2.6 of the Shed Skills section, titled How to Hammer, would be useful. There is actually not much hammering needed because the cladding is put on with a nail gun, and the framing timbers are fastened together with Pozidriv screws in pre-drilled holes.

This is a major departure from the way that framing is usually assembled in New Zealand, being much more laborious, but having the great advantage for inexperienced builders that professional levels of accuracy can be achieved.

No permit required

Other departures from normal practice include the use of adjustable metal piles for the foundation, the breaking up of the rear wall and the roof framing into smaller modules, the framing of the floor and roof prior to installation (similarly to the walls), and the use of EPDM (ethylene propylene diene monomer) rubber sheet for the waterproofing of the roof. All these are to allow someone weaker than your average chippie to do the work needed, although it is suggested that it is almost



essential to have another pair of hands in many parts of the process.

In many parts of New Zealand a building permit is not needed for buildings that are less than 10m² and more than their height away from a boundary of the property, and the builder doesn't need to be a licensed professional.

This is a British publication and some of the terms used are different from those employed in our part of the world. Our 'dwangs' are called 'noggings' and the "regularised" timber referred to in the book is what we would call 'planer-gauged' timber. It may be difficult to purchase the QuickJackPro adjustable metal piles and a kit of EPDM rubber and adhesive in New Zealand, but the book gives more than one alternative to both of these. Metric dimensions are used throughout and the timber used

for all the framing is the 100x50mm treated pine used universally in construction here.

The great strength of this book is that it would allow a complete beginner who followed the clear instructions to produce a structure that is every bit as satisfactory as a professional job, even if the builder wasn't particularly strong. Every step is spelt out, all dimensions are specified, and the design has been made as simple as it could be. The installation of the French doors (which are the only source of light, as there are no windows) is recommended to be left to a professional because of the expense of the doors. However, if second-hand doors were used the hardware would already be installed and the cost would be much reduced. The installation of electricity or a woodstove are, of course, not possible for the amateur.

Adjust the plans to suit

The author suggests that the dimensions could be changed if needed to produce a larger workshop, but this would mean that the builder would have to calculate the lengths of the framing timbers and a building permit would be required. In Christchurch since the earthquakes, the first step to obtain a permit is to commission a ground-engineering report. These are, to say the least, expensive and then the permit has to be paid for.

An attractive aspect of the book is the line drawings by the very talented Lee John Phillips.

If you would like a potting shed, a studio, or a separate space for a teenager, *How to Build a Shed* will show you (or the teenager) how to do it and to make a good job of it. 📖



Left: "An outcrop (like a box-bayed window)"

Below left: "Into what had become somewhat of a hole"

Right: The lid is the only part in the house

Far right: Wire baskets make better use of space



LATERAL THINKING HELPS TO RUN A FRIDGE OFF THE GRID FOR ONLY A FEW DOLLARS

By Murray Grimwood

In 2004 we moved onto a bare rural block, determined to demonstrate an energy-efficient lifestyle and enjoy the cost savings it represents. Initial power? One 50W solar panel. Not only did we want to run lights and a stereo on that, but we wanted a fridge as well.

I started with the premise that a top-loading fridge is best; front-loaders lose all that chilled air the moment that you open the door (which I count as already-expended energy; it might as well be dollar notes pouring away across the floor).

A dead 65-litre freezer came our way — the bonus being the better insulation freezers have, but the initial downside being a residual whiff of dog tucker. We bought a 12V Danfoss compressor (a unit long beloved by boaties) and bolted it in. A 'fridge' friend sent me off to the recyclers with a shopping list: the biggest evaporator plate (the bit inside the fridge) that I could find, the biggest condenser panel (the bit typically on the back of a fridge) ditto, and a thermostat.

The answer was obvious

The plate turned out to be a little too long, so with heart in mouth (they are made from two sheets of pressed-

CHILLING OUT





The answer was obvious enough — this is Dunedin; leave it outdoors and you've probably halved the average outside-the-fridge temperature

together aluminium) I bent one end in a radiused right angle. The friend worked out the length of capillary tube needed, plumbed and gassed it up, and we were ready to try it out. For a year it lived in an outdoor shed while I built the house — out of cool-store panel, of course! We could only power the fridge intermittently while we evolved everything else, trying out generators, chargers, inverters, and second-hand batteries. But it looked like we were pushing the envelope trying to run a fridge permanently and in-house on 50W of solar.

The answer was obvious enough — this is Dunedin; leave it outdoors and you've probably halved the average outside-the-fridge temperature. Site it on the south side of the house in the permanent shade and there will be lengthy periods when the compressor won't even be needed. But the practicalities of going out the south-facing side of a southern house every time you want milk or mayonnaise, without taking warm air out with you, seemed complicated. Then the penny dropped — only the lid needed to be in the house and the body could be outside. All we had to do was build an outcrop (like a box-bayed window) out over it.



Too easy

Cool-store panel is a doddle to work with — you use a helicopter blade (a miniature lawnmower blade) in a circular saw, set just deep enough to cut the steel skin. Then you turn the panel over and cut the other skin. A short length of MIG wire with a handle at each end is guided by both cuts, slicing the polystyrene like a knife. If your saw cuts are offset by the same as your panel thickness (e.g., 100mm offset for 100mm thick panel) you get a perfect 45-degree chamfer for corners. Inner and outer joiners are aluminium angle, usually powder-coated to match your panel colour

and riveted together. I used 4.8mm blind rivets at about 200mm spacing.

The over-fridge box took a day in total to cut, assemble, place, and attach.

It worked well enough, until I decided to add a layer of 100mm cool-store panel right around the freezer carcass. Good idea insulation-wise, but in shifting the condenser I created a gas leak. This led to frustration trying to get at the works, now buried 100mm further into what had become somewhat of a hole. So it all got torn out and remounted outside and accessibly as it should have been in the first place. ►





Above: Interior of the meat safe
Below: The meat safe framed up
Right: "I used stainless sheet to do the necessary reflecting"



Fourteen years down the track, it's still drawing smiles. Everyone 'gets' it, although I've never seen it copied. There is now a false floor at the level of the old motor-cover step, as it was a little too deep for convenience. Wire baskets make better use of the internal space and a simple hook holds the lid up if you need two hands in there. There's been a blown diode (my fault) and a recalcitrant thermostat (its fault) — but a lot of bought fridges have lived and died in that time. It draws 2A when on duty, which varies from 10 minutes in the hour to zero through many a winter's night.



Postscript

It turned out we weren't quite finished chilling out, though. We preserve a lot of what we grow so at times we needed to keep things cool, but not necessarily fridge cool. We knew the drill: south side of the house, body outside, access inside. And I knew the technology from the past — Granny's old meat safe, green and cream and multi-perforated, is a clear childhood memory.

In a touch of whimsy, I used the oven door off an old Shacklock No. 1 as the inside access door. Otherwise, it's just a box with a single-pitch roof, framed in aluminium angle and covered in fly-screen mesh. You'd think that there wouldn't be anything to go wrong with something so simple, and as winter turned into spring, we didn't either. Then the morning sun creeping along the south wall from the east started to touch the east side of the meat safe and did so more and more as summer came on. I used sheet stainless to do the necessary reflecting. Now it's perfect. The space is where we store our in-use condiments, chutneys, butter, and the like — chilled for free and forever. 📄

“Fourteen years
down the track, it's
still drawing smiles.
Everyone 'gets' it
although I've never seen
it copied”



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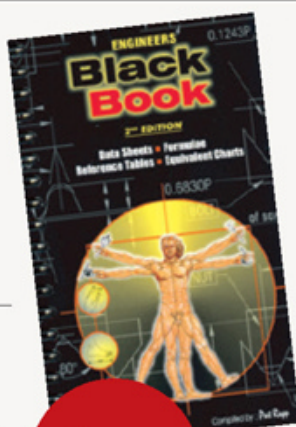
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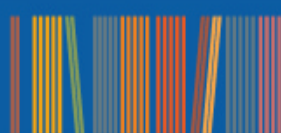
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THE EXACTING PROCESS OF BEING PRECISE

By Jude Woodside

To make anything, you will need to measure something and the progress and ultimate success or otherwise of your project will be determined by how accurate that measurement is. I have often had to shorten or alter something due to a poor measurement and I would bet I'm not alone. It has been said that the mark of a good craftsman is that he can hide his mistakes better than others.

My woodwork improved out of sight after I started using an engineer's square and a vernier caliper. The square for once gave me a true right angle that I could trust, and the caliper was more definitive than using a ruler and the 'eyechrometer'. Engineering is intrinsically more accurate than woodwork, mainly due to their respective materials. Wood is organic and moves with humidity; steel moves with heat, so tolerances, the degree of variation in a measurement, are always tighter in metal.

'Metrology', or measurement, became a science with the development of the steam engine that called for greater accuracy in machining. Simon Winchester's book *Exactly: How Precision Engineers Created the Modern World* outlines the

history in some detail. That book and a recent project that involved a great deal of imperial measurements prompted these musings.

I discovered that I possessed very few imperial measuring tools but the project, a set of speakers, had to be fairly precise in terms of volume and dimensions, as these affect the sound. Metric conversions are rarely precise, as there are always fractions of millimetre left over (an inch is 25.4mm) and these fractions add up and might lead to an accumulated error. In the end I had to buy an imperial drill set.

I have just put my surface plate on a custom stand. It is the most accurate thing in my shop. It's accurate in only one respect: it's flat, and all other measurement derives from that. I can also use it for marking out engineering projects. It's the same, of course, for wood. All measurements should proceed from the trued edge and the flat side that was formed on the jointer. The surface plate is used to calibrate the machinist's level that I use to set up the lathe. The odd thing about the surface plate is that it doesn't have to be level, just flat. Running through any flat plane is a line where the plane is level.

So much of measurement is about relationships. Angles are always in reference to another plane or surface; similarly measurements are always between other elements. It is this interrelationship that can lead to compound errors, especially if the thing you are measuring from is less than perfect. Even the thickness of the pencil line can be a factor in throwing the work out — I have taken to using a carbide scriber for marking steel, and a knife for wood.

While I don't want to appear too OCD about this I confess that I have resorted to using a laser rangefinder in setting components in place. The laser takes the guesswork out of a tape measure in a corner where you have to guesstimate the reading.

You will always have to use your eyes to gauge your precision in some jobs, especially with hand tools like chisels and handsaws. Given the imperfect nature of the human interface there will be discrepancies that will cause errors, but that's the charm of something handmade and precisely the reason we do these things.



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