

TECHNIQUE AND EQUIPMENT FOR EXPRESS FORECASTING OF MATERIALS FATIGUE CHARACTERISTICS

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Design of high-reliability structures operating under vibration involves both the development of new construction materials and more precise fatigue characteristics to be used in strength calculations.

Low-frequency fatigue tests involve considerable material costs. To reduce the labour intensity of tests under high cycling (10^8 - 10^{10}) it is very promising to apply high (sonic and ultrasonic) frequencies of cycling which permit the operating time of a set number of load cycles and define the mechanisms of the effect which deformation frequency has on the materials fatigue life.

With different cyclic strength values obtained under various frequencies, the relationships have been determined between fatigue life parameters and a number of structure-sensitive properties of materials. These relationships are based on an integrated research of kinetics of physical-mechanical characteristics under alternate stress of a broad amplitude-frequency range.

A unified physical character of fatigue under high and low frequencies has been proved including the fatigue under complex stress. This has formed a basis for the development of a physical model demonstrating the impact of vibration frequency on critical stresses at the initial stage of fatigue development. This model permitted to scientifically prove the technique of express fatigue tests.

Experimental testing of the technique for express forecasting of low-frequency fatigue was based on the results of high-frequency tests of an extended construction materials range. The testing revealed the possibility to multiply reduce duration, labour and energy intensity of determining fatigue characteristics without any inaccuracy of forecast.

Landmark instrumentation-equipped testing complexes have been designed and protected by inventor's certificates. These complexes make it possible to generate intensive bending, longitudinal and torsional symmetric- and asymmetric-cycle vibrations with a high frequency range (0.15-44.0 kHz) as well as to automatically maintain a stable operating mode aided by electronic devices and allowing fatigue tests to be carried out under constant cyclic stresses.

A wide range of metal construction materials have been experimentally tested under various frequencies and mechanical vibrations of both symmetric and asymmetric cycles under an extended temperature range.