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Research of the Microgeometry of the Surface of Cylinder Mirror of the Internal Combustion Engine

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Annotation. The article covers the determination of optimal parameters of the mirror microgeometry of the cylinder of an internal combustion engine, as well as comparison of the microgeometry indicators of the cylinder mirrors of the internal combustion engine of the domestic manufacturer with the indicators of the world's leading representatives of car factories (Audi, Nisan).

Keywords: honing tool, roughness, Abbott curve, surface profile, cylinder mirror, microprofile, profilogram

In the conditions of the vehicle service station, in the absence of automatic control systems, the preferred methods for monitoring the microgeometry of the cylinder mirror after a major overhaul are measuring the surface profile and recording with a profilograph, recording the Abbott carrier curve.

Registration of the surface microprofile is carried out on a profilogram, but it is only a commonly used and recognized basis for estimating the surface roughness parameters after honing [1].

This registration of the profile does not give an accurate characterization of the plateau-honing structure of the surface, however, the frequency and distribution, as well as the width and depth of the honing marks, are visible, so it is also necessary to evaluate the surface of the cylinder mirror using the Abbott carrier curve.

Registration of the carrying Abbott curve with the corresponding components is carried out automatically based on the surface profile stored in the instrument's memory. To use the bearing roughness parameter “Tr” and the carrying Abbott curve in practice, it is necessary, as with any specification of technical dimensions, to determine reasonable tolerances. This implies an expansion of the bearing roughness parameter, which leads to a broader interpretation of the surface parameters.

Data on the tolerance parameters of various manufacturers of internal combustion engines (kept secret) are necessary both for the practical implementation of plateau-honing, and for monitoring the results of processing in production, as well as in repair technologies.

Thereby, based on the data obtained because of the analysis of methods for evaluating the world's leading manufacturers, manufacturers of parts of the connecting rod and piston group, we consider the processing of the cylinder block hole and enter the data in Table 1 [3].

Calculated data of hole accuracy.

Table 1

	Transitions	Workmanship	Tolerances	Components of the allowance			Limit dimensions		Limit allowances	
				a	Δ	ε	D_{min}	D_{max}	Z_{min}	Z_{max}
	Die casting	10	2.5	0.2	0.25	0	83.07	85.576	-	-
	Reaming	7	0.087	0.035	0.02	0	82.17	82.263	0.45	1.7445
	TO	8	0.193	0.041	0.04	0			-	-

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	Honing draft	6	0.035	0.015	0.005	0	82.01	82.049	0.081	0.195
	Honing finishing	5	0.022	0.003	0.004	0	82	82.022	0.007	0.0355

Comparative analysis of suppliers of honing tools.

We will enter data on the parameters of tools from various manufacturers in Table 2.

Summary table about manufacturers
Table 2

Brand / Supplier	Grit	Bond	Material
Nagel Precision, Germany	80/63	Metal	AC
Rottler, USA	63/50	Metal	AC
Delapena, England	50/40	Metal-silicate	AC

DELAPENA Honing Equipment Ltd., England, has the most successful latest developments and projects in the field of honing. The work of the company is always determined by the needs of customers and is reliably supported by the high qualification of the company's personnel. DELAPENA has specialized in honing for more than 70 years, and during this time has gained experience and developed products that allow offering customers the best honing solutions. DELAPENA works with new and existing customers to provide the best end-to-end solution, selected from a wide range of machines available, both standard and automated, to meet any customer requirement. In addition, DELAPENA provides a complete range of honing tools and proven technological solutions to ensure correct and efficient operation on all supplied machines. Proven by many years of practice, honing hole finishing technologies are equally important both in the production of various parts and in the repair of automobile engines.

That is why the company DELAPENA, for the exclusive presentation of its machines and tools on the Russian market, has chosen the Specialized Motor Center "AB-Engineering" as one of the leading repair and production companies in the development and promotion of the right repair and production technologies. Over the years, DELAPENA has gained vast experience in the technology of efficient hole honing of a huge range of parts of any configuration. The implementation of these technologies in practice required the development of appropriate technical means - high-performance machine tools, precision tools and convenient equipment. Honing machines, tooling, mandrels, honing heads and honing stones are produced at the DELAPENA factory in England. Despite the fact that DELAPENA honing tools and equipment were not widely used in Russia in the past years, these products are quickly gaining popularity due to their high quality at a relatively moderate price. Significant experience in the use of diamond abrasives in the field of engine repair has allowed ROTTLER to significantly improve their performance, achieve maximum durability and optimum surface finish. ROTTLER diamond abrasives are capable of working twice as long as cheaper abrasives from other manufacturers. To achieve the best possible processing quality, an appropriate coolant must be used. ROTTLER water-based coolants have been developed specifically to work with ROTTLER diamond abrasives. New synthetic coolants are environmentally friendly compared to traditional honing oils. ROTTLER MANUFACTURING is a leader in the use of diamond abrasives in the aftermarket. Diamond abrasives are the development of leading experts from many fields of science; they created the whole process that allowed diamond technology to enter motorsport, industrial engine remanufacturing and the market for small engine repair shops. The diamond abrasive process has proven to be the most economical of all available, as well as providing consistently high results. Nagel GmbH, a manufacturer of machine tools and tools, is one of the world's leading specialists in the field of honing and super-finishing technology. Common goal: excellent quality, highest precision, development and increase in production.

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Description of the measuring instrument.

The Hommel T1000 wave is an upgraded unit based on the T1000 Basic. This equipment has the same characteristics as the basic version, but with an extended roughness measurement function [2]. The T1000 Wave can be used as a handheld device on the shop floor or can provide a very economical no-slip system in the measurement room. The main processing unit and display used in conjunction with the waveline 20 cross rail module, which includes high precision data for slip-free measurements. Whether on the production line in the workshop or in the laboratory, the HOMMEL T1000 wave fulfills the highest demands and is portable. Five measuring programs guarantee quick application and storage of many different types of measuring tasks, the results of which are shown on a high-resolution screen. HOMMEL TESTER T1000 basic/top is ideal for precise surface and transverse measurements. In addition, the HOMMEL T1000 wave top is supplied with a PCMCIA drive and a 32 MB compact flash card for transferring and archiving measurements. Hommelwerke offers a software package to make your job easier. Windows roughness measurement software TURBO DATAWIN is easy to use. The measuring device is shown in Fig. 1.

Description of the measurement process.

By using the designed installation and the device fixed in it, along the generating of the ICE cylinder, a profilogram of the roughness of the honed surface is taken, and the Abbott curve is recorded, and the data is processed in the device itself by analyzing the measured values. As results, we will use the values of the technical parameters of the device, which are necessary for constructing the Abbott curves.

Fig. 1. Hommelwerke Measuring device.

The control is carried out on the basic length Lt (corresponding to ISO standards), which is divided by the limit lengths Lc.

R_{pk} is reduced, shortened emission height that determines wear.

R_k is the depth of apparent roughness, the core of roughness, which determines the part of the surface that has been in operation for a long time.

R_{vk} is reduced depth of depressions.

M_{r1}, M_{r2} are the proportion of material in % corresponding to the inflection points on the Abbott curve.

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Experimental data from the Abbott curve from various manufacturers.

Let us consider the experimental data of Abbott curves by various manufacturers.

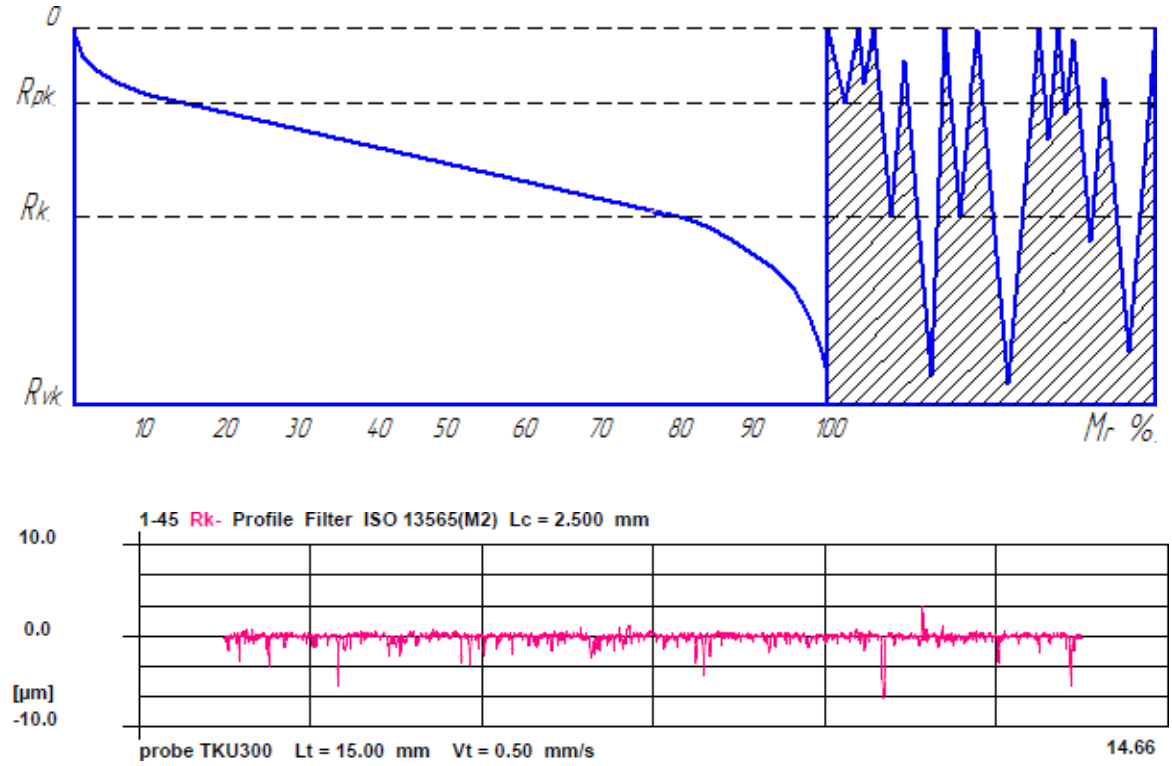

Fig. 2. Abbot curve, 21126 engine.

R_{pk}=0.43 mkm; R_k=0.67 mkm ; R_{vk}=1.39 mkm; Ra=0.38 mkm

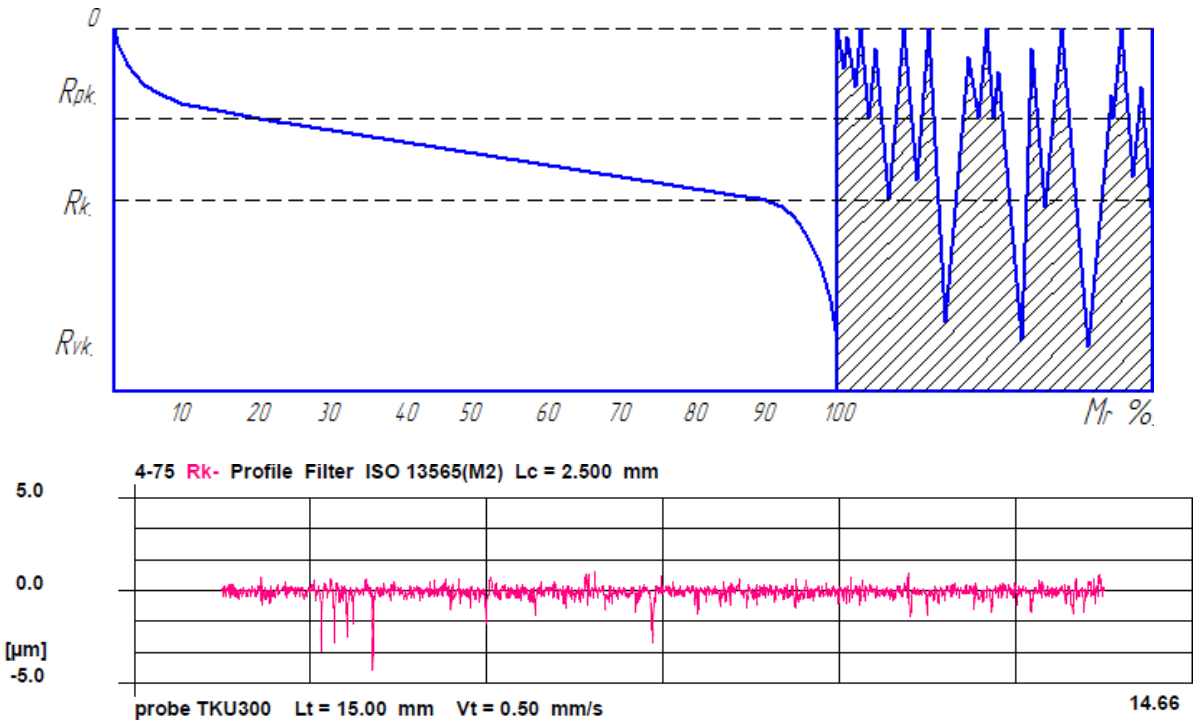

Fig. 3. Abbot curve, Audi engine.

Rpk=0.31 mkm Rk=0.56 mkm, Rvk=0.67 mkm, Ra=0.22 mkm

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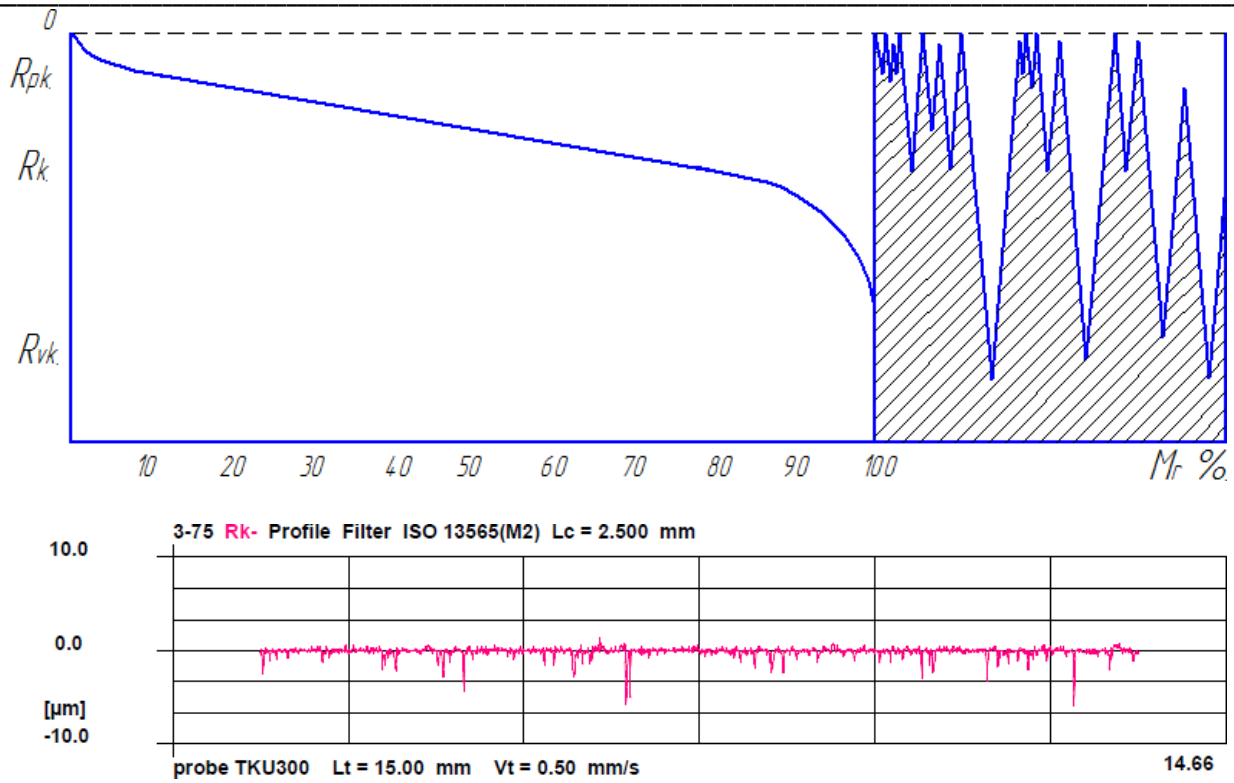

Fig. 4. Abbot curve, Nisan engine.
R_{pk}=0.27 mkm; R_k=0.58 mkm; R_{vk}=1.27 mkm; Ra=0.30 mkm

Three global manufacturers of honing tools, i.e. DELAPENA, ROTTLER, NAGEL are considered. During the experiment, it was determined that the most effective tool is by the manufacturer DELAPENA. According to the quality assessment, we found the minimal roughness from a series of experiments. Due to its fine grain and bond, this manufacturer has received good results.

The experiments were carried out in the laboratory on a HOMMELWERKE measuring instrument. It should be noted that the volume of retaining oil is significantly larger with the manufacturer NAGEL. Of the three manufacturers, NAGEL is the most rational. Since the tool along the Abbott curve got good results, and besides, the tool is not expensive.

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