

Acoustic properties of building elements and of buildings - Laboratory measurement of structure-borne sound from building service equipment for all installation conditions

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN 15657:2017 sisaldab Euroopa standardi EN 15657:2017 ingliskeelset teksti.	This Estonian standard EVS-EN 15657:2017 consists of the English text of the European standard EN 15657:2017.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 19.07.2017.	Date of Availability of the European standard is 19.07.2017.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 91.120.20

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:  
Koduleht [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage [www.evs.ee](http://www.evs.ee); phone +372 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

English Version

Acoustic properties of building elements and of buildings -  
Laboratory measurement of structure-borne sound from  
building service equipment for all installation conditions

Propriétés acoustiques des éléments de construction et  
des bâtiments - Mesurage en laboratoire des bruits  
structuraux des équipements de bâtiment pour toute  
condition d'installation

Akustische Eigenschaften von Bauteilen und von  
Gebäuden - Messung des Körperschalls von  
haustechnischen Anlagen im Prüfstand für alle  
Installationsbedingungen

This European Standard was approved by CEN on 11 May 2017.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

# Contents

Page

European foreword.....	4
Introduction .....	5
1 Scope.....	6
2 Normative references.....	6
3 Terms and definitions .....	7
4 Frequency range of measurement.....	9
5 Installed power determination.....	9
6 Direct measurement of source quantities.....	11
6.1 Source free velocity squared measurement.....	11
6.1.1 Measurement procedure.....	11
6.1.2 Expression of the results .....	11
6.2 Direct measurement of mobility (source and receiver) .....	11
6.3 Source single equivalent blocked force squared .....	12
7 Indirect measurement of source quantities (Reception plate method).....	12
7.1 Principle of the method .....	12
7.2 Source single equivalent blocked force .....	13
7.2.1 Source single equivalent blocked force squared determination.....	13
7.2.2 Low mobility reception plate(s) .....	13
7.2.3 Mounting of the source specimen .....	14
7.2.4 Link to EN 15657-1:2009.....	14
7.3 Source single equivalent free velocity .....	14
7.3.1 Source single equivalent free velocity determination.....	14
7.3.2 High mobility reception plate.....	15
7.3.3 Mounting of the source specimen .....	15
7.4 Source single equivalent mobility.....	15
8 Precision.....	15
8.1 Round Robin .....	15
8.2 Repeatability.....	15
8.3 Reproducibility .....	15
9 Expression of results.....	16
10 Test report.....	16
Annex A (normative) List of symbols .....	17
Annex B (normative) Specifications for Whirlpool baths.....	19
B.1 Scope .....	19
B.2 Specifications for whirlpool baths .....	19
B.2.1 Mounting of the specimen.....	19
B.2.2 Operating conditions .....	19
B.2.3 Expression of results.....	19
B.3 Operating conditions for the tub filling phase, using a reference water jet.....	19

<b>B.3.1</b>	<b>General .....</b>	<b>19</b>
<b>B.3.2</b>	<b>Specification for a defined water jet.....</b>	<b>20</b>
<b>B.3.3</b>	<b>Test procedure .....</b>	<b>20</b>
	<b>Annex C (normative) Power substitution method.....</b>	<b>22</b>
<b>C.1</b>	<b>General .....</b>	<b>22</b>
<b>C.2</b>	<b>Principle of the method.....</b>	<b>22</b>
<b>C.3</b>	<b>Measuring procedure.....</b>	<b>22</b>
<b>C.4</b>	<b>Specifications for low mobility plates.....</b>	<b>23</b>
<b>C.5</b>	<b>Specifications for high mobility plates.....</b>	<b>23</b>
	<b>Annex D (informative) Link to models predicting structure borne sound pressure levels.....</b>	<b>24</b>
<b>D.1</b>	<b>General .....</b>	<b>24</b>
<b>D.2</b>	<b>Link to EN 12354-5.....</b>	<b>24</b>
<b>D.2.1</b>	<b>General .....</b>	<b>24</b>
<b>D.2.2</b>	<b>Low mobility receiver.....</b>	<b>24</b>
<b>D.2.3</b>	<b>High mobility receiver .....</b>	<b>25</b>
<b>D.3</b>	<b>Link to EN ISO 12354-2.....</b>	<b>25</b>
	<b>Annex E (informative) Reference structure borne sound power calculation.....</b>	<b>26</b>
<b>E.1</b>	<b>General .....</b>	<b>26</b>
<b>E.2</b>	<b>Low mobility reference test rig .....</b>	<b>26</b>
<b>E.3</b>	<b>High mobility reference test rig .....</b>	<b>26</b>
	<b>Annex F (informative) Example of existing test rigs.....</b>	<b>27</b>
<b>F.1</b>	<b>Low mobility reception plates .....</b>	<b>27</b>
<b>F.2</b>	<b>High mobility reception plate .....</b>	<b>29</b>
	<b>Bibliography .....</b>	<b>30</b>

## European foreword

This document (EN 15657:2017) 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 January 2018, and conflicting national standards shall be withdrawn at the latest by January 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15657-1:2009.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## Introduction

This European Standard is the result of merging two documents dealing with laboratory characterization of service equipment: former standard EN 15657-1:2009, which was restricted to receivers of mobility much lower than the source mobility, and draft prEN 15657-2, valid for all installation conditions.

The characterization leads to the determination of the equipment installed structure-borne power, which depends on the source and the receiver, using expressions which have been simplified and approximated in order to use 1/3 octave single equivalent quantities, easily measurable in laboratories for input data for predictions.

The laboratory method for measuring airborne sound, part of former EN 15657-1, is not included in this revised standard. If a measurement of the airborne sound power of the equipment is required, then the methods described in EN ISO 3740 to EN ISO 3747 should be used.

## 1 Scope

This European Standard specifies methods for estimating the structure-borne sound power produced in buildings by services equipment (sources) from measurements under laboratory conditions. The data can be used as explained in Annex D, as input for EN 12354-5, or under certain conditions for EN ISO 12354-2, to calculate the sound pressure levels produced by the same equipment when installed in buildings. The data can also be used to compare the performance of products as explained in Annex E.

As for the document predicting the structure-borne sound levels produced in the buildings by service equipment (EN 12354-5), this European Standard covers water supply and sanitary installations, mechanical ventilation, heating and cooling devices, service equipment, lifts, rubbish chutes, boilers, blowers, pumps, motors and other auxiliary service equipment, such as motor driven car park doors; it can also be applied to other vibrating equipment attached to or installed in buildings. This standard is so far restricted to steady-state vibrating sources.

This revised European Standard:

- specifies laboratory measuring methods for determining the source input data required to calculate the source installed power, i.e. the equipment free velocity, the equipment blocked force and the equipment mobility;
- applies to equipment, which can be connected to isolated plates in the laboratory. For equipment, such as pipe systems or impacted lightweight stairs [16], which are connected to at least two building elements (wall and floor), a coupled reception plate system is specified, which requires the use of a power substitution method. The later method can also be used *in situ* when the equipment, such as lifts, can only be tested *in situ*;
- defines the expression of the source installed structure-borne power for any source-receiver mobility conditions, including lightweight and heavyweight receiving building elements. This power is used as input data in EN 12354-5, which predicts the sound pressure level generated by the source installed *in situ* in a building;
- defines a method to calculate the total structure-borne sound power generated by the equipment fictively mounted on two sets of reference test plates (respectively of low mobility and of high mobility); the two results will inform the manufacturers on the difference in the equipment performance between these two common but very different situations;
- does not specify any method for the measurement of the source airborne sound power. If measurements of the equipment airborne sound power are required, then refer to EN ISO 3740 to EN ISO 3747 and use the same source mounting conditions and operating conditions as in measuring using EN 15657.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 10140-3, *Acoustics - Laboratory measurement of sound insulation of building elements - Part 3: Measurement of impact sound insulation (ISO 10140-3)*

EN ISO 10848-1, *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, *Mechanical vibration and shock — Mechanical mounting of accelerometers*



ISO 7626-1:2011, *Mechanical vibration and shock — Experimental determination of mechanical mobility — Part 1: Basic terms and definitions, and transducer specifications*

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

ISO 7626-5, *Vibration and shock — Experimental determination of mechanical mobility — Part 5: Measurements using impact excitation with an exciter which is not attached to the structure*

ISO 9611, *Acoustics — Characterization of sources of structure-borne sound with respect to sound radiation from connected structures — Measurement of velocity at the contact points of machinery when resiliently mounted*

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

ISO 18312-1, *Mechanical vibration and shock — Measurement of vibration power flow from machines into connected support structures — Part 1: Direct method*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. A list of the symbols and units used in this standard is given in Annex A.

#### 3.1

##### **source**

service equipment or component of service equipment under test

#### 3.2

##### **receiver**

building element to which the service equipment is to be attached, that can be a floor or a wall or a combination of floor and walls

Note 1 to entry: For the laboratory test, the receivers are reception plates, details of which are described in Clause 7.

#### 3.3

##### **source free velocity squared**

$v_{f,RMS}^2$

expression of source activity, in terms of RMS value, at each of the contacts (the connections with the receiver building elements when installed), with the source either freely suspended (disconnected from the receiver) or connected to a much higher mobility receiver called high mobility reception plate (see Clause 7), when operating under conditions described in the test report

#### 3.4

##### **single equivalent source free velocity squared**

$v_{f,RMS,eq}^2$

expression of the source activity, in terms of RMS value, which is obtained either as the sum of the squared RMS free velocities over the  $N$  contacts,

$$v_{f,RMS,eq}^2 = \sum_i^N v_{f,RMS,i}^2 \quad (1)$$

or approximately from the high mobility reception plate power defined in 7.3.2