

International Standard



6721

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Plastics — Determination of damping properties and complex modulus by bending vibration

Plastiques — Détermination des propriétés d'amortissement et du module complexe, au moyen de vibration en flexion

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6721 was developed by Technical Committee ISO/TC 61, *Plastics*, and was circulated to the member bodies in May 1982.

It has been approved by the member bodies of the following countries:

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United Kingdom

Plastics — Determination of damping properties and complex modulus by bending vibration

1 Scope and field of application

This International Standard specifies a bending vibration method for determining the damping properties and complex modulus of homogeneous and laminated plastics especially intended for acoustical insulation, for example systems of sheet metal coated with a damping plastic layer or sandwich systems consisting of two sheet metal layers with an intermediate plastic layer.[†]

For many purposes it is useful to determine these properties as functions of the temperature.

Other methods for the determination of damping properties are described in ISO 537 and ISO 2856.

2 References

ISO 537, *Plastics — Testing with the torsion pendulum*.

ISO 2856, *Elastomers — General requirements for dynamic testing*.

3 Definitions

3.1 complex modulus, $E^* = E' + iE''$: The stress-strain ratio of a viscoelastic material that is subjected to sinusoidal loading (circular frequency $\omega = 2\pi f$). The definition of E^* takes into account the phase shift between stress and strain.

3.2 storage modulus, E' : The real part of the complex modulus; it can be considered as a measure of the energy stored and regained during a loading cycle.

3.3 loss modulus, E'' : The imaginary part of the complex modulus; it can be considered as a measure of the energy lost (dissipated) during a loading cycle.

3.4 loss factor, d ; loss tangent, $\tan \delta$: The tangent of the phase angle δ between stress and strain; it is given by the quotient $\tan \delta = E''/E'$. Commonly $d = \tan \delta$ is used as a measure of the damping of a system subject to forced vibrations.

3.5 resonance curve: Curve giving the frequency dependence of the amplitude of a damped system subjected to forced vibrations.

3.6 resonance frequency, $f_R = f_{\max}$: The frequency of the maximum amplitude of the resonance curve; f_R is proportional to the square root of the storage modulus E' of a viscoelastic system.

3.7 half-width of the resonance curve, Δf : Quantity measured at the amplitudes $A = (1/\sqrt{2})A_R = 0,707 A_R$ of the resonance curve, where A_R is the resonance amplitude. Δf is related to the loss factor d by the equation $d = \Delta f/f_R$.

4 Principle

The test is performed on bars or strips which are either vertically arranged, one end being clamped and the other end being free, or are supported horizontally by thin threads in two vibration nodes. The specimen is submitted to forced vibrations in a frequency range between about 100 and 1 000 Hz. From the resonance curve (see 3.5) determined by this test, the storage modulus E' (see 3.2) is calculated in the range of about 5×10^{-1} to 2×10^5 MPa and the loss factor d (see 3.4) in the range of about 1×10^{-2} to 1×10^{-1} .

5 Apparatus

5.1 Calibrated instruments, for measuring dimensions and density.

5.2 Clamping or supporting device, for the specimen.

5.3 Two electromechanical transducers, one for excitation of the vibrations and one for reception of the vibrations.

[†] For supplementary information on this subject, see:

OBERST, H. and FRANKENFELD, K. *Acustica* 2 1952: AB 181.

SCHWARZL, F. *Acustica* 8 1958: 164.

OBERST, H. *Phil. Trans. R. Soc. London Ser. A* 263 1968: 441.