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daidalos peutz
laboratory of acoustics

N° 451-TEST
NBN EN ISO 17025:2005

NOISE LAB
REPORT Number A-2019LAB-024-H418-42823_E

Customer :	**BSW Berleburger Schaumstoffwerk GmbH** **Am Hilgenacker 24** **57319 Bad Berleburg** **Germany**
Contacts :	Client : Enrico Eppner Noise lab : Volker Spessart
Tests :	**Laboratory measurement of the reduction of impact noise by a floating floor system on a heavyweight standard floor.**
Product name :	**REGUPOL sonus curve, 8mm**

Normative references:

NBN EN ISO 10140-3	Acoustics - Laboratory measurement of sound insulation of building elements - Part 3: Measurements of impact sound insulation

Various other related norms:

NBN EN ISO 10140-1	Acoustics - Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products
NBN EN ISO 10140-4	Acoustics - Laboratory measurement of sound insulation of building elements - Part 4: Measurement procedures and requirements
NBN EN ISO 10140-5	Acoustics - Laboratory measurement of sound insulation of building elements - Part 5: Requirements for test facilities and equipment
NBN EN ISO 12999-1	Acoustics - Determination and application of measurement uncertainties in building acoustics - Part 1: Sound insulation
NBN EN ISO 717-2	Acoustics - Rating of sound insulation in buildings and of building elements - Part 2: Impact sound insulation

To perform the above measurements, the laboratory of Daidalos Peutz is accredited by BELAC "The Belgian Accreditation Body"
BELAC is a signatory of all existing MLAs (multilateral agreements) and MRAs (multilateral recognition agreements) of EA (European co-operation for Accreditation), ILAC (International Laboratory Accreditation Cooperation) and IAF (International Accreditation Forum).
In this way, reports and certificates issued by BELAC accredited bodies are internationally accredited.

Date and reference of the request:	10/01/2017	2019LAB-024
Date of receipt of the specimen (s):	28/03/2017	SONH418
Date of tests:	29/03/2017	
Date of preparation of the report:	18/04/2019	

This test report together with its annexes contains : 13 pages and must be multiplied only in its entirety.

Technical Manager,

Volker Spessart

Laboratory Engineer,

Karolien Benoit

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MEASURING EQUIPMENT

Source signal
Brüel & Kjaer - 4292 : Omni Power Sound Source
Brüel & Kjear - 2716 : Power amplifier
Norsonic Nor277 : Tapping machine conform ISO 10140-5 Annex E

Microphone and data acquisition system:
Brüel & Kjaer - 4189 : 1/2" free field microphone, 6Hz to 20kHz, prepolarized
Brüel & Kjaer - ZC-0032 : 1/2" microphone preamplifier
Brüel & Kjaer - 4231 : Sound calibrator 94&114dB SPL-1000Hz, Fulfils IEC 60942(2003)Class1
Brüel & Kjaer - JP 1041 : dual 10-pole adaptor JP-1041
Brüel & Kjaer - 2270 : Sound level meter - dual channel instrument (measuring both channels simultaneously)
Conforms with IEC 61672-1 (2002-05) Class 1
Brüel & Kjaer - 3923 : rotating microphone boom

One rotating microphone system in the receiving room

Number of tapping machine positions:	4	
Minimum 0,7m between the different source positions		
Distances to the board of the floor at least 0.5 m		
Random positions and orientation of the tapping machine.		
Number of microphone positions for each tapping machine position:	2	
Microphone position with a rotating microphone		
Number of rotations:	3	
Rotation speed:	16	s/tr
Minimum rotation time:	30	s
Just not a rotation angle <10 ° to the chamber surfaces		

Data processing
Brüel & Kjaer - BZ-5503 : utility software for hand-held analyzers
Brüel & Kjaer - BZ-7229 : dual-channel building acoustics software
Brüel & Kjaer - 7830 :Qualifier Software for reporting results
A computer with proprietary software

Averaging Time per measurement:	48	s
Number of reverberation time measurements (with graphic control):	27	

Test chambers

Volume receiving room:	51,4	m³
Reference floor area:	12,00	m²
Surface test floor :	12,00	m²

There are diffusers and absorption material applied in the receiving room.

Standard floor
The base floor used is a 140 mm thick solid reinforced concrete slab.
According to ISO 10140-5 Annex C this is the "heavyweight standard floor".

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STANDARD METHOD

The normalised impact sound pressure level Ln and the reduction of sound pressure level (improvement of impact sound insulation) ΔL were measured according to the standard NBN EN ISO 10140-3:2010. A detailed description of the test set up has been given in the figures of annex 1 of this report.

The tests were measured as follows:

- The test sample is mounted onto a heavyweight standard floor, in accordance with the descriptions in the standard NBN EN ISO 10140-1 and 10140-3.

- The standardized (see NBN EN ISO 10140-5:2010 Annex E) tapping machine is positioned in 3 or 4 positions on the test floor (depending on the sample). The impact sound pressure levels are measured in the receiving room below the test floor using a moving microphone.
  A one-third octave band analyser measured the averaged sound levels in the third octave bands from 100 to 5000 Hz. If required, the levels are corrected to account for the background noise. The individual measurements are then averaged energetically for each one-third octave band and converted with the reverberation time measurements to the normalized impact sound pressure level Ln for a receiving room having 10m² of equivalent sound absorption area.

- The normalized impact sound pressure level of the heavyweight standard floor Ln,0 is measured using the identical procedure.

- The normalized impact sound pressure level is calculated according to the following equation:

$$L_n = L_i + 10 \log (A/A_0) \quad [dB]$$

met
L_n = The normalized impact sound pressure level, expressed in dB (ref 20μPa)
L_i = the energy average sound pressure level in a one-third octave band in the receiving room when the floor under test is excited by the standardized tapping machine
A_0 = the reference equivalent absorption area (= 10m²)
A = the measured equivalent absorption area

- The temperature, relative humidity and static pressure is also measured in the test rooms.

- The improvement ΔL of the impact sound insulation is calculated from the difference between the weighted impact sound levels of the bare floor without and with the floor covering:

$$\Delta L = L_{n,0} - L_n \quad [dB]$$

met
ΔL = The improvement of the impact sound insulation
$L_{n,0}$ = normalized impact sound pressure level of the bare floor
L_n = normalized impact sound pressure level of the bare floor with floor covering

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STANDARD METHOD

Single rating numbers

Evaluation according to EN ISO 717-2 defines single-number quantities, $L_{n,w}$ (C_i) for the impact sound insulation of floors and $\Delta L_w(C_{I,\Delta})$ for the impact sound reduction of floor coverings and floating floors from the results of measurements carried out in accordance with NBN EN ISO 10140-3.
The values obtained in accordance with ISO 10140-3 are compared with reference values at the frequencies of measurement within the range 100Hz to 3150 Hz for measurements in one-third octave bands. The calculation of the single-value indicator can not be summarised in a few lines. See standard NBN EN ISO 717-2 for details.

$L_{n,w}$ = weighted normalized impact sound pressure level
$L_{n,w}+C_i$ = weighted normalized impact sound pressure level corrected with the adaptation term Ci

$C_i = L_{n,sum} - 15 - L_{n,w}$ With $L_{n,sum}$ the summation on an energetic basis for the one-third octave bands in the frequency range 100Hz to 2,5kHz

$$L_{n,sum} = 10 \log \sum_{i=1}^{k} 10^{\frac{L_i}{10}}$$

Calculations of the spectrum adaptation term may additionally be carried out for an enlarged frequency range.
The single-number quantities of impact sound insulation properties of floors, presented as $L_{n,w}$ (C_i)
The single-number quantities of the weighted reduction in impact sound pressure level for floorcoverings, is presented as ΔL_w ($C_{i,\Delta}$) and ΔL_{lin}

The normalized impact sound pressure level of the bare floor

$L_{n,0} = L_i + 10 \log (A/10)$ and $L_{n,0,w}$ ($C_{I,0}$)

The normalized impact sound pressure level of the bare floor with floor covering

$L_n = L_i + 10 \log (A/10)$ and $L_{n,w}$ (C_I)

$\Delta L = L_{n,0} - L_n$ Reduction of impact sound pressure level

To compare the measurement results obtained in different test laboratories, the normalized impact sound level Ln, is referred to the reference floor defined in ISO 717-2 in the following way. The quantity is designated by the index "r" ("reference floor"): $L_{n,r}$

$L_{n,r} = L_{n,r,0} - \Delta L$ and $L_{n,r,w}$ ($C_{I,r}$)

with $L_{n,r,0}$ is the defined normalized impact sound pressure level of the reference floor (see ISO 717-2 point 5.2)

$\Delta L_w = L_{n,r,0,w} - L_{n,r,w} = 78 - L_{n,r,w}$ with $C_{I,\Delta} = C_{I,r,0} - C_{I,r} = -11 - C_{I,r}$

$\Delta L_{lin} = \Delta L_w + C_{I,\Delta}$

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SPECIAL MEASUREMENT CONDITIONS

n/a

ACCURACY

The accuracy of the impact sound insulation as calculated can be expressed in terms of repeatability (tests within one laboratory) and reproducibility (between various laboratories)

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

Reproducibility [R]
When: - two tests 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

In NBN EN ISO 12999-1 there is a statement on the reproducibility R to be expected, based on the results of various inter-laboratory tests.
The reproducibility of the single figure rating Lw, ΔLw is about 3 dB.

The specific value of uncertainty is available on request

ENVIRONMENTAL CONDITIONS during the tests

		Source room	*Receiving room*
Temperature :	T =	18,4 °C	18,3 °C
Atmospheric pressure :	p =	1023 hPa	1023 hPa
Relative humidity :	h_r =	61,0 %	64,0 %

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MEASUREMENT AND CALCULATION DETAILS

The results as presented here relate only to the tested items and laboratory conditions as described in this report.

The results of the measurements are presented on the next pages (6 till 9)
- on page 7 : the measurement results for the normalized impact sound level for the bare floor (the naked laboratory floor)
- on page 8 : the measurement results for the normalized impact sound level for the bare floor with floor covering, composition of the test element in annex 2
- on page 9 : the calculation of the reduction of impact sound pressure

The results are given at all frequencies of measurement, both in tabular form and in the form of a graph.

The next table present an overview of the measurements and calculations

f (Hz)	Ln,0 bare floor (dB)	Ln bare floor + floor covering (dB)	ΔL $L_{n,0}$- L_n (dB)	$L_{n,r,0}$ reference floor *according ISO 717-2 / 5.2* (dB)	$L_{n,r}$ reference floor + floor covering $L_{n,r,0}$- ΔL (dB)	
50	50,5	44,1	6,4			
63	57,4	49,4	8,0			
80	61,0	55,3	5,7			
100	57,3	52,5	4,8	67,0	**62,2**	
125	62,7	57,0	5,7	67,5	**61,8**	
160	63,2	58,6	4,6	68,0	**63,4**	
200	67,6	60,1	7,5	68,5	**61,0**	
250	68,2	63,8	4,4	69,0	**64,6**	
315	71,4	63,7	7,7	69,5	**61,8**	
400	70,5	61,3	9,2	70,0	**60,8**	
500	72,1	58,9	13,2	70,5	**57,3**	
630	73,6	59,8	13,8	71,0	**57,2**	
800	73,7	55,8	17,9	71,5	**53,6**	
1000	74,8	52,9	21,9	72,0	**50,1**	
1250	74,8	51,4	23,4	72,0	**48,6**	
1600	75,3	48,8	26,5	72,0	**45,5**	
2000	75,1	46,0	29,1	72,0	**42,9**	
2500	74,4	42,2	32,2	72,0	**39,8**	
3150	73,8	37,4	36,4	72,0	**35,6**	
4000	72,0	31,4	40,6	/	/	
5000	69,3	26,0	43,3	/	/	
ISO 717-2	$L_{n,0,w}$	$L_{n,w}$		$L_{n,r,0,w}$	$L_{n,r,w}$	ΔL_w = 78 - Ln,r,w
	81	**57**		78	57	**21 dB**
	$C_{I,0}$	C_I		$C_{I,r,0}$	$C_{I,r}$	$C_{I,\Delta}$ = CI,r,0 - CI,r
	-11	**-2**		-11	**-1**	**-10 dB**

$\Delta L_{lin} = \Delta L_w + C_{I,\Delta}$
11 dB

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$L_{n,0}$ NORMALIZED IMPACT SOUND PRESSURE LEVEL (of standard floor) in accordance with ISO 10140-3:2010

Client: **BSW Berleburger Schaumstoffwerk GmbH** Date of test: 30/03/2017

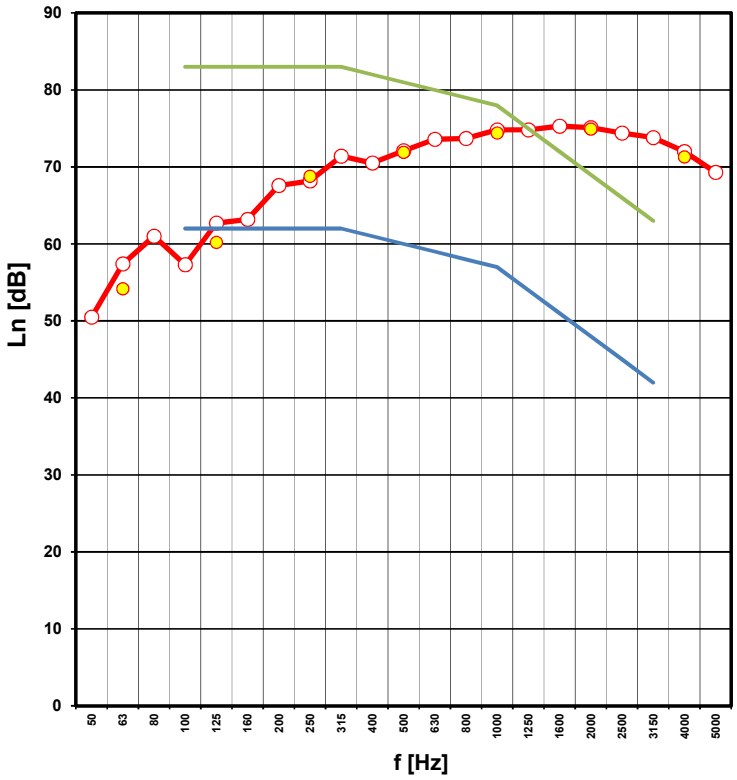
Description of the test setup:
The base floor used is a 140 mm thick solid reinforced concrete slab.
According to ISO 10140-5 Annex C this is the "heavyweight standard floor".

Receiving room volume V: 51,4 m³
Reference floor area : 12,0 m²
Tested floor area : 12,0 m²
Signal : Standard tapping machine with steel-headed hammers.

f (Hz)	$L_{n,0}$ (dB)	(*)
1/3 octave bands :		
50	50,5	
63	**57,4**	
80	61,0	
100	57,3	
125	**62,7**	
160	63,2	
200	67,6	
250	**68,2**	
315	71,4	
400	70,5	
500	**72,1**	
630	73,6	
800	73,7	
1000	**74,8**	
1250	74,8	
1600	75,3	
2000	**75,1**	
2500	74,4	
3150	73,8	
4000	**72,0**	
5000	69,3	

octave bands :	
63	**54,2**
125	**60,2**
250	**68,8**
500	**71,9**
1000	**74,4**
2000	**74,9**
4000	**71,3**

B: Ln=< value shown



(*) b : background noise correction used
B : Maximum background noise correction used

Rating according to ISO 717-2

Ln,0,w (Ci,0) = 81 (-11) dB

Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method

No.of test report: SONH430
Date: 30/03/2017
Name of test institute: Daidalos Peutz
Signature: Volker Spessart

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L_n NORMALIZED IMPACT SOUND PRESSURE LEVEL in accordance with ISO 10140-3:2010

Client: **BSW Berleburger Schaumstoffwerk GmbH** Date of test: 29/03/2017

Description of the test setup:

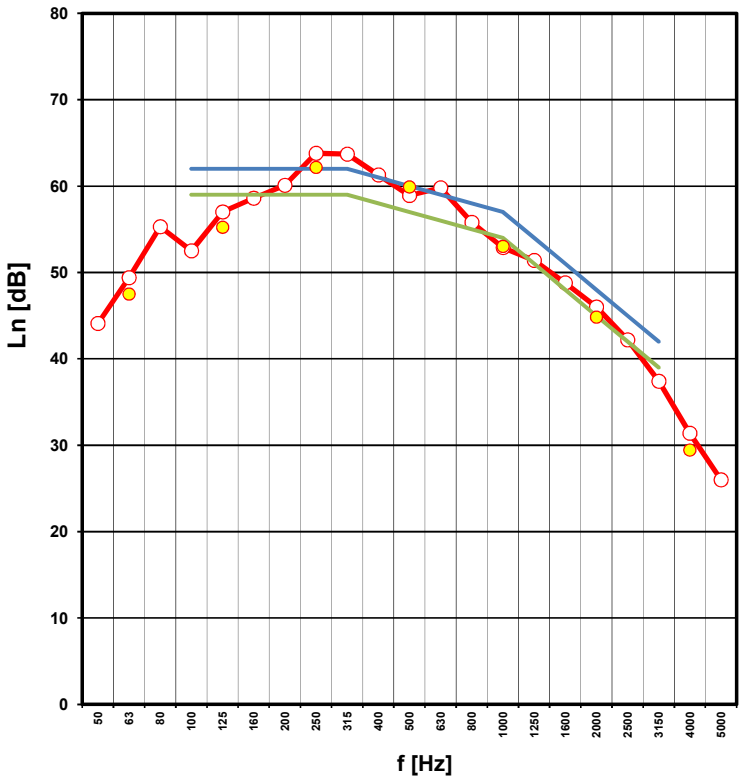
100	mm	prefab reinforced concrete slab
8	mm	REGUPOL sonus curve, 8mm
140	mm	heavyweight standard floor = solid reinforced concrete slab

Receiving room volume V: 51,4 m³
Reference floor area : 12,0 m²
Tested floor area : 12,0 m²
Signal : Standard tapping machine with steel-headed hammers.

reference values (according ISO 717-2)
shifted reference values (according ISO 717-2)

f (Hz)	L_n (dB)	(*)
1/3 octave bands :		
50	44,1	
63	**49,4**	
80	55,3	
100	52,5	
125	**57,0**	
160	58,6	
200	60,1	
250	**63,8**	
315	63,7	
400	61,3	
500	**58,9**	
630	59,8	
800	55,8	
1000	**52,9**	
1250	51,4	
1600	48,8	
2000	**46,0**	
2500	42,2	
3150	37,4	
4000	**31,4**	
5000	26,0	

octave bands :	
63	**47,5**
125	**55,2**
250	**62,2**
500	**59,9**
1000	**53,0**
2000	**44,8**
4000	**29,4**



B: Ln=< value shown

(*) b : background noise correction used
B : Maximum background noise correction used

Rating according to ISO 717-2

Ln,w (Ci) = 57 (-2) dB

Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method

No.of test report:	SONH418	Name of test institute:	Daidalos Peutz
Date:	29/03/2017	Signature:	Volker Spessart

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ΔL REDUCTION OF IMPACT SOUND PRESSURE LEVEL BY FLOOR COVERINGS in accordance with ISO 10140-3

Client: **BSW Berleburger Schaumstoffwerk GmbH** Date of test: 29/03/2017

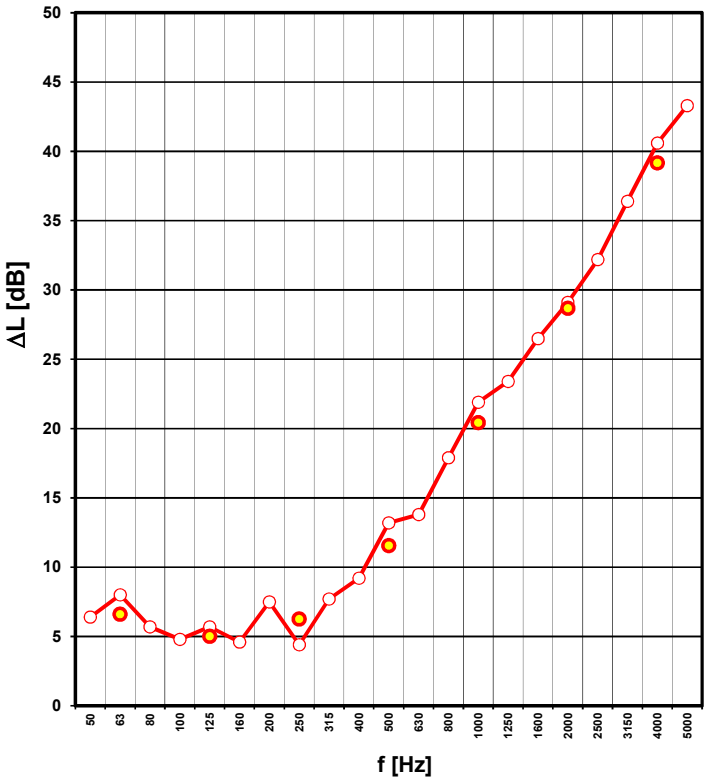
Description of the test setup:

100	mm	prefab reinforced concrete slab
8	mm	REGUPOL sonus curve, 8mm
140	mm	heavyweight standard floor = solid reinforced concrete slab

Receiving room volume V: 51,4 m³
Reference floor area : 12,0 m²
Tested floor area : 12,0 m²
Signal : Standard tapping machine with steel-headed hammers.

f (Hz)	ΔL =$L_{n,0}$- L_n (dB)
1/3 octave bands :	
50	6,4
63	**8,0**
80	5,7
100	4,8
125	**5,7**
160	4,6
200	7,5
250	**4,4**
315	7,7
400	9,2
500	**13,2**
630	13,8
800	17,9
1000	**21,9**
1250	23,4
1600	26,5
2000	**29,1**
2500	32,2
3150	36,4
4000	**40,6**
5000	43,3

octave bands :	
63	**6,6**
125	**5,0**
250	**6,3**
500	**11,6**
1000	**20,4**
2000	**28,7**
4000	**39,2**



Rating according to ISO 717-2

ΔL_w ($C_{i,\Delta}$) = **21** (**-10**) **dB**

ΔL_{lin} = 11 dB

Evaluation based on laboratory measurement results obtained in one-third-octave bands by an engineering method

No.of test report: SONH418 Name of test institute: Daidalos Peutz
Date: 29/03/2017 Signature: Volker Spessart

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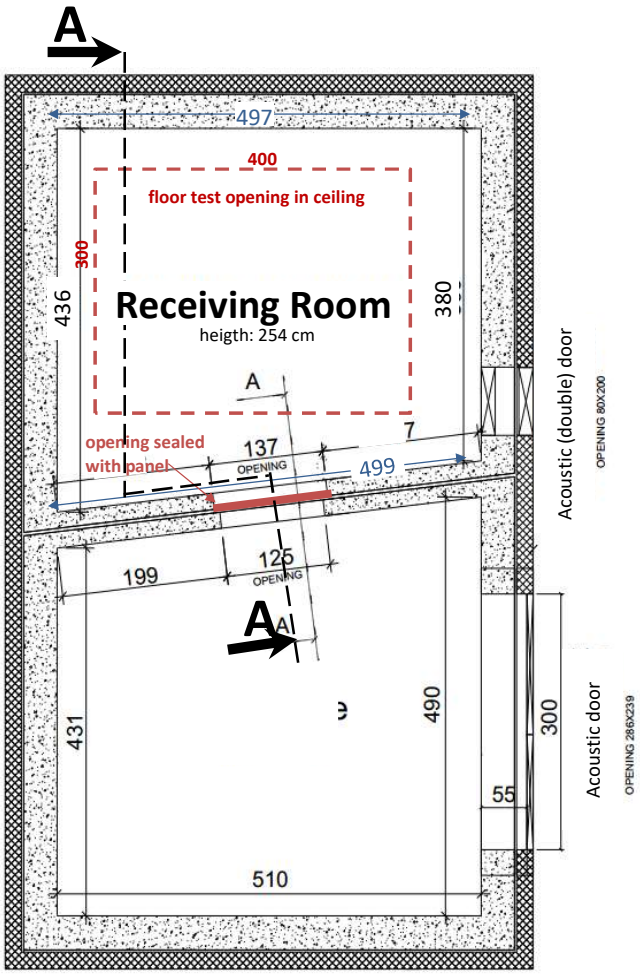
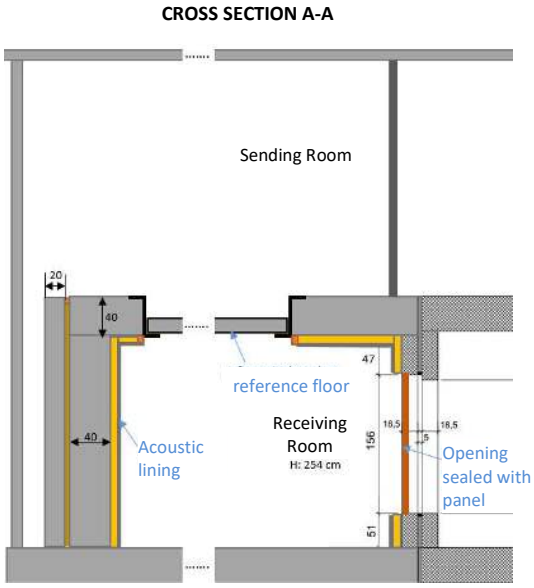
ANNEX 1 : Sound insulation test facilities

The test rooms meet the requirements of ISO 10140-5
Both rooms are isolated for vibrations by using a so called room-in-room construction.





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ANNEX 2: Description test items by manufacturer

The test sample description given by manufacturer is checked visually as good as possible by the laboratory.
The correspondence between the test element and the commercialized product is the sole responsibility of the manufacturer

Description of the test element as a layered structure

	Thickness (mm)	ρ (kg/m³)	m" (kg/m²)	Description of the layer
1	100	2500	256	prefab reinforced concrete slab
2	8			REGUPOL sonus curve, 8mm
3	140	2300	322	heavyweight standard floor = solid reinforced concrete slab
4				
5				
6				
7				
8				
9				
10				

Total thickness = 248 mm

REGUPOL sonus curve, 8mm
It is a floating floor underlayer product for impact sound isolation.
The resilient layer is made from rubber materials.

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ANNEX 3: Technical sheet

The test sample description given by manufacturer is checked visually as good as possible by the laboratory.
The correspondence between the test element and the commercialized product is the sole responsibility of the manufacturer

On request at supplier.

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ANNEX 4: photographs of the test element or the test arrangement

Description of the assembly or drawing or photo

The floating floor underlayer product was placed on the standard concrete floor.
Then a prefab concrete slab was placed on top.
The topfloor had no rigid contact with the test opening construction. Gaps between the topfloor and the test opening were filled-up with sound-absorbing material.

To improve the acoustical sealing of the perimeter edge around the topfloor, additional sandbags were placed onto the gap.
Remark: the sound-absorbing material and sandbags are not part of the floating floor product.