From the 31 January 2005 issue of *MM Das Industriemagazin* (p. 40)
www.maschinenmarkt.de

(translated from German)

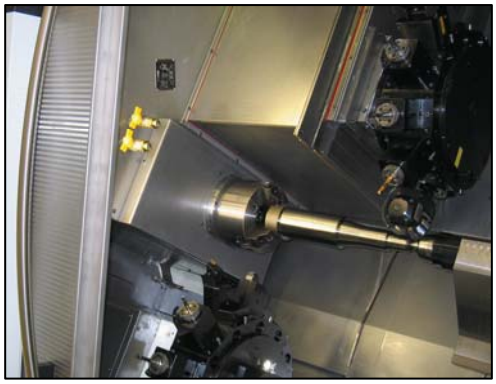
Tooth for Tooth

New tool system allows for gear cutting on CNC lathes without rechucking

by Matthias Weigele

Precise gear cutting doesn't come cheap. Until now it has been necessary to rechuck workpieces numerous times or use costly CNC lathes. But as the saying goes, "it ain't necessarily so," because EWS Werkzeugfabrik design engineers have developed, in collaboration with Gildemeister, a solution that allows gear-cutting tools to be used with conventional lathes. The new technique enables the cutter head to rotate steplessly all the way around the shaft, thus eliminating the need for costly *B* axes on the machine and allowing the entire gear-cutting process to be realized without rechucking.

The EWS solution also eliminates the need for one costly machining axis in module cutting, thus reducing costs and machining time. With the conventional method, it takes up to 16 seconds for the turret or cutter spindle to rotate all the way around the workpiece, whereas the EWS system performs this operation in only one second. And since the pivoting movement of the *B* axis is no longer required, the need for all of the associated technical equipment is eliminated.



The new system was subjected to rigorous testing under real-life conditions at the Gildemeister testing center and passed its initial tests with flying colours. In order to cut gears successfully, the workpiece and tool must be synchronized perfectly. Moreover, each cutter has a different gradient angle that must be adjusted by pivoting the tool. In the case of hob cutters fitted with swiveling tool holders, the vertical cutter is advanced to the workpiece in the *X* direction and then cuts in the *Z* direction. *No Y axis was needed for the test series because in the EWS system the workpiece holder is centered (Fig. 1).*

All machining was performed on dual-spindle Twin 65 milling centers using the EWS 64 TKW tool, which was fitted with Swiss-made carbide cutters made by Goor. In order to obtain conclusive results, the machining was performed at the upper operating limit of the lathe in the VDI 30 and VDI 40 ranges. Heavy-duty machining is not practical with this system.

C45 bar stock 100 cm in diameter was machined at a cutting rate of 90 m/min, and two types of shaft with differing parameters were produced: one 50 mm in diameter with 23 teeth, machined at a speed of 1035 min^{-1}, and a second, 80 mm in diameter with 39 teeth and machined at a speed of 1026 min^{-1}. The feed was 1 mm in each case, with a cutting depth of 4 mm. *The tool's gear ratio is 3:1 (Fig. 2).*

In order for the system to function properly, the spindle on a CNC lathe with a *C* axis must be synchronized with the turret drive. The cutter is mounted on the driven tool and is adjusted to a specific pressure angle. During machining, the spindle is synchronized with the tool, and *X* is the feed axis, while *Z* is the positioning axis. Infeed is set to the depth of a tooth, and the teeth are cut into the workpiece in a single pass. All machining steps can be performed on a single machine, thus eliminating three different setup procedures.

The EWS tool system has a broad range of applications. It can be used with standard side milling cutters, which means that longitudinal slits can be made in the workpiece, wrench surfaces can be milled, and transverse slits can be cut in shaft ends. The pivoting capacity of the cutter head opens up new possibilities such as rotating the head 90 degrees to mill crescent-shaped fins. In addition, a component can be cut off at any angle, an operation that up to now could only be performed using costly special-purpose tools. Since the system is particularly advantageous for gear cutting, this application has been a major focus for the EWS system developers.

In order to use a module milling cutter on a lathe, a suitable pressure angle must be set. This is usually done via a *B* axis in conjunction with a *Y* axis. The procedure of swinging the tool into place is time consuming owing to the fact that several axis movements must be controlled synchronously.

With the EWS tool on the other hand, the *B* axis is not needed for module milling cutters since the cutter pressure angle can be set using a precision mechanism. This means that the EWS milling tool can be used on a turret just like a standard tool. The turret station is selected and the process can then be executed immediately.

The EWS system is recommended for producing lots of up to 5,000 pieces. For example, a 2,000 piece lot would take eight hours less to process compared with the conventional technique. If this is multiplied by operating costs of €60 per hour, €500 would be saved on each lot. In addition, the lower investment cost for the EWS solution translates into reduced per-hour operating costs. Thanks to the substantial reduction in processing time provided by this tool, the system will pay for itself after only a few lots.

Although in principle dispensable on the lathe, a Y axis does enable the cutter to be used across its entire width (Fig. 3).

It goes without saying that the system also has its limitations. It should be borne in mind that work is being performed on a lathe, which due to its dynamics lacks the rigidity and stability of a gear-cutting machine, just as a driven tool does not have the same properties as a milling spindle. Consequently, the EWS solution should only be used for smaller modules.

Features at a glance

- The new tool system eliminates the need for a costly *B* axis
- The entire gear-cutting process can be performed without rechucking
- The cutting head rotates steplessly all the way around the shaft

---

Matthias Weigele is a Managing Director of EWS Werkzeugfabrik Weigele GmbH & Co. KG, D-73066 Uhingen

EWS Werkzeugfabrik
Weigele GmbH & Co. KG
Maybachstr. 1 - D-73066 Uhingen
Postfach 12 17- D-73063 Uhingen

Phone: +49(0)7161/93040-10
Fax: +49(0)7161/93040-30
Email: info@ews-tools.de
Homepage: http://www.ews-tools.de

Limited Partnership; Domicile: Uhingen,
Commercial Register: Göppingen HRA 1658
Managing Directors: Frank Weigele,
Matthias Weigele Dipl.-Ing. (FH)