m+p Impedance Tube Solution

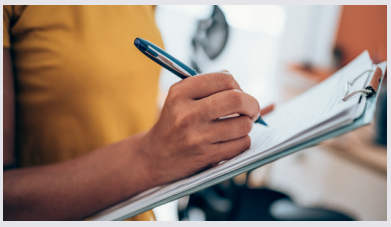
Identify Sound Characteristics of Materials

Sound quality is a key factor for product success. The impedance tube testing of acoustic materials with m+p Analyzer enables to enhance the perceived acoustics of a product. Compliant with relevant industry standards, this acoustic material testing is conducted under controlled conditions, allowing engineers to assess critical characteristics of sound-absorbing materials and improve their product designs.

The intuitive interface guides users through all necessary steps, ensuring reproducible and reliable results. m+p international's comprehensive impedance tube solution includes configurable setups, data acquisition hardware and processing. It provides detailed insights into the material's sound characteristics according to international standards.

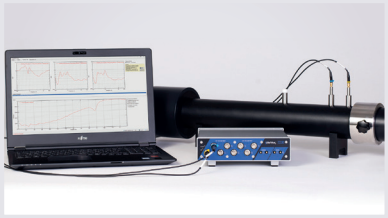
Measure all Relevant Material Sound Characteristics:

- Sound absorption
- Sound reflection
- Acoustic impedance
- Sound transmission coefficient and loss



Assure Standard Compliant Measurements:

- ISO 10534-2
- ASTM 1050-12
- ASTM 2611-17



Start Measuring with a Turnkey Solution, including:

- Impedance tube
- Power amplifier
- Microphones
- Measurement hardware
- m+p Analyzer software

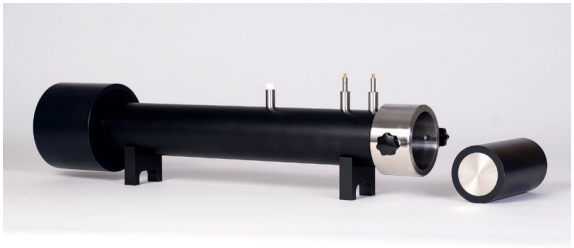
Key Benefits

m+p international's turnkey impedance tube solution provides a competitive edge in characterizing acoustic material properties. With this integrated system, you can efficiently achieve high-quality results. Seamlessly navigate through the entire workflow within a single, intuitive user interface, from setup to result reporting.

- Compliant with all industry standards, covering all relevant material sound characteristics
- Turnkey solution and expert support
- Calibration and automatic correction functions to ensure high data quality
- Upgrade options to enable you for other acoustic and vibration applications using the same system
- Proven performance and product evolution for long-term reduced cost of ownership

Impedance Tube Setups

An impedance tube consists of a cylindrical metal tube with a loudspeaker on one end and a specimen holder on the opposite end. Behind the specimen, the tube is terminated by either a solid metal plug (two-microphone setup) or an extension tube with anechoic termination (four-microphone setup). In either case, the sound waves generated by the loudspeaker travel through the tube towards the specimen where they get reflected, absorbed or pass through. Microphones measure the resulting sound field, from which the acoustic properties of the material sample are calculated. The measurable frequency range of an impedance tube is constrained by the inner dimensions of the tube. m+p international offers three tube diameters (30, 60, 100 mm) with frequency ranges from 63 Hz to 6300 Hz.



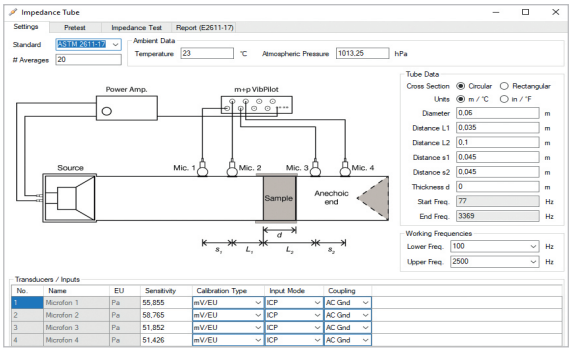
Reflection and Absorption Measurement Using Two-Microphone Setup

The tube is terminated behind the specimen, allowing for the sound to be either reflected or absorbed by the sample material. At two fixed positions, the tube is equipped with microphones measuring sound pressures. The complex transfer functions between microphone readings are calculated by the software and used to derive the absorption and reflection coefficient as well as the acoustic impedance of the sample. This is commonly referred to as the Transfer-Matrix Method described in ISO 10534-2 and ASTM 1050-12.

Transmission Loss Measurement Using Four-Microphone Setup

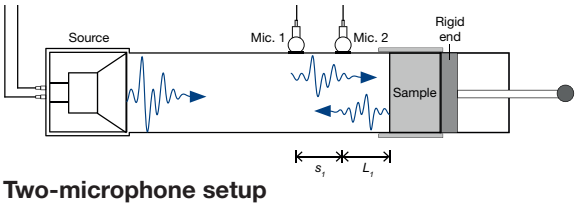
Standard ASTM 2611-17 defines a procedure to measure the transmission loss factor in addition to the absorption coefficient, reflection coefficient and acoustic impedance of a sample. In this setup, the tube is extended with a secondary cylinder behind the sample. Two additional microphones measure the sound that passes through the sample. The Transfer-Matrix Method is employed to evaluate the sound quality coefficients.

m+p Analyzer Software Features

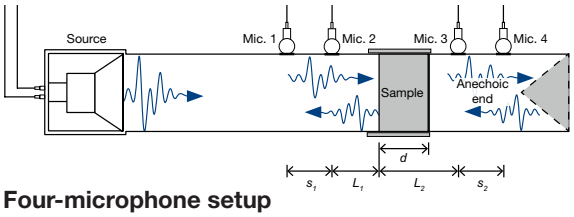


m+p Analyzer is a fully integrated solution for dynamic signal measurement, analysis and advanced reporting of all noise and vibration, acoustics and general dynamic signal applications. As part of the acoustic package that enables you to measure and improve the soundscape of your products, we offer a dedicated impedance tube solution. The clear user interface guides through the setup, pretest and impedance measurements. All sound quality metrics are automatically calculated and ready to use in the built-in reporting tool.

Measurement Principle



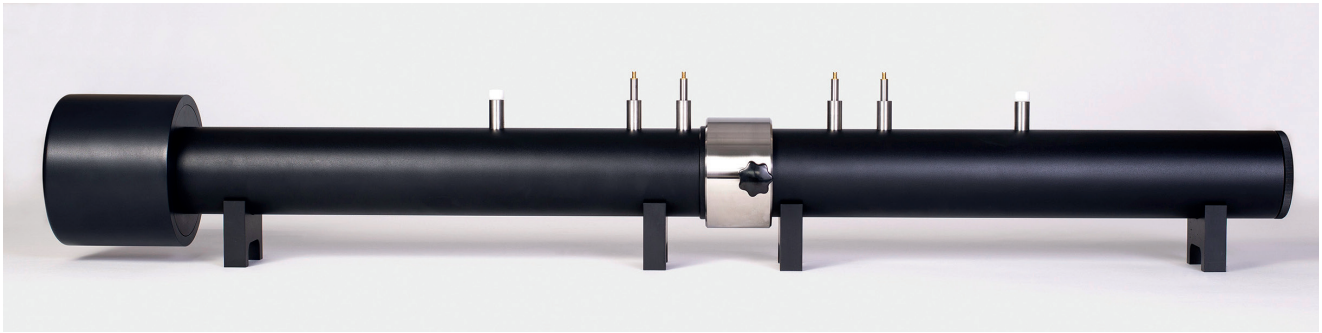
Two-microphone setup



Four-microphone setup

m+p international's impedance tube solution employs the Transfer-Matrix Method for sound impedance measurements. Using the two-microphone setup, a loudspeaker generates a random stationary white noise sound wave that travels through the tube, passes the two microphones and is reflected on the material under test. m+p Analyzer makes sure that the generated noise is compliant to the test standard. After reflection, the sound wave travels back and again passes the microphones.

Due to the random nature of the generated sound field, the sound pressure spectra at the microphone positions contain information in a wide frequency range. A typical measurement runs for several seconds, while the measured sound pressures are averaged in order to reduce noise for high quality measurements. From the acquired sound pressure spectra, the transfer function between the microphones is calculated using m+p Analyzer's fast processing routines. Based on the measured transfer function, all acoustic parameters are calculated. In case of a four-microphone setup, also the transmission coefficient is available.



Technical Features

Tube diameter	30 mm, 60 mm, 100 mm
Frequency range	1800 – 6300 Hz, 125 – 3150 Hz, 63 – 1800 Hz
Sound quantities	■ Sound absorption ■ Sound reflection ■ Acoustic impedance ■ Sound transmission coefficient (only with additional tube extension)
Supported standards	■ ISO 10534-2 ■ ASTM 1050-12 ■ ASTM 2611-17
Data acquisition hardware	m+p VibPilot with up to 204 kHz sampling frequency for up to 8 channels and battery option. Also perfectly suited for other data acquisition tasks.
Data processing software	m+p Analyzer with clear and intuitive user interface supporting the whole process from setup to processing. Upgradable for other acoustic and structural dynamics applications.
Available scope of supply	■ Impedance tube (incl. loudspeaker, tube, sample holder, cables) ■ Power amplifier ■ Two or four microphones ■ Microphone calibrator ■ m+p VibPilot measurement front-end ■ m+p Analyzer software, dongle or network license

m+p international

www.mpihome.com

GERMANY
m+p international Mess- und Rechnertechnik GmbH
Phone: +49 511 856 03-0
sales.de@mpihome.com

USA
m+p international, inc.
Phone: +1 973 239 3005
sales.na@mpihome.com

UNITED KINGDOM
m+p international (UK) Ltd.
Phone: +44 1420 521222
sales.uk@mpihome.com

FRANCE
m+p international SARL
Phone: +33 130 157874
sales.fr@mpihome.com

CHINA
m+p international China Co., Ltd.
Phone: +86 512 6510 0765
sales.cn@mpihome.com

70791/02-24