For producers of mid-size and larger bevel gears, where production volumes are low, lot sizes smaller and part changeover increasingly frequent, the idea of producing gears on a highly versatile machining center has always been a tantalizing possibility. Up until now, though, bevel gear jobbers in particular have had a difficult choice: either make the significant investment in dedicated bevel gear cutting machines that are exceptionally productive but at the expense of flexibility, or consider using standard 5-axis machining centers that are highly flexible, but too slow to be truly economical day to day.

**Bringing together the best of both worlds**

Now, Gleason and HELLER have forged an alliance designed to finally solve these long-standing challenges, and bring to market new process solutions delivering much more productivity,
flexibility and economy to large bevel gear production – all from a single source. The alliance draws from the unique strengths of both companies: the exceptional processing capabilities and renowned stability and inherent rigidity of the HELLER machining center platform; Gleason’s bevel gear process expertise and, in particular, its powerful CAGE™ bevel gear design software (critical to quickly and easily optimizing both gear design and processing downstream); and the final critical element, HELLER’s unique uP-Gear Technology, a new patent pending technology featuring a suite of software developed to design the processing for bevel gear production in conjunction with highly productive 5-axis machining centers and new rigid cutting tool technologies.

**Introducing the Gleason-HELLER CT 8000**

Today, just months after announcement of the alliance, our two companies are rolling out the first in a new generation Gleason-HELLER 5-axis machining centers at IMTS ’12: the CT 8000, for production of all types of bevel gears as large as 1,810 mm in diameter, and pinions to 1,500 mm in length. For the first time ever, gear jobbers will be able to quickly and easily produce design variations, make corrections and machine bevel gears complete, beginning with a forged raw part or a cylindrical blank up to the gear finishing operations in hardened material. Now, single setup machining in small and medium batches will be an attractive proposition to many users.

The CT 8000 draws from the many strengths and capabilities of HELLER 5-axis machining center design for which the company is well known. For example, in order to perform high-torque heavy milling and drilling operations in steel, stainless steel, cast iron and high strength materials, the CT 8000 features a particularly rigid and extremely stable bed and column design of the type proven in HELLER’s MCH-C and H series of 5- and 4-axis machining centers. The CT 8000’s extremely rigid C swivel head (the fifth axis), combined with a powerful high torque and high power main gear spindle with HSK-A100 tool taper, is capable of delivering heavy-duty rough cutting (milling, drilling and tapping) at 1,146 Nm – of particular importance for the roughing of the outer shape of the bevel gear from the raw part. The rigid structure and the stiffness of this swivel head also permits the use of the typical uP-Gear cutter with diameters up to 260 mm for roughing the tooth gaps in the soft state and finishing the tooth flanks in the hard.

Additionally, the maximum revolution of 8000 rpm allows the user to effectively use small tools for processes like drilling of small bores or chamfering and deburring operations all with the highest precision and outstanding machining quality. As compared to a less robust standard 5-axis machining center employing a typical end mill process for the production of bevel gears, the CT 8000 using standardized uP-Gear cutters with coated carbide inserts delivers extremely high material removal rates, resulting in four up to eight times faster cycle times.

The ability of the CT 8000 to perform turning operations enables the user to turn the part references and to quickly perform complete hard finishing in a single setup, which also factors into the reduction in workpiece handling times and improvements in part quality.
The productivity and versatility of the CT 8000 is further enhanced through the use of automated features such as a high-speed tool changer paired with different types and sizes of tool magazines, a robust probe for adjustment and alignment of the workpiece on the machine, as well as a pallet changer in the CP 8000 variation of the machine to minimize non-productive load/unload time. The availability of these automated features combined with the turning ability also adds a higher degree of flexibility, enabling the C series to machine a wide range of gear and non-gear parts, so that the CT 8000 can be used as a highly productive, real multi-tasking machining center.

**Gleason CAGE™ and uP-Gear Technology software working together**

Gleason customers have long benefited from powerful bevel gear design software called CAGE™, which empowers a gear design engineer to move quickly and efficiently from a simple drawing to a finalized gear design, with optimized contact pattern, in a fraction of the time it normally would take through the normal trial and error process. Now Gleason CAGE directly interfaces with HELLER uP-Gear Technology, essentially providing all the required input data, including any and all corrections and flank modifications, so that uP-Gear Technology can design the milling process and create the optimum NC part program for the Gleason-HELLEr machining center with minimal time and effort.

Powered by the CAGE output the uP-Gear Technology in combination with the flexibility of the Gleason-HELLEr NC also enables the user to take advantage of the widest range of potential flank modifications. As a result, it is possible to further optimize the flank geometry.
and the contact pattern using the additional degrees of freedom afforded by the Gleason-HELLER five axis machining center and more easily achieve the most desirable characteristics of even very complex bevel gear designs. For that kind of optimization, and also for the flank corrections after measuring (only if required) Gleason G-AGE software is used, which essentially closes the loop on quality. G-AGE, working in conjunction with Gleason inspection equipment, can take hours out of the process of measurement and correction. It generates inspection files and new summary settings based on the inspection. (See Fig. 1).

What next? Siemens NX!
Gleason and HELLER continue to collaborate on making improvements in cutter design, interference modeling, improving part quality through enhanced part grid modeling, including the critical root areas of the tooth, and many other areas across the bevel gear manufacturing spectrum. Of particular importance is the work HELLER is doing to develop, exclusively for the uP-Gear Technology, a special CAM application which will for the first time join two uP-Gear software packages: uP-Gear Technology and uP-Gear Virtual on a common platform – Siemens NX (a Siemens 840D SL controller is now standard on the CT 8000). This new uP-Gear CAM includes specific routines and modules for the machining of bevel gears using the uP-Gear Technology. The Graphical User Interface (GUI) will allow the user to more easily design the uP-Gear process and create NC programs automatically. Of course the standard functionality of Siemens NX will also be available to optimize the programming of any other part type and process whether forged part or cylindrical blank, milling, drilling or even turning operations and so on. The net result will be the user’s ability to use a single CAM system for a near-universal range of applications, all performed on the CT 8000.