INTERNATIONAL STANDARD

ISO 18437-5

First edition
2011-04-15

Mechanical vibration and shock — Characterization of the dynamic mechanical properties of visco-elastic materials —

Part 5: **Poisson ratio based on comparison between measurements and finite element analysis**

Vibrations et chocs mécaniques — Caractérisation des propriétés mécaniques dynamiques des matériaux visco-élastiques —

Partie 5: Nombre de Poisson obtenu par comparaison entre les mesures et l'analyse par éléments finis

Reference number
ISO 18437-5:2011(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18437-5 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*.

ISO 18437 consists of the following parts, under the general title *Mechanical vibration and shock — Characterization of the dynamic mechanical properties of visco-elastic materials*:

— *Part 2: Resonance method*

— *Part 3: Cantilever shear beam method*

— *Part 4: Dynamic stiffness method*

— *Part 5: Poisson ratio based on comparison between measurements and finite element analysis*

The following part is under preparation:

— *Part 1: Principles and guidelines*

Introduction

Visco-elastic materials are used extensively to reduce vibrations in structural systems through dissipation of energy (damping) or isolation of components and noise levels in acoustical applications through modification of reflection, transmission, or absorption of acoustic energy. It is often required to have specific dynamic mechanical properties in order for such materials to function in an optimum manner. Energy dissipation is due to interactions on the molecular scale and can be measured in terms of the lag between stress and strain in the material. The dynamic mechanical properties, such as Young modulus, loss factor and Poisson ratio, of most visco-elastic materials depend on frequency, temperature, pre-strain and strain amplitude. The choice of a specific material for a given application determines the system performance. The goal of this part of ISO 18437 is to provide brief descriptions of several methods, the details in construction of each apparatus, measurement range, and the limitations of each apparatus. This part of ISO 18437 applies to the linear behaviour observed at small strain amplitudes.

Mechanical vibration and shock — Characterization of the dynamic mechanical properties of visco-elastic materials —

Part 5: **Poisson ratio based on comparison between measurements and finite element analysis**

1 Scope

This part of ISO 18437 specifies two methods for estimating Poisson ratio or/and elastic modulus for isotropic visco-elastic or porous-elastic materials for use in linear finite element method (FEM) computer programs or other numerical approaches to vibrational or acoustic problems in visco-elastic structures of complicated geometry. The method is based on comparison between measurements of force-deflection or stiffness characteristics for disc-shaped specimens, with bonded boundary conditions at both ends, and FEM calculations of those conditions as a function of Poisson ratio. The choice of the single-sample or two-sample measurement method depends on whether the Poisson ratio is to be determined alone or together with the elastic modulus. Sometimes these materials are considered to be incompressible and behave non-linearly especially in large static deformations. Many commercial codes are available to solve such problems. This is not the case in this part of ISO 18437, where only small deformations observed in typical vibration problems are considered and, hence, linear FEM codes are adequate and more convenient.

For the purposes of this part of ISO 18437, and within the framework of ISO/TC 108, the term dynamic mechanical properties refers to the determination of the fundamental elastic properties, e.g. the complex Young modulus and Poisson ratio, as a function of temperature and frequency.

This part of ISO 18437 is applicable to resilient materials that are used in vibration isolators in order to reduce:

a) transmission of audio frequency vibrations to a structure, e.g. radiating fluid-borne sound (airborne, structure-borne, or other);

b) transmission of low-frequency vibrations which can, for example, act upon humans or cause damage to structures or equipment when the vibration is too severe.

The data obtained with the measurement methods that are outlined in this part of ISO 18437 and further detailed in ISO 18437-2 to ISO 18437-4 can be used for:

— design of efficient vibration isolators;

— selection of an optimum resilient material for a given design;

— theoretical computation of the transfer of vibrations through isolators;

— information during product development;

— product information provided by manufacturers and suppliers;

— quality control.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 472, *Plastics — Vocabulary*

ISO 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

ISO 4664-1, *Rubber, vulcanized or thermoplastic — Determination of dynamic properties — Part 1: General guidance*

ISO 6721-1, *Plastics — Determination of dynamic mechanical properties — Part 1: General principles*

ISO 10846-1, *Acoustics and vibration — Laboratory measurement of vibro-acoustic transfer properties of resilient elements — Part 1: Principles and guidelines*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 2041, ISO 4664-1, ISO 6721-1, ISO 10846-1, and ISO 23529 and the following apply.

3.1
dynamic mechanical properties
fundamental elastic properties of a visco-elastic material, i.e. elastic modulus, shear modulus, bulk modulus and loss factor

3.2
resilient material
visco-elastic material intended to reduce the transmission of vibration, shock or noise

3.3
Young modulus
quotient of normal stress (tensile or compressive) to resulting normal strain or fractional change in length for a long specimen of resilient material

NOTE 1 The Young modulus is expressed in pascals.

NOTE 2 The Young modulus for visco-elastic materials which are isotropic is a complex quantity with symbol E^*, having a real part E' and an imaginary part E''.

NOTE 3 Physically, the real component of the Young modulus is related to the stored mechanical energy. The imaginary component is a measure of mechanical energy loss.

3.4
loss factor
ratio of the imaginary part of the Young modulus of a material to the real part of the Young modulus (the tangent of the argument of the complex Young modulus)

NOTE When there is energy loss in a material, the strain lags the stress by a phase angle, δ. The loss factor is equal to tan δ.

[ISO 18437-2, 3.2]

