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Standard Test Method for Measuring Vibration-Damping Properties of Materials[1]

This standard is issued under the fixed designation E 756; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method measures the vibration-damping properties of materials: the loss factor, η, and Young's modulus, E, or the shear modulus, G. Accurate over a frequency range of 50 to 5000 Hz and over the useful temperature range of the material, this method is useful in testing materials that have application in structural vibration, building acoustics, and the control of audible noise. Such materials include metals, enamels, ceramics, rubbers, plastics, reinforced epoxy matrices, and woods that can be formed to cantilever beam test specimen configurations.

1.2 *This standard does not purport to address all the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standard:*[2]

E 548 Guide for General Criteria Used for Evaluating Laboratory Competence

2.2 *ANSI Standard:*

S2.9 Nomenclature for Specifying Damping Properties of Materials[3]

3. Terminology

3.1 *Definitions*—Except for the terms listed below, ANSI S2.9 defines the terms used in this test method.

3.1.1 *free-layer (extensional) damper*—a treatment to control the vibration of a structural by bonding a layer of damping material to the structure's surface so that energy is dissipated through cyclic deformation of the damping material, primarily in tension-compression.

3.1.2 *constrained-layer (shear) damper*—a treatment to control the vibration of a structure by bonding a layer of damping material between the structure's surface and an additional elastic layer (that is, the constraining layer), whose relative stiffness is greater than that of the damping material, so that energy is dissipated through cyclic deformation of the damping material, primarily in shear.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *glassy region of a damping material*—a temperature region where a damping material is characterized by a relatively high modulus and a loss factor that increases from extremely low to moderate as temperature increases (see Fig. 1).

3.2.2 *rubbery region of a damping material*—a temperature region where a damping material is characterized by a relatively low modulus and a loss factor that decreases from moderate to low as temperature increases (see Fig. 1).

3.2.3 *transition region of a damping material*—a temperature region between the glassy region and the rubbery region where a damping material is characterized by the loss factor passing through a maximum and the modulus rapidly decreasing as temperature increases (see Fig. 1).

3.3 *Symbols*—The symbols used in the development of the equations in this method are as follows (other symbols will be introduced and defined more conveniently in the text):

E = Young's modulus of uniform beam, Pa
η = loss factor of uniform beam, dimensionless
E_1 = Young's modulus of damping material, Pa
η_1 = loss factor of damping material, dimensionless
G_1 = shear modulus of damping material, Pa

4. Summary of Method

4.1 The configuration of the cantilever beam test specimen is selected based on the type of damping material to be tested and the damping properties that are desired. Fig. 2 shows four different test specimens used to investigate extensional and shear damping properties of materials over a broad range of modulus values.

[1] This test method is under the jurisdiction of ASTM Committee E33 on Environmental Acoustics and is the direct responsibility of Subcommittee E33.03 on Sound Transmission.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from America National Standards Institute, 1430 Broadway, New York, NY 10018.

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