BRITISH STANDARD

BS EN 29052-1:1992
ISO 9052-1: 1989

Acoustics — Method for the determination of dynamic stiffness —

Part 1: Materials used under floating floors in dwellings

The European Standard EN 29052-1:1992 has the status of a British Standard

UDC 699.844-405.8:534.833:620.1:533.6.011.2

Cooperating organizations

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Contents

National foreword

This British Standard has been prepared under the direction of the Environment and Pollution Standards Policy Committee and is the English language version of EN 29052-1:1992, *Acoustics — Determination of dynamic stiffness — Part 1: Materials used under floating floors in dwellings,* published by the European Committee for Standardization (CEN), which endorses ISO 5902-1:1989, *Acoustics — Determination of dynamic stiffness — Part 1: Materials used under floating floors in dwellings,* published by the International Organization for Standardization (ISO).

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 8, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

EUROPEAN STANDARD

NORME EUROPÉENNE

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June 1992

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Descriptors: Acoustics, acoustics insulation, residential buildings, slabs, insulation materials: acoustics, determination, dynamic stiffness, vibration tests

English version

Acoustics — Determination of dynamic stiffness — Part 1: Materials used under floating floors in dwellings

Acoustique — Détermination de la raideur dynamique —
Partie 1: Matériaux utilisés sous les dalles flottantes dans les bâtiments d'habitation

Akustik — Bestimmung der dynamischen Steifigkeit —
Teil 1: Materialien, die unter schwimmenden Estrichen in Wohngebäuden verwendet werden

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 29052-1:1992 E

Foreword

Following the positive result of the Unique Acceptance Procedure, CEN adopted the International Standard ISO 9052-1:1989 "*Acoustics — Determination of dynamic stiffness — Part 1: Materials used under floating floors in dwellings*".

This European Standard has been drawn up in order to comply with the request of the Standing Committee for construction following Council Directive 89/106/EEC on construction products and the provisional mandate "Protection against noise" (BC/CEN/08/1991) related to it and issued by EEC and EFTA.

National standards identical to this European Standard shall be published at the latest by 1992-12-31 and conflicting national standards shall be withdrawn at the latest by 1992-12-31.

In accordance with the Common CEN/CENELEC Rules the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Greece, Germany, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This part of ISO 9052 specifies the test method for determining the dynamic stiffness of resilient materials used under floating floors. Dynamic stiffness is one of the parameters that determine the sound insulation of such floors in dwellings.

This part of ISO 9052 applies to the determination of dynamic stiffness per unit area of resilient materials with smooth surfaces (see clause **6**) used in a continuous layer under floating floors in dwellings. It does not apply to loadings lower than 0,4 kPa[1)], for example materials in wall linings, or greater than 4 kPa[1)], for example materials under machinery foundations (see note 2).

This part of ISO 9052 is mainly intended to be used for comparing production samples of similar materials of known specified quality.

For restrictions concerning the airflow resistivity of the resilient material to be tested, see **8.2**.

NOTE 1 The dependence of dynamic stiffness on prestatic load is of minor importance in the case of materials usually applied in wall linings, for example polystyrene or mineral fibre. The differences between dynamic stiffness values measured with a static load of 2 kPa in accordance with this part of ISO 9052 and those measured with a very low preload are of the order of 10 % to 20 %.

NOTE 2 A further part of ISO 9052 will deal with the determination of dynamic stiffness of materials used in technical floating floors (high static load).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9052. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9052 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7626-2:—, *Vibration and shock — Experimental determination of mechanical mobility — Part 2: Measurements using single-point translation excitation with an attached vibration exciter*[2)].

ISO 9053:—, *Acoustics — Materials for acoustical applications — Determination of airflow resistance*[2)].

3 Definitions

3.1
dynamic stiffness

the ratio of dynamic force to dynamic displacement

for the purposes of this part of ISO 9052, dynamic stiffness per unit area, s', is used and is given by the following equation:

$$s' = \frac{F/S}{\Delta d} \qquad \ldots (1)$$

where

S is the area of the test specimen;

F is the dynamic force acting perpendicularly on the test specimen;

Δd is the resulting dynamic change in thickness of the resilient material.

in this part of ISO 9052, the following quantities are used:

— dynamic stiffness per unit area of the material's structure, s'_s;

— dynamic stiffness per unit area of enclosed gas (e.g. air), s'_a;

— apparent dynamic stiffness per unit area of the test specimen, s'_t;

— the dynamic stiffness per unit area of the installed resilient material, s'.

3.2
natural frequency, f_0

frequency of free oscillation of a system

the natural frequency of a resiliently supported floor is given by the following equation:

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{s'}{m'}} \qquad \ldots (2)$$

where

s' is the dynamic stiffness per unit area of the installed resilient material;

m' is the mass per unit area of the supported floor.

1) 1 Pa = 1 N/m²
2) To be published.

3.3
resonant frequency, f_r

frequency at which resonance occurs in the test arrangement

the resonant frequency is given by the following equation:

$$f_r = \frac{1}{2\pi}\sqrt{\frac{s'_t}{m'_t}} \qquad \ldots (3)$$

where

s'_t is the apparent dynamic stiffness per unit area of the test specimen;

m'_t is the total mass per unit area used during the test.

4 Principle

Determination of the apparent dynamic stiffness per unit area of the test specimen, s'_t, by a resonance method in which the resonant frequency, f_r, of the fundamental vertical vibration of a spring-and-mass system is measured, the spring being the test specimen of the resilient material under test and the mass being a load plate.

5 Test arrangement

The specimen shall be placed between two horizontal surfaces, i.e. the base (or baseplate) and the load plate. The load plate shall be square, with dimensions (200 ± 3) mm × (200 ± 3) mm, and made of steel. The base (or baseplate) and the load plate shall have profile irregularities of less than 0,5 mm and be sufficiently rigid to avoid bending waves in the frequency range of interest.

The excitation is applied by one of the methods shown in Figure 1, Figure 2 or Figure 3.

The total load on the test specimen including all measuring and/or excitation equipment shall be 8 kg ± 0,5 kg.

Excitation and measuring devices shall be applied in such a way that only vertical oscillations (i.e. without rotational components) occur.

For the test set-up shown in Figure 1, the inertia of the base shall be such that in vibration its velocity is negligible compared with that of the load plate.

For the test arrangements shown in Figure 2 and Figure 3, the mass of the baseplate shall be at least 100 kg.

6 Test specimen

At least three square specimens of dimensions 200 mm × 200 mm shall be taken. The surfaces of the test specimens shall be considered to be smooth if the surface irregularities are less than 3 mm.

The test specimen shall be covered with a waterproof plastic foil, approximately 0,02 mm thick, on which a thin paste of plaster of Paris and water is applied to a depth of at least 5 mm so that any unevenness is covered. Before the plaster begins to set, the load plate shall be bedded onto it as shown in Figure 1 a), Figure 2 a) and Figure 3 a).

In the case of closed cell materials, the joint between the specimen and the base (or baseplate) shall be sealed around the perimeter with a fillet of petroleum jelly. See Figure 1 b), Figure 2 b) and Figure 3 b).

7 Procedure

7.1 General

The resonant frequency, f_r, of the fundamental vertical vibration of the test specimen and the load plate can be determined by using either sinusoidal, white noise or pulse signals.

All these methods are equivalent. In case of dispute, the method using sinusoidal signals (**7.2**) shall be the reference method.

7.2 Sinusoidal signals

Obtain the resonant frequency by varying the frequency of excitation, while keeping the excitation force constant.

If the resonant frequency depends on the amplitude of the excitation force, this dependence shall be determined down to as low a value as possible and the resonant frequency shall be found by extrapolation to zero force amplitude.

Depending on the expected stiffness value, the measurement interval used as the basis for extrapolation shall be as follows:

$0,2 \text{ N} \leqslant F \leqslant 0,8 \text{ N}$ where $s' > 50 \text{ MN/m}^3$

$0,1 \text{ N} \leqslant F \leqslant 0,4 \text{ N}$ where $s' \leqslant 50 \text{ MN/m}^3$

Within these intervals, measurements shall be taken at least at three points.

NOTE When testing material with high internal damping, the vertical vibration maximum is not pronounced. In this case, resonance can be detected by observing the phase shift between the excitation and vibration signal.

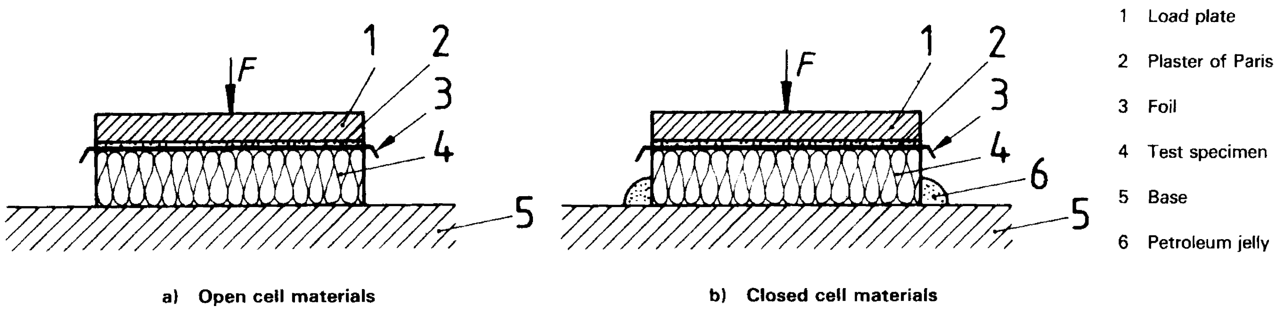

Figure 1 — Excitation of the load plate — Vibration measurement of the load plate only

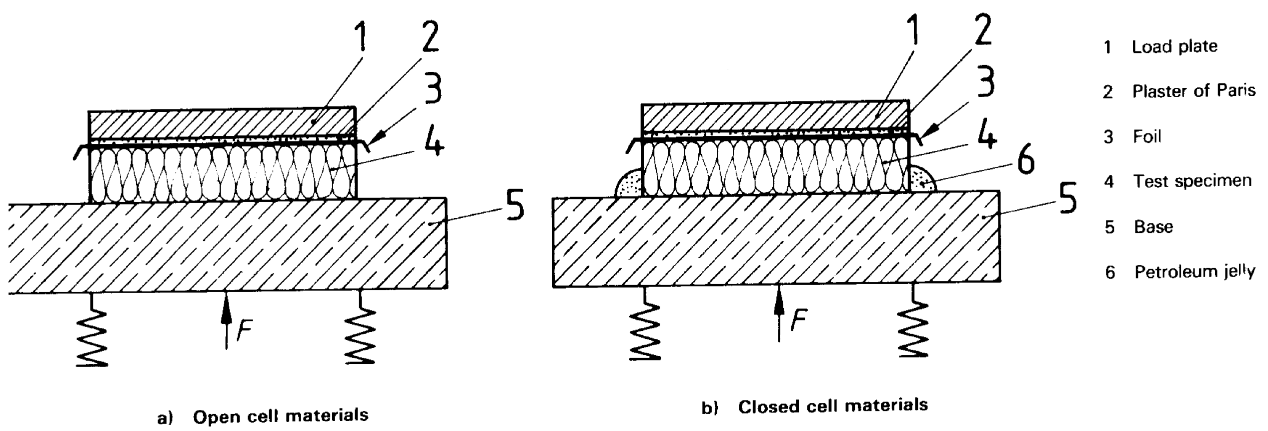

Figure 2 — Excitation of the load plate — Vibration measurements of both the load plate and the baseplate

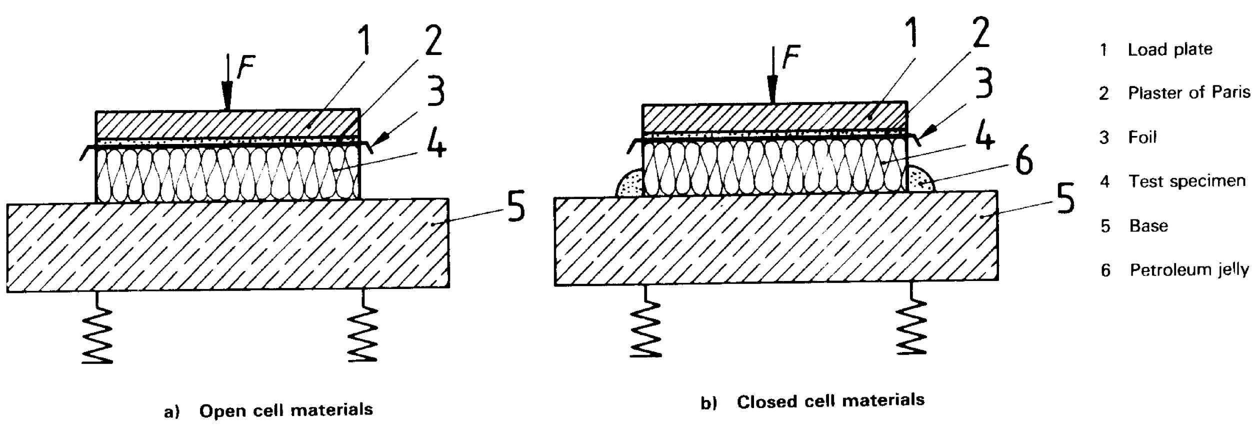

Figure 3 — Excitation of the baseplate — Vibration measurements of both the load plate and the baseplate

7.3 White noise or pulse signals

Obtain the resonant frequency by analysing the frequency response of the system in accordance with ISO 7626-2 or by using impact excitation.[3)]

8 Expression of results

8.1 Apparent dynamic stiffness per unit area of the test specimen, s'_t

The apparent dynamic stiffness per unit area of the test specimen, s'_t, in newtons per cubic metre, is given by the following equation:

$$s'_t = 4\pi^2 m'_t f_r^2 \qquad \ldots (4)$$

where

m'_t is the total mass per unit area used during the test, in kilograms per square metre;

f_r is the extrapolated resonant frequency, in hertz.

8.2 Dynamic stiffness per unit area, s', of the resilient material

Depending on the airflow resistivity, r, in the lateral direction, the dynamic stiffness per unit area, s', of the resilient material is given as shown in a), b) and c) below. The airflow resistivity, r, shall be determined in accordance with ISO 9053:

a) For high airflow resistivity, where $r \geqslant 100$ kPa s/m²

$$s' = s'_t \qquad \ldots (5)$$

b) For intermediate airflow resistivity, where 100 kPa s/m² > $r \geqslant 10$ kPa s/m²

$$s' = s'_t + s'_a \qquad \ldots (6)$$

The dynamic stiffness per unit area of the enclosed gas, s'_a, is calculated in accordance with equation (7) which is based on the assumption that sound propagation in resilient material is isothermal:

$$s'_a = \frac{p_0}{d\varepsilon} \qquad \ldots (7)$$

where

p_0 is the atmospheric pressure;

d is the thickness of the test specimen under the applied static load;

ε is the porosity of the test specimen.

NOTE For $p_0 = 0{,}1$ MPa and $\varepsilon = 0{,}9$, the dynamic stiffness per unit area of the enclosed gas, s'_a, in meganewtons per cubic metre, is given by:

$$s'_a = \frac{111}{d}$$

when d is expressed in millimetres.

c) For low airflow resistivity, where $r < 10$ kPa s/m² and if the dynamic stiffness per unit area of the enclosed gas, s'_a, calculated in accordance with equation (7) is small compared with the apparent dynamic stiffness per unit area of the test specimen, s'_t:

$$s' = s'_t \qquad \ldots (5)$$

The error caused by disregarding s'_a shall be stated in the test report.

NOTE The value of s' cannot be determined by this method, if $r < 10$ kPa s/m² and s'_a is not negligible compared with s'_t.

9 Test report

The following information shall be included in the test report:

a) the reference to this part of ISO 9052;

b) a description of the material, including date of production, test specimen, number, dimensions, thickness under the applied load, mass per unit area;

c) the excitation test arrangement (Figure 1, Figure 2 or Figure 3), excitation signals (sinusoidal, white noise, pulse), vibration measurement (acceleration, velocity, displacement);

d) the date of the test, environmental conditions (for example temperature, relative humidity);

e) the extrapolated frequency, f_r, in hertz, the apparent dynamic stiffness per unit area of the test specimen, s'_t, the dynamic stiffness per unit area of the enclosed air, s'_a, and, if possible, dynamic stiffness per unit area, s', of the resilient material.

All values for the dynamic stiffness per unit area shall be stated in meganewtons per cubic metre to the nearest meganewton per cubic metre.

If, in the case of materials with airflow resistivity less than 10 kPa s/m², the dynamic stiffness of the enclosed gas, s'_a, is not considered separately, the reason and the estimated error should be given (see **8.2**).

[3)] Impact excitation will be dealt with in ISO 7626-5 (in preparation).

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National annex NA (informative) Committees responsible

The United Kingdom participation in the preparation of this European Standard was entrusted by the Environment and Pollution Standards Policy Committee (EPC/-) to Technical Committee EPC/1 upon which the following bodies were represented:

Association of Consulting Engineers
British Broadcasting Corporation
British Occupational Hygiene Society
British Telecommunications plc
Department of Health
Department of the Environment (Building Research Establishment)
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Department of Trade and Industry (National Physical Laboratory)
Engineering Equipment and Materials Users' Association
Health and Safety Executive
Incorporated Association of Architects and Surveyors
Institute of Acoustics
Institute of Occupational Hygienists
Institute of Physics
Institute of Sound and Vibration Research
Institution of Electrical Engineers
Royal Institute of British Architects
Society of Environmental Engineers

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Aggregate Concrete Block Association
Association of Building Component Manufacturers
Association of Manufacturers of Domestic Unvented Supply Systems Equipment (MODUSSE)
Autoclaved Aerated Concrete Products Association
Brick Development Association
British Bathroom Council
British Ceramic Research Ltd.
British Precast Concrete Federation Ltd.
Concrete Block Association
Concrete Society
Gypsum Products Development Association
Heriot-Watt University
Hevac Association
Suspended Ceilings Association

National annex NB (informative) Cross-reference

Publication referred to	Corresponding British Standard
ISO 7626-2:1990	BS 6897 *Experimental determination of mechanical mobility* Part 2:1990 *Measurements using single-point translation excitation with an attached vibration exciter*

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