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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 18696.1-2004

**Acoustics -- Determination of sound absorption coefficient and
impedance in impedance tubes -- Part 1: Method using standing
wave ratio**

声学 阻抗管中吸声系数和声阻抗的测量 第 1 部分：驻波比法

(English Translation)

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1 Scope

1.1

This Part of GB/T 18696 specifies a method for the determination of the sound absorption coefficient, reflection factor and surface impedance or surface admittance of materials and objects. The values are determined for normal sound incidence by evaluation of the standing wave pattern of a plane wave in a tube, which is generated by the superposition of an incident sinusoidal plane wave with the plane wave reflected from the test object. This method can be used for the determination of the sound absorption coefficient of sound absorbers for normal sound incidence. It can further be used for the determination of the acoustical surface impedance or surface admittance of sound-absorbing materials. It is well suited for parameter studies and for the design of sound absorbers, because only small samples of the absorber material are needed.

1.2

There are some characteristic differences between this method and the measurement of sound absorption in a reverberation room (see ISO 354). The impedance tube method can be used for the determination of the reflection factor and also the impedance or admittance. The sound is normally incident on the object surface. The reverberation room method will (under idealized conditions) determine the sound absorption coefficient for random sound incidence.

The impedance tube method relies on the existence of a plane incident sound wave and gives exact values under this condition (measuring and mounting errors excluded). The evaluation of the sound absorption coefficient in a reverberation room is based on a number of simplifying and approximate assumptions concerning the sound field and the size of the absorber. Sound absorption coefficients exceeding the value 1 are therefore sometimes obtained.

The impedance tube method requires samples of the test object which are the size of the cross-sectional area of the impedance tube. The reverberation room method requires test objects which are rather large and can also be applied to test objects with pronounced structures in the lateral and/or normal directions. Measurements with such objects in the impedance tube must be interpreted with care (see 9.1).

For the computational transformation of the test results from the impedance tube method (normal incidence) to the situation of diffuse sound incidence, see annex D.

1.3

This Part gives preference to numerical methods of evaluation instead of graphical methods, from its front and rear ends; so that the position and flatness of the front surface of the test piece can be verified, and the position of the rear surface can also be verified.

The back plate of the sample holder shall be rigid and shall be fixed tightly to the tube since it serves as a rigid termination in many measurements. A metal plate of thickness not less than

20mm is recommended.

For some tests, a volume of air behind the test object, with a depth of $\lambda/4$, acts as a pressure-release termination. Movable plugs in the sample holder are used sometimes as rigid terminations, which allow for a variable depth of this air gap. They should be used with great care, because even tiny leaks between the plug and the wall of the sample holder will lead to erroneous results (for corrections for distances other than $\lambda/4$, see annex C).

6.3 Microphone

A movable microphone registers the standing wave pattern in the impedance tube, for the localization of pressure minima and for the acquisition of sound pressure amplitudes (or levels) in the maxima and minima of the standing wave.

Either the microphone moves outside the impedance tube, in which case it is connected to a probe tube with a sound pick-up opening in the impedance tube, or the microphone itself is placed (and is movable) in the impedance tube. The blockage of the cross-section of the impedance tube by the microphone and/or supports and/or other installations shall not be larger than 5 % in any cross-section of the test section.

6.3.1 Microphone with probe tube

The probe tube shall be of metal with sufficient wall thickness to avoid cross-talk of the sound field into the probe tube through the walls. The boring of the tube should be relative to its length;

a long probe tube of small diameter may have too high an internal attenuation (for a check, see annex B). In a horizontal impedance tube, a centrally mounted probe tube shall be supported to avoid flexion of the probe tube, as this might give rise to higher sound modes. The supports shall not be close to the sound pick-up opening.

In a vertical impedance tube with the installation section at the lower end, the microphone or the probe tube may hang freely in the impedance tube.

In a rectangular impedance tube, the tube may be rotated around its axis by about 45° (see figure

3) and the probe placed into the lower corner; then any supports can be avoided. A further advantage of this position is that structure-borne vibrations of the impedance tube are smallest in the corners (see annex B for a check of structure-borne cross-talk). In principle, the sound pick-up opening can be in a corner, too. For registration of the sound pressure on or near the axis of the impedance tube, an elbow termination with the pick-up opening can be used.

Mechanical contacts between the probe and the impedance tube which can transmit vibrations to the probe tube shall be avoided, especially at the opening where the probe tube enters the