The SIEG Super X2P HiTorque mill

Howard Winwood describes the uprated version of the long-established X2 mill, together with some modifications he has made to his own machine.

The X2 mini mill from the SIEG factory in China has been sold by a number of retailers under various guises and colours. There is a large amount of information around, regarding this popular mini mill and its limitations and short comings have been well documented on the many engineering forums and websites on the Internet, together with a host of modifications to get round the various problems.

Let's start with the obvious, why is the X2 (and all its variants including the SX2P) called a mini mill? Compared to a 'Proper' industrial vertical mill, it is small, lightweight and low powered and is therefore classed as a 'mini' version of its industrial father.

Most users of said industrial type machines would consider the X2 a toy rather than a serious engineering tool. So, what possible use can this 'TOY' have in a model engineer's workshop I hear you all shout? The simple answer is to ask those who are happy to own one.

The lathe is most likely to be the first purchase in one's workshop, most of us (especially of my age group) will remember the lathe from metalworking class. Having failed the 11 plus, one was deemed inadequate for the academic life and therefore needed to be taught to use one's hands rather than one's brains. On starting Secondary school we were asked to choose between woodwork or metalwork classes. Once the choice was made there was no turning back for the rest of your time at school.

So the 'Men' chose metalwork of course. Living in 'Steel City' helped, but these days sadly should be called 'not much Steel industry left City'...

Based on that experience, it should not be too difficult to select a suitable lathe (I use the term suitable, rather loosely.)

The Super X2P Mill.

The choice for most of us is between an old well worn ex -school, college or industrial lathe, a second hand Myford (a new one if your pockets are deep enough!) or a shiny new Chinese one. The shiny new Chinese lathe usually winning for most of us.

Now, for those of us with small workshops, sheds and garages, a smallish lathe is likely to be the order of the day as there is usually not a lot of room available to fit a half ton (or more) ex-industrial lathe in.

We also need some means of drilling holes with a reasonable degree of accuracy, in my case, this was a considerable concern as I new I would not have room for both a pillar drill and a milling machine as well as the lathe.

Having squeezed the largest lathe I could into my 'Mini' workshop (might as well call it as it is!), there was definitely not enough space for both drill and future purchase mill. But, would you believe it? Some kind person designed a much smaller version of the industrial sized mill and called it a mini mill/drill, as it does

both jobs in one tool, just what the workshop challenged newcomer to model engineering could desire.

It can drill, mill and mangle fingers just like its larger cousins, while still allowing you to get into your workshop to use it.

It was of course suitably priced to allow budding engineers to have a device that can do a lot more than just turn metal, we can drill and make shapes we could not easily do on a lathe. (despite the fact that model engineers have been able to do without one for more years than I have been alive. (But then who wants to do all that sawing and filing?)

There are, so called micro mills even smaller than the X2 and bigger ones like the X3, but the X2 fills the gap where space is at a premium and one's pockets are not as deep as one would like. Always a limiting factor in my case, (all donations will be gratefully received of course.)

So, after a little opening waffle, we finally arrive at the X2 mini mill and its new 'Super' variant the SX2P for Arc Euro Trade (**photo 1**).

Let's compare the two as they are as different as chalk and cheese, and in the case of the SX2P, a veritable bargain at the price, when you actually compare the old and new.

The X2 has a 350w brushed DC motor driving a two speed gearbox via plastic gears, which would shed teeth quicker than a demon dentist, if you pushed it too far. A common solution was to fit metal gears (noisier than the plastic ones) or do a belt drive conversion.

The new SX2P mill has a 500w brushless motor and direct belt drive to the spindle. It is very quiet in operation, a more powerful and controllable motor with one continuous speed range from 0 – 2500 rpm.

I should point out at this juncture that the power figures of 350w and 500w are output power. Output power is usually quoted by the more reputable retailers, as this is more relevant to the end user than input power as there is no mention of motor efficiency to enable output power to be calculated. It is the output power that will be doing the actual work, not the input power.

The specifications for the SX2P show a speed range of 100 – 2500 + or – 10% but I can assure you, with the speed control knob all the way anticlockwise the speed is 0 and is very controllable at the low speed end. Enough so that I can use it to tap holes at a safe (for me) speed. The lowest reliable speed I could achieve on my machine is 53rpm.

This last feature leads us on to the spindle taper, I think the X2 originally only had the MT3 spindle taper, presumably because its equivalent sized lathe would also have an MT3 headstock taper so you could use your MT3 accessories on both machines.

With the SX2P, you can choose MT3 or R8 at the time of purchase. Oh! The dilemma, which to choose! I um'd! and ah'd for quite some time before taking advice from lots of forum postings regarding the benefits of the R8 spindle taper (**photo 2**) and have not regretted the decision one iota, I also chose metric, so all my normal tooling, mills drills, lathe, mill etc. is the same. I do have some imperial measuring implements, though more for nostalgia than actual use.

The R8 taper releases much easier than the MT3, which if done up too tight, will need a hefty thump or two to release it, not so good on the bearings I would have thought. The R8 taper also has a key slot that engages with a pin in the spindle, which means the taper cannot slip, and doesn't need to done up as tight as the MT3 taper.

This brings me back to using the SX2P for tapping, I must say at this point I may be breaking all the rules, but, to use the mill for tapping I release the draw bar a turn, then release the R8 taper, then undo the drawbar two or three more turns which allows the taper (and chuck of course) to drop a few millimeters.

The taper has effectively been broken between the spindle and chuck but still retained by the draw bar AND locating pin mentioned earlier.

So while the chuck is disengaged from the spindle taper and will rise and fall dependent on how much slack the drawbar has, it will still turn because of the pin.

By bringing the drill chuck (with the tap) down to the hole, one can maintain slack space between the chuck and spindle so that as the tap cuts it is drawn down into the hole by its own cutting action, the operator only has to keep this slack space with the quill feed.

Try tapping with an MT3 taper and see how far you get, one up for R8 I say.

Okay! Okay! I know just what you are going to say – you have just got the tap as far as it will go into the hole, now! How do we get it out, as there is no reverse on this mill.

Well! He says, smug grin on face, actually there is, it just isn't implemented. All you need is a single pole toggle switch (Maplin's or your favorite shop) and three pieces of wire, there is an unused space on a little circuit board inside the speed control box. I used an old 3 wire RC servo lead I had lying around as the socket matched the three pins on the circuit board. You could off course just solder the wires to the pins. See later for more detail. There you have it, forward and reverse at the flick of a switch (reverse your previous actions to get the tap out) for less than £2.00 and a few minutes' work.

Ok, so far so good, what else is different? Mills like lathes need to be rigid, the less material used in its construction means it will be less rigid. The X2 did, like other similar devices, suffer from a lack of rigidity, especially as most users would push its capabilities far outside its comfort zone. Lack of material in the column together with a tilting mechanism on the X2, meant rigidity was a problem. Stiffening plates to support the column at its base and filling the column with epoxy and such like, were some of the solutions that people came up with.

Well, some kind person at Arc Euro Trade came up with an even better idea, get rid of the tilting mechanism, especially as it is a P.I.T.A to re tram the column after moving it from its set position, plus how many actually use this facility (bound to be someone, but what is wrong with tilting the work?)

The fixed column is more rigid than a tilting one, especially as it was made of thicker material as well, nice one Arc Euro person you can have a another brownie point to go with the ones for the brushless motor and R8 spindle option.

An example of R8 taper tooling.

At this point I have to say sorry to the existing X2 owners who would like the new, more rigid column; well you can't unless you buy a new base as well – Arc do a conversion kit if you must, but I would think it better to sell the X2 and get the SX2P. I feel I need to point out at this stage to say categorically, I do not have any relationship with Arc Euro Trade in any form whatsoever, other than a very satisfied customer, lovely people to deal with and fast efficient delivery service.

What else is different I hear you ask? Well, the worktable is considerably larger on the SX2P than the X2 mill, and in fact has been purloined from SX1L micro mill, and gives increased X travel – more is better, is it not?

No! I do not know why the SX1L has a larger table than the X2, hopefully someone can enlighten me – not that I am complaining of course.

Now you may be thinking that the SX2P has it all compared to the X2, well it has except that the early X2's were shipped with a gas strut to support the headstock, later versions of the X2 and the new SX2P had to make do with a cantilever arm and spring arrangement, which in my opinion was a retrograde step but fully understandable from a financial point of view.

When you look at the price of the old X2 and newer SX2P you really are getting much more value for money. It has been argued that it costs nearly as much to do all the mods to an X2 as it cost to buy the SX2P – like I said earlier, what a bargain!

Now that I have described the differences, what is the SX2P actually like to use?

At the bottom of the description on the Arc Euro Trade website it does say that the machine is sold for hobby use only – If you want a real industrial quality mill then be prepared to get your wallet out and start developing muscles and have plenty of room in your workshop.

Having never used an industrial quality mill, I am not conversant with their actual machining capabilities. I do know that if you try and take things too far, too fast the SX2P will protest – it is a hobby quality machine NOT industrial, we have plenty of time on our hands, take smaller cuts until it stops protesting and both you and the mill will be happier in the long run.

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I personally have no complaints at its material removing qualities, as I accept it for what it is and work within it's limitations. Yes! I would love the X3 or super X3 mill but where do you draw the line? (way out of my meager pension I'm afraid, but Hey Ho!)

To turn on the SX2P, make sure speed potentiometer is fully anti clockwise i.e. 0 rpm (it will not turn on otherwise), plug into a suitable 13a socket, turn mains on at the socket, lift cover of zero volt switch and press the green button, you should now have the green 'on' indicator light up on the front panel, turn the speed pot clockwise and away it goes, with a gradual ramp up to full speed.

The SX2P is very quiet in use due to the belt drive and the motor is very powerful even at low revs. There is no indication of spindle speed on the SX2P so the user has 1 of 4 options:

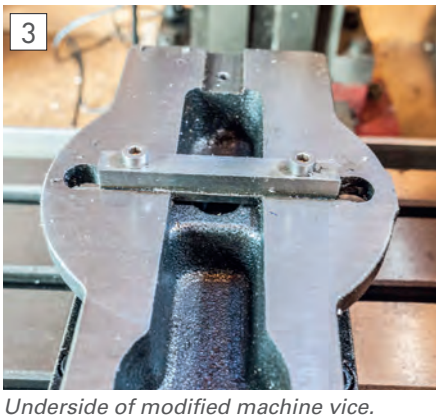
1. Guestimate the speed
2. Put ¼ , ½ and ¾ markers on the speed pot scale and mark these 600, 1200 and 1800 which should be near enough for most purposes.
3. There is an optional accessory, a digital speed display which just plugs in at the back of the control box, the socket already existing. There is a mounting plate for the speed display, already in place above the control box.
4. Get an electronic tachometer module from eBay complete with Hall effect sensor and magnet for less than £6.00, a suitable box from Maplins and a cheap wall wart power supply – see mods section later.

I chose the latter route but find I don't use it that much, preferring to guestimate by how the work is progressing/protesting and the type of material being machined.

As with most lathes, one needs to purchase other bits and bobs for our new toy so that we can actually do something with it, items such as milling vice, Collets, milling cutters, clamping set etc. Fortunately for me (you may not be so lucky, as I would imagine the SX2P is quite a popular purchase) all these items were provided free as part of a deal at the time.

As part of the package I got a nice radial milling vice, which soon lost its radial bit and I have no real desire to put it back. To me it is as useful as a tilting column. The vice was modified to provide a key into the slots on the XY table which aligns the jaws of the vice to the X axis without having to set it up each time (**photo 3**).

I also got four R8 collets 6,10,12 and 16mm, together with some 4 flute end mills, which are more than enough to get one started. I have of course, purchased a lot more milling cutters but not needed any more collets. The clamping set has of course, also been very useful.



Underside of modified machine vice.

When I purchased the SX2P I elected to go down to ArcEuro, near Leicester, to pick it up, rather than pay the £40 delivery charge, it cost me £20 in petrol, but as a bonus I got to look at all the goodies in their shop.

The SX2P was ready and waiting for me when I arrived and two polite young men put it in the back of my car. How was I going to get it out again at the other end? I had already pre planned this operation – or so I thought!.

Trying to think ahead I had put bricks and pieces of timber in the boot (Ford Focus 1.6) to get a level platform from which the packing crate could be easily slid from the boot.

However, all my efforts to think ahead were to no avail, as to get the packing crate in the boot would entail laying it down on its side, which according to the young men was a big no-no, as they did not want to risk damage in transit and insisted it be placed upright in the boot, which meant all my bricks and wood had to be discarded and the packing crate placed on the floor of the boot, which is some 6 to 8 inches lower than the boot lip. (best laid plans etc)

Weighing in at some 70+ kilograms, I did manage to get it out of my car boot, in one undamaged piece and without damaging myself or the car, all by myself.

Necessity IS the mother of invention they say. Fortunately I maintained my deep manly voice, but would recommend you have two pairs of hands as I think the maximum safe handling load for a man is 35Kg.

I did however get a second pair of hands to help me get it round the back of the house to the shed (sorry! Workshop) and onto the bench in its final resting place, already pre drilled for its mounting bolts.

I had read somewhere that it pays to mount the mill on something to lift it clear of the bench so you do not rattle your knuckles when turning the Y axis handle. I managed to find some high density fibreboard about 20mm thick which seemed to do the trick.

The SX2P when removed from its packing crate was in a heavy gauge plastic bag, the mill itself was coated in a fairly light but sticky oil, it was easily washed off with paraffin and paper towels and the various parts oiled as recommended.

I did NOT at this stage strip it down but decided to use as is, then see what might need doing. The gibbs needed adjusting as you would imagine, but essentially it was ready to use.

I have of course stripped it down since and adjusted the lead screws to eliminate some of the backlash on the X and Y axis but did not find much in the way of casting sand/general debris under the table and carriage.

My initial impressions of quality were very positive and have had no reason to change my mind in this respect. Interestingly, Chinese built lathes and mills tend to come in for a lot of criticism from certain quarters with regard to quality, or lack off, depending on which side of the fence one is on.

It is a simple matter of fact that you get what you pay for. The Chinese will make anything for you at any price you want, but quality costs money. Something most of us do not like parting with. From my perspective, I tend to find that the critics are just repeating quality issues of 20 – 30 years ago rather than actual personal experience of more up to date Chinese machines. The dealers have played a huge part here by insisting on improvements being made where needed while still maintaining a fair price. The X2 v SX2P being a good example.

Back to the SX2P, gibs need to be adjusted and unused axis locked down to prevent vibration/movement when milling, the more so as you take more aggressive cuts. Conventional milling did not show up any problems and neither did climb milling but you do have to be aware of the above regarding gibbs etc. and depth/speed of cut.

Climb milling will give a better finish to the cut but on these lightweight machines can be hazardous as it will try and pull the work into the cutting tool. There are lots of references to the hazards and benefits of climb milling, read them and make your own decision whether you stick to conventional milling or not, but I am sure there are a lot of X2 users who happily climb mill without a second thought.

The head of the mill is raised and lowered by a rack and pinion system and can be locked in position with a locking screw (it does have a suitable handle unlike the X and Y axis gibb locking screws). There is also a locking slide underneath the head to give a limit stop function. The head does of course have gib adjusting screws, these are located on the right hand side.

For fine feed, the quill feed mechanism can be pushed in towards the head to locate with the fine feed mechanism, which is a dial with moveable scale, on the front of the head.

Once engaged, fine feed is obtained by turning the dial clockwise to feed downwards, one complete turn moving the quill down by 1.5mm and there are 60 graduations of 0.025mm . There is however more backlash than you can shake a stick at, surprisingly, there has not been any mods to this particular bit of the mill that I could find, something I will have to look into in the near future. Digital scales help here so perhaps not a pressing need. For digital scales see the Mods section at the end of the article.

The SX2P is provided with a 13mm keyed chuck on the appropriate spindle taper and has a clear plastic chuck guard fitted to the head by two bolts.

The chuck guard was swiftly discarded as being as much use as a chocolate fire guard.

You may choose to remove yours also, but old hands will well know that milling cutters have VERY sharp cutting edges, newbies like me, whilst knowing that cutters had to be sharp to do their job, didn't realize they are attracted to human flesh like magnets to steel, whether rotating or not.

I have a healthy respect for rotating cutters of any description and keep body parts well away from rotating cutters, but it is when your guard is down (not the one supplied with the mill as I have removed

it!!!) and the cutter is not rotating, that the little devil's bite you. I have the scars on the back of my hand to prove it! (I recommend making a guard from a sheet of flat polycarbonate, mounted on an inexpensive magnetic base – Ed.)

The SX2P has proved to be a very worthwhile purchase; living up to everything I expected it to be. It appears to be well made and is very quiet when in use, depending on the depth of cut of course, as it will protest loudly if you go too far.

There is a yellow fault LED on the front panel which I suppose should light up if a problem is detected, mine has not lit up yet, despite stalling the motor a couple of times. On the odd occasion it has stalled it was my fault for not tightening the part down properly in the first place.

One little point I will make is the use of the speed pot to stop the motor. I always position the speed knob at zero when the drilling or milling is finished BUT then turn the mill off at the no volt switch.

The speed knob is very easy to nudge past the zero revs position, as there is no detent to offer any resistance. The mill spindle WILL turn and catch you unawares. If you are lucky no physical damage will occur, if you are unlucky, the part you are machining may well acquire a nice red paint job. I can now see why SEIG chose a blood red for the mill colour scheme!

The cantilever arm arrangement for supporting the head, may work reasonably well when the head is positioned some way down the column, as this will load up the spring sufficiently to take the weight. It is when the head is near to the top of the column that problems can arise. There is not sufficient force in the spring to counter balance the head, which can lead to the head (and drill bit or milling cutter) being pulled further into the work than one would want, leading to possible ruined work.

Modifications

You would have thought that with all the changes from the X2 to SX2P there would not be any need for mods – wrong!

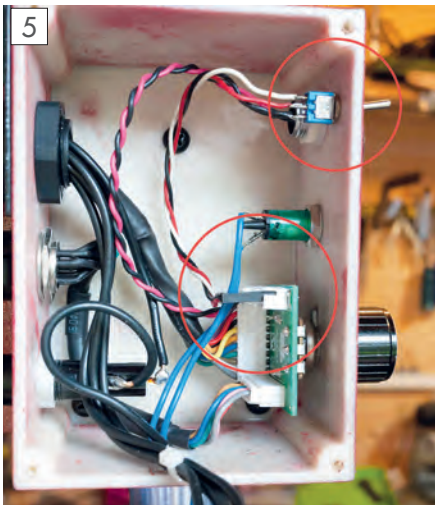
Despite all the improvements, there is still a lot that can be done to improve the user experience of the SX2P.

My list is as follows, not necessarily in order of importance:

1. Gas strut conversion (I class the counterbalance weights system below as an interim solution.)
2. DRO's on all three axis
3. Spindle speed readout
4. Some form of lighting system to illuminate the work one is milling/ drilling
5. Some means of aligning the milling vice jaws to the X axis
6. Adding a reversing switch
7. Find a solution to the fine feed backlash, probably not needed if DRO scales are fitted, but I am sure there must be a better way to implement this.
8. Some means of powering the X axis at least, to avoid developing arms

Thinking that the gas strut conversion kit would be somewhat expensive, the postage from the USA being more than the actual conversion kit cost, I decided on a simpler approach. After all, three of my boys had left home and I was left with lots of detritus to get rid of, including some cast iron barbell weights, which duly found their way into my workshop for possible future use.

The 'angel eyes' in position.



Inside the control box.

Well! The future is now the present and those weights are about to be brought into service. I removed all the cantilever arm bits and pieces and installed a system of pulleys and weights to counterbalance the head. In total I had used about 6 to 7Kg of weights. Which seemed to do a better job than the now removed spring arm arrangement.

That done, I could now fit the DRO scales.

The simplest mod is item 4 - lighting. There have been lots of ideas on many ME forums regarding this one topic and everyone will have their own favorite solution.

I started out with a clamp on halogen lamp which was quite good but I was always burning myself on it as they get very hot in use – very frustrating (and painful). I eventually replaced this with a clamp on LED lamp, can't remember where I got it from but it has a large clamp with a small LED head on a bendable swan neck. I transfer this to use on the lathe when I need to.

I have also glued on an LED ring light under the head surrounding the spindle which gives a good even shadow less light (**photo 4**). You can get these from eBay, cheapest option is to buy from China and only took a week to arrive. They are also called 'angel eyes' and come in a range of colours, obviously white being best. The Ring light can be fed from any suitable 12v wall wart power supply.

Mini 10w flood lights are available quite cheaply (less than £10.00) and will give good illumination, I have one above my lathe but still use the swan neck lamp to get light right where I need it. I am of an age when bodily parts are starting to malfunction, eyes especially, I need LOTS of light to see what I am doing these days.

For lots more ideas on lighting, check out the forums on the Internet.

The next simplest is the reversing switch, as stated earlier, all you need is a single pole two way toggle switch and three lengths of stranded wire about 4 inches long. I have included **photos 5** & **6** but diagrams and wiring information can be found here http://tinyurl.com/hbdk36t

Outside of the control box with forward/reverse switch.

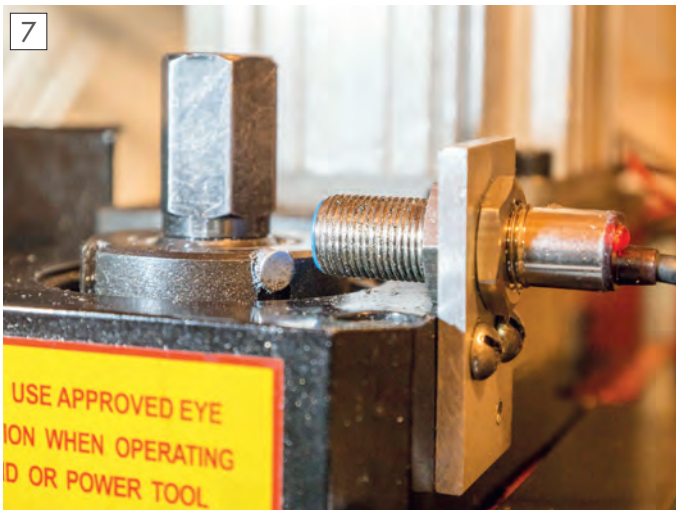
On a serious note please pull the mains plug from its socket until you have everything screwed back together. ***MEW*** does not want to loose any readers/ subscribers. (Also consider using an insulated switch in case it come in contact with voltages inside the control box – Ed.)

Item 5 would be next on my list, as you will not get far without a decent milling vice. Once you have your vice, free or paid for you will probably want some means of aligning the jaws of the vice with the X axis without having to do it every time you remove/reposition the vice.

The basic principle is very easy to do, refer back to photo 3. I removed the radial part of the vice, you may wish to retain yours in which case everything you need is here: http://tinyurl.com/jrj2k66 You can adapt this to suit your particular vice etc.

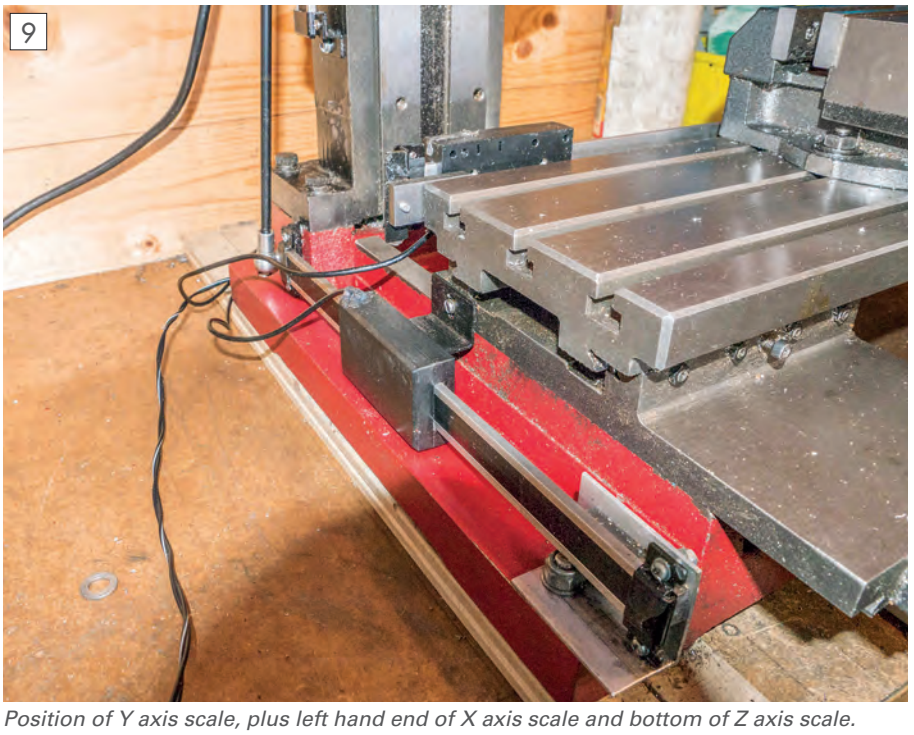
Next is the spindle speed readout. Off we go to good old eBay, for a Digital LED Tachometer speed meter with Hall effect Proximity switch sensor. The cheapest I could find cost less than £6.00 with free postage.

The electronic module comes with a hall effect sensor switch and a 5 x 3 mm magnet and will work from 8 to 24 volts DC. A small plastic box from Maplins to

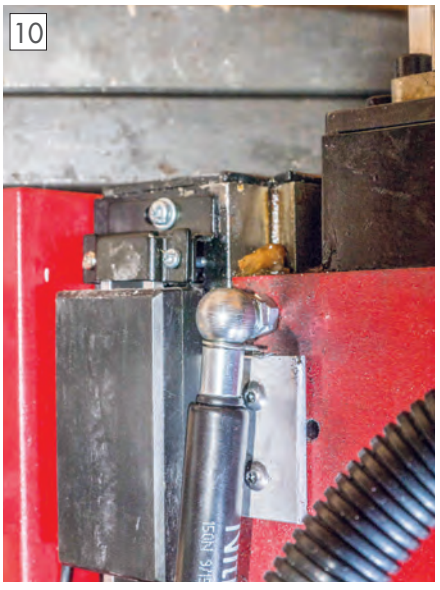


The Hall Effect sensor.

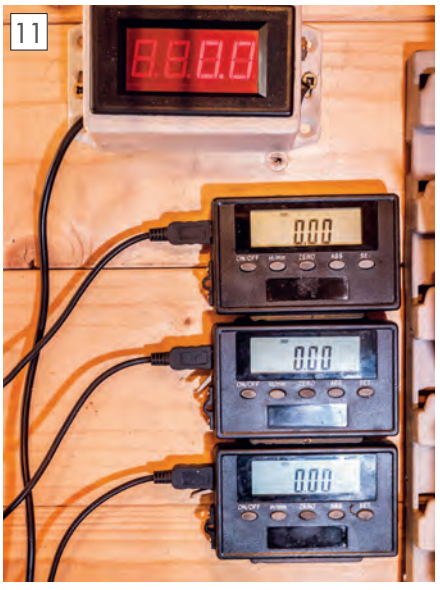
Tachometer didsplay.



Position of Y axis scale, plus left hand end of X axis scale and bottom of Z axis scale.



Top of Z axis scale with read head at maximum.



Remote read out heads for the scales.

put it in and a little bracket to position the Hall effect sensor and away you go.

You can test the module by waving the magnet near the hall sensor, there is a convenient LED at the back of the sensor that lights up when the magnet is close. If it does not light just turn the magnet round. If the magnet is being detected, you should get a change on the display reading. I have included photos of how I installed mine.

Photograph 7 shows placement of Hall effect switch and magnet and photo 8 is the rev counter module mounted in box affixed above DRO scale remote readouts.

Now for the DRO (digital Read out) system. You have a number of solutions here depending on how deep your pockets are and as you have decided on the SX2P rather than the Super X3, they will be as shallow as mine and you will elect to use the I-Gaging scales (from ArcEuro surprise! Surprise! (As Cilla would say) like I did.

There are better quality magnetic and glass scales available, but in my humble opinion are better suited to a bigger (more expensive) mill as they cost considerably more.

The big question now arises as to where to put them, I elected to put the X axis scale on the back of the table so it would not interfere with the gibb adjusting and locking screws. The Y axis was placed on the left hand side of the base, again so it would not interfere with the gibb adjusters and locking screws which are located on the right hand side (**photo 9**).

The Z axis position had already been decided as the left hand side of the column which is why the lever arm spring arrangement for supporting the head had to go (**photo 10**).

You may choose different locations, especially for the X axis as this placement does limit the Y axis travel by a small amount.

I chose 40cm scales for X and Z axis and 30cm for the Y axis but in hindsight 30cm should be more than enough for the Z axis as the gas strut limits the Z movement anyway. It is now just a case of making up suitable brackets (where needed) to mount your scales.

The remote readouts were positioned to the right of my mill and arranged vertically – X, Y and Z with the spindle speed meter above these (**photo 11**).

You may do without the remote readouts if you build Yuriy's Android DRO project, I chose to have both as I can unplug the cables from the remote heads and just plug them into the Android DRO box whenever I need to, especially when drilling holes on a PCD, though even that task has been somewhat superseded by my purchase and conversion to stepper motor drive, of a rotary table.

The only thing to be careful of is that the measuring heads are not subject to any undue stress or strain when fitted and at the limits of table/column travel, so you do not get false readings.

These scales are NOT swarf proof, nor sealed against fluids such as cutting oil and so should be given some means of protection if you want to get the maximum life out of them, plastic or aluminium covers have been suggested on some web sites. I chose cycle inner tube, split down the middle and super glued at the mounting bracket position, which so far has proved to be adequate.

The cables from the scales to the remote readouts are positioned behind the column and I used cable tidy to keep them together and out of the way.

The gas strut conversion

I did look at the X2 conversion kit from the USA but discounted the idea for two reasons. The kit contained the gas strut, various brackets, rods and fixings together with an extended length rack and is good value for money, but while the actual kit was quite cheap the postage certainly was not.

It is a very simple mod to do, the hard part is deciding on where to attach the ends. I found out from various websites that the brushless motor has a bigger mounting footprint than the brushed one and so you cannot use the strut mounting location as advised in the kit.

I also did not particularly like the strut sticking out of the top of the column so decided to position the strut on the left hand side of the column, making sure it did not foul the Z axis scale or anything else (**photos 12**, **13** & **14**).

I am not saying that the locations I chose for the strut ends are necessarily the best, I just did not want to remove the XY assembly to drill/tap holes. It does however seem to work quite effectively where it is.

Various forum postings mention getting the gas strut from a breakers yard and mention certain makes of car, which have suitable struts, fine if you have the time/inclination etc. but I found an article that specified the size and spec of the gas strut he used and where/who to get it from – SGS Engineering UK Ltd. The order code/part number GS6-15-220-260 is the one I used.

To translate the part number – GS I assume is gas strut, 6 is the shaft diameter in mm, 15 is the body diameter in mm, 220 is the stroke of the strut (shaft length) in mm and 260 is the body length in mm. You also need to specify the total length of the gas strut when fully extended, i.e. 500mm

The final part which is separate to the strut part number is the gas pressure you require which can be anything from 15 to 400 Newton's.

Gas strut bottom fixing, circled in red is a better area to place this end but is harder to access for drilling and tapping.

I decided on 150N as this equates to 15KG which should be more than adequate for supporting the mill head. I believe the one supplied with the USA kit is considerably less, I may have gone too far the other way but it seems fine in use.

The threaded ends of the strut are M6 and included in the price are two fixing ends of your choice, I chose 10mm ball studs with M6 female thread for both ends.

I removed the limit stop at the top of the column to make it easier to fit the gas strut and chose not to put it back as it gave me another 5 to 6 mm at the top of the Z axis without the rack and pinion disengaging. The gas strut acts as a limit stop anyway and the few extra millimeters gained at the top end are always welcome.

Modifications 7 and 8 are more 'something to ponder over' at the moment, item 7 is not too much of a problem with DRO's fitted anyway. Item 8 however is my current task, when not doing anything else of course!

I have a defunct rechargeable screwdriver with duff NiCads that I am trying to use to power the X axis lead screw. There was an article in *MEW* a few months ago regarding low voltage DC motor speed control. At one time I might have been inclined to make it, as electronics is one of my other hobbies and has been for over 50 years.

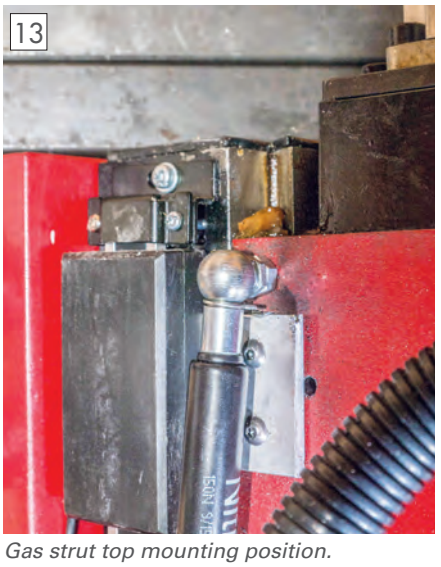
However, electronic assemblies to do that function abound on EBay at prices that do not encourage self build. I chose a 6A DC 6V 12V 24V Motor Speed Controller Switch Pulse Modulation PWM Control that had a speed pot and a center off reversing switch, for less than £6.00 including postage.

I have just got to work out a suitable way to attach the motor to the lead screw. I am sure I will come up with something even Heath Robinson would be proud of.

So! There we have it, the Super X2 Plus mini mill designed for those with minimum space, minimum funds and no desire to make a 6inch scale traction engine, yet still be able to do light milling and drilling work.

I am sure there are lots of others who have and use, to good effect, both the X2 and its newer much improved sibling the SX2P, especially at its price point.

Editors Note: Applying some modifications to a new machine may invalidate your guarantee. Check with your supplier first. ■



Gas strut top mounting position.

Gas strut in position and fully extended.