POLITECNICO DI MILANO





Estimation of Impact Sound Insulation

Data:

- dynamic stiffness of resilient layer s'= 25 [MN/m^2]
- floor covering areic mass m' = 80[kg/m^2]
- Structural floor areic mass m' = 300 [kg/m^2]
- Partitions areic mass m' = 150 [kg/m^2]

- **Evaluate:**
- $\mathbf{L_{n,w,eq}}$
- $\mathbf{\Delta L_w}$
- $\mathbf{L_{n,w}}$

Equivalent weighted normalized impact sound pressure level of the bare floor : $L_{n,w,eq}$

The equivalent weighted normalized impact sound pressure level of the bare massive floor, $L_{n,w,eq}$, is calculated as:

$$L_{n,1}(f) = L_{n,0}(f) - \Delta L_r(f) \quad \Rightarrow L_{n,1,w}$$

$$L_{n,w,eq} = L_{n,1,w} + \Delta L_{r,w} = L_{n,1,w} + 19 \quad [\text{dB}]$$

where

$L_{n,1,w}$ is the weighted normalized impact sound pressure level of the bare floor with the reference floor covering;

$\Delta L_{r,w}$ is the weighted reduction in impact sound pressure level by reference floor covering;

$L_{n,1}$ is the calculated normalized impact sound pressure level of the actual bare floor with the reference floor covering.

Estimation of normalized impact sound pressure level of bare floor, $L_{n,0}$

The normalized impact sound pressure level $L_{n,0}$ of a bare floor, in a the usual frequency range of impact phenomena, can be estimated with theoretical expressions, that consider the physical and elastic characteristics of the floor, or experimental relationships.

Hypothesis:

The duration of application of each force is short with respect to the highest frequency period considered.

The spectrum, for constant percentage bands of radiated noise from the plate, has a substantially flat trend with the frequency.

Experimental correlations:

1) beam and pot floor, total thickness 20< s <30 [cm]

$$L_{n,0}(f) = 30 + 15\log_{10}(f)$$

f frequency [Hz]

Reduction in impact sound pressure level of the reference floor covering

Reference floor covering

The reference floor covering is defined by the values for the reduction of impact sound pressure level (improvement of impact sound insulation), ΔL_r, given in Table.

The weighted reduction in impact sound pressure level of the reference floor covering, $\Delta L_{r,w}$, is 19 [dB].

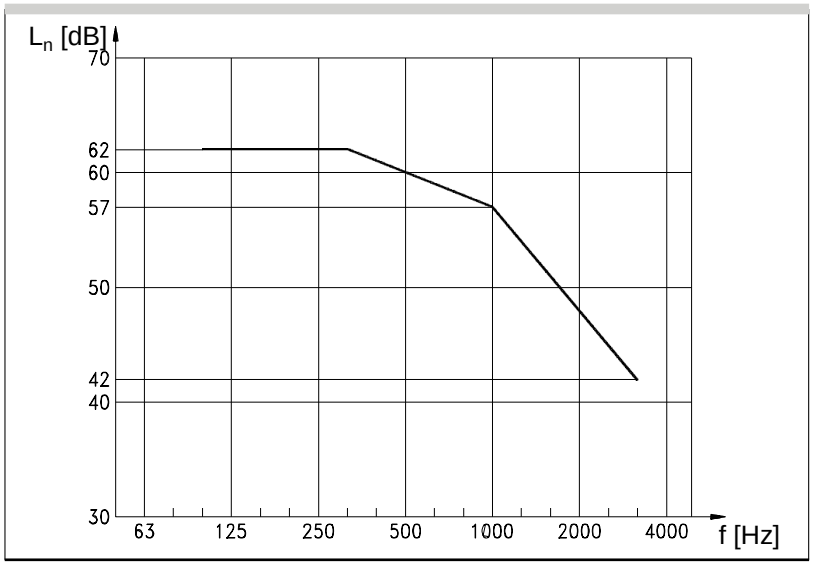
Frequency Hz	ΔL_r dB
100	0
125	0
160	0
200	2
250	6
315	10
400	14
500	18
630	22
800	26
1 000	30
1 250	30
1 600	30
2 000	30
2 500	30
3 150	30
Index at 500 Hz	**19**

Evaluation of Weighted Normalized Impact Sound Pressure Level : L'n,w

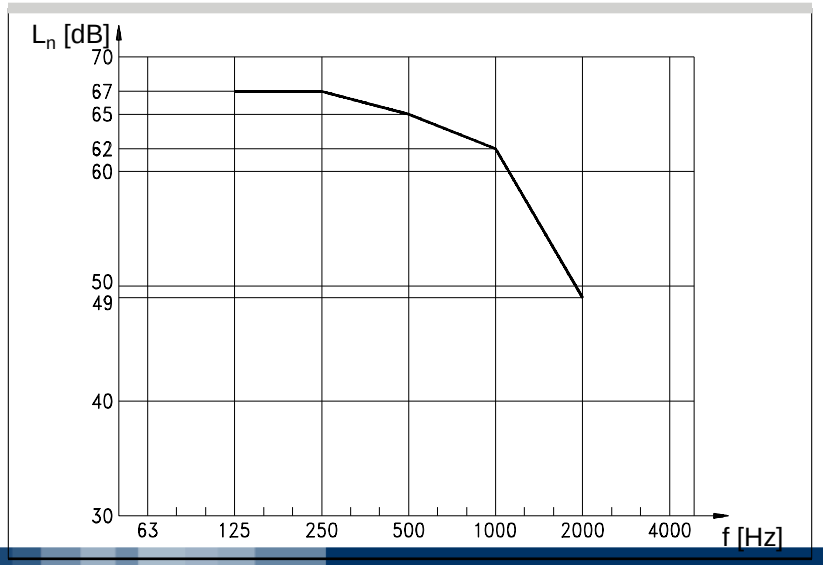
Reference curve

Frequency Hz	Reference Values, dB one-third-octave bands	octave bands
100	62	
125	62	67
160	62	
200	62	
250	62	67
315	62	
400	61	
500	60	65
630	59	
800	58	
1 000	57	62
1 250	54	
1 600	51	
2 000	48	49
2 500	45	
3 150	42	

Octave Bands



one-third-octave bands



Correction for impact sound transmission over the homogeneous flanking constructions: *K* [dB]

Correction ***K*** for flanking transmission in decibels (EN ISO 12354-2)

Massa per unit area of the separating elements (floor) kg/m²	Mean mass per unit area of the homogeneous flanking elements not covered with additional layers in kg/m²								
	100	150	200	250	300	350	400	450	500
100	1	0	0	0	0	0	0	0	0
150	1	1	0	0	0	0	0	0	0
200	2	1	1	0	0	0	0	0	0
250	2	1	1	1	0	0	0	0	0
300	3	2	1	1	1	0	0	0	0
350	3	2	1	1	1	1	0	0	0
400	4	2	2	1	1	1	1	0	0
450	4	3	2	2	1	1	1	1	1
500	4	3	2	2	1	1	1	1	1
600	5	4	3	2	2	1	1	1	1
700	5	4	3	3	2	2	1	1	1
800	6	4	4	3	2	2	2	1	1
900	6	5	4	3	3	2	2	2	2

Evaluation of the weighted reduction in impact sound pressure level by floor coverings: ΔL_w

The reduction of impact sound pressure level (improvement of impact sound insulation), ΔL, of floor coverings ΔL_w is calculated, starting from the experimental measurement reduction in impact sound pressure level by floor coverings $\Delta L(f)$, as:

$$L_{n,r}(f) = L_{n,r,0}(f) - \Delta L(f) \quad \Rightarrow \quad L_{n,r,w}$$

$$\Delta L_w = L_{n,r,0,w} - L_{n,r,w} = 78 - L_{n,r,w}$$

where:

$L_{n,r}$ is the calculated normalized impact sound pressure level of the reference floor with the actual floor covering;

$L_{n,r,0}$ is the defined normalized impact sound pressure level of the reference floor;

ΔL is the reduction in impact sound pressure level measured in accordance with ISO 10140-2;

$L_{n,r,w}$ is the calculated weighted normalized impact sound pressure level of the reference floor with the actual floor covering;

$L_{n,r,0,w}$ is calculated from $L_{n,r,0}$ in accordance with ISO 717-2 curves comparison procedure at 500 Hz and its value is 78 dB.

NOTE: for lightweight reference floors $L_{n,r,0}$ is just replaced by $L_{n,tr,0}$

Normalized impact sound pressure level of the reference floor (EN-ISO 717-2): $L_{n,r,0}$, $L_{n,tr,0}$

bare heavy floors

Frequency Hz	$L_{n,r,0}$ dB
100	67.0
125	67.5
160	68.0
200	68.5
250	69.0
315	69.5
400	70.0
500	70.5
630	71.0
800	71.5
1 000	72.0
1 250	72.0
1 600	72.0
2 000	72.0
2 500	72.0
3 150	72.0
Index 500 Hz	**78.0**

lightweight reference floors

Frequency Hz	$L_{n,t,r,0}$ floor Type 1 , 2 dB	$L_{n,t,r,0}$ floor Type 3 dB
100	78	69
125	78	72
160	78	75
200	78	78
250	78	78
315	78	78
400	76	78
500	74	78
630	72	78
800	69	76
1000	66	74
1250	63	72
1600	60	69
2000	57	66
2500	54	63
3150	51	60
Index 500Hz	**72**	**75**

Reduction of impact sound pressure level ΔL: floating floors

The EN 12354-2 standard, if no measured values for the reduction of impact sound pressure level ΔL of floating floors are available, suggests to apply the following formulae:

$$\Delta L_n = 30 \log_{10}\left(\frac{f}{f_0}\right)$$

for floating floor screeds made of sand/cement or calcium sulphate

f centre frequency of the octave band or third octave band [Hz]

f_0 system resonance frequency [Hz]

$$f_0 = 160\sqrt{\frac{s'}{m'}}$$

s' dynamic stiffness of resilient layer [MN/m^2]

m' mass per unit area of the floating floor [kg/m^2]

$$\Delta L_n = 40 \log_{10}\left(\frac{f}{f_0}\right)$$

for asphalt floating floors or dry floating floor constructions