



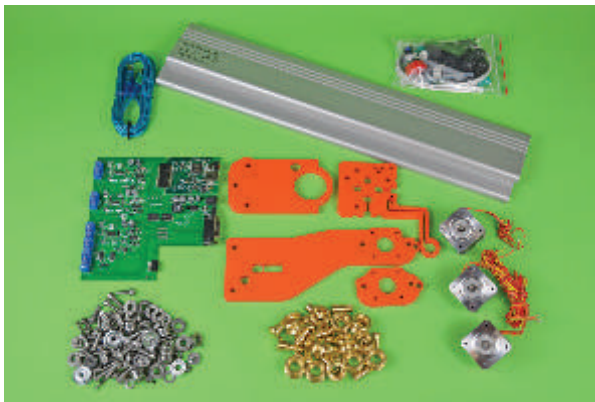
*I built that all on my own! The self-assembly Stepcraft 420 represents a very entertaining and satisfying day's work. What's more, the quality of the product is superb. It really is a beautifully made bit of kit.*

# Stepcraft 420

PETE LOWE GOES ONE-ON-ONE WITH A DOMESTIC CNC CUTTER THAT'S PERFECT FOR THE HOME BUILDER

*Engineering heaven! The self-assembly option has heaps of scrumptious metal parts and fittings that are a joy to work with.*

Once upon a time, aeromodellers had nothing but balsa sheet and a plan from which to produce a model. Then came kits, with components printed onto the wood ready to be cut out with a hard-backed razor blade.



Die-cutting was the next stage in our hobby's development and I can well recall this advancement being frowned upon by some traditionalists and considered cheating.

Over the past few years all the kits I've built have contained CNC (Computer Numerical Control) cut components and I suspect that my collection of ARTF models have been factory assembled from similarly created parts.

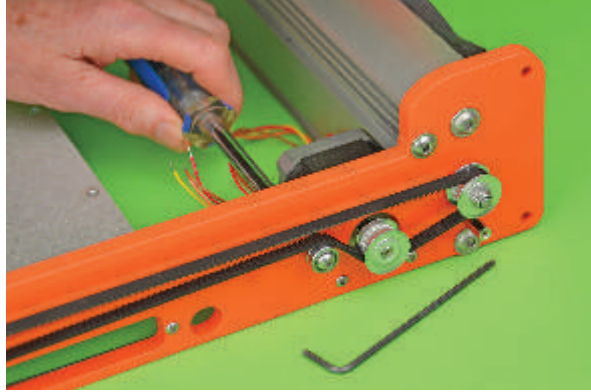
Until now the mysterious CNC machine responsible for making my building more accurate and removing the tedium of cutting by hand has remained the privilege of the kit or model manufacturer. Well, thanks to Stepcraft, all that has changed for not only are its compact, desktop CNC machines cost effective, they take up very little workshop space and are surprisingly user-friendly.

### THREE TO GO

Stepcraft offers three sizes of machine, the model number and working areas of each being:

Model	Working area
300	210 x 300 x 80mm
420	300 x 420 x 80mm
600	420 x 600 x 80mm

All are available either fully assembled and ready for action or, like the 420 model featured here, as a modular system for home assembly. I'd actually recommend the self-assembly version for during the process of putting the 420 together the knowledge gained about the machine has helped me not only with general maintenance but to understand exactly how it operates, dispelling some of the mysteries of the technology along the way.



*Confusing? Not at all, since each part is carefully documented and directed to its proper place in the machine by crystal-clear instructions.*

## **TIMELESS**

I originally set out to time the assembly process but found it such a gratifying experience that I soon turned the stopwatch off.

The instruction manual is probably the best example of its kind that I've seen in a long, long time; it's clear that Stepcraft really wants you to not only succeed, but to enjoy the experience as well. To this end the instructions and drawings are exceptionally clear, each component having a detailed image including a part number, the quantity supplied and a brief description. Tools and materials required for the job are listed and the building sequence is divided into manageable units, each having clear drawings of all the parts required and their position within the construction.

The electronics are straightforward, too. There are two small circuit boards (although my particular machine came with these two already joined) plus the three 'end' switches, their purpose being to halt the travel of the three axis movements: X (side-to-side), Y (front-to-back), and Z (cutter up and down).

Router bits are driven by your choice of rotary tool, and Stepcraft can supply a suitable example in the form of a Proxxon IBS/E drill / grinder. I opted for this, which secures to the 420 via an aluminium tool holder that's an optional extra.

With the assembly complete, it was time to apply some oil and grease to the various points indicated in the (by now indispensable) instructions.

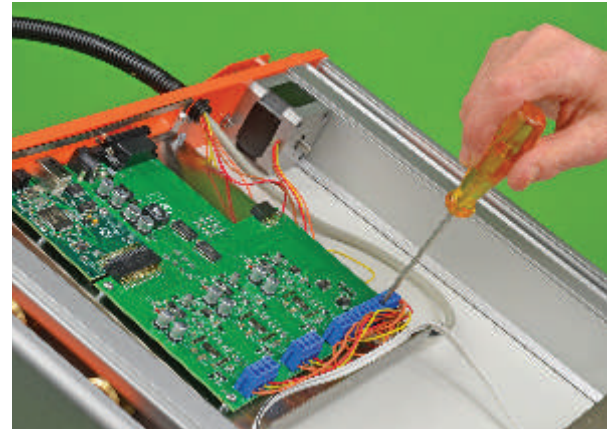
## **LOG ON**

A computer is required to control this machine so the next stage in my CNC adventure was to load up my PC with the supplied software. This was a reassuringly straightforward procedure, requiring nothing more than the occasional mouse click. Once loaded, and before hooking the 420 up to my laptop via the (supplied) long, bright blue USB



cable, I decided to explore the software. Intrepidly I opened up one of the drop-down boxes, to discover a mind-boggling array of pages and parameters. My heart sunk. Although I'm quite happy working with computers I've never tried to become too friendly with them, however the vast amount of possibilities on the screen before me suggested that before too long, this piece of technology and I would very soon have to become seriously involved.

Undeterred, I powered up the 420 and connected it to the laptop. Joy unbounded – it would appear that the small circuit board I installed during assembly was already good friends with the software, and the worrying pages of parameter options vanished, leaving only those necessary for my particular machine. With technology once again tamed I opened the next manual, entitled 'Getting Started'. This was another confidence builder of a publication that explains in easy-to-understand terms the software, the setting up of the machine, and how to use one of the 22 drawings supplied within the program to produce your very first



piece of CNC work. Of course, before you do this the 420 must be located on a stable, flat surface, with the computer far enough away so that it doesn't get covered in the dust produced by the cutter, yet positioned so that you can keep a close eye on both machines. Should things go wrong, there's a big red knob on the front of the 420 that, when pressed, interrupts the power supply and signals the software to stop the working process. The machine stops immediately although, with its own power cable and independent on / off switch, the router bit will continue to revolve.

Okay, we're now ready for a manual test in order to make sure that the arms travel along all axes in smooth and silent fashion. The first job is to loosen a few screws as directed and then open up the 'Jog' command on the screen. Each axis then moves to its extremity, and the screws at each respective axis point are retightened. Once happy that all is operating smoothly, 'Reference' is then selected from the menu, which drives all axes to a position over the work surface that's set by the three end switches.

In reality all this is very simple and should be well within the capabilities of the practically-minded modeller, for with the book, machine and

*The electronics are basically 'plug and play', with some very simple wiring. Just route the coloured wires in conjunction with the drawings. Nothing could be simpler.*

*The self-assembly option not only provides a great workshop activity but also teaches you much about how the machine functions.*

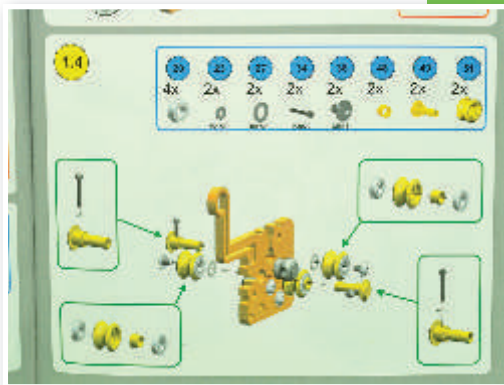


*I really warmed to the instruction manuals. Easy to understand with good clear drawings, they certainly hit the spot for me.*

computer screen in front of you, the process is perfectly logical.

**FIRST PASS**

To become familiar with the machine's operational parameters I decided that it would be prudent to start with some test runs, using two of the templates supplied in the software. When cutting out a pattern (rather than engraving) the router bit will, of course, penetrate the work completely, so in order to protect the high-pressure laminate bed the instructions suggest using a secondary cover, made from MDF or similar. With said protective cover in place and my piece of 3mm ply duly



dial in the Z (vertical) axis parameters that would allow the spinning router bit to enter the ply workpiece by 1mm and carve my flower. By following the instructions to the letter this was considerably easier than I'd first anticipated, and after the 420 had run its program I triumphantly held aloft my very first

**System requirements**  
 PC with 1GHz processor and USB interface, Windows XP, Windows Vista, Windows 7 / 8 (32 / 64 bit), MAC OS X 10.3.9 or higher with Windows emulation.

clamped using the two plates (as supplied) I was good to embark on my first piece of work, a flower engraving as depicted in the instructions.

On the first run I decided not to allow the router to come down far enough and actually touch the ply. In this way, when the start button was selected from the options menu, I could carefully watch the X and Y axis movements and make sure that the travel remained within the confines of the anticipated work area and foul neither the machine's sides nor the two clamping plates.

With this non-cutting run successfully completed it was time to

piece of home-produced CNC work. I was truly impressed!

The next stage was to produce an item that used both red and blue cutting lines. Let me explain...

**REDS & BLUES**

If you're trying to produce, say, a non-solid fuselage former, i.e. one that has a cut-out within it, then you have to deal with the cut-out before

the outline; cut the outline first and the work would no longer be fixed to the cutting bed, leaving the router to chase the work around. Cut-outs are therefore made blue and the overall outline red. With this, the machine will tackle the blue lines first before transferring its attention to the red outline. Cunning eh?

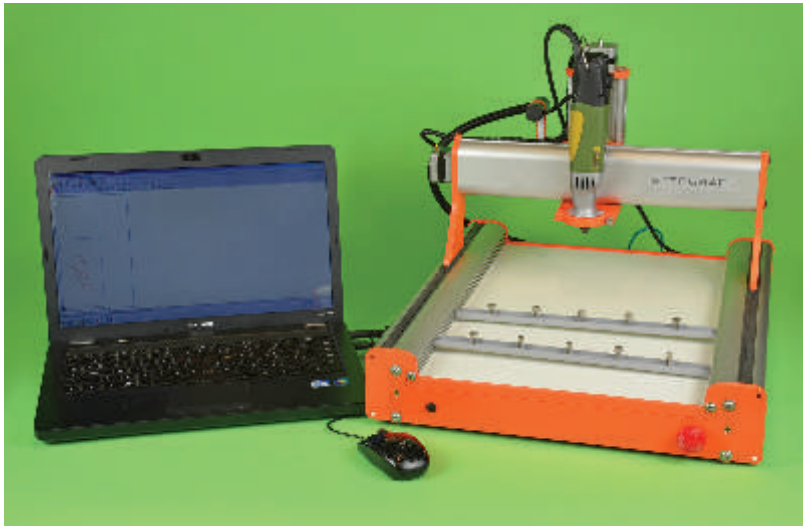
I tested this process by loading up the rather neat-looking dolls house chair from the supplied templates. Again, I set the cutter just above the ply, which enabled me to confirm that the holes would indeed be cut first. With the test completed and the router now set to cut completely through the 3mm ply I selected 'start', sat back and watched as the four pieces of my miniature chair were slowly created.

Although I was very pleased with both the flower engraving and attractive little chair, I really couldn't see how to incorporate them into my latest warbird project. I needed something aircraft shaped, and that would mean either obtaining a template from a third party – which is basically a friend with the necessary computer skills (and too much time) who can be coerced with helpings of cream buns – or drawing my own. My favoured drawing program is CorelDRAW and as this supports the PLT type files needed for the 420's software I wasted no time in opening the program and creating something appropriate.

*The Proxxon unit is held in place by an optional aluminium tool holder adapter.*

*A selection of router bits is needed for cutting and engraving. Keep your fingers away, they can bite even when they're not turning!*





which presented the perfect opportunity to sample how easy it was to obtain spares and accessories. A quick visit to Stepcraft's website – [www.stepcraft-systems.com/en](http://www.stepcraft-systems.com/en) – had me back in business in no time. Whilst on the site it became apparent that Stepcraft must be constantly developing and improving its machines, as I discovered that Pt. No.54, a plastic spindle nut, is now available in brass. The four plastic nuts supplied in the unit are incredibly tough and I feel sure will last a very long time, nevertheless here was another opportunity. I ordered just two brass replacements with the intention of changing the most inaccessible plastic example just to see how easy it is to work on

*Before you can start planning that new and exotic project, the 420 will need to be linked to a computer that's loaded with the supplied software. Mind you, this is an easy task.*

*This big red button stops the machine in its tracks should you suspect anything untoward.*

### FIRST FORM

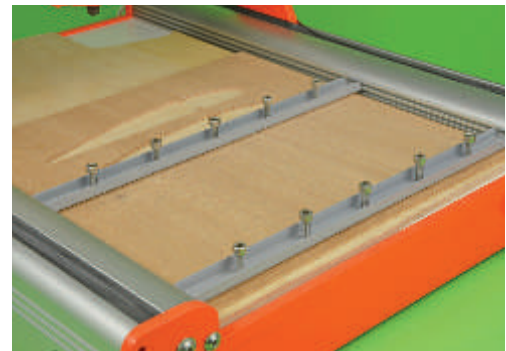
With no particular model or project in mind I decided to cut a basic wing rib and fuselage former, both with cut-outs, meaning that the aforementioned red 'n' blue strategy would be needed. From my previous experience I set the cutter's Z-axis to stop just above the ply to confirm that my red and blue line programming was correct.

To be honest I'm always surprised when a computer does exactly what I ask of it but, sure enough, the router slowly operated as planned, scribing all of the internal holes before selecting the red line outer perimeters. Happy with the test run I reset the Z-axis, pressed start and awaited some proper, computer-created, CNC-cut aircraft parts.

I was so engrossed that I'd forgotten to take the direction of wood grain into account, and although two perfectly identical ribs resulted, the grain ran vertically as opposed to horizontally... Oops! Easily remedied; rotate either the computer drawing or the ply though 90°. I chose the more practical rotation of the ply, then re-ran the cutting program to produce a pair of ribs with the grain running correctly, i.e. along their length.

When creating a drawing I allowed for the diameter of the router bit, which seems to follow the centre of the drawn line. That is to say that if I'd used a 2mm diameter cutter and hadn't compensated for it, the outer dimensions of the parts would have ended up 1mm smaller than the drawing. Of course, there may be some way of compensating for this in the software but I'll be honest I've not found it yet.

In line with its siblings, the 420 is capable of machining wood, plastics



*The supplied software allowed me to make this rather splendid... er... Graf Zeppelin dining chair!*

the machine. This is where the knowledge gained by choosing the self-assembly purchase option comes into its own. As a result I disassembled only what was necessary, changed the parts over, and had the machine back in working order in no time. Man and machine were indeed beginning to bond!

*Here you can see the secondary covering to the work surface and the 3mm ply clamped in place, ready for the router to move into action.*

### WELL WORTHY

Stepcraft's 420 is a very welcome and worthy addition to my workshop. As a traditional modeller my tendency has always been to go for a sharp blade, hand saw or mechanical fret saw when it comes to cutting wood, but when working thicker, harder

*Spot the grain mistake on two of the wing ribs! All part of the learning process.*

and non-ferrous metals, and will also accommodate Stepcraft's 3D printer head. This trio of machines are designed specifically for low volume use for the enthusiast, and not for large scale productions. They're compact, can be coupled to the average domestic laptop, and programming and operation is, thanks to a superb set of manuals, very user-friendly.

One slight mishap early on resulted in me snapping the 1mm router bit,



# DATAFILE

<b>Name:</b>	Stepcraft 420
<b>Type:</b>	CNC cutter
<b>Manufactured by:</b>	Stepcraft Systems www.stepcraft-systems.com
<b>Available from:</b>	StoneyCNC Tel. 01432 607909
<b>RRP:</b>	£799.00 (kit), £1074.00 (built)
<b>Overall size:</b>	435 x 560 x 280mm
<b>Weight:</b>	12kg
<b>Clamping surface:</b>	312 x 500mm
<b>Working space:</b>	300 x 420 x 80mm
<b>Passage height:</b>	115mm
<b>Repeatability:</b>	+/- 0.04mm
<b>Programmable res:</b>	0.005mm
<b>Backlash:</b>	0.08 approx. (with software adjustable to 0.00mm)
<b>Speed:</b>	1800mm / min
<b>Spindles:</b>	Round thread
<b>Motor:</b>	Stepper
<b>Tool clamp:</b>	43mm diameter with optional smaller diameters
<b>Input voltage:</b>	100 – 240V
<b>Output volt. (motors):</b>	19V
<b>Power consumption:</b>	90W
<b>Interface:</b>	USB



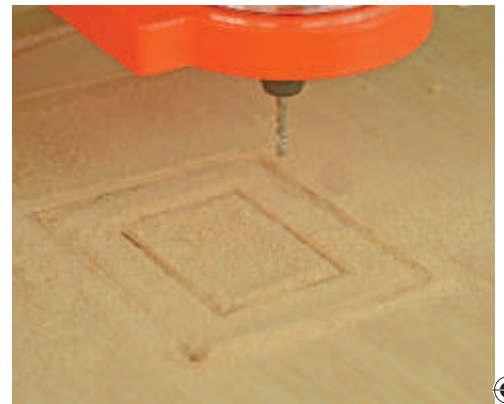
*Remember to take the router diameter into account when programing a component outline.*



most certainly be seeing more of the 420 in my Totally Traditional column over the coming months for it's clear that the days of my old hard-back razor blade are numbered.

pieces of ply it's becoming easier to send even single requirements over to the 420 as well as multiple pieces of the same dimensions. It's the only way to go, especially when you consider the consistency and accuracy of the work.

Potential CNC tasks are now being added to the mental list on a regular basis; Janet would like an engraved brass plaque for her (full-size) yacht, whilst I'm contemplating the cockpit detail for my next scale model. You'll



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