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Acoustics — Laboratory measurement of sound insulation of building elements —

Part 5: Requirements for test facilities and equipment

AMENDMENT 1: Rainfall sound

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

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

AMENDEMENT 1: Bruit produit par la pluie

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Foreword

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The committee responsible for this document is ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*.

Acoustics — Laboratory measurement of sound insulation of building elements —

Part 5:
Requirements for test facilities and equipment

AMENDMENT 1: Rainfall sound

Page v, Introduction

Delete the last sentence before Table 1.

Page 8, 4.1

Add the following paragraph as the third and last paragraph.

> For these and other measurements also reference objects could be defined to calibrate the test facility; see Annex I for the measurement of rainfall sound as an example.

Page 9, 5.2

Add the following paragraph as the third and last paragraph.

> Annex H gives information on an artificial rain source to be used to characterize the generation of rainfall sound by building elements, as explained in ISO 10140-1:2010, Annex K.

Pages 34 to 35

At the end of Annex G, and before the Bibliography, insert new Annex H and Annex I (see below).

Annex H
(normative)

Specification of heavy and intense rain with example of a tank with perforated base

H.1 Specification of artificial rain production

Two different tanks with different perforated bases are required for artificial raindrop production; one for heavy type rain (mandatory) and the second for the intense type rain (only recommended if lower rainfall rates are needed). Based on the classification of rainfall, see ISO 10140-1:2010, Annex K, the specifications for these two types of rain are given in Table H.1. Upper limits have been chosen since larger drops produce most of the sound generated.

Table H.1 — Characteristic parameters for generation of artificial raindrops

Rainfall type	Rainfall rate mm/h	Volume median drop diameter mm	Fall velocity m/s
Intense	15	2,0	4,0
Heavy	40	5,0	7,0

The rainfall rate is the depth of water layer created by spreading the rainfall on a horizontal surface in a 1 h time interval. The volume median drop diameter is the value when 50 % of the total volume of water sprayed is made up of drops with diameter larger than the median value and 50 % with smaller diameter.

The appropriate specifications for the perforated bases are given in Table H.2. The tanks are made from polycarbonate plates of thickness 1 cm; the base is reinforced by metal strips.

Table H.2 — Specifications

Parameters of tank with perforated base		Intense	Heavy
1	Diameter of holes	0,3 mm to 0,5 mm	1 mm
2	Number of holes per unit area	Approx. 25 m^{-2}	Approx. 60 m^{-2}
3	Fall height	Approx. 1 m	Approx. 3,5 m
4	Volume median drop diameter	2 mm	5,0 mm
5	Distribution of drop size	Max. uniformity	Max. uniformity
6	Fall velocity at fall height	4 m/s	7 m/s
7	Rainfall rate	15 mm/h	40 mm/h
8	Water supply	To allow a constant height of water in the tank (50 mm to overflow limit)	

If the tank with perforated base does not correspond to the geometrical characteristics given above, the drop size, impact velocity and rainfall rate shall be measured as mentioned in ISO 10140-1:2010, Annex K,

and correspond to the values given in Table H.1. Tolerances on the three characteristic parameters for artificial raindrops generation given in Table H.1 are as follows:

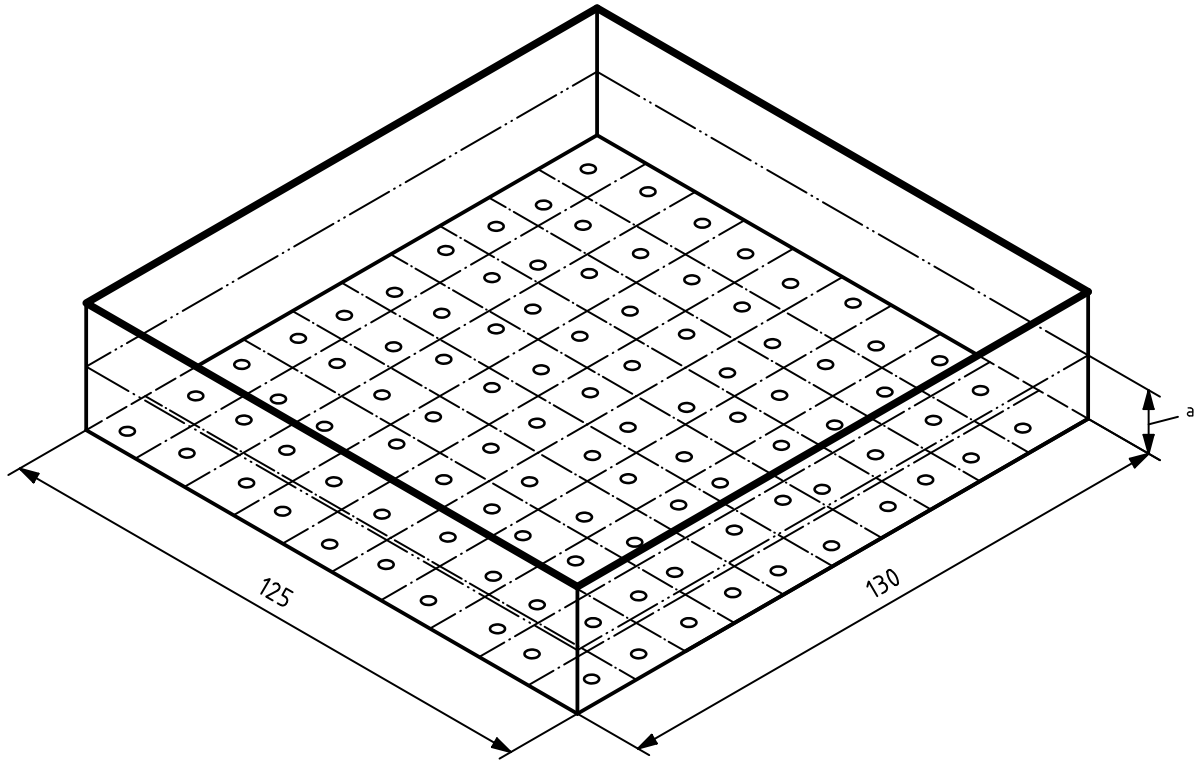
— the rainfall rate shall be within ±2 mm/h of the rainfall rate given in Table H.1;

— 50 % of the drops should be within ±0,5 mm of the volume median drop diameter, given in Table H.1;

— 50 % of the drops should be within ±1 m/s of the fall velocity given in Table H.1.

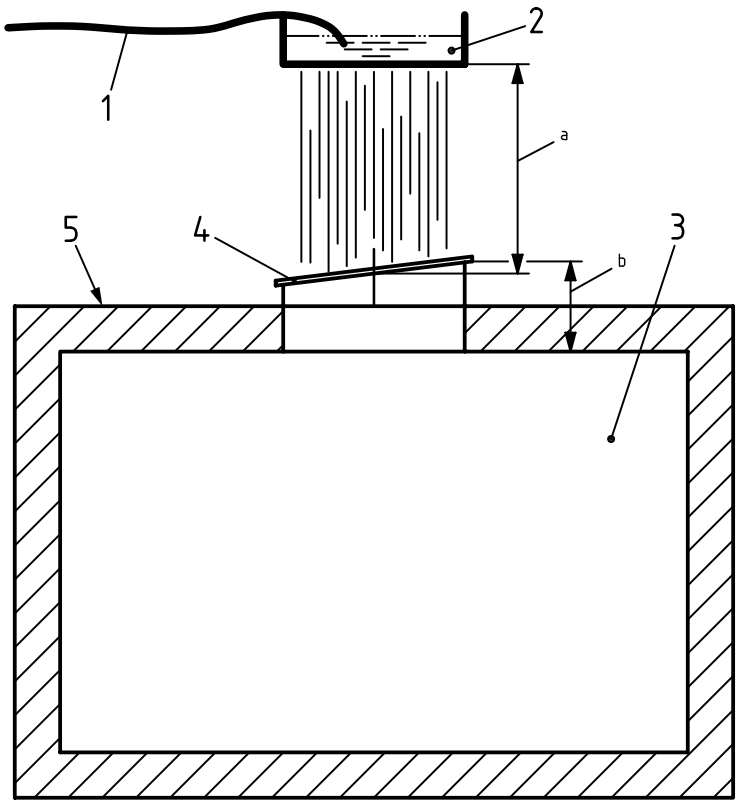
The fall height is evaluated from Figure 6 of Reference [20].

Dimensions in centimetres



a Typical water height.

Figure H.1 — Schematic diagram of tank with perforated base



Key

1 water-supply system
2 tank with perforated base
3 test room
4 test specimen
5 water drainage (arranged by user)
a Fall height.
b Height of the niche.

Figure H.2 — Typical test arrangement

H.2 Rain production for generation of artificial raindrops

H.2.1 General

The artificial raindrop generation system, when connected to a water supply, is capable of generating water drops of uniform diameter in a full water spray pattern. The water supply to generate artificial raindrops may be either a closed loop type or a continuous type that enables continuous generation of constant diameter water drops over a long period of time.

H.2.2 Artificial raindrop generation system

The artificial raindrop system shall be a tank with a perforated base capable of generating water drops with the specification given in Table H.2 in a full spray pattern. The perforations on the tank base should be distributed over a minimum area of 1,6 m^2, thus totally covering smaller test specimens in the standard configuration with a 30° slope; a random distribution is preferred rather than a uniform distribution (see Figure H.1).

The water supply pressure and the number of perforations shall be chosen so that the water height in the tank is constant and allows the rainfall rate given in Table H.2 to be generated by the perforated tank. The perforation characteristics (diameter) of the tank base shall be chosen so that water drops with the volume median drop diameter given in Table H.2 are produced by the perforated tank. The fall height of the artificial raindrops shall be adjusted such that either the measured or the theoretically calculated fall velocities based on perforation dimensions, water pressure and fall height are as given in Table H.2. For the determination of the fall height for inclined surfaces, see Figure H.2.

H.2.3 Calibration of the raindrop generation system

The artificial raindrop generation system shall be calibrated.

If a water tank system is used and therefore follows the geometrical characteristics given above, only the rainfall rate shall be checked by collecting the water over a given area over a precisely measured time period; the measurement of the rainfall rate allows a quick and simple method for periodic verification of the artificial raindrop generation system.

If another system is selected in order to generate other types of rainfall, the rainfall type characteristics, i.e. the drop size, drop velocity and rainfall rate, shall be given by the manufacturer; if they are not available, they should be measured. Here again, the measurement of the rainfall rate allows a quick and simple method for periodic verification of the artificial raindrop generation system.

NOTE There are several non-intrusive methods to measure drop size and drop velocity as, for example, imaging analysers consisting of a light source (typically a strobe light), a video camera and a computer, or phase Doppler particle analysers consisting of a transmitter, a receiver, a signal processor and a computer.

Annex I
(informative)

Reference test specimens for rainfall sound measurements

I.1 General

Standard reference test specimens are described in this annex for quality control and to check the reproducibility of laboratory rain sound measurements in different laboratories. Details of the reference test specimens are as follows.

I.2 Small test specimen

The small reference test specimen is made up of a single glass pane with a thickness of (6 ± 0,1) mm and an area of (1 250 ± 50) mm × (1 500 ± 50) mm (as specified in this part of ISO 10140); the mounting of the glass pane is shown in ISO 10140-1:2010, Annex D, except for the edge used for water drainage. The position of the artificial rainfall generation system is centred with respect to the test specimen.

WARNING — The single glass pane might break during handling. Therefore, the use of thermally toughened safety glass is strongly recommended. Special care should be taken during handling.

To calibrate the mounting conditions of the reference test specimen, the structural decay time, T_s, should be measured according to ISO 10140-4, from which the total loss factor, η, of the reference specimen is calculated, using:

$$\eta = \frac{2{,}2}{f\,T_s} \tag{I.1}$$

The sound intensity level, $L_{I,\mathrm{ref}}$, obtained according to ISO 10140-1:2010, Annex K, for the reference specimen, is then corrected for the difference between the measured loss factor, η, and the reference loss factor, η_{ref}, given in Table I.1, using:

$$L_{I,\mathrm{m,ref}} = L_{I,\mathrm{ref}} + 10\lg\frac{\eta}{\eta_{\mathrm{ref}}}\ \mathrm{dB} \tag{I.2}$$

A correction, ΔL_{Ic}, is then calculated from the difference:

$$\Delta L_{Ic} = L_{I,\mathrm{m,ref}} - L_{Ic,\mathrm{ref}} \tag{I.3}$$

where $L_{Ic,\,\mathrm{ref}}$ is the reference sound intensity level for the small test specimen, given in Table I.1.

I.3 Large test specimen

No reference test specimen is defined.

Table I.1 — Reference loss factor and reference intensity level used for the small reference test specimen

One-third-octave band Hz	**Reference loss factor:** $10\ \lg(\eta_{ref}/\eta_0)$ (η_0 = 1) dB	**Intensity level:** $L_{I,\mathrm{c,ref}}$ dB
100	−10	45
125	−11	45
160	−11	46
200	−12	46
250	−13	47
315	−13	47
400	−14	47
500	−14	47
630	−15	47
800	−15	46
1 000	−16	44
1 250	−17	42
1 600	−17	43
2 000	−18	46
2 500	−18	51
3 150	−19	50
4 000	−19	46
5 000	−20	44

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