



Standard Test Method for Impedance and Absorption of Acoustical Materials Using A Tube, Two Microphones and A Digital Frequency Analysis System¹

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1. Scope

1.1 This test method covers the use of an impedance tube, two microphone locations, and a digital frequency analysis system for the determination of normal incidence sound absorption coefficients and normal specific acoustic impedance ratios of materials.

1.2 *Laboratory Accreditation*—A procedure for accrediting a laboratory for performing this test method is given in Annex A1.

1.3 *This standard does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to consult and 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 Method²
- C 634 Terminology Relating to Environmental Acoustics²
- E 548 Guide for General Criteria Used for Evaluating Laboratory Competence³

2.2 ISO Standards:

- ISO 10534-1 Acoustics—Determination of Sound Absorption Coefficient and Impedance or Admittance—Part 1: Impedance Tube Method⁴
- ISO 10534-2 Acoustics—Determination of Sound Absorption Coefficient and Impedance in Impedance Tubes—Part 2: Transfer-Function Method⁴

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 Absorption.

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² Annual Book of ASTM Standards, Vol 04.06.

³ Annual Book of ASTM Standards, Vol 14.02.

⁴ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

3. Terminology

3.1 *Definitions*—The acoustical terminology used in this test method is intended to be consistent with the definitions in Terminology C 634.

NOTE 1—Historical literature regarding the measurement of normal incidence absorption coefficients referred to “transfer function” measurements; however, the term arises from Laplace transform theory and is not strictly rigorous when the initial conditions have a non-zero value. The term “frequency response function” arises from more general Fourier transform theory (1).⁵ This test method shall retain the use of the former term although not technically correct. Users should be aware that modern FFT analyzers may employ the latter terminology.

3.2 *Symbols*: The following symbols are used in Section 8 (Procedure):

- 3.2.1 b_{pc} —normal specific acoustics susceptance ratio.
- 3.2.2 c —speed of sound, m/s.
- 3.2.3 g_{pc} —normal specific acoustic conductance ratio.
- 3.2.4 G_{11} , G_{22} —auto power spectra of the acoustic pressure signal at microphone locations 1 and 2, respectively.
- 3.2.5 G_{12} —cross power spectrum of the acoustic pressure signals at microphones locations 1 and 2.
- 3.2.6 H —transfer function of the two microphone signals corrected for microphone response mismatch.
- 3.2.7 $\bar{H}$ —measured transfer function of the two microphone signals.
- 3.2.8 H^I , H^{II} —calibration transfer functions for the microphones in the standard and switched configurations, respectively.
- 3.2.9 $\bar{H}_c$ —complex microphone calibration factor.
- 3.2.10 j —equals $\sqrt{-1}$.
- 3.2.11 k —equal $2\pi f/c$; wave number, m^{-1} .
- 3.2.11.1 *Discussion*—In general the wave number is complex where $k = k' - jk''$. k' is the real component, $2\pi f/c$ and k'' is the imaginary component of the wave number, also referred to as the attenuation constant, Nepers- m^{-1} .

⁵ The boldface numbers in parentheses refer to the list of references at the end of this test method.