Accurate; repeatable; rigid

First a customer of Hardinge, German toolholder maker Eppinger now supplies its new high accuracy system for Hardinge's latest turning centres. Andrew Allcock reports

The new toolholding system for the all-new Hardinge RS-Series turning centres – Eppinger's ESA top plate, toolholders and PreciFlex adapters — was developed and made on the German toolholder specialist's four Hardinge Quest CNC turning centres. Today, with the new tooling system on these turning centres, set-up and machining time for almost all parts have been reduced by 80 per cent.

The story of this achievement started some years ago, recalls Eppinger GmbH president Ewe Eppinger, when he met a representative from Hardinge at an exhibition. The representative explained that Hardinge machines could do what Eppinger's current turning centres were doing, but much more easily and precisely.

"So, we tested a Hardinge Super-Precision Quest 8/51 in our plant, and after two weeks we bought it," explains Mr Eppinger. But his objective was not simply replacing turning centres to do the same jobs but rather to incorporate hard turning to eliminate grinding operations on the company's range of fixed and driven toolholders.

This was a big change, and Eppinger's staff didn't really believe it was possible.

Eppinger president Ewe Eppinger – first a Hardinge machine tool customer but now a supplier of a high precision turret top plate/toolholder/adapter system for Hardinge's new RS range (below), developed for use with Eppinger's own Hardinge CNC lathes

However, very quickly the company president's conviction (and Hardinge's, of course) was justified.

"The new Quest was running a single shift ," reveals Mr Eppinger, "but we were just so impressed with the capabilities and remarkable precision of the Hardinge that I ordered the second one within a couple of months, not knowing what I would do with it."

SHIFT TO DRIVEN TOOLING

Eppinger GmbH was founded 81 years ago in 1925 and since then has been making turning centre toolholders and tooling systems. The company now has three plants (one in Germany and another two in India), employs some 500 people and ships 80 to 90 per cent of its turning centre products overseas.

"When the company was founded," says Mr Eppinger, "we focused on making static toolholders for lathes. But in the last 20 years our focus has shifted to driven tooling that enables today's multi-tasking turning centres to complete complex parts in one set-up.

"What we would once typically have done in a machining centre, followed by multiple secondary operations and

machines we're now doing on one machine — a turning centre. Making tooling systems for this growing range of turning centre applications is our speciality." A speciality it has used for its own purposes, in fact.

While Eppinger works with many different turning centres, according to the company's president, Hardinge machines have an edge. "The big advantage is that we can finish a part on a Quest which is not the case with all other turning centres that I know. With a general precision turning centre, we can do pre-machining, followed by heat treatment, and then finish grinding. With the Quest turning centres, we can completely finish the same part on the turning centre, in a single set up, largely because the axial movement of the machine is so precise.

"If we need a finish dimension within microns, we can do it on the Quest. When the operator calls for one micron of axis movement, this is what the machine really does. With some other turning centres, if you enter one micron, either the machine cannot read the instruction, or it moves five microns or more, which is not precise enough for finish work."

QUEST FOR PRECISION

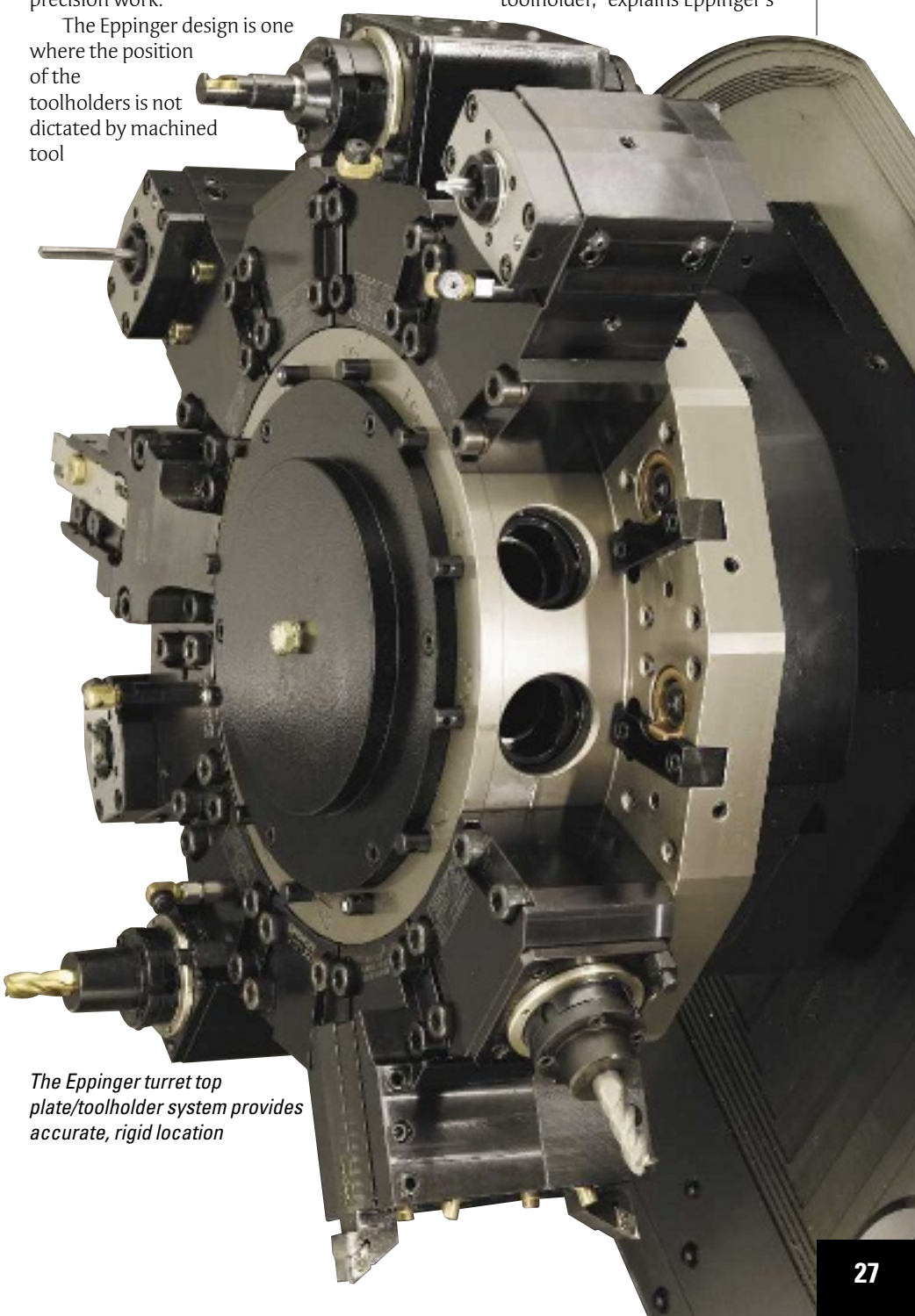
To complement such precision, the company developed the new toolholding system which is fitted to Hardinge's all-new RS-Series turning centres. Until quite recently, explains Mr Eppinger, the toolholding system most commonly in use was the VDI system. This is really just a shank sitting in a machined pocket. It was designed some time during the 1960s for static toolholders on drum-type turrets – and in this arrangement it works pretty well, as long as your main goal is turning rotating parts, he adds. But while it was known as "quick change tooling", setting tools often took hours.

Other areas where VDI systems have fallen short include backend machining and the use of live tooling. "The VDI system was just not made for live tooling. That's why we concluded that if highly precise, rigid toolholders were needed, we had to look at the way the toolholder was attached to the top plate.

"VDI just doesn't work well enough for today's needs. We needed a different system and this became our ESA system. A couple of years back we started from scratch, because it was very obvious that the whole top plate and toolholder arrangement was not made for real precision work."

The Eppinger design is one where the position of the toolholders is not dictated by machined tool pockets, but by a patented key and keyway system. Each top-plate has 12 ground keys that can be individually adjusted in the y-axis, allowing each to be positioned precisely on the spindle centreline.

"Next, the toolholder itself has a keyway. The toolholder is pulled against the key on the top-plate to position the toolholder," explains Eppinger's



The Eppinger turret top plate/toolholder system provides accurate, rigid location

president. "This is a backlash-free system, so we ensure by the way it's designed that there is contact between one phase of the key and the keyway. Normally, when you're working with a key and keyway, you have to make sure that the key itself is a little bit smaller than the keyway, but when there is clearance, then again you can introduce positional inaccuracy. In our case, we've designed a clearance-free system because we get contact only on one side of the key, leaving one side of the keyway completely free.

"Without any adjustment, we just bolt each toolholder under the top-plate, and it sits there within microns, station-to-station, to the centreline of the spindle," Mr Eppinger adds. "The toolholder system is highly precise because each cutting tool tip is sitting exactly within two to three microns. This dramatically reduces set-up time. When an operator puts a toolholder under the top-plate he doesn't even have to check: he knows that his cutting tool is sitting exactly where it is meant to be."

Another consideration is the way the toolholders are attached to the top-plate. They are much more rigid, bolted down with five or six times' the force than would be common with VDI. This produces a far stronger and much more precise and rigid arrangement.

RIGID CONNECTION

Complementing this system is the company's modular PreciFlex (Precision Flexibility) system. Until now, cutting tools, like a drill, were clamped, in most cases, with a collet, explains Mr Eppinger. But while a collet has some advantages – it is very flexible, for example – it has disadvantages as well. Runout inaccuracy of a collet can be a severe limitation.

"We developed a system where all our spindle collet seats have a ground spindle nose with four threads," says Mr Eppinger, "and against this ground spindle nose we attach an adapter with a cone face contact. The cone of the adapter has the same shape as an ER collet, but in the toolholder we can use either the ER collet, as we have always done, or we can use an adapter. The adapter is bolted down under the spindle and sitting in the ER seat, so it has contact with the ground spindle nose. This gives a very rigid connection between adapter and spindle, as well as extremely high repeatability.

Eppinger's PreciFlex (Precision Flexibility) system offers far better runout accuracy than traditional collet chucks. Reduced runout equals better tool life

"The big advantage now is that we can leave the toolholder on the top-plate and change only the preset adapter. That adapter can be preset outside of the machine, and we are getting an extremely fast tool change as well as very, very high repeatability."

Hardinge North American turning product manager Jeff Ervay became such a believer in the Eppinger top-plate and toolholder system that he pushed hard to make them standard features on the all-new Hardinge RS-Series turning centres. "We set out to design and build the best Hardinge turning centre ever... nothing less would do. Therefore we decided early on in our development that Eppinger products would be required features," he explains.

The system Eppinger is supplying on the new Hardinge RS-Series High Precision turning centres consists of the top-plate, the toolholder and the adapter. The Preciflex adapter delivers four times higher clamping force than a collet, for example.

And the runout accuracy is much better, so the tool life is much longer, especially at high speeds. The Hardinge RS-Series machines are capable of running at 6,000 rpm, and runout is key for the lifetime of the cutting tool. If runout at any rpm is halved, that equates to a doubling of tool life, says Hardinge.

WELL-PROVEN COMBINATION

The combination of Eppinger toolholding and Hardinge turning centres is well proven by the German company. "We have the capability to make high precision spindles and we are eliminating nine work steps per spindle – nine other machines – with a single specially equipped Hardinge Super-Precision Quest. So you can imagine what this means to set-up costs and precision now that we're clamping the part just once," underlines Mr Eppinger.

"In fact, we're not really setting it up any more. We are leaving the 12 toolholders on the machine and we are changing the adapters. To change the adapters takes a minute or so. It depends upon how many you have to change, but the change itself is something less than 10 minutes, total, with set-up time limited to a maximum of 15 minutes. What my operators do is put the first workpiece in the machine, push a button and that's that. And we would normally not see that on other machines."☐

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