# Driving Down Gear Noise in E-Mobility

## Gleason Combi Honing System Meets eDrive Transmission Standards

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**As the automotive industry moves toward E-mobility, transmission manufacturers are faced with new challenges.** Larger gear ratios are necessary to reduce the high input speeds of electric motors to the required speed of the drive wheels. At the same time, gear noise that was concealed by the sound of a combustion engine is now evident, presenting completely new challenges for acceptable transmission noise levels. Finally, there are the special requirements to consider for the various new transmissions developed specifically for eDrive application. A common solution for eDrive transmissions are planetary transmissions using "stepped pinions."

In specific planetary gear applications, the two gears on the stepped pinion are synchronized to fulfill an exact timing within very tight tolerances.

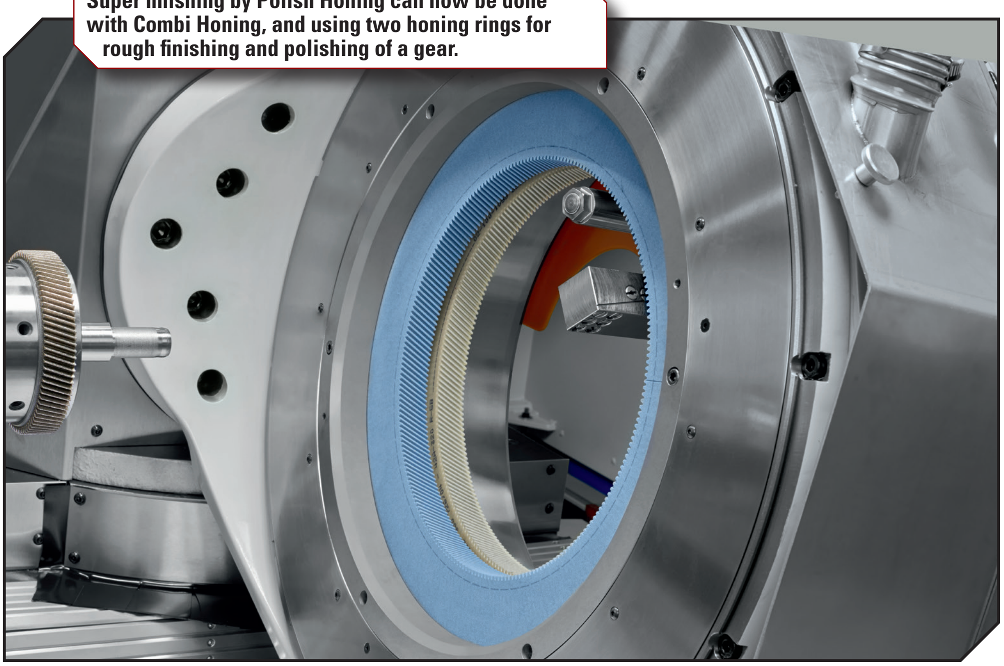
Due to the noise sensitivity of such components, hard finishing by grinding or honing is indispensable. Gear honing proves to be particularly advantageous, since honed components have a proven lower noise behavior than ground components due to their specific, curved surface structure. Gear honing is also a requirement for machining gears with interfering contours, as is the case with stepped pinions. This is due to the small cross axis angle between the honing tool and the component and the fact that, unlike grinding, no tool overrun paths are required.

With the acquisition of the Faessler gear honing business, Gleason has added a unique process to its gear hard finishing portfolio that makes it possible to hone synchronized stepped pinions in one clamping with extremely tight tolerances and the highest quality. This so-called Combi Honing system uses two honing rings. The honing head of a Gleason 260HMS Honing Machine, for example, can clamp two honing rings in parallel. The resulting eccentric offset of the honing rings is compensated for with a B-axis (swivel axis). In addition, flank line modifications such as crowning can be realized with the B-axis during the honing process.

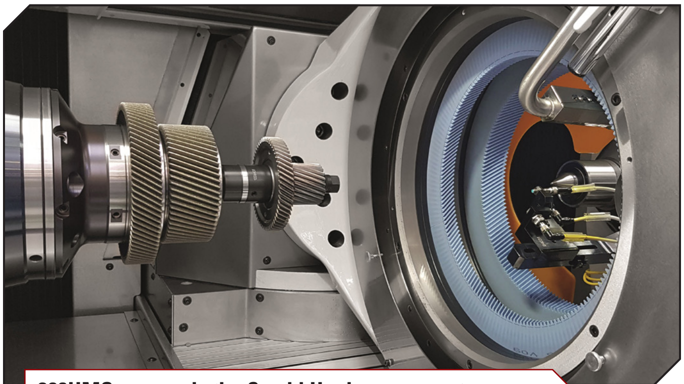
The Combi Honing process starts with honing ring 1 honing the larger gear, and then honing ring 2 honing the smaller gear, all in the same clamping. Although this may sound trivial, this process has decisive and unique advantages, especially with regard to finished quality. While this specific component could also be machined in two separate set-ups, e.g. grinding the larger gear and honing the smaller one, the quality of the resulting gear would not be the same, particularly the angular synchronization of both gears. When finishing both gears in one clamping, non-productive time for loading/unloading as well as indexing (centering tools and gears) occurs only once and not twice per component.

The Combi Honing Process on the 260HMS was specially developed for synchronized stepped pinion applications. A particular challenge was achieving the reliable and accurate positioning of the synchronized gears in relation to the honing rings. When indexing, i.e. centering gear teeth and tools, both teeth of the large and the small gear must be detected while corresponding exactly to the required angular offset and the tolerances of the index hole on the face side of the gear. The latter guarantees the final correct installation position of the stepped pinion in the planetary transmission. Three indexing sensors are used to measure the position of all teeth of the large and small gear as well as the position of the index hole on the face side. A corresponding algorithm calculates the correct position of the gear teeth in relation to the honing rings. Parts with excessive hardening distortions, which can't be honed in exact tolerances to the index bore, are automatically ejected.

Another important feature determining quality is the fixed



Super finishing by Polish Honing can now be done with Combi Honing, and using two honing rings for rough finishing and polishing of a gear.



**260HMS can apply the Combi Honing process to produce stepped pinions reliably and at the quality levels needed to ensure the correct installation position in the planetary transmission. Integrated sensors measure the position of all teeth on both gear as well as the position of the index hole on the face side.**

position of the two diamond dressing tools on the work spindle. The location of the dressing tools ensures that the position of the teeth on the honing rings does not change either absolutely or relatively — even after dressing of the honing rings. Loading/unloading of dressing tools to the work spindle, as is often the case in other honing applications, cannot reliably achieve this important quality aspect.

Another advantage of the Combi Honing process is the possibility of super finishing gears with Polish Honing. The requirements for increased transmission efficiency and reduced noise levels demand a superior surface quality of hard-finished components. While Polish Grinding using a two-zone polish grinding worm is a proven approach, a similar process has not, until now, been possible with gear honing.

With Combi Honing, however, it is now possible to use two honing rings in one clamping and thus use two completely different tool specifications for rough finishing and polishing of a gear. This makes it possible to achieve the surface qualities of $Rz \leq 1\,\mu m$ typically required for polish grinding by means of gear honing — but with the added benefit of achieving the surface structures typical for the gear honing process.

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