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Determination of reduction of transmitted impact noise by floor coverings on heavyweight standard concrete floor – testing in laboratory according to EN ISO 140-8:1997; Measurements and estimations

Commissioner

LK system

Test object

The test object comprises a 45mm screed on 30 mm LK Foil Board 30 Silent.

Test object arrival date

2017-02-1

Date of test

2017-02-08; 2017-02-09; 2017-02-10; 2017-02-13;

Results

The results can be used when the floor assembly is applied to a stiff concrete structure, for example for calculation according to EN 12354.

A floor covering should have as high ΔL_w as possible as well as $\Delta L_w + C_{i\Delta}$.

The results are compiled in Table 1 below. In the annexes, detailed information is presented.

The results are only applicable for the tested objects.



Overview of results

This report summarizes measured and estimated results for the reduction of impact sound levels of floor coverings with certain products on a reference concrete floor of 150 mm thickness. The various configurations tested in laboratory conditions are presented in Table 1. The estimated results for supplementary products are presented in Table 2.

Table 1 – Results from measurements

Floor of 45 mm screed on 30 mm EPS Silent	Weighted impact sound improvement, ΔL_w [dB]	Adaptation term for the impact sound improvement, C_{IA} [dB]	Floor covering class according to SS 25267, edition 3	Annex
As above, no floor covering	8	-3	-	M01
14 mm parquet on AIROLEN Combi PE25	21	-11	8B	M02
8 mm laminate flooring on AIROLEN Combi PE25	19	-10	7	M03
with 10 mm ceramic tiles	9	-2	-	M04

Table 2 – Results from estimations

Floor Structure: Surface layer (type)-EPS board(mm)-Screed (mm)	Weighted impact sound improvement, ΔL_w [dB]	Adaptation term for the impact sound improvement, C_{IA} [dB]	Floor covering class according to SS 25267, edition 3	Annex
Ceramic - 50 - 45	10	-2	-	E01
Ceramic - 50 - 35	8	-1	-	E02
Ceramic - 30 - 35	8	-1	-	E03
Laminated - 50 - 45	23	-8	8B	E04
Laminated - 50 - 35	19	-8	7	E05
Laminated - 30 - 35	13	-7	-	E06
Parquet - 30 - 35	15	-7	-	E07
Parquet - 50 - 45	24	-9	8B	E08
Parquet - 50 - 35	21	-9	8B	E09
Screed - 50 - 45	8	-1	-	E10
Screed - 50 - 35	5	-1	-	E11



Screed - 30 - 35	5	-1	-	E12
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Usage of results

For any stiff concrete floor structure with a floor covering with known impact sound improvement, the weighted impact sound level plus spectrum adaptation term can be calculated according to:

$$L_{n,w} + C_I = L_{n,w,1} + C_{I,1} - \Delta L_w - C_{I\Delta}$$

For any stiff concrete floor structure with a floor covering with known impact sound improvement, the weighted impact sound level can be calculated according to:

$$L_{n,w} = L_{n,w,1} - \Delta L_w$$

Where

$L_{n,w,1}$ = Impact sound level for the current concrete structure without floor covering

$C_{I,1}$ = Adaptation term for the current concrete structure without the floor covering

ΔL_w = weighted impact sound level improvement for the entire floor covering

$C_{I\Delta}$ = Adaptation term for the entire floor covering

Measurement method

Measurements and evaluations have been carried out according to SS-EN ISO 140-8, SS EN 717-2 and SS 25267. The impact sound improvement has been calculated from:

$$\Delta L_w = L_{n,0} - L_n$$

Where $L_{n,0}$ is normalized impact sound level in the receiving room without floor covering and L_n is normalized impact sound level in the receiving room with the floor covering. Normalization means an recalculation according to the reference absorption 10 m² Sabine in the receiving room using the measured reverberation time.

Weighted impact sound level improvement has been determined according to:

$$\Delta L_w = 78 - L_{n,r,w}$$

where $L_{n,r,w}$ is the weighted impact sound level normalized to a reference floor structure.

The adaptation term for floor coverings impact sound damping is calculated according to the following:

$$C_{I\Delta} = C_{I,r,0} - C_{I,r}$$

where

$C_{I,r}$ = adaptation term for the reference floor with the tested floor covering

$C_{I,r,0}$ = adaptation term for the reference floor ($C_{I,r,0} = -11$)



The floor coverings were mounted on a 150 mm reference concrete slab in the test opening in Lund University. The dimensions of the slab were 4.05m × 2.94 m. The receiving room volume was 94.7 m³ (dimensions 5.1 × 5.8 × 3.2 m³). As a sound source the standardized tapping machine was used. During measurements 9 positions were used for the impact sound source.

Measurement uncertainties

The measurement uncertainty is given in Table 2 below (ISO 140-2). The reproducibility displays the spread in measurement data when comparing measurements are carried out in different laboratories, with various measurement rooms, equipment, personnel etc. The reproducibility in the same laboratory is however, normally considerably better, e.g. the spread in results are lower.

Table 2 – Measurement uncertainty levels

1/3 octave band center frequency [Hz]	Reproducibility, ISO 140-8 [dB]
100	2,5
125	2,5
160	2,5
200	2,5
250	2
315	1,5
400	1,5
500	1,5
630	1,5
800	2
1000	3
1250	6
1600	9
2000	11
2500	11,5
3150	8

Mounting conditions and preconditions

The products were applied by LK – system and their personnel themselves directly on the standard concrete floor in the test opening. The floating floor were applied one day and then it was left to harden for 8 days.



Summary of results

Measurement data (Annex M01-M04)

This report presents measured and estimated results for the reduction of impact sound levels of floor coverings. The measured values are summarized in Table 1 and Annex M01-M04 while the relevant laboratory measurement process follows ISO 10140, ISO 140-8 and evaluation per ISO 717-2.

The measurements indicate the the best solution is the configuration M02, providing values of $\Delta L_w = 21$ dB and $C_{i\Delta} = -11$ dB, which fulfills the floor covering class 8B evaluated per the Swedish Standard SS 25267:2004, edition 3. Namely this configuration is the following:

- M02: Floor of 45 mm screed on 30 mm EPS Silent + 14 mm parquet on AIROLEN Combi PE25

Class 8B indicates that a measured configuration can fulfil Class B (BBR-Boverket classification) for apartments separated by a concrete floor, without considering the correction spectrum term $C_{i,50-2500}$.

Estimated data (Annex E01-E12)

Furthermore, a set of estimated results, based on previous laboratory measurements and relevant uncertainties, is presented in Table 2 and Annex E01-E12. The effectiveness of predicted values relies on the quality of preexisting data. Discrepancies in a realized setup in buildings may be found in standardized measurements due to the following reasons:

1. Different conditions between laboratory data and in situ measured data,
2. Flanking transmission in a building setup,
3. Structural effects and boundary conditions
(e.g. gluing, spikes or metal connections between layers).

As Table 2 suggests, there are 3 cases of interest which seem to fulfill the floor covering class 8B evaluated per SS 25267:2004. Those cases are summarized below in order of effectiveness due to estimated impact sound reduction:

- E08: Floor of 45 mm screed on 30 mm EPS Silent + Parquet 50-45
- E04: Floor of 45 mm screed on 30 mm EPS Silent + Laminated 50-45
- E09: Floor of 45 mm screed on 30 mm EPS Silent + Parquet 50-35

The best of those cases is E08 providing values of $\Delta L_w = 24$ dB and $C_{i\Delta} = -9$ dB. Similar results are indicated for case E04, with $\Delta L_w = 23$ dB and $C_{i\Delta} = -8$ dB. Finally, the configuration of E09 yields slightly worse results with $\Delta L_w = 21$ dB and $C_{i\Delta} = -9$ dB.



ANNEX M01

Impact sound improvement of floor covering in laboratory according to ISO 140-8

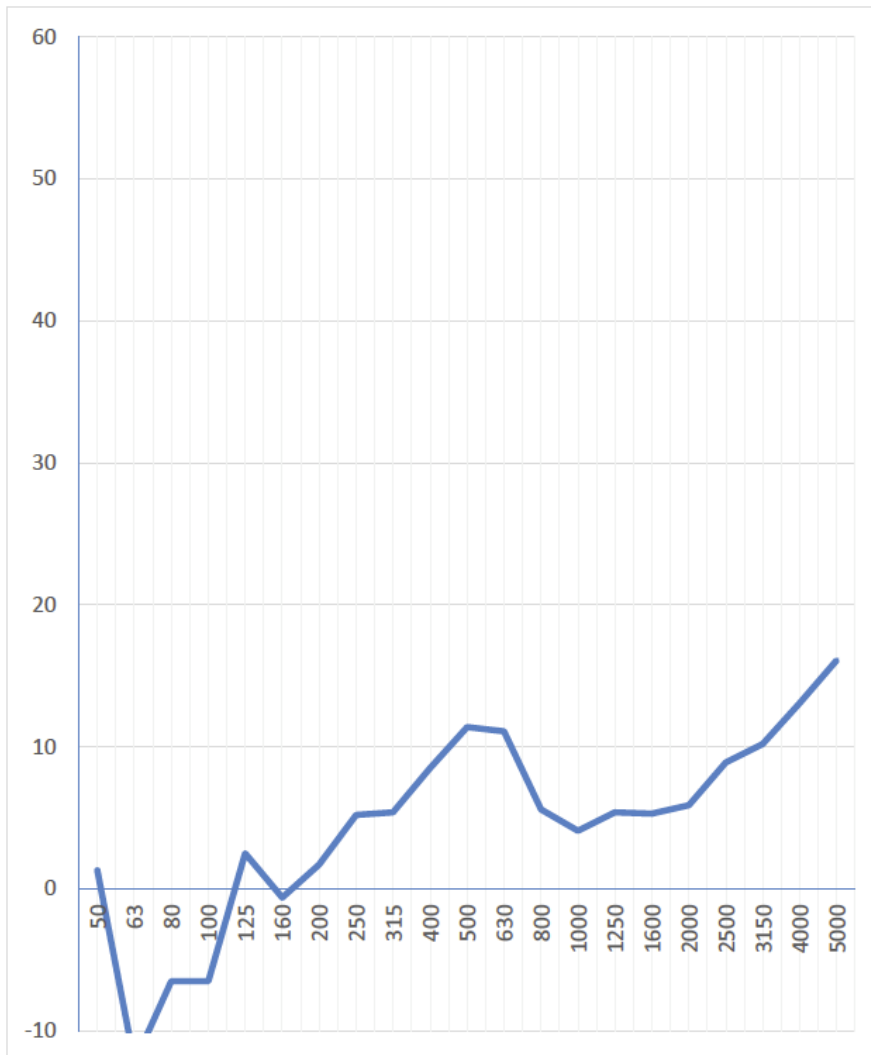
Commissioner: LK System AB

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent

Measurement date: 2017-02-08

Standard floor: 150 mm concrete (4.05 x 2.94 m²)

Results: Impact sound improvement ΔL and weighted impact sound improvement ΔLw



frequency, Hz	ΔL
50	1,3
63	-12,2
80	-6,5
100	-6,5
125	2,5
160	-0,6
200	1,7
250	5,2
315	5,4
400	8,5
500	11,4
630	11,1
800	5,6
1000	4,1
1250	5,4
1600	5,3
2000	5,9
2500	8,9
3150	10,2
4000	13,1
5000	16,1
ΔLw	8
CI,Δ	-3
Ln,r,w	70
CI,r	-8



ANNEX M02

Impact sound improvement of floor covering in laboratory according to ISO 140-8

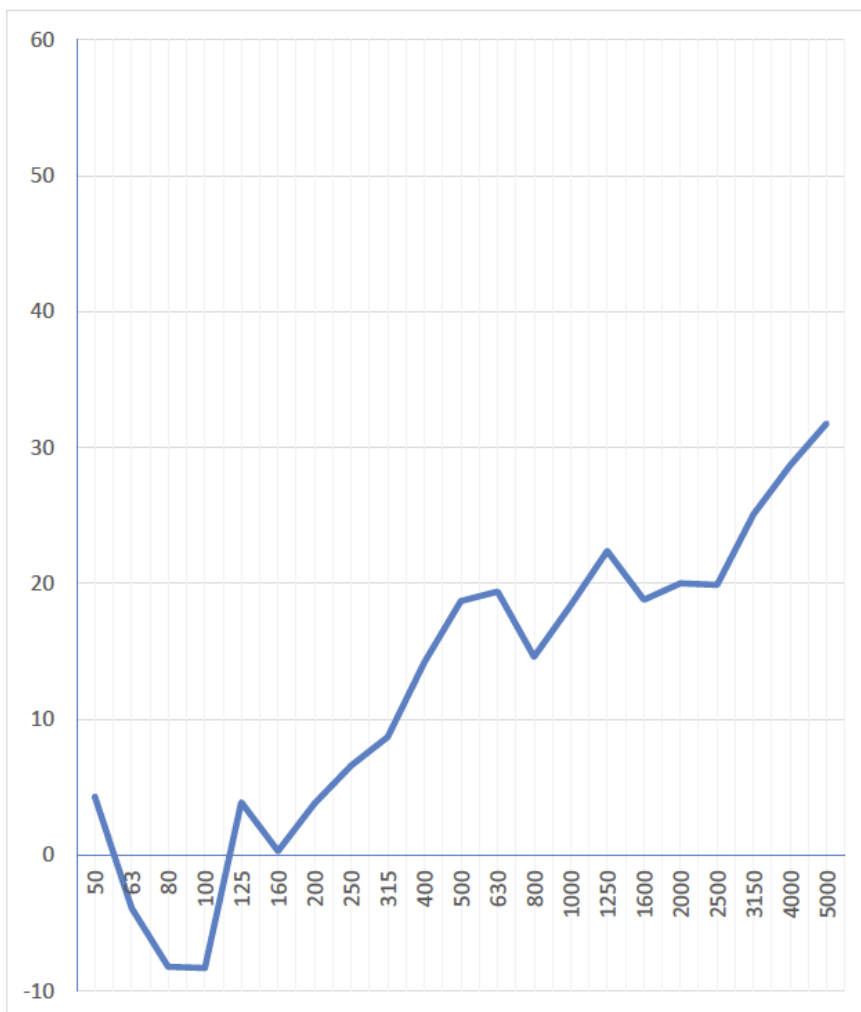
Commissioner: LK System AB

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and 14 mm parquet on 2 mm AIROLEN Combi PE25.

Measurement date: 2017-02-09

Standard floor: 150 mm concrete (4.05 x 2.94 m²)

Results: Impact sound improvement ΔL and weighted impact sound improvement ΔLw



frequency, Hz	ΔL dB
50	4,3
63	-3,9
80	-8,2
100	-8,3
125	3,9
160	0,3
200	3,8
250	6,6
315	8,7
400	14,2
500	18,7
630	19,4
800	14,6
1000	18,4
1250	22,4
1600	18,8
2000	20
2500	19,9
3150	25,1
4000	28,7
5000	31,8
ΔLw	19
CI,Δ	-10
Ln,r,w	59
CI,r	-1



ANNEX M03

Impact sound improvement of floor covering in laboratory according to ISO 140-8

Commissioner: LK System AB
Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and 8 mm laminate on 2 mm AIROLEN Combi PE25.
Measurement date: 2017-02-10
Standard floor: 150 mm concrete (4.05 x 2.94 m²)
Results: Impact sound improvement ΔL and weighted impact sound improvement ΔLw

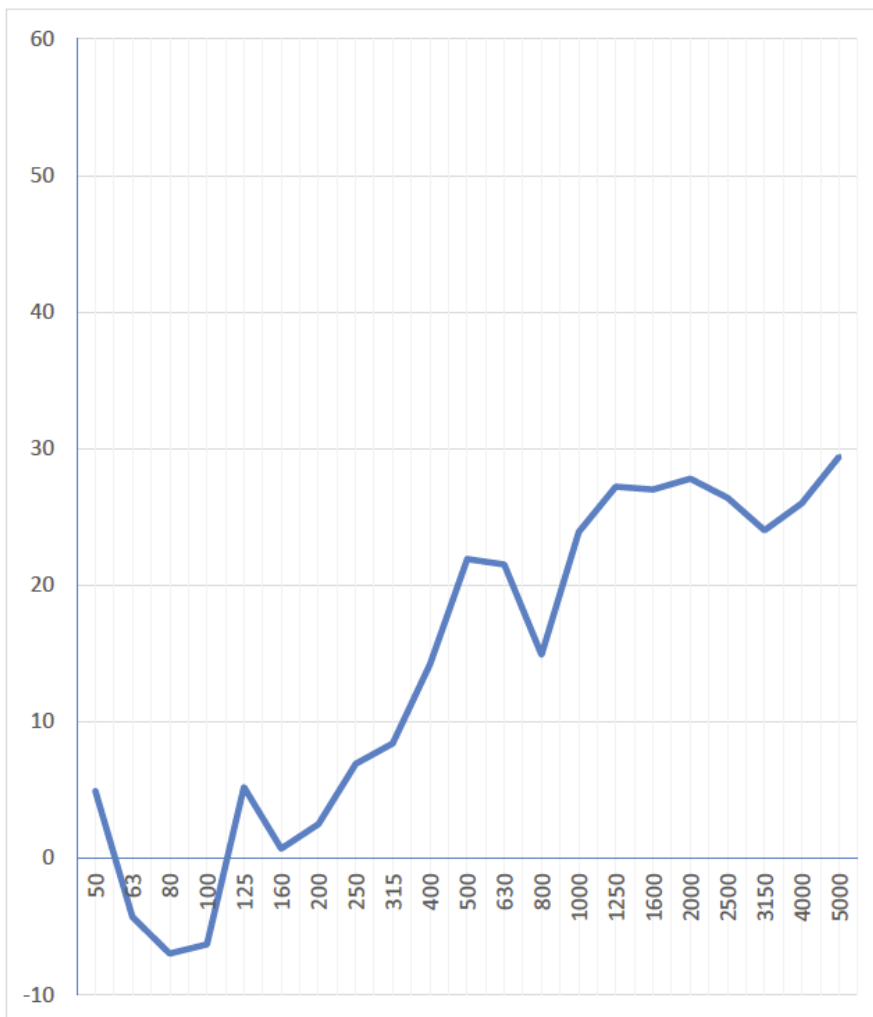


Table with 2 columns: frequency, Hz and ΔL. It lists values for frequencies from 50 to 5000 Hz, along with summary statistics: ΔLw (21), CI,Δ (-11), Ln,r,w (57), and CI,r (0).



ANNEX M04

Impact sound improvement of floor covering in laboratory according to ISO 140-8

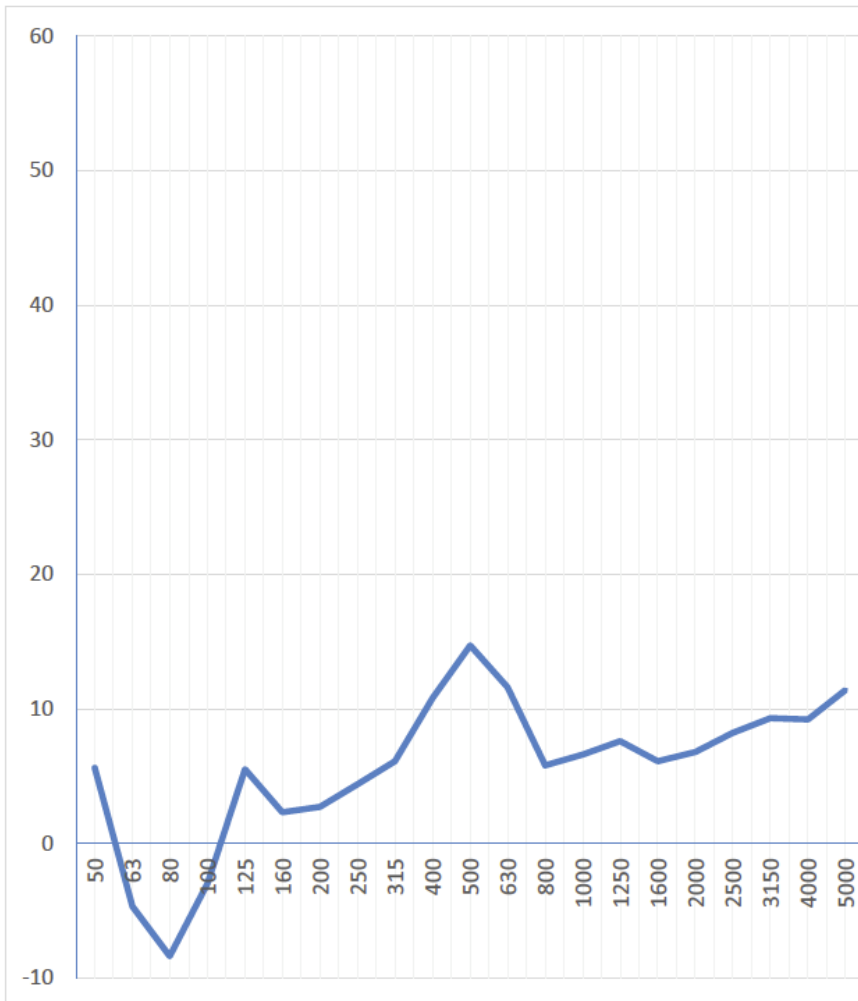
Commissioner: LK System AB

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of 10 mm ceramic tiles.

Measurement date: 2017-02-17

Standard floor: 150 mm concrete (4.05 x 2.94 m²)

Results: Impact sound improvement ΔL and weighted impact sound improvement ΔLw



frequency, Hz	ΔL
50	5,6
63	-4,7
80	-8,4
100	-3
125	5,5
160	2,3
200	2,7
250	4,4
315	6,1
400	10,8
500	14,7
630	11,6
800	5,8
1000	6,6
1250	7,6
1600	6,1
2000	6,8
2500	8,2
3150	9,3
4000	9,2
5000	11,4
ΔLw	9
CI,Δ	-2
Ln,r,w	69
CI,r	-9



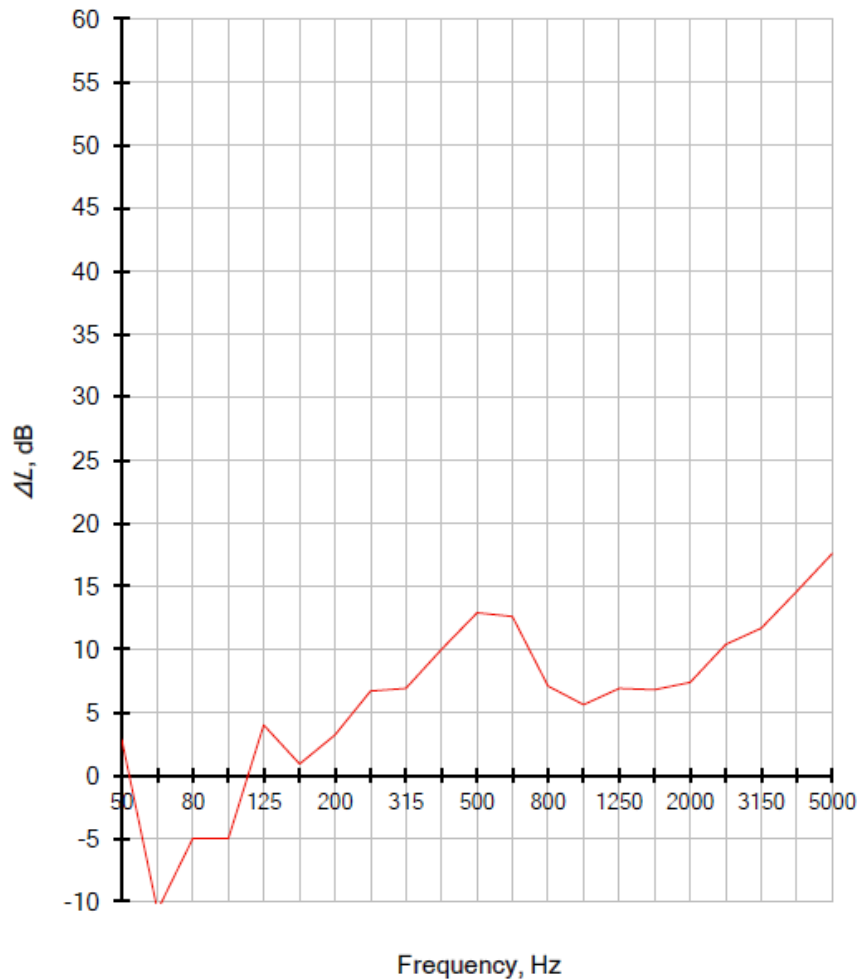
ANNEX E01

**Estimated impact sound improvement of floor covering in laboratory
(ISO 10140, ISO 717-2)**

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:
ceramic 50-45 tiles.

Evaluation date: 2022-05-30

<i>f</i> (Hz)	<i>L_{n,0}</i> (dB)	ΔL
50	65.2	2.8
63	67.6	-10.7
80	62.7	-5
100	65.1	-5
125	64.5	4
160	66.0	0.9
200	64.6	3.2
250	61.7	6.7
315	60.8	6.9
400	59.1	10
500	58.2	12.9
630	58.7	12.6
800	64.7	7.1
1000	67.9	5.6
1250	66.7	6.9
1600	65.8	6.8
2000	64.1	7.4
2500	60.7	10.4
3150	58.7	11.7
4000	54.1	14.6
5000	47.5	17.6



ISO 717/2

$\Delta L_w =$	10 dB	$C_{l,r} =$	-9 dB
$C_{l\Delta} =$	-2 dB	$C_{l,r,50-2500} =$	-8 dB

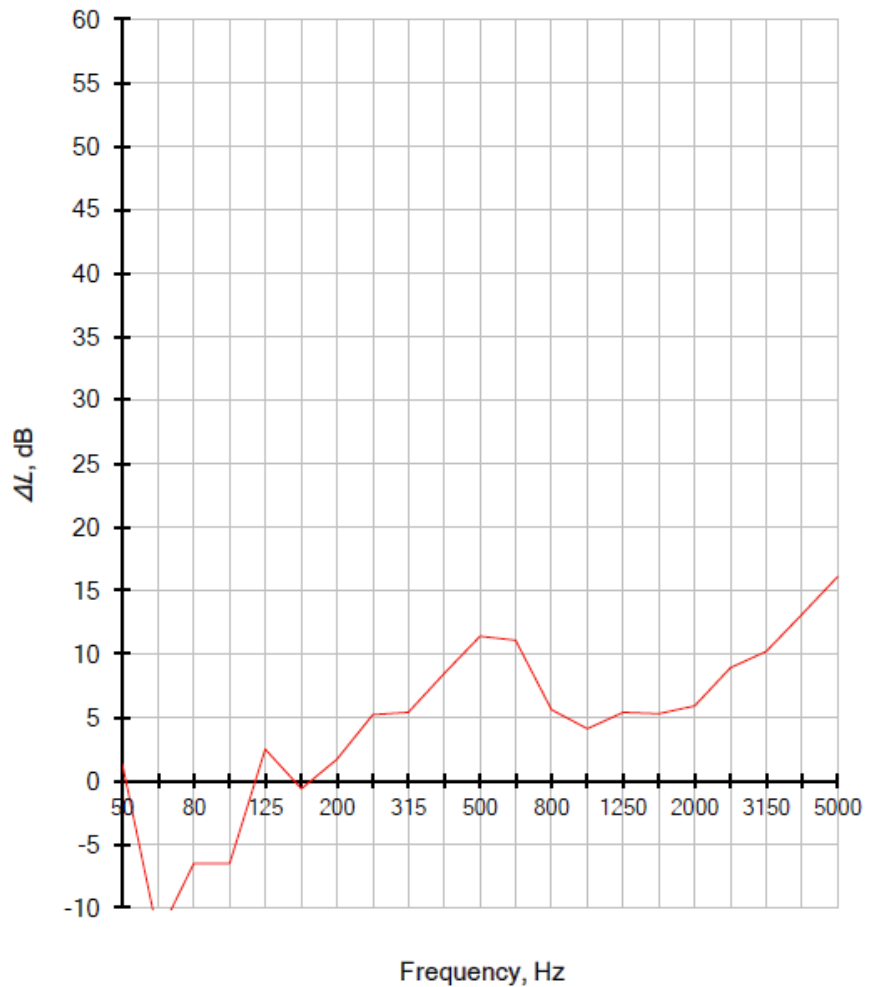
ANNEX E02

**Estimated impact sound improvement of floor covering in laboratory
(ISO 10140, ISO 717-2)**

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:
ceramic 50-35 tiles.

Evaluation date: 2022-05-30

<i>f</i> (Hz)	<i>L</i> _{n,0} (dB)	ΔL
50	65.2	1.3
63	67.6	-12.2
80	62.7	-6.5
100	65.1	-6.5
125	64.5	2.5
160	66.0	-0.6
200	64.6	1.7
250	61.7	5.2
315	60.8	5.4
400	59.1	8.5
500	58.2	11.4
630	58.7	11.1
800	64.7	5.6
1000	67.9	4.1
1250	66.7	5.4
1600	65.8	5.3
2000	64.1	5.9
2500	60.7	8.9
3150	58.7	10.2
4000	54.1	13.1
5000	47.5	16.1



ISO 717/2

$\Delta L_w =$	8 dB	$C_{l,r} =$	-10 dB
$C_{l\Delta} =$	-1 dB	$C_{l,r,50-2500} =$	-8 dB



ANNEX E03

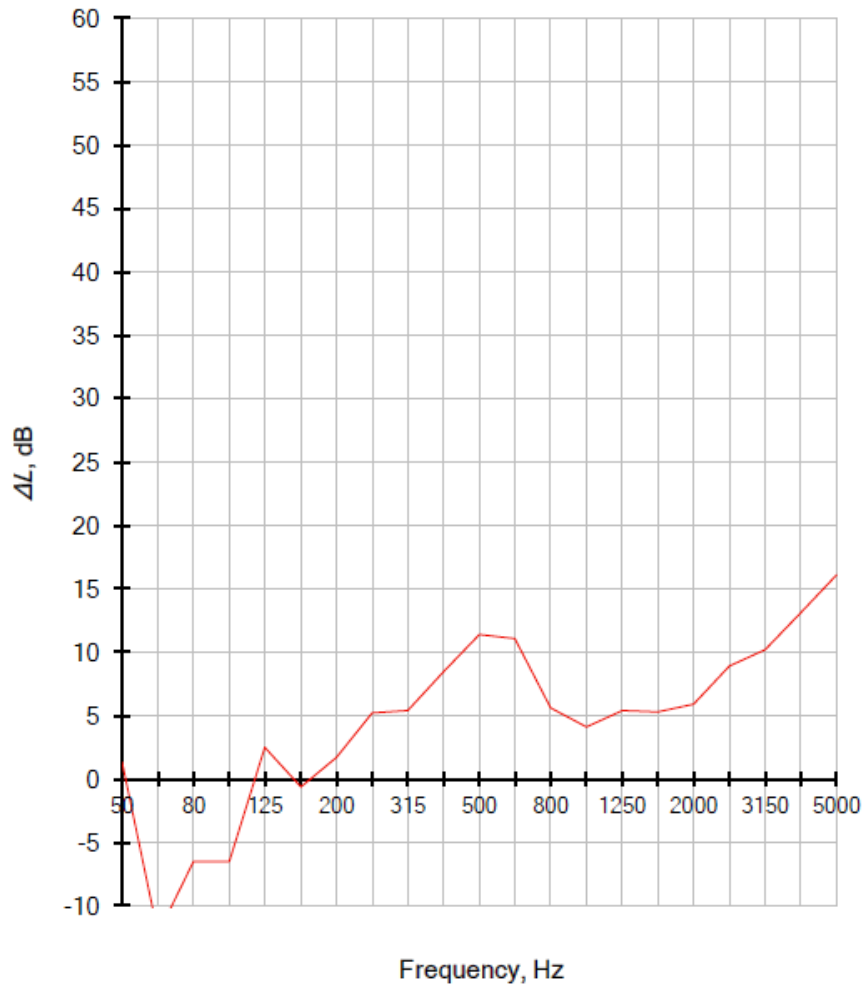
Estimated impact sound improvement of floor covering in laboratory (ISO 10140, ISO 717-2)

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

ceramic 30-35 tiles. Same report results as E02 - see above +below !

Evaluation date: 2022-05-30

<i>f</i> (Hz)	<i>L</i> _{n,0} (dB)	ΔL
50	65.2	1.3
63	67.6	-12.2
80	62.7	-6.5
100	65.1	-6.5
125	64.5	2.5
160	66.0	-0.6
200	64.6	1.7
250	61.7	5.2
315	60.8	5.4
400	59.1	8.5
500	58.2	11.4
630	58.7	11.1
800	64.7	5.6
1000	67.9	4.1
1250	66.7	5.4
1600	65.8	5.3
2000	64.1	5.9
2500	60.7	8.9
3150	58.7	10.2
4000	54.1	13.1
5000	47.5	16.1



ISO 717/2

$\Delta L_w =$	8 dB	$C_{l,r} =$	-10 dB
$C_{l\Delta} =$	-1 dB	$C_{l,r,50-2500} =$	-8 dB

ANNEX E04

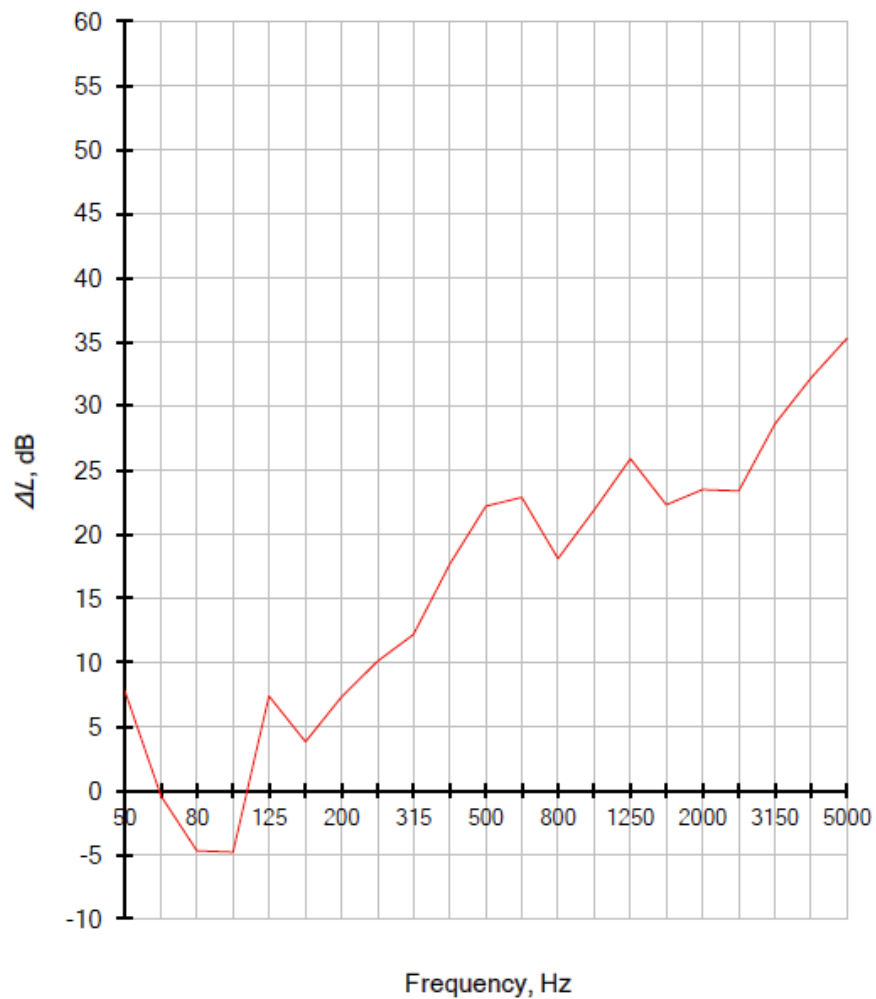
**Estimated impact sound improvement of floor covering in laboratory
(ISO 10140, ISO 717-2)**

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

ceramic 30-35 tiles. < Same object name as previous E03 !!!

Evaluation date: 2022-05-30

f (Hz)	$L_{n,0}$ (dB)	ΔL
50	66.5	7.8
63	55.4	-0.4
80	56.2	-4.7
100	58.6	-4.8
125	67.0	7.4
160	65.4	3.8
200	66.3	7.3
250	66.9	10.1
315	66.2	12.2
400	67.6	17.7
500	69.6	22.2
630	69.8	22.9
800	70.3	18.1
1000	72.0	21.9
1250	72.1	25.9
1600	71.1	22.3
2000	70.0	23.5
2500	69.6	23.4
3150	68.9	28.6
4000	67.2	32.2
5000	63.6	35.3



ISO 717/2

ΔL_w =	23 dB	$C_{l,r}$ =	-2 dB
$C_{l\Delta}$ =	-8 dB	$C_{l,r,50-2500}$ =	0 dB



ANNEX E05

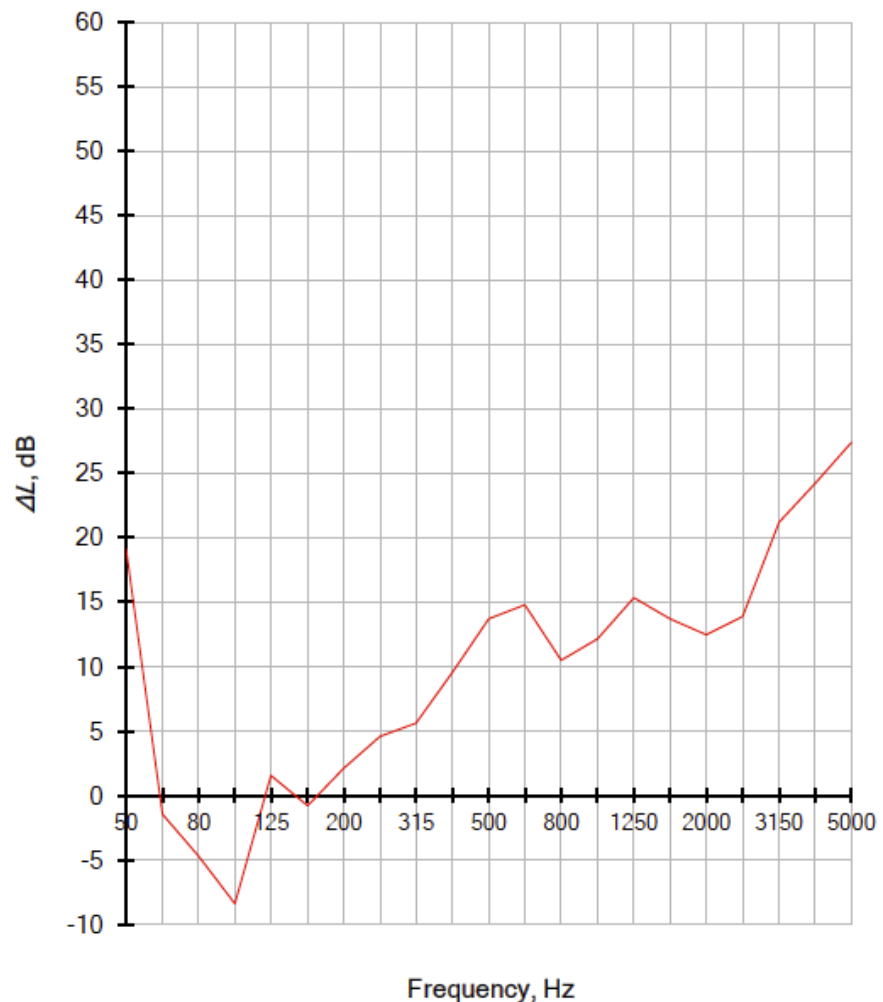
Estimated impact sound improvement of floor covering in laboratory (ISO 10140, ISO 717-2)

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

laminated 50-35 tiles.

Evaluation date: 2022-05-30

f (Hz)	$L_{n,0}$ (dB)	ΔL
50	66.5	19.1
63	55.4	-1.45
80	56.2	-4.7
100	58.6	-8.4
125	67.0	1.55
160	65.4	-0.8
200	66.3	2.1
250	66.9	4.6
315	66.2	5.6
400	67.6	9.6
500	69.6	13.7
630	69.8	14.8
800	70.3	10.5
1000	72.0	12.15
1250	72.1	15.35
1600	71.1	13.7
2000	70.0	12.45
2500	69.6	13.9
3150	68.9	21.2
4000	67.2	24.2
5000	63.6	27.4



ISO 717/2

$\Delta L_w =$	19 dB	$C_{l,r} =$	-3 dB
$C_{l\Delta} =$	-8 dB	$C_{l,r,50-2500} =$	-2 dB



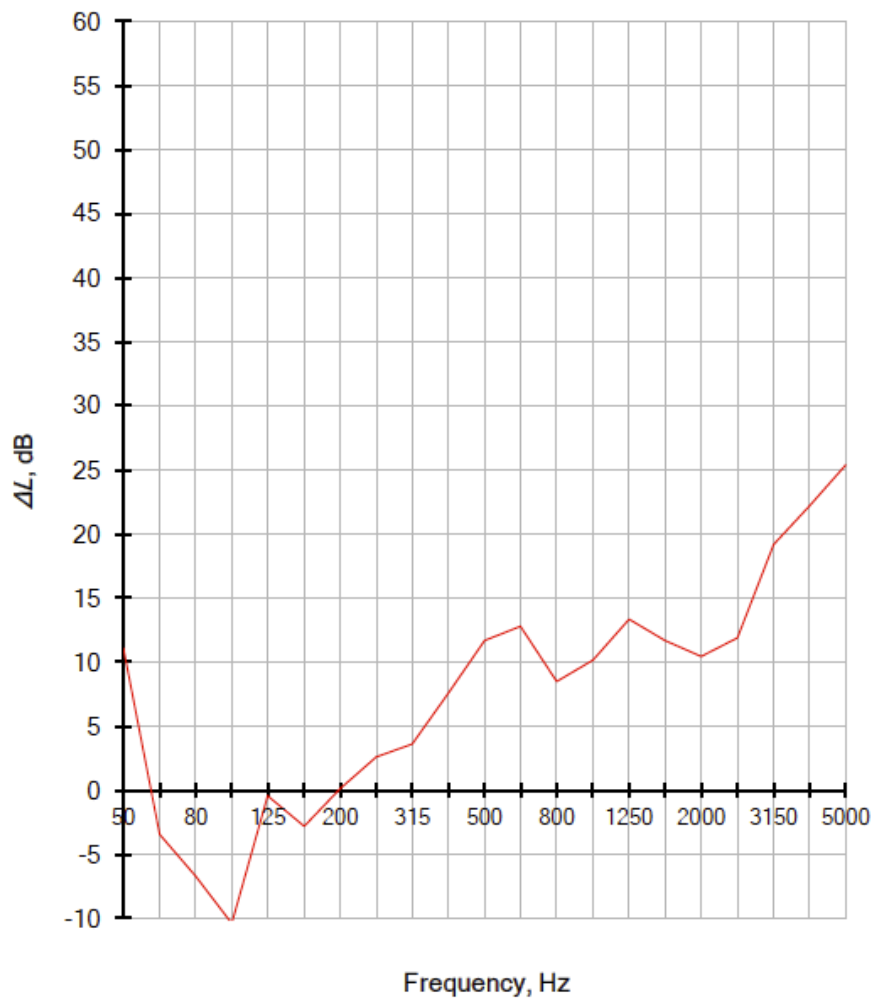
ANNEX E06

Estimated impact sound improvement of floor covering in laboratory (ISO 10140, ISO 717-2)

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of: laminated 30-35 tiles.

Evaluation date: 2022-05-30

<i>f</i> (Hz)	<i>L</i> _{n,0} (dB)	ΔL
50	66.5	11.1
63	55.4	-3.45
80	56.2	-6.7
100	58.6	-10.4
125	67.0	-0.45
160	65.4	-2.8
200	66.3	0.1
250	66.9	2.6
315	66.2	3.6
400	67.6	7.6
500	69.6	11.7
630	69.8	12.8
800	70.3	8.5
1000	72.0	10.15
1250	72.1	13.35
1600	71.1	11.7
2000	70.0	10.45
2500	69.6	11.9
3150	68.9	19.2
4000	67.2	22.2
5000	63.6	25.4



ISO 717/2

ΔL_w =	13 dB	$C_{l,r}$ =	-4 dB
$C_{l\Delta}$ =	-7 dB	$C_{l,r,50-2500}$ =	-4 dB

ANNEX E07

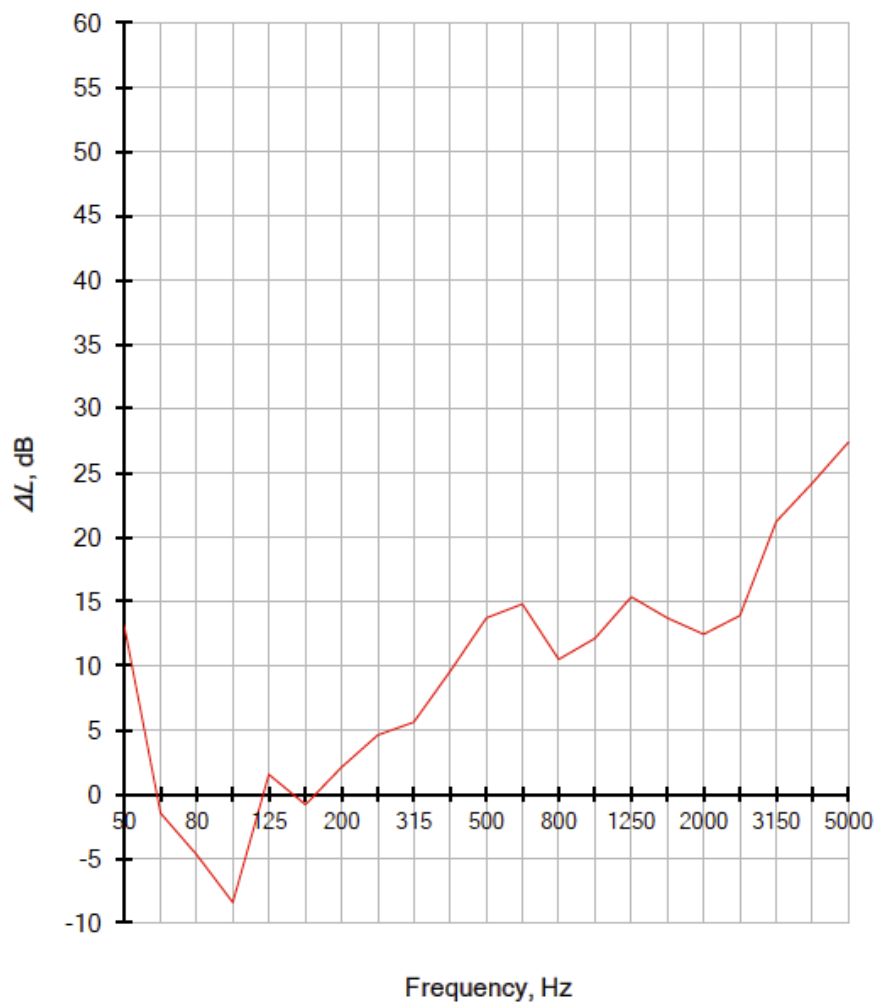
**Estimated impact sound improvement of floor covering in laboratory
(ISO 10140, ISO 717-2)**

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

Parquet 30-35.

Evaluation date: 2022-05-30

<i>f</i> (Hz)	<i>L</i> _{n,0} (dB)	ΔL
50	66.5	13.1
63	55.4	-1.45
80	56.2	-4.7
100	58.6	-8.4
125	67.0	1.55
160	65.4	-0.8
200	66.3	2.1
250	66.9	4.6
315	66.2	5.6
400	67.6	9.6
500	69.6	13.7
630	69.8	14.8
800	70.3	10.5
1000	72.0	12.15
1250	72.1	15.35
1600	71.1	13.7
2000	70.0	12.45
2500	69.6	13.9
3150	68.9	21.2
4000	67.2	24.2
5000	63.6	27.4



ISO 717/2

ΔL_w =	15 dB	$C_{l,r}$ =	-4 dB
$C_{l\Delta}$ =	-7 dB	$C_{l,r,50-2500}$ =	-4 dB

ANNEX E08

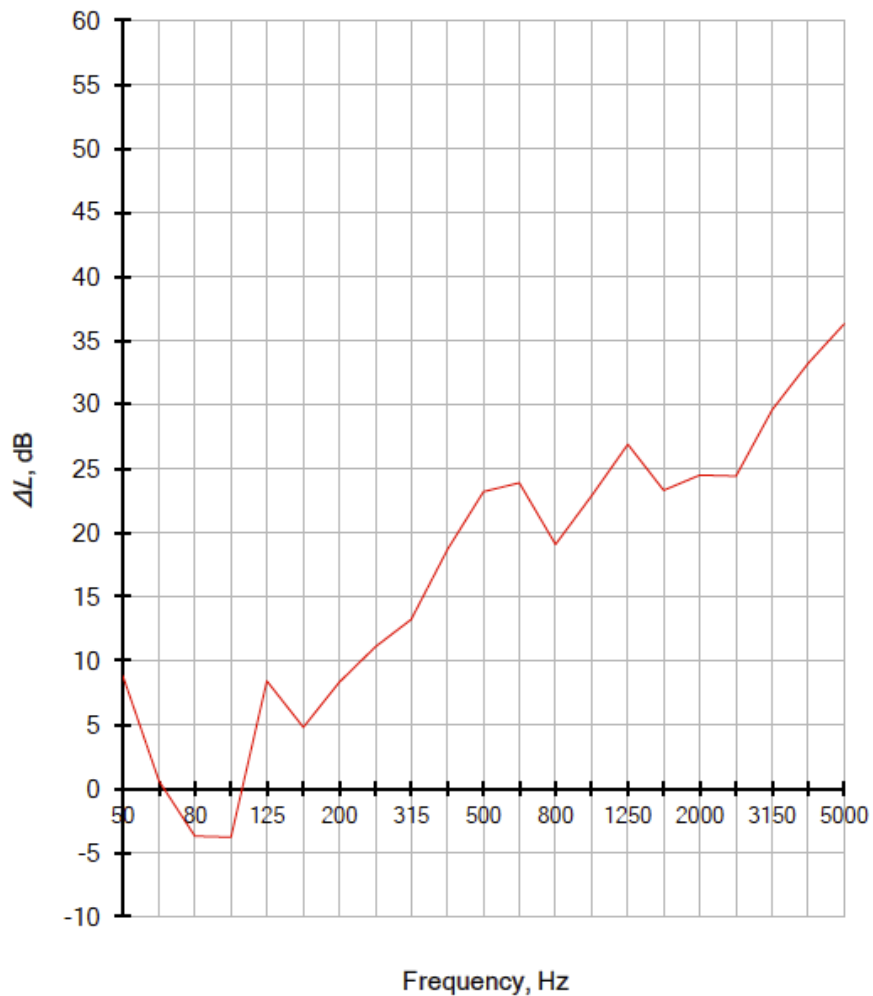
**Estimated impact sound improvement of floor covering in laboratory
(ISO 10140, ISO 717-2)**

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

Parquet 50-45.

Evaluation date: 2022-05-30

<i>f</i>	<i>L_{n,0}</i>	ΔL
(Hz)	(dB)	
50	66.5	8.8
63	55.4	0.6
80	56.2	-3.7
100	58.6	-3.8
125	67.0	8.4
160	65.4	4.8
200	66.3	8.3
250	66.9	11.1
315	66.2	13.2
400	67.6	18.7
500	69.6	23.2
630	69.8	23.9
800	70.3	19.1
1000	72.0	22.9
1250	72.1	26.9
1600	71.1	23.3
2000	70.0	24.5
2500	69.6	24.4
3150	68.9	29.6
4000	67.2	33.2
5000	63.6	36.3



ISO 717/2

ΔL_w =	24 dB	$C_{l,r}$ =	-2 dB
$C_{l\Delta}$ =	-9 dB	$C_{l,r,50-2500}$ =	0 dB



ANNEX E09

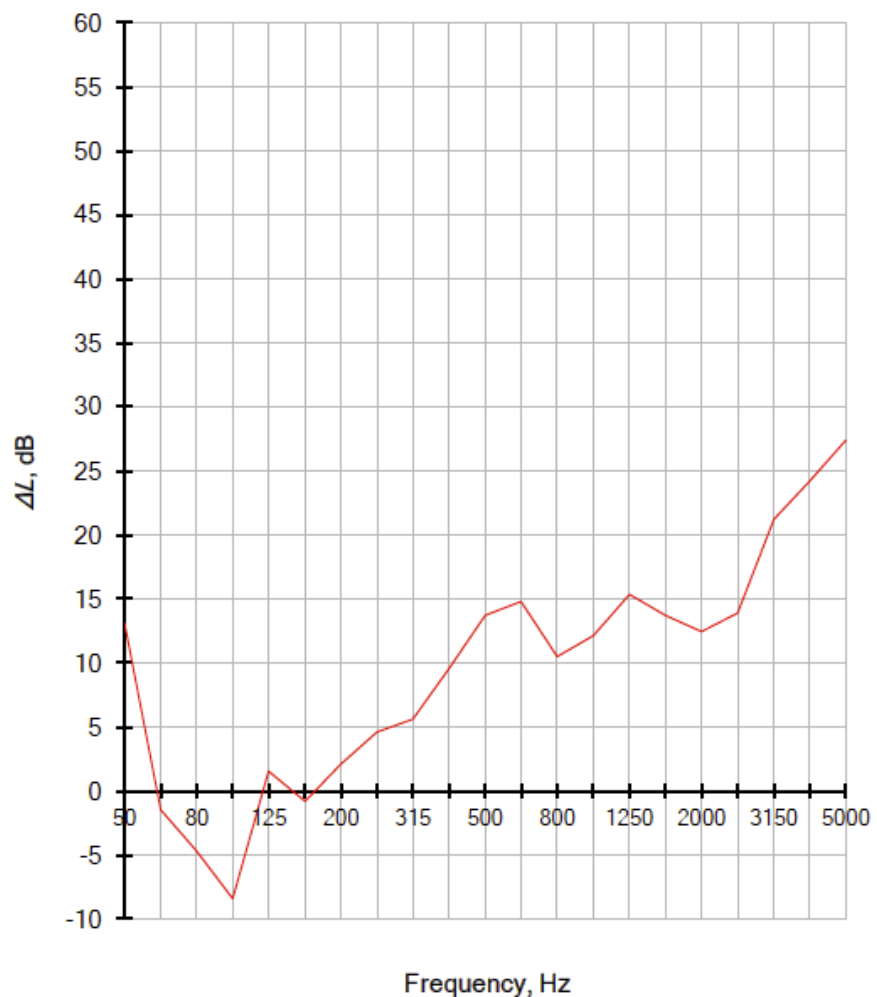
Estimated impact sound improvement of floor covering in laboratory (ISO 10140, ISO 717-2)

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

Parquet 50-35.

Evaluation date: 2022-05-30

f (Hz)	$L_{n,0}$ (dB)	ΔL
50	66.5	13.1
63	55.4	-1.45
80	56.2	-4.7
100	58.6	-8.4
125	67.0	1.55
160	65.4	-0.8
200	66.3	2.1
250	66.9	4.6
315	66.2	5.6
400	67.6	9.6
500	69.6	13.7
630	69.8	14.8
800	70.3	10.5
1000	72.0	12.15
1250	72.1	15.35
1600	71.1	13.7
2000	70.0	12.45
2500	69.6	13.9
3150	68.9	21.2
4000	67.2	24.2
5000	63.6	27.4



ISO 717/2

$\Delta L_w =$	21 dB	$C_{l,r} =$	-2 dB
$C_{l\Delta} =$	-9 dB	$C_{l,r,50-2500} =$	-1 dB

ANNEX E10

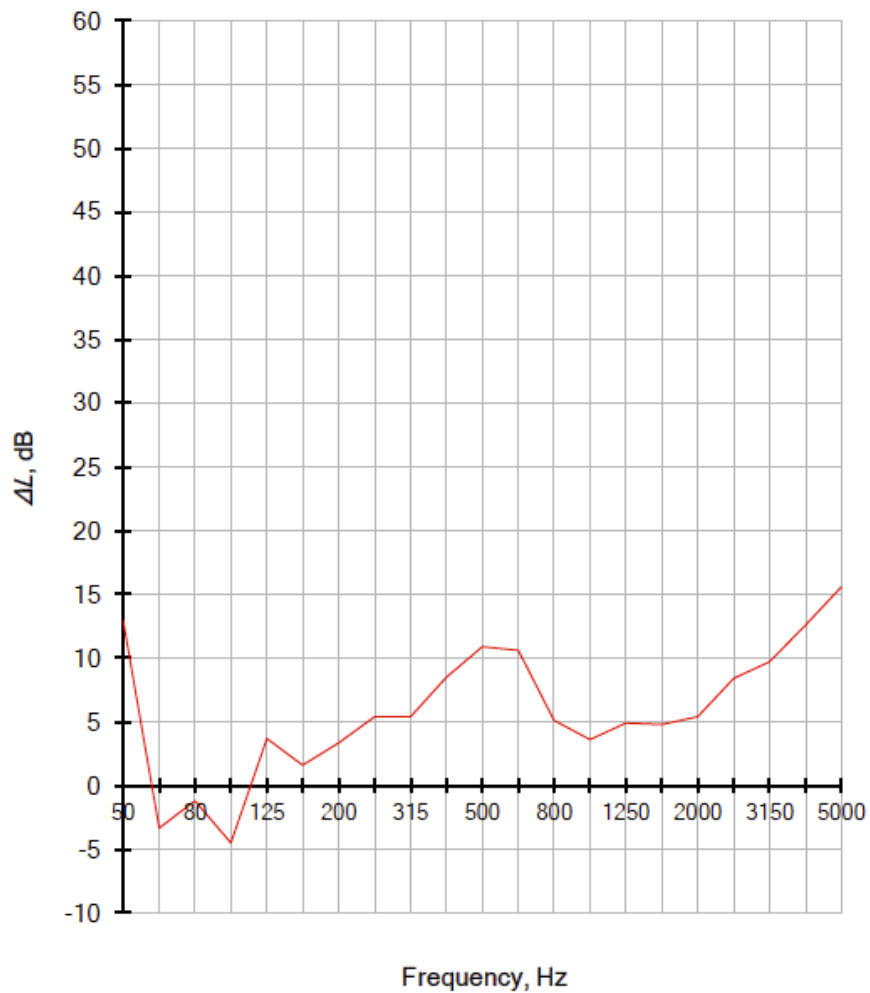
**Estimated impact sound improvement of floor covering in laboratory
(ISO 10140, ISO 717-2)**

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

Screed 50-45.

Evaluation date: 2022-05-30

f (Hz)	$L_{n,0}$ (dB)	ΔL (dB)
50	66.5	12.95
63	55.4	-3.35
80	56.2	-1.2
100	58.6	-4.5
125	67.0	3.7
160	65.4	1.6
200	66.3	3.35
250	66.9	5.4
315	66.2	5.4
400	67.6	8.5
500	69.6	10.9
630	69.8	10.6
800	70.3	5.1
1000	72.0	3.6
1250	72.1	4.9
1600	71.1	4.8
2000	70.0	5.4
2500	69.6	8.4
3150	68.9	9.7
4000	67.2	12.6
5000	63.6	15.6



ISO 717/2

$\Delta L_w =$	8 dB	$C_{l,r} =$	-10 dB
$C_{l\Delta} =$	-1 dB	$C_{l,r,50-2500} =$	-9 dB

ANNEX E11

**Estimated impact sound improvement of floor covering in laboratory
(ISO 10140, ISO 717-2)**

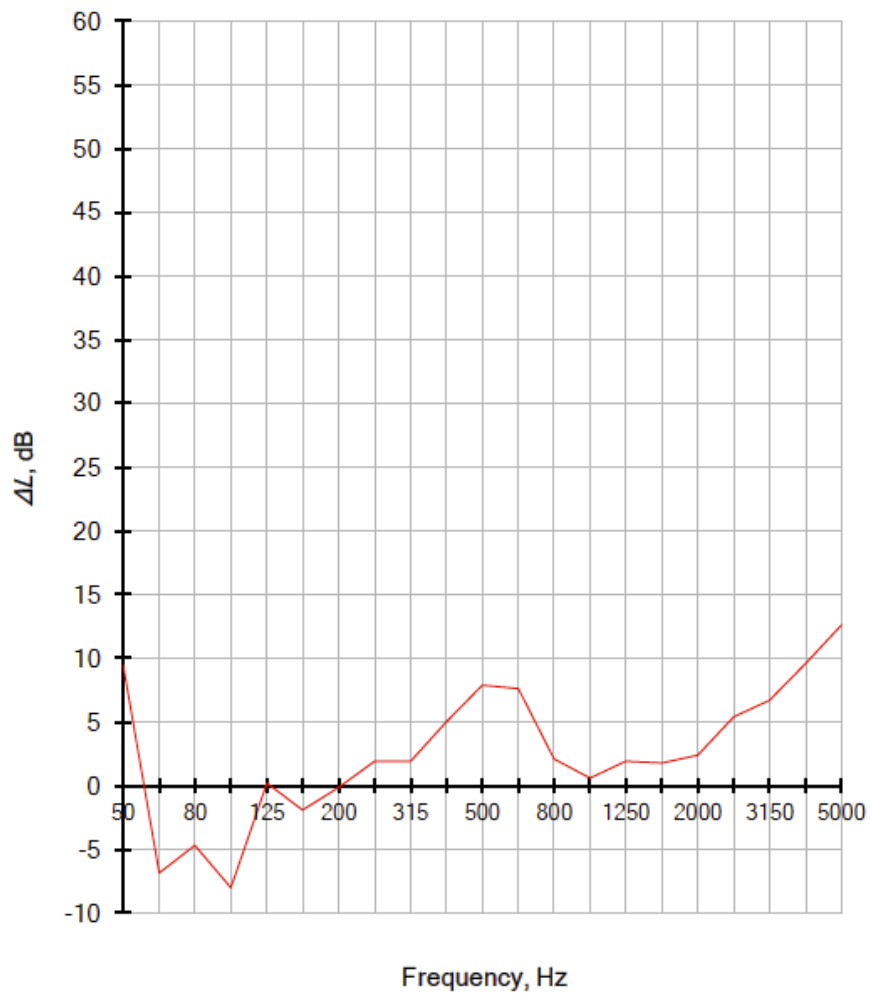
Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

Screed 50-35.

Logo falls on report results - see below !

Evaluation date: 2022-05-30

<i>f</i> (Hz)	<i>L</i> _{n,0} (dB)	ΔL (dB)
50	66.5	9.45
63	55.4	-6.85
80	56.2	-4.7
100	58.6	-8
125	67.0	0.2
160	65.4	-1.9
200	66.3	-0.15
250	66.9	1.9
315	66.2	1.9
400	67.6	5
500	69.6	7.9
630	69.8	7.6
800	70.3	2.1
1000	72.0	0.6
1250	72.1	1.9
1600	71.1	1.8
2000	70.0	2.4
2500	69.6	5.4



ISO 717/2

$\Delta L_w =$	5 dB	$C_{l,r} =$	-10 dB
$C_{l\Delta} =$	-1 dB	$C_{l,r,50-2500} =$	-9 dB



ANNEX E12

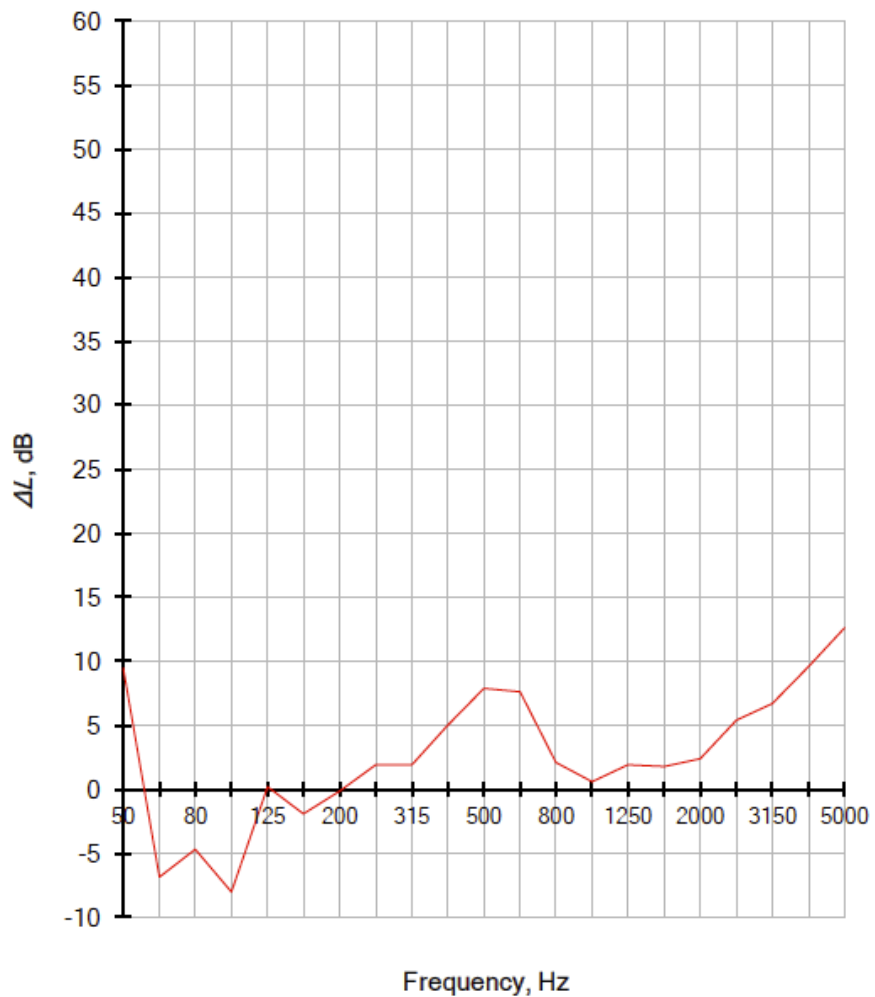
Estimated impact sound improvement of floor covering in laboratory (ISO 10140, ISO 717-2)

Test object: 45 mm screed on 30 mm LK Foil Board 30 Silent and floor covering of:

Screed 30-35. Same report results as E11 - see before +below !

Evaluation date: 2022-05-30

<i>f</i> (Hz)	<i>L</i> _{n,0} (dB)	ΔL (dB)
50	66.5	9.45
63	55.4	-6.85
80	56.2	-4.7
100	58.6	-8
125	67.0	0.2
160	65.4	-1.9
200	66.3	-0.15
250	66.9	1.9
315	66.2	1.9
400	67.6	5
500	69.6	7.9
630	69.8	7.6
800	70.3	2.1
1000	72.0	0.6
1250	72.1	1.9
1600	71.1	1.8
2000	70.0	2.4
2500	69.6	5.4
3150	68.9	6.7
4000	67.2	9.6
5000	63.6	12.6



ISO 717/2

$\Delta L_w =$	5 dB	$C_{l,r} =$	-10 dB
$C_{l\Delta} =$	-1 dB	$C_{l,r,50-2500} =$	-9 dB

