Multistep: the next step

Ahead of its launch at the forthcoming EMO exhibition, Andrew Allcock travelled to Rottweil, Germany, to witness the literal unveiling of a new production machine for prismatic parts

The residents of a small, quiet town some 30 minutes' drive out of Rottweil, Germany, were probably surprised [a] to see a coach-load of journalists dismount into a small side road and [b] to subsequently hear the strains of *Simply the best* played on saxophone wafting through the late afternoon on a rather dull, wet day.

If they had been closer to the action, they would have also seen stage smoke wafting out of an opening factory unit roller-shutter door. Behind the door was the reason for all the fuss: Mikron Machining Technology's new Multistep XT-200 machine. The machine had been assembled in secret, away from the main plant in Rottweil with parts delivered to the main plant and then shipped to this secret location. Until 25 June, no one at Rottweil had seen it, save for those most closely involved with the project.

The machine is the bigger brother to the original Multistep launched in 1993 and now with a worldwide presence of some 180 installed units. The original Multistep has a working envelope of 150 mm^3, the new XT-200 has an envelope of 200 mm^3. But the seemingly simple increase in working envelope was not the reason for all the celebrations. Behind this most obvious change lies a thorough reappraisal of the design and the methods of manufacture that have delivered a machine which, on a like-for-like part, is 10 per cent faster, while machine cost is around 15 per cent lower.

STILL SURPRISING

Multistep is still a design that surprises. Multistep machines are effectively linear transfer units for prismatic parts that would most ordinarily be made on machining centres. A system incorporates one load/unload unit and up to three machining units capable of simultaneous 5-axis /6-side machining (in-cycle reclamping; 5fi-side without reclamping) each serviced by a toolchanger (either 12 or 36 – the smaller allows complete turret change by hand) and twin, independent spindles.

The latter means that toolchange and spindle acceleration/deceleration to speed/stop can be achieved while the second spindle cuts – a chip-to-chip time of under 1 second at any spindle speed is claimed. Spindle options are 15,000 rpm with a conventional belt drive – 18 kW and the torque is 85 Nm at the maximum speed. Internal coolant at 120 bar features. A second option is a 14 kW, 42,000 rpm direct drive unit with a maximum torque of 9 Nm. Standard is 80 bar coolant, but 120 bar is an option. Both spindles feature HSK-40-A. A high power spindle with HSK 63-A interface, 12,000 rpm and 180 Nm is also available on request, coolant pressure is 80 bar.

Machining centres cannot compete with the Multistep because toolchange time cannot be zero (while spindle acceleration/deceleration must also be considered) and twin-spindle machines can't either because the spindles are not independent.

So, for an exampled component that requires 50 tools to machine, a machining centre would demonstrate 60 per cent non-cutting time (40 per cent cutting time), a twin-spindle would still have 60 per cent non-cutting per cycle but would produce two parts per cycle (20 per cent cycle time), while for Multistep non-cutting time is just 30 per cent (40 per cent cutting time). So, a machining centre requires 100 per cent

Complex components such as these are the prime target for Multistep – a machine concept that still surprises. The new XT-200 is a re-engineering of the original concept as well as providing greater capacity

time, the twin spindle machine requires 80 per cent of the machining centre's time, but Multistep requires 70 per cent of the machining centre's time for the same result.

Transfer between machining modules is done by an arm that picks up parts from two connected units and swaps them. In this fashion, parts travel 'up' and then 'down' the machine. And components travel permanently located in a workholding fixture; the fixture/part is changed as one so there are no part relocation issues – fixture location repeatability is 0.002 mm; clamping force is 18,000 Nm (Erowa interface).

Operations that can be performed within a Multistep machine include milling, turning and assembly, with in-cycle probing also possible. Machine control is via Bosch Rexroth or Fanuc.

Compared to the rotary transfer machines made at the Mikron Machining Technology sister plant in Agno, Switzerland, Multistep machines are lower in terms of productivity but higher in terms of flexibility. In one example, for instance, a family of 17 power steering pump bodies made from cast iron and requiring 46 operations sees a Multistep change-over between parts of under 10 minutes. The parts took 89 secs in a one-module system, 64 secs in a two-module system.

Multistep technology is the means of production for many automotive parts including injection components, complex housings and pump components, while outside of this the watchmaking industry is a customer, as are the hydraulics and pneumatics industries plus the medical sector.

HIGH ADDED-VALUE TARGETS

High value added parts where design lifetimes are short are a target and take in difficult-to-work materials. The 200 bar pressure petrol piezoelectric injection systems used in the very latest BMW 6-cylinder engines, for example, feature injectors with very deep small inclined holes which intersect with others in the body of the part. There is no room for error, or burrs, on these tightly toleranced parts or anywhere else where rejects are expected to be no more than 1 in a million or 1 in a 1,000 even, particularly as CpK of 2 is now being discussed, says Mikron; and that's why having cutting tool technology within the group is pivotal.

Both Mikron plants benefit from in-house cutting tool design and manufacturing experience stretching back more than 40 years in the form of Mikron Tool. The combination of machines plus this tooling capability is a claimed to be a positive boon where very deep small holes are required – depths of up to 60x diameter can be achieved.

The rigidity of Multistep – one machining module weighs 6.5 tonnes – plus Mikron Tool expertise have combined to support hard milling to eliminate grinding for a tightly toleranced curved surface in a rocker arm for variable distribution – 15.8 secs/part versus 2 min 24 sec previously; and only one machining set-up versus two previously with milling undertaken in the soft state. This customer runs nine machines three shifts 24/7 producing three parts per clamping.

The Multistep continues to stand out as a unique machining approach: bigger, faster, cheaper, more rigid, more easily maintainable, more accessible – all can be applied to the new Multistep XT-200 over its smaller brother; but then as Mikron would argue, it is 'simply the best'. Judge for yourself at EMO, Hall 17, Stand C76.□