



## *Machining Master Class*

### **Horn Supermini<sup>Ô</sup> broaching and threading help Ottaway get the job done**

Use of Horn Supermini™ Type 105 broaching and grooving tools has enabled Ottaway Engineering, Eastleigh, to develop a highly efficient sliding head process route for single cycle manufacture of miniature ballscrew nuts.

Without the broaching tooling it would have been necessary to wire erode the applicable feature, adding an additional operation, increasing lead time and incurring fixturing costs. Likewise the profiled grooving tool generates the helical ball track; this feature was impossible to produce economically by tapping as the material, hardened 17-4 pH stainless steel, is difficult to machine.

As well as allowing efficient manufacture of the component, the precision inherent to the Ottaway process route has enabled its customer to assemble the finished product using a reduced range of ball bearing sizes. A key role in this is played by the form accuracy of the grooving tool, which is profile ground by Horn to a precise 0.520 mm radius.

Ottaway manufactures four major components of the ballscrew assembly, these being the ball nut, the screw, a linear transfer (which locates in the broached slot in the nut) and a plastic carrier/sleeve. Tony Allen, Engineering Manager at Ottaway, explains. "The tolerances for all of the components are very tight. Of particular importance are the alignment of the broached slot relative to the thread and the thread itself, which has a 5 micron profile tolerance."

The slot measures 3.5 mm wide and 1.5 mm deep with a  $\pm 20$  micron tolerance, and extends the full length of the nut, which is 17 mm long. The slot is machined into the wall of a cylindrical bore of 5.35 mm diameter - with the material in a pre-hardened state.

Essentially it is the type of component with which Ottaway Engineering has made its reputation. The shop floor of the soon-to-be extended factory is crammed with high quality machine tools. The inspection area is similarly packed with a class of precision component that is best described as challenging, in terms of features, tolerances and material.

#### **Single cycle machining**

"When the job came in it was immediately apparent that the nut and screw would suit single cycle production on a sliding head machine as this would guarantee the required alignment accuracy." Mr Allen remarked. "However this was conditional on us developing a suitable process. We initially produced a small batch of sample component sets. We used wire erosion to produce the slots but this added a second operation and needed special fixtures for the call-off of several hundred per week.



Mr Allen and his team were more-or-less reconciled to using EDM for the slotting operation but placed an enquiry on Horn for a specially profiled Super Mini insert to use for the thread cutting operation.

Fortuitously the enquiry coincided with early availability of the Horn broaching system. When they became aware of it Ottaway decided to do a basic fitness for purpose broaching trial using standard tooling before committing to a customised insert.

### **Geometry**

Trials were carried out using a variety of feedrate and cutting depth permutations with the component held in the sub-spindle of Ottaway's Traub TNL26 sliding head machine. Initial results were not promising as the tool exhibited a tendency to skip, producing a chatter-like finish on the slot. However Gary Priestley, the Horn engineer engaged on the trial, re-assessed the tool geometry and made some adjustments. This brought an immediate benefit in terms of finish with no productivity penalty and led Mr Allen to commission the special insert profile required for production of the part.

The machining sequence is to produce the thread, then do the broaching operation, then re-run the thread finishing pass to remove burrs. "The rigidity of the threading tool is an asset to the process." Mr Allen confirmed. "Tool life is very good considering the high demands being placed on it while the repeatability of positioning in the Horn toolholder is such that it is very easy to replace a worn insert in situ without loss of accuracy - though we obviously check the first-off every time an exchange is made."

The broach has been similarly successful as it allows the component to be finish machined in one continuous cycle. This is highly desirable in maintaining critical geometric and spatial tolerances.

"Horn's broaching system has proved to be very effective and makes a major contribution to the overall efficiency of our process." Mr Allen concluded. "Without the Horn Super Mini system as a whole it would be much more difficult to produce this type of component to the required accuracy at competitive cost."

