

Form honing



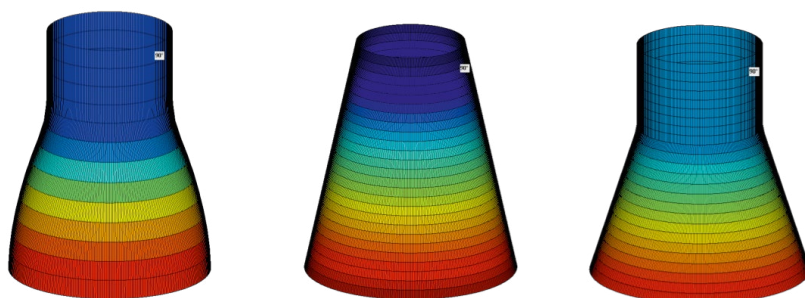
The future development impetus of the internal combustion engine will focus on the reduction of CO₂ emissions. This is dependent on fuel consumption, which in turn is determined by the internal engine friction. The goal of form honing is a form optimized cylinder bore under operating conditions.

Gehring has developed a honing process that doesn't target a cylindrical bore shape. The bore shape is based on the distortions of the geometry under operating conditions of the engine. Through the means of form honing the reverse shape will be produced so that in running conditions, a cylindrical shape exists.

The deformation in the operating condition depends on:

- static assembly distortions
- thermal cylinder distortions

This technology can be sub divided



Examples of variations of functional shapes

into two process variations, form honing light and form honing professional.

Form honing light simulates thermal distortion by creating different tapered shapes. The thermal expansion due to the higher taper in the top dead center leads to a cylinder bore which has to be honed to a smaller size at the top and a larger size at the bottom. Thus, the piston skirt has less contact with the bore. This results in significantly less friction.

The process works with newly developed process hardware such as

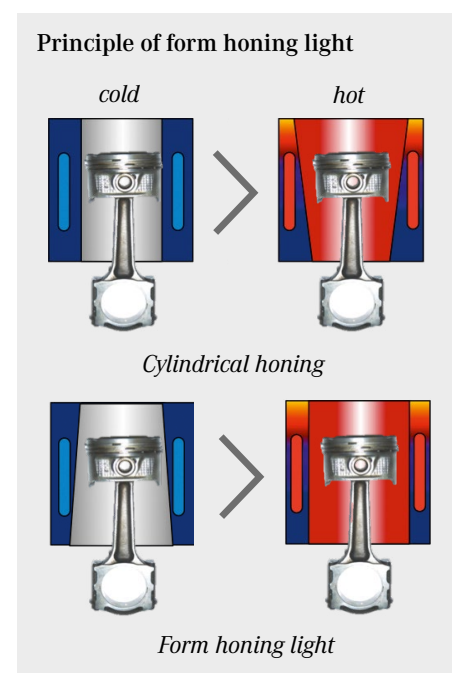
- special honing tools with shorter abrasives
- dynamic stroke control
- dynamic electromechanical expansion system
- spring-mounted finish honing tool

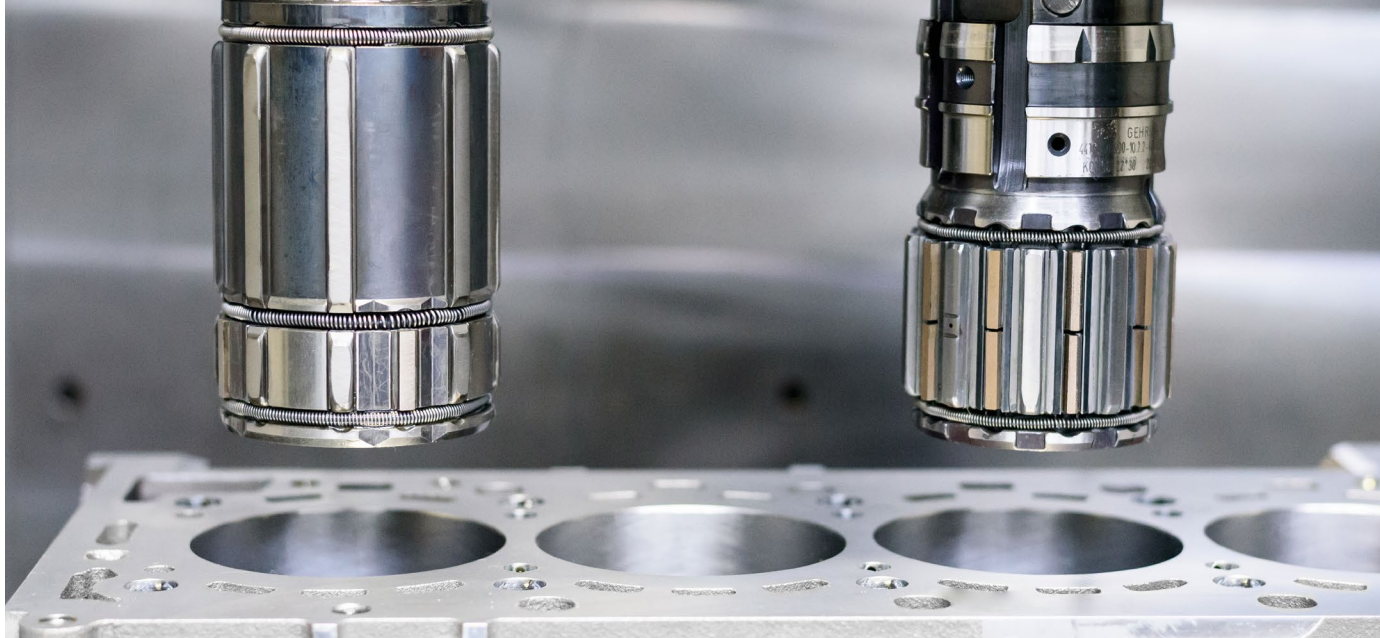
The conical shape is generated by feedback controlled stroke displace-

ment with higher stock removal in the lower bore section due to increased contact time of the abrasives.

The dynamic electro-mechanical feeding changes the radial expansion position of the honing stones during the stroke movement according to the form and improves herewith the previous conical shape. These process components assure the reliable process of round non-cylindrical tapered bores within the known cycle times.

Form honing has been already integrated globally into mass production scenarios. Application of form honing light technology has shown that significant improvements in emissions reductions are possible.





Form honing professional does not only optimize the local piston clearance but also compensates for cylinder deviations from static and thermal distortions. That means that in running conditions round and straight bores can be achieved. Ring tension is reduced which results in adaptive friction and CO₂ reductions.

The non-cylindrical shape deviations can be defined through CAE assessments or torque plate bracing and tempering. In order to be able to implement form honing professional,

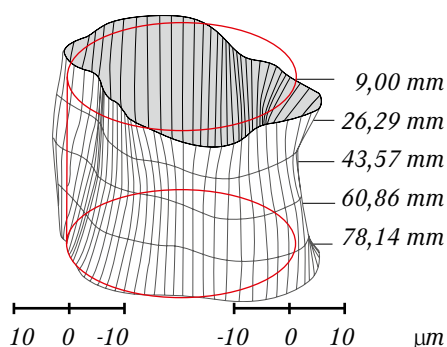
innovative processing hardware is necessary:

- special honing tools with independent actuated abrasives
- Piezo feeding system
- shape adaptive control
- spring loaded finish honing tool

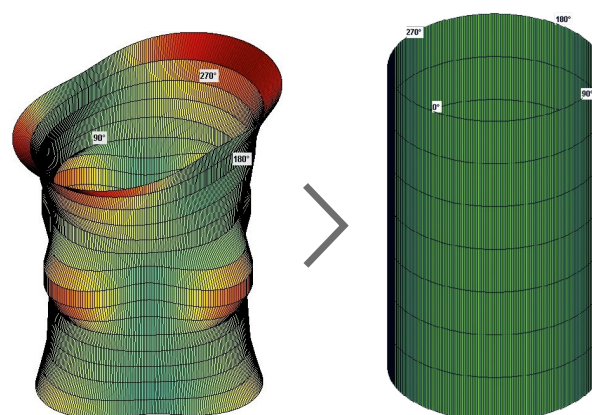
The shape data for the cylindrical deviations will be converted for every single cylinder of the engine using the form honing control. This dynamic process interaction between the feeding system, shape and the form honing tooling creates

an optimal result.

Form honing professional has been implemented by customers for small production batch scenarios. The process produces cylinder deviations and surface finish profiles with high reproducibility and economical processing times.



The desired free form serves as allowance for a cylindrical functional geometry.



Free shape and quasi-cylindrical functional shapes

Trust in the technology leader with many years' experience and global presence! Innovative technology combined with an economical mindset sets us apart.