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SUAI State University of Aerospace Instrumentation

Science & Technology City Hall

«Metrological Support of Innovative Technologies» ICMSIT-2020

«Assessment of the influence of measurement error on the quality of selective assembly»

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Problem statement

The purpose of the research is to study the degree of influence of measurement error on the scattering area of the dimensions of cylinder liners during processing and control during group interchangeability, the formation of the number of incorrectly received and incorrectly rejected parts, as well as determining the probabilistic value of the output for each tolerance border for incorrectly accepted sizes liners.

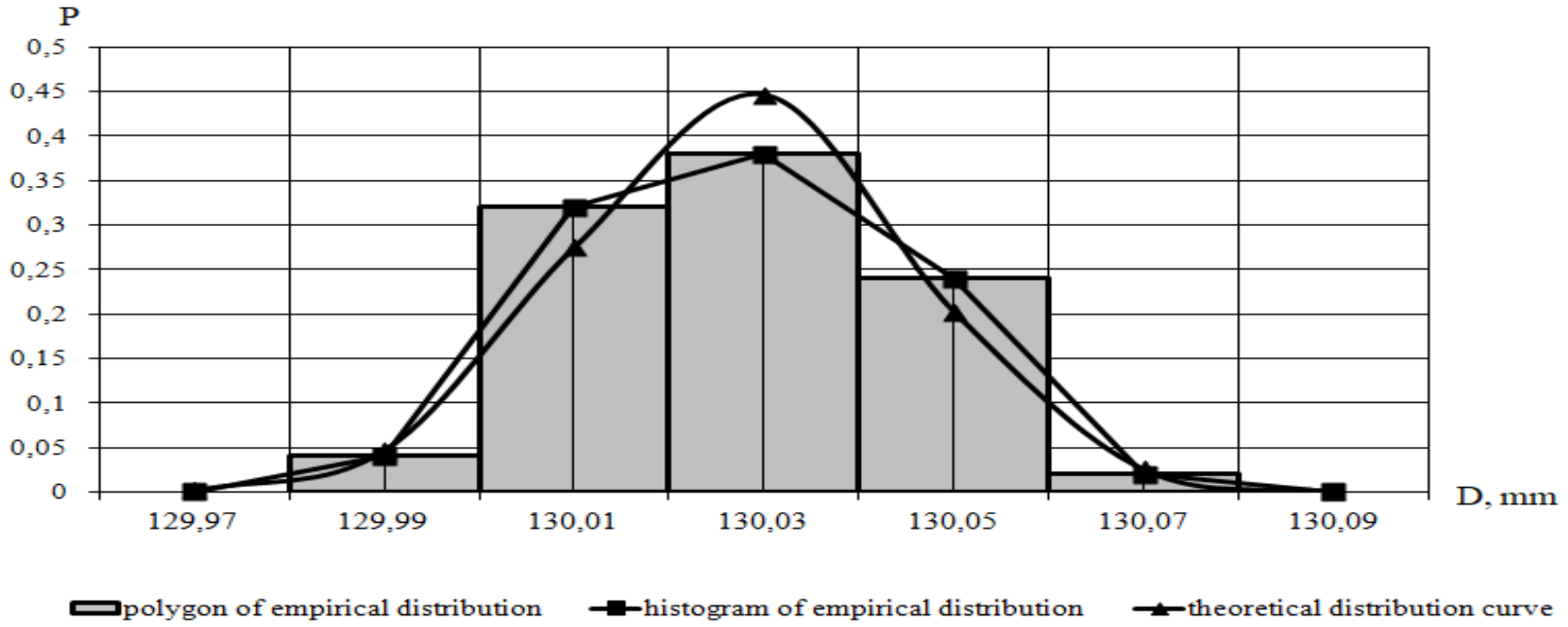
Solution methods

- To analyze the formation of scattering of the diameters of the sleeves in the control process in order to ensure group interchangeability of sleeves with pistons, the following measuring instruments were selected:
- - internal dial with a division value of the reading device of 0.001 mm when configured according stack of gage blocks 1 Δlim1 = ± 6.5 μm (denoted by MI1);
- - internal dial with a division value of the reading device 0.001 mm when setting on mounting rings Δlim2 = ± 4 μm (denoted by MI2).
- The diameters of the cylinder liners were controlled in two mutually perpendicular planes and in cross-section and longitudinal section. The average size was determined, which can be taken as the actual diameter.
- The determination of the number of incorrectly rejected parts from the number of suitable, the number of incorrectly received parts from the number of accepted, the maximum size over the border of the tolerance field was carried out according

Scattering of cylinder liners by selection groups

Selection group	Size, mm	Number of details	Theoretical probability
Rework material	Less 110.00	2	0.046
Group M	$110^{+0,02}$	16	0.278
Group C	$110^{+0,04}_{+0,02}$	19	0.445
Group B	$110^{+0,06}_{+0,04}$	12	0.201
Waste	More 110.06	1	0.027

Scattering of diameters of the bore of the cylinder liners of the engine MMZ



Parameters for sorting cylinder liners when using an internal dial with different measurement errors

The distance from the middle of the tolerance field to the border of the corresponding group 2t, mm	Number of incorrectly rejected parts, n,%		Number of incorrectly accepted parts, m, %		The value of the output of the measured parameter beyond the tolerance limit, c, μm	
	MI1	MI2	MI1	MI2	MI1	MI2
0.0152	7.6	5.2	7.7	4.9	2.28	1.75
0.0248	4.7	2.8	4.1	2.9	2.85	1.49
0.0552	1.9	1.2	1.3	0.4	2.07	1.93
0.0648	0.4	0.4	0.2	0.2	1.56	1.36
Amount	14.6	9.6	13.2	8.4	-	-

Conclusions

When choosing measuring instruments for monitoring the quality of processing cylinder liners in a single, small-scale and repair production, the most accurate should be used from the proposed range of universal linear measuring instruments. In this example, this is an internal dial with a division value of the reading device of 0.001 mm when tuning by the installation rings, while the measurement error will be the smallest: $\Delta lim_2 = \pm 4$ µm. If it will be possible to replace this measuring instrument with a more accurate one from the category of universal ones, then this must be done. Reducing the error of measuring instruments leads to a significant reduction in the number of incorrectly admitted to the group and incorrectly left the group or rejected parts. This, in turn, affects not only the quality of the subsequent assembly of the connection, but also the economy of the enterprise.

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