1.3.80. MODERNIZED REFERENCE INSTALLATION FOR MEASURING AND REPRODUCTION OF AMPLITUDE OF ULTRASONIC OSCILLATIONS OF SOLID BODY SURFACE AND ELECTROACOUSTIC TRANSFORMATION COEFFICIENT

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Special requirements are imposed on the level of metrological support of acoustic measurement means and methods. It is due to the leading positions of these methods [1] among ones used in non-destructive testing, as well as to specificity of their application: most of test objects are referred to the category of hazardous production facilities amounting in our country, under data of Rostekhnadzor of Russia, to about 250 thousands [2]. Moreover, approximately 100 millions of people (about 70% of the country's population) live in zones with direct threat to human life and health in the result of occurrence of technogenic accidents and catastrophes. On the other hand, more than hundred thousand units of ultrasonic (US) probes, equipment, diagnostic and monitoring means is used in country and these products are demanded at the market.

These considerations, in their turn, dictate the necessity of higher level for metrological support (MS) in measurements of this type. Not only trustworthiness of testing results, products and performed works quality, but operational safety of facilities, environmental security and, eventually, human security depend on this level.

Creation of reference installation for measuring and reproduction of amplitude of ultrasonic oscillations of solid body surface and electroacoustic transformation coefficient based on hardware components of new generation and principles of laser interferometry represents namely one of specific measures allowing the MS level of acoustic measurement means and methods to be increased significantly. Amplitude-frequency response (AFR) of the electroacoustic transformation coefficient and threshold sensitivity to the minimal detected acoustic signal (in the limit, its value amounts about to $1 \cdot 10^{-16}$ m, which is close to the level of thermal noises of as solid body [3]) are ones of the most important characteristics of acoustic (ultrasonic) measuring means and their receive paths.

Measuring base of the Far East branch of the FGUP "VNIIFTRI", modern software-hardware measuring means, as well as scientific and technical materials on this subject became the sources for development ([3], [4] and others).

Method of comparison of the amplitude value of ultrasonic (US) displacement of surface particles of a solid body with the laser irradiance wavelength by means of laser interferometer is taken as a basis of work on creation of reference (standard) installation. Electroacoustic transformation coefficient is reproduced by laser interferometer including photo-receiving module.

Within the frames of works on creation of reference installation, the following is performed: operation algorithm for the created standard is developed; measuring scheme is optimized; basing on hardware components of new generation and principles of laser interferometry, individual units of measuring complex of initial installation forming the part of the created standard are modernized; main unit of the reference installation (two-beam laser inreferometer with concentrated optical circuit) and modules (photo-receiver, piezoelectric drive, etc.) are developed (structurally, in the form of single module) [5].

Expected main metrological characteristics of the reference installation:

– range of values of the US displacement amplitude, m …… $5 \cdot 10^{-11} – 5 \cdot 10^{-10}$;
– range of values of the electroacoustic transformation coefficient, m/V.. $5 \cdot 10^{-11} – 5 \cdot 10^{-10}$;
– mean-square deviation and residual bias, respectively ……..…….…. $5 \cdot 10^{-3}$ and $1 \cdot 10^{-2}$.

Creation of reference installation for measuring and reproduction of amplitude of ultrasonic oscillations of solid body surface and electroacoustic transformation coefficient provides in its field technical bases at the highest level of accuracy for metrological support of acoustic measuring means and methods.

Scientific and technical basis behind operation of the reference installation allows, in principle, its application as a means of highest accuracy during studying of various processes, and methods (experimental evaluation of reciprocity method; metrological support at the highest level of accuracy in the field of phase measurements, etc.); tests of developed US means and ones in service, including for compliance with general requirements to safety under admissible value of ultrasonic displacements on their contact surfaces.

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