



Machining Master Class

Standards replace specials for better accuracy on spool valves

At Vickers Systems Ltd., Havant, Horn Mini Type 100 Series single edge groove milling inserts have replaced specialised indexable tooling for generation of land edges on hydraulic control valve bodies. As a result a requirement for 50 per cent improvement in positional accuracy on these features has been achieved - in fact the Horn tooling allows Vickers Systems to hold 25 per cent of the previous tolerance - while tool maintenance costs have reduced.

More Flexibility

Added flexibility also means 'specials' are more easily produced. And while it was previously necessary to dedicate one specialised tool to each valve body variant, all bodies having the same bore diameter can be machined with a single Horn toolholder/insert combination.

Despite the change from multi-edge tooling to the single-edge Horn insert, ability to machine at 90 metres/minute compared with c. 35 m/min, combined with quicker tool positioning, means cycle times per component compare favourably. Also, when the Horn insert is worn or damaged by casting inclusions, repeatability of cutting edge position is such that the machine operator can replace the insert in situ in minutes.

The Horn tooling is applied to machining of ranges of Vickers directional control and proportional valves. These are widely used by OEMs for a variety of industrial control applications. Valve bore diameter ranges from 9 mm up to 35 mm but each bore diameter in the range may have any number of variants. There are, for instance, six different configurations of the 12 mm bore valve. The principal distinguishing features are land width, land spacing and the number of lands.



Bodies are manufactured using grey iron and some SGI castings with the voids between the lands formed as part of the casting process. Land edges are defined following machining of the main bore; they are a key determinant of the valve's performance as they regulate flow in concert with the spool. Tightening the land positional tolerance provides the product with improved repeatability between units, which translates into better performance in the final application.

Senior production engineer Tony Armstrong comments. "Historically we used an expanding tool with multiple carbide or brazed carbide cutting edges. This included a pilot to position it concentric to the bore and had sufficient cutting edges for all of the lands on a body to be cut simultaneously in a facing operation as the edges expanded.

“However each body variant needed a customised tool, which was costly in terms of set-up time as well as money. In addition, though the tools were accurate when new they were less so when re-sharpened. Moreover, we needed a minimum of three of each tool for use, stock and sharpening so the method was/is expensive.”



The incentive for change resulted from tightening of positional tolerances, which the old tooling could not support. Bodies are produced in batches of between 100 and 1000 under a quality regime which demands high levels of repeatability. With this target to meet the expandable tooling was proved not to offer a suitably capable process on most bore sizes.

Tony Armstrong continued. “We had previously used the Horn Mini insert/toolholder combination on a project where we needed to generate a 7.5 mm wide internal groove in a bore on an SGI casting. A 1.5 mm wide coated insert proved well up to the job so the tools seemed well worth a try-out on the less demanding grey cast iron used on most of these bodies.”

For the current application the insert swept diameter is greater than that of the internal lands so the insert is indexed into the void areas between the lands stationary. The spindle then switches on and a helical in-feed path is used to minimise loading on the leading cutting edge as the land edge is machined.

Edges are machined in front and back pairs, so for the second land the spindle reverses to the initial datum position, the programmed tool offset alters to the trailing edge of the insert and the second land edge is machined. The spindle then indexes to the next void and the process repeats until all of the land edges have been machined.

Capable Process

Mr Armstrong stated. “It’s a fully capable process; we only have one pair of cutting edges to consider and the carbide tool shank is extremely rigid. Once the tool is set in the spindle holder, accuracy is as good as the positional feed-back system on the machine allows. Also, if we replace an insert due to breakage, the Horn Mini system’s insert location repeatability is such that it can be done by the operator at the machine without removing the tool so interruption is minimal.”

Vickers tends to use the largest cutting insert that will fit down any bore with the extreme example being a 17.7 mm swept diameter cutter passing through a 17.95 mm diameter bore to begin work. In practice Horn Mini tools are used on components with bore diameter of 12 mm or greater, and standard Horn groove milling tools have been applied to extend the application up to 35 mm.

Whereas each type of body used to require individual tooling, one insert type now suffices for an entire family of parts. Moreover, the Horn tooling facilitates machining of small batch special jobs - which were previously subcontracted out - within general production.

“Horn Mini tools have proved to be very effective in this application and provide significant tool management benefits and cost savings.” Mr Armstrong concluded. “Tool life has historically been very good and Horn’s latest TF45 carbide grade has demonstrated further improvement on trial. We’re very satisfied with its performance.”

