INTERNATIONAL STANDARD

Second edition 2021-04

Acoustics — Laboratory measurement of sound insulation of building elements —

Part 5:

Requirements for test facilities and iTeh STANDARD PREVIEW

S Acoustique — Mesurage en laboratoire de l'isolation acoustique des éléments de construction —

Partie 5; Exigences relatives aux installations et appareillage d'essai

https://standards.iteh.ai/catalog/standards/sist/82f1e450-8c0a-4dff-9206a17b54003862/iso-10140-5-2021



Reference number ISO 10140-5:2021(E)

iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>ISO 10140-5:2021</u> https://standards.iteh.ai/catalog/standards/sist/82fle450-8c0a-4dff-9206a17b54003862/iso-10140-5-2021



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office CP 401 • Ch. de Blandonnet 8 CH-1214 Vernier, Geneva Phone: +41 22 749 01 11 Email: copyright@iso.org Website: www.iso.org

Published in Switzerland

Contents

Page

Forew			iv	
Intro	luctio	n	v	
1	Scop	e	1	
2	Normative references			
3	Terms and definitions			
4	I aboratory test facilities for airborne sound insulation measurements			
4	4.1 General			
	4.2	Test rooms	2	
		4.2.1 Volume	2	
		4.2.2 Diffusion	2	
		4.2.3 Reverberation time	2	
		4.2.4 Background noise		
	1.3	4.2.5 Suppression of Hanking transmission	ວ ຊ	
	т.Ј	4.3.1 General		
		4.3.2 Full-sized test opening		
		4.3.3 Reduced-size test opening	5	
		4.3.4 Specific small-sized test opening	6	
5	Labo	ratory test facilities for impact sound insulation measurements		
	5.1	General Genera		
	5.2	Receiving room		
		5.2.1 Volume		
	F 2	5.2.2 Further requirements	8	
	5.3	5 2 1 https://mudarda.tela.pi/catalog/standards/sist/82f1e450-8c0a-4dff-9206-	δ Ω	
		5.3.2 Frame specification		
6	Equi		0	
0	Equ	Airborne sound field	9 Q	
	6.2	Impact sound source	9	
	6.3	Measurement system		
Annes	z Δ (no	rmative) Estimation of the maximum measurable sound reduction index	11	
Annex	x B (no soun	ormative) Standard basic elements for measuring the improvement of airborne dinsulation by linings	15	
Annos	C (no	u mound for the management of impact cound	10	
Annez	incul	ation by floor coverings	16	
Annos	n Sun	ation by noor coverings	21	
Annos	\mathbf{F} (no	rmative) Standard tanning machine	25	
Annos		rmative) Alternative impact sound sources		
Annez		Thative Arter native impact sound sources		
Annex	soun	ormative) Wooden mock-up floor for measuring the improvement of impact d insulation by floor coverings		
Annez	KH (no	ormative) Specification of heavy and intense rain — Example of a tank with		
	perfo	orated base		
Annex	x I (inf	ormative) Reference test specimens for rainfall sound measurements		
Biblio	graph	y		

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 126, *Acoustic properties of building elements and of buildings*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 10140-5:2010), which has been technically revised. It also incorporates the Amendment ISO 10140-5:2010/Amd1:2014.

The main changes compared to the previous edition are as follows:

- all references in the text have been updated;
- in <u>Clause 2</u>, the normative references have been updated;
- in <u>Clause 3</u>, the terms and definitions have been added;
- <u>Annex B</u>, <u>Annex C</u> and <u>Annex H</u> have been updated.

A list of all parts in the ISO 10140 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at <u>www.iso.org/members.html</u>.

Introduction

ISO 10140 (all parts) concerns laboratory measurement of the sound insulation of building elements (see <u>Table 1</u>).

ISO 10140-1 specifies the application rules for specific elements and products, including specific requirements for the preparation and mounting of the test specimens, and for the operating and test conditions. ISO 10140-2 and ISO 10140-3 contain the general procedures for airborne and impact sound insulation measurements, respectively, and refer to ISO 10140-4 and this document where appropriate. For elements and products without a specific application rule described in ISO 10140-1, it is possible to apply ISO 10140-2 and ISO 10140-3. ISO 10140-4 contains basic measurement techniques and processes. This document contains requirements for test facilities and equipment. For the structure of ISO 10140 (all parts), see Table 1.

ISO 10140 (all parts) was developed to improve the layout for laboratory measurements, ensure consistency and simplify future changes and additions regarding mounting conditions of test elements in laboratory and field measurements. ISO 10140 (all parts) aims at presenting a well-written and arranged format for laboratory measurements.

ISO 10140-1 is planned to be updated with application rules for other products.

Relevant part of ISO 10140	Main purpose, contents and use iTeh STANDARD P	Detailed content REVIEW
ISO 10140-1	It indicates the appropriate test procedure CI for elements and products. For certain types of element/product, it can contain addi-2021 tional and more specific instructions about quantities and test element size and about preparation, mounting and operating condi- tions. Where no specific details are includ- ed, the general guidelines are according to ISO 10140-2 and ISO 10140-3.	 Appropriate references to ISO 10140-2 and ISO 10140-3 and product-related, specific and additional instructions on: 450specificquantities measured; 2021 size of test element; boundary and mounting conditions; conditioning, testing and operating conditions; additional specifics for test report.
ISO 10140-2	It gives a procedure for airborne sound insu- lation measurements according to ISO 10140- 4 and ISO 10140-5. For products without specific application rules, it is sufficiently complete and general for the execution of measurements. However, for products with specific application rules, measurements are carried out according to ISO 10140-1, if available.	 Definitions of main quantities measured General mounting and boundary conditions General measurement procedure Data processing Test report (general points)
ISO 10140-3	It gives a procedure for impact sound insula- tion measurements according to ISO 10140- 4 and ISO 10140-5. For products without specific application rules, it is sufficiently complete and general for the execution of measurements. However, for products with specific application rules, measurements are carried out according to ISO 10140-1, if available.	 Definitions of main quantities measured General mounting and boundary conditions General measurement procedure Data processing Test report (general points)

Table 1 — Structure and contents of ISO 10140 (all parts)

Relevant	evant Main nurnose contents and use Detailed content				
part of					
ISO 10140					
ISO 10140-4	It gives all the basic measurement techniques and processes for measurement according to ISO 10140-2 and ISO 10140-3 or facility qualifications according to ISO 10140-5. Much of the content is implemented in software.	— Definitions			
		 Frequency range 			
		 Microphone positions 			
		 SPL measurements 			
		 Averaging, space and time 			
		 Correction for background noise 			
		 Reverberation time measurements 			
		 Loss factor measurements 			
		 Low-frequency measurements 			
		— Radiated sound power by velocity measurement			
ISO 10140-5	It specifies all information needed to design, construct and qualify the laboratory facility, its additional accessories and measurement	Test facilities, design criteria:			
		 volumes, dimensions; 			
	equipment (hardware).	 flanking transmission; 			
		 laboratory loss factor; 			
	iTeh STANDAR	maximum achievable sound reduction index;			
	(standarde	— reverberation time;			
	(stanuar	— influence of lack of diffusivity in the laboratory.			
	ISO 10140-	Test openings:			
	https://standards.iteh.ai/catalog/standard	s /sist/standand_openingsfor_ walls and floors;			
	a17b54003862/iso-	¹⁰¹⁴⁰ other ² openings (windows, doors, small tech- nical elements);			
		— filler walls in general.			
		Requirements for equipment:			
		 loudspeakers, number, positions; 			
		— tapping machine and other impact sources;			
		— measurement equipment.			
		Reference constructions:			
		 basic elements for airborne and impact insulation improvement; 			
		— corresponding reference performance curves.			

Table 1 (continued)

Acoustics — Laboratory measurement of sound insulation of building elements —

Part 5: Requirements for test facilities and equipment

1 Scope

This document specifies laboratory test facilities and equipment for sound insulation measurements of building elements, such as:

- components and materials;
- building elements;
- technical elements (small building elements);
- sound insulation improvement systems.

It is applicable to laboratory test facilities with suppressed radiation from flanking elements and structural isolation between source and receiving rooms.

This document specifies qualification procedures for use when commissioning a new test facility with equipment for sound insulation measurements. It is intended that these procedures be repeated periodically to ensure that there are no issues with the equipment and the test facility.

a17b54003862/iso-10140-5-2021

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3382-2, Acoustics — Measurement of room acoustic parameters — Part 2: Reverberation time in ordinary rooms

ISO 9052-1:1989, Acoustics — Determination of dynamic stiffness — Part 1: Materials used under floating floors in dwellings

ISO 10140-1, Acoustics — Laboratory measurement of sound insulation of building elements — Part 1: Application rules for specific products

ISO 10140-2, Acoustics — Laboratory measurement of sound insulation of building elements — Part 2: Measurement of airborne sound insulation

ISO 10140-3, Acoustics — Laboratory measurement of sound insulation of building elements — Part 3: Measurement of impact sound insulation

ISO 10140-4, Acoustics — Laboratory measurement of sound insulation of building elements — Part 4: Measurement procedures and requirements

IEC 60942:2017, Electroacoustics — Sound calibrators

IEC 61260-1, Electroacoustics — Octave-band and fractional-octave-band filters — Part 1: Specifications

IEC 61672-1, Electroacoustics — Sound level meters — Part 1: Specifications

IEC 61672-2, Electroacoustics — Sound level meters — Part 2: Pattern evaluation tests IEC 61672-3, Electroacoustics — Sound level meters — Part 3: Periodic tests

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at <u>http://www.electropedia.org/</u>

4 Laboratory test facilities for airborne sound insulation measurements

4.1 General

The laboratory test facility shall consist of two adjacent reverberant rooms with a test opening between them, in which the test element is inserted.

The area of the test opening can vary depending on the type of test element. This document defines full-sized test openings, a specific small-sized test opening and alternative reduced-size test openings.

For measurement of the improvement of sound reduction index by acoustical livings, these rooms shall be separated by a standard basic element on which the lining under test is installed, in accordance with <u>Annex B</u>.

4.2 Test rooms

<u>ISO 10140-5:2021</u> https://standards.iteh.ai/catalog/standards/sist/82fl e450-8c0a-4dff-9206a17b54003862/iso-10140-5-2021

4.2.1 Volume

The volumes of the test rooms shall be at least 50 m³. Volumes and corresponding dimensions of the two test rooms should not be exactly the same. A difference of at least 10 % in room volumes and in the linear dimensions is recommended.

Choose the ratios of the room dimensions such that the eigenmode frequencies in the low-frequency bands are spaced as uniformly as possible.

When measuring the sound insulation of walls or floors, theoretical calculation as well as experiments have indicated that the test element should cover a total partition wall or ceiling of the test room, i.e. the test opening should extend from wall to wall and from floor to ceiling. In such a case, a volume of 50 m^3 to 60 m^3 is appropriate in view of the recommended size of the test opening.

4.2.2 Diffusion

Large variations of the sound pressure level in the room indicate the presence of dominating strong standing waves. In this case, diffusing elements shall be installed in the rooms. The positioning and number of diffusing elements should be arranged in such a way that the sound reduction index is not influenced when further diffusing elements are installed.

NOTE For some kinds of test element, as for elements with one surface significantly more absorbent than the other (see ISO 10140-2), the installation of diffusing elements is mandatory.

4.2.3 Reverberation time

The reverberation time in the rooms under normal test conditions (with negligible absorption by the test element) should not be excessively long or short. When the reverberation time at frequencies at

and above 100 Hz exceeds 2 s or is less than 1 s, check whether the measured sound reduction index depends on the reverberation time. When such a dependence is found, even with diffusers in the rooms, the rooms shall be modified to adjust the reverberation time, *T*, such that:

$$1 \le T \le 2(V/50)^{2/3}$$

where

V is the value of the room volume, in cubic metres;

T is the reverberation time, in seconds.

Measurement of the reverberation time is specified in ISO 10140-4.

4.2.4 Background noise

The background noise level in the receiving room shall be sufficiently low to permit measurements of the sound transmitted from the source room, considering the power output in the source room and the sound insulation of the test elements for which the laboratory is intended (see ISO 10140-4:2021, 4.3).

4.2.5 Suppression of flanking transmission

In laboratory test facilities designed for measuring the sound reduction index, the sound transmitted by any indirect path should be negligible compared with the sound transmitted through the test element. One approach to achieve this in such facilities is to provide sufficient structural isolation between source and receiving rooms. Another approach is to cover all surfaces of both rooms with linings that reduce the flanking transmission in such a way that the requirements on room volumes and reverberation times are still met.

ISO 10140-5:2021

Annex A specifies the methods to be used for estimating the maximum (achievable sound reduction index, R'_{max} , which is determined by indirect paths 0140-5-2021

4.3 Test opening

4.3.1 General

A horizontal and a vertical full-sized test opening, as well as a specific vertical small-sized test opening are defined. Other reduced-size test openings may be applied under certain restrictions.

4.3.2 Full-sized test opening

4.3.2.1 General

The area of the full-sized test opening shall 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 being not less than 2,3 m for both walls and floors.

4.3.2.2 General frame specification

The measured sound reduction index of a test element can be affected by the connections to the laboratory structure surrounding the element. The mass ratio of the tested structure to the surrounding structure should be taken into consideration. For tests on lightweight structures ($m < 150 \text{ kg/m}^2$),

(1)

there are no special requirements to be taken into account. For heavier structures under test, it should be ensured that the loss factor, η , of the test element is not less than that given by Formula (2):

$$\eta_{\min} = 0.01 + \frac{0.3}{\sqrt{f}}$$
(2)

where *f* is the test frequency value, in hertz.

To check this requirement, use as the test element a brick or block wall having a mass of (400 ± 40) kg/m² plastered on one side. Measurement of the loss factor is specified in ISO 10140-4.

4.3.2.3 Specific requirements on the frame for lightweight double-leaf partitions

With lightweight double-leaf partitions, the sound reduction index is affected by vibration transmission between the wall leaves via the frame of the test opening (see Figure 1). This is influenced by the mounting conditions in the laboratory test opening and by the material properties and dimensions of the frame(s). Vibration transmission between the coupled structures of the partition itself (e.g. common or coupled studs) is dependent on the specific construction of the partition and is a property of the test element itself. This vibration transmission is not treated in this document.

In order to improve the reproducibility of the sound reduction index between laboratories for walls, guidance is given for the mass per unit area of the frame of the test opening. If there is an acoustic break in the laboratory test opening, the frame on one side of that break should be considered. The mass per unit area of the frame shall be much larger than the mass per unit area of the heaviest leaf of the double partition. The ratio of the mass per unit area of the heaviest leaf of the double partition to that of the frame of the test opening shall be at least 1:6. The minimum thickness of the frame should be 100 mm and the minimum depth should be 200 mm. The frame shall have a density of at least 2 000 kg/m³. The cross-sectional surface mass shall be more than 450 kg/m². In addition, the frame(s) shall consist of a homogeneous, massive construction, such as dense concrete or masonry. Wood or metal frames connecting the two leaves shall not be used.

https://standards.iteh.ai/catalog/standards/sist/82f1e450-8c0a-4dff-9206-

The surface mass per unit area is calculated from the density ρ_{i} and the thickness, *t*, of the elements, as shown in Figure 2, using Formulae (3) and (4):

$$m'_{\rm L} = \rho_{\rm L} t_{\rm L} \tag{3}$$

where

- $m'_{\rm L}$ is the mass per unit area of the test facility wall, in kilograms per square metre;
- $\rho_{\rm L}$ is the density of the test facility wall, in kilograms per cubic metre;
- $t_{\rm L}$ is the thickness of the test facility wall, in metres.

$$m'_{\rm e} = \rho_{\rm e} t_{\rm e} \tag{4}$$

where

- $m'_{\rm e}$ is the mass per unit area of the element, in kilograms per square metre;
- $ho_{
 m e}$ is the density of the element, in kilograms per cubic metre;
- $t_{\rm e}$ is the thickness of the element, in metres.



Кеу

1 frame of the test opening

Figure 1 — Vibration transmission across the border frame of the test opening



Key

- 1 test facility wall
- 2 element under test
- $t_{\rm L}$ thickness of the test facility wall
- $t_{\rm e}$ thickness of the test element

Figure 2 — Determination of the mass per unit area of the elements

4.3.3 Reduced-size test opening

The test opening may have a reduced area:

- a) if the test element area is smaller than the full-sized test opening;
- b) if special acoustical conditions are met on the test element;
- c) if the test element is a small technical element.

ISO 10140-5:2021(E)

Reduced-size test openings are specified in ISO 10140-1 and ISO 10140-2.

4.3.4 Specific small-sized test opening

Specific small-sized test openings are 1 250 mm in width and 1 500 mm in height, with an allowable tolerance on each dimension of ± 50 mm, preferably maintaining the same aspect ratio. The test opening has a maximum depth of 500 mm, with staggered niches with a reflective finish. The larger niche is 60 mm to 65 mm wider at the sides and the top only.

The wall with the test opening is constructed from two walls of about equal thickness made of concrete, plastered bricks or similar material 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 resilient material. Care should be taken to ensure that the resilient material does not add flanking transmission by coupling the two walls. This wall may be a filler wall in the full-sized test opening.

A vertical and a horizontal section are shown in <u>Figure 3</u> with a detail of the gap as an example of the test opening within the specifications given. The dimensions of the niches in the horizontal section shall be the same as in the vertical section.

The minimum distance between the small-sized test opening and any wall, floor or ceiling of either room shall be 500 mm. The opening should not be symmetrical in the separating wall.

iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>ISO 10140-5:2021</u> https://standards.iteh.ai/catalog/standards/sist/82f1e450-8c0a-4dff-9206a17b54003862/iso-10140-5-2021

ISO 10140-5:2021(E)

Dimensions in millimetres



Key

- 1 mineral wool
- 2 resilient material (acoustically reflective)
- 3 double partition wall
- 4 reflective finishing

Figure 3 — Example of the construction of the specific small-sized test opening