INTERNATIONAL STANDARD

ISO 9053

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Acoustics — Materials for acoustical applications — Determination of airflow resistance

Acoustique — Matériaux pour applications acoustiques — Détermination de la résistance à l'écoulement de l'air

Reference number
ISO 9053:1991(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9053 was prepared by Technical Committee ISO/TC 43, *Acoustics*.

Annex A of this International Standard is for information only.

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Introduction

The airflow resistance of porous materials indicates, in an indirect manner, some of their structural properties. It may be used to establish correlations between the structure of these materials and some of their acoustical properties (for example, absorption, attenuation, etc.).

This International Standard is, therefore, useful for two purposes:

a) in relating some of the acoustical properties of porous materials to their structure and their method of manufacture;

b) in ensuring product quality (quality control).

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Acoustics — Materials for acoustical applications — Determination of airflow resistance

1 Scope

This International Standard specifies two methods for the determination of the airflow resistance of porous materials for acoustical applications.

It is applicable to test specimens cut from products of porous materials.

NOTE 1 Details of publications relating to flow behaviour under both laminar and turbulent conditions are given in annex A.

2 Definitions

For the purposes of this International Standard, the following definitions apply.

2.1 airflow resistance, R: A quantity defined by

$$R = \frac{\Delta p}{q_V}$$

where

Δp is the air pressure difference, in pascals, across the test specimen with respect to the atmosphere;

q_V is the volumetric airflow rate, in cubic metres per second, passing through the test specimen.

It is expressed in pascal seconds per cubic metre.

2.2 specific airflow resistance, R_s: A quantity defined by

$$R_s = RA$$

where

R is the airflow resistance, in pascal seconds per cubic metre, of the test specimen;

A is the cross-sectional area, in square metres, of the test specimen perpendicular to the direction of flow.

It is expressed in pascal seconds per metre.

2.3 airflow resistivity, r: If the material is considered as being homogeneous, that quantity defined by

$$r = \frac{R_s}{d}$$

where

R_s is the specific airflow resistance, in pascal seconds per metre, of the test specimen;

d is the thickness, in metres, of the test specimen in the direction of flow.

It is expressed in pascal seconds per square metre.

2.4 linear airflow velocity, u: A quantity defined by

$$u = \frac{q_V}{A}$$

where

q_V is the volumetric airflow rate, in cubic metres per second, passing through the test specimen;

A is the cross-sectional area, in square metres, of the test specimen.

It is expressed in metres per second.

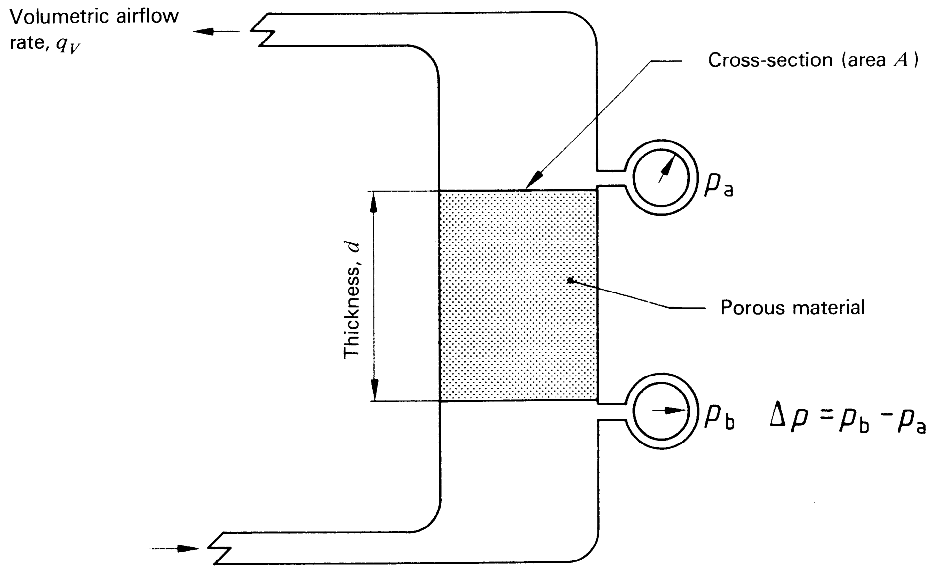

Figure 1 — Direct airflow method (method A) — Basic principle

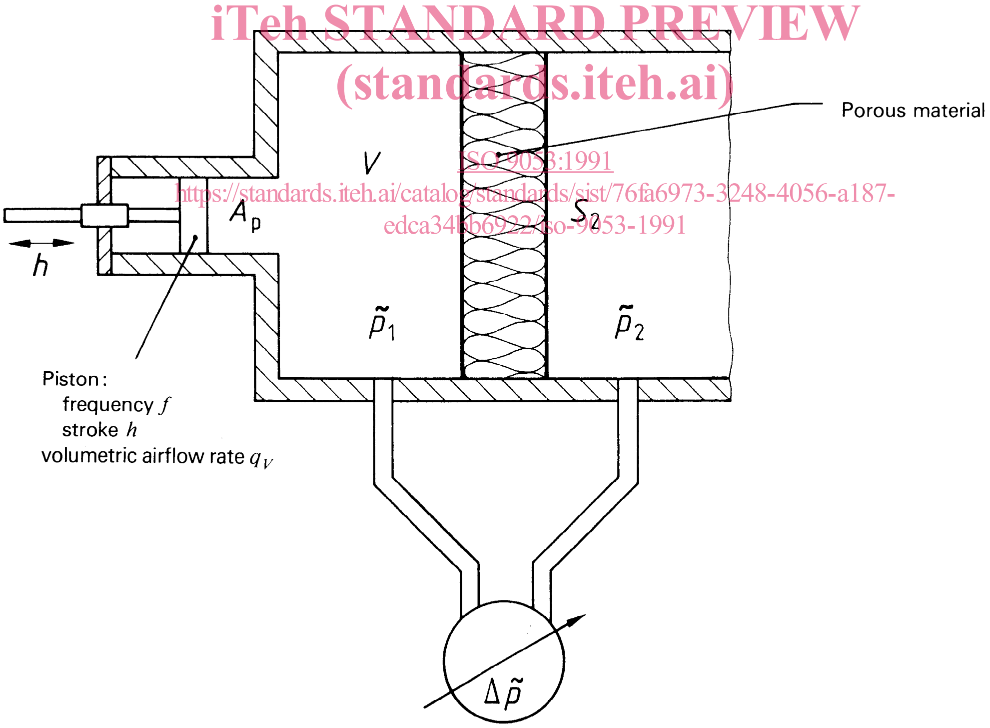

Figure 2 — Alternating airflow method (method B) — Basic principle

3 Principle

3.1 Direct airflow method (method A)

Passing of a controlled unidirectional airflow through a test specimen in the form of a circular cylinder or a rectangular parallelepiped, and measurement of the resulting pressure drop between the two free faces of the test specimen (see figure 1).

3.2 Alternating airflow method (method B)

Passing of a slowly alternating airflow through a test specimen in the form of a circular cylinder or a rectangular parallelepiped, and measurement of the alternating component of the pressure in a test volume enclosed by the specimen (see figure 2).

4 Equipment

4.1 Equipment for method A

The equipment shall consist of

a) a measurement cell into which the test specimen is placed;

b) a device for producing a steady airflow;

c) a device for measuring the volumetric airflow rate;

d) a device for measuring the pressure difference across the test specimen;

e) a device for measuring the thickness of the test specimen when it is in position for the test.

An example of suitable equipment is shown in figure 3.

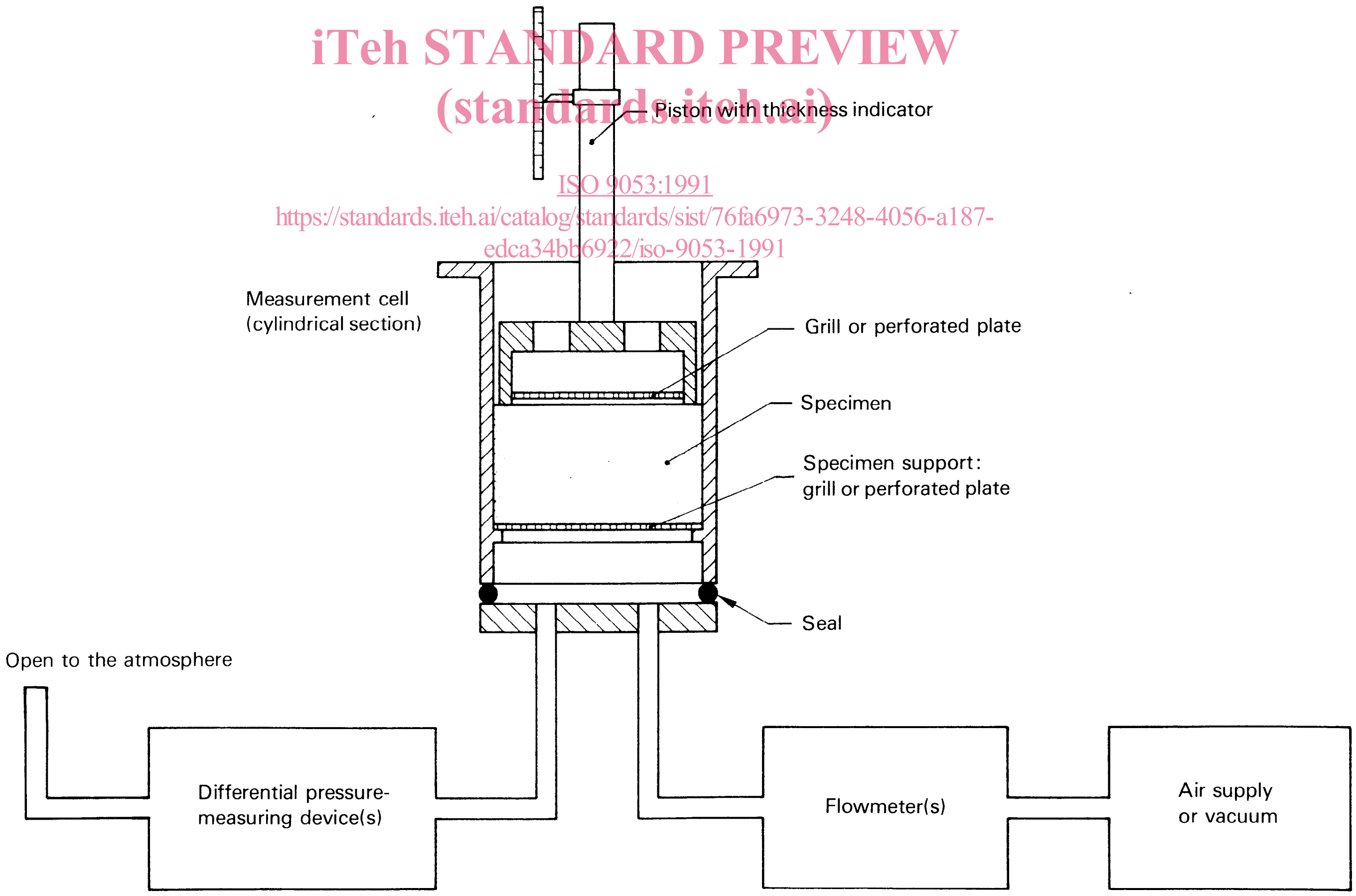

Figure 3 — Measurement equipment, with cylindrical section, for direct airflow method (method A)

4.1.1 Measurement cell

The measurement cell shall be in the shape of a circular cylinder or a rectangular parallelepiped. An example of a cylindrical measurement cell is shown in figure 3.

If it is circular in cross-section, the internal diameter shall be greater than 95 mm.

For the rectangular parallelepiped shape, the preferred cross-section is a square. In any case, all sides shall measure at least 90 mm.

The total height of the cell should be such that there is essentially laminar undirectional airflow entering and leaving the test specimen. The height should be at least 100 mm greater than the thickness of the test specimen.

The test specimen shall rest inside the measurement cell (on a perforated support if necessary), positioned far enough above the base of the cell to meet the above requirement. This support shall have a minimum open area of 50 %, evenly distributed. The holes in the support shall have a diameter not less than 3 mm.

NOTE 2 In some cases it may be necessary to increase the percentage of the open area in order not to restrict the airflow through the test specimen.

The tapping points for the measurement of pressure and airflow shall be leak-free and arranged below the level of the perforated support.

4.1.2 Device for producing airflow

It is recommended that pressure depression systems of the water reservoir or vacuum pump type be used. Alternatively, pressurization systems (air compressor, etc.) may be used if they do not contaminate the air.

Whatever airflow source is used, the installation shall permit fine control of the flow and shall ensure the stability of the flow in the lower part of the test cell.

The airflow source should provide airflow rates such that the resulting velocities will be low enough to ensure that the measured airflow resistances are independent of velocity.

It is recommended that the source be such as to permit airflow velocities down to $0,5 \times 10^{-3}$ m/s to be obtained.

4.1.3 Device for measuring volumetric airflow rate

The pressure tap of the instrument for measuring the volumetric airflow rate shall be placed between the source and the test specimen, inside the test cell as close as possible to the test specimen.

The arrangement used shall permit measurement of the airflow to an accuracy of ± 5 % of the indicated value.

4.1.4 Device for measuring differential pressure

The equipment used for measuring differential pressures shall permit measurements of pressures as low as 0,1 Pa.

The arrangement used shall permit measurement of the differential pressure to an accuracy of ± 5 % of the indicated value.

4.2 Equipment for method B

The equipment shall consist of

a) a measurement cell into which the test specimen is placed;

b) a device for producing an alternating airflow;

c) a device for measuring the alternating component of the pressure in the test volume enclosed by the test specimen;

d) a device for measuring the thickness of the test specimen when it is in position for the test.

Two examples of suitable equipment with different specimen holders are shown in figure 4 and figure 5.

4.2.1 Measurement cell

The measurement cell is composed of two parts:

a) the specimen holder;

b) the test volume (see figure 4 and figure 5).

Both parts shall be in the shape of a circular cylinder, as shown in figure 4 and figure 5, or a rectangular parallelepiped.

If the shape of the specimen holder is circular in cross-section, the internal diameter shall be greater than 95 mm.

For rectangular specimen holders, the preferred cross-section is a square. In any case, all sides shall measure at least 90 mm.

In all cases, the test volume shall have a cross-section equal to at least that of the specimen holder.

The test specimen shall rest inside the specimen holder (on a perforated support if necessary). The lower face of the test specimen delineates the test volume.

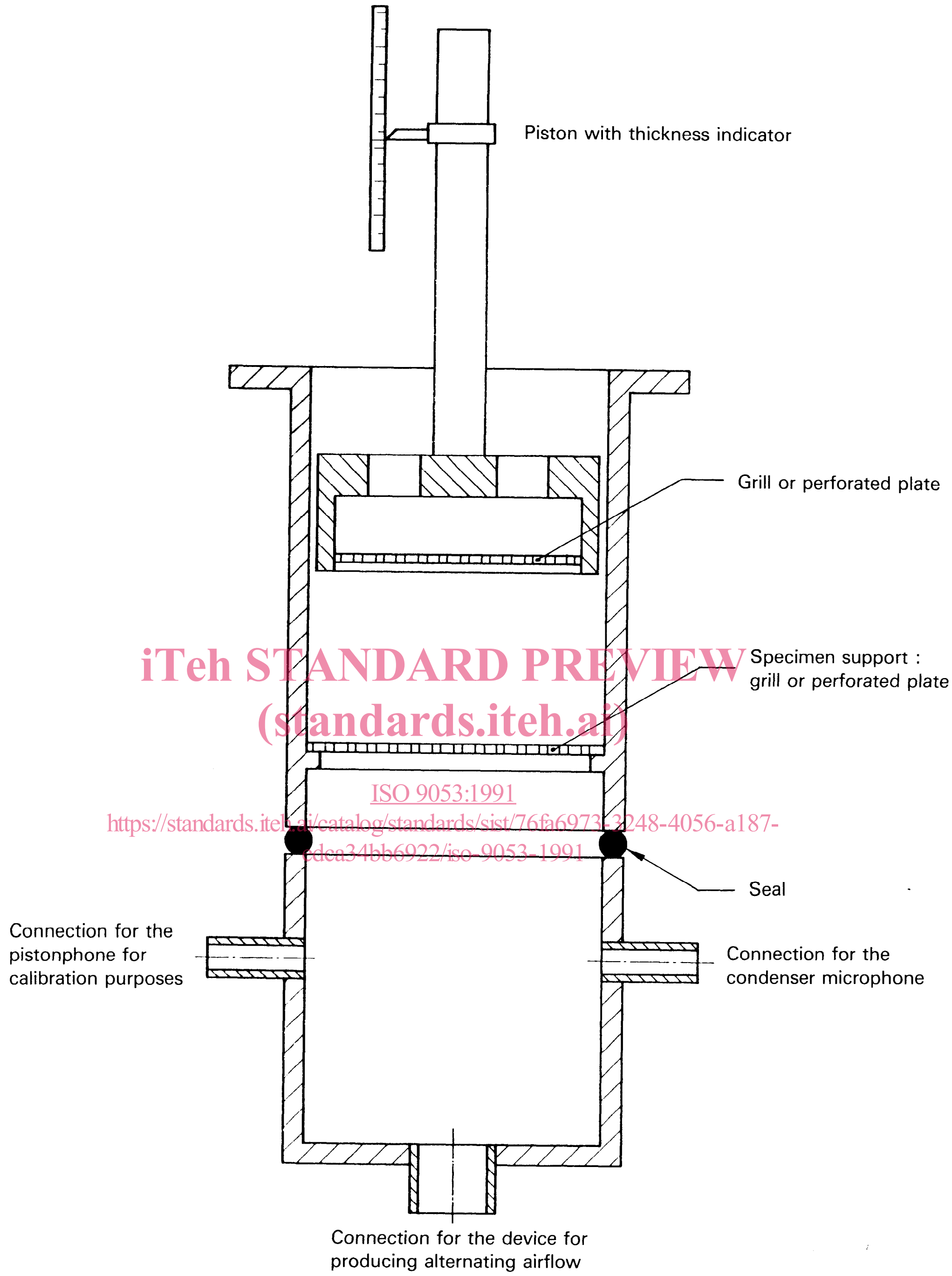

Figure 4 — Measurement cell with specimen holder for measuring fibre materials of loose and wadding structure (method B)