



## *Machining Master Class*

### **Type 311 special notches up superiority over Woodruff**

**The** range of 'mobile' hydraulic valves produced by Eaton Corporation Vickers Industrial Hydraulics Division, Havant, finds its way into a wide range of industrial applications. Off-highway vehicles, mobile cranes and other systems all benefit from the high levels of control repeatability available with these components.

The spool used to control the flow of fluid through the valve is a high precision component, ground to a diametric tolerance of three microns. Flow is regulated by adjusting its axial position relative to the land areas within the valve body, with fine adjustment achieved by a series of carefully developed notches on the spool land sections.

#### **Faster generation**

Generation of these notches has been significantly speeded up by development of a Horn groove milling form tool, based on the 17.7 mm swept diameter Type 311 Series insert. This can operate at much higher speed and feed rates than its high speed steel Woodruff-type predecessor. In addition, the Horn tool exhibits improved tool life while there is no problem in meeting notch form requirements or the specified positional tolerance of  $\pm 0.1$  mm.

Senior production engineer Kevin White comments. "The mobile valve products have been manufactured for some years by the company but only recently joined the range produced at Havant, having previously been subcontracted. We therefore had the opportunity to update the manufacturing process and opted for single cycle machining using a Traub CNC mill turning centre."



Spools for the 'mobile' valve family range from 16 mm to 22 mm diameter and from 30 mm to 275 mm in length. There are about 75 part numbers in all, of which c 85 per cent have a V-notch on some or all of the lands. The notches have included angles of 40, 45, 60 or 90 degrees of arc, and the form is reminiscent of the bow of a boat. Material of manufacture is ETG 100, a free cutting carbon steel.

Initially a six or eight bladed Woodruff cutter - which was ground to form by a local tool supplier - was used to generate the notches. Depending on the land position on the spool the cutter may either plunge into the land surface or be traversed in Z to generate the notch.

Says Mr White. "The Woodruff cutter performed quite well and certainly proved the concept of single set-up machining of these parts. However tool life was indifferent and, as the tool began to wear, it burned the machined surface through excessive friction. Likewise the overall cost and tool maintenance requirements, coupled with the cycle time associated with the tools meant it could only be a short term solution."

The move to custom-made Horn groove milling cutters was always part of the plan as it was felt that this would allow the performance of the machining package to be optimised. From the outset, Horn external grooving tools had been specified to produce the stitching grooves on the spool land surfaces.

Using the Horn tooling, cycle times for these parts are in the range 1 minute 20 s to 3 minutes on batch quantities from 10 to 200-off. On components where there are a large number of notches to be made, the time allocated to this operation within the cycle can be 30 per cent of the total so there is much to be gained from improving this part of the process.

### **Large time saving**

"Once we got the Horn cutters we were able to double both spindle speed and feed rate immediately." Mr White recalls. "The effect has been to reduce the overall cycle time by 15 to 20 per cent on the affected components so on a batch of 50 parts we can save half an hour. As we make to order that level of saving is very worthwhile."

As well as improved productivity, notches produced with the Horn tools exhibit improved finish and tool life is 'at least' doubled. Compared with high speed steel it is arguable that tooling costs have actually reduced.

"It has been a very satisfactory project all round." Mr White concluded. "The Horn tooling has provided the final link in the chain so far as 'mobile' spool production is concerned, enabling us to meet customer demand reliably and repeatably. Throughout, we've had very good technical and sales support from Horn UK."

