Designation: C 522 – 87 (Reapproved 1997)

Standard Test Method for Airflow Resistance of Acoustical Materials[1]

This standard is issued under the fixed designation C 522; 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 covers the measurement of airflow resistance and the related measurements of specific airflow resistance and airflow resistivity of porous materials that can be used for the absorption and attenuation of sound. Materials cover a range from thick boards or blankets to thin mats, fabrics, papers, and screens. When the material is anisotropic, provision is made for measurements along different axes of the specimen.

1.2 This test method is designed for the measurement of values of specific airflow resistance ranging from 100 to 10 000 mks rayls (Pa·s/m) with linear airflow velocities ranging from 0.5 to 50 mm/s and pressure differences across the specimen ranging from 0.1 to 250 Pa. The upper limit of this range of linear airflow velocities is a point at which the airflow through most porous materials is in partial or complete transition from laminar to turbulent flow.

1.3 A procedure for accrediting a laboratory for the purposes of this test method is given in Annex A1.

1.4 *This standard does not purport to address all of 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 Standards:*

C 384 Test Method for Impedance and Absorption of Acoustical Materials by the Impedance Tube Method[2]

C 634 Terminology Relating to Environmental Acoustics[2]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of Test Methods[3]

3. Terminology

3.1 *Definitions:* The definitions used in this test method are contained in Terminology C 634.

3.2 *Definitions of Terms Specific to This Standard:* The following items have been modified to exclude alternating flow.

3.2.1 *airflow resistance, R;* mks acoustic ohm (Pa·s/m^3)—the quotient of the air pressure difference across a specimen divided by the volume velocity of airflow through the specimen.

3.2.2 *airflow resistivity,* r_0; mks rayl/m (Pa·s/m^2)— *of a homogeneous material*, the quotient of its specific airflow resistance divided by its thickness.

3.2.3 *lateral airflow resistivity— of an anisotropic homogeneous material*, the airflow resistivity when the direction of airflow is parallel to the face of the material from which the test specimen is taken.

3.2.4 *specific airflow resistance, r;* mks rayl (Pa·s/m)—the product of the airflow resistance of a specimen and its area. This is equivalent to the air pressure difference across the specimen divided by the linear velocity of airflow measured outside the specimen.

3.2.5 *transverse airflow resistivity— of an anisotropic homogeneous material*, the airflow resistivity when the direction of airflow is perpendicular to the face of the material from which the test specimen is taken.

3.3 *Application of Terms*:

3.3.1 The term *airflow resistance* can be applied to specimens of any kind.

3.3.2 The term *specific airflow resistance* has meaning only when applied to a specimen of uniform thickness that is homogeneous in directions parallel to its surface but not necessarily homogeneous in the direction of airflow perpendicular to its surface.

3.3.3 The term *airflow resistivity* has meaning only when applied to a specimen that is homogeneous in directions parallel to a and perpendicular to its surface but not necessarily isotropic.

3.4 *Symbols:*

3.4.1 P = air pressure difference across test specimen, Pa.

3.4.2 U = volume velocity of airflow through the specimen, m^3/s.

3.4.3 $u = U/S$ = linear velocity of airflow outside the specimen, m/s.

3.4.4 S = area of specimen, m.^{2}

3.4.5 T = thickness of specimen, m.

[1] This test method is under the jurisdiction of ASTM Committee E-33 on Environmental Acoustics and is the direct responsibility of Subcommittee E33.01 on Sound Absorption.

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[2] *Annual Book of ASTM Standards*, Vol 04.06.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

4. Summary of Test Method

4.1 This test method describes how to measure a steady flow of air through a test specimen, how to measure the air pressure difference across the specimen, and how to measure the volume velocity of airflow through the specimen. From the measurements may be calculated the airflow resistance, *R*, the specific airflow resistance, *r*, and the airflow resistivity, r_0.

5. Significance and Use

5.1 The specific airflow resistance of an acoustical material is one of the properties that determine its sound-absorptive and sound-transmitting properties. Measurement of specific airflow resistance is useful during product development, for quality control during manufacture, and for specification purposes.

5.2 Valid measurements are made only in the region of laminar airflow where, aside from random measurement errors, the airflow resistance ($R = P/U$) is constant. When the airflow is turbulent, the apparent airflow resistance increases with an increase of volume velocity and the term "airflow resistance" does not apply.

5.3 The specific airflow resistance measured by this test method may differ from the specific resistance measured by the impedance tube method in Test Method C 384 for two reasons. In the presence of sound, the particle velocity inside a porous material is alternating while in this test method, the velocity is constant and in one direction only. Also, the particle velocity inside a porous material is not the same as the linear velocity measured outside the specimen.

6. Apparatus

6.1 The apparatus, assembled as shown schematically in Fig. 1, consists of the following components:

6.1.1 *Air Supply*, a suction generator or positive air supply arranged to draw or force air at a uniform rate through the test specimen.

NOTE 1—It may be necessary to use a large surge tank or other means to reduce pressure fluctuations.

6.1.2 *Flowmeter*, to measure the volume velocity of airflow through the specimen. It is preferable to have two or more flowmeters with overlapping ranges to enable different airflow velocities to be measured to the same precision.

6.1.3 *Differential Pressure Measuring Device*, for measuring the static pressure difference between the faces of the specimen with respect to atmosphere.

NOTE 2—A slant manometer or pressure transducer system with a range from 0 to 250 Pa is usually satisfactory, but a second instrument with a smaller range, for example, 0 to 25 Pa, may be necessary for measuring small pressures to the desired precision.

6.1.4 *Specimen-Mounting Assembly*, consists essentially of a mounting plate and a specimen holder as shown in Fig. 2. The mounting plate has two holes for tube connections to the pressure measuring device and to the airflow supply. The specimen holder, which is sealed to the mounting plate, is preferably a transparent plastic tube at least 150 mm long with a diameter not less than 50 mm. For testing materials that will support themselves, such as disks cut from boards, a slight

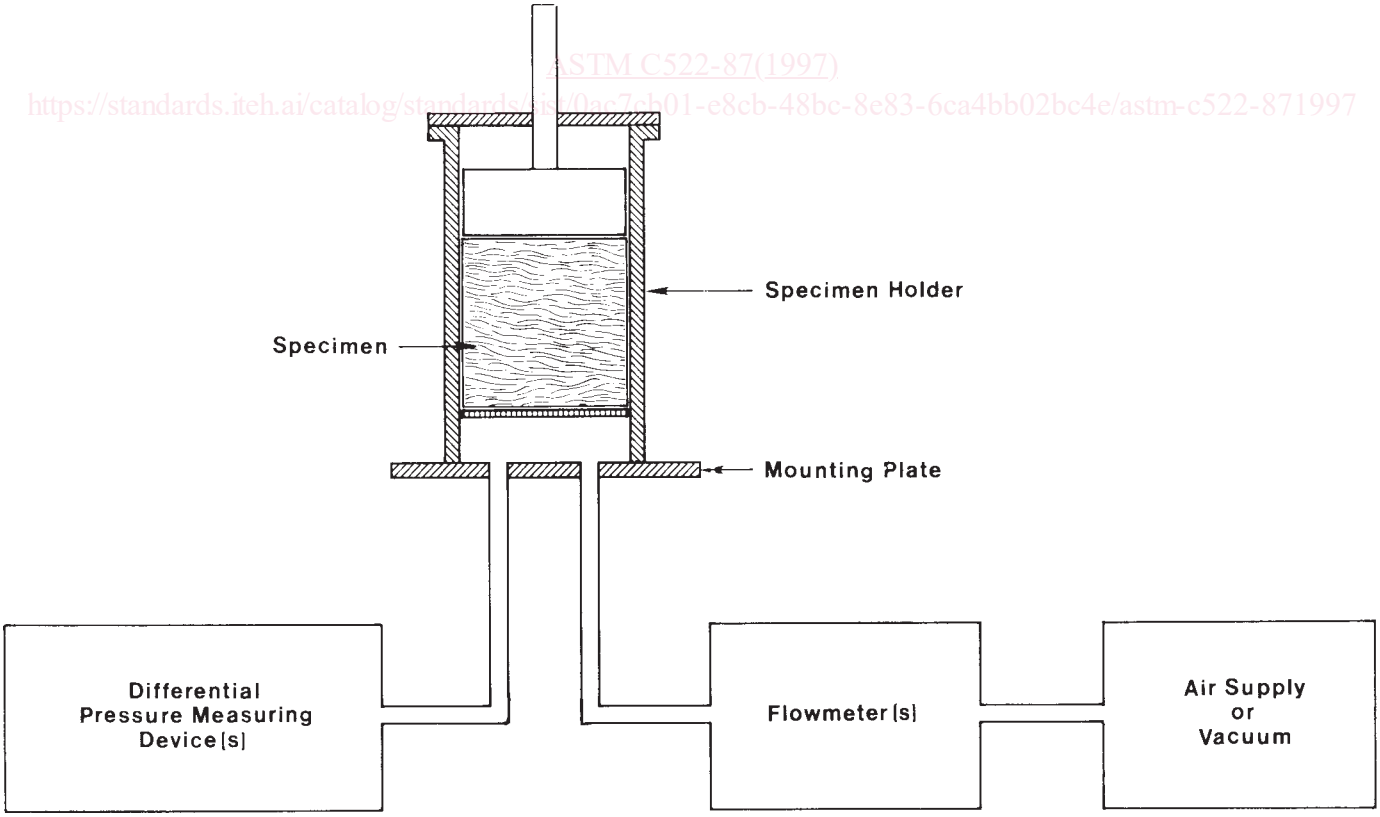

FIG. 1 Schematic Diagram of Airflow Apparatus