PEUTZ

Laboratory for Acoustics

TESTING
RvA L 334

Determination of the improvement of impact sound insulation of cast floors, manufacturer Senso Flooring System

Report number A 3900-3E-RA-002 d.d. 30 september 2020

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Determination of the improvement of impact sound insulation of cast floors, manufacturer Senso Flooring System

Principal	Senso
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1 Introduction

At the request of Senso based in Rhenen (The Netherlands) sound measurements have been carried out in order to determine the reduction of transmitted impact noise of:

cast floors type
BCRETE
FUSION
SUPERQUARTZ
manufacturer Senso Flooring System

in the Laboratory for Acoustics of Peutz bv, at Mook, the Netherlands (see figure 1).

TESTEN
RvA L 334

For these type of measurements the Laboratory for Acoustics has been accredited by the Dutch Accreditation Council (RvA).

The RvA is member of the EA MLA (**EA MLA**: **E**uropean **A**ccreditation Organisation **M**ulti**L**ateral **A**greement: http://www.european-accreditation.org).

EA: "Certificates and reports issued by bodies accredited by MLA and MRA members are considered to have the same degree of credibility, and are accepted in MLA and MRA countries."

2 Standards and guidelines

The measurements have been carried out according to the Quality Manual of the Laboratory for Acoustics aswell as:

ISO 10140-3:2010	Acoustics - Laboratory measurements of sound insulation of building elements – Part 3: Measurement of impact sound insulation
Note:	*The standard ISO 10140-3 is in all countries of the EG accepted as European standard EN ISO 10140-3:2010*

Other related standards:

ISO 10140-1:2016	Acoustics - Laboratory measurements of sound insulation of building elements – Part 1: Application rules for specific products
Note:	*The standard ISO 10140-1 is in all countries of the EG accepted as European standard EN ISO 10140-1:2016*
ISO 10140-4:2010	Acoustics - Laboratory measurements of sound insulation of building elements – Part 4: Measurement procedures and requirements
N.B.	*The standard ISO 10140-4 is in all countries of the EG accepted as European standard EN ISO 10140-4:2010*
ISO 10140-5:2010	Acoustics - Laboratory measurements of sound insulation of building elements – Part 5: Requirements for test facilities and equipment
Note:	*The standard ISO 10140-5 is in all countries of the EG accepted as European standard EN ISO 10140-5:2010*
ISO 717-2:2013	Acoustics - Rating of sound insulation in buildings and of building elements - Part 2: Impact sound insulation
Note:	*This international standard is accepted by all members of the European Union as European standard EN ISO 717-2:2013*

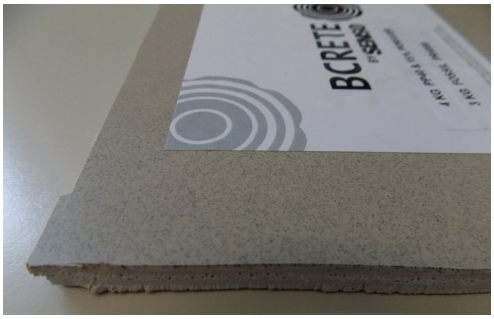
3 Tested construction

The following data have been provided by the principal, supplemented by observations in the laboratory where applicable.

The next floor coverings are investigated:

BCRETE

thickness:	ca. 5 mm
mass:	7,8 kg/m^2 (weighted)



FUSION

thickness:	ca. 8 mm
thickness rubber backing:	ca. 3 mm
mass:	9,6 kg/m^2 (weighted)

SUPERQUARTZ

thickness:	ca. 6 mm
mass:	8,7 kg/m^2 (weighted)

The results as presented here relate only to the tested items and laboratory conditions as described in this report. The laboratory can make no judgement about the representativity of the tested samples. The test report ahead is valid as long as the tested constructions and/or materials are unchanged.

4 Measurements

4.1 Method

The tests were conducted in accordance with the provisions of the test method ISO 10140-3. A detailed description of the test set up has been given in the figures 1 and 2 of this report. For the tested material (see chapter 3) three samples with dimensions of c. 1 m^2 is used.

Two vertically adjacent rooms are used, the upper one being designated the "source room" and the lower one the "receiving room". The rooms are separated by a so called "heavyweight standard floor" on which the covering under test is installed. This floor is a 140 mm thick concrete floor.

By means of an "impact sound generator" as defined in ISO 10140-5, Annex E (also called "tapping machine") the impact sound is generated. This tapping machine has five steel hammers which continuously and in turn fall on the floor in such a way that the floor is excited with a frequency of 10 strokes per second. The impact sound generator's mass is about 12 kg and it is supported by three points resting on the floor or on the covering under test.

The tapping machine is positioned at 6 or more different positions on the standard floor as well as on the covering under test.

In the receiving room the resulting sound pressure level is measured by means of a microphone on a continuously rotating boom, so the (time- and space-) averaged sound pressure level in this room is determined.

The reverberation time of the receiving room is also measured.

4.2 Calculations

The measurements as well as the calculations are made with a 1/3-octave bandwidth from 50 to 5000 Hz. Where applicable octave-band values are calculated from those 1/3-octave bands.

4.2.1 Normalized impact sound level

From the reverberation measurements the equivalent sound absorption A (per frequency-band) is determined (and expressed in m^2) according to the next equation:

$$A = \frac{0{,}16\,V}{T} \qquad (1)$$

in which:

A = the equivalent sound absorption [m^2]

V = the volume of the receiving room [m^3]
T = the reverberation time in the receiving room [s]

Subsequently the normalized impact sound level L_n is calculated according to:

$$L_n = L_i + 10 lg \frac{A}{A_0} \quad (2)$$

in which:
L_n = the normalized impact sound level [dB]
L_i = the average sound pressure level in the receiving room as a result of the impact sound generator on 6 positions [dB]
A = the equivalent sound absorption of the receiving room [m^2]
A_0 = the reference sound absorption (= 10 m^2)

4.3 Reduction of transmitted impact noise

By comparison of the normalized impact sound level of the bare standard floor and of the standard floor with the covering under test the relative reduction in transmitted impact noise can be determined. This procedure will result in the frequency dependant reduction of transmitted impact noise ΔL. The calculations are made according to:

$$\Delta L = L_{n1} - L_{n2} \quad (2)$$

in which:
ΔL = the reduction of transmitted impact noise
L_{n1} = the normalized impact sound level in the receiving room while the tapping machine is on the standard floor
L_{n2} = the normalized impact sound level in the receiving room while the tapping machine is on the covering under test applied on top of the standard floor

4.4 Accuracy

The accuracy of the results may be expressed in terms of repeatability (within one laboratory) and the reproducibility (between different laboratories)

4.4.1 Repeatability r

When: - two tests are performed on identical test material - within a short period of time - by the same person or team - using the same instrumentation - under unchanged environmental conditions - the probability will be 95% that the difference between the two test results will be less than or equal to r.

In order to determine the repeatability of this type of measurements carried out at Peutz a series of measurements were made according to ISO 140-2. From the results it can be concluded that the repeatability r is 1,9 dB (maximum) for the frequency-bands 100 to 250 Hz and 1,0 dB (maximum) for the frequencybands 315 to 3150 Hz.

De repeatability regarding the single number rating L_n is 0,3 dB (maximum), after rounding to an integer dB (as demanded by ISO 717) a repeatability of ±1 dB may be assumed.

From those results it is clear that the repeatability is in agreement with the demands of ISO 140-2.

4.4.2 Reproducibility R

When: - two testst are performed on identical test material - in different laboratories – by different person(s) - under different environmental conditions - the probability will be 95% that the difference between the two test results will be less than or equal to R

Based on various series of measurements ISO 140-2 points out what level of reproducibility may be expected. The reproducibility R of the single number rating ΔL_w will be about 3 dB.

4.5 Environmental conditions during the measurements

t4.1 *Environmental conditions during the measurements*

Measuring room	temperature [°C]	barometric pressure [kPa]	relative humidity [%]
1	19,7	101,2	67

4.6 Results

In figure 3 the normalized impact sound level of the standard laboratory floor with its related single number ratings are presented. The results of the measurements of the floor coverings under test are presented in table I and in figures 4 to 6 of this report.
In this table as well as in the graphs the calculated values are presented in 1/3 octave bands. From those values the following single number rating has been calculated and presented:

- the "weighted reduction of impact sound pressure level ΔL_W" according to ISO 717-2;
- the "single number reduction based on the unweighted linear impact sound pressure level ΔLlin" according to ISO 717-2, Annex A

t4.2 Measurement results

	REDUCTION OF THE TRANSMITTED IMPACT NOISE ΔL					
type cast floor	**BCRETE**		**FUSION**		**SUPERQUARTZ**	
thickness:	ca. 5 mm		ca. 8mm		ca. 6 mm	
record nr.	#28		#36		#44	
figure nr.	4		5		6	
frequency [Hz]	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.
50	3,8		6,2		4,4	
63	6,8	3,6	6,0	3,9	5,8	3,0
80	1,7		1,3		0,6	
100	2,5		2,4		1,7	
125	1,1	1,5	1,4	2,1	3,3	2,3
160	1,0		2,5		2,1	
200	1,9		3,5		2,6	
250	2,1	1,9	4,1	3,8	3,8	2,8
315	1,8		3,9		2,2	
400	0,6		5,2		2,2	
500	1,6	1,2	7,2	7,0	3,0	2,8
630	1,6		10,0		3,2	
800	2,1		16,7		3,7	
1000	2,4	2,6	26,6	21,0	4,1	4,1
1250	3,3		36,2		4,7	
1600	4,3		39,0		6,0	
2000	5,5	5,6	45,2	42,6	7,3	7,3
2500	7,6		50,9		9,3	
3150	10,9		56,8		12,5	
4000	17,1	14,6	60,7	59,1	18,7	16,2
5000	26,0		61,1		27,5	
ΔL_{lin}	2 dB		8 dB		4 dB	
ΔL_{w}	6 dB		18 dB		8 dB	

These results were obtained using a tapping machine with steel hammers and under laboratory conditions. The reduction of transmitted impact noise is depending on the floor on which this covering will be installed. If that situation differs from the laboratory conditions, different results may be expected.

Mook,

Th. Scheers
Laboratory Supervisor

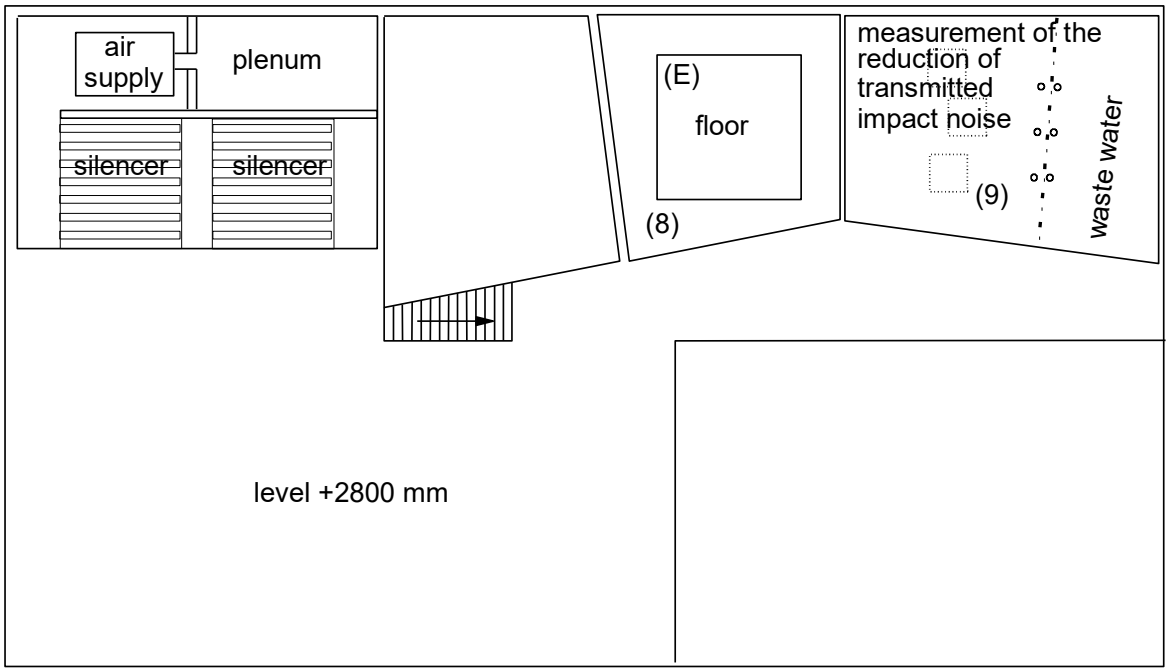
dr. ir. M.L.S Vercammen
Manager

This report contains 11 pages and 6 figures.

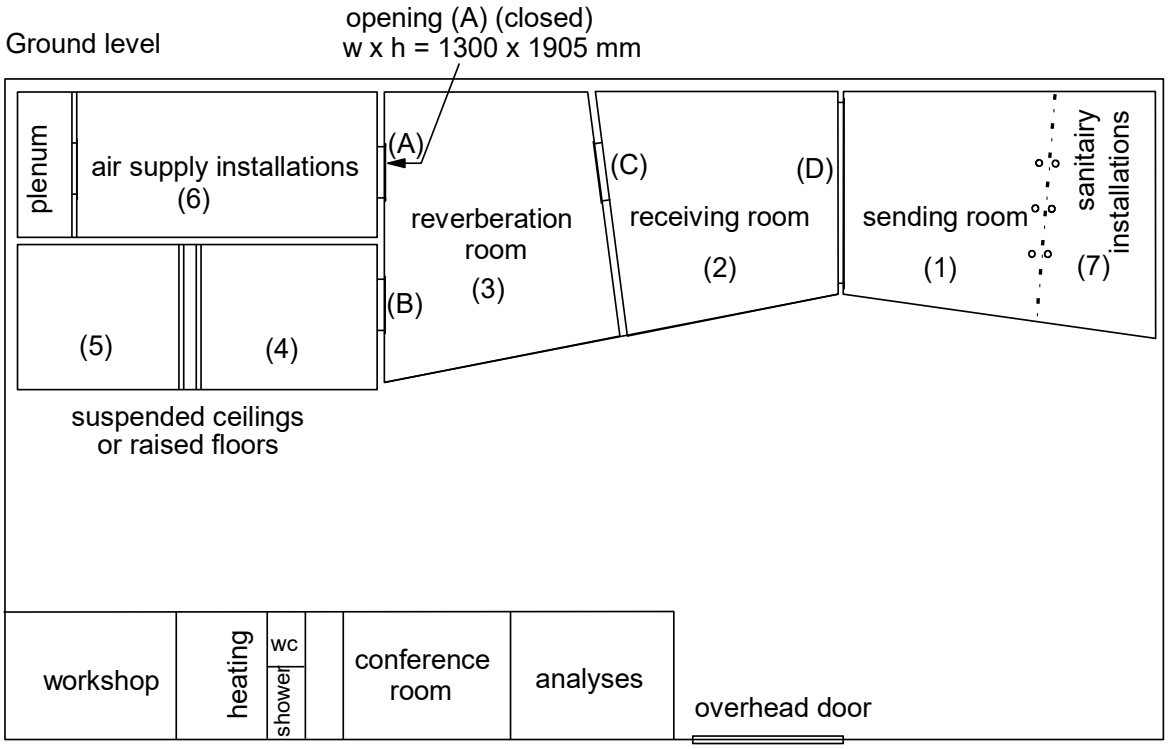
PEUTZ bv
Lindenlaan 41, NL-6584 AC MOLENHOEK (LB), THE NETHERLANDS

OVERVIEW

Story



Ground level



TEST OPENINGS (w x h in mm)
(B) 1000 x 2200
(C) 1500 x 1250
(D) 4300 x 2800
(E) 4000 x 4000

0 1 2 3 4 5 m
scale

PEUTZ bv
Lindenlaan 41, 6584 AC MOLENHOEK (LB), NETHERLANDS

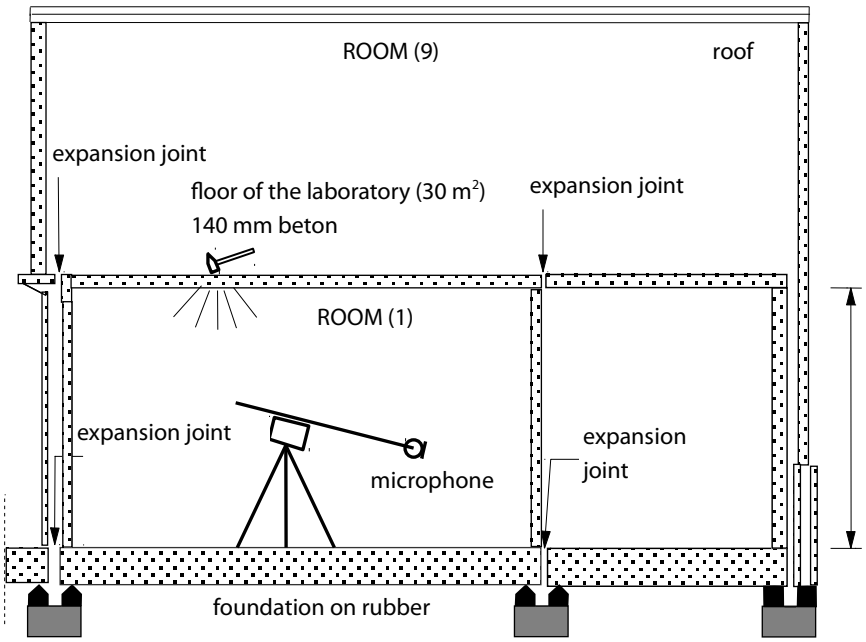
DETERMINATION OF THE REDUCTION OF TRANSMITTED IMPACT NOISE

The testrooms meet the requirements ISO 10140
Additional data: volume of room (1) : 94 m^3

Reverberationtimes of room (1) measured at 28-07-2020

frequency (1/1 oct.)	125	250	500	1000	2000	4000	Hz
reverberationtime	1,83	2,02	2,24	2,31	1,99	1,60	sec.

vertical section



Plan

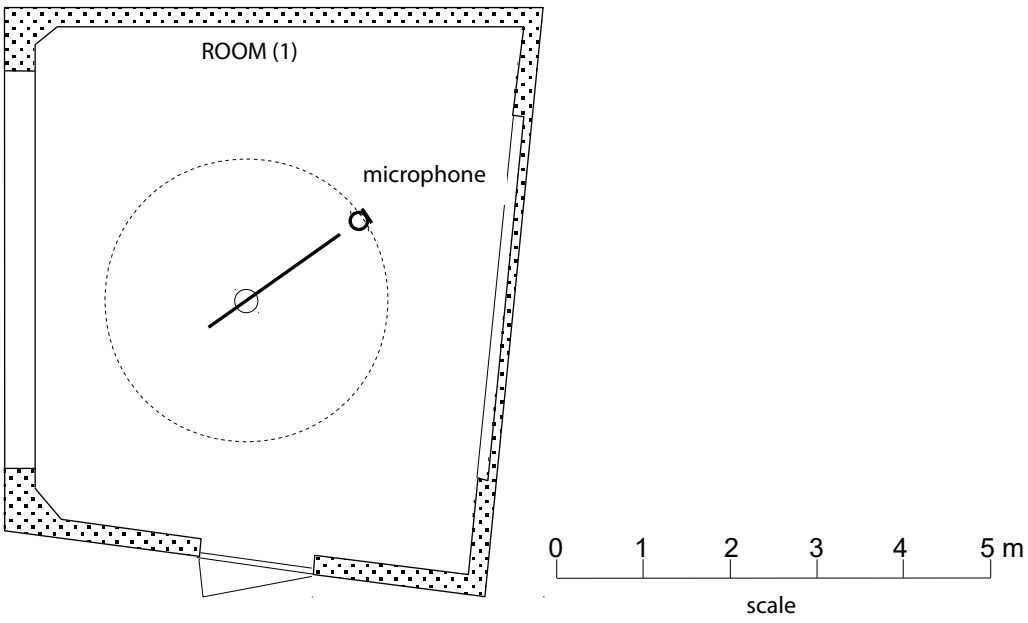


figure 2

LABORATORY FOR ACOUSTICS

THE NORMALIZED IMPACT SOUND PRESSURE LEVEL L_n OF A FLOOR

ACCORDING TO ISO 10140-3:2010

principal: Senso

TESTEN RvA L 334

construction tested: Peutz bare laboratory floor 140mm concrete

volume measuring room: 94 m^3

measured at:
Peutz Laboratory for Acoustics

signal: tapping machine

bandwidth: 1/3 octave

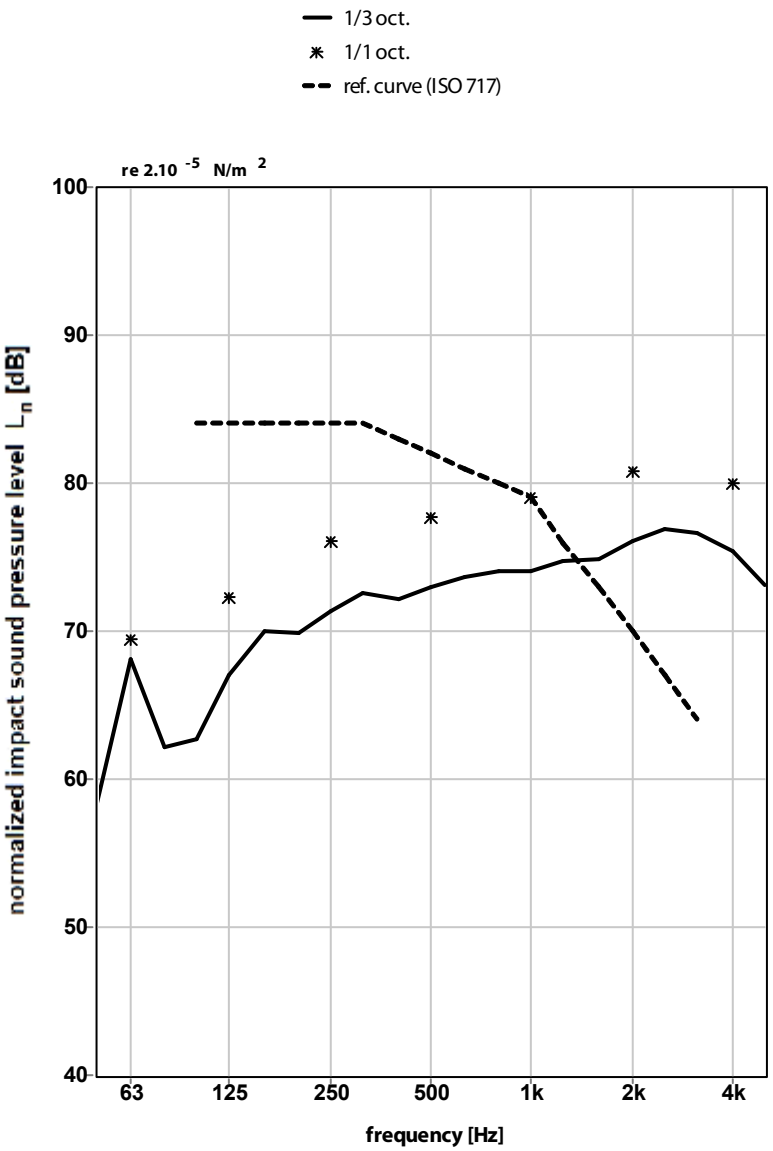
A_0 = 10,0 m^2

ISO 717-2:2013

$L_{n,w}(C_I)$ = 82(-12) dB

NEN 5079:1990

$I_{co,lab}$ = -10 dB



	58,3	62,7	69,8	72,2	74,0	74,9	76,6	
1/3 oct.	68,1	67,0	71,3	73,0	74,1	76,1	75,4	dB
	62,2	70,0	72,5	73,6	74,7	76,9	73,1	
1/1 oct.	**69,4**	**72,3**	**76,1**	**77,7**	**79,0**	**80,8**	**80,0**	**dB**

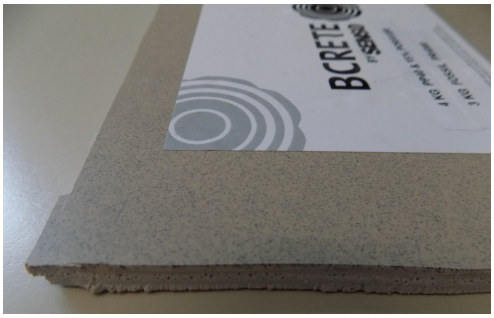
Mook, measured at 09-06-2020

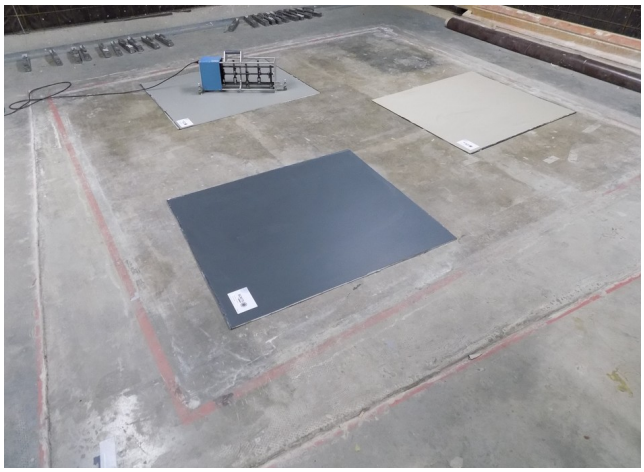
DETERMINING THE REDUCTION OF TRANSMITTED IMPACT NOISE BY FLOOR COVERINGS ACCORDING TO ISO 10140-3:2010

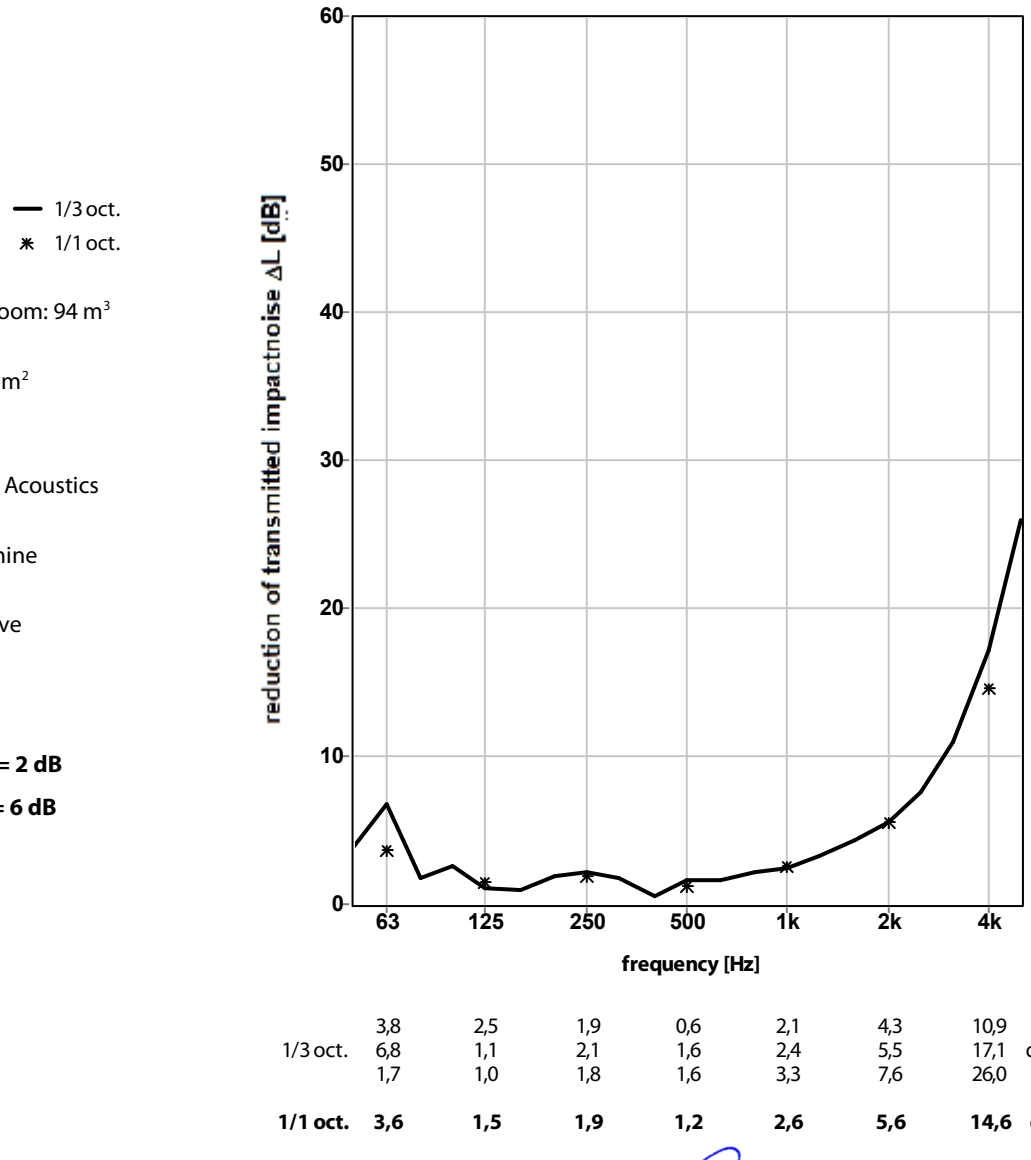
TESTEN RvA L 334

principal: Senso

construction tested:
BCRETE
thickness: ca. 5 mm
mass: 7,8 kg/m^2 (weighted)







volume measuring room: 94 m^3

surface area floor: 1 m^2

measured at:
Peutz Laboratory for Acoustics

signal: tapping machine

bandwidth: 1/3 octave

ISO 717-2:2013
ΔL_{lin} = 2 dB
ΔL_w = 6 dB

	3,8	2,5	1,9	0,6	2,1	4,3	10,9	
1/3 oct.	6,8	1,1	2,1	1,6	2,4	5,5	17,1	dB
	1,7	1,0	1,8	1,6	3,3	7,6	26,0	
1/1 oct.	**3,6**	**1,5**	**1,9**	**1,2**	**2,6**	**5,6**	**14,6**	**dB**

Mook, measured at 28-07-2020

DETERMINING THE REDUCTION OF TRANSMITTED IMPACT NOISE BY FLOOR COVERINGS ACCORDING TO ISO 10140-3:2010

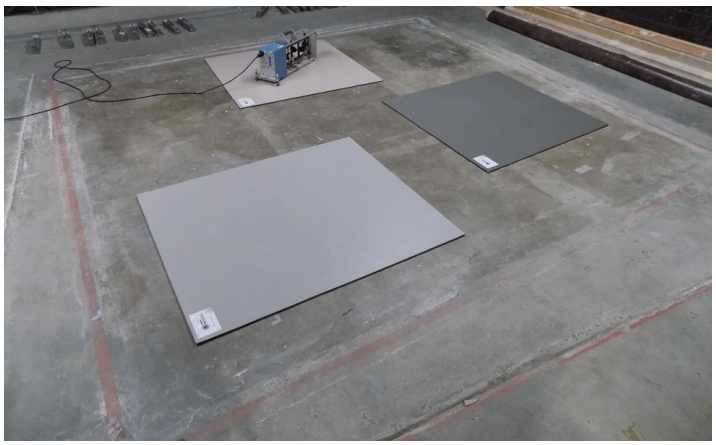
TESTEN RvA L 334

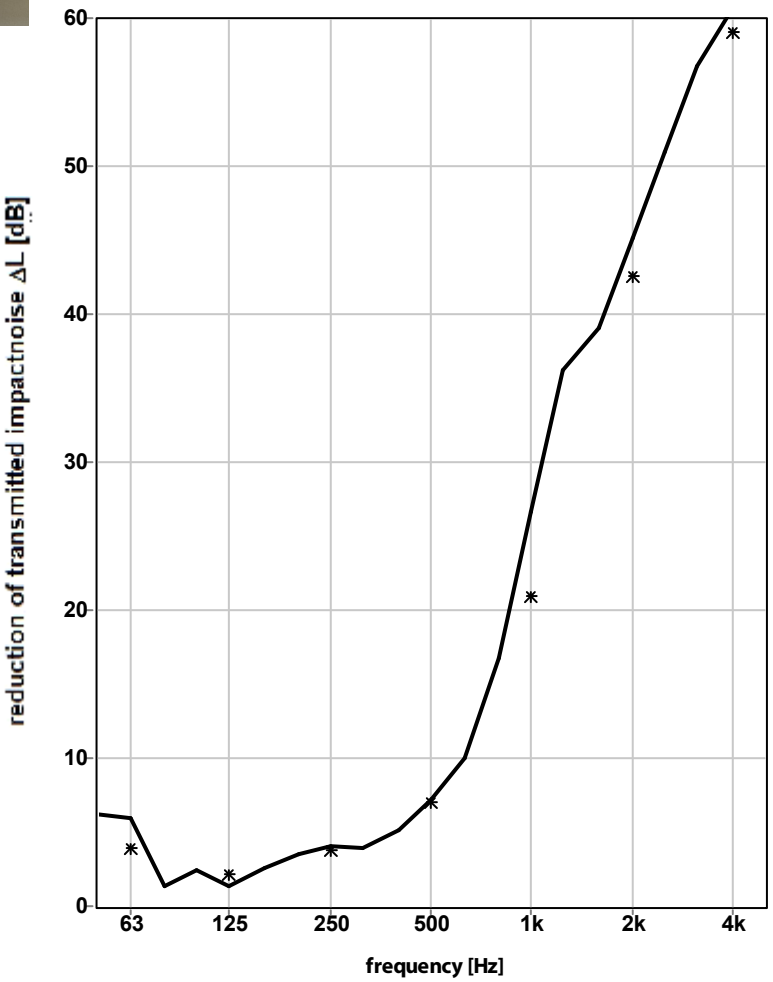
principal: Senso

construction tested:

FUSION

thickness:	ca. 8 mm
thickness rubber backing:	ca. 3 mm
mass:	9,6 kg/m^2 (weighted)





volume measuring room: 94 m^3

surface area floor: 1 m^2

measured at:
Peutz Laboratory for Acoustics

signal: tapping machine

bandwidth: 1/3 octave

ISO 717-2:2013

ΔL_{lin} = 8 dB

ΔL_w = 18 dB

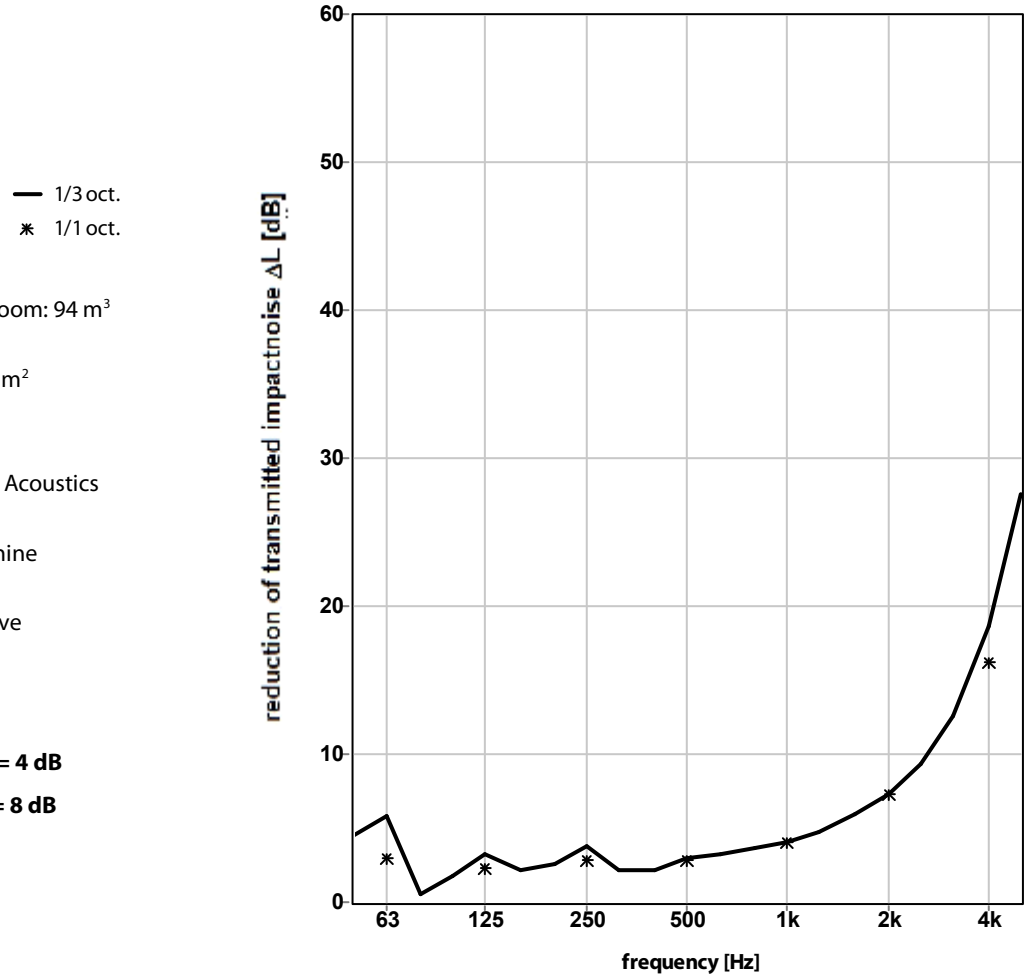
	6,2	2,4	3,5	5,2	16,7	39,0	56,8	
1/3 oct.	6,0	1,4	4,1	7,2	26,6	45,2	60,7	dB
	1,3	2,5	3,9	10,0	36,2	50,9	61,1	
1/1 oct.	**3,9**	**2,1**	**3,8**	**7,0**	**21,0**	**42,6**	**59,1**	**dB**

Mook, measured at 28-07-2020

DETERMINING THE REDUCTION OF TRANSMITTED IMPACT NOISE BY FLOOR COVERINGS ACCORDING TO ISO 10140-3:2010

principal: Senso

construction tested:
SUPERQUARTZ
thickness: ca. 6 mm
mass: 8,7 kg/m^2 (weighted)



volume measuring room: 94 m^3

surface area floor: 1 m^2

measured at:
Peutz Laboratory for Acoustics

signal: tapping machine

bandwidth: 1/3 octave

ISO 717-2:2013
ΔL_{lin} = 4 dB
ΔL_w = 8 dB

	4,4	1,7	2,6	2,2	3,7	6,0	12,5	
1/3 oct.	5,8	3,3	3,8	3,0	4,1	7,3	18,7	dB
	0,6	2,1	2,2	3,2	4,7	9,3	27,5	
1/1 oct.	**3,0**	**2,3**	**2,8**	**2,8**	**4,1**	**7,3**	**16,2**	**dB**

Mook, measured at 28-07-2020