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MARCH–APRIL 2018
ISSUE 77

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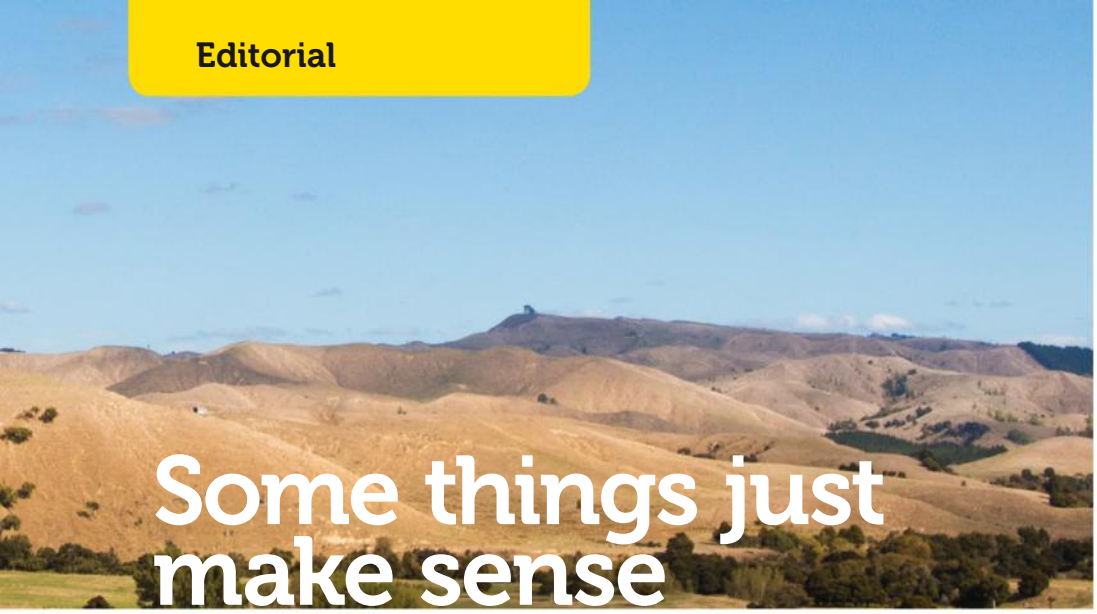

Some things just make sense

There can be no doubt that the weather is right at the forefront of our thinking in our daily life, especially at this time of year. It often leads the TV and radio news bulletins and is no stranger to the front page of the paper.

You can say and think what you like about climate change but there is no denying that, nowadays, we just can't escape the constant weather barrage. It goes without saying that this is not just a media beat-up — many of us Kiwis are experiencing these extreme weather events on a much more regular basis. It's either hotter, wetter, windier, or drier than we have ever known it and it's not going to go away or get better. It's going to get worse. So, what are we sheddies going to do about it?

Our theory is, because we can, we do — or, more important, because we can, we should. Many sheddies have the skills to sort some of our own needs and not be so dependent on infrastructure to completely look after us. If we can ensure that we can have our own water supply we should. If we can ensure that we have our own power supply, etc., then we should. Many of our neighbours can't solve these kinds of issues for themselves, so by sorting ourselves out we are lessening the load on the local infrastructure. To us, it seems logical to look after ourselves when we can. In a crisis, we will be in a position to help others.

Now, I'm not prophesying the end of days (not currently in my skill set) or saying we are doomed, but there is no doubt that we need to make sure we are secure in many more ways that we have been used to for most of our lives. It seems that droughts are now a factor of life every summer. Even if the end is not nigh, it would still be great to keep the garden going strong through the hotter months — there's nothing sadder than wilting veggies and dead flowers.

The result of this thinking is the reason for our main feature this issue — some basic guidance to help you secure your own rainwater supply. Even if you live in a city, setting up a supply is not rocket science and it just makes sense to do so. Tanks come in all different shapes and sizes these days and there are options galore for that awkward space that is the only place you can really install a tank. The options, too, for gathering, cleaning, pumping, etc., are also plentiful and varied. Think about it — you will regret not arranging your own supply every time you get that water bill and for sure that water cost is only going to go one way. If you are not paying for your water now, there is nothing more certain than you soon will be.

So dive into our rainwater feature this issue (page 22), and plan to arrange your own supply before next summer — the resultant saving will have you singing in the shower like never before.

How can that be a bad thing?
Greg Vincent

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THE Shed WHERE DREAMS ARE MADE REAL

ISSN: 1177-0457

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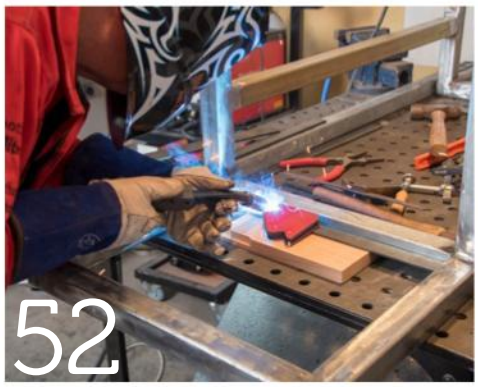

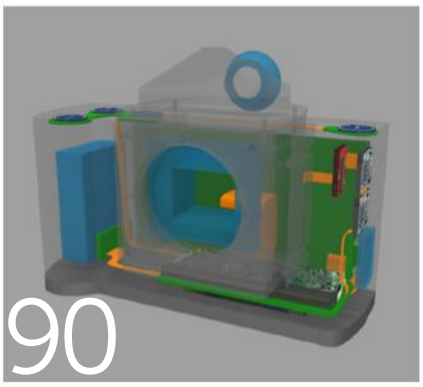

Every issue


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MAKING THE CUT

TWO SOUTH ISLAND SAWMILLERS ARE SOUGHT AFTER FOR BESPOKE TIMBER PRODUCTS AT EACH END OF THE SPECTRUM — ONE USING CHAINSAWS AND THE OTHER TINY HANDMADE BLADES

By Sue Allison

Photographs: Juliet Nicholas

Dave Neame: chainsaw milling

Sentimentality and chainsaws don't usually go hand in hand but Dave Neame uses the machines not to massacre but to preserve pieces of wood for posterity.

The long-time logger, who is based in North Canterbury, uses his prowess with a chainsaw to mill trees into slabs that can be turned into furniture, kitchen benches, or used as building features.

"I get approached by people who've got trees that have sentimental value and they want more than firewood or mulch out of them. I come and mill them up and they can get made into something that becomes a family heirloom," he explains.

Dave's gear

Dave's mobile mill comprises a Kubota tractor and three chainsaws, which he carts around on a trailer behind his Nissan Navara — "That's my shed. I can take it all round the country." He stores his gear in a container in Okuku, but has a semi-permanent set-up for bespoke milling in a macrocarpa grove on a friend's property in nearby Ohoka. A sign nailed high on a tree declares it to be "Dave Neame's Thinking Forest" and, clad in leather chaps and earmuffs, he is probably the only one who can think above the roar of his saw.

> *"That's my shed. I can take it all round the country"*

Dave has a range of chainsaws. His "baby saw", which can cut up to 500mm, is a 92cc Stihl MS661, a fuel-efficient saw with an impressive power-to-weight ratio. His big double-end

Dave also makes signs out of timber slabs. He uses an electric hand router to cut out the letters and images, which he draws freehand, then paints the grooves

Chainsaw chronicle

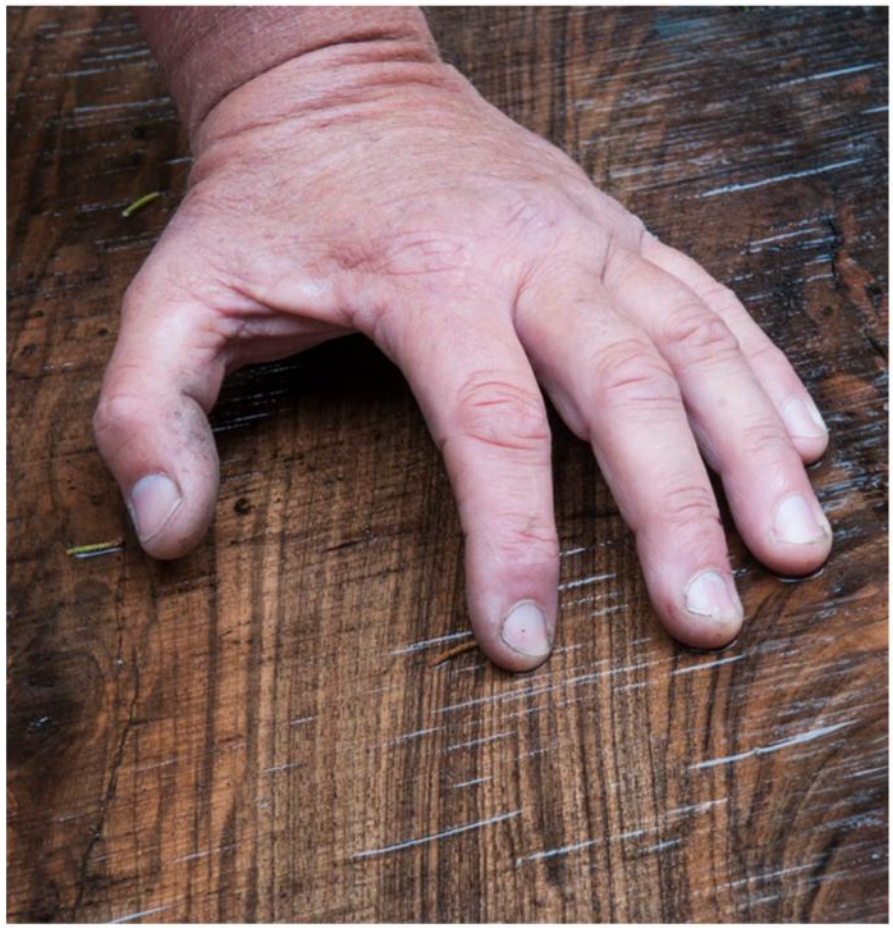
The prototype of today's chainsaw was a hand-operated device used for cutting bone by doctors in the late 18th century. A handle connected to a sprocket wheel turned the serrated chain.

In 1905, Samuel Bens, from California, patented the 'endless chain saw' (a chain of links carrying saw teeth and running in a guide frame) as a means to fell giant redwoods.

The first portable chainsaw was developed in 1918 by Canadian millwright James Shand.

In 1926, Andreas Stihl patented a 116-pound (53kg) electric two-man saw. One year later, Emil Lerp, founder of Dolmar, mass-produced the world's first gasoline-powered chainsaw, the Type A saw, which weighed 125 pounds (56kg).

McCulloch started to produce chainsaws in 1948. The early models were two-man contraptions with long bars, often so heavy that they had wheels.



saw is an Alaskan Mill Mark III. With a contraption with a 92cc Stihl fitted at one end and an MS880 121cc at the other it has a maximum cut of 1.45m. He says, "It was designed for milling in remote places. It needs two people so I usually get my client to help." His third contraption is a vertical saw, also known as a 'saw fish', which has been engineered to cut at 90 degrees to the horizontal.

Old walnut myths

Dave works with a variety of wood, from elm and oak to macrocarpa and windfall natives, but his favourite is walnut. "It always comes up the nicest," he says of the hardwood fruit timber with its distinctive grain and rich colours. But it has a drawback: "I hit nails all the time with walnut. There was an old myth that the more iron you

Process

Dave uses a standard 3.6m aluminium ladder as his guide, bolting it to the timber to be milled with two coach screws. His smallest horizontal saw, a Stihl MS 661, is connected to an adjustable steel frame that allows it to be set to the depth of the cut. The frame slides along the top of the ladder while the blade cuts below it. Wedges are banged into the end and along the length as cutting proceeds to prevent slumping. An oiler has been fitted to drip on the saw tip. Most slabs are cut to around 40–50mm. Hardwoods, like the walnut shown here, can be sliced thinner, while macrocarpa lends itself to a chunkier cut. "This little log is worth $1K milled," says Dave. "It's shocking that timber like this is used for firewood. People don't realize its value."

put into a walnut tree, the more fruit it would bear so they banged nails and even horseshoes into them. That's why sawmills won't touch it."

Nails aside, sharpening the teeth is a tedious part of the job and the chains have a limited life. "I have to sharpen the saw after every slab on a big cut. It takes me about two minutes with a hand file. I've sharpened so many I could do it with a blindfold," he says. "The chain gets hot and deteriorates quickly with continuous cutting like this, so I'll only get about two weeks out of a chain."

> *"I'll only get about two weeks out of a chain"*

In the blood

Dave, born in Greymouth, comes from a family of West Coasters with an affinity for the forest: "My grandad started milling in 1950 at Jacksons doing silver pine for sleepers for New Zealand Rail. It was all done by hand with two-man cross-cut saws in those days."

His father, a bulldozing contractor from the Taramakau, also loved his wood. When he died two years ago, Dave had a piece of 600-year-old rimu he had heli-logged from the area made into his urn box.

Dave cut his teeth logging in Nelson before taking to the air heli-logging. It was dangerous work and while retrieving pine in the Motueka area, the helicopter crashed and burned, killing






the pilot, Pete McColl. Dave, who was lucky to have just got out of the machine, milled the timber for Pete's headstone and his plaque at the crash site.

He then headed to the North Island to do some native-timber contract work before being called up by a Hokitika-based company in 2004.

"I did all their sustainable heli-logging from Nelson Lakes up the Howard Valley through to Maruia." In between logging contracts and private tree felling, Dave started dabbling in one-off chainsaw slab work about 12 years ago. It proved so rewarding that he decided to turn his hand to it full-time and set up Chainsaw Tree Milling New Zealand in 2016.

Interesting scrap timber

As well as milling private clients' timber, he keeps his eye out for unwanted trees, windfalls, and standing dead trees to mill into slabs to sell. "DIY people love it," he says. Wood destined for the firewood heap is often the most interesting. "Logs with a bend in them make fantastic natural bar leaners," he says. "I cut

Dave creates replica manuka mining trolleys using coal wagon wheels from abandoned West Coast mines. They are constructed out of long-length manuka firewood and bolted together to form sturdy decorative garden features.

Drying out

Dave's forest is full of stacks of timber, drying naturally in the elements. The drying time depends on the type of wood and the thickness of the slabs — the rough guide being a year per inch. Dave recently milled 50 slabs from a 90-year-old walnut, timber that will now sit for seven years before it can be used. "Old timers on the Coast told me to leave hardwood in running water for 12 months to flow the sap out," says Dave, but he hasn't tried it.

10 out of two big pine logs that were otherwise worthless and sold them all to a Christchurch pub."

Dave has also been called on by people who have lost trees or had to abandon their properties after the Christchurch earthquakes. "I've done a few trees in the red zone. People like to take something away with them and use it in their rebuild," he says. "One lady approached me about a walnut tree the family had grown up with that had been wrecked in the quakes. I milled it up and she was over the moon. She had platter boards made for their daughters as keepsakes and her husband even got a 20-litre bucket of sawdust out of it to smoke his fish. If that's not sustainable I don't know what is."

Wood destined for the firewood heap is often the most interesting

Dave's guide to cutting huge beams with a chainsaw!

Dave milled these huge 100-year-old Douglas fir beams on a private property in Geraldine, where they were used for an outdoor entertainment area. At 9.5m long and 400x400cm square, it was a massive undertaking and one not possible for a sawmill. "Your first cut is the most important," says Dave. "We had to get everything dead level with string lines. We basically did it by joining a whole heap of scaffolding planks together. After we had taken off that first cut we used the ladder." He used his vertical saw for the sides, again using string lines to mark the right angles. "It took a day per beam and we did three beams."

Lloyd Knowles: sawmilling

The smell of macrocarpa and scream of saws greets visitors to a family-run sawmill up a valley behind Motueka where Lloyd Knowles specializes in making one-off timber products, often with intricate profiles, for do-it-yourself builders, renovators, and furniture-makers.

"We make a whole range of stuff, from weatherboards to architraves, as well as replica mouldings using different profiles. We just make a pattern to fit whatever they want. 'Negative detail' is the flash term," says Lloyd, who runs the business with his wife, Diane. Most requests for bespoke work come from Golden Bay and Motueka. "A lot of people around here are doing their own building now, especially baches."

Lloyd's father ran a small mill on the property in the 1960s before turning to tobacco farming. "He made the mill up from parts, starting with derelict steam-driven machines hitched to a tractor and adding electric motors. The gorse grew up through it and you couldn't even see the sawmill when I got there," he says.

"A lot of people around here are doing their own building now, especially baches"

Lloyd was working as a joiner in Motueka in the 1970s before hanging

Above: Lloyd makes all the knife steels by hand, cutting new ones to specific profiles if they are not already in his collection. It takes a good eye and a fair bit of maths to replicate the negative detail of samples to be copied. He has 200 little patterns and drawers of curved knives and set-up gauges in the workshop

up his hammer to resurrect the mill and build a house. “I made all the windows and cupboards before I left, then just had to build a house to put them in and hope they fitted,” says the droll sawmiller, who claims that he built the house, where he and Diane raised their family and their daughter now lives, with a skill saw.

Fruit boxes

In 1985, he transformed an old lean-to barn below the house into an operational mill and from small beginnings grew it into a boutique business that now employs a full-time staff member as well as the couple and their son.

“We started out making pallets for the kiwifruit industry,” says Lloyd. “Next they wanted trays. Little boxes out of thin bits of wood. One year I

Right: He fits his homemade knife steels to the cylinders (you can see a couple to the far left of the photo), which are then attached to the machine and shape the timber in one pass

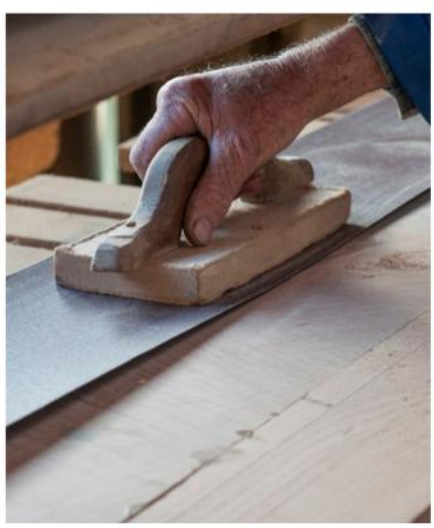
From logs to lumber

Technology may have changed but the milling process remains much the same. A sawyer uses a 'head rig' (or 'head saw') to break the log into 'cants' (partially processed logs with at least one cut surface). The irregular surfaces are trimmed, or edged, leaving four-sided lumber, and the ends squared to length. Lumber must be dried before use to remove the natural moisture. It can be stacked to dry naturally, a process that can take several years, or kiln dried. Once dry, the timber is planed to smooth the surface and give a uniform width and thickness, and any embellishments or profiles can be worked.

"It can be a challenge. It takes a lot of time to set it all up and make a few bits of timber"

made 44,000 of them. We got two or three years out of that before they went to cardboard."

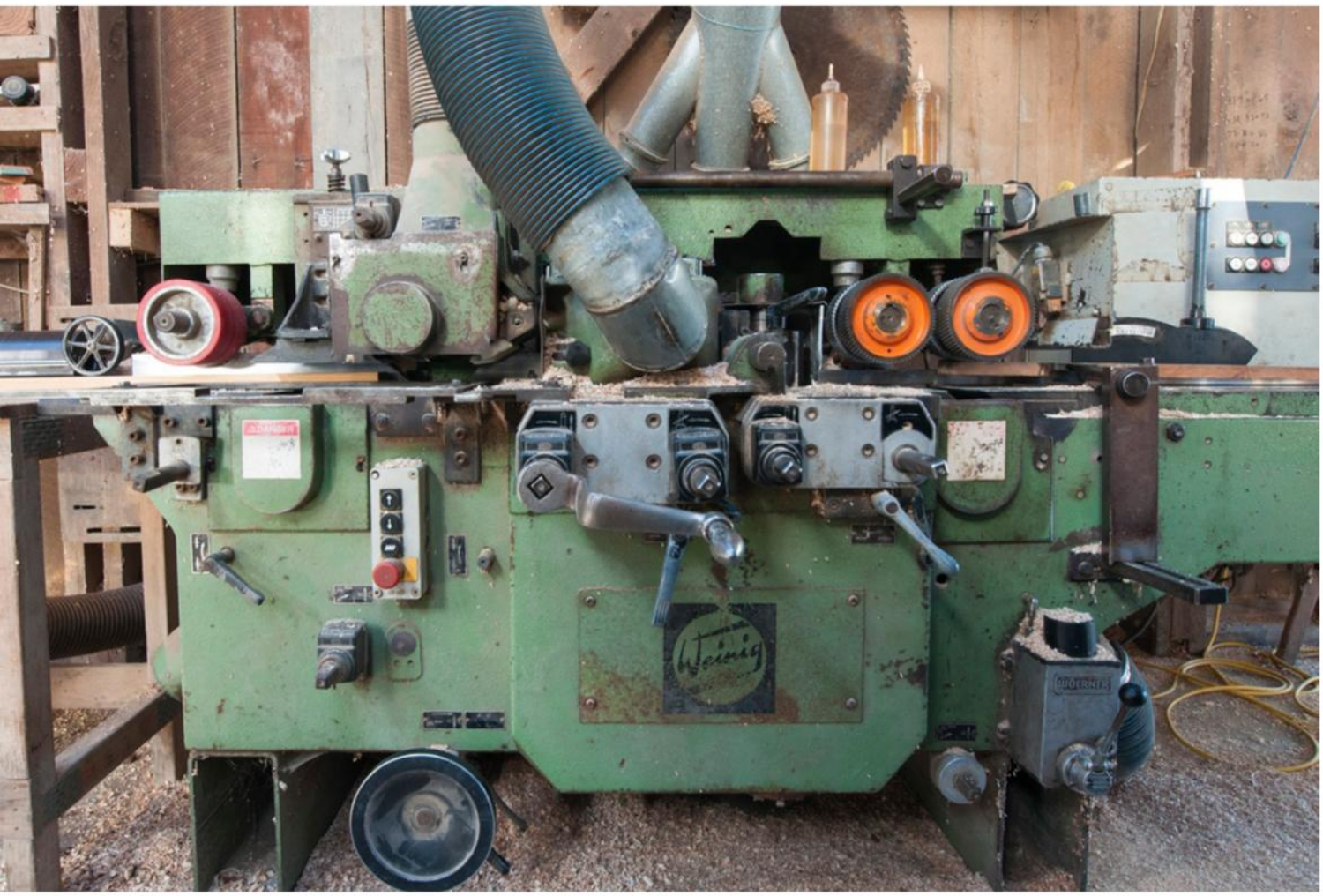
Garden trellis was their next bread-and-butter line. "We made miles and miles of that, then started doing tongue-and-groove with an old four-sider. It's a museum piece now," he says. "Once we got this high-speed machine, we were away." The Weinig four-sider sawmilling moulder acts like a giant router, with moulding blades attached to cylinders to shape the profiles a bit at a time. Lloyd cuts and files all the blades, or knife steels, to shape by hand.



No job is too small but Lloyd admits to losing a bit of sleep over fiddly jobs. "It can be a challenge. It takes a lot of time to set it all up and make a few bits of timber," he says. "People restoring old houses will bring in a sample and ask for so many this long and so many that long. We've just done four 27cm pieces of detail for a tile edging."

Hand-built belt sander

They keep a stock of dry timber stacked and ready to use, including macrocarpa, poplar, pine, and lawson cypress, as well as native beech and rimu. ▸



Above: Sharpening and 'setting the teeth' of the saw blades are time-consuming. Lloyd uses both machine grinders and hand files to sharpen the blades, and a spirit level-type device and gauge to measure and adjust the angles of the teeth. If any teeth are out of line, the saw will chew the wood. "I can get round a big blade in about 10 minutes," says Lloyd. The saw blades last about five years if sharpened correctly, which essentially, over time, moves the teeth around the circumference

Above right: Lloyd's very-old-but-still-very-effective sanding belt

Right: All the Knowles' machines are hooked up to extractors, which suck the sawdust up chutes and into bins outside. "It's handy having a farm, because it can be a problem disposing of it," says Lloyd, who dumps it in pits, being careful to keep any treated sawdust separate. It is also used for calf bedding by local farmers and compost by gardeners

History

Before the invention of the sawmill, boards were split ('rived') and planed or sawn by two men with a two-handled whipsaw. 'Saddleblocks', or 'dogs', were used to hold the log in position over a sawpit. It was exhausting work, especially for the top sawyer, who had to balance on the log, guide the saw, and didn't have the pitman's advantage of gravity.

Early sawmills adapted the whipsaw to mechanical power, generally driven by a waterwheel. A connecting rod known as a 'pitman arm' (the origin of a term now widely used) converted the circular motion of the wheel to the back-and-forth motion of the saw blade.

Circular-saw blades were invented around the late 17th century. 'Gangsaws', which had several parallel blades so that a log could be reduced to boards in one step, soon followed. Circular-saw blades were prone to damage by overheating or dirty logs, giving rise to a new technician, the sawfiler, whose job was to set and sharpen teeth.

Mills became highly mechanized with the advent of steam power in the 19th century, and further so with electricity. Most aspects of sawmilling are now computerized.

Right: Lloyd insists timber needs air to dry correctly
Below: Many of the tools in this shed are decades old - but still as reliable as the day they were new

Most of it is plantation-grown or windfall, though a lot of people bring in wood from their own properties to be machined. Dryness can be an issue with privately supplied wood. "People have often stored it in sheds under plastic so it isn't dry enough. It's got to have air," says Lloyd, who sometimes stacks wood in the office to speed-dry timber. "It's my kiln," he says.

The Knowles have built up an array of heavy-duty equipment over the years, much of it adapted from the early milling days. There's nothing shiny in this shed and barely a shred of plastic in sight. The oldest saw still has its original Cadillac gearbox. Lloyd reckons his hand-built belt sander, a "relic" in leather and wood, does just as good a job and is more reliable than its modern counterparts.

> *"Most of it came out of the ark. The whole site really needs to be turned into a museum"*

"Most of it came out of the ark," says Lloyd. "The whole site really needs to be turned into a museum."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Going for gold

By Sarah Beresford

A KIWI EXCELS IN A WORLD-CLASS COMPETITION FOR TRADIES

It's enough of a buzz to have the skills you've developed as an apprentice recognized nationally but to win international plaudits launches the thrill level into the stratosphere.

Aircraft engineer Jarrod Wood is familiar with the excitement of having his skills acknowledged after winning both regional and national WorldSkills competitions for aircraft maintenance. He crowned this achievement by winning the gold medal in his field at the recent international WorldSkills competition in Abu Dhabi.

"It was a truly amazing experience," the Air New Zealand aircraft maintenance engineer says of attending the event. "I was blown away just to be there and wasn't expecting to win, so that was just the icing on the cake."

Jarrod says that he still finds it hard to believe he was so successful in the face of such tough competition.

"We had to compete in seven modules over a period of four days. The modules all had allocated time frames of between two to four hours. There were apprentices from 16 countries competing in my category in everything from flight-control rigging to component changes and it was really intense."

Jarrod says even the size of the venue and the number of spectators was daunting. "I have competed in the regional and national WorldSkills competitions here in New Zealand but the atmosphere in Abu Dhabi was on another level. It's basically the Olympics for trades. The venue was three to four times the size of the ASB Showgrounds in Auckland and there were more than 125,000 spectators so the scale of the competition was amazing. It was nerve-racking."

He says that he kept tension at bay by focusing on the task at hand and keeping in mind on the tips given to him by his mentor, Mike Naus, who is the WorldSkills aircraft maintenance deputy chief expert in New Zealand.

"Mike was great — we had reviews about how each day went and how I felt I was tracking, which was really useful to get some perspective. I've had so much support from the staff of Air New Zealand all the way through my apprenticeship — you're always under the pump at work but there's nothing quite like doing a job under the eyes of judges," he says laughing.

The 25-year-old from South Auckland always knew an office job was not for him and initially thought that he might train as a car mechanic until he became fascinated by complex aircraft systems. When he left Sancta Maria College he worked as a baggage loader at Air New Zealand for a year before joining the Aviation Institute and starting his apprenticeship in 2013.

Jarrod was among 13 other New Zealanders who flew to Abu Dhabi to compete against 1500 competitors from 76 countries in 51 skill tournaments at the event. As well as the gold medal Jarrod was awarded Best in Nation for scoring the highest points among all competitors from New Zealand.

"New Zealanders really punched above our weight in the competition. We weren't the underdogs but we don't have the backing and sponsorship that some of the teams enjoy. For instance, France was sponsored by Adidas. There are international scouts that attend the event who focus on some of the trades and are on the lookout for promising new talent."

Jarrod says that he has now finished his apprenticeship and his next goal is to share the knowledge he has gained with the next competitor in the event, which is held every two years.

"Competing in WorldSkills has increased my skill level 10-fold and I'm much more confident. Overseas it is well known and enjoys a very high profile. In New Zealand it's sort of kept under wraps and it deserves more recognition. WorldSkills offers so many opportunities and has great potential so it deserves to be under the spotlight."

Teng Tools socket set prize draw

Congratulations to Bryce Glifford who wins a Teng socket set with this entry. This competition ran in the last issue of The Shed, issue #77

"I am currently at home off work sporting a broken leg due to falling out of my garage roof. I was obtaining some two stroke motorcycle wheels stored in the roof space above in early December. (I am not a happy camper, the disruption to Christmas Holidays and New Years etc has been far reaching to say the least).

I hit the concrete at 8.25m/sec, when two seconds later the wheels in question fell the 2.4 m onto my already crumpled pelvis and ankle while I was lying horizontal across my ladder. It was Keystone Cops all over again.

No cell phone to hand, no neighbours handy and no one home as everyone was overseas on holiday in Greece and Italy. I clearly missed the Health and Safety Lecture before my better 7/8th flew out to sunny Greece. (I have enough for a short novel should you need an article on what I learned)

One photo here shows the dismantled Villiers two stroke engine which hopefully soon will look like the other photo when its restored. Then it will go into my 1954 Excelsior Roadmaster 197cc motorcycle that I am restoring.

The Teng Set 34 pc or the 30 pc set would be fine should I be worthy, as some of my gear is looking a bit ropey after 30 odd years working on bikes. But preferably an AF set because the motorcycle in question was built not in the metric age but in the imperial age.

Many thanks, great issue this month too."

Flattery always works with us Bryce! We'll be in touch soon to arrange delivery.

Letter of the MONTH

Jakob's hut

Over last winter my eight-year-old grandson and I built a hut for him in his parents' backyard. Before we started I turned to two back issues of *The Shed* magazine (August/September 2013 and April/May 2015) to get some guidance. I wish to acknowledge and thank the contributors of the two articles (Build a Playhouse and Child's Play). Between them they started us off in the right direction.

We thought that you might like to see some photos of the final result. My grandson Jakob had a very good idea of what he wanted. Among the requirements [were that] it had to have a porch, windows that opened and closed, a table to work on, and a bunk. In place of the last item we installed a hammock, which is much more practical in the small space available. It has been assembled so that it can be taken apart and reassembled somewhere else in the future. The main issue for me was to get the height right – not too high for an eight-year-old but still high enough that he could still use it in his teens. Also we were limited in space to 2.4m wide by approximately 3m long.

It was a joint effort, with him helping much of the time. There were many good things that happened during the project, most important of all was quality time spent together. The final result is worthwhile and he will be able to benefit from it for some time to come. In the process he learnt many useful things that he will be able to use in the future. Sure, it was not safe for him to use all the equipment, such as power saws, but he learnt what they are used for and the safety issues around them. Jakob learned how to use a battery-powered drill and drilled many holes for me to follow putting in the screws. He also learned about the hand tools, their names and their uses, and was able to use many of them on the project. The final job was to help with the painting.

Jakob learned a little about first aid during the project. One day he grazed one of his fingers and it bled a little bit. He came to me and said, "Grandad I've cut my finger." I had a look at it and said, "It will be alright, just suck up the blood, it will be fine and carry on." He did not accept my first-aid assessment and treatment. He said "I don't like the taste of blood." I asked him if had tasted blood before. The answer was in the negative. I suggested that he toughened up a bit. His response was: "I'm not tough like you, Grandad" and he rushed off to get some TLC and sticking plaster from his parents. On the last day of the project I slipped with the screwdriver and it shot into my finger. It was one of those shallow cuts that really bleed a lot, the blood was dripping off my finger in seconds. My grandson said, "Never mind, Grandad, be tough, just suck up the blood and carry on."

Tom Nimmo

Nelson

The winner of the Letter of the Month wins this fine Channellock Fastener set.

Channellock has put together this fastener set, made in the US since 1886 by forging high-carbon steel. Tradesmen have enjoyed the Channellock Blue grips for the comfort of use and the undercut tongue-and-groove design, which won't slip. The Permalock fastener eliminates nut-and-bolt failure, while the patented reinforcing edge on the channel minimizes stress breakage.

The set includes models CH420G, CH426G, and CH440G (9.5 inches / 240mm, 6.5 inches / 165mm, and 12 inches / 300mm) straight-jaw tongue-and-groove joint pliers.

The set is available from all plumbing and engineering stores (RRP $120).

Letters should be emailed to editor@theshedmag.co.nz, or posted to Editor, The Shed *magazine, PO Box 46,020, Herne Bay, Auckland 1147.*

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MARLEY®

rain, rain, come again

PRESERVING OUR MOST PRECIOUS RESOURCE PRESENTS SOME DISTINCT CHALLENGES

By Jude Woodside

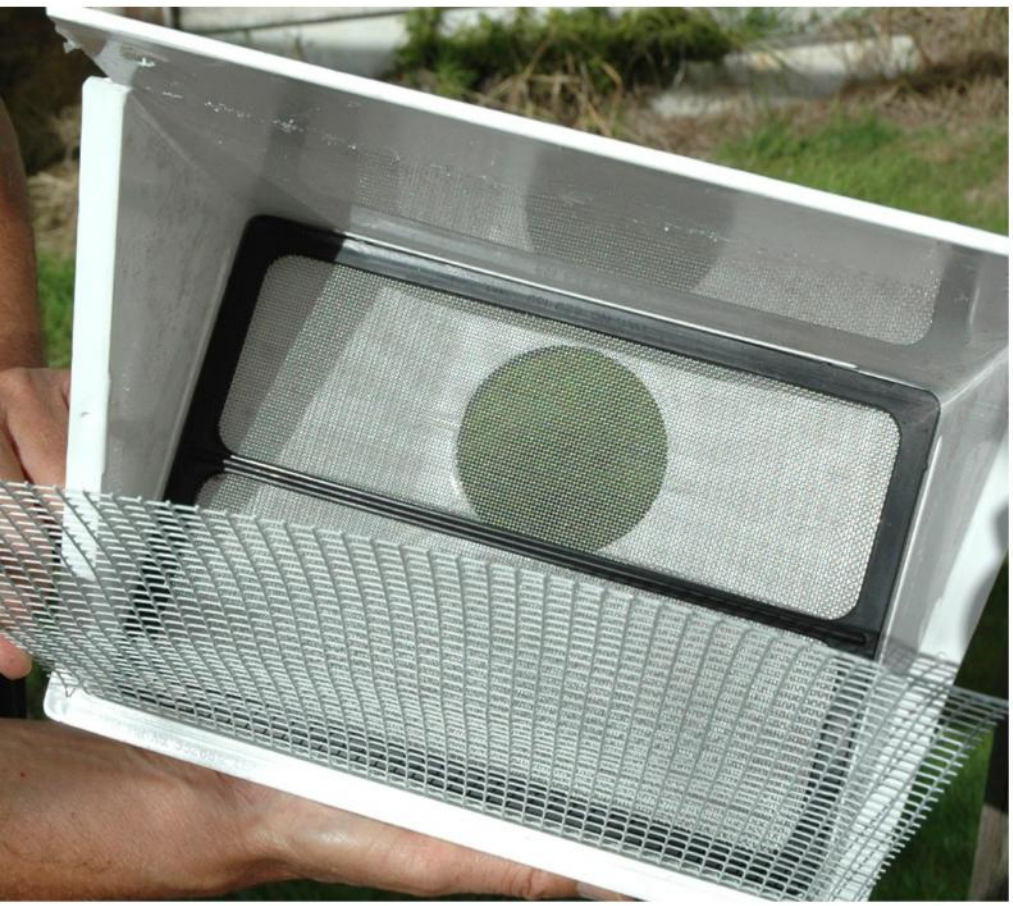
Photographs: Jude Woodside

Water is becoming political; it won't be long till we are taxed for it or paying for how much we use. Climate change will only exacerbate this as droughts become more frequent.

It will soon be incumbent on all of us to preserve and reuse water. That is already the case in Australia where many states insist that new homes have water tanks, and grey-water tanks are often mandatory too. In New Zealand around 10 per cent of the population relies on tank water, mostly rural or coastal properties. Others use tank water to supplement their town supply for gardening and other purposes especially where usage is monitored and charged.

Mandatory harvesting

New Zealand is blessed with ample supplies of water, in the main, but even we can suffer from seasonal shortages in regions according to the weather. The east coast of both islands has quite significantly reduced rainfall compared with the west coast or central regions. In areas where the water supply is problematic or will require large investment in infrastructure to secure in the future, some district councils such as Kapiti have passed by-laws so that all new dwellings from 2008 on must have a 10,000-litre rain water tank or a 4000-litre rain water tank and a grey-water diversion system. ▸



The case for mandatory water harvesting is gathering momentum

Left: The rainhead fitting with both screens fitted

Below left: The stuff you don't really want in your tank

In parts of Australia it is mandatory to have water-storage tanks in any new building consent and grey-water diversion is encouraged too.

The case for mandatory water harvesting is gathering momentum. In an age when we are urged to conserve resources as much as possible it seems fairly ludicrous to be using treated potable water for flushing the toilet. In fact only a small proportion of our water supply is used for purposes that require potable water: drinking and personal washing — we drink or cook with only five per cent of our water. The rest goes on showering, washing clothes, flushing toilets, watering the garden, and cleaning the car, etc. — tasks which could just as easily be accomplished with harvested water. In fact flushing the toilet could reuse grey water from the shower or washing machine, but that's another story.

Gather 500 litres a day

Depending on where you live in New Zealand you can collect around 180,000 litres per year or an average of 500 litres a day for an average 150m^2 house, where rainfall is around 1200mm annually as it is in Auckland. Around 80–90 per cent of this can be collected, with the rest being lost to evaporation or spillage. In an area that charges for water consumption — both supply and waste, as in Auckland — it makes good sense to take advantage of the free stuff and use it for things that can offset the metered usage such as watering the garden or cleaning the car.

Installing a 35,000-litre tank that is sited on the ground on a suitable substrate does not generally require a permit or resource consent although it pays to check with your local authority. Bear in mind that that 35,000-litre tank

Above: Attaching a rainhead

Far right: Fitting a downpipe first-flush diverter

holds 35,000kg (35 tonnes) of water so try to position it on a dry substrate in an area where it will not sink into the ground with the first decent rain in winter.

Cleanliness

Where water is reticulated in regional towns and indeed in some cities, its purity is not always guaranteed, as the residents of Havelock North recently discovered. The same can be said of water harvested from your roof. But if the cleanliness of reticulated supply is suspect that stuff washing off your roof is even worse. Too often we are simply creating a tank of pathogens that we then blithely consume. A survey of 560 tanks taken across the country over five years up to 2006 by Massey University showed at least half of the samples exceeded minimal acceptable levels for contamination, and more than 40 per cent of samples showed evidence of heavy faecal contamination. That study was conducted by the Roof Water Research Centre at Massey University in Wellington headed

by microbiologist Stan Abbott. He is an enthusiastic supporter of urban water harvesting, both to offset the waste of potable supplies and for emergency situations.

Of course those who have lived with tank water for years will claim that "it never hurt me" and that may well be true but it is unlikely be true for your visitors. You may indeed be immune to some of the pathogens in your tank, but not all — a recent Food Safety Authority study showed that there is significant under-reporting of illness related to tank water. In fact less than a third of people who became ill due to contaminated water were reported to health authorities.

Most of the disease-causing pathogens come from the roof and are delivered in the first flush of rain that washes all the recent bird and small-mammal faeces and decaying plant material in the gutters and microorganisms that are present in road dust on the roof into the tank. Bird faeces carry a variety of microorganisms including the ubiquitous *E. coli* but they can also host *Salmonella*, *Campylobacter*, and *Cryptosporidium*. Most of these thrive in warm tank water but can survive even in cold weather. ▸

Top: (Left) Dripper washers. These regulate how quickly the diverter will empty. (Right) An internal filter to prevent the dripper from getting blocked

Above: The washer fitted to the end cap

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Above: Showing how the ball valve works blocking the diverter

Left: Fitting the ball into the diverter

Primary treatment

Of course you can filter and treat the water after harvest but most of these pathogens can be simply avoided with some simple precautions. The most obvious should be a first-flush diverter, a tank that collects or diverts the first few litres from the roof, and allows this to drain away. The first flush from rain will contain all the accumulated road dust and dried bird faeces that have settled on your roof since the last rain. In fact the Massey University study found the first-flush diverter to be the single most effective method of maintaining good water quality.

Most first-flush diverters work by having a cylinder that can contain between 50 and 100 litres of water. There is a ball in the unit that rises as the diverter fills until it eventually blocks the intake and lets the remaining water run to the tank. Prior to the first-flush diverter it is wise to include a leaf screen that ensures that the diverter does not get clogged with leaves or other rubbish. The diverter will slowly release the water or it can be drawn off for watering the garden.

> *Of course those who have lived with tank water for years will claim that "it never hurt me" and that may well be true but it is unlikely be true for your visitors*

Tank fittings

Within the tank, pathogens and microorganisms will gradually fall to the bottom, as will any algae and other impurities. The layer at the bottom of the tank is typically an anaerobic layer that is often low in dissolved oxygen. Water entering the tank should do so

The completed downpipe diverter

Typical water usage in the home

Usage	Litres
Cleaning teeth	5
Bath	100-200
Shower	30-100
Toilet (Half Flush)	6
Garden Hose (On Full)	50/minute
Dishwasher	25
Washing Machine (Top Loading)	100-200
Washing Machine (Front Loading)	70-85
Dripping tap	60,000/ year

Above: Cutting 300mm pipe for the standalone diverter

Below: Bevelling the cut end of the pipe

Right: Gluing on the end cap

Above: Adding the first stainless-steel filter … Left: … and the second plastic filter

> *In fact the Massey University study found the first-flush diverter to be the single most effective method of maintaining good water quality*

through a calmed inlet set above the base that prevents the incoming stream from stirring up this material and making the water turbid. The output of the tank is ideally taken from the water at the top of the tank where it should be relatively clear and clean. This is often achieved with a floating intake that ensures the output is taken a controlled distance from the top of the water column.

A siphon is generally used to spill water when the tank is over-full. This is a pipe with a bend that runs from the base of the tank's interior to the outside. The top of the siphon bend has a hole. When the water level covers the hole, the siphon starts automatically and will tend to suck up debris off the base and from the anaerobic layer first rather than spilling the cleaner water at the top. When the water level drops and uncovers the hole again and air enters the siphon it will automatically stop to avoid the entire tank being emptied.

Getting started

If you are setting up your rainwater-harvesting system for the first time or thinking of modifying your present arrangement in light of what we've just discussed, here's how to do it.

(This is a revision of material we published in 2008 in a similar article. It utilizes mainly Marley products. David Oliver, the business development manager with Marley at the time, presented it for us. Marley makes a comprehensive collection of rainwater-harvesting accessories that make the business of securing your water supply straightforward.)

Rainhead

Assuming your guttering is installed correctly with adequate fall, first calculate the amount of water that needs to be diverted to the first-flush diverter (see First-Flush Calculations panel). There are two options — you can either flush into a downpipe collector from the gutter or into a separate freestanding cylinder, ideally near the tank. The latter is useful for larger roof spaces and larger flushes, especially for areas near the coast or where birds might be a problem — do you have a pigeon fancier as a neighbour?

You must install a rainhead with a leaf screen; this needs to be installed as high

as possible under the eaves. It's the point where the gutters meet. The mesh on the leaf screen is less than 1mm to stop mosquitos and insects getting though into the tank. There is also a wider secondary mesh to collect leaves and other larger debris before the fine filter of the rainhead. The mouth of the rainhead is intentionally wide to cope with a sudden dump of rain in a storm. There are other leaf screens, including the Marley curve, but the rainhead has the most comprehensive filtering. It pays to have some kind of debris-filtering system in your gutter too, either one of the many gutter screens or bristle filters to eliminate most of the debris at source.

First-flush diverter

If you wish to make your first-flush diverter in the downpipe from the rainhead, fix a T-shaped connector at the outlet of the rainhead to the diverter. The diverter chamber can run off this if it is a small diverter. Alternatively, run the outlet of the rainhead to the tank and install the diverter to a separate post closer to the tank. The diverter itself contains a plastic ball that floats upwards as the diverter fills, until it eventually blocks the inlet. As the diverter slowly leaks it will, from time to time, need to be refilled with the run-off from the roof but this will only be a very small part of the flow. ▸

Fitting the bracket to hold the diverter to a post

First flush calculator

To calculate the safe amount of water to divert from the roof, Marley recommends the following formula

Roof area x pollution factor= litres to divert

The pollution factor varies with the environment:

- Minimal Pollution (open field, no trees , no bird droppings and a clean environment) Use pollution factor 0.5
- Substantial Pollution (leaves and debris, bird droppings, insect matter). Use pollution factor 2.0

So for a house with a roof area of 120 sq metres in a low pollution environment would require 120 x 0.5= 60 litres diverted.

From the table you can work out the length of pipe required for the first flush diverter.

Pipe volumes

Product	Length of chamber	Volume in litres
90mm First flush diverter	1 metre	5.7 litres
	2 metres	11.4 litres
	3 metres	17.1 litres
300mm First flush diverter	1 metre	
	1.5 metres	112 litres
	2 metres	147 litres
	3 metres	218 litres

Attaching the first-flush diverter

The diverter tank empties via a drip filter attached to the end of a secondary mesh filter in the tank that makes sure the drip hole is not blocked by debris. Marley supplies a variety of filters with different-sized holes that will cause the stored water to drip at different rates. There are usually two filters: one larger one made of stainless-steel mesh to clear the larger material, and a finer one to trap anything that got through the first one. It's a good idea to clean the filter at least once or twice a year. Larger diverter tanks can be made using 300mm pipe cut to size.

Marley makes a kit that only requires you to supply the 300mm pipe of your choosing. A galvanized bracket is even included in the kit to secure the tank to a post or a wall — the tank will have to hold upwards of 70–150kg depending on how big it is.

Cut the 300mm tube with a fine-toothed saw or an angle grinder with a thin blade and bevel the edge of the cut end so it makes a better seat for the solvent cement to mate to the caps at either end of the pipe. You can attach a hose to the end of the diverter and use it to empty the contents later on the garden.

Sterilization

These measures will ensure that what is going into your tank is as clean as it realistically can be. It is worth considering adding other filtering and cleaning devices after the output too. The

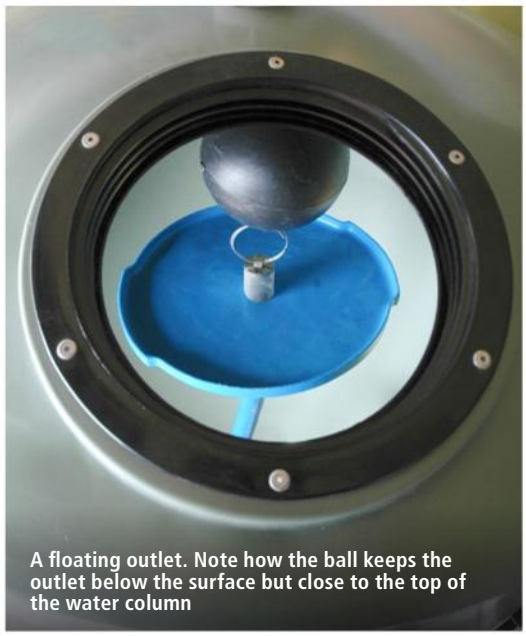
> *It is worth considering adding other filtering and cleaning devices after the output too*

gold standard is ultraviolet tank-water filtration, in which the water is exposed to high levels of ultraviolet light that will kill any parasites of microorganisms and even some viruses.

But there are alternatives, such as carbon filters and under-sink filters, that are very effective at removing contaminants. The drawback with these is they must be replaced periodically, but the cleaner the water supply to them is, the longer the filters will last.

Cleaning or painting

If you are doing roof improvements, cleaning your gutters, or painting the roof, do remember to disconnect the roof connection to the tank first.



A floating outlet. Note how the ball keeps the outlet below the surface but close to the top of the water column

Attaching a hose to the outlet — the wastewater can be used on the garden

INNOVATIVE WATER HARVESTING PRODUCTS

DON'T GET CAUGHT OUT

Supplementing your water supply by harvesting nature's reserves can really save on water costs, but in those drier months it can be a struggle to keep anything in reserve. The Hansen Rapidflo Rain Relief Valve is your insurance against an empty tank. Designed to supplement your rainwater tank by 50 or 100mm from an alternative source when your water level gets too low, it will ensure that you always have water on hand, but also allows enough space in your tank in case rain is on the way.

Visit www.hansenproducts.co.nz for your local stockist and more info.

SWITCHING UP

If you're keen to reduce your water usage by making the most of nature's generous supply, you may want to consider the benefits of using rainwater alongside your mains water, and the products that can make that happen seamlessly. The Rainsaver MK4E and MK6 switch-over devices are designed in Australia, where water restrictions mean that by necessity, they're serious about their water conservation.

These devices automatically switch to the mains supply when your tank gets too low. Switching between rainwater and mains also maximises the efficiency of your rainwater system by sending your free rainwater to your toilets, laundry, and garden, reserving mains water for drinking and cooking.

The Rainsaver MK4E, the company's premium water-harvesting system, is ideal for large homes and commercial applications, using a tank-based float for positive switching, and pumping up to 100l per minute. These pumps include a 24-hour automatic pump restart, which switches back to tank water once the tank is refilled by rain.

The Rainsaver MK6 is an economically priced mechanical switch-over device requiring zero power supply. The unit uses differential pressure to make the switch, and checks every 24 hours to see if water is available to harvest.

The MK4E is $560.75, with a compatible pump ranging from $685–$1,295, and the MK6 and pump package costs between $940–$1,585. To find out more, visit whiteint.co.nz.

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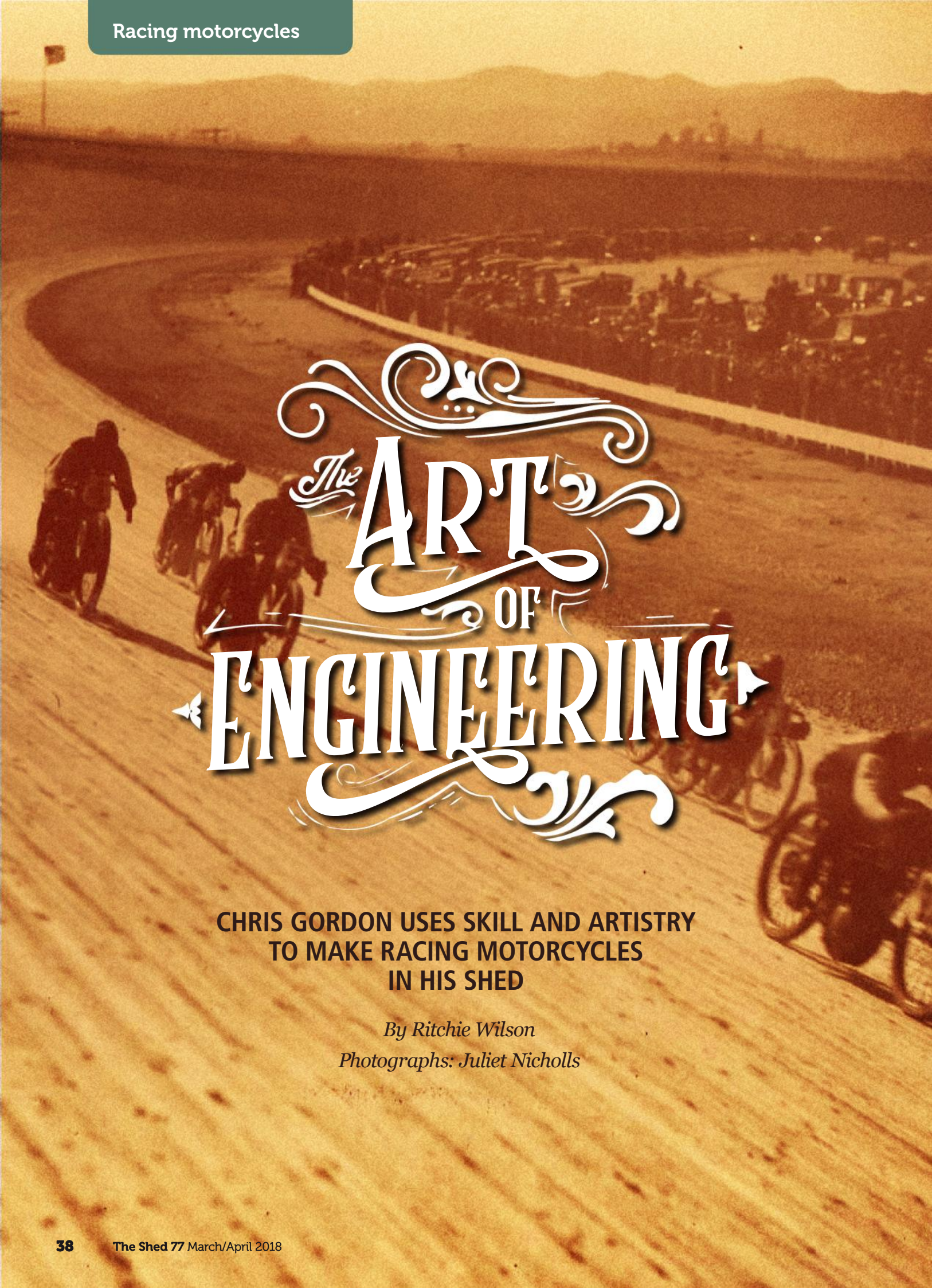


The Art of Engineering

CHRIS GORDON USES SKILL AND ARTISTRY TO MAKE RACING MOTORCYCLES IN HIS SHED

By Ritchie Wilson

Photographs: Juliet Nicholls


3

Chris doesn't race bikes himself, he enjoys building them

Chris Gordon has been devoted to the internal combustion engine since his earliest days when his next-door neighbour was a motor mechanic.

At 14 he was a crew member for Ron Collett, who successfully ran a Top Eliminator class dragster at strips throughout New Zealand. His Chris Gordon Racing Team won the 1998/'99 125cc New Zealand Road Racing Championship, with well-known rider Dennis Charlett riding a Honda RS125 that Chris owned and prepared. Chris and his team ran the bike in the 125cc class at the Australian MotoGP at Phillip Island in 1999. ▸

Milling machine

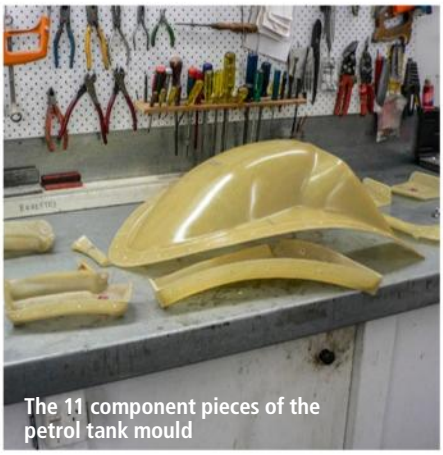
This is a Bridgeport-type mill made by Luxcut, and it has a very useful digital readout that allows much improved resolution and hence more dependable operation. Chris has used the machine to produce parts for his bikes and the very many gigs and mounts needed when undertaking precision machining.

▸ Chris has also from a very early age made things: models, an electric bicycle, an electric go-kart, a fibreglass road-registered scratch-built car, and a 500cc V8-powered Grand Prix racing bike. He has a minimalist approach to tools and equipment, but to make the racer's V8 engine he had to buy and master a small lathe and a serious large and highly capable milling machine. The alternative would have been to get the machining and development done professionally. Chris calculates that this would have involved thousands of hours of very expensive machine time — say, 3000-plus hours at $100 per hour. That's a lot of money.

One of the many jigs Chris made. In this case, for the machining of the V8 racer's crankcase

The crankcase patterns for the V8 engine

Chris assembling the mould for the V8 racer's glass-reinforced-plastic (GRP) (fibreglass) petrol tank


The 11 component pieces of the petrol tank mould


The V8 racer's fabricated GRP airbox


The GRP body of the V8 racer

Chris is outstandingly well organized and his workshop is a model of thoughtful planning. Partially this is a result of his racing background — you need to be able to access the necessary gear immediately at the track and there is no place for not-needed stuff. It is also a reflection of his practical approach: "I can make a mess, but I can't work in a mess."

Development of the V8 racer

Chris has an ongoing interest in the use of multiple engines in a bike and came up with the idea of making a 500cc V8 engine by mating two 250cc four-cylinder engines. The donor in-line-four motors chosen were Kawasaki ZXR250s, which can rev to 20,000 rpm, complete to their crankshafts. These were bolted to castings, which Chris made the patterns and moulds for and which he machined. The original sump is retained at the bottom of the engine. Gears at the end of each crankshaft drive the common clutch. The meshing of these gears is arranged so that the combustion impulses don't coincide, making the engine run smoother.

> *"I can make a mess, but I can't work in a mess"*

Having made an engine, the next step was to make a bike for it to power. This required more work than Chris is happy to recall, but the immaculate fibreglass petrol tank and fairings reflect his skill and painstaking approach.

Chris doesn't race motorcycles himself and so would have had to let someone else compete on the bike. This brought the issue of his personal liability should an accident occur. The inevitable blowback from an accident involving a machine that he made the vast majority

The artist and his work

of was not something he was prepared to contemplate. So the racer has never raced.

For his next project Chris decided that something much slower would have fewer legal risks. A friend was building a replica of a 1920s board-track racer and this appealed as something that could be built from readily available materials but would be a significant technical challenge.

Chris would like to have been born in 1880 so that he would have been able to produce bikes at the dawn of motorcycle racing, before World War I, when the fastest form of racing was on the board-track racers that competed on banked, oval, wooden motordromes.

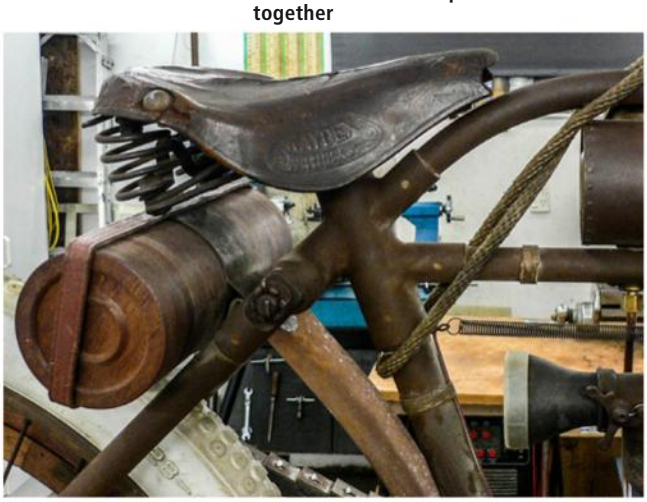
Board-track racer

The only part of Chris' board-track racer that dates from the early part of last century, is the JAP crankcase and crankshaft. JAP engines were made by JA Prestwich Ltd in England from 1895 to 1963. The rest is new, purchased locally and online.

The wheels and tyres are new and are the most expensive parts of the racer. They were imported from America,

> *Chris would like to have been born in 1880 so that he would have been able to produce bikes at the dawn of motorcycle racing*

Caption here...



Frame brackets machined from the solid and the several pieces TIG welded together

The wooden pattern for the head of the board-track racer's engine (left) and an unfinished cast iron head (right)

The reproduction racing number was made from an old biscuit tin. The rods controlling the throttle can also be seen

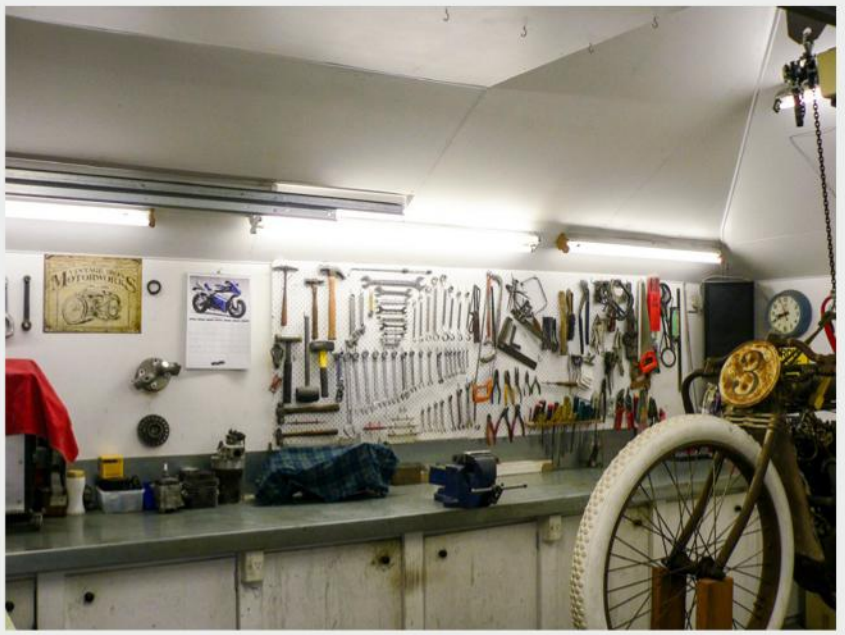
where a genuine Harley-Davidson Board Track Racer can fetch more than $200K. Professionally made replicas are available in the US from $27K.

Chris started with old photographs of racers and, taking the wheels as a guide, scaled the images up to arrive at the dimensions of his machine.

The frame is constructed of seamless mild-steel tubing brazed into bracketry made by Chris from solid steel. First, the pieces were turned to size on the lathe, then notched on the mill, then temporarily bolted together, and finally TIG welded together.

The eye-catching handlebars were

The workshop

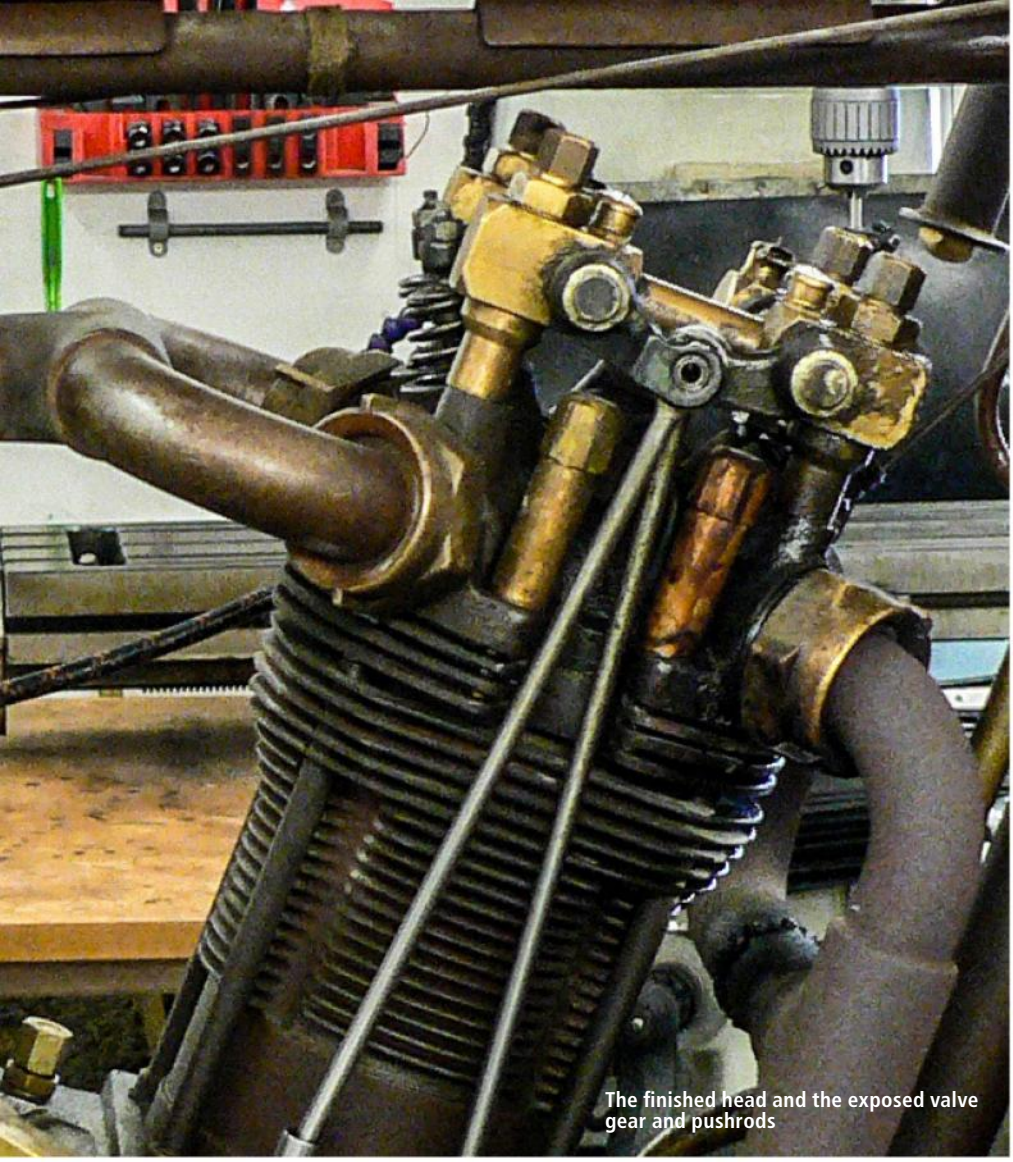


The neatness and organization of Chris's workshop's reflects his no-nonsense approach to things mechanical. He has also extensively worked in fibreglass, which is unrivalled in messiness. As a result his machine tools are carefully shrouded in cloth covers and most of his gear is safely stored in cupboards. Surfaces are regularly cleaned. The only workshop I have seen that was cleaner was the Vespa repair depot in Hanoi, Vietnam, which could have served as a hospital operating theatre.

He has a metal-covered bench running the length of the south side of his workshop. Floor-to-ceiling cupboards are on the west side; his lathe, milling machine, grinder, door, fire extinguisher, and phone are on the north side. The east side has his drawing table with the double door behind it.

His quick-release vice — a boon when working alone — tube bender, and racing toolbox are on the bench, with a tool board above. A Rolls-Royce Merlin engine part is, perhaps, a clue as to Chris's next project.

Chris would like to thank the New Zealand Electricity Department and its world-class tutors for giving him a comprehensive technical education while paying him. He was taught skills and, even more important, attitudes that have allowed him not only to earn a good living and compete at the highest level in motorcycle racing but also to complete projects that are equal parts engineering and art.

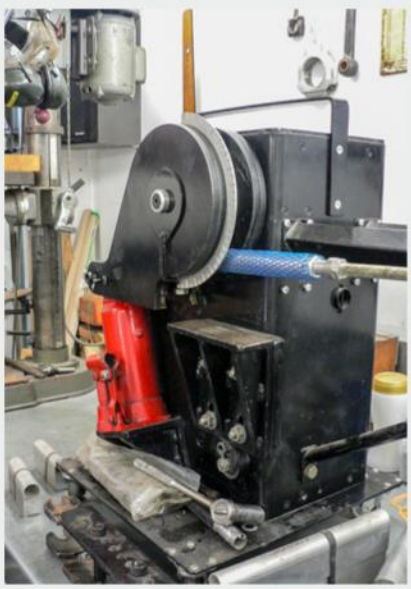


The finished head and the exposed valve gear and pushrods

Tube bender

The 28mm diameter chromoly tubing used in Chris's V8 bike wasn't able to be bent commercially in New Zealand so he had to build his own bender. The mandrels that sit inside the tube as it is bent, stopping it from collapsing, were purchased from the US. Chris turned the formers, which the tube is rolled around, from aluminium plate. The holders for the formers were very nicely laser-cut from steel plate by a local Pegasus Bay company, and the holes for attaching bolts machined on the Luxcut mill.

A bender requires more than formers and mandrels though. It needs grunt. The first version was horizontal and electric powered. It could not bend the tube at all. Several more versions were constructed — all proved inadequate. It wasn't until Chris saw a photograph of a large tube bender in a racing motorcycle–building manual that he fully appreciated the amount of force needed.



The fourth version has a large hydraulic jack pushing on long and strong levers to provide a more-than-adequate bending force. The jack operates best when upright, so the bending is in the vertical plane.

bent on the tube bender that Chris constructed when making the V8 bike and incorporate an ingenious throttle mechanism using rods. As the handlebars are turned, a sliding section stops the throttle setting from changing.

The engine is based on a 1908 250cc JAP crankcase and crankshaft; a VW Beetle cylinder and piston; and a Chinese-made connecting rod, which is a copy of a very early Harley-Davidson one. Chris designed the head, with its exposed valve gear and four valves. It was cast by CanCast in Timaru, and machined by Chris. The valves and springs are Honda copies, the rockers are modified Lifan, and the pushrods have been fabricated from silver-steel shafting. He is at a loss to understand why the valve gear was exposed on the original racers, as the weight of an effective, oil-tight cover would be minimal. The dusty environment of the board tracks would have promoted rapid wear. His best guess is that it was fashionable.

Is it real or is it a copy?

I first saw Chris' replica board-track racer at this year's New Brighton beach race, where it was surrounded by an admiring crowd, despite the presence of literally hundreds of fascinating two-wheelers, and a smattering of very desirable four-wheeled devices.

Even very knowledgeable observers were unsure if the bike was the real thing or a copy. The most discussed aspect of the replica was the flawlessly aged patina of the steel frame, which was gratifying to Chris because he had gone to extraordinary lengths to achieve the correct look to the bike's finish.

The frame tubes were sanded, painted, assembled, then the visible paint was sanded off, a chlorine solution lightly sprayed on and left to oxidize the surface of the steel. When dry, the tubes were wiped with an oil-soaked rag. The resulting finish is exactly what you would expect to see on a hard-used racing machine after more than a century had passed. Anyone working on it would see the original paint finish when the frame was disassembled. ▸

The Gordon GRP city car

After converting a motorcycle to run on electricity so he could get around the huge thermal power station he worked at, a very young Chris Gordon decided to make an electric car. Like most makers of one-off cars, he made the body out of fibreglass and used the running gear from a donor car — in this case a Triumph Herald.

The GRP is up to 5mm thick, with a central layer of core mat and includes the metal front-window surround from a Hino Contessa. The windscreen is (of course) from the same car.

The other windows are made from specially made Pilkingtons toughened glass. The car was designed from first principles and its shape reflects not only the trends of the late '70s (think Austin Princess), but also the futuristic designs of other electric vehicles of the time. The interior finish is of a similar standard to a production vehicle of the time.

The chassis is made from steel tube brazed together, and the wheels, hubs, brakes, steering, and differential are all from the small Triumph.

The electric power option was killed off by the weight of the lead-acid batteries needed, so a motorcycle engine and gearbox were used instead. The unit chosen was a Honda CB360 — a 356cc two-valve single overhead camshaft (SOHC) twin that could provide enough power to attain a top speed of over 50kph. The drive from the engine to the short driveshaft is by chain.

When the car was completed all Chris had to do to make it road legal was to take it along to the Ministry of Transport (MOT) testing station and obtain a warrant of fitness, which it still proudly wears.

The maker's name at the rear was made from brass strip. The letters were shaped using hacksaw and files. The logo combines Chris's initials, C and G, with an arrow and was designed by him when he was at school.

Right: The board-track racer on a section of reproduction board track. Note the post-earthquake vertical support

Motordromes

Year opened	Speedway	Length	Racing surface
1907	Brooklands, England	4.4km	Concrete
1909	Indianapolis, US	4km	Bricks
1910	Los Angeles, US	1.6km	Wood
1929	Western Springs, Auckland	0.4km	Mildly banked clay
1949	Aranui, Christchurch	0.4km	Gas-works cinders

The mock tool-roll attached to the vintage leather saddle is turned from wood recycled from a hardwood pallet. It contains the battery and the electronics of the ignition system, which were purchased online.

The drive from engine to rear wheel is by belt. The belt, manufactured for the emergency repair of industrial drive belts, is made from rectangles of polyurethane riveted together, originally bright orange coloured. It drives a period-correct large pulley, also made from recycled pallet wood, which is attached to the rear wheel by brass plates. The large diameter of the driven pulley gives a high gearing, which means the slow-revving engines of the 1910s could power the racers around the banked wooden tracks at lethal speeds.

The bike has no brakes; only one gear; but, unlike an original example, does have a clutch. This is a copy of the clutch from the celebrated Honda GY6 scooter, which is now produced in China in vast numbers, so parts are remarkably cheap.

The dangers of racing these machines were numerous

Motordromes

The dangers of racing these machines at the motordromes were numerous. The speeds were high (well over 100mph [161kph]), tyres were outstandingly unreliable, safety equipment consisted of goggles and a thick jumper, brakes were non-existent, and the surface could be slippery with oil from the total-loss oiling systems or break up into holes and nightmarish splinters. If you went too fast you could slide off the upper edge of the banking to your doom — hence the expression 'over the top'. There was probably also an expression for being impaled by long splinters of wood from the track, but it hasn't survived.

Some motordromes used 100x50mm boards on the edge, and others were 300x25mm. The amount of banking on the turns varied from 30° to more than 60°. The spectators sat at the top of the track, looking down on the racing, and were in great danger — competitors losing control and sliding over the top would land in the crowd. Deaths were a regular occurrence. At one race, four young boys were killed when a riderless bike struck their heads as they leaned out over the edge of the track.

The popular name for the tracks was 'murder-dromes'. In America from the end of the 1920s, motorcycle racing increasingly took place on dirt tracks which were not only safer but also didn't need to be extensively rebuilt every few years. The Indianapolis banked oval, dating from 1909, has survived because it was made of brick. Brooklands in England, opening in 1907, was concrete and it only closed when World War II broke out in 1939.

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take aim

THEY SAY YOU NEED TO MAKE AT LEAST THREE BOWS BEFORE YOU CAN MAKE A DECENT ONE. RAF NATHAN SHOWS HOW TO MAKE YOUR FIRST ONE

By Raf Nathan
Photographs: Raf Nathan

Archery is a satisfying sport that has its roots fixed in the primal skill of hunting. It is an added bonus that you can make at least part of your own bow yourself. A bow like the one in this project is called a 'recurve' and consists of a handle, or 'riser'; two 'limbs' (the flexible parts that bend); a string; and an arrow rest.

When you pull back on the string, the energy is transferred to the limbs, which on release propel the arrow forward. Limbs are graded into poundage: beginners may use 28 pounds whereas the pros may be drawing 40 pounds or more. Hunting bows can go up to 60 pounds. This poundage represents great force, which the riser must be able to withstand. This article is about my third bow — the first two broke.

Practice makes perfect

My first was made from two pieces of blackwood laminated together. My idea was that two pieces would be more dimensionally stable than one. I used epoxy bought at a hardware shop and the bow broke along the glue line. Number two was made of mahogany with maple and blackwood detail veneers laminated at the middle. This bow broke purely due to wood failure. The mahogany lacked guts.

To avoid any problems with glue, I made number three from walnut because it adds cross-grain strength and looks beautiful. The limbs are 34 pounds — any more poundage probably requires the skills of a professional bow-maker to ensure long life.

Purchase your limbs first. The international standard for archery is the imperial system, so your limbs will be 1½ inches wide (about 38mm). Phone around archery shops to locate one that will sell limbs separately. Buying them second hand on Trade Me is an option. Limbs of 28–30 pounds are a good starting point. The limbs sit in a pocket consisting of a shoulder on the riser and brass side pieces. The brass sides are set flush into the riser. A final thickness of 42mm for the riser, less the two thicknesses of 1.6mm brass, houses the limbs snugly.

Be warned that some people will tell you that it's all too hard and to forget the whole thing

Making the bow

Select wood clear from defects and orient the grain if possible so that it is quarter sawn with the heart side towards the face of the riser (the side facing the archer). Dress the wood square and straight. The wood should be 90mm or more in width and, say, 44mm thick. The final thickness will be 42mm (the extra 2mm is to accommodate any wood movement). Trace the pattern (see Fig. 1) onto the wood and bandsaw the shape, but do not saw out the shoulders where the limbs sit. You will also need to bandsaw the cutaway where the arrows rest. This is sawn full at the arrow cutaway in preparation for later routing.

Put the riser away for about a week to let the wood settle. All the sawing will release any inherent tensions in the wood and a bow or twist may develop. To re-straighten the riser, skim it over a jointer and then thickness it down to 42mm thickness.

Fig. 1

2

Plane the edge above the shoulder square and parallel (Steps 2 and 3), and then use a marking gauge to mark out the shoulder (Step 4). Next, bandsaw out the shoulder (Step 5).

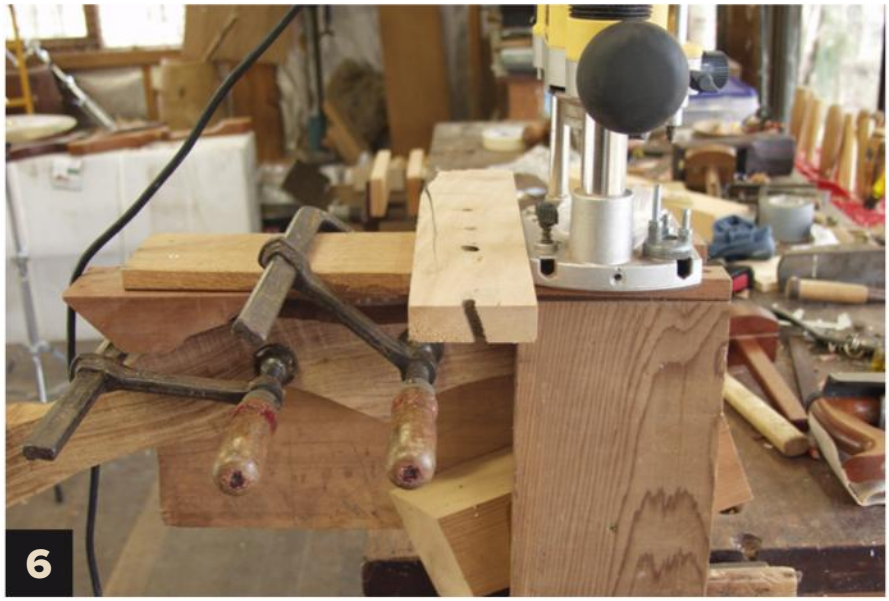
The shoulders need to be as perfectly level as possible and square to the faces. To achieve all this you can work quietly with a saw and chisel, or use a power tool and a jig. Steps 6 and 7 show a shop-made jig used to cut the shoulders with a router.

The arrow cutaway consists of a level face that ends with a lip that continues up in a sweep. The level face can also be made with a jig and router as in Steps 8 and 9. The jig holds the router level and makes a clean arrow cutaway. A 'bowl cutter' (a flat-bottom bit with radiused corners) was used to rout this (Step 10). Rout down deep enough so that 18mm thickness of wood remains. This should then position the arrow shaft central to the string. The sweep that continues up allows you to sight the arrow when it is mounted.

Shaping

Now begins the actual shaping of the riser. This requires sanders, chisels, spokeshaves, and patience. Step 11 shows a belt sander reversed and the front drum being used to shape the hand grip. Using a rounding-over bit in the router and running this over some of the edges can speed things up. A spokeshave is of great value for refining lines, as is a scraper. An inflatable sanding bobbin is absolutely invaluable for this type of work, but not essential — just a lot faster. Try to refine the shape as much as possible before starting hand sanding. Use 80-grit paper followed by 100 and 120 grit.

At this stage the holes for the limbs can be drilled. The holes need to be exactly centred. Mark a centre line on the shoulder, then hold the limbs in place and mark where the holes need to be. In this case a horizontal mortising table was used for the drilling with a 9.5mm (⅜-inch) bit.

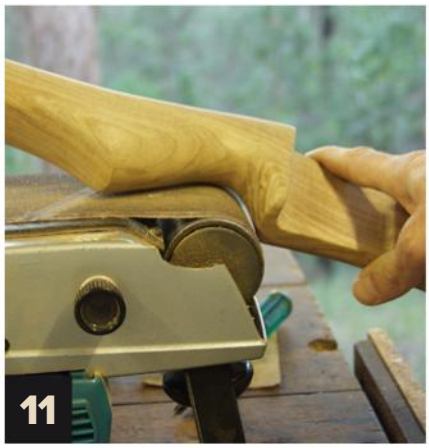


An inflatable sanding bobbin is absolutely invaluable for this type of work, but not essential — just a lot faster

Now the brass sides can be fitted. The action of the sides is to position the limbs parallel to the riser. The brassware (Step 12) was prepared by a local engineer. He was presented with a drawing and the shapes were cut with a metal router. The holes for the four square-drive screws were drilled and countersunk, and a sink with an 82-degree angle was used to ensure a tight fit with the screw heads.

Set your drill press to allow the screw heads to protrude slightly; they will sand back flush to the plates later. Hold the brass plates in position and mark out the shape with a scriber. A laminate trimmer with a flat-bottom bit can remove most of the waste and, important, keep the surface flat and level. Before routing set the cutter depth to the thickness of the brass. Pre-drill the holes and fit steel screws first, then remove them and replace with brass screws.

The hard walnut can break soft brass screws and removing broken screws is a hassle. Without the use of specially made brass sides an easier but more simplistic way to align the limbs would be to have the riser at 38mm (1½-inch) thickness so that the limbs were flush with the sides. Small shaped pieces of wood could then



be fixed at the sides to form pockets for the limbs.

Sanding and polishing

The brass sides can then be sanded level with the wood with a belt sander. Next the whole piece must be hand sanded up to at least 320 grit. Polishing comes next and the choice of finish is optional. A bow will be used outdoors, hence a water-resistant polish is best — oil, lacquer, and oil/shellac/varnish mixtures can work well.

Now the limbs can be fitted. I sprayed the original white limbs shown with a black enamel. Brass bolts with dome heads and washers have been used in this piece, but stainless steel is another option.

At this stage it is time to visit an archery shop for help with a string and arrow rest. Strings and rests are inexpensive and the shop will be able to recommend what to use. It can fit the rest and set up the bow, matching arrows to suit your bow and personal draw length.

A bow, like a gun, is shot, hence it can be a dangerous implement, so sensible and supervised use is critical. A novice will benefit from joining a club to learn correct technique and, more important, safe shooting practices.

LOOKING HOT

A NEW TROLLEY GIVES A BARBECUE A FRESH LEASE OF LIFE

By Jude Woodside

Photographs: Samantha Woodside and Jude Woodside

I recently moved house. This is not an experience I want to repeat anytime soon. Part of the process necessarily involves discarding the broken and useless stuff. My kwila barbecue trolley had seen better days, although the basic stainless-steel barbecue was worth retaining. I happen to have a reasonable stock of 40x40mm steel tube and, although it is rather heavy, it would do the job, and at least it won't rust in a hurry. If you do emulate this design you can easily use thinner walled tube — even 1.6mm as there is very little weight in the barbecue itself.

Upgrade opportunity

I began by careful measurement of the existing barbecue and designed a framework around it. At the same time I decided to upgrade and purchased a reasonably cheap single burner that didn't have a long burner tube to contend with.

The framework is essentially just four legs with a couple of bars to sit the barbecue on, two outriggers that can be used for the side burner, and a table for placing meat on before and after cooking. The barbecue is attached to the base by four screws through the lid hinge.

I cut all the parts on the bandsaw, starting with all the bevelled parts. I elected to make the four legs contiguous with the arms of the outriggers so they are welded together as one piece, rather than making the outriggers as separate pieces and welding them to the tops of the legs.

I prefer using 45-degree angle joins when possible because they are

The finished barbecue

This meant of course cutting the arms with bevels on two different faces, which is fraught with the possibility of disaster

Cutting the outrigger piece of the leg

Parts cut and ready for assembly

Grinding a bevel on the edges to create a V-groove

I have found it is often worth the time to grind the zinc off around the weld

aesthetically more pleasing and there are no holes that need to be plugged. It also means that if you get it right, you can grind the weld to make it virtually disappear. This meant of course cutting the arms with bevels on two different faces, which is fraught with the possibility of disaster. You need to be aware where each piece will go so you don't end up with an extra left-hand piece where you need a right-hand one. I managed this time to avoid cutting at least one angle on the wrong end by cutting each one as the mirror of the last.

Start with the outriggers

I started by welding the outrigger parts and then welded the leg to the outrigger. It is important to get the leg perpendicular and square to the outrigger table. The outriggers are not the same size, as the one on the left has to accommodate a single gas burner, so it's a bit smaller than the one on the right. The gas burner is cast aluminium and conveniently arrived flat-packed in a box.

With both legs assembled I added the cross member between the legs on each and ground the welds flush. I was having quite of bit trouble with splatter and erratic welding, which is uncharacteristic of the BOC Smootharc Elite 180. I traced the fault to a loose earth cable at the connection to the machine, but some of my problems were due to the galvanized coating. I have found it is often worth the time to grind the zinc off around the weld.

It's always a good idea to bevel the ends on each piece to allow for a V-groove that will allow you to get good penetration. I set the machine to 2.5mm for some of the joints, especially where there were larger gaps to fill that required multiple passes, but by and large, the 3mm setting worked best at about 19.7V at 125A. I used .8mm wire and an Argon-CO_2 mix.

No need for overkill

With the two leg units now completed I tack welded a strip of 25x4mm flat bar in place along the long edge of each outrigger. This is to carry the burner on one side and timber slats on the other, so I was able to use a piece of the macrocarpa timber I planned to use to set the depth of the strip. I clamped it temporarily while I tacked it in place and went back and welded each side

Setting up the leg

Welding up one of the outrigger tables

Grinding off the weld

Left: Tacking the support for the outrigger slats

Below: Setting up the crossbars

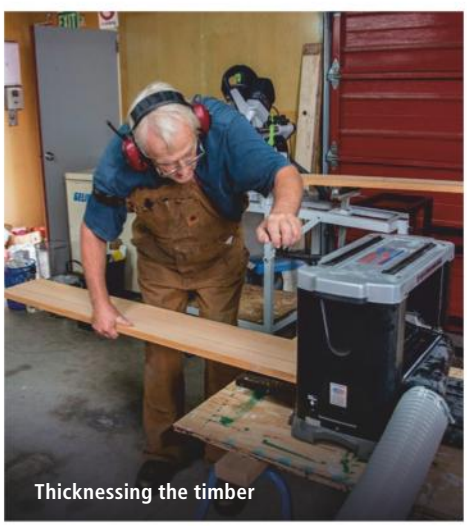
Test fitting the barbecue

with longer tacks. It's not likely to carry an enormous weight so it seemed like overkill to run a weld bead the entire length of the strip.

With the outriggers and the leg units completed all that remained was to fix the ends to each other. The bars that do that would also hold the barbecue. This worked out to be at 160mm below the top of the outriggers, which was conveniently four times the depth of the tube I used. That made it easy to set up the tube at the right height. I added the lower stretchers to the piece by standing the unit on the table and using the leftover tubing to set the height, which I had set to 120mm deliberately since that was conveniently three times the tube height. I intended to add castors to one end too, although they hadn't arrived at the time.

Once the lower pieces were in place, I placed the unit on the floor upside down and, using a couple of clamps, I set out the strips that would carry the timber slats to make up the lower shelf. ▸

Adding the lower shelf



Thicknessing the timber

Planing the edges

Get the right gas working for you

Shielding gas selection is a critical part of cost-effective welding

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- Labour
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- Welding wire
- Power consumption

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your specific application, as opposed to using regular gas for your welding, you will notice that while the cost of the welding gas is slightly higher, your actual overall production cost can be reduced dramatically as shown on the diagram.

Welding gases can positively influence your welding result through the following:

- Surface appearance
- Welding speed
- Metallurgy and mechanical properties
- Weld geometry
- Arc stability
- Metal transfer
- Shielding effect

Shielding gas selection chart.

(For GMA, flux-cored, metal-cored, solid wire welding)

Arc Transfer ■ Spray ■ Modified Spray ■ Dip
Weld Characteristics ★★★ Excellent — ★½☆☆ Poor
P = Performance Line C = Competence Line

Cylinder Colours	Gas	Material Thickness (mm) 1–12	13+	Penetration	Spatter free	Speed	Fillet shape	Finish	Principal Benefits	
GMAW Carbon and Low Alloy Steels										
	Argoshield® Light			★★☆	★★★	★★★	★★★	★★★	Versatile for thin material, Minimal spatter.	C
	Argoshield® Universal			★★½	★★½	★★½	★★½	★★½	Most versatile wide working range.	C
	Argoshield® Heavy			★★★	★★☆	★★☆	★★☆	★★☆	Good appearance Low defect levels on thick material.	C
	Argoshield® MCW			★★☆	★★★	★★½	★★½	★★½	Versatile suitable for solid and Metal Cored wire, up to 12mm.	C
	Specshield® FCW			★★★	★½☆	★½☆	★★☆	★★☆	Ideal for flux cored welding Good penetration.	C
	Industrial CO_2			★★★	★☆☆	★☆☆	★☆☆	½☆☆	Good penetration.	C
FCAW Carbon, Alloy and Stainless Steels										
	Specshield® FCW			★★½	★★★	★★★	★★★	★★★	Good weld appearance, superior control in positional welding.	C
	Industrial CO_2			★★★	★★★	★★☆	★★½	★★½	Some wires designed for use under CO_2 only, high cylinder contents.	C
MCAW Carbon and Low Alloy Steels										
	Argoshield® MCW			★★☆	★★★	★★★	★★★	★★★	Excellent appearance, low slag.	C
	Specshield® FCW			★★★	★★☆	★★☆	★★☆	★★☆	Good penetration.	C
GMAW Stainless Steels										
	Specshield® Multi			★★☆	★★☆	★★☆	★★★	★★☆	Downhand fillet welding, thin plate.	C
	Stainshield® MIG			★★☆	★★☆	★★☆	★★½	★★½	General purpose mixture,good wetting action,smooth weld surface.	C
	Stainshield® Heavy			★★★	★★★	★★½	★★★	★★★	Versatile for thick material. Excellent arc stability, good penetration.	P
	Stainshield® Universal			★★★	★★★	★★★	★★★	★★★	Excellent arc stability, fast speed, good penetration. Low defect levels.	P
	Stainshield® Light			★★★	★★★	★★★	★★★	★★★	Good for sheetmetal recommended for root passes on pipe without purge.	P
GMAW Aluminium and Alloys										
	Alushield® Light			★★½	★★★	★★½	★★★	★★★	Minimal spatter, good appearance, fast weld speed.	P
	Alushield® Universal			★★★	★★★	★★★	★★★	★★★	Good for thick or thin plate, excellent arc characteristics.	P
	Alushield® Heavy			★★★	★★★	★★★	★★★	★★★	Fast, good penetration on thicker material, wide bead shape.	P
	Welding Argon			★★☆	★★★	★★☆	★★★	★★★	Versatile, general purpose mixture.	C

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Ripping the slats to size

Having the unit inverted meant that I didnt have to work on my knees — at my age, that's something I prefer to avoid

Tidy up and paint

After a final clean up and grind off I applied a gap-filling primer to the whole piece, focusing on the welds in particular. Then I masked off the central areas that would most likely be exposed to some heat and painted the rest of the frame in gloss black paint and left it to dry overnight. The areas that required a heat-resistant paint were done last.

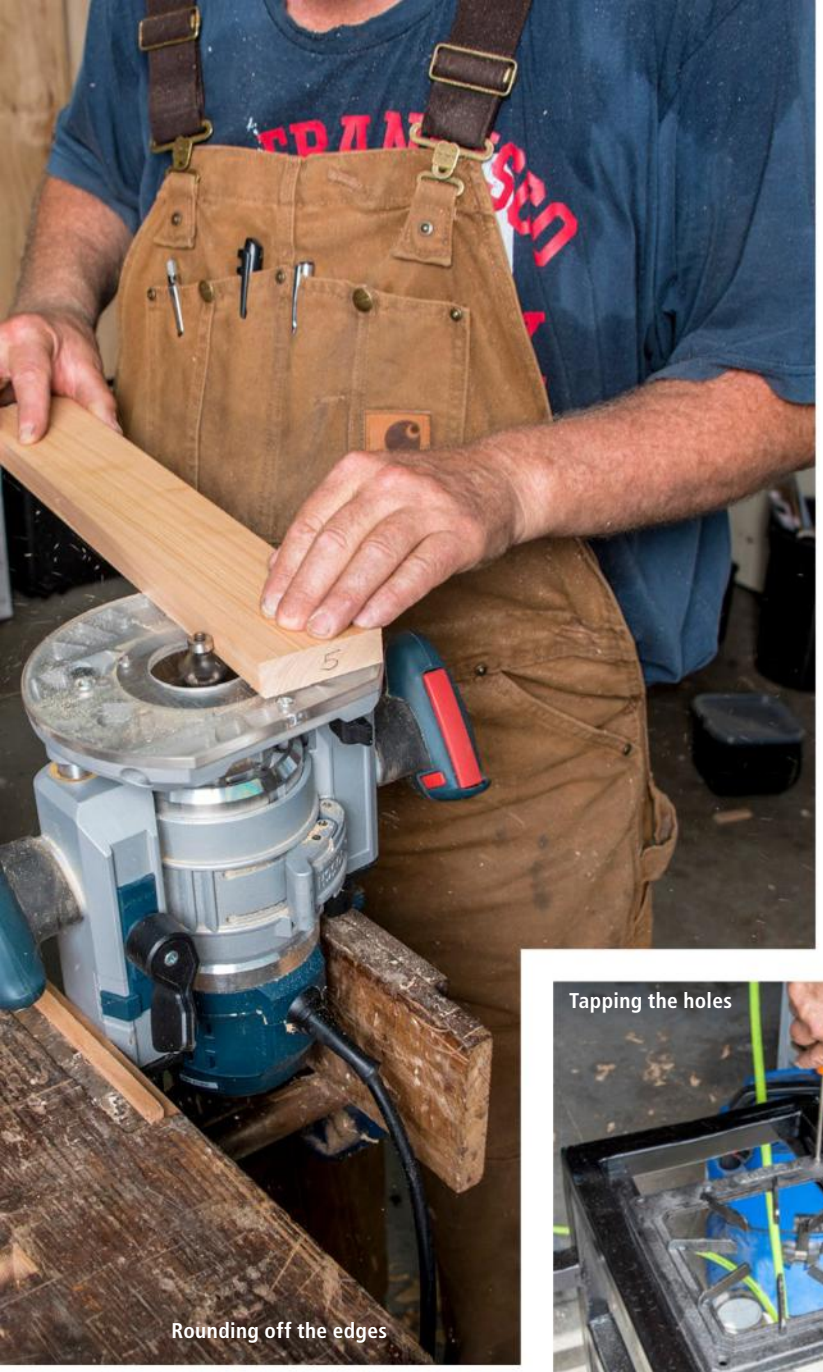
I fitted the burner for the outrigger in place and marked the four mounting holes that would normally fit short legs to it. In this case the screws for the legs would be screwed directly into the strips tacked into the outrigger. I drilled and tapped the holes and screwed the burner in place. By this stage, the castors for the base had turned up so I was able to cut 105mm off one end the old-fashioned way with a hacksaw. The castors are 100mm and the plug that holds them in the tube has a 5mm lip. These castors have a central bolt that screws to a threaded nut embedded in a rubber tube end. The tube plugs usually need to be ground a bit to fit these tubes but then they can be seated with a hammer. The other leg ends I fitted with a plastic plug.

Stylish macrocarpa slats

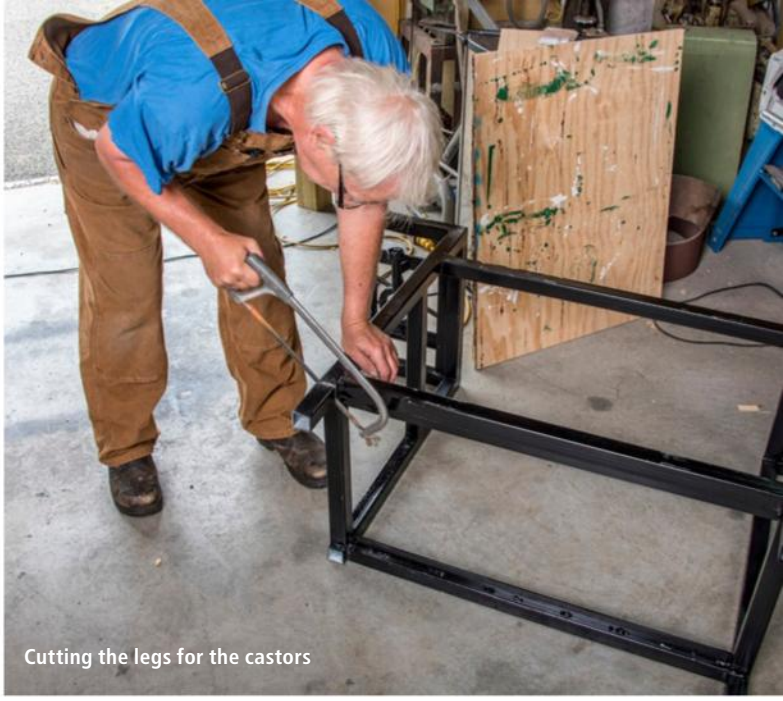
I have some very nice 200x25mm macrocarpa and I used this for the slats in the right-hand outrigger and the lower shelf. I cut two pieces at 1500mm and thicknessed each piece 20mm then I cut it to size and fed it through the table saw to make the slats. The outrigger pieces were 50mm and the lower shelf worked out to be 67mm, allowing for a 2mm gap between the slats. I set up the router and rounded over each edge and the ends. A quick sand and a coat of oil and the slats were good to go.

I have used nails in the past to set gaps between boards but rivets are a better bet; they are usually more consistent in size and are less likely to fall through. To work out where the holes for the holding screws were to go, I set out the slats and clamped them in place and then inverted the whole unit.

Yes, I could have measured and laid out the marks from the top, but having the unit inverted meant that I didn't have to work on my knees — at my age, that's something I prefer to avoid. With

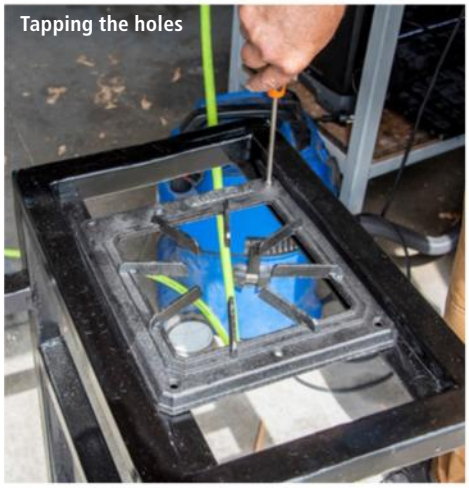


Rounding off the edges

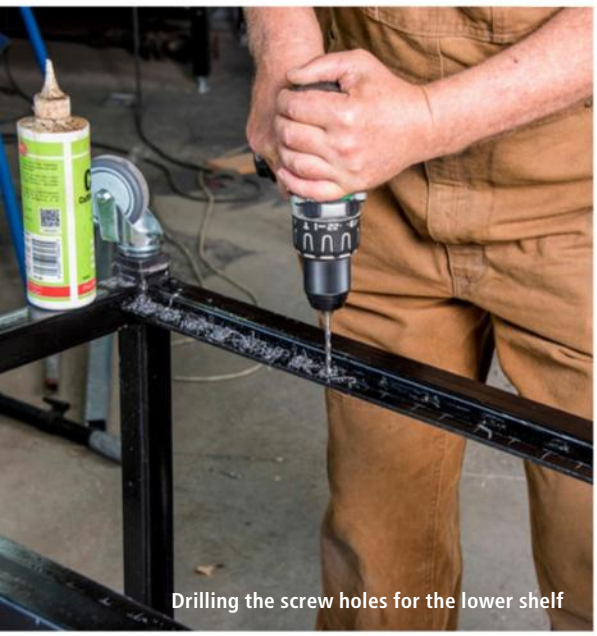


Cutting the legs for the castors

Drilling holes for the burner



Tapping the holes



Drilling the screw holes for the lower shelf

Fixing the slats

Marking holes for the barbecue hinge

Above: Attaching the hinge
Below: The gas manifold

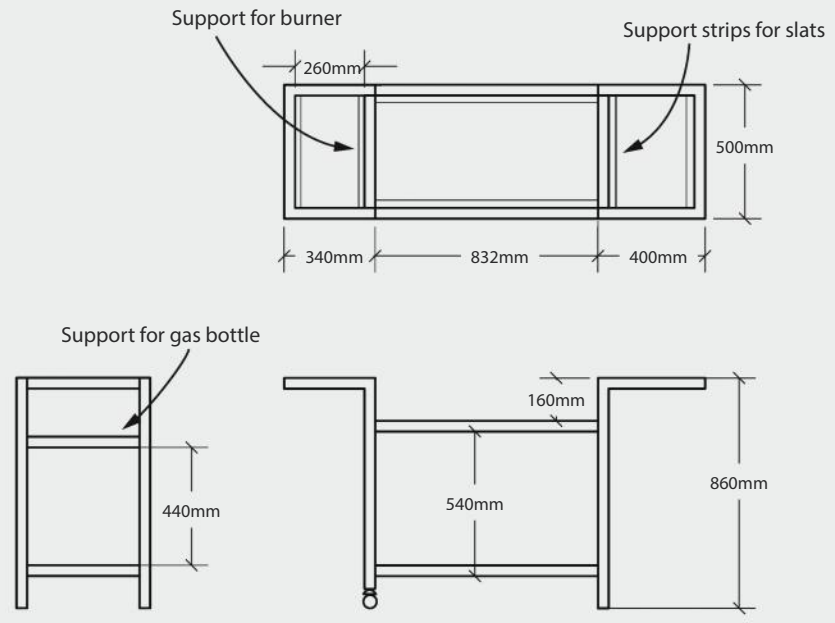
the piece inverted and the slats in place I could apply the rivets to get the gaps correct and mark where the screw holes were to go. I used two holes for each of the bottom shelf pieces — it might be overkill but macrocarpa can curl — and one each on the outrigger table.

Finishing touches

I then had to mark the holes to fit the lid-hinge parts; the screws go through the body of the barbecue holding the whole unit together. I marked the position of the holes as carefully as I could then drilled them to 5mm and tapped them. Next I set the unit in place and screwed the hinges through the unit to the base.

Now all that remained was to upgrade the gas lines. I am fortunate that I have a branch of Gameco in town and spent half an hour with its very helpful staff sorting out what I needed to make up a gas manifold to supply both the main barbecue and the side burner from the same bottle. I would recommend the Gameco website if you need to find similar parts. It did require rather a lot of fittings and adaptors but after the application of copious amounts of thread tape I have an effective manifold.

Trolley Dimensions



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The restored 1937 Drewry locomotive heads out from the workshop

RETIRED TRADIES LEARN SKILLS — AND MAKE FRIENDS — RESTORING RAILWAY CARRIAGES

By Nathalie Brown

Photographs: Derek Golding

Volunteer Kevin Conlan busy at one of the work benches

Every Wednesday and Saturday morning about 20 retired tradesmen leave their lunch boxes in the Oamaru Steam and Rail Society smoko room, shrug themselves into their overalls, and head for the old railway workshop to get on with the day's tasks.

They might be restoring turn-of-the-20th-century railway carriages, stripping down a locomotive, or installing wiring systems. Each man brings a lifetime's worth of skills and the willingness to learn something new.

They work out of the old New Zealand Rail wagon workshop, or 'lifting shop' as it was called, at the back of Oamaru's historic precinct. The Oamaru Steam and Rail Society Inc took over the building in 1989. Most of the tools and equipment needed to complete the volunteers' first major project were on hand so they rebuilt the 60x12m workshop, which had been partially demolished by New Zealand Rail when it decamped.

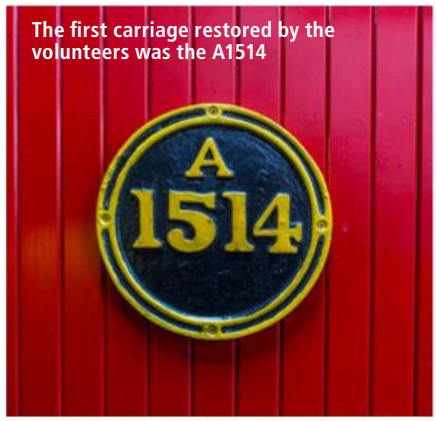
Several of the volunteer sheddies bring tools from their home workshops; these include magnetic drills, welders, lathes, drill presses, and all the woodworking gear needed to make the shapes and mouldings.

Puke, poo, and diesel

However, the bulk of the equipment can be found at the back of the workshop in three old corrugated-iron storage sheds. This is also where a few little blue penguins make their homes. The air is rich with the smell of engine grease and diesel fumes overlaid with penguin puke and poo — you've got to really love the work to spend much time out here.

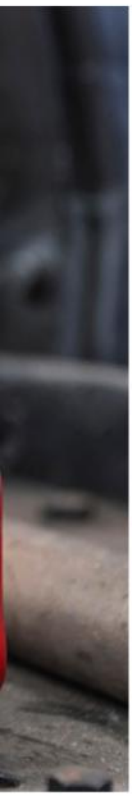
But it's where Harry Andrew, manager of the outfit, stores an impressively tidy collection of metal pipes and poles, gigantic metal structures, tools, and equipment once used by New Zealand Rail. And

This 1921 Fowler is about to be restored



The first carriage restored by the volunteers was the A1514

The interior view of the smoke box in the B10 — the Hudswell Clarke locomotive



he knows pretty well what's here, right down to the last bucket of bolts and sprockets. The sheds aren't big enough to store everything, so more iron is stored in old carriages out the back, and down the sides of the workshop.

Harry sources anything else that might be needed. He writes the grant applications for items required for specific projects, and because everyone in town knows Harry and the impressive work he does, he is well received when he visits local engineering shops asking to borrow specialist equipment such as a Rotabroach for drilling extra big holes or thread cutters for bolts and pipes.

Highly skilled team

Most of the volunteers bring specific skills to each job, and the workshop can call on a fitter and turner, an electrician, tinsmiths, plumbers, a car painter, a house painter, motor mechanics,

You've got to really love the work to spend much time out here

Geoff Ellis paints the roof of one of the carriages

Technical discussions in the smoko room involving, from left, Wally Smaill, Allan Killark, Geoff Ellis, Phillip Screen and Graham Bull

Harry Andrew restored the DSA 1954 virtually single-handedly over two years.

"We drink a lot of tea and coffee and spend ages talking about technical problems"

and general engineers. There are also retired white-collar workers with impressive DIY skills.

Harry says, "Most of the men also come here to learn different things — things to do with compressed air, electrical things, mechanical things. A lot of people haven't had those linked and they learn how to link them here.

"If we come up against any problems around repairs and maintenance, we discuss it in the smoko room. The ideas are sketched out on paper and if necessary we do a bit of internet research. We drink a lot of tea and coffee and spend ages talking about technical problems. From the smallest task to the big jobs — there's no rushing in."

Train WOFs and safety

Harry points out that in the past five or six years, the club has focussed on doing the work rather than just cleaning up and painting. ▸

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The next job for a team of men is the fitting of new tubes to the B10

"We decided that, with enough money to pay for the parts, we could do a better job ourselves"

"We used to farm out the work but now we do as much as we can on our own. We farmed out the steam loco to be refurbished and decided that with enough money to pay for the parts we could do a better job ourselves. In fact, we save more money by doing it in house and the men enjoy it more. Recently we were working on brakes. We've modernized one loco that didn't have the proper brakes and couldn't do the job Land Transport [NZ Transport Agency (NZTA)] wanted it to do, so we've designed new brakes and put them in.

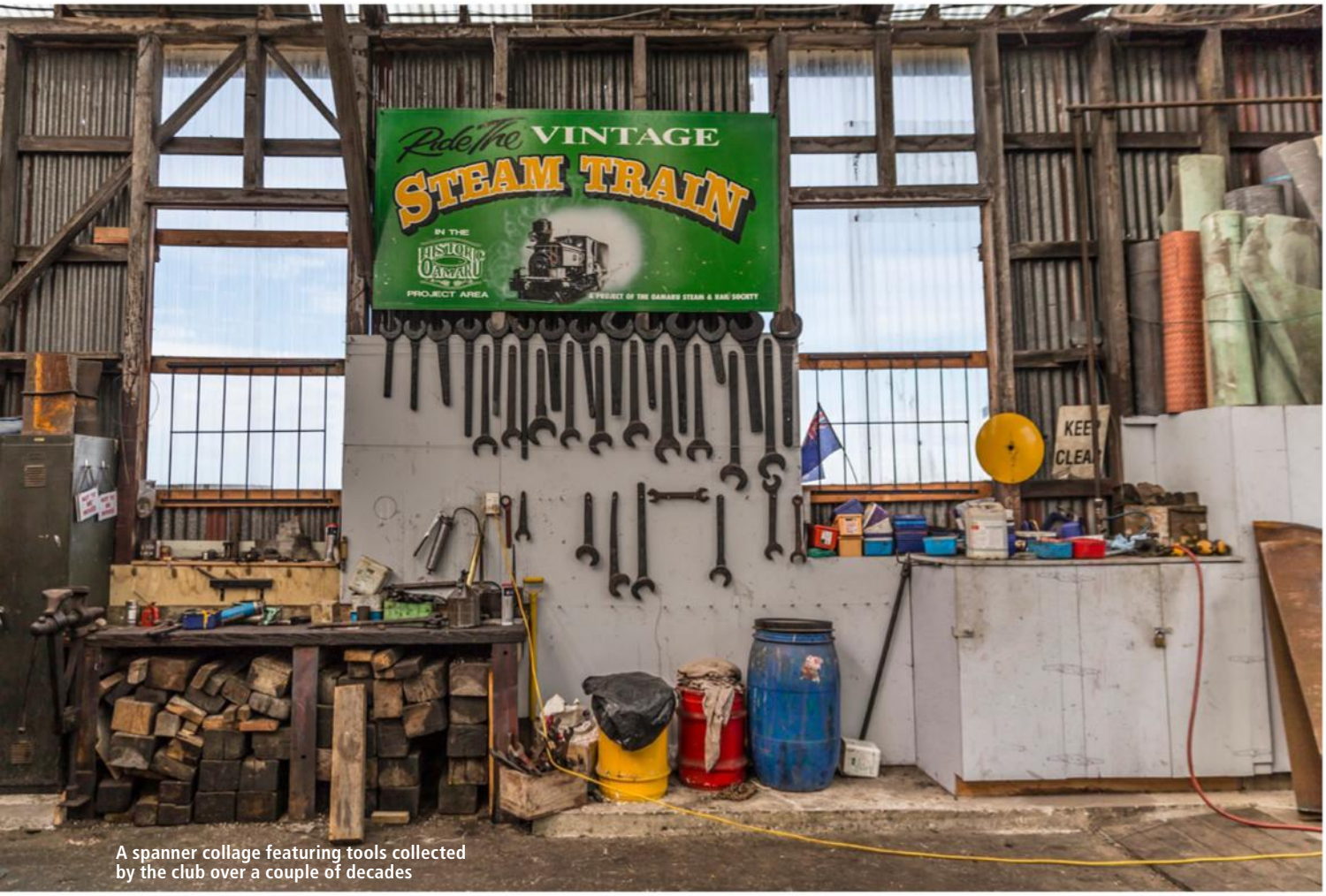
"Every year we've got to do a warrant of fitness for each loco, bringing them up to a safety standard that complies with NZTA specifications. Then all the time we have maintenance to do on the locos, because they're old. They break down and you've got to make parts using a lathe, a drill press, all sorts of welders, and woodworking equipment.

"Our biggest concern is safety. No shortcuts are taken. We don't expect anyone to take on big, heavy work alone. We share it out and work together on it. We have a few women involved in the station work, and one woman just loved to cleaning our locomotive B10, but here, by choice, the men do the heavy, dirty work." ▸

Community railway

In the late '80s, through a fair bit of wheeling and dealing, the Oamaru Steam and Rail Society Inc secured about 2km of dedicated line from the little station on the edge of the historic precinct called Harbourside to the disused quarry at the far side of the harbour, very close to where the Oamaru Blue Penguin Colony now stands. They offer train rides for $20 for a family, $8 for an adult, and $3 for a child every Sunday and, together with Dunedin Railways, do occasional excursions to Herbert, 22km south of Oamaru.

It's a community railway. There are 110 members in the society and a good number are families who join for the discounted rides on offer. There are some 20 maintenance workers and about 15 Sunday workers, some of who double up. A trained crew of five works on Sundays to operate the little railway: there's a ticket seller, the station master, a guard and assistant guard, a driver — sometimes two drivers for diesel — and a fireman if it's a steam train. They work under NZTA rules, and people have to be qualified to run the trains, even on a 2km track. Harry Andrew, the manager of Oamaru Steam and Rail, can trace his involvement with the railway in Oamaru back to the centennial in 1962 when he rode on the trains as a 15-year-old passenger.



A spanner collage featuring tools collected by the club over a couple of decades

The B10 nameplate

Spare 70-pound (32kg) rails are stacked in the yard

The 1937 TR35 Drewry parked at the end of the line near the Oamaru Blue Penguin Colony

Good skills abound

Wally Smaill is a qualified plumber, drain layer, and gas fitter who was the trades supervisor at the local freezing works for 32 years. He is building the new double seats for the open carriage, which requires good metal and woodworking skills.

He has completed the decorative wrought-iron end of the seat and another one 3m further apart with wooden slats between. He uses a bandsaw to cut the ends and supports, belt sanders, and a handsaw for the rest of the woodwork. Scrap metal is used to manufacture the bases that the bench supports stand on.

The sheddies have been successively laying concrete floor sections throughout the workshop, parts of which are still covered in the original orange Ngapara gravel flooring. ▸

"They're a great bunch of fellas and this really gives us something to keep us occupied two days a week"

Some of the volunteer crew (from left): George King, John Lister, Stephen Hinds with Anthea Brown, Allan Killark, Geoff Ellis, Harry Andrew

Murray Jones (left) in his standard running-day uniform, with Bruce Cawley and Stephen Hinds

There is a fair bit of train memrobilia about in the sheds too

Three-month project

Harry Andrew steadies the ladder while Geoff Ellis works on the roof of the CW57, which is being rebuilt as a service wagon

Over the Spring of 2017 the volunteers spent much of their time building the Ways and Works wagon — a workshop on wheels. It will be used for track work, like replacing old wooden sleepers with modern concrete ones.

When *The Shed* visits, the Ingersoll-Rand compressor has already been bolted to the floor and John Paul (JP) is using a lathe to turn out a plug to go in the bottom of a gantry to take the weight when the men lift anything into the wagon. By way of conversation, JP says he served his apprenticeship as a fitter and turner and has his own machine shop at home.

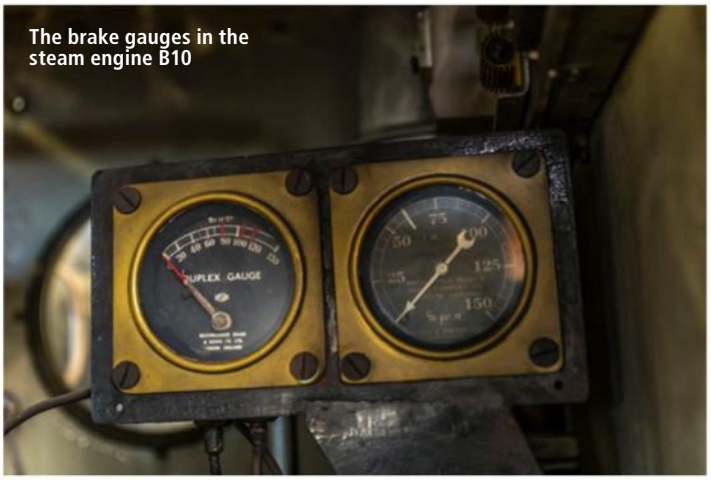
Another two men are linking an air compressor to the reservoir tank underneath the wagon so they can use pneumatic gear.

Restoring the Ways and Works wagon is a three-month project, two days a week, for about five men.

"There's a lot of welding to be done," says retired motor mechanic Kevin Conlan. "We've made new doors for it, put in a bench, a new metal-plate floor, a vice, and we are about to paint it. There are also the pipes to carry air the full 20m length of the wagon. We have yet to install a 12-tonne digger on the front end.

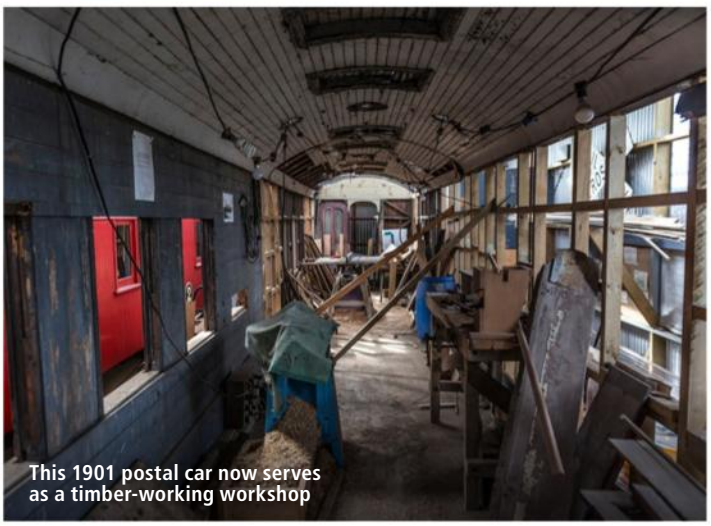
"Some of the other jobs we've done include replacing and painting the barge boards on the shed [and] reconditioning the red loco — the Husky — so we can take the old blue loco out of service and do repairs on that. And we've done quite a bit of track work, like replacing the wooden sleepers with concrete sleepers, which are a four-man lift. That's why we want the digger on the front of the wagon. They're a great bunch of fellas and this really gives us something to keep us occupied two days a week."

The track and yards lie behind Oamaru's historic precinct



The brake gauges in the steam engine B10

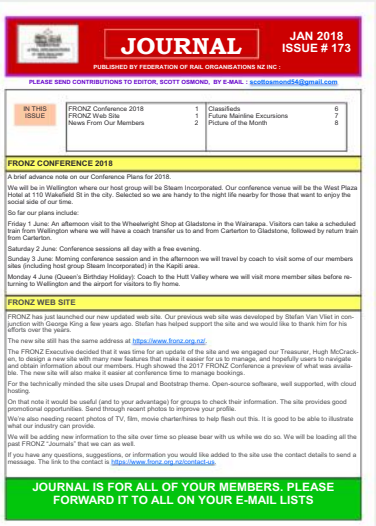
Harry is understandably proud of his DSA 1954



This 1901 postal car now serves as a timber-working workshop

Trading equipment

The railway equipment and spare parts stored in the three sheds and railway carriages behind the Oamaru Steam and Rail workshop are not always sufficient to do a particular job. "We trade the equipment we've got in storage with different railway groups," says Harry Andrew. "We belong to the Federation of Rail Organisations of New Zealand (FRONZ), which has about 90 railway groups, and we can advertise in their magazine to buy, sell, or exchange most of the gear we need. The federation tries to keep all its costs down, so the magazine is only in an online format but as soon as they send it to me I forward it on to all the Oamaru Steam and Rail members." www.fronz.org.nz/journals



JOURNAL

JAN 2018
ISSUE # 173

PUBLISHED BY FEDERATION OF RAIL ORGANISATIONS NZ INC :

PLEASE SEND CONTRIBUTIONS TO EDITOR, SCOTT OSMOND, BY E-MAIL : scottosmond54@gmail.com

IN THIS ISSUE

FRONZ CONFERENCE 2018

A brief advance note on our Conference Plans for 2018.

We will be in Wellington where our host group will be Steam Incorporated. Our conference venue will be the West Plaza Hotel at 110 Wakefield St in the city. Selected so we are handy to the night life nearby for those that want to enjoy the social side of our time.

So far our plans include:

Friday 1 June: An afternoon visit to the Wheelwright Shop at Gladstone in the Wairarapa. Visitors can take a scheduled train from Wellington where we will have a coach transfer us to and from Carterton to Gladstone, followed by return train from Carterton.

Saturday 2 June: Conference sessions all day with a free evening.

Sunday 3 June: Morning conference session and in the afternoon we will travel by coach to visit some of our members sites (including host group Steam Incorporated) in the Kapiti area.

Monday 4 June (Queen's Birthday Holiday): Coach to the Hutt Valley where we will visit more member sites before returning to Wellington and the airport for visitors to fly home.

FRONZ WEB SITE

FRONZ has just launched our new updated web site. Our previous web site was developed by Stefan Van Vliet in conjunction with George King a few years ago. Stefan has helped support the site and we would like to thank him for his efforts over the years.

The new site still has the same address at https://www.fronz.org.nz/

The FRONZ Executive decided that it was time for an update of the site and we engaged our Treasurer, Hugh McCracken, to design a new site with many new features that make it easier for us to manage, and hopefully users to navigate and obtain information about our members. Hugh showed the 2017 FRONZ Conference a preview of what was available. The new site will also make it easier at conference time to manage bookings.

For the technically minded the site uses Drupal and Bootstrap theme. Open-source software, well supported, with cloud hosting.

On that note it would be useful (and to your advantage) for groups to check their information. The site provides good promotional opportunities. Send through recent photos to improve your profile.

We're also needing recent photos of TV, film, movie charter/hires to help flesh out this. It is good to be able to illustrate what our industry can provide.

We will be adding new information to the site over time so please bear with us while we do so. We will be loading all the past FRONZ "Journals" that we can as well.

If you have any questions, suggestions, or information you would like added to the site use the contact details to send a message. The link to the contact is https://www.fronz.org.nz/contact-us

JOURNAL IS FOR ALL OF YOUR MEMBERS. PLEASE FORWARD IT TO ALL ON YOUR E-MAIL LISTS

Two diesel and one steam-driven locomotives line up in the workshop.

From left: Kevin Conlan, Murray Jones (obscured), and Geoff Ellis press a bearing into a housing

Plenty to do and learn

Some of the men are working on installing public-address-system wiring throughout the newly restored train carriages. The work is supervised by Phillip Screed, a volunteer and retired electrician.

The club members have restored two carriages: a 1904 and a 1924. The 1904 glories in 70 wooden-slat seats, wrought-iron seat ends, wood-panelled walls, a pressed-tin ceiling, and replica light fittings. The 1924 has also been rebuilt by the team of volunteers. When Harry found it, the carriage had been used as a welder's workshop. Much of it has been restored but they have yet to bring in the grant money to restore the 40 leather seats. The guard's van has also been rebuilt and to a certain extent reappointed. Volunteers built a heavy aluminium loading ramp to take the wheelchairs of disabled passengers, who ride in the restored 1947 guard's van, which also houses the new PA system.

Ask any of the sheddies at the steam and rail workshop and they'll tell you that there's always some new project to be worked on. There's always something more to learn, and good friendships are being made and cemented among men who share a common interest.

The Magic of Mud

A POTTER'S FIRST RULE WHEN MAKING HER QUIRKY PIECES IS THAT THEY MUST BE A DELIGHT TO USE EVERY DAY

By Sue Allison

Photographs: Juliet Nicholas

Weighing clay after kneading to ensure bowls are all of uniform weight/size for easy stacking and good appearance

Renate kneading clay to expel air

Various finished items ready for sale

Christchurch potter Renate Galetzka draws inspiration for her colourful and quirky pots from her daughter's stint as a circus trapeze artist and the books of Dr Seuss.

"I want to make people smile," says Renate, whose pots are fanciful but functional, made to be used not left on the shelf. "I make pots to brighten your day every day."

German-born Renate met her Kiwi husband, Liam, in the Abel Tasman National Park in the 1980s. "I was on an OE and I'm still on an OE," she declares, and part of that on-going overseas experience included discovering the art of ceramics. She took hobby classes in Christchurch, followed by "work experience" with one of the grand dames of New Zealand pottery, Frederika Ernsten, looking after her gallery in return for lessons. Renate went on to run and teach pottery at the Risingholme Community Centre.

Traditional engobe earthenware

In the early 2000s, she and Liam spent several years in Switzerland where Renate did an adult apprenticeship in ceramics at the Schule für Gestaltung (School of Design) in Zurich. Here, she became interested in the traditional 'engobe' earthenware of the Swiss mountains, which uses coloured clay slurry, or 'slip', as a decorative underglaze. Renate has adapted the technique to her own designs, painting and trailing stained slips to produce colourful raised patterns on her pots. The decorations are applied to the raw, dry clay, after which the pots are fired to low 'biscuit' temperatures before being finished with a clear over-glaze fired to 1200°C.

Renate works from home in a converted two-car garage in the seaside suburb of Brighton. Her equipment includes two electric wheels — a Japanese Shimpo for dark clays and a New Zealand–made Cowley for her more often-used white ones. She has a bench grinder for sharpening tools, a skill saw, drills, and an array of buckets and sacks full of clays and glazes. But otherwise her shed seems to be filled with items more often found in the kitchen: an electric frying pan (for waxing), a rolling pin, pastry sticks, spatulas, potato peelers, even a three-tier tea trolley — "In our house, if you can't find something in the kitchen, look in the garage," says Renate.

But her favourite modelling tool — and there is some pleasure in seeing it covered

Tectonic pot

Every year Renate embarks on an experimental project. Last year's was tectonic bowls. To create the colourful cracked surface, Renate first pulls up a cylindrical shape then covers it with black slip. Once this is dry, she coats the outside with a chemical that prevents the clay from stretching. "From then on, you can only work from the inside, pushing the clay out a bit at a time." The pressure creates cracks on the outside surface, which she fills with coloured ceramic stain. "Sometimes it works and sometimes it doesn't. If you aren't careful, it just rips open." Renate coats the outside with wax to preserve the effect before glazing inside the pot.

Coloured paints/dyes and brushes

in mud — is a credit card. Although purpose-made tools can be purchased online, nothing beats a credit card for the firm bendiness required when shaping a pot on the wheel, she says.

Natural sequence

One domestic device that never appears in her workshop is the vacuum cleaner. "All that does is create fine suspended dust particles, which are the most dangerous of all," she says. Instead, she sprays daily with a water bottle to, literally, keep the dust down.

Just outside is a tin shed containing her electric kiln, which is partially powered by photovoltaic panels on the house roof. "If I fire my kiln on a sunny day it will hardly cost me anything," she says.

A comfortable dog's bed is a permanent fixture in the workshop. Every morning Renate takes retriever-doodle Milly for a walk before they settle into the studio for around six hours each day, tuned into National Radio.

Renate works around firings, which take three days by the time the kiln has cooled down enough to empty. She follows the natural sequence of pot-making, devoting blocks of time to throwing, turning, decorating, and glazing. "I try not to do too many repetitive things to avoid RSI [repetitive strain injury]," she says, stretching her hands before settling at the wheel. She adds a few neck rolls today as she is suffering from whiplash, not from a car accident but from an extra-heavy landing during one of her thrice-weekly Aikido sessions. It seems that this mild-mannered potter, who also crochets and knits her own socks, is a third-degree black belt. ▸

Preparing the leather-hard surface before attaching the handle

"I was on an OE and I'm still on an OE"

Nice to use

Renate uses Mac's Mud man-made white clay for most of her work. Her pots are microwave- and dishwasher-proof and she only uses food-safe glazes. A stickler for producing well-made domestic ware, she emphasizes the importance of light, well-thrown pieces.

"Sometimes you buy things because you like the look of them but they end up at the back of the cupboard because they aren't nice to use."

Proof is in the pudding, and her domestic ware is sought-after by restaurants, with a recent order for a new Christchurch eatery incorporating earthquake liquefaction in the glazes. "I collected liquefaction from three different sites around the city. I knew I wanted to use it in something sometime." She added the strained silt to the glaze, making it "go a bit sparkly". Renate supplies a number of galleries around the country, as well as working to exhibitions and private orders.

One of Renata's unique 'tools'

The process

Wedging: Clay must be 'wedged', or kneaded, before use to remove any air bubbles and get a homogenous consistency. When making a set of uniform-sized pieces, Renate weighs the clay on a set of vintage scales picked up in an op shop for $5.50. She uses 600g for her muesli bowls. "If you want bowls to stack, you have to be precise," she says. The clay is wedged with a rhythmic roll-press-roll-press motion. While it resembles kneading dough, it achieves the opposite — expelling air rather than lightening a loaf.

Throwing: The process of making a pot on a potter's wheel is called 'throwing', strangely.

"You throw the lump of clay into the centre of the wheel to start with, but that's the last time a pot should be

Several aspects of throwing/ turning a bowl using various reused 'tools' in the process, including credit cards, baking utensils, etc. Note the well-positioned mirror that enables her to see her creation side-on while she is wheel turning

Forming and attaching a handle to a mug

Renate starts by decorating the foot of the bowl.

The application of decorative colours by brush. After this, the raised slip is squeezed on from a plastic bottle

Renate's kiln is partially powered by solar panels on her roof

It seems that this mild-mannered potter, who also crochets and knits her own socks, is a third-degree black belt

thrown anywhere," says Renate. It turns out the term comes from the Old English 'thrawan', meaning to twist or turn.

Renate forms a dome with wet, cupped hands, then presses her thumb gently but firmly downwards to form an opening at the centre. She takes care to compress the base to prevent it cracking when it dries. The thickness of the base can be measured with a needle. Renate works quickly, regularly wetting the clay with a sponge as she brings the form up. A mirror propped on the wheel ledge allows her to see the shape side-on. Renate uses her trusty credit card to take off any surface slurry and to compress the sides. Once the sides are stable, she opens the form, using a pastry scraper to shape the inside of the bowl.

Fishing nylon on a champagne cork is ideal for cutting off the pot, which she then puts in a sealed polystyrene box to dry at an even temperature. An allowance of 12- to 15-per-cent shrinkage during firing needs to be made, depending on the clay.

Turning: After a couple of days, the bowl will be leather hard and ready to have its base and foot ring 'turned'. Renate turns the pot on a flat ceramic floor tile attached to the wheel with wet clay. She draws concentric circles on it with a pencil so that the centre is easy to find. She sticks the bowl, rim down, to the centre of the tile with water — "Some people secure it with blobs of clay but I find it distorts the rim."

After giving the surface a quick tidy-up, she starts shaving off ribbons of clay around the base with a steel turning tool. (The discarded clay is re-wedged or used to make slip.) The bowl's shape should continue through the foot ring. Renate takes off any finger lines with a kidney-shaped tool to leave a smooth surface for decorating. She inverts it to tidy the rim, then places it upside down to fully dry.

Making handles: To make her distinctive tail-like cup handles, Renate rolls coils, keeping them fatter at the top. She cuts each to length and slaps it on the bench to flatten one side. "If you have a handle that's completely round, it's difficult to hold," she says. She curls them to shape and leaves them till leather hard. The handles are attached with slurry mixed with a little vinegar to help them adhere. She scratches the points of attachment with an expired library card cut with fine teeth (quicker than scratching with a sharp tool). She paints slip on the attachment points, leaves it to dry until tacky, then gently presses the handle into place.

Decorating: Renate buys powdered pigments to make her own slips, mixing about 50g of pigment with 200g of slurry. The stains fire to 1300°C without losing colour. She uses a hand-spun banding wheel marked with concentric circles for decorating, resting the bone-dry bowl on its rim while she decorates the base area. Renate buys cheap brushes but ones that carry a "good load" to hand-paint her decorations and uses slip trailers to draw black spirals, outlines, and dots. She adds a few drops of bleach

States of clay

'Clay' is finely-grained earthy material composed mainly of hydrated silicates of aluminium. Clays are plastic due to their water content and become hard when fired in a kiln.

'Leather-hard' clay has been partially dried, with about 15 per cent of its moisture content remaining, leaving it firm but not brittle. It can be cut without distorting the form.

'Bone dry' refers to clay that has no moisture content and is ready to be fired. It is brittle at this stage.

'Fired' clay has been chemically transformed, irreversibly, whether into the lower-temperature 'bisque' state or high-temperature vitrification, which also fuses the glaze.

> *Proof is in the pudding, and her domestic ware is sought-after by restaurants*

to the black stain to stop it going mouldy and clogging her slip trailers. The slip has the consistency of thick cream and the moisture is quickly absorbed by the dry, porous clay. She holds the bowl in one hand to decorate the upper part and inside, finishing with the rim. The bowl is then biscuit fired to around 1000°C.

Waxing: The base or foot ring of a pot must be waxed before glazing or the glaze would stick to the kiln shelves. Renate finds an electric frying pan the best device for waxing as she can roll the base evenly in the heated wax without having to paint it on by hand.

Glazing: Renate buys glazes by the sackful, mixing them with water and storing them in buckets. The heavy glaze materials sink to the bottom, and she finds toilet brushes the best thing for stirring her glaze buckets. Tongs are used to dunk the pots in the glaze.

A fun and quirky clock

Colourful Salt Pig

The clear glaze used over slip-decorated pots is opaque until fired.

Firing: Renate uses high-temperature earthenware clay fired in an electric kiln to 1200°C. It takes 10–15 hours to get the temperature up, a pyrometer reading the temperature to within 5°C. Once the kiln has reached the desired temperature, she turns it off. It is so well-insulated that the temperature comes down very slowly. Once the kiln is down to about 100°C, she props open the lid. It's important to resist the temptation to lift the lid too soon or the pots will crack. "It's a shock not only to the pots but also to the electric elements, which are expensive," says Renate. Renate records every firing in an exercise graph book, from the contents of the kiln to any problems. "Sometimes I have a disaster," she says. One notable one was documented on 22 February 2011, the day of the big Christchurch quake when, with a mere mess of pots stuck to the kiln shelves, the philosophical potter simply counted her blessings.

Candlesticks

Renate's candlesticks are made by throwing the individual beads on the wheel and drilling a hole in them when they are leather hard. She stacks them on a steel rod on a polished stainless-steel base, which she gets made by a local metalworker.

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Desolder pumps, with Phillips one on the left — note its smaller length

SOLDERING ON

PART ONE

ALL SOLDERING EQUIPMENT IS NOT CREATED EQUAL. HERE ARE SOME TIPS AND TRICKS

By Mark Beckett

Photographs: Mark Beckett

The other day I was having a conversation with *The Shed* editor Greg Vincent, and I realized that although we have been doing a variety of articles on electronics, we haven't talked about the tools needed to do decent work.

Everyone knows that at some stage you need to blame your tools (after the other excuses have run out), and like most things you can pay a little money or a lot, and sometimes there is little difference in the result … or so it would seem.

The purpose of this article is not to separate you from your hard-earned cash, but to share a few tricks and provide some information so you can make an informed choice when buying equipment.

Stations and irons

Everyone knows that the best soldering iron is some large lump of material that you throw into the fire until it is red hot and then apply to the job and hope that some of the exploding material fuses the bits together.

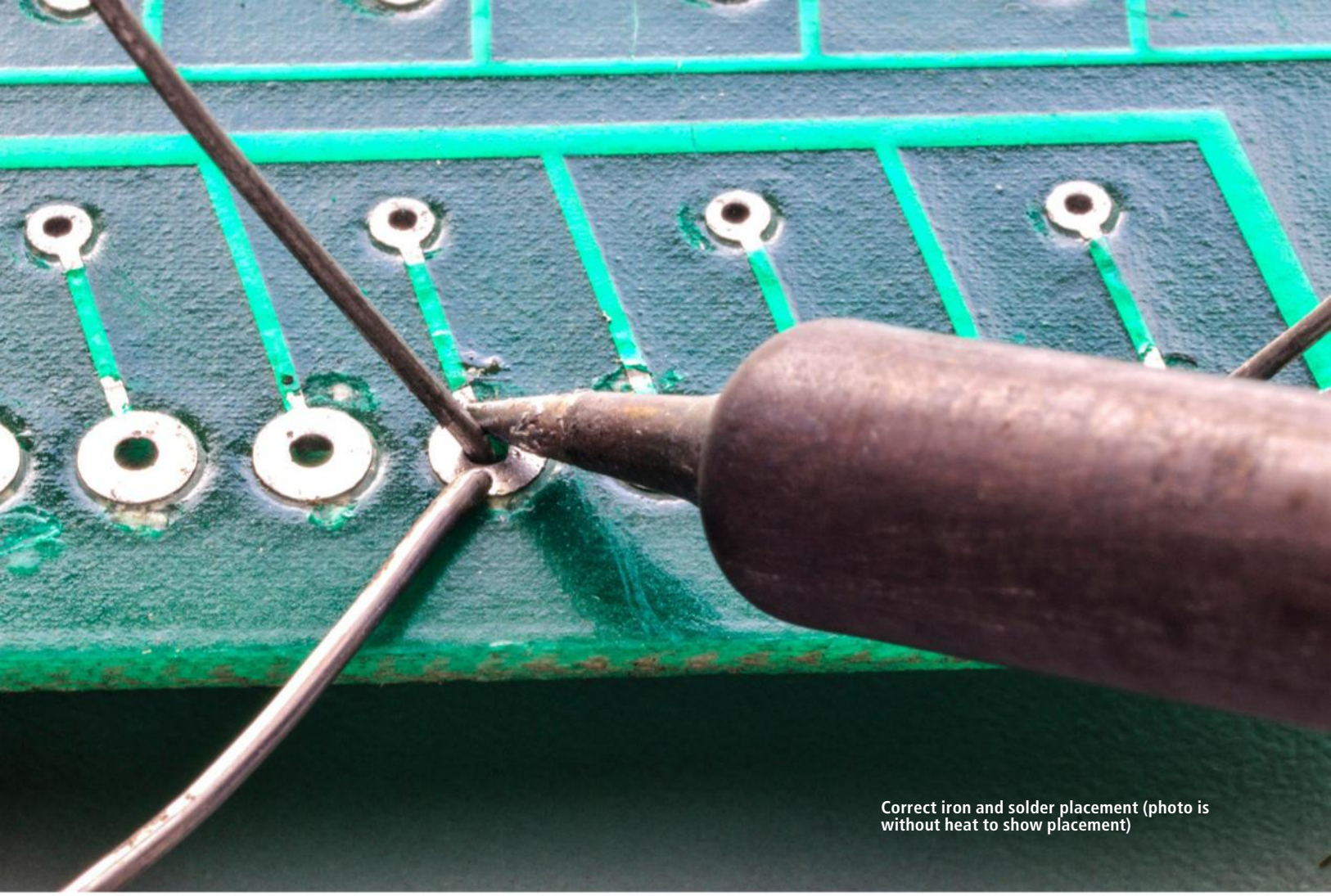
That might work for simply joining two bits of metal together but it is not going to work for electronics.

Soldering electronics involves making not only mechanical bonds but also electrically conductive joints. The solder used has a particular temperature range and if it is too hot it will overheat the joint and make it porous, while if it is too cold it may stick to one or another part but not bond.

The basic soldering iron consists of a heater and a tip. The wattage is limited to 25–40W to stop overheating the tip. It works well on small joints and relies on the thermal mass for larger joints.

As it takes time to warm up, it tends to get left on and there have been attempts to reduce the heating with inbuilt or aftermarket controllers, much like a light dimmer, which simply reduce the power applied and therefore the maximum heat.

Clever versions detect when the iron is in the stand and put full power back on when it lifted, but the thermal lag becomes a nuisance and often is bypassed.



Correct iron and solder placement (photo is without heat to show placement)

I have never really paid any attention when I'm soldering — it's either hot enough or not

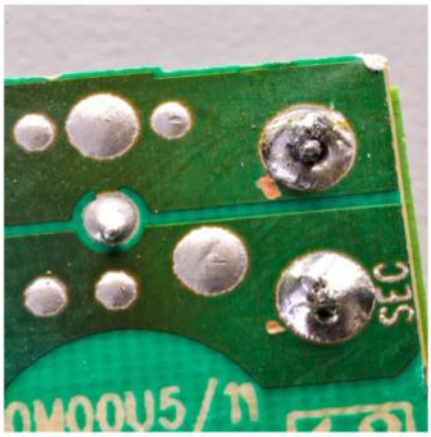
Temperature-controlled irons

Weller produced a version that controlled the temperature by using a magnet inside the tip. As the tip heated to the desired temperature, the magnetic force reduced and switched off the heater. As the tip cooled, it switched back on. The tips were expensive but lasted for many years if looked after.

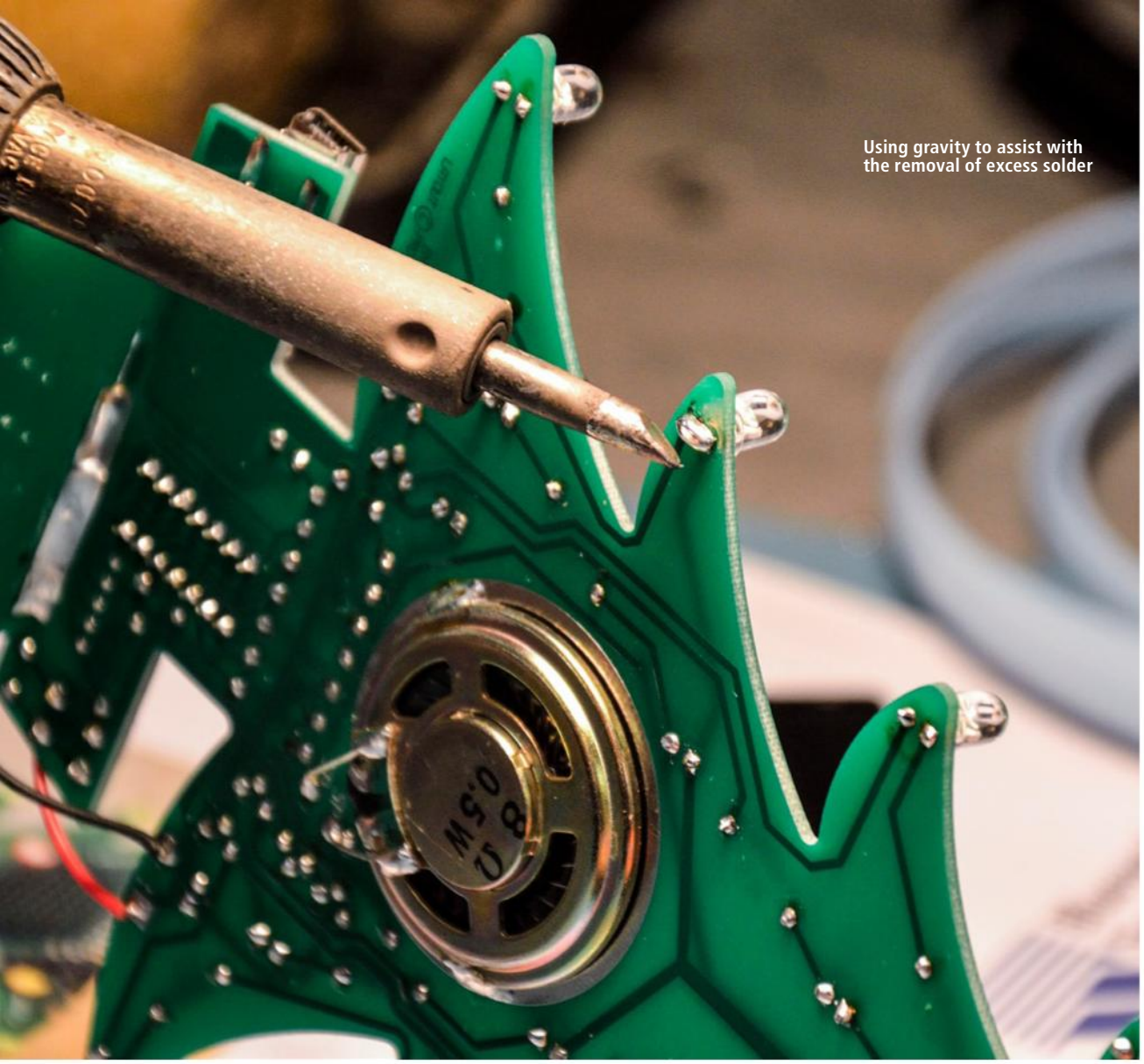
Since then electronics has taken over and there are a range of stations with adjustable temperature control, either by using a setting or a knob.

Some models include active measuring of the tip temperature, although I have never really paid any attention when I'm soldering — it's either hot enough or not. ▸

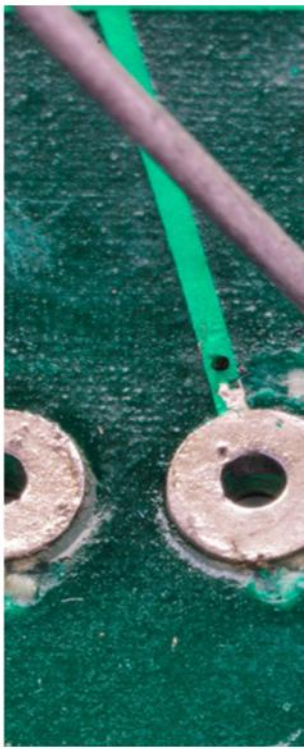
A solder joint where the solder has not adhered to the connector, resulting in issues later



Desolder pump placement while heating the solder joint



Using gravity to assist with the removal of excess solder



The temperature control approach has allowed a much higher wattage iron to handle the wide range of solder joints we find on modern circuit boards.

As a consequence, the time to warm up has been reduced, along with the thermal mass problem with larger joints.

Rework stations often include a soldering iron, but if I were to purchase one separately I'd be looking very hard at this: http://nz.element14.com/tenma/at980d-eu/soldering-station-80w-220vac-eu/dp/2535192?rpsku=clone:253519201&isexcsku=true.

Proper solder joint

When introducing the subject of electronics, pupils are taught how to solder and how to recognize the difference between a good solder joint and one that may cause problems later.

The shape of Mount Fuji is an example of what a good solder joint should look like. When viewed in profile the mountain has a curve, or 'fillet', in the transition from horizontal to vertical on both sides (well, it does in the pictures).

The board (PCB pad) and component wire are heated equally and then solder is applied to complete the joint. This whole process takes less than five seconds.

Applying heat to a printed-circuit-board (PCB) pad for much longer is likely to lift the pad from the board (giving you another issue), so unless it is a very large joint, keep the heating time to a minimum.

The state of flux

One problem we see is that the iron is placed on the joint and solder is applied onto the upper surface of the tip, rather than at the junction of the pad and component. Solder for electronics contains a resin flux and the flux gets burnt off when incorrectly applied.

The smoke and visible fumes are indicators of this happening, along with dark flux residue on the board. By applying solder down at the intersection of the board and component, you'll be able to see it melt and disperse. At this point remove the solder, *then* the iron.

Adafruit has a very good guide to soldering and problems: https://learn.adafruit.com/adafruit-guide-excellent-soldering.

Soldering takes practice and some people never seem to be able to master it, so don't worry if you struggle … you're not alone.

Poor solder joint

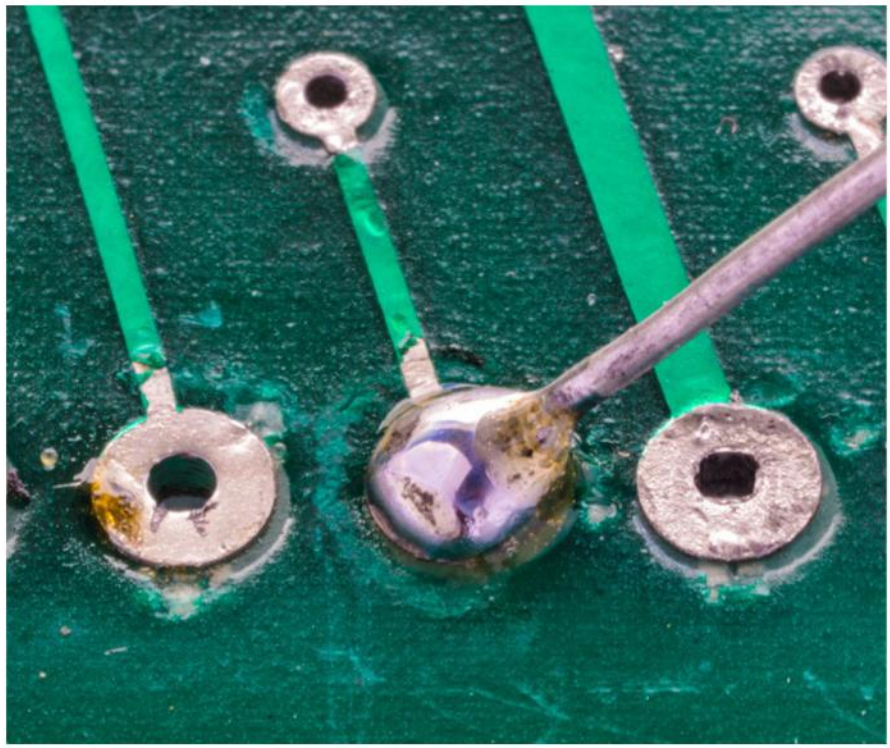
So now we have a good soldering iron, and we use the right technique, what can go wrong?

For proper bonding to occur, both surfaces need to be clean and shiny. If the components you are using have been sitting around, then the tin coating may have oxidized, which can cause problems.

You can 'tin' the component lead before inserting it, or sometimes the soldering process (flux) will clean it.

'Tinning' is when you apply heat and solder to the component only and

Here the solder has not adhered to the component lead either due to oxidation or use of the wrong technique



There is too much solder, which could be masking a poor connection to the PCB pad

the result is a light coating of solder. It may release the impurities (often dark-looking reside), so sometimes a quick wipe is required to be sure it doesn't get into the solder joint.

If the board is not shiny, then a pencil eraser works wonders to remove any oxidation.

Solder solutions

You may have applied too much solder and the joint is covered, so you can't be sure if it has bonded.

My first solution to this is to use gravity to remove the excess solder. I turn the board upside down and apply heat to the solder joint, then pull it down the component lead and away from the joint.

The next solution is to desolder it.

The guides always talk about finished solder joints being nice and shiny, and while that is true for lead-based solder, the move by manufacturers to lead-free solder results in a dull surface.

Surface-mount-technology (SMT) solder joints are far less obvious and the method, tools, and solder used to join the component to the board is different.

Desoldering

This is the process of removing solder, usually with the aim of separating the component from the PCB.

There are several methods and each has its place and cost for the tools required.

Here, we will talk about cheap, simple tools, and in a later article touch on desoldering stations.

Desolder braid/wick

I've heard people swear by desolder braid/wicks and I've heard people just swear.

'Solder wick' is a copper braid-like product that soaks up the solder. It is more suited to SMT but is useful to remove excess solder.

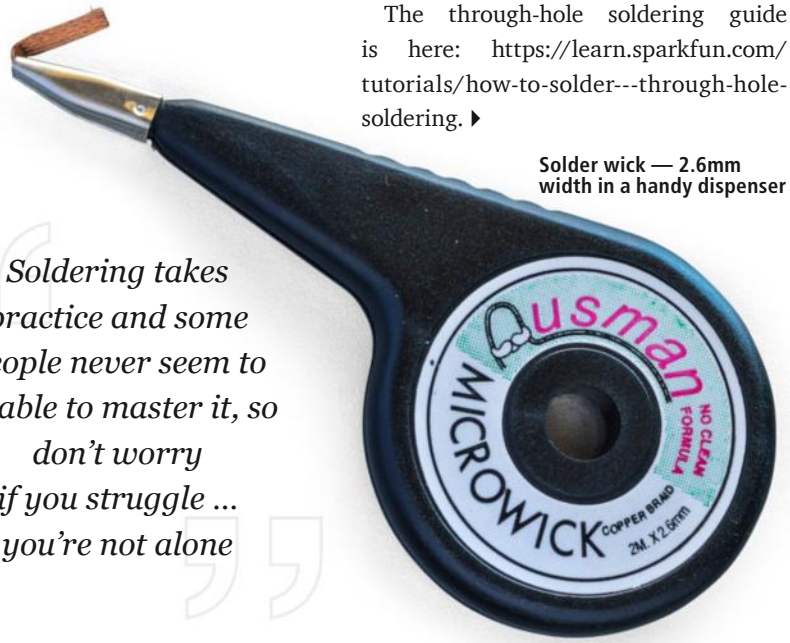
It comes in different sizes and there are some cheap products that cause more frustration and damage than they are worth.

The technique is to apply the soldering iron onto the wick and then onto the solder joint. The heat goes through and it pulls the solder away from the board.

The heat and force can lift solder traces so be careful about how long it is used in one spot. It is very useful for cleaning up holes, but then so is a solder pump.

Don't be fooled — they come in different widths and the cheap stuff may not work as well. This soldering guide is rather good, and they use the braid/wick to clean up a joint: https://www.sparkfun.com/tutorials/96.

The through-hole soldering guide is here: https://learn.sparkfun.com/tutorials/how-to-solder---through-hole-soldering. ▸



Solder wick — 2.6mm width in a handy dispenser

Soldering takes practice and some people never seem to be able to master it, so don't worry if you struggle ... you're not alone

Relative sizes of desolder pumps against AA batteries

Desolder pump

A 'desolder pump' is a tube with a spring inside that is released, causing a vacuum at the tip. The soldering iron and desolder pump are applied to the joint and once the solder is melted, the spring is released and the solder gets sucked up the tube.

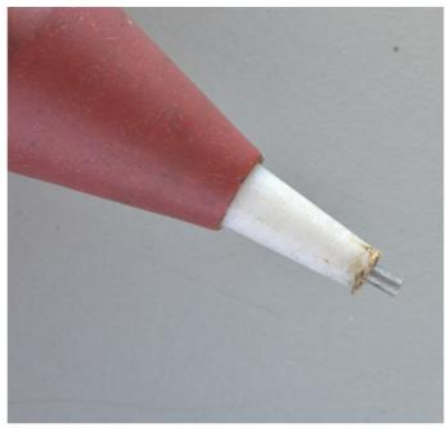
It is a bit of an art but with some luck mixed with dexterity, you can easily suck all the solder from the joint. Again, excess heating of the pad can cause it to lift.

Desolder pumps work well on one or two joints, but can be a pain to use. To use them, you press down the plunger to compress the spring. Heat up the joint and bring the nozzle as close as you can, then press the release button.

As the plunger is released it sucks up the hot solder inside the pump. Obviously, the closer the nozzle is to the joint, the more effective it is.

The best model I have is a Phillips-branded version that is slightly smaller than others and utilizes a smaller nozzle. This means you're not fighting

> *I should have bought three or four at the time, because they don't seem to be available anymore, so I'm looking after mine*



A metal plunger rod extends past the end to clean out solder from the nozzle

The internal components of a twist-lock-style desolder pump

the soldering iron for the same space and the suction velocity is higher.

I should have brought three or four at the time, because they don't seem to be available anymore, so I'm looking after mine.

Buy and try

Something to watch for are desolder pumps models that have the nozzle inserted from the outside.

When you push the plunger down fully, it protrudes through the nozzle to clean out any solder lodged on the sides. With the external-insertion-type nozzle, they can be pushed out.

Models with softish nozzles can deform rather than clean out properly.

The only maintenance is to make sure the O-ring is clean and lubricated, and check that the nozzle is not damaged. Along with replacement tips, they should outlast your ability to keep soldering.

It's rather hard to see all these things just from looking at a catalogue, so don't be afraid to ask at your local suppliers or buy different types until you find the one you want.

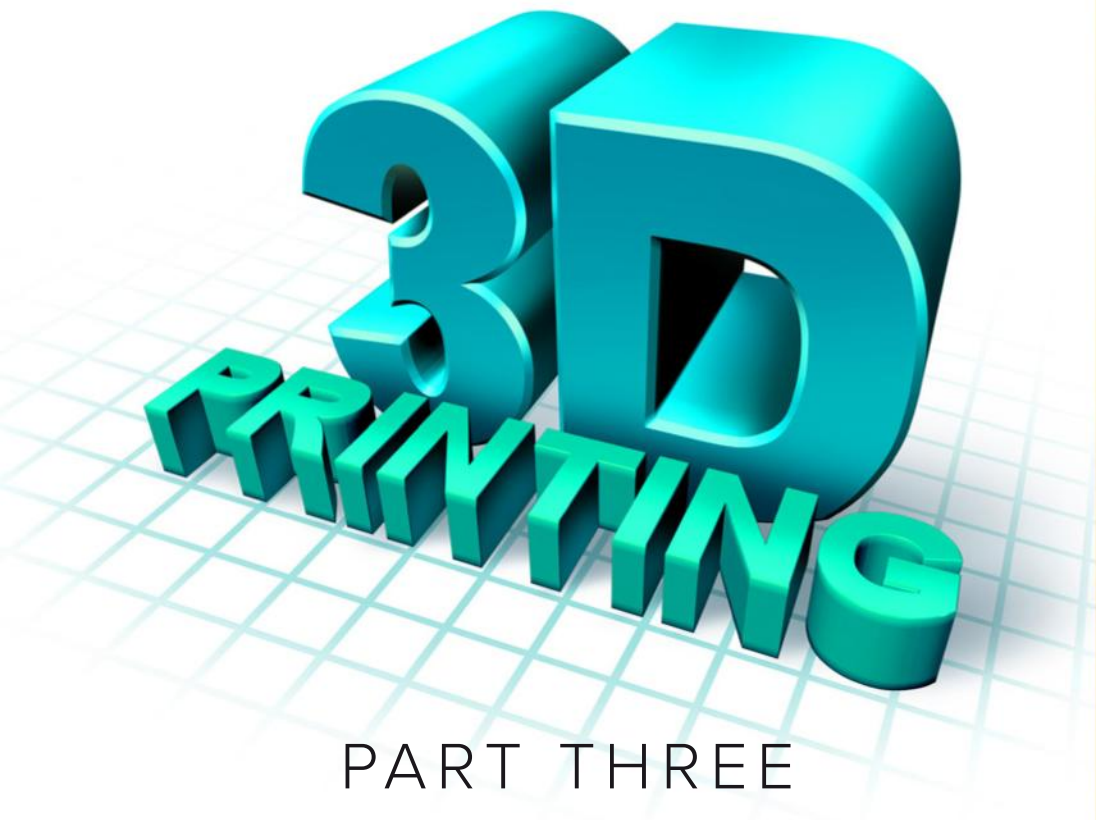
If you have smaller hands, the length can also be very important as they are meant to be used with one hand. Element14 has a good range, with varying types and different prices; you can expect to pay from $5 to $70.

My suggestion is to buy one that screws together as I've seen the others fly apart.

I usually stretch the spring to apply suction more quickly; however some argue that Mr Newton's third law of equal and opposite force means it makes contact with the heated pad and increases the damage.

Whatever version of solder pump you buy, make sure you grab a couple of extra tips for it.

In the next issue of The Shed, we'll talk about desoldering stations like this one



PART THREE

THE THIRD PART IN OUR 3D PRINTING SERIES LOOKS AT THE IMPORTANCE OF SETTINGS IN ACHIEVING AESTHETICALLY PLEASING RESULTS

By Enrico Miglino

Photographs: Enrico Miglino

In this third part of our series, we will address the 3D printer setting details by following a real-world creation: the model mock-up of the PONF camera (the official site is http://ponfcamera.com), an innovative project aimed at creating the first dual-back (digital and analogue) reflex camera.

This is a kind of 3D-printed item for which the aesthetic result is a key factor. Our goal is achieving (as much as possible) the same skeleton that the product will have. The process described here is not limited to the bare 3D printing of the STL files but also involves some interesting craftwork / post-production.

The first step was creating the design of the components with Rhino 5 CAD software — you can see some of the 3D renderings in the illustrations on these pages. The process described can be easily applied to plenty of 3D-printed static models.

Bed calibration

We mentioned in a previous article the importance of the correct bed calibration for a good printing job. To proceed to calibrate the 3D printer bed manually, we will adjust the four calibration screws, one at every corner. In an attempt to make things easier, some models provide only three calibration points. I had the opportunity to use both methods and found that I obtained better results with the four-screw system. The procedure is not too difficult but should be precise. ▸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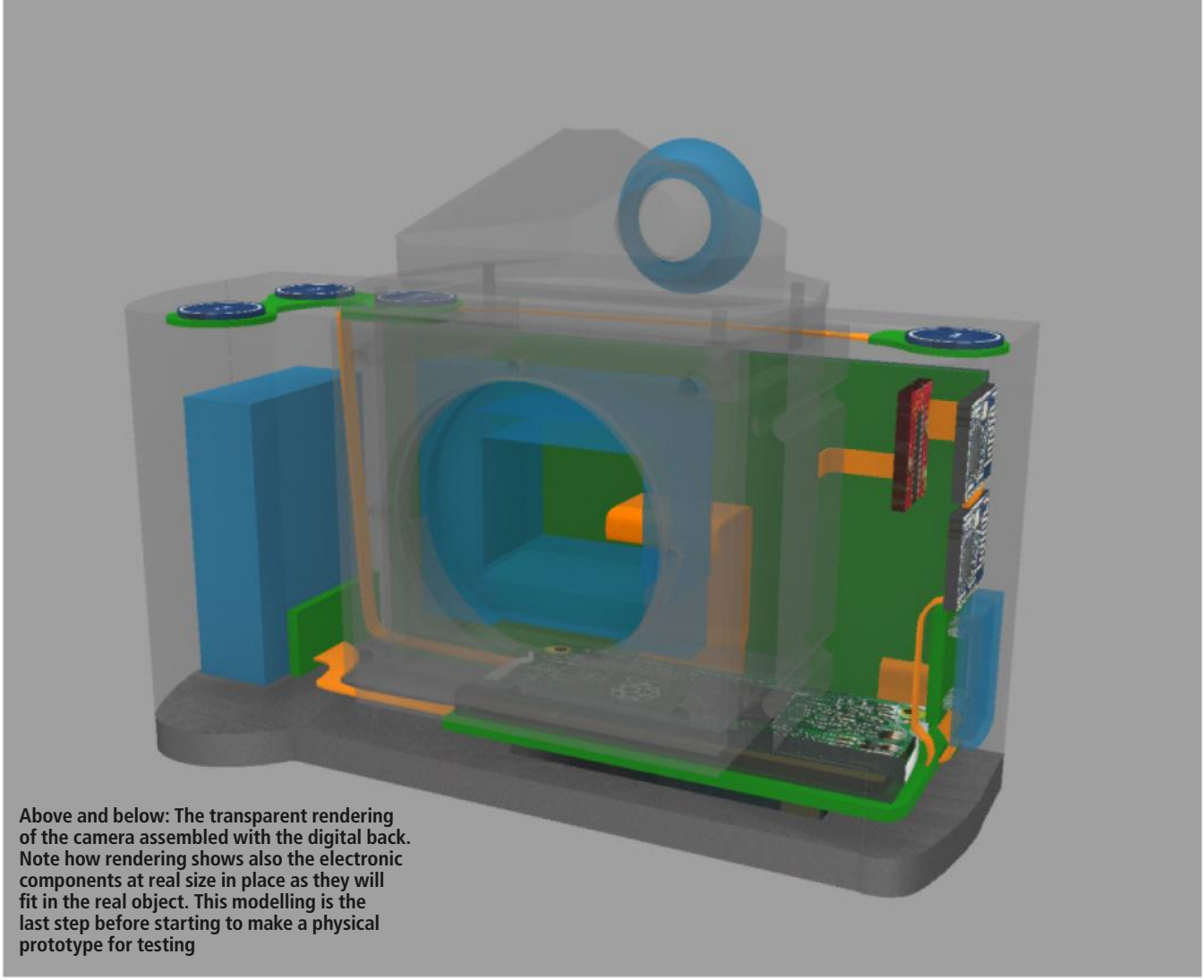


Above and below: The transparent rendering of the camera assembled with the digital back. Note how rendering shows also the electronic components at real size in place as they will fit in the real object. This modelling is the last step before starting to make a physical prototype for testing

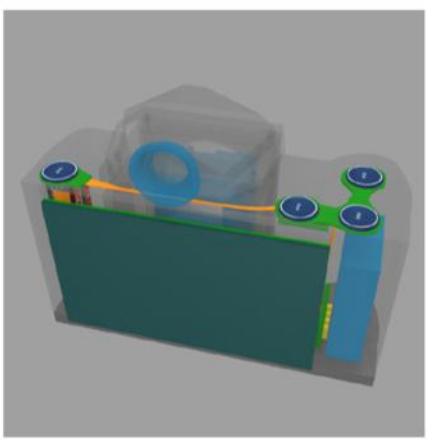
Four-point calibration procedure

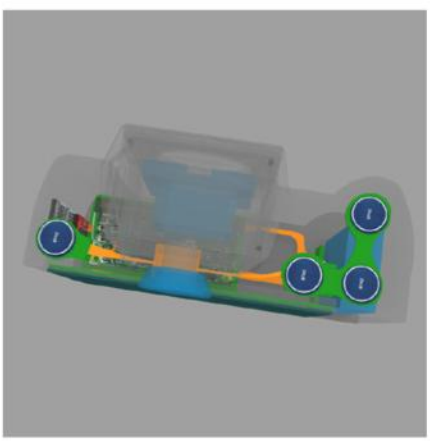
Position the extruder making the Z-zero at about .5mm from the bed. The 3D printing software has an auto-zero function to position the extruder nozzle at the axis origins.

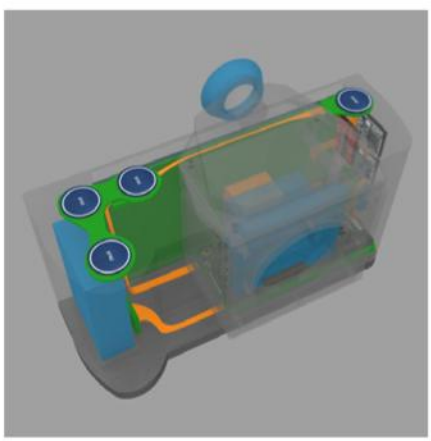
Using the manual controls on the printer or the 3D printing software, move the extruder nozzle to the first corner. No matter what method you choose, check the distance of the nozzle from the bed surface with a .10mm thick feeler and rotate the corner calibration screw to the right distance. Repeat the same procedure on all the four corners.

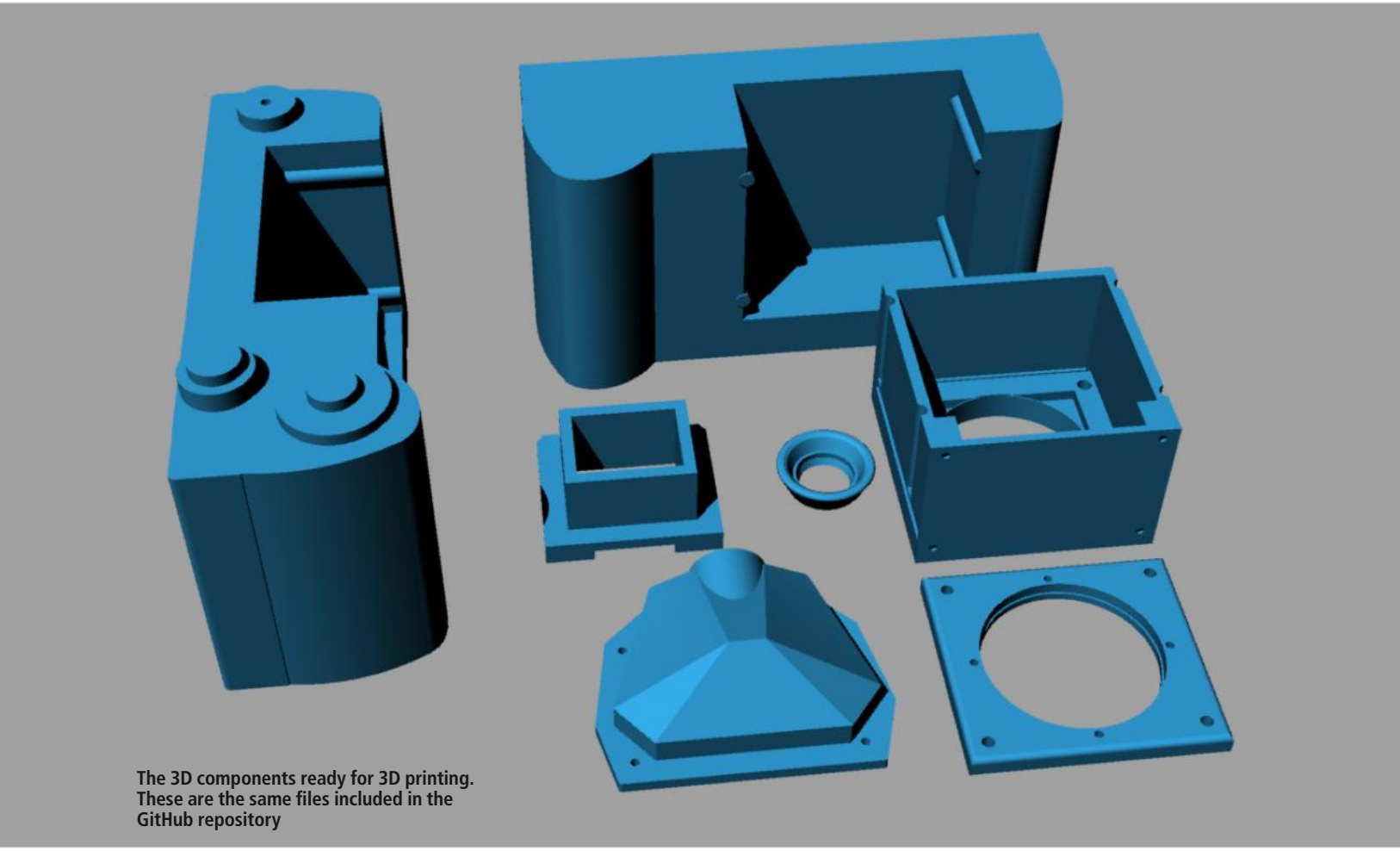
The process we describe can be easily applied to plenty of 3D printed static models

The optimal distance between the nozzle and the flat bed should be .5–.7mm. However, one calibration on every corner is not sufficient — modifying the distance of one corner of the bed slant will affect the settings of the other three corners. So you will need to repeat the four-corner calibration until the distance value is constant at all the test points. It is important to note that the calibration process is not a stable condition — temperature variations during print jobs and other factors affect the settings. It is good practice to check the bed calibration frequently and always before starting a new job.









The 3D components ready for 3D printing. These are the same files included in the GitHub repository

Automatic calibration

Alternatively, the manual procedure can be automated with a 3D printer auto-levelling sensor. This is a tool permanently applied to the extruder, which is able to detect the distance from the bed. The automated process has pros and cons and can be applied only with compatible 3D printers.

Pros: The automatic levelling sensor is a good choice if the user has no experience and is not sure of being able to carry out the manual calibration. The automatic levelling process is faster and can be very efficient if the bed is (almost) aligned correctly. After the sensor installation, it is easy to use.

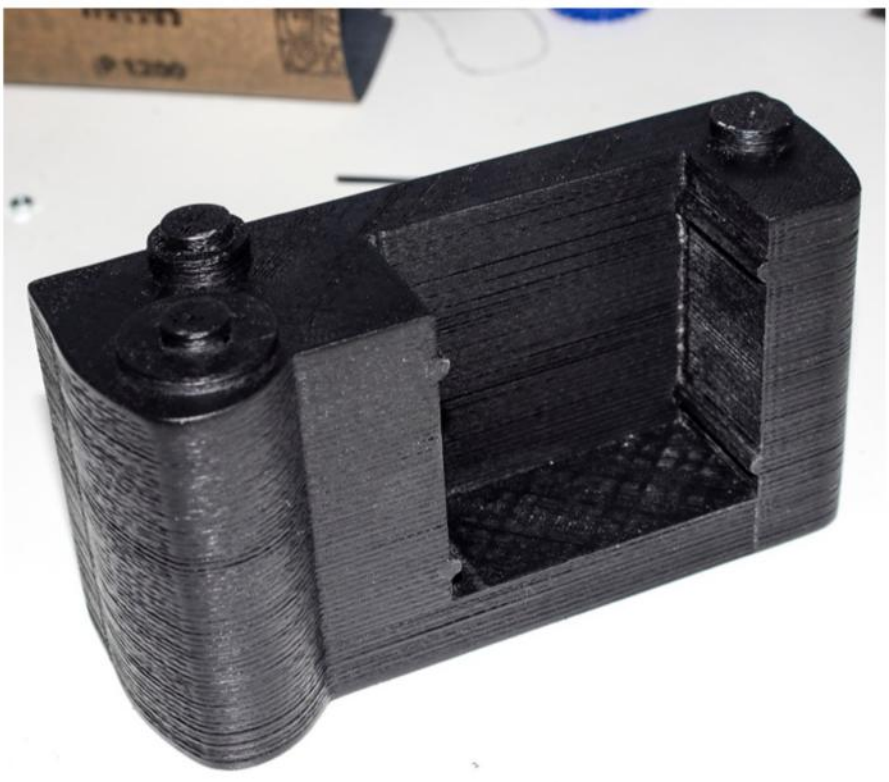
Cons: The sensor is not expensive but not super cheap, either. If it is included with the 3D printer it can increase the cost of the device as a meaningful value-added. The extruder model and 3D printer should be compatible with the sensor installation. The 3D printer controller board should be compatible; an extra connector for the level sensor should be available on the board. A firmware upgrade is needed to make the sensor work correctly.

Unfortunately, the auto-levelling sensor cannot be considered 100-per-cent trustworthy. It can detect the bed slant but will not change its orientation. During the 3D printing process, the controller firmware applies the mathematical corrections to the G-code `instructions, compensating for the bed misalignment. This is as if the extruder were correctly moving over a non-plane surface. It risks introducing a systemic error, resulting in imprecise object generation.

During the past couple of years, this

The toolset used to finish the 3D-printed components before painting. The surfaces were completed with multiple passes with sandpaper (800 and 1200). As electric tools heat up and PLA plastic material tends to melt when it becomes hot, the process can only be completed by hand

This page and top of next: The bare 3D-printed parts of the model. Now the finishing process should be applied, before the parts get painted



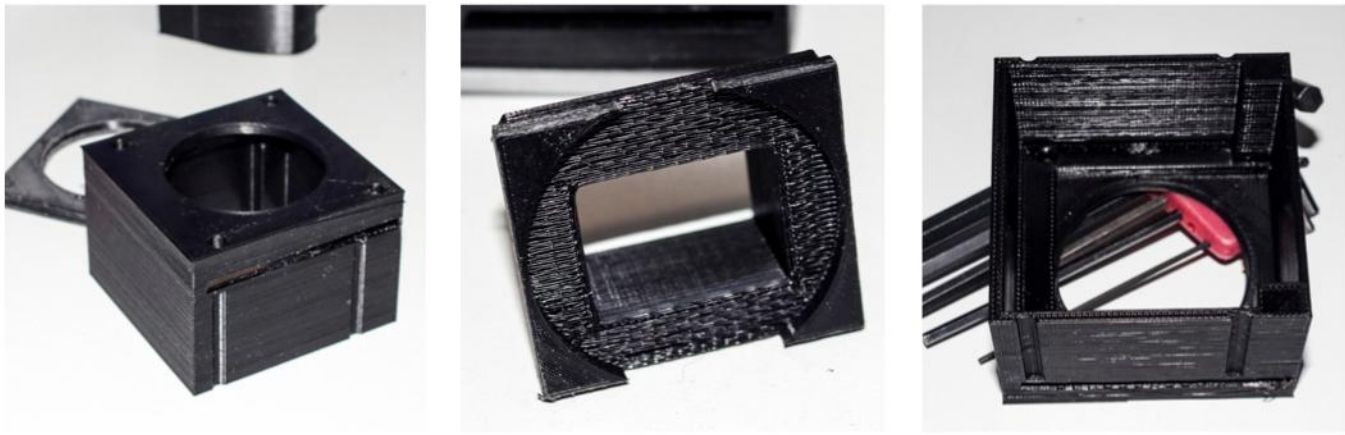
tool has become more popular and there are always more 3D printer models arriving that are compatible with or include the sensor in their original build specs.

STL model control parameters

Starting from the same STL file we can achieve very different results and qualities depending on how we configure the slicing algorithm. Our choices depend on what kind of object we are creating and its usage. In our case, we are building a model, so aesthetics is more important than robustness.

The two parameters that influence the final quality the most are speed and layer-thickness settings.

It is important to keep the printing speed within an acceptable range, as the faster the extruder moves the greater the loss of precision. Consider that every filament has its own best 3D printing speed. Different materials have different fusion temperatures and



The camera body's two-parts. The interior will host the re ex mirror and has been left rough without paint, to enforce the material difference with the exterior, finished and painted. The chassis parts of the camera will be produced with light Aluminium or Magnesium while the internal components will be a plastic molded shell to host electronics and flat connectors.

> *To achieve good quality with a DIY 3D printer, don't count on the maximum printing speed declared by the manufacturer*

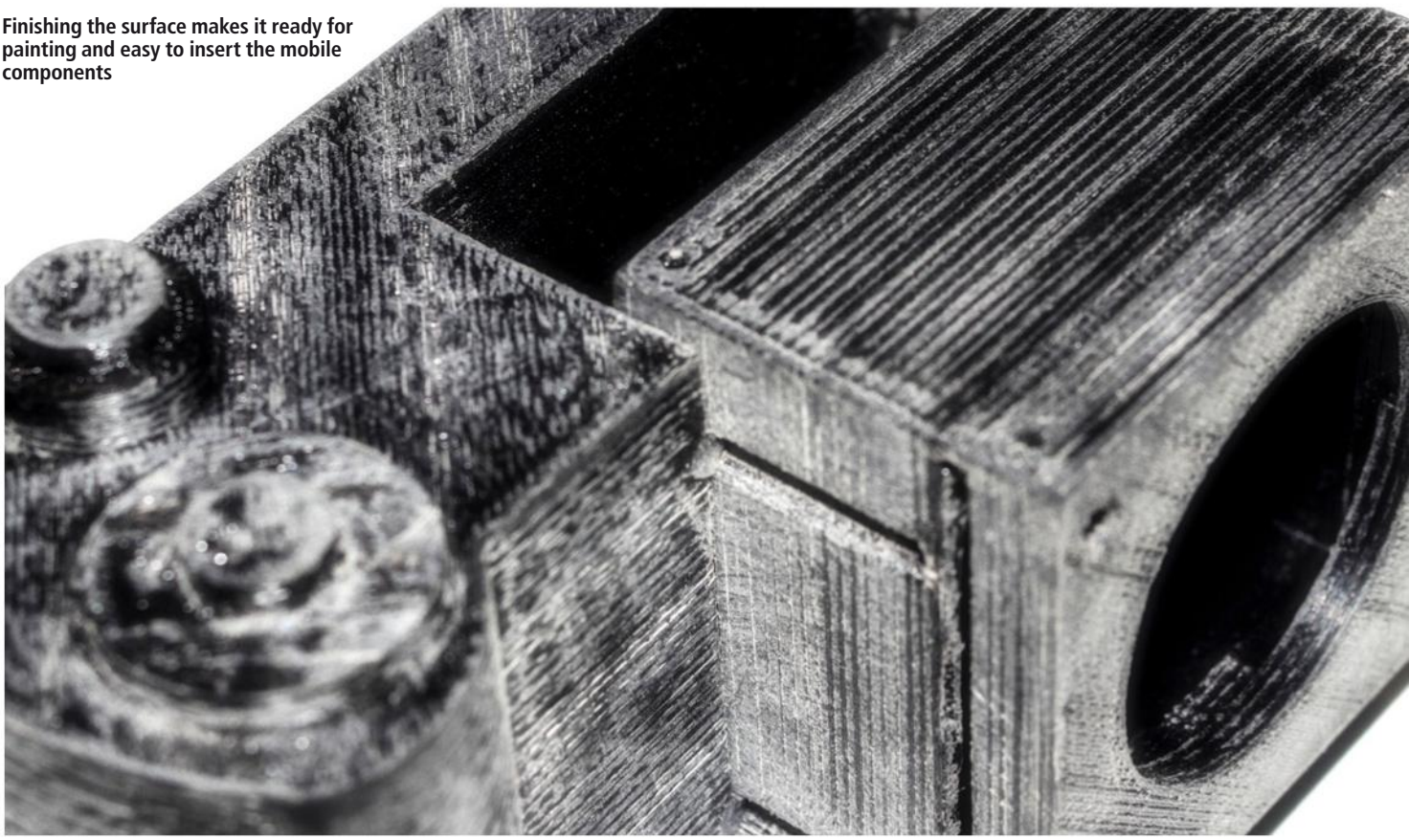
different physical characteristics. For example, ABS (acrylonitrile butadiene styrene) is more flexible than PLA (polylactic acid), has a higher fusion temperature (about 220°C) and the model may be more resistant to temperature changes, but it is more flexible. However, mechanical printed parts — especially mechanical moving parts — may end up being difficult to use and require a lot of refining.

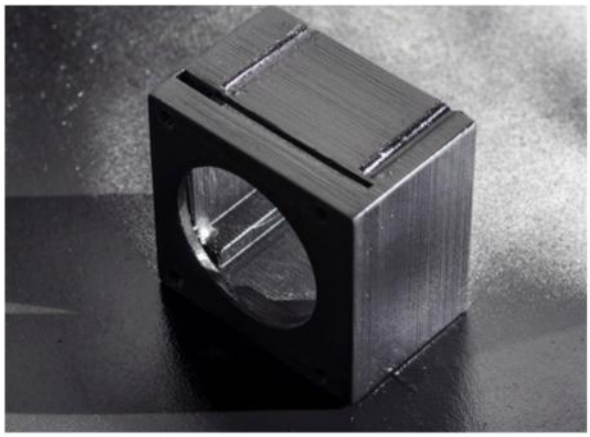
In the past, I have tried to make motion pieces with ABS and experienced a lot of difficulty. PLA (which fuses at about 180°C) is easier to manage. I prefer to use PLA as I get more precise results.

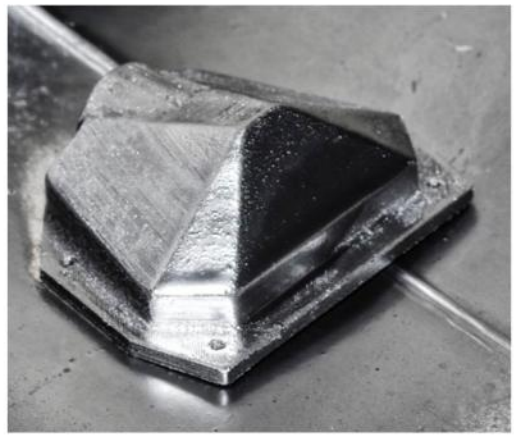
When working with different materials, you should consider adopting different configuration settings (i.e., speed, kind of support, preferred nozzle diameter, etc.). The settings we use in this example refer to PLA filament.

The STL files were sliced with the Cura algorithm, slice thickness of .2mm and nozzle diameter of .4mm. A slice thickness of .1mm may generate more precise vertical surfaces but double the printing time. In this case, as we will be

Finishing the surface makes it ready for painting and easy to insert the mobile components







Metalized and black painting of the finished parts done with matte black and aluminium metalized spray paint. To obtain a good surface effect, every piece was painted five times very lightly to avoid imperfections as much as possible

finishing the parts and spray painting, it is not necessary, so I have opted for the faster printing process.

The best solution when deciding the print speed should be based on tests on the printing model you are using. There are too many parameters that influence this value so that it is almost impossible to find a general methodology.

To achieve good quality with a DIY 3D printer, don't count on the maximum printing speed declared by the manufacturer. The 3D-printed parts shown in the illustrations were produced with the following parameters:

- global printing speed: 55mm/s
- outer perimeter speed: 28mm/s
- infill speed: 65mm/s.

Note: A more detailed view of the set-up used to print the camera mock-up model (and all the relative CuraEngine settings) can be found in the Issue No. 77 folder on *The Shed* magazine GitHub repository: https://github.com/alicemirror/ShedMagazine/tree/master/Issue77.

Positioning the model

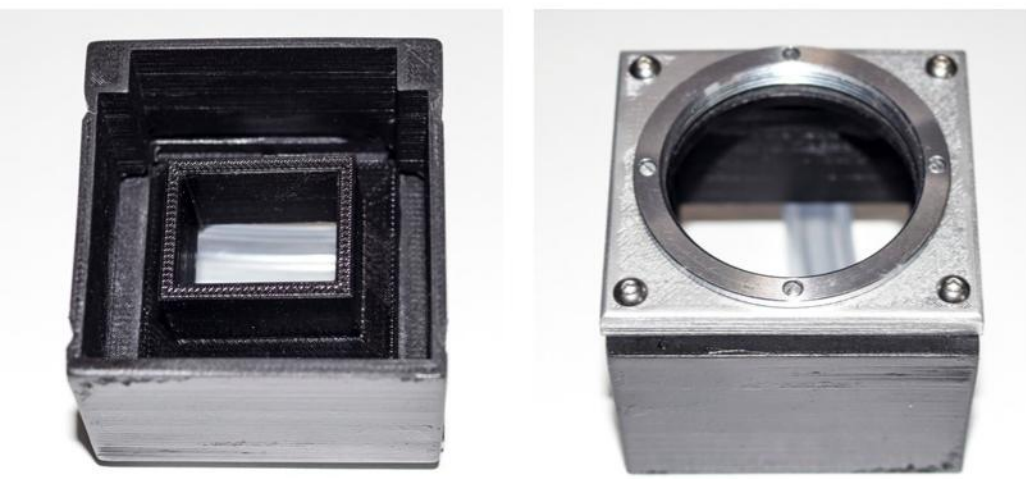
In regards to model orientation, there are some good practices beyond the obvious. First, always try orienting the object with its largest side to the bottom. This will provide better adhesion. Second, the lower layer should, when possible, be the flattest surface of the model.

'Brim' is the first layer extra surface created by the slicer algorithm to increase the adhesion of the printed object on the bed. A good brim width is 5mm. Setting a larger value does not add any worthwhile improvement but instead consumes extra material that will need to be discarded. Brim setting is a must when printing small components, but it should be considered a good habit. I always enable this feature on all my print jobs.

Support set-up is not always needed. It is a means to automatically add building structures to the model to print 'impossible' parts. For example, without a proper support setting you get very bad results on a vertical side with a rectangular hole in the middle.

The slicing technique is based on a progressive vertical construction of a 3D object. It is essential that the filament of every layer is extruded over the previous one. To avoid filament extrusion 'on the air', we need to create a support. It is a light grid — automatically added by the slicer algorithm — starting from the last layer, printed until there is no next solid layer. ▸

> *As there will be no mechanical stress on these components, printing at full density would have been a waste of time*



The finished model of the camera body (above) with the Aluminium M43 ring for the lenses and the finished analog back model (below).

Fill percentage

The CuraEngine supports a fill percentage of between zero and 100. With a 100-per-cent fill setting we make a solid plastic object. In my experience with many printing experiments, a fill percentage range between of 20 and 75 per cent covers most needs.

When a solid STL design needs to be printed empty, the zero-percentage setting is perfect, but the object should be open on top otherwise the 3D printer will try to close the object with the top surface, resulting in a bunch of melted plastic inside the model.

In some cases, when I need to print thin objects of 2–3mm, it is mandatory to set a 100-per-cent fill to avoid weakness. The two camera-back components of our project here were printed with a fill percentage of 20 per cent. They have no mechanical stress and should be as light as possible. The small parts, the ones metal painted, were printed with a fill percentage of 50 per cent to increase robustness. Also, as there will be no mechanical stress on these components, printing at full density would have been a waste of time.

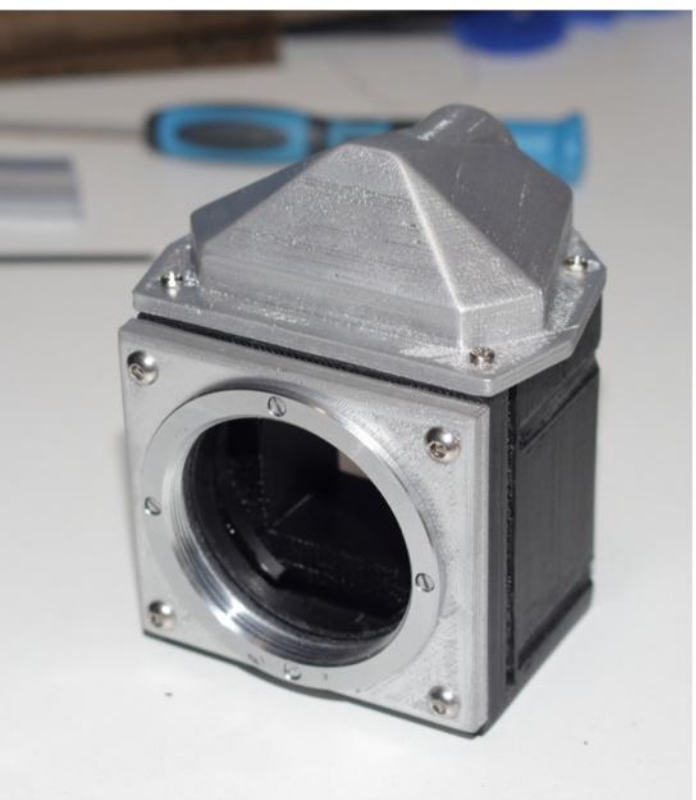
Finishing the model

In most cases, the print process is the most time-consuming phase of the prototype production but not here. As shown in the accompanying images, there is a considerable difference between the bare printed components and the model. The 3D printing with black PLA filament, 1.75mm thick, was completed in one day, but the finished model required another three days of handcrafting.

1. Preparing the components

Remove extra brim material from the parts with pliers and a small cutter. To remove the extra support material, you need rectangular-sized pliers and a small clipper. The support gets printed very near to the vertical surface, but it does not touch it, so it is not difficult to remove. To avoid damaging the model while

The finished model with a lens mounted on it. This should be the camera skeleton structure. The industrial designer's crew will start from this model to "dress" the object with the final plastic components like the hand grip, external texture, protection parts and connector closures



removing the support, I suggest using a fill density not lower than 50 per cent.

2. Cleaning and refining the surfaces

This is the hardest job. It is not good practice to use electric tools (like a Dremel) because when rotating relatively slowly (e.g., 800rpm — the lowest speed of my tool), PLA becomes hot very quickly and tends to melt and deform. The best results can be obtained with multiple sandpaper passages starting from 400 grade up to 1200. To remove a more consistent quantity of material I here used several types of files before the sandpaper. Remove the plastic dust and move to the last step.

3. Painting the model parts

Common acrylic spray paint works very well on PLA and the colour will remain stable. Paint multiple, fast passes. It is a boring process but really does give the best results. Wait about half an hour then repaint. I applied five layers of paint to achieve the best result. If you find small drops on the surface, be patient. Wait until the paint is dry, clean the drops with sandpaper, then paint it again. The final result can be seen on these pages.

For the software download of this series of articles, head to https://github.com/alicemirror/ShedMagazine

Note that the digital back has a rectangular area to fit the LCD screen. To print this part of the model it was necessary to set up the support while printing

The three-part finished model with a lens mounted on it

BURNING BRIGHT

USE THESE TECHNIQUES AND TIPS TO GET PROFESSIONAL-LOOKING FINISH ON YOUR OUTDOOR FIREPLACE

By Lachlan Jones

Photographs: Tony Lowe

Grind high points off the mould, then put a fine 100mm fibreglass mesh over the joins

Once this is applied, apply a flick coat (or scratch coat)

Use the flick-coat method only for a sand and cement system

In the previous issue of *The Shed* (Issue No. 76), we built a kitset block fireplace from Aztec Fires. This month, we're putting on the finishing touches.

A quick Google search will return thousands of finishing options for outdoor fires. From brick to timber to polished concrete, the options seem endless. It is, of course, ideal to tie the look of your fireplace in with the surrounding area, as the outdoor fire will undoubtedly become your main entertaining area in the summer months and can't be beaten on a still winter's evening.

Regardless of the desired finish, you will need a few hands on deck to ensure levels are just right and that everything is in good shape from every angle. You'll only get one shot at finishing so it's certainly worth ensuring that you do it properly. ▸

> *You'll only get one shot at finishing so it's certainly worth ensuring that you do it properly*

This is the sand cement used for the key coat only

Key-coat mix

Plastering tips and tricks

- The structure needs to be dampened down with a hose prior to plastering.
- This kitset is pumice based, so it will suck the plaster onto it. Applying a masonry sealer first will make it easier for a handyman to stop the sucking of moisture and reduce work time.
- The plaster needs to be 25mm thick. To ensure consistency, the straight edge can come in handy to make up for any variation in moulds.
- The sand and cement system needs to be hosed with plenty of water the day after application to reduce or eliminate cracking.
- Fine-mesh coat requires resin.

Always check your structure is level first — it may have sunk into the dirt as it has settled

The six-inch broad knife used for mesh-coat application and the trowel used for sand and cement application

Plaster perfection

Our owners of the newly built fire decided to go for a sand and cement plaster finish on their fireplace, so here we'll step you through what's involved and give you a few expert tips and tricks for the plastering process.

If you've decided a plaster finish is what you're after, there are two options to consider. One is a bagged product that has a fibre called 'Putz' in its mix. This makes it easier for the non-professional to use because of its formula that uses fibres to help to bind the material as opposed to concrete, which can be quite tricky.

Always check your structure is level first — it may have sunk into the dirt as it has settled over the time since installation. Our one was 25mm different, so we were able to make up this difference with the plaster.

We used a steel trowel to apply our plaster. ▸

Left: Yellow plastic trowel for more accurate finishing
Right: Blue trowel used for a more rustic finish
Below left: Textured finishes can hide a multitude of sins

The scratch coat on perimeter around stainless and refractory components

Above and below: The flick coat can be applied with a cut down block layer's trowel

Above: Key coat ready for sand and cement

Below: Plaster needs to be applied to the corners to hold and form straight edges. For this to be achieved, a smooth piece of timber or aluminium should be used

Once applied and levelled we can then trowel on the mortar, being careful not to move the straight edge. It can help to have someone holding the straight edge. Now that the edge has been formed, you'll need to screed off excess plaster by shaving small amounts on a 45-degree angle upwards from the inside out to prevent the corners collapsing. It is preferable to use a slightly bowed piece of sharp-edge timber for this step (we used a 40x10mm piece of sharp-edged pine timber from Mitre 10)

Done and dusted

As you can see, the completed fire looks fantastic and does the job, just like a bought one. Finally, one vital part of finishing your plastered fireplace is that you really should paint the plaster after a couple of days. Some folks like that unpainted raw colour and look, but it will crack before you know it. Undercoating the plaster and giving it a couple of top coats with a good brand of concrete paint will ensure cracks are kept to a minimum and give you years of good looks.

Your outdoor fire will become a focal point for outdoor entertaining and your family and friends will no doubt enjoy hearing you describe your build process in excruciating detail every time you light it up.

Your family and friends will no doubt enjoy hearing you describe your build process in excruciating detail

The Shed thanks all those involved in this outdoor fire project and we are rather envious of the owners, the Lowe family, who tell us they are looking forward to many an enjoyable evening sitting in the garden watching the flames with a chilled beverage in hand. Nice.

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FIGMENTS OF IMAGINATION

THE FUN OF MAKING STEAMPUNK TOYS REQUIRES EQUAL AMOUNTS OF CREATIVITY AND RESOURCEFULNESS

By Coen Smit
Photographs: Coen Smit

A steampunk toy (for want of a better term) combines two passions of mine. First, I love making things that are a bit different, even a bit quirky. Something that stands out from the run of the mill stuff that you buy at the shops. Second, I enjoy the challenge of bringing together bits and pieces to make seemingly disparate objects into a semi-plausible whole toy. Steampunk toys give me the opportunity to do both.

I built the race car pictured here using a variety of odds and ends. The engine came from an old air compressor, the wheels were turned out of wooden shelving, destined to be burnt, and were combined with a set of stainless discs that previously helped to support a network of shade cloths over a courtyard. The headlights were made from a couple of egg fryers and little brass taps, while the exhaust was rescued from a kitchen tap shroud and the radiator had a past life as a heat sink in a computer.

> *I love making things that are a bit different, even a bit quirky*

More than a toy

My second steampunk toy, the construction of which I detail in this article, is an articulated three-wheeler, again built from odds and ends, including some aluminium off-cuts and bits of box section. Sticking to my mantra that these things should have some practical use when possible, the three-wheeler can also do duty as a light for a side table or cabinet.

My inspiration for these toys generally starts with a central component or two, around which the rest of the toy is fashioned. Once I have decided on these critical components, I then search for other bits and pieces that will add to the overall look of the finished toy.

For the race car it was the old compressor housing and the stainless discs, while for the three-wheeler it was the valve cover from an old motorcycle engine, which forms the central element. As for the race car, I built the wheels for the trike out of Tasmanian oak salvaged from timber shelving and incorporated the discs of discarded computer hard drives as hubs. Their chrome finish imparts instant bling. (Incidentally, each

A steampunk race car reminiscent of the grand old sports cars of the pre–World War I era, when utilitarian designs based around four wheels and an engine with a nod to accommodating the driver, were the norm

hard drive has two small-but-powerful magnets on plates that are perfect for screwing to your shed wall to hold those small tools you always seem to misplace when you're working.)

BMW donations

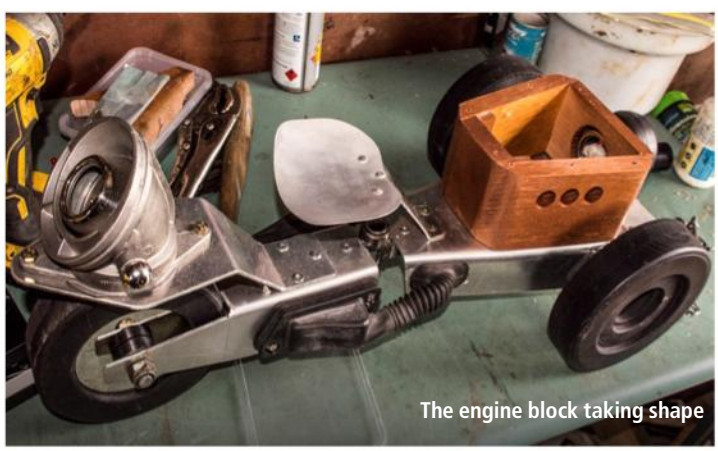
The head of the engine became the valve cover mounted on a timber engine block. The tail above the rear wheel is from an air-intake manifold and a leftover housing from a door lock that happened to fit perfectly inside it. Some plastic and rubber parts were donated from a dismantled BMW car. The novel steering wheel was also made from a couple of the discarded computer hard drives.

Turning the wheels was the first order of business as their size determined the overall scale of the finished toy. I did this by cutting out six rough timber circles on my small bandsaw and gluing them together in pairs. I then turned them down on my metal lathe to get a uniform size and recessed their centres to accommodate the axles and the computer-hard-drive discs as hub caps. A can of flat black spray paint applied to the wooden wheels gives an acceptable approximation of rubber tyres.

The next step involved creating a simple T-bone chassis with a pivot in the middle made from two short sections of steel pipe (see the accompanying diagram).

I clad the chassis by shaping off-cuts of aluminium sheet using an old guillotine and my homemade sheet bender. An inverted U-shaped section connects the rear wheel to the chassis. Having constructed the basic design I could then move on to the best part of the project — bringing the various bits together to make the toy look plausible. ▸

The rolling chassis under construction



The engine block taking shape

Above: Close up of the front end
Right: Trueing the wooden wheels for the toy

Tools you will need

- Hacksaw
- Guillotine and/or tin snips
- Welder
- Lathe (if you do not have access to a lathe, you can use a drill press to turn fairly good timber wheels. Locate the roughed out wheel by clamping it in the drill press chuck and clamping a section of steel cut off at an acute angle to the base plate, gradually moving it in until it takes a uniform skim off the wheel. Alternatively, use a sander to remove the high spots gradually, until the wheel is round)
- Drill
- Sander
- Hole cutters
- Selection of screwdrivers and pliers
- Bandsaw or jigsaw

Front of the trike

Fitting the light

First, I constructed the rear mudguard and mounted the tailpiece on it. The air-intake elbow was exactly the right size to hold the chrome lock housing, behind which I situated a 12V halogen downlight. I wired that to a switch hidden in one of the rubber arms either side of the swivel and located a small speaker jack under the chassis so that the 12V transformer could be located discreetly some distance from the trike, or not used at all.

I unearthed an old rubber trailer lamp assembly the exact size to house the deeply convex lens from one of the BMW's broken headlights. To hide the 12V halogen light, I used the second chrome lock housing and recessed it into the front of the engine block to hold it in the correct place against the rubber trailer lamp. By not gluing these pieces together, if either light happens to fail in the future, it can be replaced.

Once the basic engine block was formed it needed to be made a bit more believable by adding an exhaust stack on the left-hand side and by drilling out and inserting three Sodastream cartridges on the right. After a few coats of copper-coloured spray paint were applied it was time to mount the block and attach the parts, finishing it off by mounting the valve cover on top of an aluminium plate. To add a touch of difference, I sourced some stainless

Having constructed the basic design I could then move on to the best part of the project — bringing the various bits together to make the toy look plausible

The essence of a steampunk vehicle, combining old, tested design features with flights of fancy to create a unique vehicle

security screws to lock the plate and valve cover down.

Bodywork and seating

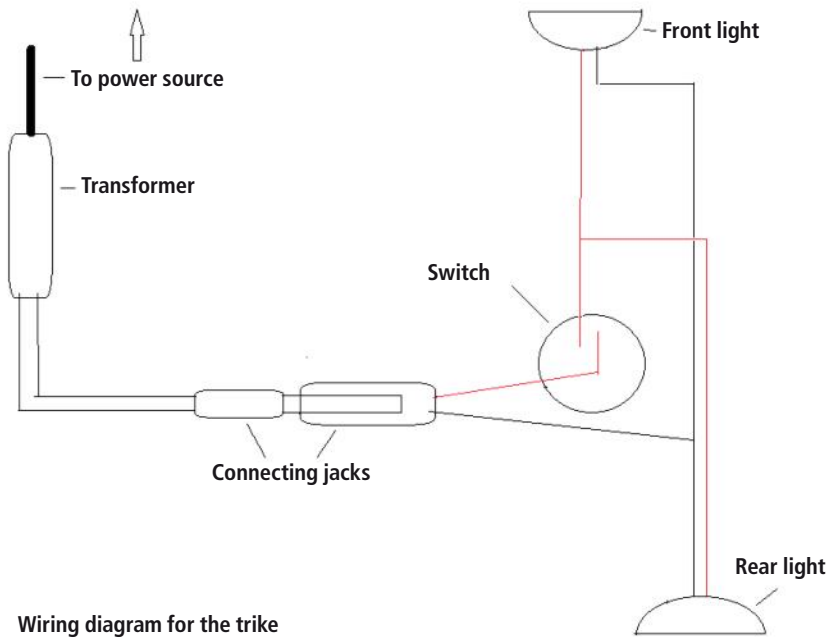
Fashioning the two front mudguards was largely accomplished by trial and error to ensure that the bend for each was uniform and that they matched the rest of the toy in size and shape.

To complete the trike I used an old fan blade and bent up a section of aluminium to act as a seat, reminiscent of the style found on old motorbikes. Finally I fashioned the steering arm by tapping a thread on both ends and screwing it into the valve cover, then fixing the two hard-drive arms to form the steering wheel on the other.

The cost of creating the trike was minimal, somewhere less than $25 for the lights and associated transformer as well as some stainless security screws. The rest came from salvageable items. Of course this ignores the cost in time the project incurred (somewhere around 20 hours, I'd guess), but what sheddie ever counts this as a cost? We do it because we enjoy it and we can't put a price on that!

Purists will quickly realize that neither of the toys could ever be successfully created as a life-size working vehicle. However, that has never been my intention in creating them. I believe that they should be appreciated for what they are: figments of imagination akin to the fanciful machines that artists create to illustrate pulp science-fiction stories.

> *They should be appreciated for what they are: figments of imagination*



Wiring diagram for the trike

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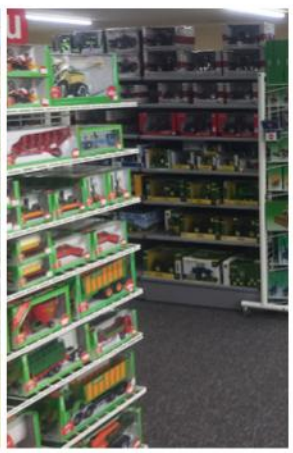

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FROZEN IN TIME

A WORKSHOP SALE IS TESTIMONY TO A BUSINESS AND EQUIPMENT FROM ANOTHER ERA

By Bob Hulme

Photographs: Bob Hulme and Adam Croy

A power press by John Heine, recognized as one of the very best brands of presses — solid and reliable

I just love nosing around other people's workshops to see what they are making and what gear they have, and I recently just had the special opportunity to look at a manufacturing workshop that was about to be sold up and, as a bonus, learn about its history.

Macdonald Refrigeration surely has a place in Auckland's heritage as a pioneer in its field. The factory has been closed for some time now and it has been hard for the family to let go of all the gear, but it is filling a lot of valuable space. Property leasing is the main focus for the business now and prospective tenants have been pushing them to make this building available in the sought-after suburb of Grey Lynn in central Auckland.

Those early years would have been a struggle, with the rewards coming later

History of Macdonald Refrigeration

Refrigeration was in its infancy when Allan Macdonald decided to start his own business servicing commercial and domestic refrigerators. He had completed a fitting and turning apprenticeship at Winstone's workshop in Auckland and had the entrepreneurial spirit to take on this exciting new field. It was in 1938, the year his son Ian was born, that he took the plunge.

As refrigeration was new and there were no courses or qualifications yet available he had to learn as he went. He developed connections with American brands such as Westinghouse and Beech for servicing their products. Of course in those days most households still used a safe and refrigerators were regarded as a luxury, so there were very few servicing specialists. Being involved early in any field in its infancy is always an advantage, particularly when it has so much potential. Those early years would

Macdonald was a manufacturer of fridges and freezers — this meant the company had to import compressors, electric motors, and the refrigerant fluids

Vacuum pump

Still in its original shipping crate is an American-made Kinney vacuum pump that Allan Macdonald bought over 60 years ago for a project that he apparently didn't get around to. Still, it might come in handy one day! You can see in the photo that it came without a motor due to the US voltage being different to ours.

have been a struggle, with the rewards coming later.

The company initially worked from premises at 1A Albany Road, Herne Bay, Auckland, concentrating on service work, but with the decision to add manufacturing to the business, it moved to Weld Street in nearby Freemans Bay.

Don't plan on looking Weld Street up though, as it no longer exists. It was dug up and is now covered with buildings. It was a link between Napier and Union Streets. At that time there were neighbours, including the warehouses of Farmers Trading Co and Walker and Hall. There was also a row of small houses that the Macdonalds bought as they became available to use for storage. Their factory had 70 employees manufacturing domestic refrigerators as well as commercial units for butcher's shops, hotels, hospitals, etc. Many of these were custom-made units, such as refrigerated window displays for butcher's and fish shops.

Importing materials

Being a manufacturer also meant being an importer of the materials needed to build the units. These included compressors, electric motors, and the refrigerant fluids. Organizing shipments had to be coordinated with production. Often goods would be shipped to Australia first, then on to New Zealand. With labour strikes

A sturdy Logan metalworking lathe

Lathes

There was a row of three lathes — two Colchesters and a Logan. Now, Colchester has always been a good brand and either of those would be welcome in anyone's home workshop. They may be old, but the quality of those British-made machine tools lives on. The Logan would make a great replacement for a Myford. I am thinking about my own experience here when I bought a Myford for my home workshop, but quickly found it was too small for most of the jobs I wanted to do. A Logan is a bit bigger, but not so big that workshop space is severely tested. Logans were never as rigid as Colchesters yet they filled that gap between Myford size and the heavier floor-standing lathes really well.

at docks on both sides of the Tasman occurring from time to time the coordination was often frustrating. An understanding bank manager was vital then, just as is today.

Imported refrigerant gas was typically shipped in tall cylinders, which were then decanted into smaller ones that were easier for servicemen to handle on site. Typical refrigerants in those early days were methyl chloride and sulphur dioxide.

With refrigeration becoming more popular, especially for retail businesses, the need to travel outside Auckland to service customers was vital. Servicemen from Macdonald were sent as far north as Kaitaia (Ian tells me that he once went there and back in a day to do a repair job) and as far south as Hastings and Palmerston North.

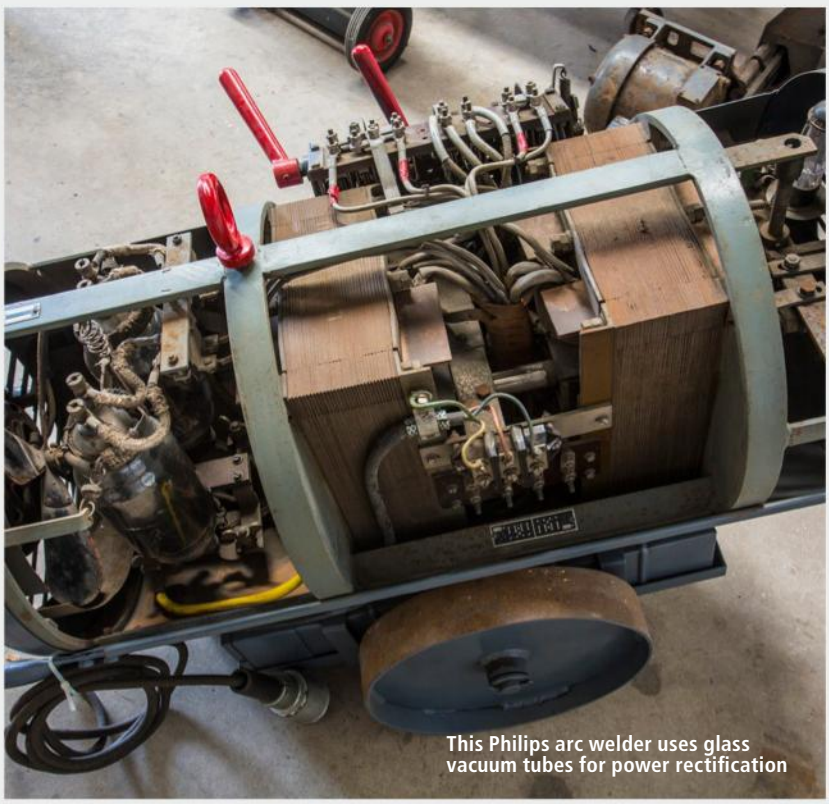
Famous clients

One of Macdonald's customers was Adams Bruce, who had a chain of shops that served delicious ice cream, chocolates, and biscuits — at least they are the things I remember buying there as a kid. Each shop had a freezer for the ice cream of course, but Ian recalls that the Adams Bruce ice-cream factory was in Collingwood Street, in Freemans Bay, and ice cream was sent to the Bruce shops on New Zealand Rail (NZR) Road Services buses. This was achieved by packing the ice cream in round steel cylinders that had a glycol hold-over tank with dry ice underneath — all wrapped in an insulated canvas jacket. Before the advent of courier companies most packages were handled by NZR Road Services buses.

After hassles with the Auckland City Council rezoning the area where the factory was in Freemans Bay and the council flip-flopping on that zoning, Macdonald Refrigeration decided to move. In 1968, it moved to a new factory the company built in Richmond Road, Grey Lynn. The site was purchased from the well-known local Warnoch family, who had a soap factory next door, on a handshake deal — totally unheard of today. Staff numbers at this time were 42. ▸

Macdonald Refrigeration has a fine selection of lathes. Here two Colchester lathes bookend a Logan

Fraser and Ian Macdonald, grandson and son, respectively, of the business founder, Allan Macdonald, who started the refrigeration business in 1938



This Philips arc welder uses glass vacuum tubes for power rectification

I felt like a kid in a lolly shop wandering around the Macdonald factory. There was such a range of metalworking machines that I didn't know where to start. There were folders, guillotines, a press brake, and power presses. Even a trusty Dyco drill press (brands such as Dyco and Tanner are very desirable today as they are solid and reliable). I was especially interested in an old Philips arc welder. It can be set for AC or DC welding, and on closer inspection I could see large, old glass vacuum tubes inside, presumably for rectifying the power. I was told that the welds it produced were wonderful and it is still in working order. Smooth finish and deep penetration were typical of the output. I have never seen one like this before — amazing.

All the machinery has obviously been kept in good condition and some appeared to have been modified to improve output. I noticed a guillotine driven by an old, but solid, electric motor and looked closer to see that it was John Heine brand — the same as the two power presses that were there. Heine is recognized as one of the very best brands of presses. I have worked with this brand of power presses and they are so solid and reliable that they seem to keep going forever. Even their fly press was a John Heine!

Even the fly press was a John Heine!

Large fabricated frame guillotine

Edwards is another brand that was once revered as a maker of top-quality equipment and Macdonald had an Edwards folder. This was a fine example of a folder made with a cast-iron frame, meaning that it has great rigidity.

Spot welder

The famous John Heine brand featured large in this manufacturing shed. Here is a John Heine guillotine

With labour strikes at docks on both sides of the Tasman occurring from time to time the coordination was often frustrating

There was another folder of more recent manufacture with a fabricated (welded) frame. I don't want to give fabricated folders a bad rap as they do work quite well, but my pick would be the old Edwards.

Another Edwards machine was a foot-treadle-operated small guillotine — ideal for small jobs like chamfering corners on sheet-metal items. Yet another Edwards machine was the press brake. No, it doesn't break things, it bends them. The top blade moves down onto a fixed die block to bend the sheet metal between the blade and the die block. By changing the blade and the die-block shape (the die block can be rotated to bring different forms to play) it is possible to create different bends or even radiused shapes.

An Edwards press brake

One customer felt that, when she passed away, the fridge she had loved so much should go back to the company that made it, Macdonald Refrigeration

Every fridge has a story

I saw several examples of the company's domestic refrigerators in storage together with factory equipment when I visited. Some had a story behind them. I saw a red-coloured fridge and a matching chest freezer. Ian related the story of the lady who bought the red fridge new from them and when it needed to come to the factory to be serviced, she followed the truck in her car to make sure that her beloved red fridge did not get scratched. When she passed away some years later the fridge and freezer came back addressed to Fraser Macdonald, Ian's son, who had assisted the lady when her fridge had needed remedial work. He had given such good service and she loved that fridge so much that she felt it should go back to the company.

Another old-timer was a double-door fridge that I recognized as one similar to a model a relative of mine had had years ago. This also had been bequeathed to the Macdonalds by a satisfied customer. Inspection showed that over the course of its life, all that it had needed was a new V-belt for the drive from the motor to the compressor. Every other part was exactly as it was when bought new. Amazing!

> *She followed the truck in her car to make sure that her beloved red fridge did not get scratched*

Fill those freezers

The production of domestic refrigerators was eventually dropped as competition stepped up from other companies, as well as imported product, but Macdonald established a niche producing chest freezers and was a pioneer in the field. However, the company was approached by a competitor, Bonaire, which also made chest freezers, and was offered a deal to sell its products. The economics stacked up so they did the deal. This was a time when it was popular to buy a whole beast and store it in the home freezer.

Many Aucklanders will recall butchers like Albany Meats, which sold wholesale and in bulk to the public. Ian tells me that the butcher would sell direct from the factory and on the weekends people would often arrive with an animal carcass in the back of their car needing a freezer right away. They sold as many as 27 chest freezers per day at the height of that era.

However, commercial refrigeration was seen as the backbone of the business and eventually Macdonald concentrated solely on that market.

Manufacturing in New Zealand

Most of my own career has been in manufacturing in New Zealand and I am saddened to see so many businesses close their workshops and instead become importers of products manufactured in low-cost countries. It seems wrong that we allow our innovative Kiwi companies to suffer against imports of items from countries where their governments probably subsidize them so that they can overrun the competition. However, I am heartened by the stories I do hear of New Zealand manufacturers making a go of it even in this climate. Just last week I heard of a local manufacturer making rivets for export to China and another making fishing gear and selling successfully in many other countries.

Come on, Kiwis, you can make stuff on home turf and if you can't think of something clever to make just yet, at least try buying locally made things in the meantime — the standard of living for all of us will improve. Ahh, I feel better now I've had my rant.

Solid bench

It is not every day that you come across such a large wooden work bench made entirely from kauri. This one has seen some work and I did not appreciate the timber until Ian Macdonald pointed it out to me. I hope that someone buys it to keep as a work bench, as I think it would be a shame to pull it apart just to sell off the timber.

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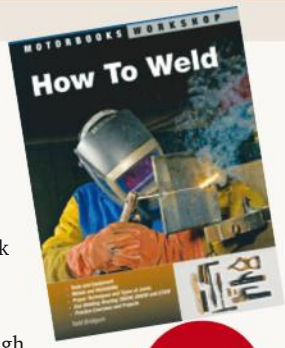

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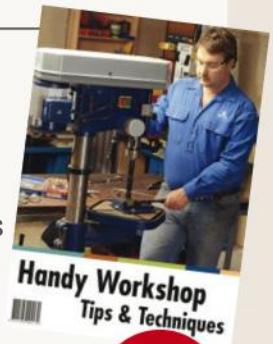

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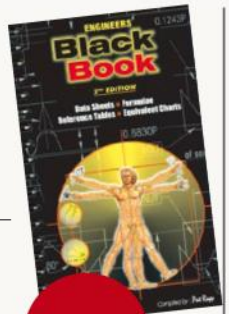

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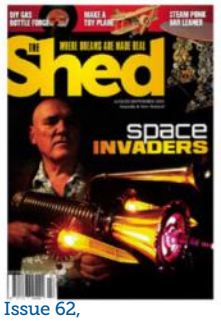

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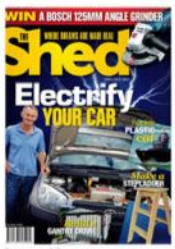

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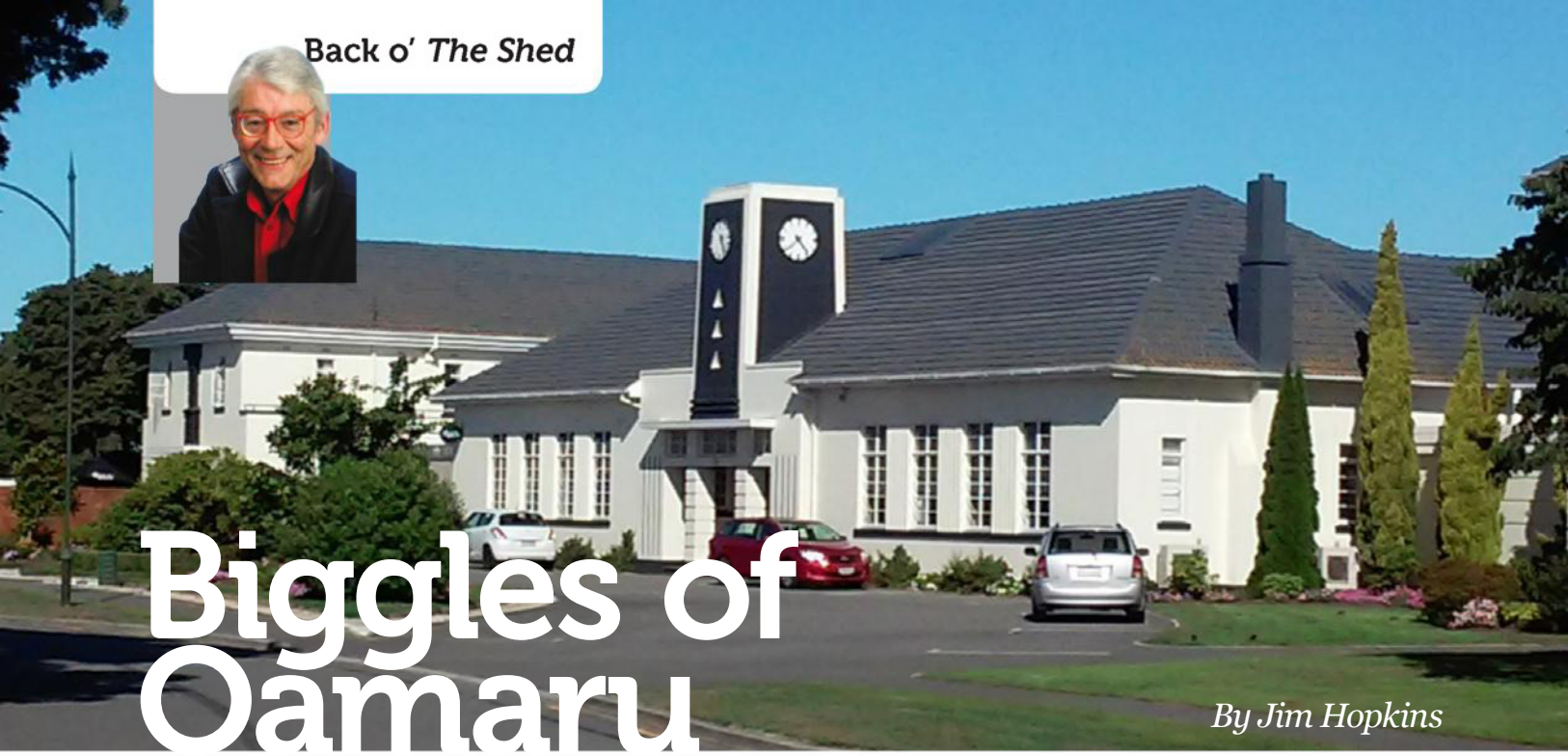

Biggles of Oamaru

By Jim Hopkins

No question, it was déja view. The moment I saw the building I knew that I'd been there before, and that recollection triggered a rush of other memories, most marvellous, some bittersweet.

As the building was the old officer's mess at Wigram, where I'd been the after-dinner speaker one anxious evening, and Wigram was my first field of dreams, back in the days of 3s 9d Airfix models and visions of Vampires — de Havilland Vampires, you understand, the kind the Royal New Zealand Air Force (RNZAF) flew.

And since little Jim, fighter pilot supreme (in the cockpit of his imagination), wanted to fly them too, he got the Brasso, polished the buttons, pressed the sky blue tunic, and turned up at No. 9 hangar Wigram every Wednesday to parade as a proud member of No. 17 Squadron, Air Training Corps (ATC).

Wigram was still an airbase then, hangars full of aircraft — Mustangs, Devons, and a host of Harvards, lined up in front of the control tower, canopies open, fluoro-tails red, awaiting the next tranche of trainees.

Which would soon include me. That was certain. I was going to be a fighter pilot; looping, diving, dogfighting, flashing silver through the sky. That's why I'd joined the ATC and endured all the 'ten-shunning', quick marching, and square bashing, our footsteps echoing off the walls in the cavernous dim of the empty hangar.

Then, one chill, mid-winter night, we got drilled and grilled by a particularly curmudgeonly flight sergeant. Maybe he'd had a bad day; maybe he was a bad person; maybe he just had a tough way of saying true things. Whatever the reason, he minced no words as he strode along, questioning each cadet in turn.

"Why are you here?" he bellowed.

"I want to fly Vampires, Sir!" I boldly replied.

"Vampires?" he snorted. "With glasses like that? Milk-bottle bottoms? You're dreaming!"

So the air force lost its best Biggles ever and I found other things to do on Wednesdays. Yet I've remained connected with Wigram through the years. I've flown gliders there; taken young son Tom up in the Catalina Preservation Society's PBY5A, each of us peering excitedly out of the massive observation blisters at the rear of the fuselage, trying to spot our house; I've been a passenger in a Convair 444 and a DC-3, each heading through the alps to Westport (on separate occasions, of course); and, one Easter, had an absolutely fantastic flight from Wigram to the Omaka air show (and back) in ZK AKY, the Croydon Aviation Trust's wonderful ex–National Airways Corporation (NAC) Dominie biplane. I remember our pilot, Ryan Southam, circling low so we could see the dolphins off Kaikoura and feeling sorry for everyone who wasn't on that plane that day.

Back on the ground, before Wigram closed, a group of Skyhawk jocks on an instructor's course asked me to make a (pretty crazy) film, which they showed at their (pretty crazy) final dinner. That led to an invitation to speak at the mess at Ohakea — and my second great RNZAF disappointment.

"What would your fee be?" an instructor asked.

"Fee?" I said, sensing a unique opportunity. "Ummm, err … how about a flight in a Skyhawk?"

Well, the deal was seemingly done, the speech duly delivered and, next morning, Biggles' juices flowing, I politely inquired what preparation was needed for my A-4 flight. There were embarrassed looks and shuffled feet.

"Oh, we thought you were joking. We're not allowed to take civilians up for joy rides." But they did let me sit in the Skyhawk's tiny cockpit and explained that I was quite lucky not to be flying because, if I'd had to eject, I'd have probably had my kneecaps ripped off by the control panel on the way out. That had happened, they said, to tall people.

It all came roaring back, faster than the speed of sound, when I saw that imposing 1938 building once again. They do say your life flashes before your eyes when you're checking out. But mine flashed when I was checking in. You see, Wigram's old officer's mess isn't a mess any more. It's an Airbnb place, housing tourists, not recruits, single rooms just $25 a night — no en suite or telly, mind, but who gives a toss when just being there brings back to life some of the best times ever, free of charge?

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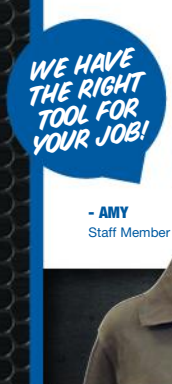

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