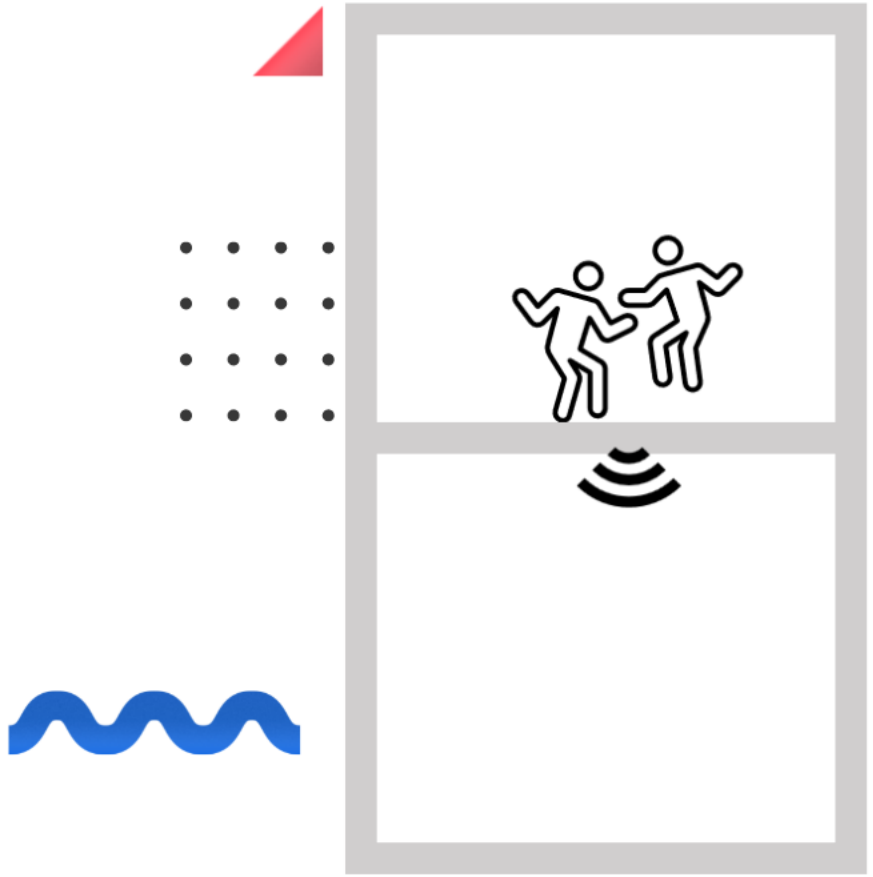
ALT
Acoustic Laboratory
Thailand

ISO10140-3

Laboratory Measurement of Impact Sound Insulation



Terms and Definitions

- L_i : Impact sound pressure level
  = average sound pressure level in the receiving room when the floor under test is excited by the impact source

- L_n : Normalized impact sound pressure level

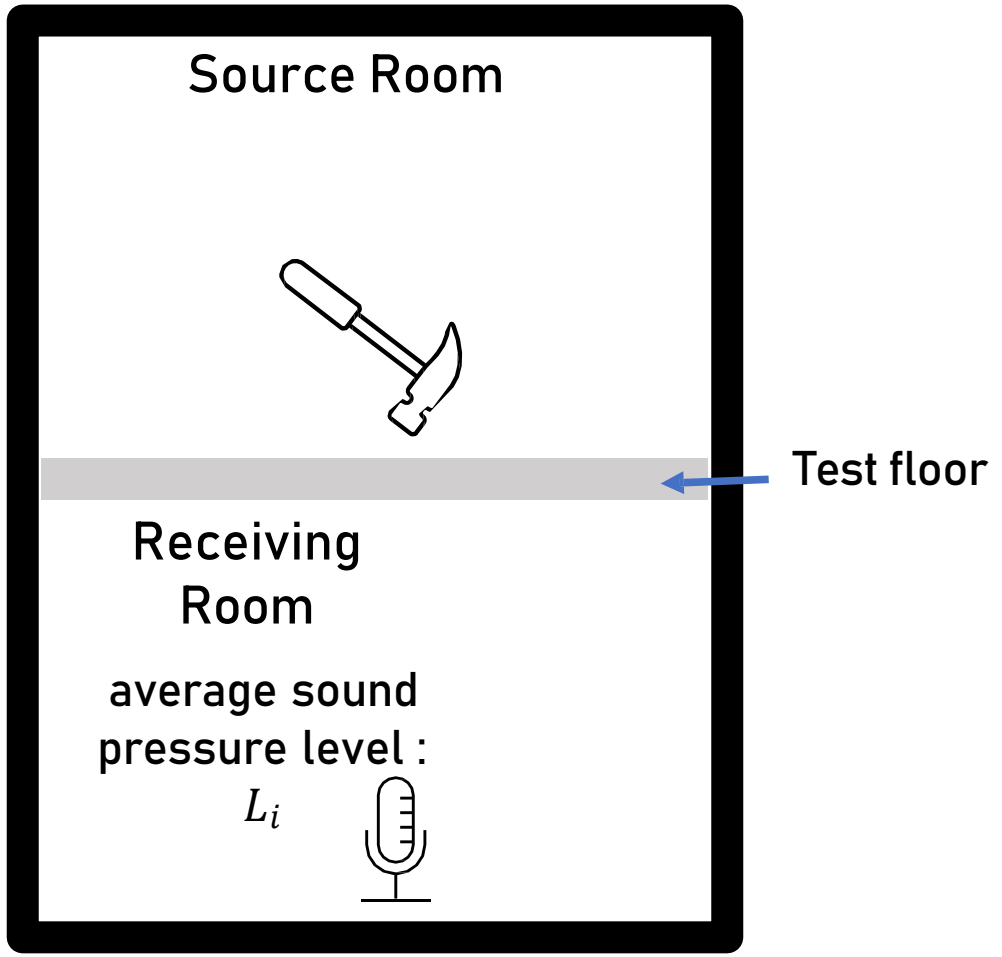
$$L_n = L + 10 \log \frac{A}{A_0}$$

; A_0 = ref. absorption area (for laboratory A_0 = 10 m²)

Measurement of Impact sound

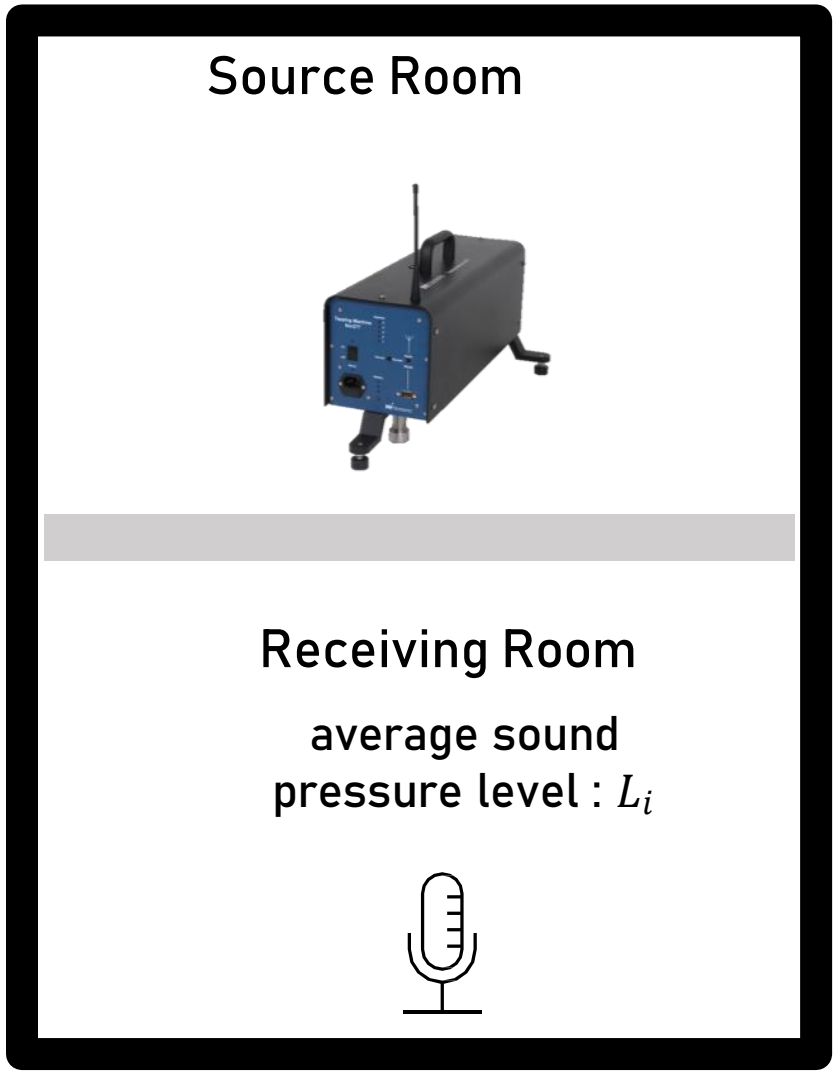
Main principle:

1. Measure background noise level in receiving room
2. Measure sound level in receiving room: L_i at source position 1-4
3. Measure reverberation time in receiving room



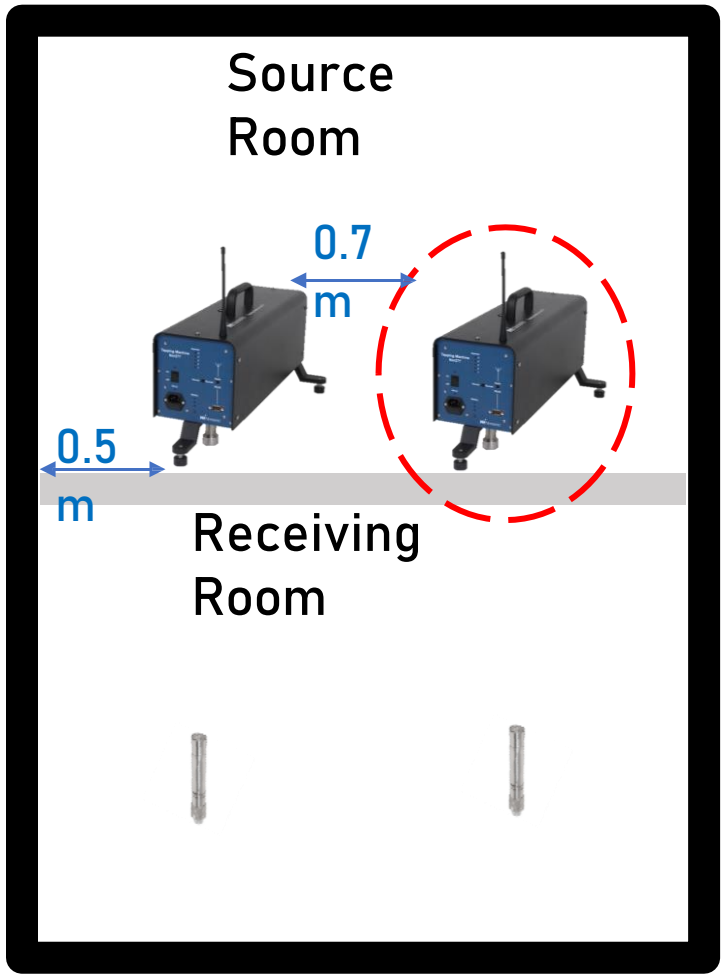
Getting ready

- Select 1/3 octave band measurement
- Frequency range:
  100 Hz – 5000 Hz
- If low-frequency range is required : 50 Hz – 80 Hz



"Tapping Machine"

Getting ready | Source positions



Tapping machine positions

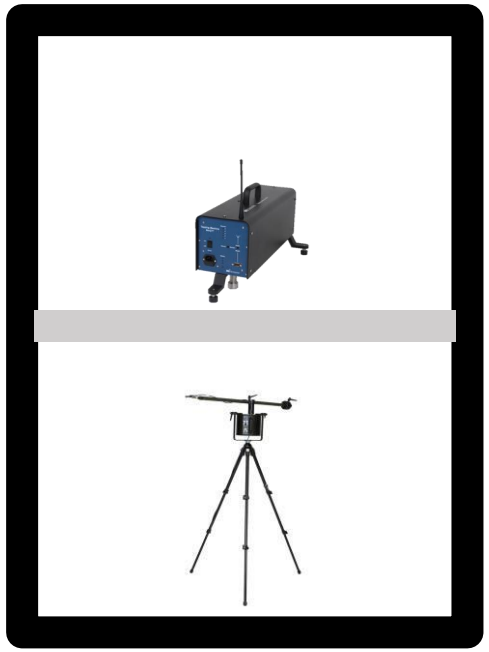
- The test source : Tapping machine shall be place on the test floor for at least 4 positions
- Distance between tapping machine positions shall be at least 0.7 m.
- The distance of the tapping machine from the edges of the floor shall be at least 0.5 m

Measurement of sound pressure levels

Measurement with a continuously moving microphone (Receiving Room)

- At least one measurement using a continuously moving microphone shall be used for each tapping machine position.
- The sweep radius: at least 1m.
- The plane of traverse : not less than 10° to a room surface
- The duration of a traverse period : not less than 15 s.

*The location of the fixed point about which the continuously moving microphone moves may be changed for each loudspeaker position. The same number of measurements shall be taken at each location.



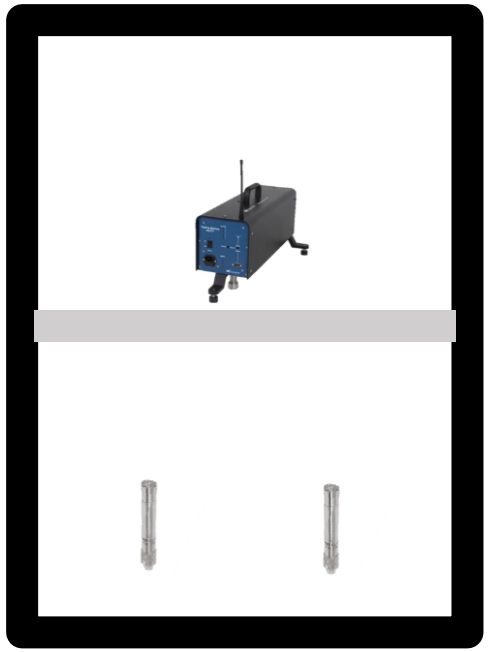
$$L = 10 \lg \frac{\frac{1}{T_m} \int_0^{T_m} p^2(t)\,dt}{p_0^2}$$

energy average sound pressure level

Measurement of sound pressure levels

Measurement with fixed microphone positions (Receiving Room)

- If 4-5 tapping machine positions are used:
  - Measurements shall be made in at least two microphone positions for each tapping machine position
- If six or more tapping machine positions are used:
  - at least one measurement shall be made for each tapping machine position
- The averaging time shall be at least 6 s for each frequency band from 100 Hz – 400 Hz
- For bands of higher frequencies, it is permissible to decrease the time to not less than 4 s.



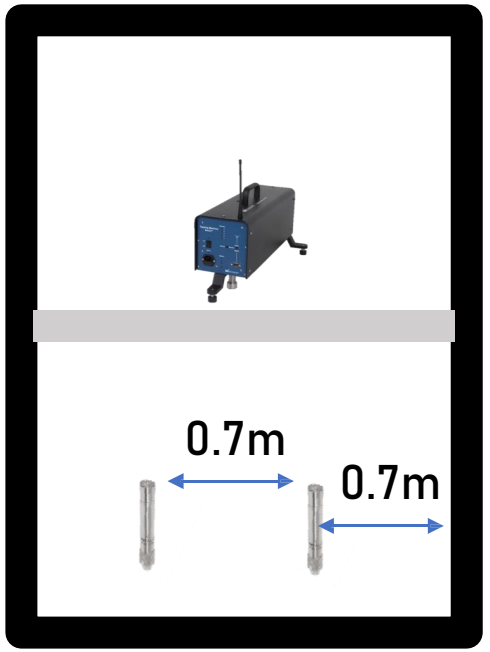
$$L = 10 \lg \frac{1}{n} \sum_{j=1}^{n} 10^{L_j/10}$$

energy average sound pressure level

Measurement of sound pressure levels

Measurement with fixed microphone positions (Receiving Room)

- Minimum separation distances for microphone positions
  - 0.7 m between fixed microphone positions;
  - 0.7 m between any microphone position and the room boundaries
  - 0.7 m between any microphone position and any diffusers
  - 1.0 m between any microphone position and the test floor



$$L = 10 \lg \frac{1}{n} \sum_{j=1}^{n} 10^{L_j/10}$$

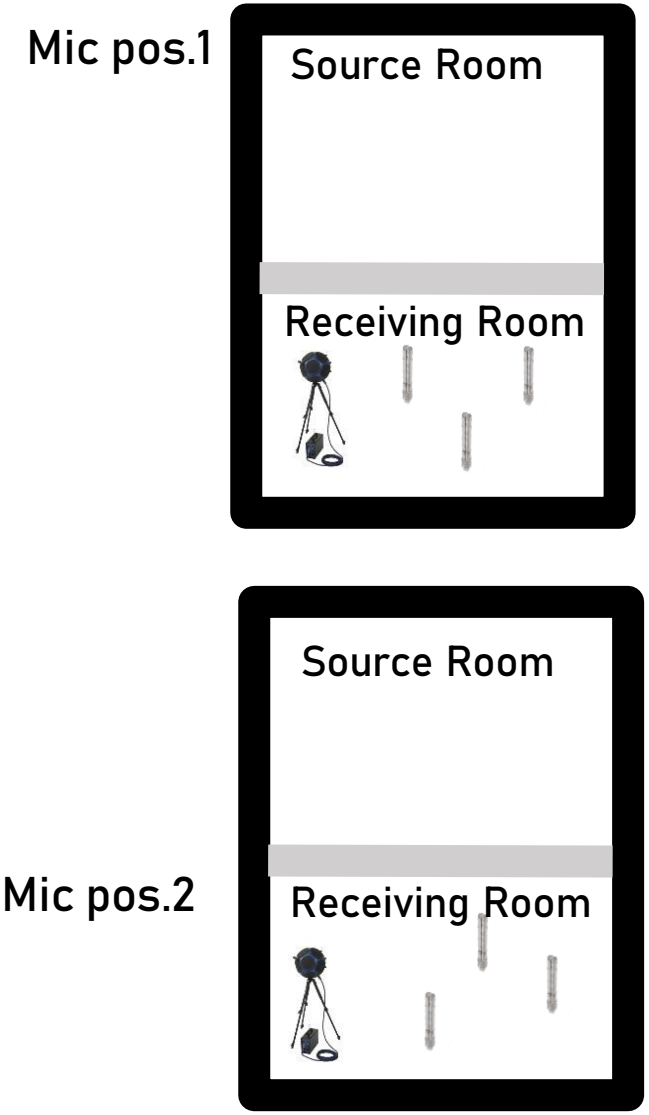
energy average sound pressure level

ISO10140 – Measurement of reverberation time

- Interrupted noise method
  - The minimum number of measurements required for each frequency band is six.
  - At least one loudspeaker position shall be used with three fixed microphone positions and two measurements at each position
  - Or six fixed microphone positions and one measurement at each position

- Integrated impulse response method

  **Require an impulse source

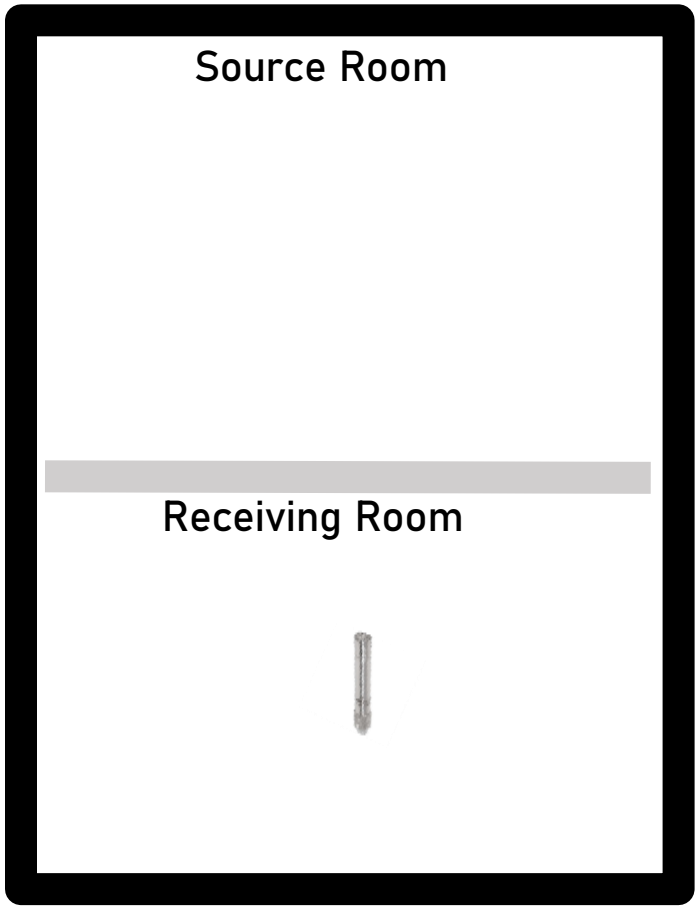


ISO10140 – Correction for background noise level

- To ensure that the observations in the receiving room are not affected by the background noise.

- The background noise level shall be at least 6 dB (and preferably more than 15 dB) below the level of signal and background noise combined at each frequency band.
- If the difference in levels is smaller than 15 dB but greater than 6 dB, calculate corrections to the signal level:

$$L = 10 \log \left(10^{\frac{LSB}{10}} - 10^{\frac{LBG}{10}} \right)$$



ISO10140-3 : Correction of airborne sound transmission

- In case that the airborne sound transmission from the source to the receiving room cannot be neglected
  - airborne and impact sound pressure levels in the receiving room differ by less than 10 dB
  - for long reverberation times in the source room or floors with good impact but poor airborne sound insulation
- The measured impact sound shall be corrected as follows

$$L_n = 10\lg\left(10^{L_i/10} - 10^{(L_{TS}-D)/10}\right) + 10\lg\left(\frac{A}{A_0}\right)$$

A	is the equivalent absorption area in the receiving room;
A_0	= 10 m^2;
L_{TS}	is the sound pressure level generated by the tapping machine in the source room;
L_i	is the sound pressure level generated by the tapping machine in the receiving room.

- If Li – (LTS – D) ≥ 10 dB in all one-third octave bands, a correction of airborne sound transmission is not necessary
- If Li – (LTS – D) ≤ 3 dB, sound transmission is dominated by airborne sound and impact sound insulation cannot be measured correctly

ISO10140-3 : Correction of airborne sound transmission

$$L_n = 10\lg\left(10^{L_i/10} - 10^{(L_{TS}-D)/10}\right) + 10\lg\left(\frac{A}{A_0}\right)$$

A is the equivalent absorption area in the receiving room;

A_0 = 10 m²;

L_{TS} is the sound pressure level generated by the tapping machine in the source room;

L_i is the sound pressure level generated by the tapping machine in the receiving room.

- $D = L_{LS} - L_{LR}$
- Place the loudspeaker at the edge of the source room at a distance of 1.0 m from the closest wall, and at a height of 1.0 m from the floor
- the resulting sound pressure level in the source room (L_{LS}) and receiving room (L_{LR}) shall be measured in one-third octave bands

- If Li – (LTS – D) ≥ 10 dB in all one-third octave bands, a correction of airborne sound transmission
  is not necessary
- If Li – (LTS – D) ≤ 3 dB, sound transmission is dominated by airborne sound and impact sound
  insulation cannot be measured correctly

Single-number Rating for Impact Insulation

- The single-number quantity Ln,w (ISO717-2) is the 500 Hz value of the *Reference Curve* when shifted in 1 dB steps until the sum of *unfavourable deviation* is maximum 32.0 dB

Frequency [Hz]	Reference values [dB]	
	One-third octave	octave
100 125 160	62 62 62	67
200 250 315	62 62 62	67
400 500 630	61 60 59	65
800 1000 1250	58 57 54	62
1600 2000 2500	51 48 45	49
3150	42	

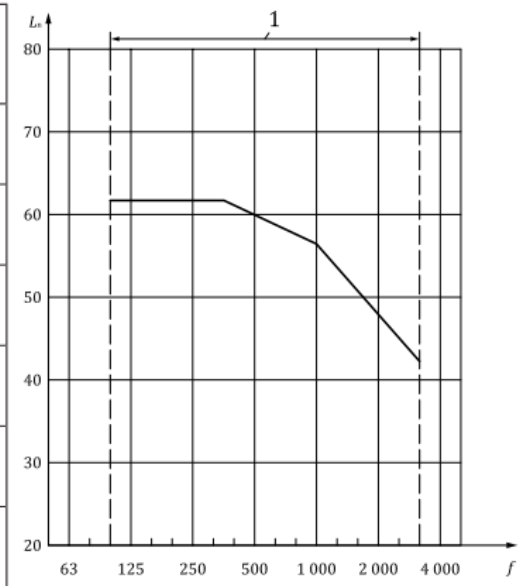
Expression of results

Normalized impact sound pressure level, L_n, in accordance with ISO 10140-3

Laboratory measurements of impact sound insulation of floors

Manufacturer:		Product identification:	
Client:		Test room identification:	
Test element mounted by:		Date of test:	
Description of test facility, test element and test arrangement:			
Mass per unit area:	kg/m²		
Curing time:	h		
Air temp. in the test rooms:	°C;	in receiving room:	°C
Relative humidity in the test rooms:	%;	in receiving room:	%
Static pressure:	Pa		
Receiving room volume:	m³		

Frequency f Hz	One-third octave L_n dB
50	
63	
80	
100	
125	
160	
200	
250	
315	
400	
500	
630	
800	
1 000	
1 250	
1 600	
2 000	
2 500	
3 150	
4 000	
5 000	



Key

L_n normalized impact sound pressure level, in dB

f frequency, in Hz

1 frequency range in accordance with the curve of reference values (ISO 717-2)

Rating in accordance with ISO 717-2:

$L_{n,w}(C_I)$ = ( ) dB $C_{I,50\text{-}2\,500}$ = dB

Evaluation based on laboratory measurement results obtained by an engineering method.

No. of test report: Name of test institute:

Date: Signature:

Spectrum Adaption Terms C_I

C_I: Representing the characteristics of typical walking noise spectra

$$C_I = 10 \log \sigma_{i=1}^{n} 10^{\frac{L_i}{10}} - 15 - L_{n,w}\ [dB]$$

Other impact insulation ratings

- L'_n: *Normalized impact sound pressure level*

$$L'_n = L_i + 10 \log \frac{A}{A_0} ;$$

A = Equivalent absorption area in receiving room
A_0= Reference equivalent absorption area (A_0=10)

- L'_{nT}: Standardized impact sound pressure level

$$L'_{nT} = L_i - 10 \log \frac{T}{T_0} ;$$

T = Reverberation time in receiving room
T_0= Reference Reverberation time (T_0=0.5)

Field Measurement

Reference

[1] ISO 717-2, *Acoustics —Rating of sound insulation in buildings and of building elements — Part 2: Impact sound insulation*

[2] ISO10140-1, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 1: Application rules for specific products*

[3] ISO10140-3, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 3: Measurement of impact sound insulation*

[4] ISO10140-4, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 4: Measurement procedures and requirements*

[5] ISO10140-5, *Acoustics — Laboratory measurement of sound insulation of building elements —Part 5: Requirements for test facilities and equipment*