



Standard Test Method for Impedance and Absorption of Acoustical Materials by Impedance Tube Method¹

This standard is issued under the fixed designation C 384; 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 use of an impedance tube, alternatively called a standing wave apparatus, for the measurement of impedance ratios and the normal incidence sound absorption coefficients of acoustical materials.

1.2 *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.*

1.3 The values stated in SI units are to be regarded as the standard.

2. Referenced Documents

2.1 ASTM Standards:²

C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
C 634 Terminology Relating to Environmental Acoustics
E 548 Guide for General Criteria Used for Evaluating Laboratory Competence³

2.2 ANSI Standards:

S1.6 Preferred Frequencies and Band Numbers for Acoustical Measurements⁴

3. Terminology

3.1 The acoustical terminology used in this test method is intended to be consistent with the definitions in Terminology C 634. In particular, the terms “impedance ratio,” “normal incidence sound absorption coefficient,” and “specific normal

acoustic impedance,” appearing in the title and elsewhere in this test method refer to the following, respectively:

3.2 Definitions:

3.2.1 *impedance ratio*, $z/\rho c \equiv r/\rho c + jx/\rho c$; [dimensionless]—the ratio of the specific normal acoustic impedance at a surface to the characteristic impedance of the medium. The real and imaginary components are called, respectively, *resistance ratio* and *reactance ratio*. **C 634**

3.2.2 *normal incidence sound absorption coefficient*, α_n ; [dimensionless]—of a surface, at a specified frequency, the fraction of the perpendicularly incident sound power absorbed or otherwise not reflected. **C 634**

3.2.3 *specific normal acoustic impedance*, $z \equiv r + jx$; [$\text{ML}^{-2}\text{T}^{-1}$]; mks rayl (Pa s/m)—at a surface, the complex quotient obtained when the sound pressure averaged over the surface is divided by the component of the particle velocity normal to the surface. The real and imaginary components of the specific normal acoustic impedance are called, respectively, *specific normal acoustic resistance* and *specific normal acoustic reactance*. **C 634**

4. Summary of Test Method

4.1 A plane wave traveling in one direction down a tube is reflected back by the test specimen to produce a standing wave that can be explored with a microphone. The normal incidence sound absorption coefficient, α_n , is determined from the standing wave ratio at the face of the test specimen. To determine the impedance ratio, $z/\rho c$, a measurement of the position of the standing wave with reference to the face of the specimen is needed.

4.2 The normal incidence absorption coefficient and impedance ratio are functions of frequency. Measurements are made with pure tones at a number of frequencies chosen, unless there are compelling reasons to do otherwise, from those specified in ANSI S1.6.

5. Significance and Use

5.1 The acoustical impedance properties of a sound absorptive material are related to its physical properties, such as airflow resistance, porosity, elasticity, and density. As such, the

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

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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 Withdrawn.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

