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INTERNATIONAL STANDARD

ISO 140-1

Second edition
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Acoustics — Measurement of sound insulation in buildings and of building elements —

Part 1: Requirements for laboratories

Acoustique — Mesurage de l'isolation acoustique des immeubles et des éléments de construction —

Partie 1: Spécifications relatives aux laboratoires

Reference number
ISO 140-1 : 1990 (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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 140-1 was prepared by Technical Committee ISO/TC 43, *Acoustics.*

This second edition cancels and replaces the first edition (ISO 140-1 : 1978), of which it constitutes a technical revision.

ISO 140 will consist of the following parts, under the general title *Acoustics — Measurement of sound insulation in buildings and of building elements*:

— *Part 1: Requirements for laboratories*

— *Part 2: Determination, checking and application of precision data*

— *Part 3: Laboratory measurements of airborne sound insulation of building elements*

— *Part 4: Field measurements of airborne sound insulation between rooms*

— *Part 5: Field measurements of airborne sound insulation of façade elements and façades*

— *Part 6: Laboratory measurements of impact sound insulation of floors*

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— *Part 7: Field measurements of impact sound insulation of floors*

— *Part 8: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a standard floor*

— *Part 9: Laboratory measurement of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it*

— *Part 10: Measurement of airborne sound insulation of small building elements*

Annex A forms an integral part of this part of ISO 140. Annex B is for information only.

Introduction

The purpose of this part of ISO 140 is to provide a coordinated statement of requirements for laboratories used for measurements of sound insulation of building elements.

Laboratories for the determination of airborne and impact sound reduction of structural elements should be constructed in such a way that the measurement results can be directly or indirectly applied to the conditions in actual buildings.

In the case of laboratories with suppressed radiation from flanking elements, the behaviour of the element in the actual building can be concluded only indirectly and only in some cases from the measurement results in the laboratory. The test rooms described in this part of ISO 140 belong to this group of laboratories. This group includes laboratories where the specimen is structurally isolated from both test rooms, and laboratories where the test specimen is connected to one or both of the test rooms, the radiation from flanking elements being reduced either by the use of heavy elements or by the use of appropriate linings.

A direct application of the results of laboratory measurements is possible if the flanking transmission is included. For this purpose, the test rooms and the coupling of the test specimen to the flanking construction must resemble the situation in usual buildings ("laboratories with flanking transmission", "mockups"). The requirements for such laboratories are under consideration.

For the determination of airborne sound insulation of some building elements (for example windows and glazing) it is necessary to specify the test arrangement more completely.

Acoustics — Measurement of sound insulation in buildings and of building elements —

Part 1:
Requirements for laboratories

1 Scope

This part of ISO 140 lays down the specifications concerning laboratories for sound insulation measurements of building elements. It applies to laboratories with suppressed radiation from flanking elements.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 140. 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 140 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 140-3 : 1978, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 3: Laboratory measurements of airborne sound insulation of building elements.*

ISO 140-8 : 1978, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 8: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a standard floor.*

3 Laboratories for airborne sound insulation measurements under diffuse conditions

The laboratory test facility consists of two adjacent reverberant rooms with a test opening between them in which the test specimen is inserted.

3.1 Rooms

The volumes and shapes of the two test rooms shall not be exactly the same. A difference in room volumes of at least 10 % is recommended. The volumes of the test rooms shall be at least 50 m^3.

The ratios of the room dimensions shall be so chosen that the natural frequencies in the low-frequency region are spaced as uniformly as possible.

If necessary, diffusing elements should be installed in the rooms to obtain a diffuse sound field.

NOTES

1 The volume of the rooms and the size of the test opening as well as the position of the test specimen within this opening are under consideration. Theoretical calculation as well as some experiments have indicated that it may be advisable that — when measuring walls or floors — the specimen should cover a total side wall or ceiling of the test room, i.e. the test opening should extend from wall to wall and/or from ceiling to floor. In such a case, a volume of 50 m^3 is appropriate in view of the recommended size of the test opening.

2 The reverberation time in the rooms should not be excessively long. Where the reverberation time at low frequencies exceeds 2 s, a check should be made to determine whether the measured sound reduction index depends on the reverberation time. When such a dependance is found — even with diffusors in the rooms — the room must be modified to reduce the reverberation time to not more than 2 s at low test frequencies.

The background level in the receiving room shall be sufficiently low to permit a measurement of the sound transmitted from the source room, considering the power output in the source room and the sound insulation of the specimens for which the laboratory is intended.

In laboratory test facilities for measuring the sound reduction index, the sound transmitted by any indirect path shall be negligible compared with the sound transmitted through the test specimen. One way to achieve this in such facilities is to provide sufficient structural isolation between source and receiving room. Another method might be to cover all surfaces of both rooms with linings that reduce the radiation sufficiently.

NOTE — A suitable measure to use as a reference value is R'_{max} defined in ISO 140-3.

3.2 Test opening

The size of the test opening should be approximately 10 m^2 for walls, and between 10 m^2 and 20 m^2 for floors, with the length of the shorter edge not less than 2,3 m for both walls and floors.

A smaller size may be used if the wavelength of free flexural waves at the lowest frequency considered is smaller than half the minimum dimension of the specimen. The smaller the

specimen, however, the more sensitive will the results be to edge constraint conditions and to local variations in sound fields.

A smaller size may be appropriate for tests of doors and similar components. Test openings for doors should be so arranged that the lower edge is situated as near to the level of the floor of the test rooms as will reproduce conditions in the actual building.

A smaller size may also be appropriate for tests on glazing samples or window assemblies. These should be inserted into a filler wall built into the test aperture between the two rooms.

This wall shall comply with the following requirements:

a) its sound insulation at any test frequency shall be such that the sound energy transmitted through the wall is at least 6 dB, but preferably more than 10 dB, lower than that transmitted by the test specimen. A method for testing the sound insulation of the filler wall including any flanking transmission is given in annex A;

b) the total thickness of the filler wall shall not exceed 500 mm and shall not be less than 300 mm;

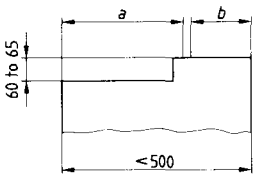
c) the niche depths on each side of the test specimen shall be different, preferably in the ratio of approximately 2:1. The boundaries of the niche shall be lined with materials having a sound absorption coefficient of less than 0,1 at all test frequencies.

The dimensions of the test opening for glazings shall be 1 250 mm × 1 500 mm with an allowable tolerance on each dimension of ± 50 mm, preferably maintaining the same aspect ratio. The same size is preferred for windows, but variations from this size may be necessary due to national building practice.

In the case of a window assembly or a door-window, dimensions may be chosen to be representative of the assembly used in practical circumstances.

For glazings the test opening shall be staggered on both sides and on the top with a step of 60 mm to 65 mm. The glazing shall be mounted in the smaller opening as shown in figure 1; for windows the test opening may be staggered or not.

Dimensions in millimetres



$a : b \approx 2 : 1$

Figure 1 — Geometry of test opening with glazing — Horizontal section

The minimum distance of glazings or windows from the opening to walls, floor and ceiling of the rooms shall be 500 mm and the opening shall not be symmetrical in the filler wall.

An example of a suitable construction for the filler wall with the test opening is given in annex B.

NOTE — The details for the test conditions for the measurement of the sound insulation of glazings are prescribed in order to ensure the best possible comparison between results obtained by different laboratories.

4 Laboratories for impact sound insulation of floors and floor coverings

4.1 Receiving room

The volume of the receiving room shall be at least 50 m^3.

The ratios of the receiving room dimensions shall be so chosen that the natural frequencies in the low-frequency region are spaced as uniformly as possible.

If necessary, diffusing elements should be installed in the receiving room to obtain a diffuse sound field.

NOTES

1 The volume of the receiving room and the size of the test opening as well as the position of the test specimen within this opening are under consideration. Theoretical calculation as well as some experiments have indicated that it may be advisable that the specimen should cover the total ceiling of the receiving room, i.e. the test opening should extend from wall to wall. In such a case, a volume of 50 m^3 is appropriate in view of the recommended size of the test opening.

2 The reverberation time in the receiving room should not be excessively long. Where the reverberation time at low frequencies exceeds 2 s, a check should be made to determine whether the measured impact sound insulation depends on the reverberation time. When such a dependence is found — even with diffusors in the room — the room must be modified to reduce the reverberation time to not more than 2 s at low test frequencies.

The background level in the receiving room shall be sufficiently low to permit a measurement of the transmitted impact sound, considering the properties of the tapping machine and the sound insulation of the specimens for which the laboratory is intended.

The airborne sound insulation between the receiving room and the source room shall be sufficiently high that the sound field measured in the receiving room is only that generated by the impact excitation of the test floor.

4.2 Test opening

The size of the test opening for floors should be between 10 m^2 and 20 m^2, with the length of the shorter edge not less than 2,3 m.

NOTE — When measuring reduction in impact sound pressure level by floor coverings in accordance with ISO 140-8, special precautions with respect to the test opening may not be necessary.

Annex A
(normative)

Measurement of the sound reduction index of the filler wall (and any flanking constructions) for test openings for windows and glazing

The apparent sound reduction index of the filler wall including all flanking elements — calculated using the area of the test opening — should be at least 6 dB higher than the sound reduction index of the test specimen at any frequency. This can be determined by remeasuring the apparent sound reduction index R'_T with substantially reduced transmission through the test specimen.

Two ways of reducing transmission through the test specimen in order to measure R'_T are recommended:

a) Mounting an additional flexible layer of mass per unit area of 25 kg/m^2 (for example gypsum board covered with 2 mm iron sheet) flush with the face of the filler wall in that part of the test opening where the test specimen is mounted and filling the space between this layer and the test specimen with absorbing material.

b) Removing the test specimen, installing 13 mm sheet lead glued to wood chipboard at each face of the part of the test opening where the test specimen is mounted and filling the intervening space with absorbing material. The joint between the two layers of the filler wall (if relevant) should not be covered by this construction.

The results of measurements R'_S of glazing or windows shall be compared with the apparent sound reduction index R'_T measured with the construction complying with a) or b) and calculated with the area of the test opening. If the difference is greater than or equal to 6 dB but smaller than 15 dB, the result of the measurement R'_S shall be corrected for the influence of the flanking transmission by calculating R_S as follows:

$$R_S = -10 \lg \left(10^{-R'_S/10\ \mathrm{dB}} - 10^{-R'_T/10\ \mathrm{dB}}\right)$$

where R_S is the corrected sound reduction index, in decibels, of the test specimen.

R'_S is measured with the test specimen in the test opening and R'_T is measured with the special construction in the test opening.

If the difference between R'_S and R'_T is less than 6 dB in any of the frequency bands the correction shall be 1,3 dB at the most, corresponding to a difference of 6 dB. In that case R'_T shall be given in the measurement report so that it appears clearly that the reported R_S values are minimum values.

Annex B
(informative)

Test opening for the measurement of the sound insulation of glazing

The dimensions of the test opening are 1 250 mm × 1 500 mm. The test opening has a depth of 410 mm ± 10 mm and the niches are covered with a reflecting finish.

The filler wall is constructed from two walls of concrete or plastered brickwork with a density of at least 1 800 kg/m³. The gap between the two walls is filled with mineral wool and shall be covered with an airtight reflecting material.

A vertical and a horizontal section are shown in figure B.1 with a detail of the gap.

Dimensions in millimetres

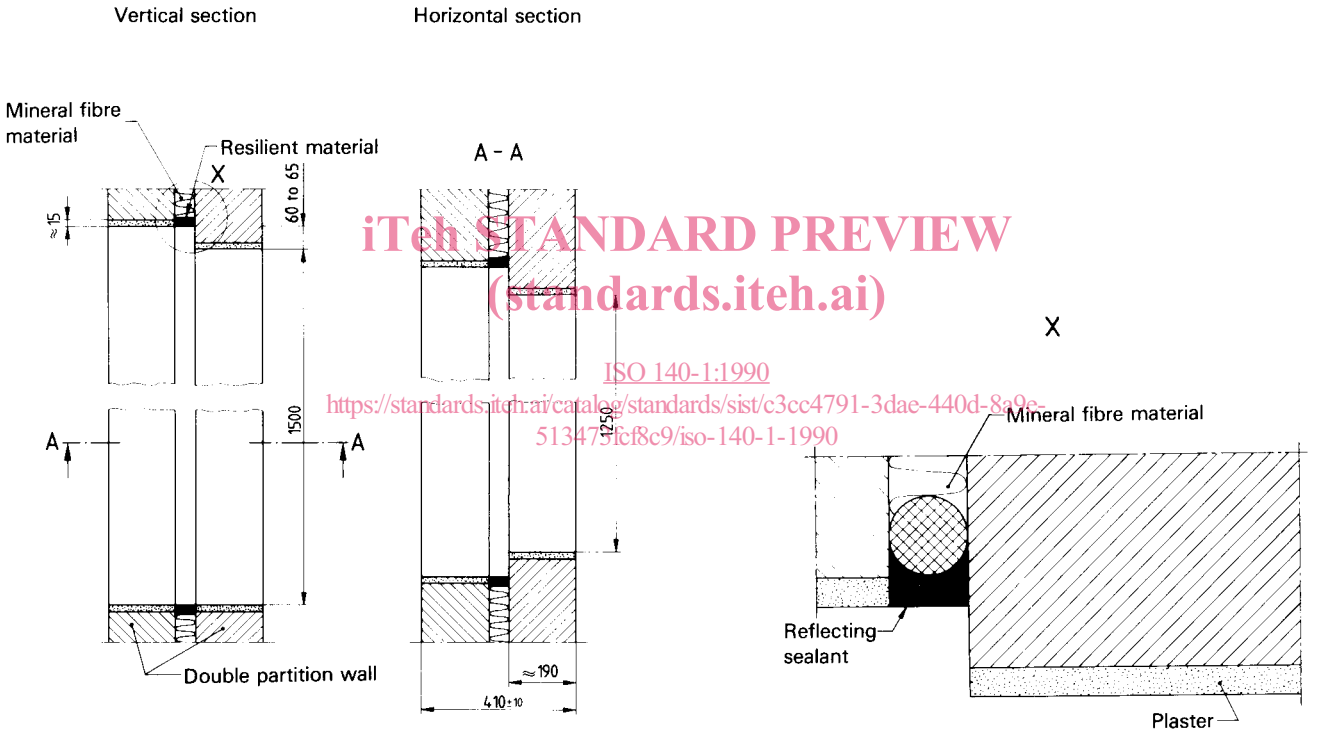


Figure B.1 — Test opening for glass panes

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