

# THE X-3 MILLING MACHINE



1. The X3 Milling Machine

## Background

About 4 years ago I purchased a CNC mill having seen it demonstrated at a Model Engineering exhibition. I had been interested in clock making for nearly 25 years and had become tired of cutting out skeleton clock plates and crossing wheels by hand. Over the last 4 years I have become more and more fascinated by the endless applications of CNC not only to clock making but more generally in the amateur workshop. Recently I decided to take my interest in CNC a step further and to retrofit a mill entirely myself. I wanted the result to be a machine that was configured precisely to my own specifications and requirements. I also did not want to invest a great deal of money in the project as at the end of the exercise I intended sell one of the mills. If my retrofit turned out not as I had hoped then I would not have lost too much if I had to sell it.

## Which machine?

The first problem was choosing a mill to retrofit. I wasn't interested in any of the small mills that are available, due to the simple fact that one can make small items on a large machine but it is however impossible to make large items on a small one. I wanted a machine with an X-axis

**Dick Stephen takes delivery of a new machine, and is suitably impressed by Far Eastern design and quality.**

movement of 300 mm and a Y-axis of a minimum of 150 mm. The problem with nearly all the machines I looked at was the Z-axis. This had to have a screw feed, but should not have a round column. Most of the imported new machines, mainly of far eastern origin had round columns and rack and pinion feeds. This rendered them, in my opinion, unsuitable. I simply could not see how I would get sufficient accuracy for the Z-axis feed or adequate stability of the head, when movement up and down the column is considered. Eventually I found the X-3. This was the appropriate size and most importantly, in addition to the normal quill arrangement, it had a dove tail Z-axis and a screw feed. It was, like nearly all the mills available, made in China. Chinese machine tools for one reason or another, enjoy in some quarters, a reputation for inferior quality. This has not been my experience. I have several items of Taiwanese origin and frankly they are all excellent and as good or better than equivalents made in Europe. So this last January I took myself down to the Wembley exhibition to have a closer look at the X-3. I spent some time over a careful examination of the machine. The overall finish was good, and in fact, the more I looked the better I liked it.

Several features are worth mentioning. As can be seen from the photo, the stand incorporates a useful lockable cupboard

for tool storage, and safety wise, a clear plastic guard is fitted which slides up and down and also hinges forwards. Most purchasers of this machine will no doubt wish to use it as supplied (rather than carry out the CNC conversion) and in this respect, the graduated rule along the front of the table is the sort of detail which makes it much easier to avoid miscounting turns of the handle on long traverses. The spindle power is provided by a 600 watt permanent magnet DC motor driving through a two speed gearbox via a toothed belt. The electronic speed control system includes overload protection and feedback for speed stability. The specification claims a speed range from 100rpm to 2000rpm in high range, and 100rpm to 1000rpm in low, although it seems possible to go well below this.

## Arc Euro Trade and the machine in pieces

As luck would have it the X-3 is available from Arc Euro Trade, who are based in Leicester not too far from my home. A further piece of good fortune was that a friend of mine had just started working for Arc cleaning and setting up Arc's machines before they are sent out to the customers.

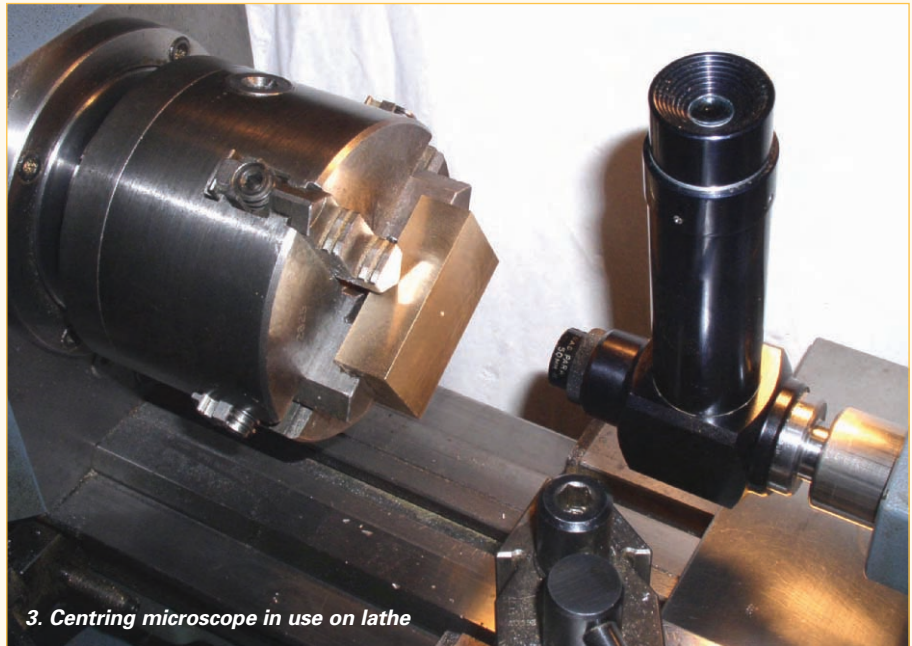
2. The retaining cap which holds the 3 - 2 Morse taper adapter in place



This is a very important point to bear in mind if you intend buying a far eastern machine. All the machines supplied by Arc (excluding Z1 & X0) will have been stripped down, cleaned and any problems sorted before the machine reaches the customer. The person doing this is also very good at it. When I paid Arc a visit I was able to see an X3 in pieces being cleaned. This allowed me to assess the quality of the construction as well as to take measurements to see how feasible it would be to fit ball screws, which I believe are an absolute must for CNC. The first thing I noticed was the high quality of the castings; the quality of the construction was first class. All parts are screwed and doweled making assembly very precise. In fact I was not able to fault the construction in any way. The head is very solid and heavy being entirely of cast iron construction. To counteract the weight of the head the Z-axis is fitted with a gas spring. (The same sort of device used to counter the weight of a hatchback rear door) The substantial weight and rigidity of the head means that the mill should handle large cutters without trouble. I then examined the X and Y axes. Again here no problems in fact, only plus points. The X-axis screw is supported at both ends. This means that the nut does not have to serve as both a nut and a bearing. This will significantly reduce the wear on the nut and reduce backlash. The Y-axis screw is unsupported at its free end, which is fine with the existing acme screw. When converting to ball screws, a rear bearing will be needed, but this will be a very simple task to fit and that is certainly something I will do when I fit the ball screws. The existing nuts on all three axes are anti-backlash bronze nuts of substantial proportion. Measuring up the space available at all three axes I realised that it would be possible to fit ball screws without having to do any machining on the castings. A very major plus as far as the retrofit was concerned. By this time I had seen enough to convince me that the X3 was a goer and without delay placed an order for a machine with a No. 3 Morse taper spindle. That the machine was an Imperial one mattered little as I was going to replace the screws with metric ones.

## Delivery

The mill was duly delivered by Arc, the machine in one crate and the stand in a second. Getting the stand into the workshop was no problem, the mill presented a heavy problem. There was no way that I could have moved the machine into the workshop let alone raised it on to the stand even with another pair of hands. Arc when delivering extremely heavy machines come fully equipped with a mobile lifter to solve such heavy problems. (ARC provides this service by special arrangement only, at extra cost). Readers purchasing this size of machine should therefore make the necessary preparations before placing an order, as carriers will only deliver the machines to your door without installing the machines. If you are unprepared, you could be faced with a bit of tricky installation work requiring specialist lifting gear, rather as Jack Cox outlined in his article in MEW issue 97.



3. Centring microscope in use on lathe

## Small mod. and little niggles

I have had the mill for some time and been able to carefully check every aspect of the machine before I take it apart to install the ball screws and stepper motors. As I have already said, the spindle comes with a No.3 Morse taper. All the tooling that I have, has No.2 Morse taper. This has required the fitting of a No.3 to No.2 Morse adapter. **Photo 2** illustrates the way I have done this. Fortunately the spindle comes with a transverse groove into which two drive dogs are secured by 5 mm cap heads which I was able to use to attach the cover piece I made, which retains the No. 3 to No.2 adapter while the No. 2 tooling is removed. Without such a retainer, the chances are that each time the No. 2 tooling is ejected, the adapter comes out with the tool and then has to be separated and refitted. I have been able to find only two aspects of the mill I don't like. The first is the draw bar which is a typical item and a bit crude for my taste. Again this is a trivial problem to solve. I have tapped the hole at the top end of the spindle with a 15 mm by 1 mm pitch thread and made a differential thread draw bar. This will allow a "push" action for tooling removal. I use a centring microscope a lot (**Photo 3** shows this in use on the lathe) and I didn't fancy using a mallet to remove it. The other aspect I don't like is the accessibility of the electrical controls on the side of the column. I guess though, that one would get used to the position in time. Fitting the Z-axis stepper motor will require the electrics to be moved which in turn will allow me to situate them in a position more convenient for my way of working.

## Overall

I have checked the set up of the table with a dial gauge. Both the X and the Y axes are set precisely at 90 degrees to the spindle. I could not detect any movement of the dial gauge when traversing along either axes. The concentricity of the

spindle, even after the addition of the Morse adaptor is also perfect. The adjustment of the gib screws on the X and Y axes is also very precise and convenient. The Z-axis too, is fitted with a tapered gib strip for ease of adjustment. **Photo 4** was taken during the strip down phase and serves to give some idea of the thickness and weight of the head casting.

In my opinion the X3 mill is an excellent machine very well constructed and at around £1,000 including the stand, superb value for money.



4. The weight of the head casting augers well for the general rigidity of the machine.

## Supplier

Arc Euro Trade, 10 Archdale Street, Syston, Leicester, LE7 1NA. Tel 0116 269 5693  
See also advert. on page 4.