Honing of Gray Cast Iron Cylinder Blocks
Contents

Chapter 1: Honing 3
  1.1 General Information on Honing 3
  1.2 Adjustment of the Hone 3

Chapter 2: Honing Today 4
  2.1 Honing Angle 4
  2.2 Surface Roughness 4
  2.3 Honing Stones and Honing Oil / KS Honing Accessories 5
  2.4 Hommel Tester 5

Chapter 3: Honing of State-of-the-art Engines 6
  3.1 Advantages of Honing plus Brushing 6
  3.2 Honing and Brushing Procedure 7
  3.2.1 Honing 7
  3.2.2 Hone Brushing 8
  3.3 Roughness Values 8

Chapter 4: Examining the Honing Result 9
  4.1 Why 9
  4.2 Factors Influencing the Honing Result 9
  4.3 What to Check 9
  4.4 How to Check 9
  4.5 Next Follows the Assessment 9
  4.6 Certificate 10
1.1 General Information on Honing
The gray cast iron cylinder liner surface is typically finished by honing. The surface should not be too smooth, but exhibit fine scores. Ensure a clean cut at all times. Chapter 2 shows the normal basic honing procedure to be applied for cylinder blocks of gray cast iron. The surface roughness will be removed to a certain extent when the engine is run in and the sliding contact surfaces adapt to each other. This condition is optimum for the piston ring and cylinder surfaces. This run-in wear can be anticipated by finishing the surfaces by hone brushing, see Chapter 3.

1.2 Adjustment of the Hone
The honing stone length should cover 50–60% of the cylinder bore length. The most favorable top overstroke is typically 25–30% of the hone stone length. At the bottom cylinder end, the design geometry of the bearing supports should be taken into account. The applicable overstroke of the honing stone is to be seen from the cylinder block drawing or the workpiece. It may be between 15 and 30 mm, (see Fig. 1).
Chapter 2: Honing Today

2.1 Honing Angle
The honing angle, Fig. 2, should be between 40° and 80°. The angle can be verified using the transparent honing angle mask, Fig. 3.

The metal smearing or deformation produced in the honing process may lead to waviness of the liner surface which is again partly removed by the steep upward and downward movement of the hone. The larger the honing angle, the less pronounced will the waviness on the surface be. On the other hand, a smaller honing angle has the effect of reduced oil consumption.

2.2 Surface Roughness
In order to ensure the necessary adherence of the oil film to the cylinder surface, especially in the running-in phase, it is essential for the cylinder to have a certain roughness. Three measuring and valuation methods are in common use for determining roughness: Rt, Ra, Rz. Fig. 4 provides a comparison of these three methods with the desirable values.

<table>
<thead>
<tr>
<th>Comparison of measured values</th>
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<tr>
<td>Surface roughness Value measured by instrument</td>
</tr>
<tr>
<td>Rt</td>
</tr>
<tr>
<td>Ra</td>
</tr>
<tr>
<td>Rz (DIN)</td>
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2.3 Honing Stones and Honing Oil
The right honing stones are:
- for rough honing: grain size 150. Provide for a material removal of about 0.06 mm referred to the diameter.
- for finish honing: grain size 280. Provide for a material removal of approx. 0.02 mm referred to the diameter (about 5-6 strokes)

The use of the right honing oil is a prerequisite for a satisfactory honing result. It is important always to use the honing oil recommended by the honing stone manufacturer.

2.4 Hommel tester
The surface roughness is reliably measured with roughness tester Hommel T 1000 E, accuracy class 1. It ensures surface measurements in the µm range satisfying applicable standards for all honing operations at cylinder liners and cylinder blocks, with digital indication of Ra, Rz, Rt values. If the corresponding graphic printer P1010 is available, the measurement results can be recorded on paper and documented.

<table>
<thead>
<tr>
<th>KS Art.No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 009 857</td>
<td>Hommel T 1000 E</td>
</tr>
<tr>
<td>50 009 811</td>
<td>Hommel T 1000 E with P 1010</td>
</tr>
<tr>
<td>50 009 873</td>
<td>Honing angle test mask</td>
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</table>
Already some time ago, engine manufacturers started finishing engines for trucks and passenger cars by honing and brushing. Brushing has an advantage in that it reduces the oil consumption and provides for an easier run-in of pistons, piston rings and cylinders. What is more, it prevents problems in connection with plateau honing with regard to the defined minimum material removal.

### 3.1 Advantages of Honing plus Brushing

- After brushing, the surface is perfectly clean.
- A high graphite exposure rate of 50% is desirable, 20% having to be reached as a minimum. Fig. 6 shows a graphite vein exposure of 50%, scale 500:1.
- Fig. 7, Roughness Diagram, shows a plateau-like surface.
3.2 Honing and Brushing Procedure

3.2.1 Honing
If the cylinder block is to be brushed after honing, it is essential not to hone to too fine a grain. That is why honing stones with grain sizes between 120 and 180 should be used:
- Bond of honing stones:
  - for parent bore engines: bond 5-7
  - for liners (centrifugal casting) bond 5 max.
Material removal:
0.03 - 0.05 mm referred to diameter
3.2.2 Brushing
Honing brushes consist of nylon fibers with silicon crystals. At least 10 strokes are required, using honing oil. This cleans the bores and removes the peaks (see roughness diagram, Fig. 8). Brushing does not involve any further dimensional changes!

3.3 Roughness values
Allowable roughness:

<table>
<thead>
<tr>
<th>KS Art. No.</th>
<th>Article</th>
</tr>
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<tbody>
<tr>
<td>50 009 864</td>
<td>Hone brush set, Sunnen C 30 PHT 731</td>
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<thead>
<tr>
<th>R3Z</th>
<th>Cars</th>
<th>2-5 μm</th>
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<tr>
<td>Trucks</td>
<td>3-5 μm</td>
<td></td>
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<tr>
<td>Rmax</td>
<td></td>
<td>11 μm</td>
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</table>
Chapter 4: Examining the Honing Result

The service offered by KS Motor Service International for engine reconditioners

4.1 Why?
Today, a state-of-the-art engine is composed of heavy duty components. For diesel engines, for example, a performance increase was achieved through turbochargers and charge-air intercooling. The piston ring material (steel rings) has changed, the number of piston rings was reduced and the piston ring width decreased. The treatment of the cylinder running surface by honing is therefore critical for the quality of the reconditioning operation.

4.2 Factors Influencing the Honing Result
Regular checking of the honing result is essential in order to detect and remedy various sources of defects.

Sources of defects:
• too little or the wrong honing oil
• contact pressure of honing stones too high
• too little material removal for the honing process
• selection of wrong honing stones
• incorrect feed + revolutions

4.3 What to Check
The service range of KS Motor Service International comprises the checking of:
• honing angle
• roughness values
• graphite exposure rate (metal smearing)

4.4 How to Check
• Customer will send us a cut-out of a honed surface, approx. 5x3 cm.
• The honing angle and roughness are measured.
• The exposure of graphite veins is determined under the microscope at a magnification of 500:1 (micrograph).

4.5 Next Follows the Assessment
• The customer receives a honing certificate attesting to the honing quality.
• If necessary, suggestions for improvement are made.
• As the costs of such an examination are very high but it is extremely important for the customer, we charge a share in the cost.
Honing Certificate

for Specimen Company

in Specimen Town

Honing angle:

Target value 40-80 degrees
Actual value 60 degrees

Roughness of cylinder surface:

Target value Rt 3-6 μm
Actual value 4 μm

Target value Ra 0.4-0.8 μm
Actual value 0.5 μm

Target value Rz max. 4 μm
Actual value 3 μm

Graphite exposure rate

Target value 20% min.
Actual value 21 %

Neckarsulm
Place

10. September 1998
Date

Schmidt
Signature

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