The new Chamfer Hobbing process offers an extremely efficient solution to create the desired chamfer without secondary burrs. (Photos courtesy: Gleason)
New Chamfer Hobbing adds a highly desirable process to the integrated hobbing and chamfering options now available to gear manufacturers — just in time for eDrives.

By GOTTFRIED KLEIN

ew gearbox developments, particularly for eDrives, are creating a whole new set of gear design and manufacturing criteria. Compact gearbox design is paramount, and the requirements can include gears designed for high torque on one side and high RPM on the other side. To ensure optimum power transmission, producing defined chamfers with tight tolerances is often a requirement. Precise chamfers minimize the potential for sharp, brittle edges after heat treat and avoid flank edge load which can lead to breakouts in the gearbox under load.

Preparing the flank for a hard-finishing operation downstream is yet another significant reason for chamfering, especially for gear power honing, where excessive stock and hardened burrs can greatly diminish honing tool life and, as a result, significantly increase tool cost per piece.

An additional benefit of chamfering and deburring is to help reduce the health and safety risks that can result from operators handling parts with sharp burrs.

THE OPTIMUM SOLUTION FOR EVERY APPLICATION

Gleason offers manufacturers several highly desirable chamfering and deburring solutions that are just as easy to apply as the primary soft and hard processes. With the latest series of Gleason hobbing and chamfering machines, users now can apply the optimum chamfering technology for their particular application using forming or cutting technologies. These technologies include tried and true chamfer rolling, ideal for planetary pinions with cycle times of less than 10 seconds or for shafts with obstacle contours in high volume production; Chamfer Contour Milling, for highly flexible cutting chamfering with indexable carbide inserts for small and medium batch production of truck-sized gears; and now Chamfer Hobbing. Chamfer Hobbing is the process of choice for medium and high-volume production and dry cutting for highest tool life with lowest tool cost per workpiece.

While chamfering with hobs has been known for decades, Chamfer Hobbing takes the process to a completely new level. Chamfering is performed using a Gleason Chamfer Hob. The new cutting tool has characteristics very similar to a gear hob. It’s made with high-speed steel materials such as G30, and features AlCrNite® Pro coating for exceptional tool life in dry cutting conditions. With Gleason Chamfer Hobbing, one Chamfer Hob is used for each tooth flank, with a tooth profile specifically designed for the particular chamfer form that’s required. The Chamfer Hob looks similar to a standard gear hob but with asymmetric teeth. One flank is designed for cutting the chamfer, the other flank is designed to not touch the counter flank. This process delivers great flexibility regarding required chamfer angles. Additionally, comma or parallel-chamfer forms are possible as well as chamfers along the tooth edge only, or including the root area. Chamfer angles similar to those commonly produced in the chamfer rolling process are easily achievable (15-30 degree on obtuse edge, 25-45 degree on acute edge).

LOWERING THE COST PER WORKPIECE

In the Chamfer Hob design process, Gleason technology software is used to simulate the required chamfer and identify and avoid all potential collisions of the tools with the counter flank and with interfering integrated chamfering/deburring station performs Chamfer Hobbing in parallel to hobbing. A high speed 2-position gantry loads the workpiece for hobbing, transfers the workpiece to the chamfering station, and delivers the finished workpiece to the parts conveyor.
contours above and below the actual gearing. By cutting into the gap, burrs are avoided on the face side of the gears. With chamfer angles such as those produced by the chamfer rolling process, there are no measurable burrs on the flank that require removal downstream. Since Chamfer Hobs use materials and coatings similar to gear generating hobs, low tool cost per part is expected, especially since tool shifting is possible. Existing sharpening capabilities for gear hobs can be used as well for Chamfer Hobs. Ultimately, longer tool life not only increases the efficiency of the process but also leads to minimized changeover times and, ultimately, to lower manufacturing cost per piece.

While two Chamfer Hobs are sufficient for workpieces with parallel gear faces, up to four Chamfer Hobs on a single spindle could serve parts with non-parallel gear faces such as inclined gear faces or special gears like beveloid, sprockets, asymmetric profiles or even two gears on a shaft—all of which could be chamfered in one setup.

THE PERFECT MACHINE PLATFORM

The new-design Genesis® 160HCD combines the proven Genesis vertical hobbing platform with an integrated chamfering/deburring station to perform the new Chamfer Hobbing process in parallel to hobbing, and thus achieving cycle times to satisfy the requirements for double clutch or eDrive transmission gears. The 160HCD is based on the well-known Genesis 210H Hobbing Machine, and incorporates several product improvements. These include: reduced machine footprint; modification of the fluid power unit for easier adaption to automotive specifications; improving the hydraulic primary deburring; and, most importantly, adding a high-speed, 2-position NC-gantry for efficient and fast workpiece loading.

This NC gantry loading system connects the hobbing station with the Chamfer Hobbing unit and the parts conveyor. A pallet ring conveyor is standard, although other stocking systems or interfaces to external automation can easily be applied to integrate the machine into different production environments.

The integrated Chamfer Hobbing unit employs an axis configuration similar to the main hobbing machine; all NC-controlled by the shared Siemens 840D sl control. The fluid power unit serves both operations as well. The standard configuration of the Chamfer Hobbing unit contains a Chamfer Hob head with the capacity to mount two Chamfer Hobs. An optional Chamfer Hob head with outboard support accepts up to four Chamfer Hobs for non-standard gears as described above. Alternatively, longer Chamfer Hobs could increase tool life per hob and decrease unproductive tool changes. Chamfer Hobs are mounted on a hob arbor with HSK interface to ensure accuracy and fast tool change. For shaft-type parts up to 380 mm in length, a tailstock is available not only at the hobbing position but in the Chamfer Hob unit as well.

Even in medium and high-volume production environments, the ability to machine economically in smaller batches is essential. Short tool change is one key element—workholding changeover is another. With Gleason’s Quik®-Flex system the fixtures in both the hobbing and Chamfer Hobbing stations can be changed in under a minute each. While the expanding bushing and the base plate are the same for both operations the locating ring and fixture body are optimized for each process: rigid clamping close to the root diameter of the workpiece is chosen for high speed hobbing and achievement of shortest hobbing times.

Thinner fixture bodies with smaller location rings are preferred for more clearance below the root diameter for root chamfering and achieving chamfer angles according to the gear design requirements.

Finally, the application of new GEMS® operating software greatly enhances the machine/operator interface. Data input is supported with interactive graphics that guide the operator through the setup and changeover process. The software interface is also designed to minimize the learning period and to avoid wrong inputs with plausibility checks.

SUMMARY

Every gear production challenge is different. Fortunately, manufacturers now have a variety of integrated and automated chamfer/deburr options available, whether the proven chamfer rolling process for shortest cycle times, Chamfer Contour Milling process for highest flexibility, and now Chamfer Hobbing, for medium to high volume production, producing chamfer forms according to customer standards, and with low tool cost-per-part. Depending on the specific requirements it is very likely that one of Gleason’s well-known or brand-new chamfer technologies will address the varying challenges customers may have.

ABOUT THE AUTHOR

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