

Heller

INTRODUCES GEAR MANUFACTURING ON FIVE-AXIS MILLING MACHINES



Heller has developed a process that enhances the productivity of milling operations on a 5-axis machining center.

Manufacturers of gear components and bevel gears have been looking for alternatives to traditional manufacturing processes for larger gears. In addition, improving machine tool flexibility has become more important because many gear-makers can no longer afford to depend on dedicated gear machine tools. They want the capability and flexibility typical of a machining center.

In co-operation with Voith, a major transmission manufacturer in Germany, Heller has developed a process that significantly enhances the productivity of pre-milling and gear milling operations performed on a single 5-axis machining center. Both companies have applied for a patent on the jointly developed process.

The process is aimed at manufacturers of vehicles, machines or

machine components that can use the machining center for lower-volume production of larger gears as well as other machining tasks.

Gear milling has recently been an interest of some machine tool builders as it is more efficient to use the existing capability of a five-axis machining center for new applications beyond those typical for machining centers. According to Heller, gear milling provides an ideal opportunity to use the full potential of its 5-axis machining centers from its new F series machines to its heavy-duty MCH-C series.

Heller pointed out that traditional gear-making machine manufacturers continue to concentrate on special-purpose machines and tools dedicated to gear machining, but that manufacturers of machining centers can provide complete machining for a wide range

of applications as well as solutions for gear modeling using special software. The software permits the user to generate an ideal gear geometry from which the gear-making process can be developed.

Gear Data Drives the Program

Technical literature on gear technology says there is no comprehensive mathematical model for bevel gear tooth systems. Therefore, every CAD model used for the CAD/CAM process is an approximated model. Traditional gear cutting machines are based on a specific machine structure with corresponding kinematics. The machine generates the appropriate tooth shape based on the setting parameters entered into the machine.

The approach taken by Heller is a totally different one, although it resembles the process used with most dedicated gear machines: i.e., the gear parameters specified on the drawing are directly input into the machine control. The control then uses the data to generate the 5-axis paths for roughing and finishing in real time. As a result, no mathematically accurate 3-D geometry model is required. Instead, the pre-defined gear data from the drawing are used.

The measuring machine reports compensation data that can be directly entered in the machine control for pro-



cessing. Another major benefit of this approach is that current tool data, such as tool wear, can be incorporated into the ongoing process in real time. As a result, precision is enhanced. Also, the process provides users with flexibility and productivity without creating a new dependency on special software.

Besides tooth space machining, Heller also provides a process solution for pre-milling/turning of blanks. Complete pre-machining of external and internal contours is possible in the first setup, while tooth milling takes place in the second. Specially adapted NC cycles have been developed to facilitate process control. As a result, the complete workpiece can be machined on a single machine.

New Type of Cutter Raises Productivity by 300 Percent

There are other 5-axis machining centers claiming to be equally versatile and suited for gear milling when programmed accordingly. The use of an end milling cutter, for instance, provides high flexibility.

But according to Dr. Hannes Zipse, business development manager at Heller, the method is not particularly efficient or productive. "We operate in fields with high chip removal rates and aim to achieve the same in gear milling. We cooperated with Sandvik Coromant to develop a customized crown-milling cutter with indexable inserts, resulting in a type of hob. This had a major role in increasing productivity by the factor of three compared to conventional methods. The wider the tooth space, the more productive we will be."

The level of productivity essentially depends on the static and dynamic stability of the machine. For Reinhold Siegler, head of technology development at Heller, this is the most important point of all. "Very compact clamping is essential. That means that the position of the pallet chuck in the Heller solution is very close to

the upper pallet edge to enable deep clamping of the gear or bevel gear.

"Additionally, our extremely robust spindles and highly rigid machine elements plus the use of short tools designed for roughing are key benefits. For this reason, we achieve higher productivity in the roughing



operation than can a vertical machining process," he said.

Versatility

The new process is for workpieces of different sizes starting from gear module 4: the smaller Heller 5-axis machining center model FP 2000 for diameters of up to 720 mm, the larger model FP 4000 for diameters of up to 900 mm, the model MCH-C with HSK100-spindle taper for diameters of up to 1,800 mm and an upcoming new machine range for diameters of up to 3,000 mm.

Despite the time-consuming changeover required, the use of a special-purpose machine is still more efficient for the manufacture of small gears produced in high volumes. Therefore the Heller/Voith process is not directly aimed at classic contract gear manufacturers producing a small variety of workpiece types in high volumes.

Instead, the Heller solution is for

system suppliers; e.g., manufacturers of vehicles, machines or machine components that can also use the machine for other machining tasks. The process will also be of interest to gearbox manufacturers, whose products also include complete assemblies. This applies in particular to large gears, since the machines and the technology provided by Heller are suited for a wide range of machining tasks and provide the additional benefit of enabling efficient machining of gears and bevel gears.

Kenneth Sundberg, global business development manager at Sandvik Coromant, considers this a very interesting market opportunity. "The recent past has shown that the market continually comes up with machining solutions for gear components and bevel gears. For this reason, Sandvik Coromant has modified standard tools and incorporated new developments in the milling cutters. We are extremely satisfied with the machining results achieved so far. In a second step, we will focus on hard-milling processes.

"Although it is possible to use solid carbide end milling cutters for this purpose, we and Heller believe that using special crown milling cutters and side milling cutters will provide higher productivity and economic efficiency," he concludes.

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