SLOVENSKI STANDARD
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Laboratorijsko merjenje hrupa pri napeljavah za odpadno vodo

Laboratory measurement of noise from waste water installations

Messung der Geräusche von Abwasserinstallationen im Prüfstand

Mesurage en laboratoire du bruit émis par les installations d'évacuation des eaux usées

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17.140.20	Emisija hrupa naprav in opreme	Noise emitted by machines and equipment
91.140.80	Drenažni sistemi	Drainage systems

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Messung der Geräusche von Abwasserinstallationen im Prüfstand

This European Standard was approved by CEN on 23 September 2004.

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Contents

Foreword

This document (EN 14366:2004) 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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

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

Introduction

Noise from wastewater installations is generated by the flow and fall of water in the piping system. There are many different ways to install such systems in buildings, depending on national building codes. They may be firmly cemented into walls and floors, fixed by clips in walls and covered slabs, or hung exposed in the plenum above a suspended ceiling. It seems advisable, therefore, to define measuring methods for both structure-borne and airborne sound.

Important noise sources are bends after vertical sections, but also discontinuities, e.g. inlets, couplings and sleeves. Apart from that the noise impact on the inhabitants of a building strongly depends on the material properties of the pipes, on the methods used in joining and fastening them and on the local building practice.

1 Scope

This document:

— specifies methods for the measurement of airborne and structure-borne sound produced in waste water and rain water installations under laboratory conditions;

— defines the expression of the results.

It is applicable to waste water piping systems and parts thereof, but not to the actual sources of the wastewater, e.g. lavatories, toilets and bathtubs or any active units. It applies to pipes with natural ventilation and made of any common material in commonly used diameters (up to 150 mm).

The results obtained can be used for the comparison of products and materials. It may serve in estimating the behaviour of waste water systems in a building under certain conditions. Nevertheless, this standard does not provide a normalized procedure for calculating the acoustical properties of such installations in a building.

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 61672-1, *Electroacoustics - Sound level meters - Part 1: Specifications (IEC 61672-1:2002).*

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 354, *Acoustics – Measurement of sound absorption in a reverberation room (ISO 354:2003).*

EN ISO 6926, *Acoustics – Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels (ISO 6926:2000).*

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

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

3 Terms and definitions

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

3.1
waste water
any type of water including rainwater evacuated from buildings into the sewer system

3.2
waste water installation
the total of pipes and all fixing components, used to evacuate waste water, but excluding the actual sources of the waste water, e.g. sinks, toilets, bathtubs, gutter or any active units (pumps…)

3.3
specimen
object of tests according to this standard. Specimens are simple wastewater installation systems with a single path of water flow. Any combination of commercial elements may be assembled to form a specimen

3.4
source room
test room used for airborne sound measurement; the specimen is mounted inside the test room

3.5
receiving room
test room used for structure-borne sound measurement; the specimen is mounted outside the test room

3.6
standard configuration
a mandatory form of specimen used for comparison

3.7
standard mounting
mandatory mounting conditions for the standard configuration

3.8
standard test wall
mandatory test wall used for comparison

3.9
wall structural sensitivity
normalised ratio between a point force exciting the test wall and the sound power radiated by the test wall. The wall structural sensitivity is measured according to a reciprocity method described in Annex A

3.10
reference wall
standardized wall of 250 kg/m^2 used for normalisation of the measurement results and described by a reference structural sensitivity spectrum (given in clause 9)

3.11
frequency range of measurement
range in 1/3 octave bands over which measurements are carried out

4 Notations

f	frequency in Hz
T_e	reverberation time measured in the source (emission) room, in seconds (according to EN ISO 354)
T_r	reverberation time measured in the receiving room, in seconds
V_e	volume in the source room in cubic metres
V_r	volume in the receiving room in cubic metres
L'_s	average sound pressure level due to structure-borne sound measured in the receiving room (according to EN ISO 140-3) before correction for background noise, in decibels
L'_t	average total sound pressure level measured in the source room (according to EN ISO 140-3) including airborne and structure-borne sound, before correction for background noise, in decibels
L_B	measured background sound pressure level, in decibels
L_s	structure-borne sound pressure level after correction for background noise, in decibels
L_t	total sound pressure level after correction for background noise, in decibels
L_{sn}	structure-borne sound pressure level normalized to an equivalent absorption area of 10 m^2, in decibels
L_{tn}	total sound pressure level normalized to an equivalent absorption area of 10 m^2, in decibels
L_{an}	airborne sound pressure level normalized to an equivalent absorption area of 10 m^2, in decibels
$L_{s,A}$	A-weighted structure-borne pressure level, in decibels
$L_{a,A}$	A-weighted airborne sound pressure level, in decibels
D_A	attenuation values of the A-weighted filter, in decibels
T_m	measuring time, in seconds
L_{SS}	wall structural sensitivity level, in decibels
L_{SSR}	structural sensitivity level of the reference wall, in decibels
ΔL_{SS}	structural sensitivity correction in decibels : $\Delta L_{SS} = L_{SS} - L_{SSR}$
L_{sc}	structure-borne sound characteristic level, in decibels : $L_{sc} = L_{sn} - \Delta L_{SS}$
L_W	sound power level (ref 10^{-12} watts) of the sound reference source, in decibels
L'_v	vibration velocity level (ref 10^{-9} m/s) at the clamp fixing, in decibels, before correction for background vibration
L_v	vibration velocity level (ref 10^{-9} m/s) at the clamp fixing, in decibels, after correction for background vibration

5 Principle of the test method

5.1 Structure-borne sound measurements (index s)

The specimen is mounted outside the test room (receiving room), connected as in practice to the test wall using the fixing material specified by the manufacturer of the system. A steady flow of tap water is applied and the total sound transmitted into the test room is measured (L'_s). The specimen is then disconnected from the test wall and the water system operated in order to measure the background noise. The values L'_s are then corrected for background noise giving the values L_s. These values are then normalized (see 9.5) to an equivalent absorption area of 10 m^2 using the measured reverberation time T_r of the receiving room giving the values L_{sn}.

After the last step, the results are corrected for the difference in structural sensitivity between the test wall used and the reference wall (correction given in clause 9).

5.2 Airborne sound measurement (index a)

The specimen is mounted on a test wall inside the test room (source room). Appropriate openings in the ceiling and in the floor are provided. A steady flow of tap water is applied. The sound in the test room, produced as airborne sound radiated directly from the object but also as structure-borne sound radiated by the wall is measured (L'_t). The water flow is stopped in order to measure the background noise. The values L'_t are then corrected for background noise giving the values L_t and normalized to an equivalent absorption area of 10 m^2 using the measured reverberation time T_e of the source room giving the values L_{tn}.

Later in the progress of calculation the structure-borne contribution is subtracted giving the values L_{an}.

6 Equipment

6.1 Requirements for the frequency range of measurement

Throughout this standard the frequency range is limited to the eighteen 1/3 octave bands with mid-frequencies from 100 Hz to 5 000 Hz. If additional information is required in the low frequency range, measurements at 1/3 octaves 50 Hz, 63 Hz and 80 Hz can be made; guidance for such additional measurements is given in EN ISO 140-3:1995 Annex F.

6.2 Requirements for the acoustic equipment

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

6.3 Requirements for the hydraulic equipment

The hydraulic equipment shall be able to generate flow rates between 0,5 l/s and an upper limit depending on the inner diameter of the tested specimen (given in 9.2). The equipment shall be able to measure the flow with an accuracy of 5 %.

6.4 Requirements for the wall structural sensitivity measuring equipment

The reciprocity method requires the use of a reference sound source calibrated according to EN ISO 6926. The vibration transducer used shall be calibrated according to ISO 16063-21 and fixed according to ISO 5348.

7 Test facilities

7.1 Construction requirements

7.1.1 Test room

The test room shall have a volume of at least 50 m^3 and an interior height of (3,0 ± 0,5) m. The test wall shall not be less than 3,5 m wide. Openings in the ceiling and in the floor are provided for the installation of the test objects.

A combination of two adjacent test rooms may be advantageous, allowing the simultaneous measurement of the airborne and the structure-borne sound.

Additional space above and below the test room is required to ensure the standardised falling height of the measured system of about 6 m (see 8.1.2.).

7.1.2 Test wall

A single wall built of bricks, blocks or poured concrete shall be defined as the standard test wall; hollow bricks or blocks are not allowed. Its mass per unit area, including a coat of mineral based plaster on both sides, shall be (200 ± 50) kg/m^2.

Any other mass per unit area can be used, as long as the applicability condition defined in Annex A.2 is fulfilled.

7.2 Acoustic requirements

According to EN ISO 140-3, the reverberation time shall be in the range 1s – 2s.

8 Test specimen

8.1 Geometry

8.1.1 Components

The objects tested according to this standard consist of systems of wastewater installations with a single path of the water flow. They consist of:

— an inlet, part of the test object according to Figure 1;

— any combination of straight pipes with tees, bends, joints and inlets, mounted on the test wall;

— a basement bend of totally approximately 90 degree angle, being part of the specimen.

8.1.2 Falling height *h*

The falling height *h* shall be in the range 5,8 m – 7,5 m, measured between the inlet point and the impact point (Figure 2). The inlet point is given as the intersection of the axis of the inlet tube with the axis of the vertical pipe; the impact point is defined by the intersection of the vertical pipe axis with the wall of the basement bend.