TO THE QUESTIONS OF ULTRASONIC TESTING OF BIMETALLIC MATERIALS (TYPE "STEEL - BABBIT")

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Abstract: The possibility to discover the units of roughness at the boundary of bimetallic material "steel – babbit" with the usage of ultrasonic echo technique, while testing the steel part of the material.

Introduction: Friction bearings of different types are able to function in conditions characterized by the quantity of loading, the average circumferential speed, the number of revolutions and the working temperature (up to 1000˚C).

The reasons of lay-up are usually connected with the insert's body destruction, and also with its peeling off the steel basis (the latter is defining) and determined by the bearing production technology, the conditions of its assembling and the conditions of exploitation. That is why the certification of insert's material fitness and its junctions with the steel basis in the process of the bearing's production and exploitation are considered to be an important condition to guarantee its proper work without any hitch.

The most successive way of diagnostics is to use nondestructive testing techniques. Side by side with the others (penetrating substances testing, radiographical method, acoustic emission technique, etc.) ultrasonic technique is preferable according to some of its advantages.

In practice this technique is used for testing from the inserts' side. This very circumstance brings a number of problems (usage of special adapters for ultrasonic electric transformer; sufficient ultrasound attenuation size in casting; casting defects, decreasing the testing objectivity degree; etc.), the most essential of which is incapability of the bearing's diagnostics in the process of exploitation without its disassembling. Taking in some cases into consideration the access limitation, the usage of ultrasonic testing from the bearing's steel basis side of the pack has a practical meaning.

The only problem in using this testing from the bearing's steel pack is the fact of sufficient reverberation of ultrasonic waves from the boundary "basis – insert" on account of considerable difference in wave resistances of the mentioned materials.

Results: Calculations show that these characteristics for steel and babbit (label B83) are 45.9 MPa*s/м и 23.6 MPa*s/м correspondingly, and longitudinal waves'
reflectance from the boundary "steel – babbit" on account of the waves' fall from the steel side is 0.32.

The given circumstance foresees the determination of minimum essential change of the echo signal amplitude from the boundary with the unit of roughness (violation of cohesion) on it with reference to the echo signal from the qualified boundary (supporting echo signal). The size of such a change can be defined experimentally with the help of some artificial reflectors in specially produced or visual (segments of the bearings of different size) referential samples.

Objectivity of the supporting signal size determination, and its change on account of the violation of roughlessness on the boundary is defined by means of technical characteristics of the used defectoscope.

The aim of this report was the comparison of calculated and experimental sizings of amplitudes' exceeding of the given echo signals.

Discussion: At the calculation of echo signals correlation the following units were used: frequencies – 1.25 MHz, 1.8 MHz, 2.5 MHz и 5 MHz; diameters of plates' sensing devices – 6, 12 and 20 mm; ultrasonic sound's speed in steel – 5.92 km/s; steel thickness – from 65 up to 150 mm; reflectance from the boundary "steel – babbit" – 0.32; diameters of the flat-bottomed reflectors – 2, 3, 5, 8, 10, 12 and 20 mm; formulae for amplitudes' calculation of the echo signals from the surface and the defects – according to [1].

On evaluating the results of calculation the following characteristics of the russian defectoscope UD2 – 102 were taken into consideration: the limit of the accessible absolute error of measuring the correlation of signals' amplitudes from the defects; discontinuity of the amplitude's size measuring - ±1 dB и 1dB correspondingly.

The criterion of determination the possibility to discover the reflector with minimal diameter is the exceeding of the echo signal from the flat-bottomed reflector over the supporting signal not less than at 2 dB.

As means of references the cylindrical samples with diameter of 200-300 mm were used. Babbit layer thickness (label B83, casting) was 15 mm in all cases. Steel layer thickness – 65, 100 and 150 mm. Flat-bottomed openings were situated near the boundary by the steel side (not more than 2 mm). Scanning was made on the flat steel surface of the sample.

Equipment: russian defectoscope UD2-102 "Peleng"; sensing devices – russian ones; frequencies and diameters of plates are mentioned above.

Conclusions: Experimental data confirm the results of calculations. These data concern the exceeding of the echo signal from the flat-bottomed reflector over the supporting signal from the boundary, where the minimum revealed diameter of the flat-bottomed opening is not less than 5 mm.

References: 1] Yermolov I.N. Ultrasonic testing: brief reference book. – Moscow, CNIITMASH, 1992 – 86 p.