Radial Chamfering Arrives for E-Drive Gears

Horizontal hobbing makes an ideal solution for geared shafts with interfering contours, including EV transmission shafts

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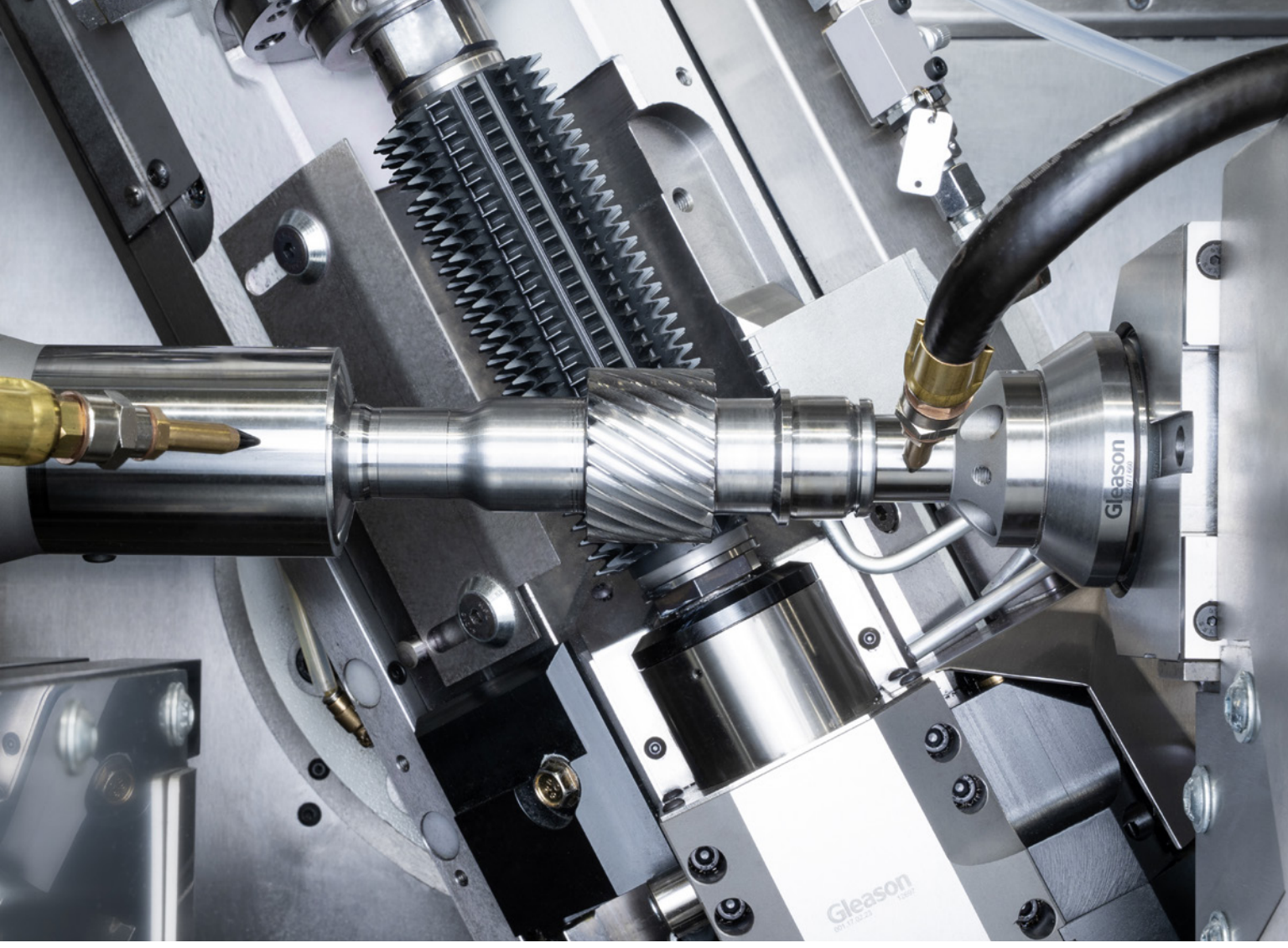

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Manufacturers of EV drive systems are leaving no stone unturned in their quest for quiet-running, dependable transmission gears and shafts. Where once chamfering and deburring operations were almost an afterthought, they're now considered a primary soft machining process, with widespread recognition that anything less than a flawless tooth flank can result in premature transmission failure, less-than-optimal efficiency, and unacceptable noise.

Gleason has been comprehensive in its pursuit of new chamfering technologies that can be more easily, and economically, integrated into the gear manufacturing processes, whether to produce smaller automotive gears, pinions, and shafts, or larger gears for trucks and tractors. In every instance, these new technologies have been combined with proven horizontal or vertical hobbing machines so that the chamfering operation can be performed with minimal impact on cycle times and tool cost per piece. One such example was the recent introduction of the vertical Genesis 280HCD gear hobbing machine, which combines two chamfering processes: chamfer hobbing, ideal for high volume automotive and light truck applications, including final drive ring gears and shafts; and fly cutter chamfering, delivering exceptional flexibility for lower volume, small lot jobber applications. Both are performed in parallel to the hobbing operation.

Introducing the New 100HCD

Now, Gleason has a solution for smaller e-drive transmission gears, pinions, and shafts that require both production in high volumes, and the cutting of precise, repeatable chamfers. With the introduction of the 100HCD horizontal hobbing machine allowing radial chamfering in parallel with hobbing, the platform is ideally suited to meet the challenges posed by today's very high precision, ultra-quiet e-drive transmission gears and shafts.

Background

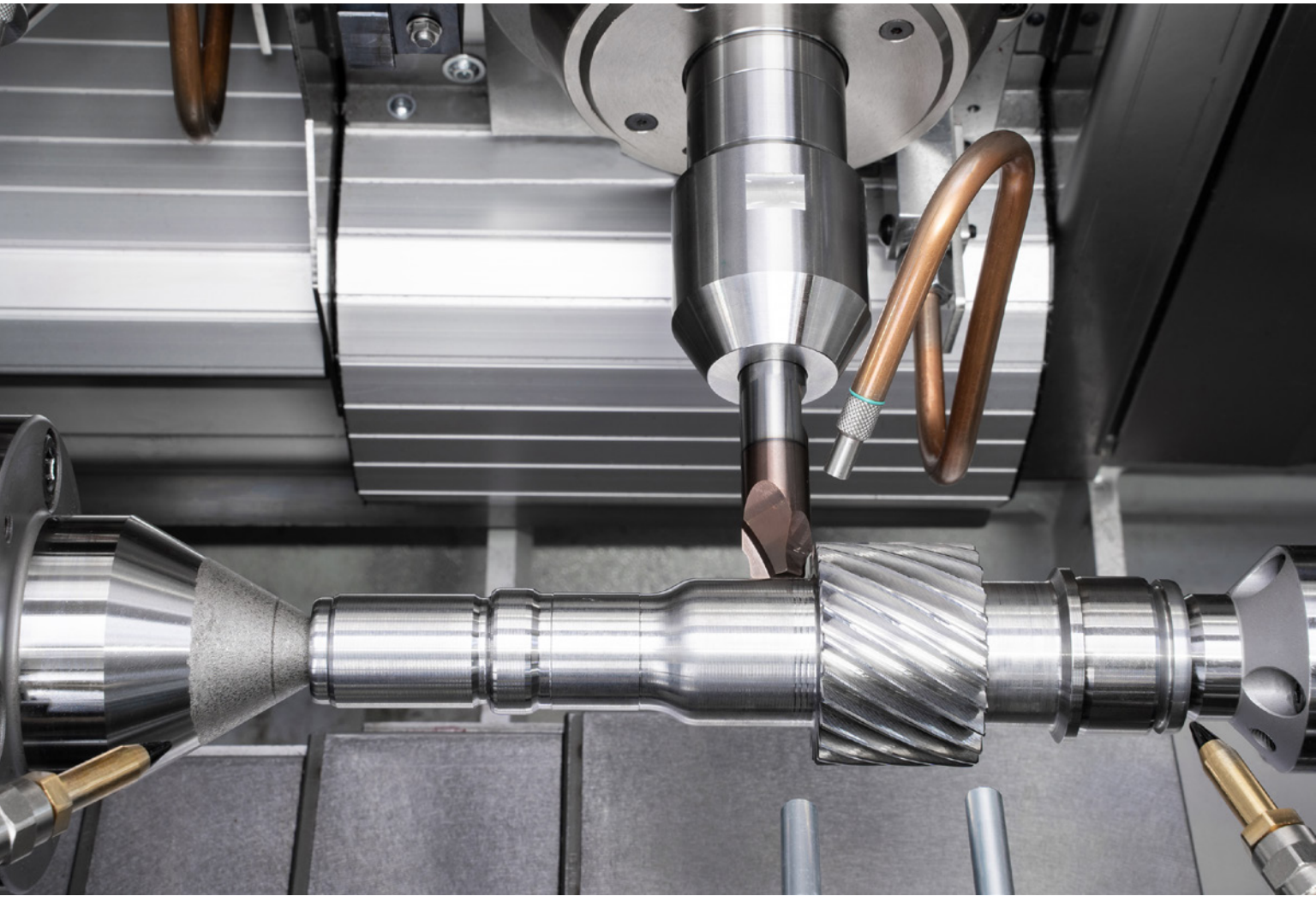
The 100HCD is a variation on Gleason's recently developed 100H horizontal hobbing machine—the next generation of the well-known P90 Series, with improvements in design, functionality, and operator interface. This new series, including variants such as the 100HCD, is designed to handle a wealth of geared profiles up to a workpiece diameter of 120 mm, module 4, and a shaft length of 450 mm. With design improvements to the hobhead and workspindle and the use of the Gleason GEMS human-machine interface (HMI), the 100

series delivers extremely fast cutting and processing times, making it a good match for the large batch production of gears and pinions. And like the P90 series, which integrated chamfering/deburring along with horizontal hobbing, the 100HCD also combines this new and improved hobbing platform with an integrated chamfering/deburring station.

Reinventing Radial Chamfering

Most importantly, with the 100HCD, a significant improvement has been made as compared to the P90, with the replacement of the traditional chamfer rolling process with radial chamfering. How are they different? Chamfer rolling, also known as rotary deburring, is a fast, versatile forming process that creates chamfers along the tooth edges using gear-shaped tools that mesh with the workpiece. Excess material flows mainly to the face side of the gear, where it's then cut away by single blades, deburring discs, or file discs, depending on gear shape and/or machine configuration. However, small amounts of material can also flow into the gear tooth flank itself, thus forming a secondary burr, necessitating that this secondary burr be removed by either edge zone burnishing or a two-cut-hobbing process before the subsequent hard finishing operations downstream.

With radial chamfering however, applied in parallel with hobbing by the 100HCD, the chamfer is produced with a cutting process using one or two single-point cutting tools, rather than rolling, thus eliminating a subsequent operation needed to remove excess material in the form of the secondary burr that can result from chamfer rolling. With cycle times and tool cost per piece of paramount importance, the replacement of chamfer rolling with radial chamfering makes perfect sense. And while Gleason's chamfer hobbing process—first introduced with the 160HCD and the 280HCD—is ideal for disc-type parts, radial chamfering is better suited for shafts typically produced on a horizontal hobbing machine of this type. These shafts, often with the root diameter of the chamfered gear and the shaft diameter in very close proximity, are inherently more difficult to chamfer and deburr due to the clearance requirement. The hob-type cutting tool used in the chamfer hobbing



With radial chamfering, available now in parallel with hobbing on the 100HCD, the chamfer is produced with a cutting process using one or two single-point cutting tools. This eliminates subsequent operations needed to remove the secondary burr that often resulted from the chamfer rolling process used in the past.

process, while ideal for disc-type parts, makes it challenging to chamfer shafts with interferences typical of those found in today's most common e-drive transmissions.

Parallel Performance

Gleason's radial chamfering process uses economical, highly productive resharpenable carbide cutting tools, with from one to three cutting edges.

The 100HCD operates similarly to its P90CD predecessor. By performing chamfering/deburring in parallel with hobbing, it delivers a remarkable cycle time, with the assistance of highspeed gantry load/unload automation and Gleason workholding with a very fast clamp/ unclamp capability. The gear is first hobbed and the rough burr that results from hobbing is removed in a single setup at the hobbing station. The gear then is unloaded by the gantry and loaded into the chamfering/deburring station, where radial chamfering is performed simultaneously while another gear is hobbed. Depending on the application requirements, the chamfering station can be equipped with a single-tool spindle or an optional two-tool spindle for single or two-tool radial chamfering. Economical, highly productive resharpenable carbide cutting tools, with from one to three cutting edges, and sourced through Gleason are used in both cases. A single tool can be designed for chamfering the gear flanks, with or without root chamfering. The two-tool option adds more flexibility to influence the chamfer angle with tools specifically designed for the obtuse and acute edges (particularly advantageous in the case of gears with high helix angles where obtuse and acute angles can be quite different) to meet a customer's specific design requirements in advance of the subsequent hard finishing operations. In both cases, radial chamfering is fast and efficient, with no impact whatsoever on chip-to-chip times since the operation is performed in parallel to the hobbing of more workpieces.

The Complete Package

The 100HCD has a redesigned direct-drive hob head, delivering speeds up to 12,000 rpm, and with three different power options, combined with several hob clamping alternatives, ensures every application can benefit from the best possible cutting tool solutions, now and in the future. For dry cutting, for example, the latest G60, G90, or carbide hob cutter material is ideal. Several chip evacuation options ensure dry, hot chips

Coupled with the latest Siemens Sinumerik One control, Gleason's GEMS HMI hobbing software guides the operator intuitively through the workflows of the machine, both hobbing and radial chamfering.

won't interfere with the highly productive cutting process. The CNC tailstock will support clamping disc- and shaft-type parts as long as 450 mm, using the fast, adaptable Quik-Flex horizontal workholding system for hobbing, which cuts workholding changeover in both the hobbing and chamfering stations to under a minute each.

Shorter cycle times and more efficient, error-free operation also result from Gleason's GEMS HMI hobbing software, which makes setup and changeover more intuitive and simpler to both learn and operate. This HMI, coupled with the latest Siemens Sinumerik One control, provides several new process options and guides the operator intuitively through the workflows of the machine, both hobbing and radial chamfering.

Like all the latest generation of Gleason machines, the 100HCD is supported by Gleason's complete manufacturing system, including hobs, radial chamfering tools, modular workholding, and smart grippers, as well as process engineering and ongoing training to help ensure the system is operating at peak efficiencies and producing the optimum in quality.

Summary

Manufacturers now have a variety of integrated and fully automated chamfer/deburr options available, whether for gears or shafts, of the type in high demand for the latest e-drive transmissions and larger vehicles. These latest Gleason solutions are available today to apply the right chamfer process for applications as widely disparate as automotive-type gears and shafts, truck-size gears, or job shop applications.

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