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# Non-destructive evaluation of stressed states of solids with the help of acoustoelastic effect

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The essence of the acoustoelastic phenomenon is the dependence between elastic wave velocity and mechanical stress (strain) value in solids. The cause of such a dependence existence is the solid medium non-linearity. Experimentally the acoustoelastic effect was revealed by Benson and Raelson in 1959 [2]. Since this time, the developing of the non-destructive methods of the elastic stresses evaluation have it's beginning. However, some essential problems of possibility and precision of those measurements are not neglected to next years. For example, the velocity is not a directly measuring value: to determine the velocity is to measure length and time. But length varying with the strain <stress> varying.

Here the acoustoelastic effect realisation based on using the bulk (longitudinal and shear) waves propagated normally to the plane of stresses acting is proposed. In order to investigate in-plane residual stressed state shear waves of ultrasonic frequency can be used rathereffectively. Longitudinal waves are used in addition to shearwaves in order to neglect the variations of material's thickness due to deformation during the stress acting. Directions of in-plane principal stresses, which are not so evident at first sight, can be founded with the help of shear wave transducer rotating.

The values of two-axial (or, in a simplest case – uniaxial) residual stresses are determined on the base of time-of-flight measuring corresponding to shear and longitudinal wave packets propagation in stressed material. Special piezoelectric transducers are used for generating and receiving of ultrasonic pulse of smooth envelope and main frequency equal to 2-10 MHz. The pulse-echo-method provides testing of details which have only one free surface. Time-of-flight measuring with relative error equal to 0.005% is provided for bulk wave packets. The results of residual stresses practical evaluation are presented.

The constructive elements producted from engineering alloys were exposed to thermo- or vibrostabilization after working. The acoustoelastic measurements of residul stresses decreasing show the efficiency of vibrostabilization in relation to termal working apart from it's cheapness.