Switch to Horn maximizes productivity for Higar

By replacing an existing grooving tool system with Horn 229 pattern inserts and compatible toolholders, for machining of a forged Nimonic alloy component, Higar Engineering & Automation Ltd has been able to reduce a five hour machining cycle to three hours. In addition, whereas the previous route wore out three insert edges per component, the Horn system needs one roughing and one finishing insert edge to complete.

Actual Horn insert consumption is therefore one edge per part as Higar utilises a 'used' finishing edge to rough the subsequent component.

Availability of the Horn tooling has allowed the company to gain maximum advantage from investment in a new CNC turning machine. The previous route for machining these components used a lighter duty machine; arguably this would not have been able to exploit the doubling of spindle speed enabled by Horn's system.

Top flight engineer

Higar Engineering & Automation, based in New Milton, Hants, is a top rank sub-contract precision engineer and manufacturer. Customers include leading UK aerospace, defence, medical equipment, electronics and telecommunications companies.

The machine shop is extremely well equipped with a wide variety of mainly CNC equipment, and production is carried out under an ISO 9002 certified quality assurance system. As well as high precision machining the company also offers high level assembly facilities, including Class 100/1000 clean room facilities.

Says Higar's CNC machining manager Kevin Baker. "This particular component is used in an aerospace application and is machined from a high quality Nimonic alloy forging. Stock removal is considerable - nearly 50 per cent - including about 12 mm on the inside diameter with the part located in a purpose-built fixture."

The component is basically a frustum - a conic section of trapezoidal cross section - which tapers from 200 mm to 137.5 mm diameter. There is a substantial lip at the smaller diameter end. The internal surface incorporates a parallel bore section from the small diameter end leading into the taper section.

Internal features of the taper include a step about mid way and a circumferential groove close to the large diameter end; this end also has an internal lip. Machining the groove therefore requires tool reach of 11.5 mm to the bottom of the groove to clear the lip.

The component is not easy to manufacture as Mr Baker confirms. “Firstly, Nimonic is a notably difficult material to machine. Secondly, we are almost always cutting on an inclined surface which makes considerable demands of toolholder rigidity to maintain accuracy. Thirdly the tolerances on the part are quite tight; front-to-back dimensional tolerance, for instance, is ±0.002 inches.”

The cycle for internal machining of the part is to rough bore the parallel bore section, then rough out the internal profile, including the undercut at the wider end, then finish the internal profile. Higar opted for turning with a full radius grooving tool on the internal operations because the complicated internal profiling is most effectively produced using a narrow tool point. However, the grooving system initially used did not have the requisite location rigidity; movement of the insert in its location exacerbated tip wear, raising consumption to three tips per component despite modest cutting speeds of c. 50 m/min.

Previous productivity problems

This was an unsatisfactory situation in all respects as high tooling costs were combined with relatively poor productivity; to make matters worse, availability of inserts was poor. Mr Baker therefore set about finding an alternative.

“I looked at various manufacturers’ groove-turning systems but most of the alternatives looked to be inadequate in one way or another. However, we had satisfactory experience with Horn Mini and Super Mini grooving tooling on other jobs so we asked if there was anything they could suggest for this one. The rest is history, you might say.”

The solution put forward by Horn uses a standard Type 214 internal grooving and turning toolholder, combined with the Type 229 double edged indexable insert. The holder is designed to clamp the hexagonal section insert over 80 per cent of its length, providing extremely secure location and full support for the cutting edge but allowing grooving up to 15 mm deep.

For Higar’s application an uncoated carbide insert with fully radiused 4 mm wide cutting edge is supplied, to cope with the tough material.

Dramatic improvement

The resultant dramatic improvement in performance is outlined above. Machining speed has doubled to 100 m/min with feed rate remaining the same at around 0.05 mm/rev. As machined finish is comparable or better than that which was previously achieved.

Tooling costs have reduced through reduced insert consumption, while there is now no problem with insert supply; in the unlikely event that Horn UK has none in stock, availability from Germany is 24 hours to anywhere in the UK. As an added bonus, repeatability of insert positioning in the tool holders is rated as excellent by Higar’s machine setter/operators, at within 20 to 30 microns; in practice the machine’s tool probe is used to set an offset for the finishing insert only.

Mr Baker concluded. “Applying the Horn tooling has transformed the job from one which was difficult and took an unreasonable amount of time into one which is manageable. Whereas a batch of twenty parts could tie up a machine for a full working week we can now expect to complete the same quantity in around three days.”