

4.5.4. ORIGINAL INSTALLATION FOR COMPLEX MEASUREMENT OF ACOUSTIC PARAMETERS IN CONDENSED MEDIA

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Attenuation factor α_L and propagation speed of longitudinal C_L and shear C_S ultrasonic (US) waves are the important informative parameters in US non-destructive testing materials and products. The accuracy and reliability of measurements of these physical quantities, metrological verification of acoustic measurements in solid media are very actual questions.

Reference installations of immersion type for measuring the speed of propagation and attenuation of US waves in metals (models IWA, UISU, ALPHA) do not meet modern requirements because of high measurement errors, and they are designed to measure only one parameter (α_L or C_L). An essential point in estimating a systematic component of uncertainty in measurements by the immersion method is the influence on the result of measurements at the border section of the liquid-solid medium.

In the Far Eastern Branch of VNIIFTRI there has been developed an installation MAI-1 and approved as the working standard of 2-nd echelon (according to the State Verification System in conformity with Metrology Instructions MI 2055-90 and MI 2163-91). The installation is designed to measure the attenuation factor α_L in the range of (0.2–2000) dB/m and propagation speed C_L of longitudinal US waves in the range of (2000–15000) m/s in solid media in the of frequency band of (1–100) MHz and to transmit the sizes of these units to the measuring means. An error of measurement of attenuation factor of longitudinal US waves is $\leq 10\%$. The installation also allows to measure the group speed of shear wave propagation C_S . In the installation MAI-1 non-contact capacitance methods of generation and reception of US vibrations are implemented on the basis of capacitive transducer with thin-film oxide dielectric.

The main advantages of the installation are:

- Complex measurement of parameters of US wave propagation α_L , C_L , C_S ;
- Use of non-contact methods of generation and reception of US waves eliminating the use of immersion liquids, and, thereby eliminating distortions of amplitude-phase characteristics of US pulses and losses of acoustic energy in passing through the border section of liquid-solid medium, which reduces the systematic error component;
- Elimination of necessity for recustomizing the radiator and the receiver in the full range of working frequencies for measurement.

The major areas of MAI-1 application are precision acoustic measurements in solid media, determination of elastic heterogeneity of the material of a sample, checking and certification of standard samples by attenuation factor of longitudinal US vibrations and on propagation speed of longitudinal and shear acoustic waves.