SLOVENSKI STANDARD

SIST EN 15657-1:2009

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Akustične lastnosti gradbenih elementov in stavb - Laboratorijsko merjenje zvoka v zraku in strukturalnega zvoka v gradbenih elementih - Poenostavljeni primeri, kjer je premik opreme mnogo večji od gibanja sprejemnika, kot so na primer masažne kadi

Acoustic properties of building elements and of buildings - Laboratory measurement of airborne and structure borne sound from building equipment - Part 1: Simplified cases where the equipment mobilities are much higher than the receiver mobilities, taking wirlpool baths as an example

Akustische Eigenschaften von Bauteilen und von Gebäuden - Messung des Luft- und Körperschalls von haustechnischen Anlagen im Prüfstand - Teil 1: Vereinfachte Fälle, in denen die Admittanzen der Anlagen wesentlich höher sind als die der Empfänger am Beispiel von Whirlwannen

Propriétés acoustiques des éléments de construction et des bâtiments - Mesurage en laboratoire des bruits aériens et de structure des éléments de construction - Partie 1: Cas simplifiés prenant comme exemple les bains bouillonnants

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Acoustic properties of building elements and of buildings - Laboratory measurement of airborne and structure borne sound from building equipment - Part 1: Simplified cases where the equipment mobilities are much higher than the receiver mobilities, taking wirlpool baths as an example

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Foreword

This document (EN 15657-1:2009) has been prepared by Technical Committee CEN/TC 126 “Acoustic properties of building elements and of buildings”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

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Introduction

This European Standard, prepared by CEN/TC 126/WG 7, specifies methods for the measurement of airborne and structure borne sound produced by building equipment under laboratory conditions. It is the task of WG 7 to prepare laboratory test methods to determine the source characteristics, while WG 2 concentrates on the method predicting the airborne and structure-borne sound pressure levels produced in the buildings; the prediction method, described in document EN 12354-5, is based on power flow considerations and uses the laboratory test results as input data. The link to WG 2 is explained in more details in an informative annex (Annex B).

The quantities considered in this standard are the following:

a) the airborne sound is characterized by the airborne sound power radiated by the equipment; this power is calculated from the airborne sound measured in a test room in which the equipment is mounted;

b) the structure-borne sound is characterized by the structural power injected by the equipment to the receiving structure to which the equipment is connected; since, in general, the equipment is connected up to three building elements (two walls and one floor), a three plate test rig is used and three structural power components are determined, calculated from vibration velocities measured on the plates.

When the equipment is mounted on low mobility structures (having point mobilities much lower than the mobilities measured on the equipment), the coupling between the source and the receiving structure is simpler and the way of transforming the power components measured in laboratory into the power components injected *in situ* to the building elements, greatly simplified. This first part (part 1) of the standard is restricted to these simplified cases; a second part (part 2) applicable to the other cases will be a future task of WG 7 and is not available yet.

1 Scope

Part 1 of this European Standard shall apply to any source –receiver configuration where the receiver mobility is 10 dB below the source mobility (see definition of mobility in Clause 3 below). However, part 1 is restricted for the moment to whirlpool baths since only this type of building equipment has been experimentally studied so far; for other types of building equipment, the principle of the method is still valid, but some details in the standard might not be relevant.

Therefore, this first part:

— specifies methods for the measurement under laboratory conditions of airborne and structure borne sound produced by whirlpool baths connected to low mobility structures; for the case of whirlpool baths, building structures of mass per unit area equal or greater than 220 kg/m^2, hollow elements excluded, are considered as low mobility elements;

— defines the expression of the results, including data for comparison between products (single value descriptors) and input data for the prediction method (link to EN 12354-5 explained in Annex B).

2 Normative references

The following referenced documents are indispensable for the application 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.

EN ISO 140-1:1997, *Acoustics – Measurement of sound insulation in buildings and of building elements – Part 1: Requirements for laboratory test facilities with suppressed flanking transmission (ISO 140-1:1997)*

EN ISO 140-3:1995, *Acoustics – Measurement of sound insulation in buildings and of building elements – Part 3: Laboratory measurements of airborne sound insulation of building elements (ISO 140-3:1995)*

EN ISO 3741:1999, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for reverberation rooms (ISO 3741:1999)*

EN ISO 10848-1:2006, *Acoustics – Laboratory measurement of the flanking transmission of airborne and impact sound between adjoining rooms – Part 1: Frame document (ISO 10848-1:2006)*

ISO 5348:1998, *Mechanical vibration and shock – Mechanical mounting of accelerometers*

ISO 7626-1:1986, *Vibration and shock – Experimental determination of mechanical mobility – Part 1: Basic definitions and transducers*

ISO 7626-2:1990, *Vibration and shock – Experimental determination of mechanical mobility – Part 2: Measurements using single-point translation excitation with an attached vibration exciter*

ISO 16063-21:2003, *Methods for the calibration of vibration and shock transducers – Part 21: Vibration calibration by comparison to a reference transducer*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
specimen
object of tests according to this European Standard
active building component (to be connected to building structures)

3.2
whirlpool bath
completely assembled unit which comprises a bath, water and/or air agitating device and associated electrical installation and in which noise and vibration control treatments such as resilient mounts can be included

3.3
overflow level
level at which water in the bath will start to flow through any overflow pipe

3.4
reception plate power component
structural power, measured in laboratory, injected to each plate of the test rig

3.5
point mobility of a plate
frequency dependent ratio of the complex (amplitude and phase) vibrational velocity that a point force produces at its point of application, to the (complex) force applied, both force and velocity being normal to the plate

3.6
characteristic mobility of a plate
point mobility of an infinite plate that has the same thickness and that is made of the same material as the plate considered

3.7
characteristic reception plate
fictive plate having a constant input mobility of 5 10^{-6} m/Ns

NOTE See 9.5.3.

3.8
installed power component
structural power (calculated) injected to each building element to which the equipment is connected (input datum for the prediction method)

3.9
reference structure borne sound pressure level
structure borne sound pressure level obtained when mounting the equipment in the reference building

3.10
reference building
well defined building configuration in which the equipment is fictively mounted and used when comparing products

4 Symbols

A list of the symbols and units used in this European Standard is given in Annex A.

5 Principle of the test method

5.1 Airborne sound measurement

The specimen is mounted inside the test room. The sound in the test room, produced as airborne sound radiated from the object, is measured. The source sound power is then estimated from the measured sound corrected for background noise, and from the measured reverberation time of the test room. Later in the process of calculation, a single value descriptor for the source sound power is calculated (see Clause 10).

NOTE The structure borne sound radiated by the structures, to which the specimen is connected, is usually much lower than the airborne sound and can be neglected; nevertheless, the validity of this assumption can always be checked afterwards by calculating the structure borne contribution using the prediction method given in EN 12354-5 and by comparing the result to the airborne sound measured.

5.2 Structure borne sound measurement

The specimen is connected to a three plate test rig. The spatially averaged vibration velocities of the three plates (reception plates) are measured. The three structural powers injected to the plates are then estimated from the measured velocities corrected for background vibration and from the measured structural reverberation times of the plates. The results are then corrected for the difference in input mobility between the reception plates used and a characteristic reception plate, leading to three characteristic reception plate power components (see Clause 9), which can be used in round robin tests.

Later in the process of calculation, a single value descriptor for the source structural power is calculated (see Clause 10).

6 Measuring equipment

6.1 Requirements for the frequency range

Throughout this standard the frequency range is limited to the twenty one 1/3 octave bands with mid-frequencies from 50 Hz to 5000 Hz.

NOTE Guidance for airborne sound measurements at 1/3 octaves 50 Hz, 63 Hz and 80 Hz is given in EN ISO 140-3:1995, Annex F.

6.2 Requirements for the acoustic measuring equipment

The measuring equipment shall comply with the requirements of EN ISO 140-3:1995, Clause 4.

6.3 Requirement for the vibration measuring equipment

The vibration transducers used shall be calibrated according to ISO 16063-21:2003 and fixed according to ISO 5348:1998.

7 Test facilities

7.1 Test room

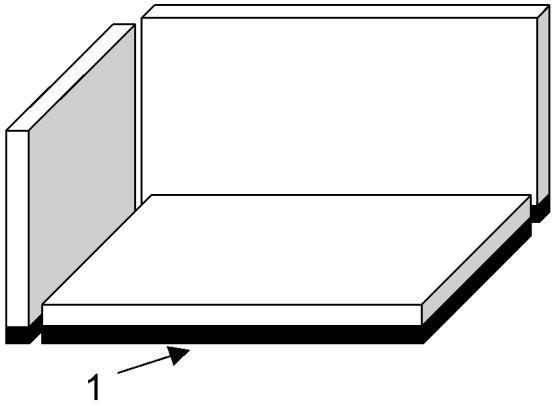
7.1.1 Construction requirements

For airborne sound measurements, the test room shall have a volume of at least 50 m^3. Each of the test room walls shall not be less than 3,5 m wide and shall have a minimum mass per surface area of 230 kg/m^2 if the equipment is directly connected to it.

7.1.2 Acoustic requirements

According to EN ISO 140-1:1997, the reverberation time shall be in the range 1s - 2s.

7.2 Three plate test rig



Key

1 Resilient material

Figure 1 — Schematic drawing of the three plate test rig

The three plates shall be isolated from each other (see Figure 1), the corresponding velocity level difference, measured according to EN ISO 10848-1 without the equipment installed, being greater than 10 dB in each frequency band.

The three plates shall be made of concrete (density of 2300 ± 200 kg/m^3), have a thickness of 10 ± 1 cm, a minimum surface area of 5 m^2 and preferably more than 7 m^2, a ratio length/width close to $\sqrt{2}$ and a minimum loss factor at low frequencies (50-100 Hz) of 8 %. The loss factor η can be estimated from the structural reverberation time T_s of the plate using:

$$\eta = 2{,}2 / (f\, T_s) \quad (1)$$

The minimum dimension of the plates must be equal or greater than the maximum dimension of the specimen. The specimen must not overhang the edge of the reception plate when installed.

The example of an existing three plate test rig is given in Annex D.

8 Mounting of the specimen

The mounting is performed exactly according to the instructions given by the manufacturer (or distributor or other interested party) of the product; it shall be described in full detail in the test report. The bathtub is measured with skirt according to the instructions given by the manufacturer.

If the three plate test rig is located in the test room, the measurement of airborne and structure borne sound power can be made sequentially on the same setup of the specimen; the bathtub is connected to the three plate test rig as in real building, according to the instructions given by the manufacturer.

If the three plate rig is not installed in the test room, then the measurements of airborne and structure borne sound power are made separately; for the airborne sound measurements, the bathtub is installed in a corner of the test room or as near to it and connected to the walls and floor as in real building, according to the instructions given by the manufacturer.