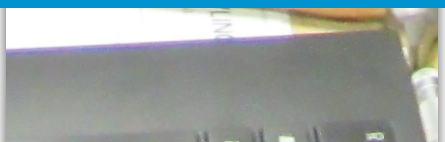


Chris-Marine honing and deglazing

- 4-stroke engines

Innovative engineering since 1962

CHRIS-MARINE®



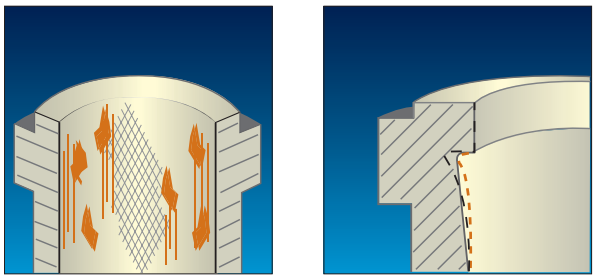
Why honing?

4-stroke engine makers normally enforce honing / deglazing during piston overhauls to avoid running-in problems and to restore the nominal engine performance. Honing / deglazing will reduce lubrication oil consumption by improving the surface structure of the cylinder liner. This is of particular interest in Otto-cycle or lean-burn cycle gas engines since excessive lube oil consumption can cause knocking (detonation).

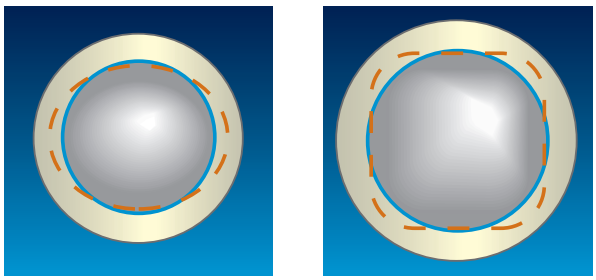
Knocking is a destructive process that will eventually lead to severe engine damage if not avoided. Modern Otto-cycle / lean-burn engines have a knock detection system that will reduce power when knocking is detected, thereby reducing the engine's performance and increasing fuel consumption. Regular honing or deglazing of cylinder liners for these engine types can therefore save fuel as well as increase power output.

For engines running on MGO, gas or other low-sulphur fuels, cylinder liners will eventually become glazed or polished but not necessarily worn. In these cases it is normally sufficient to refresh the running surface without changing the cylinder geometry. This process is called deglazing.

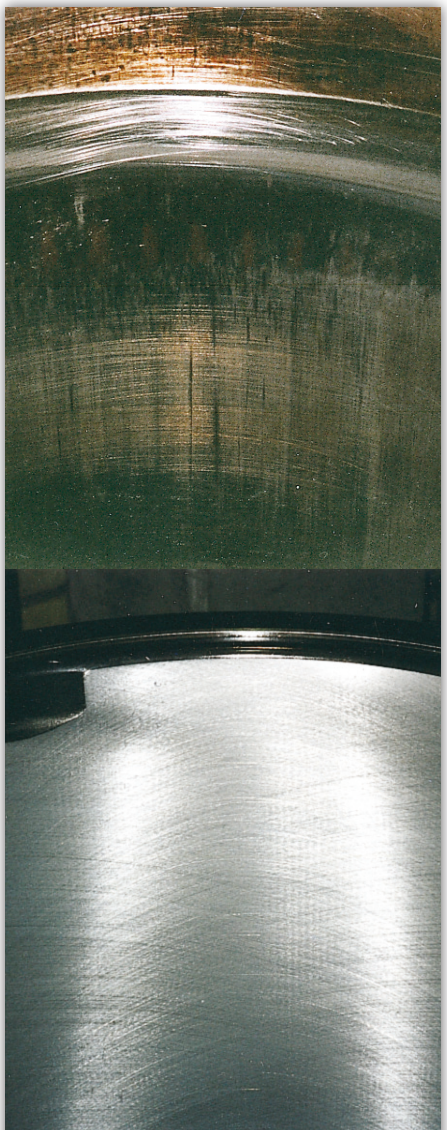
When the cylinder liners are worn (e.g. at the second piston overhaul for engines operating on HFO), ovality and wear edge must be removed to avoid cylinder condition issues later in the life cycle. This process is called honing.



Glazing and micro-seizures in the running surface and wear edges can be removed with all machine types, but the process is faster with HON S and HON A compared to DGL.



Roundness can be restored with 4-armed and 8-armed heads (HON S and HON A) but not with three-armed heads (DGL).



Pictures taken before and after honing / deglazing of a cylinder liner in poor condition.

Honing and deglazing machines

The Chris-Marine honing / deglazing machine range consists of compatible modules offering several configurations and upgrading opportunities. There are three types of honing and deglazing machines that are well suited for restoring 4-stroke engine cylinder liners:

CHRIS-MARINE®
DGL

MANUALLY OPERATED, IN-SITU ONLY

Electric rotation, pneumatic vertical motion and pneumatic stone pressure control, with three-armed head.

CHRIS-MARINE®
HON S

MANUALLY OR SEMI-AUTOMATICALLY OPERATED, IN-SITU OR WORKSHOP

Pneumatic rotation, pneumatic vertical motion and mechanical stone pressure control. Intended for use with four-armed and eight-armed honing heads. The machine has recently been equipped with a remote control box for improved safety and can be equipped with automatic stroke control and chain slack detector for maximum performance and safety.

CHRIS-MARINE®
HON A

FULLY AUTOMATICALLY OPERATED, IN-SITU OR WORKSHOP

Electric rotation, electric vertical motion and mechanical or automatic stone pressure control. Intended for use with four- and eight-armed honing heads. The machine can be equipped with chain slack detector for maximum performance and safety.



The different deglazing and honing machine types intended for restoring 4-stroke engine cylinder liners: DGL, HON S with remote control, HON A with remote control and the HR honing rig series.

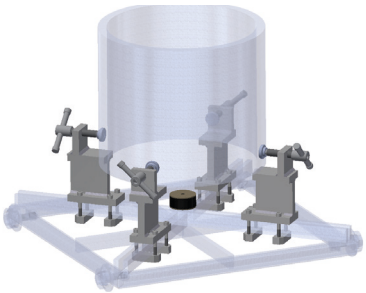
Choose your equipment

The choice of equipment has an impact on quality, process time, noise level and safety. The DGL is the least costly, but also the most time-consuming machine to use, and it does not remove ovality. The HON S machine removes ovality, is faster and more ergonomic than the DGL, but also more noisy and less flexible than the HON A machine. The HON A machine is our fastest, safest and most user-friendly honing machine. It has the same functions as HON S, but additionally electric control of rotation and vertical motion making it silent and flexible. The HON A covers the entire range of honing angles and engine bores without need for multiple gear boxes. For HON A, honing angle, honing speed, upper / lower turning points, number of strokes and other parameters are set in the digital control panel.

Upgrade kits are available so that customers can get the latest DGL, HON S or HON A standard or add options to an existing machine.

HON S and HON A can be used both in-situ and in a honing rig thereby improving flexibility, whereas DGL is a pure in-situ machine.

The largest honing rig, HR800, has recently been upgraded to enable honing throughout the liner, thereby completely avoiding any wear edge at the lower end of the liner. There is an upgrade kit available for customers who would like to upgrade to the latest standard.



Upgrade kit from HR80 to HR800, to allow honing throughout the liner.

Safety in honing

Several safety features have been added to the Chris-Marine range of honing equipment to minimize risk for injury.

Recent safety features also available as upgrades:

- **Chain slack detector:**
  Available for HON S and HON A. Stops the honing process when the stone pressure is too high for the head to be able to move down. Protects both operator and equipment.
- **Remote control**:
  Standard for HON A and available as upgrade for HON S. Keeps operator at a safe distance from moving parts during the honing process.
- **Honing cage:**
  Available as upgrade for honing rigs in combination with HON A. Ensures that the operator cannot touch moving parts at all. A cage is protecting the operator from all moving parts. Opening the cage door will stop the honing process immediately.



HONA remote control honing settings: angle, speed, sequence, upper/lower turning points and other parameters.

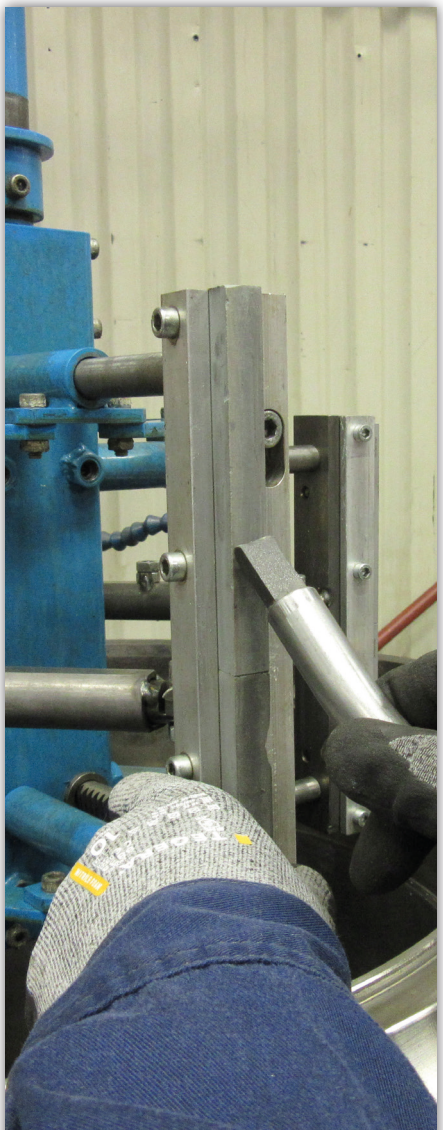


Dressing tool for ceramic stones.

Honing and deglazing heads

4-stroke engine honing and deglazing is carried out using four-armed or three-armed heads. Eight-armed heads can be used too, but with stones mounted on four arms only.

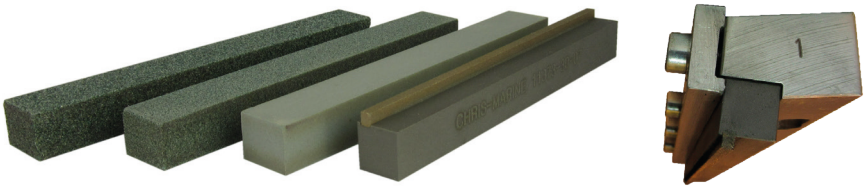
Chris-Marine has recently introduced vibration dampers in order to minimize head wear, avoid vibration patterns in the cylinder liner and improve productivity. The vibration dampers effectively reduce rotational vibration modes, making it possible to operate at higher stone pressure. Vibration damper upgrade kits are available for most existing head types.



Honing process with different honing stones

The honing process takes place in three steps for 4-stroke engine cylinder liners:

- Initially, a diamond stone is used for removing wear edge, micro-seizures and surface glazing and for providing a well-defined starting surface for the next step. Diamond stones have superior endurance and remove material faster than ceramic stones.
- A rough ceramic stone is then used for removing smeared liner particles from the diamond stage and for giving the surface excellent oil-retaining properties.
- Finally, a fine ceramic stone is used for removing edgy peaks from the surface while sustaining the good oil-retaining property of the surface.



Different stone types from the Chris-Marine range are needed when honing / deglazing 4-stroke engine cylinder liners. Use one stone holder per arm and stone type.

Honing stones and other honing accessories

Stones have been carefully selected for most 4-stroke engine types to achieve a fast and robust process meeting the makers' surface specifications.

Chris-Marine recommends using one set of detachable stone holders for each stone type, because it makes it possible to pair stone holder and stone with the arm. This makes the final result more consistent, reduces stone wear and minimizes the risk for cracked stones.

The Chris-Marine honing liquid ensures shortest possible honing time by preventing residues from clogging the stones. The liquid also provides corrosion resistance for the cylinder liner.

The Chris-Marine honing liquid is non-toxic and more environmentally friendly than alternatives such as petroleum oils. The cleanliness of the honing liquid does have an impact on the end result so make sure to filter or replace it regularly.

Cleaning brushes are used at the end of the honing process to remove debris from the running surface. Make sure to use fresh brushes to achieve consistently clean result.

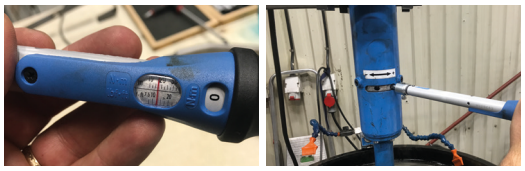


Chris-Marine honing head equipped with vibration dampers for optimum performance.

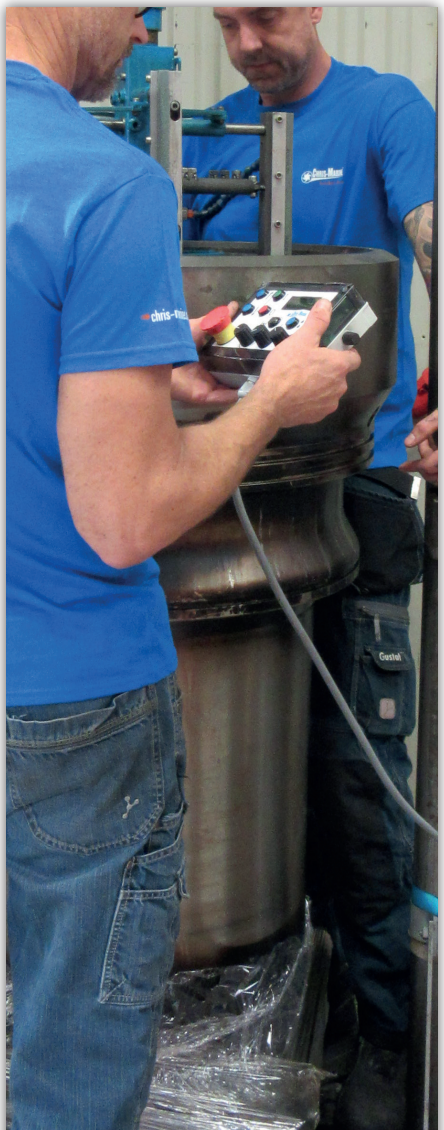


Torque wrench and adapter

For HON S and HON A machines with mechanical stone pressure control, a kit that improves stone pressure accuracy has recently been introduced. The kit incudes a torque wrench and an adapter.

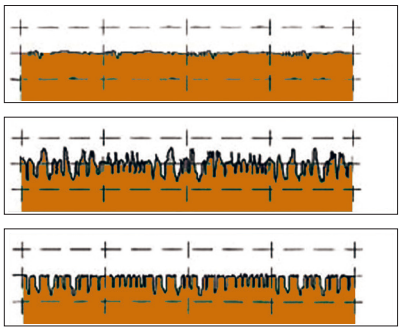


Adjusting torque wrench (left) and setting stone pressure (right) with HON S and HON A.



Monitoring and controlling the honing process

An ideal honing and deglazing process generates a surface with deep sharp valleys but without sharp peaks. Such a surface provides excellent oil-retaining properties, doesn't harm piston rings and prevents break-out of hard particles from the liner.

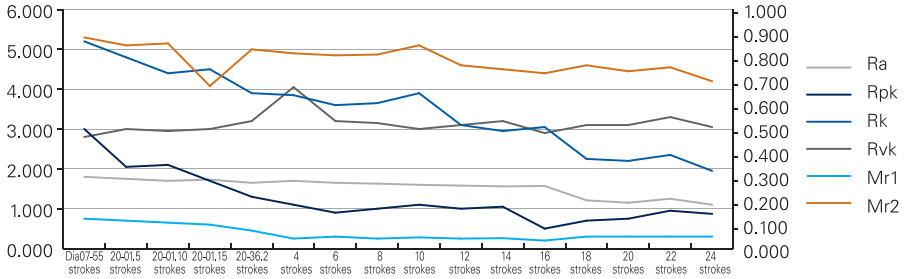


Surface profile of the running surface from glazed surface (top) through coarse honing (middle) and fine honing (bottom) stages.

Honing results

Several parameters describe the end result after the honing / deglazing process:

- Maximum diameter and ovality, sometimes prescribed at certain depths. These dimensions are normally verified through micrometer measurement before and after honing / deglazing. Chris-Marine provides micrometer kits well suited for this purpose.
- Surface roughness parameters describing the peakiness and the oil retaining property of the resulting surface. Common parameters here are Rz, Ra, Rpk, Rk, Rvk, Mr1 and Mr2. Chris-Marine provides a Surface Roughness Measurement tool (SRM) intended for verifying surface characteristics.



Chris-Marine Honing App

The honing result depends on a number of process parameters such as honing speed, stone pressure and number of strokes for each stage. Three types of stones are used throughout the process and up to five surface roughness parameters and several more geometrical parameters should fall within a pre-specified range at the end of the honing process. This means that monitoring and controlling the process is challenging also for quite experienced users. Chris-Marine has therefore developed a tool intended to make it easier to monitor and control the honing process, thereby improving quality while also saving time. This tool is the Chris-Marine Honing App.

The Honing App collects geometrical dimensions measured with the micrometer kit and surface roughness values logged with the SRM and guides the user through the honing process step by step. At the end of the process, the data collected is summarized in a measurement report.

The Honing App has a set of pre-defined recipes and measurement report formats making it easy to save time and improve quality at the same time.

It takes 20 – 60 minutes per liner to carry out honing / deglazing, measurement and reporting when using HON A or HON S together with the Chris-Marine Honing App. Time increases with bore size and wear condition of the liner. Best practice, report formats and honing recipes can be updated remotely by Chris-Marine as long as the Honing App has Internet access.



Honing by Chris-Marine

The Chris-Marine Honing App is available as an accessory for all honing / deglazing machines, making it easy to control process quality, produce measurement records and save time throughout the honing process.

The honing / deglazing process, step by step

Preparations

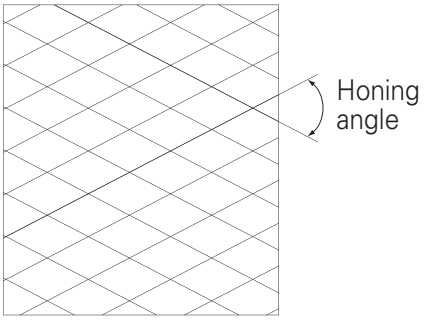
Before starting, make sure to have fresh cleaning brushes, honing liquid and three sets of stone holders prepared with the correct stone types and an extra set of ceramic stones for each type.

For DGL, adjust up/down speed to achieve a correct cross pattern. For HON A, the honing angle is set in remote control, as shown above. For HON S, honing angle is given by the gear box type.

Use plenty of clean honing liquid during the entire process.

Step 1: Measure the diameter of the liner

- Measure the diameter of the cylinder liner with a micrometer to make sure that it has not been worn out. The honing / deglazing process will increase the maximum diameter by 0.05-0.10 mm.



Step 2: Diamond stone deglazing / honing

- Mount diamond stones and set stone pressure
- Set rotation speed and hone until the entire surface has been touched by the stones and all scoring marks have been removed.
- Measure the surface with the SRM.

A new stone or a dressed stone will be in the upper acceptable Rk range. If Rk is too low, turn or dress the stone and start over.



Step 3: Coarse ceramic stone deglazing / honing

- Mount and dress the coarse ceramic stones and set stone pressure.
- Make the prescribed number of strokes with intermediate dressing if needed.
- Measure the surface with the SRM.

If the surface is too coarse, repeat the process until Rk reaches the target range.

Step 4: Fine ceramic stone deglazing / honing

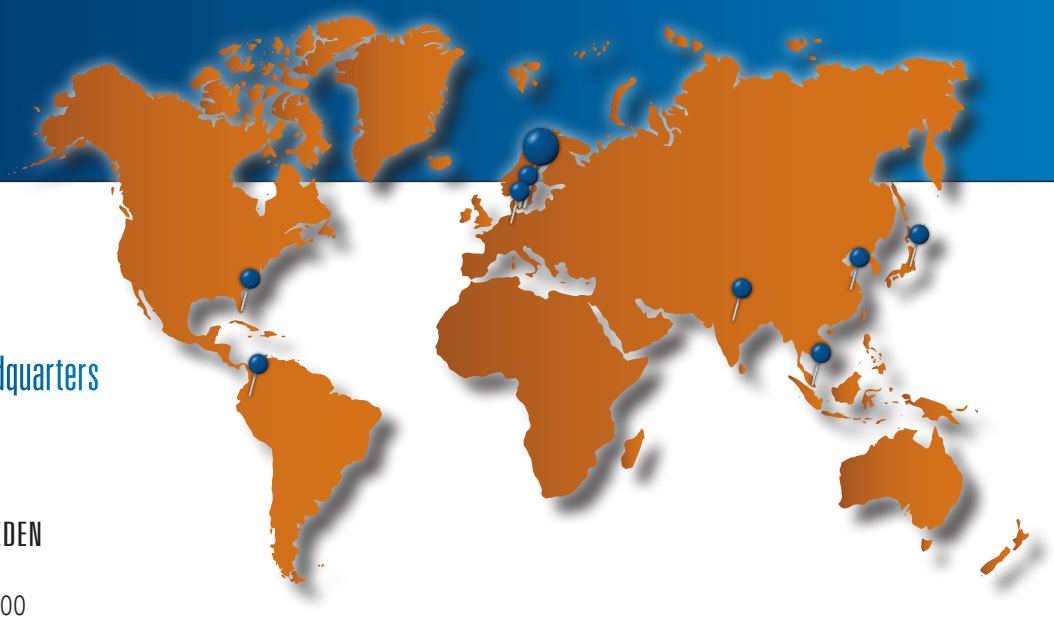
- Mount and dress the fine ceramic stones and set stone pressure
- Make the prescribed number of strokes with intermediate dressing if needed.
- Measure the surface with the SRM.

Rk should be just below the maximum limit. If the surface is too coarse, repeat the process until Rk reaches the target range. If the surface is too fine, go back to step 3, but reduce the number of strokes.

Step 5: Cleaning liner

- Mount cleaning brushes and make the prescribed number of strokes.

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