

7.9.2022

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Mission

The task was to get information about the sound insulation of the Das Kelo wooden apartment building included in the Tallwood project. Apartment buildings differ in their structure from small houses. In the Das Kelo wooden apartment building, the surface materials of the corridors are also wood.

Theory

Calibrated Norsonic equipment was used for the measurements. The sound analyzer was Nor 140. The microphone capsule Nor 1225 was calibrated with a Nor 1251 sound pressure calibrator. In airborne sound insulation measurements, a sound source placed on the floor and transmitting into half space was used. In the impact sound insulation measurements, the Nor 211 impact sound device was used as the sound source.

In airborne sound insulation measurement, the sound source is set to space 1. The sound intensity level L_1 is measured in space 1 and on the other side of the structure under investigation in space 2 (L_2). The measurement result L_2 of room 2 is influenced by the property of the surfaces of the room to absorb sound. This effect is removed by measuring the reverberation time T of the sound from space 2. The equipment measures the intensity levels L_1 and L_2 and the reverberation time by frequency band for sound frequencies from 100 to 3150 Hz. The sound level difference D_{nT} by frequency band for the investigated structure between spaces 1 and 2 is obtained from the formula

$$D_{nT} = L_1 - L_2 + 10 \lg \left(\frac{T}{T_0} \right) \quad (1)$$

missä $T_0 = 0,5$ s.

The sound level difference number $D_{nT,w}$ is calculated from the sound level differences measured by frequency bands. According to the Ministry of the Environment's regulation on the sound environment of buildings (796/2017), the smallest permitted sound level difference between two apartments is 55 dB and from the exit to the residential apartment is 39 dB.

In impact sound insulation measurements, a impact sound device that produces standard sound directly in the structure is set to space 1. The sound intensity level L_2 and the reverberation time T are measured in the space on the other side of the structure under investigation by frequency bands in the frequency range 100 to 3150 Hz. The pitch level L'_{nT} by frequency band for the investigated structure between spaces 1 and 2 is obtained from the formula

$$L'_{nT} = L_2 - 10 \lg \left(\frac{T}{T_0} \right) \quad (2)$$

From the impact sound levels measured by frequency band, the impact sound level number $L'_{nT,w} + C_{1,50-2500}$ is calculated. According to the Ministry of the Environment's regulation on the sound environment of buildings (796/2017), the maximum permitted sound level between two apartments is 53 dB and from the exit to the residential apartment is 63 dB.

In the measurements, it was possible to use the Nor 848 acoustic camera to locate sound leakage points. The camera in question contains 256 microphones on a circular plate base, which enables the detection of the incoming direction of the sound.

Performance of the measurement

The measurements were performed as a student project on 2nd December 2021. Airborne sound insulation measurements were made for two partition wall structures and one intermediate foundation. Impact sound measurements were made on two intermediate floors and two structures between the corridor and the apartment.

Measurement results

airborne sound insulation measurements:

partition, apartments 75 and 74	$D_{nT,w}(C;C_{tr}) = 54 (-7,-16)$ dB
partition, apartments 73 and 74	$D_{nT,w}(C;C_{tr}) = 58 (-3,-10)$ dB
midsole, apartments 89 and 74	$D_{nT,w}(C;C_{tr}) = 59 (-2,-5)$ dB

impacts sound insulation measurements:

midsole, apartments 75 and 60	$L'_{nT,w}(C_{l,50-2500}) = 43 (8)$ dB
midsole, apartments 89 and 74	$L'_{nT,w}(C_{l,50-2500}) = 44 (7)$ dB
midsole, corridor apartment 60	$L'_{nT,w}(C_{l,50-2500}) = 48 (-3)$ dB
midsole, corridor apartment 74	$L'_{nT,w}(C_{l,50-2500}) = 52 (-1)$ dB

The graphical measurement results are in Attachment 1. According to the regulation, **the smallest** allowed $D_{nT,w}$ number for airborne sounds is 55 dB. Except for the first measurement (54 dB), the measurements exceeded the limit value. If the first measurement was repeated, it would probably meet the requirement because the individual measurement results look good except for one partial measurement. In both measurements, resonance at low frequencies can be observed in the partition structure, which almost completely explains the low value of the first measurement.

According to the regulation, **the maximum** allowed $L'_{nT,w}(C_{l,50-2500})$ number for the sound of impacts is 53 dB. All results meet the regulations.

An acoustic camera was also used at the measurement site. The camera did not show any sound leakage points due to the good sound insulation of the structures, as shown by the measurements.

Summary

In the Das Kelo wooden apartment building, creating good sound insulation has been successful. No further measurements need.

ATTACHMENT 1.

Standardized level difference according to ISO 16283-1

Field measurements of airborne sound insulation between rooms

Client: DAS KELO
 Description: Ilmaääneneristävyyden asuntojen 75 ja 74 välillä
 Äänilähde huoneistossa 75

Date of test: 2.12.2021

Object:

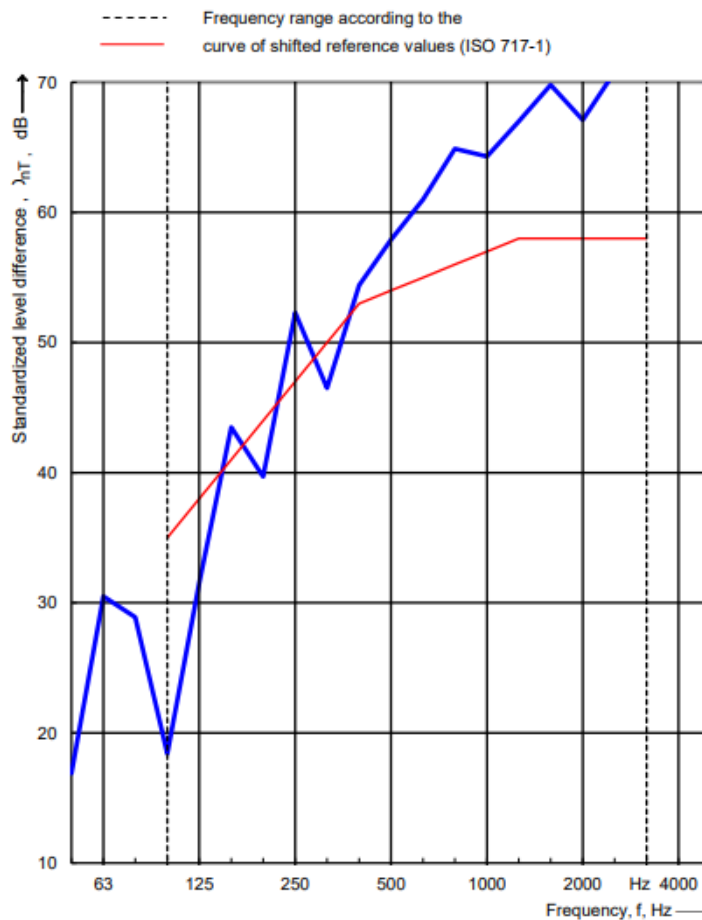
Source room:
 Condition:
 Type:
 Location:

Receiving room:
 Condition:
 Type:
 Location:

Area of common partition: 1,00 m²
 Source room volume: 1 m³
 Receiving room volume:

Frequency f [Hz]	D _{nT} 1/3 octave [dB]
50	16,9
63	30,5
80	28,9
100	18,4
125	31,5
160	43,5
200	39,7
250	52,3
315	46,5
400	54,4
500	57,9
630	61,0
800	64,9
1000	64,3
1250	67,0
1600	69,8
2000	67,1
2500	70,8
3150	71,2
4000	70,3
5000	70,2 ¹

¹ Limit of measurement



Rating according to ISO 717-1

D_{nT,W}(C;C_{tr}) = 54 (-7 ; -16) dB

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

C₅₀₋₃₁₅₀ = -8 dB C₅₀₋₅₀₀₀ = -7 dB C₁₀₀₋₅₀₀₀ = -6 dB

C_{tr,50-3150} = -18 dB C_{tr,50-5000} = -18 dB C_{tr,100-5000} = -16 dB

Name of test institute:

No. of test report:

Date: 2.12.2021

Signature:

Level difference according to ISO 16283-1

Field measurements of airborne sound insulation between rooms

Client: DAS KELO

Date of test: 2.12.2021

Description: Ilmaääneneristävyys väliseinä asunnot 73 ja 74
Äänilähde asunnossa 73

Object:

Source room:

Receiving room:

Condition:

Condition:

Type:

Type:

Location:

Location:

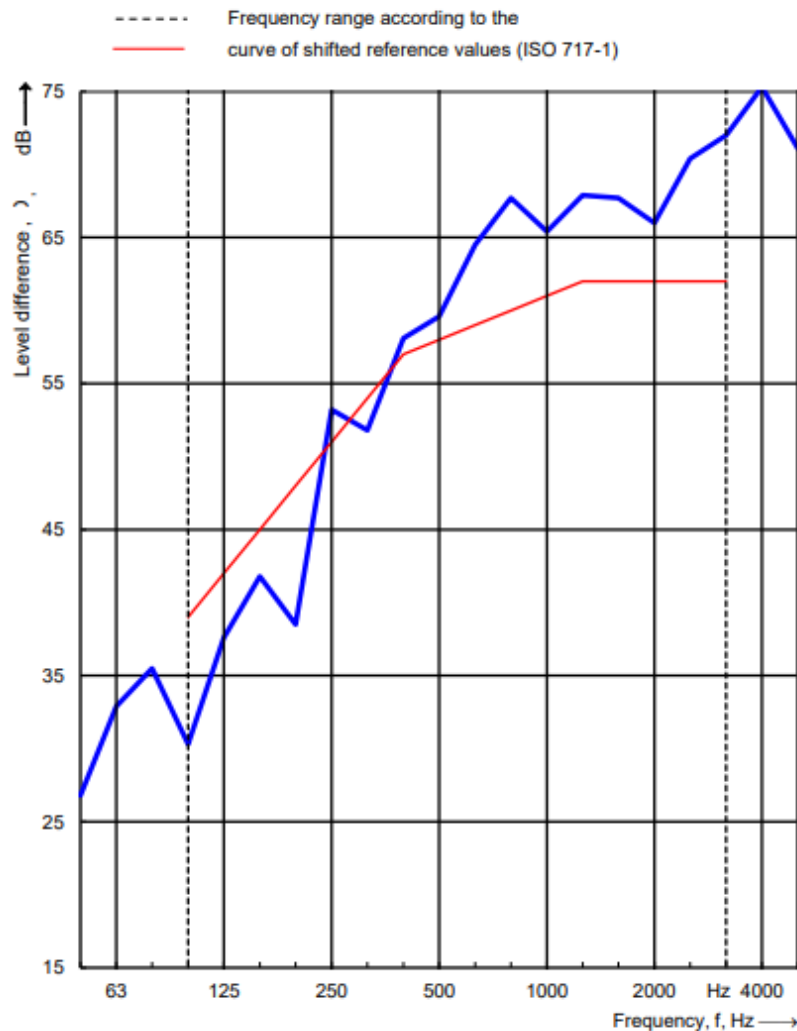
Area of common partition: 1,00 m²

Source room volume: 1 m³

Receiving room volume: 1 m³

Frequency f [Hz]	D 1/3 octave [dB]
50	26,8
63	32,9
80	35,5
100	30,3
125	37,6
160	41,8
200	38,5
250	53,2
315	51,8
400	58,1
500	59,6
630	64,5
800	67,7
1000	65,4
1250	67,9
1600	67,7
2000	66,0
2500	70,4
3150	72,0
4000	75,3 ¹
5000	71,1 ¹

¹ Limit of measurement



Rating according to ISO 717-1

$D_w (C;C_r) = 58 (-3 ; -10) \text{ dB}$

Evaluation based on field measurement results obtained

in one-third-octave bands by an engineering method.

$C_{50-3150} = -4 \text{ dB}$ $C_{50-5000} = -3 \text{ dB}$ $C_{100-5000} = -2 \text{ dB}$

$C_{r,50-3150} = -12 \text{ dB}$ $C_{r,50-5000} = -12 \text{ dB}$ $C_{r,100-5000} = -10 \text{ dB}$

Name of test institute:

No. of test report:

Date: 16.12.2021

Signature:

Standardized level difference according to ISO 16283-1

Field measurements of airborne sound insulation between rooms

Client: DAS KELO

Date of test: 2.12.2021

Description: Ilmääneneristävyys välipohja asunnot 89 ja 74
Äänilähde asunnossa 89

Object:

Source room:

Receiving room:

Condition:

Condition:

Type:

Type:

Location:

Location:

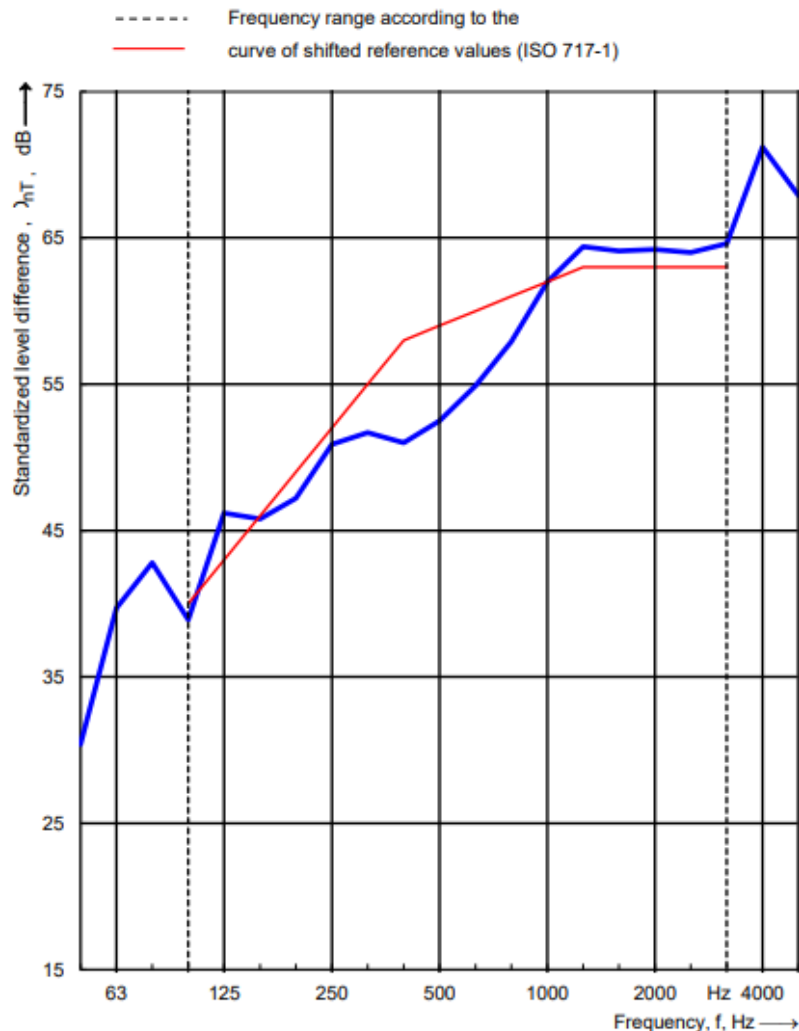
Area of common partition: 1,00 m²

Source room volume: 1 m³

Receiving room volume: 1 m³

Frequency f [Hz]	D _{nT} 1/3 octave [dB]
50	30,4
63	39,7
80	42,8
100	38,9
125	46,2
160	45,8
200	47,2
250	50,9
315	51,7
400	51,0
500	52,5
630	54,9
800	57,9
1000	62,0
1250	64,4
1600	64,1
2000	64,2
2500	64,0
3150	64,6
4000	71,2
5000	67,9 ¹

¹ Limit of measurement



Rating according to ISO 717-1

$D_{nT,w}(C;C_w) = 59$ (-2 ; -5) dB

Evaluation based on field measurement results obtained

in one-third-octave bands by an engineering method.

$C_{50-3150} = -2$ dB $C_{50-5000} = -1$ dB $C_{100-5000} = -1$ dB

$C_{tr,50-3150} = -8$ dB $C_{tr,50-5000} = -8$ dB $C_{tr,100-5000} = -5$ dB

Name of test institute:

No. of test report:

Date: 16.12.2021

Signature:

Standardized impact sound pressure levels according to ISO 16283-2

Field measurements of impact sound insulation of floors

Client: DAS KELO

Date of test: 2.12.2021

Description: Askelääneneristävyys asuntojen 75 ja 60 välillä
Äänilähde huoneistossa 75

Object:

Source room:

Receiving room:

Condition:

Condition:

Type:

Type:

Location:

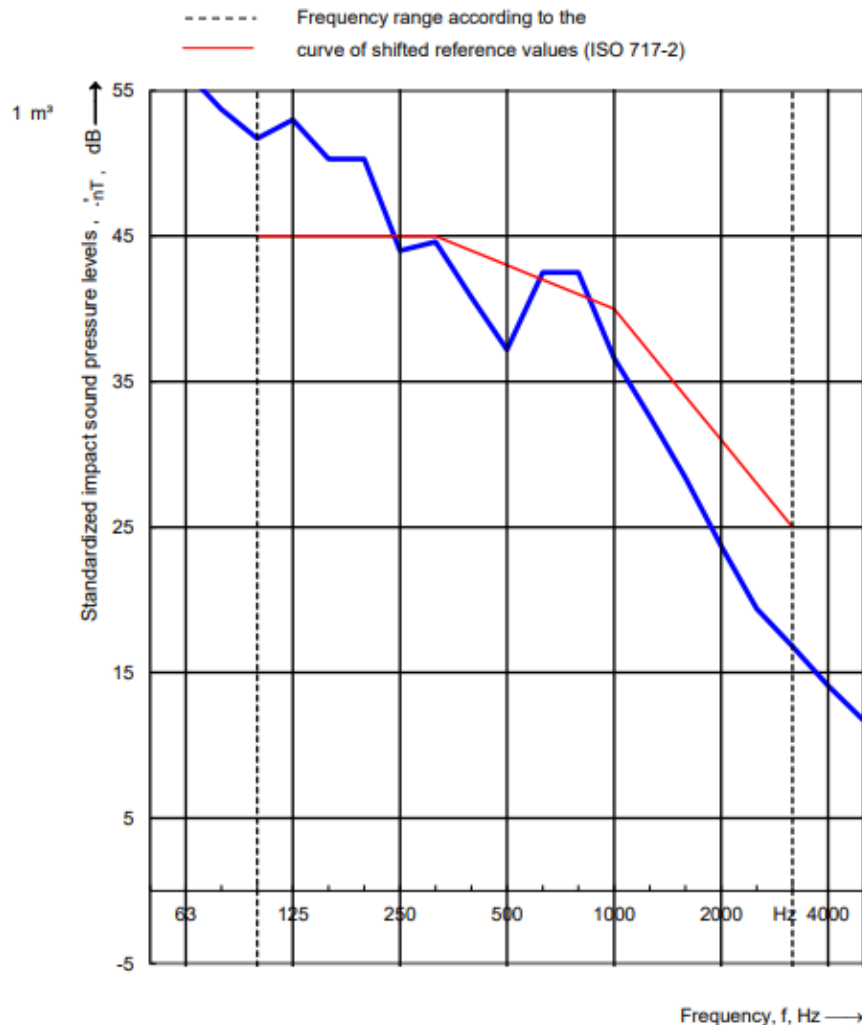
Location:

Source room volume:

Receiving room volume:

Frequency f [Hz]	L'_{nT} 1/3 octave [dB]
50	63,5
63	56,3
80	53,7
100	51,7
125	53,0
160	50,3
200	50,3
250	44,0
315	44,6
400	40,8
500	37,2
630	42,5
800	42,5
1000	36,6
1250	32,6
1600	28,4
2000	23,7
2500	19,4
3150	16,8
4000	14,1 ¹
5000	11,7 ¹

¹ Limit of measurement



Rating according to ISO 717-2

$L'_{nT,W} (C_1) = 43 (0)$ dB

$C_{1,50-2500} = 8$ dB

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

Name of test institute:

No. of test report:

Date: 2.12.2021

Signature:

Standardized impact sound pressure levels according to ISO 16283-2

Field measurements of impact sound insulation of floors

Client: DAS KELO

Date of test: 2.12.2021

Description: Askelääneneristävyyden asuntojen 89 ja 74 välillä
Äänilähde asunnossa 89

Object:

Source room:

Receiving room:

Condition:

Condition:

Type:

Type:

Location:

Location:

Source room volume:

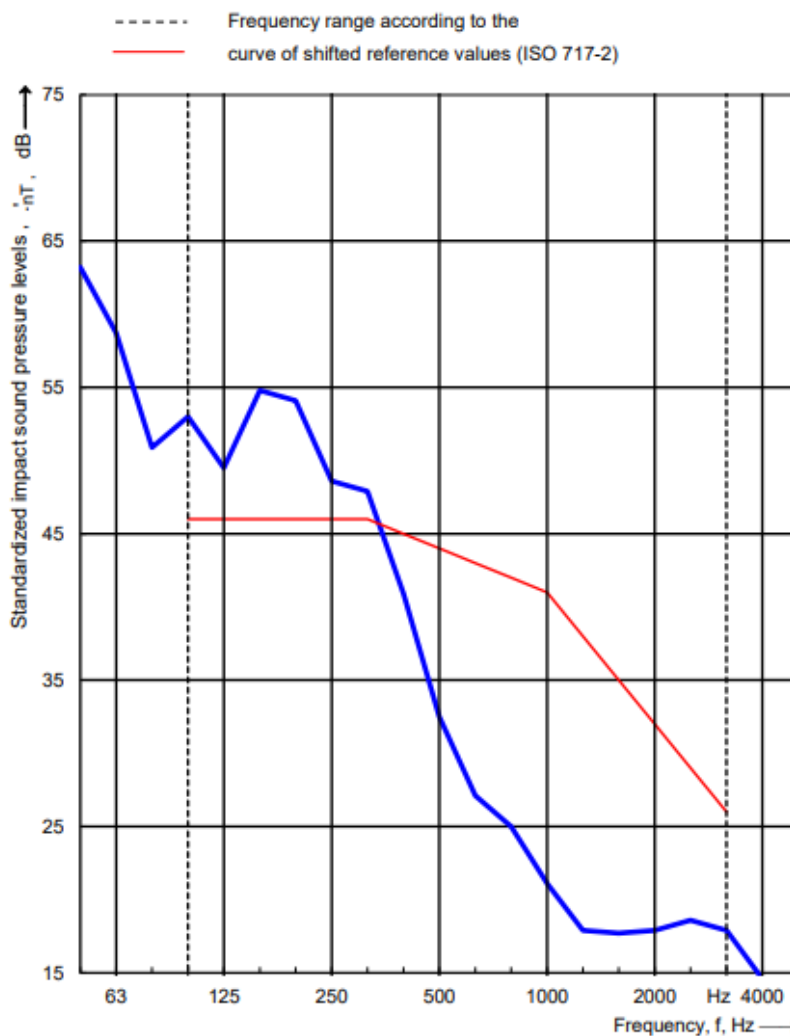
1 m³

Receiving room volume:

7 m³

Frequency f [Hz]	L' _{nT} 1/3 octave [dB]
50	63,2
63	58,7
80	50,9
100	53,0
125	49,5
160	54,8
200	54,1
250	48,6
315	47,9
400	40,9
500	32,5
630	27,1
800	25,0
1000	21,1
1250	17,9
1600	17,7
2000	17,9
2500	18,6
3150	17,9
4000	14,6 ¹
5000	13,1 ¹

¹ Limit of measurement



Rating according to ISO 717-2

L'_{nT,w} (C₁) = 44 (1) dB

C_{1,50-2500} = 7 dB

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

Name of test institute:

No. of test report:

Date: 16.12.2021

Signature:

Standardized impact sound pressure levels according to ISO 16283-2

Field measurements of impact sound insulation of floors

Client: DAS KELO

Date of test: 2.12.2021

Description: Askelaäneneristävyys käytävän ja asunnon 60 välillä
Äänilähde käytävässä

Object:

Source room:

Receiving room:

Condition:

Condition:

Type:

Type:

Location:

Location:

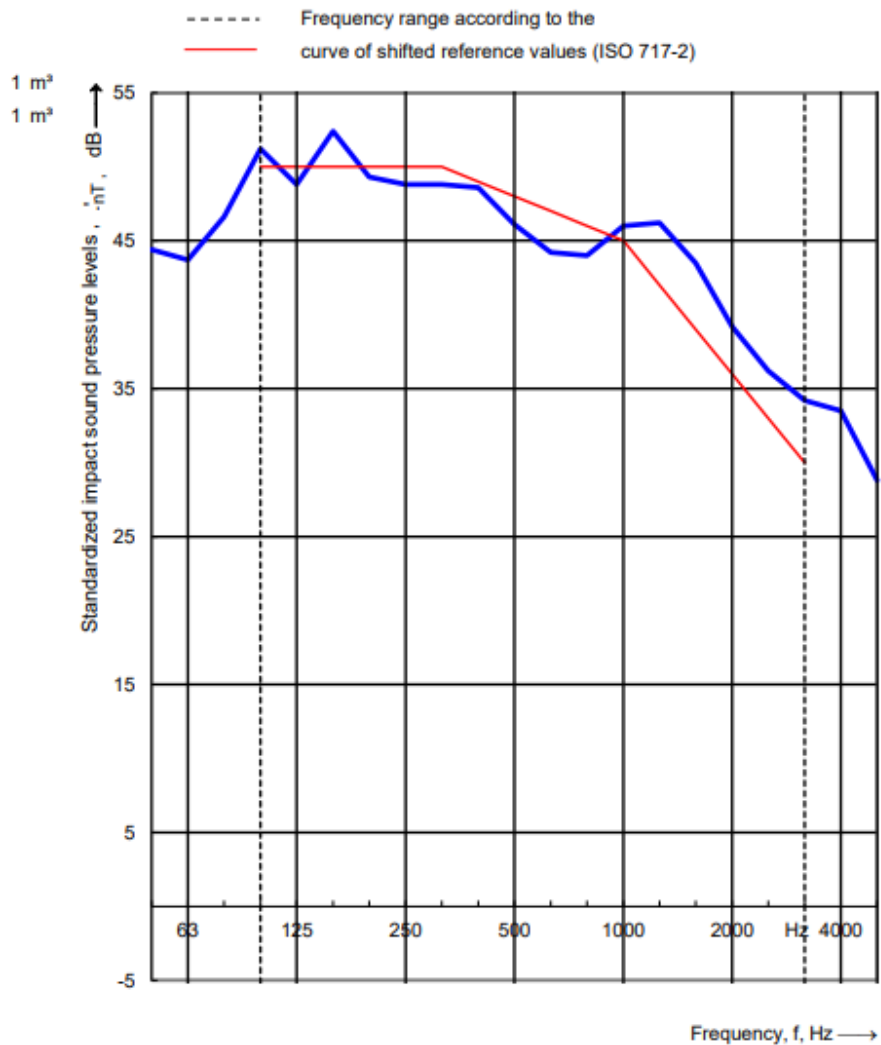
Source room volume:

1 m³

Receiving room volume:

1 m³

Frequency f [Hz]	L' _{nT} 1/3 octave [dB]
50	44,4
63	43,7
80	46,6
100	51,2
125	48,8
160	52,4
200	49,3
250	48,8
315	48,8
400	48,6
500	46,1
630	44,2
800	44,0
1000	46,0
1250	46,2
1600	43,5
2000	39,2
2500	36,2
3150	34,2
4000	33,5
5000	28,8



Rating according to ISO 717-2

$L'_{nT,w}(C_1) = 48$ (-3) dB

$C_{1,50-2500} = -3$ dB

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

Name of test institute:

No. of test report:

Date: 16.12.2021

Signature: