Impact noise in underfloor installations

Technical information

Sound protection and impact noise

The aim of sound protection in buildings is to prevent sound from being transferred between various rooms and/or floors. The DIN 4109 standard contains guidelines on sound and impact noise levels in residential buildings. Impact noise consists of two types of sound.
Airborne sound travels through the air, whereas structure-borne sound travels through solid bodies.

Standard DIN 4109 specifies noise limits $L_{n,w}$ that must not be exceeded in certain areas of application.

Examples of segment-related noise limits:

- Office buildings: residential dividing ceilings and ceilings between third-party office rooms $L_{n,w} \leq 53$ dB
- Recreation rooms and hotels (increased sound protection requirements): $L_{n,w} \leq 46$ dB

Basic rule: The lower the values, the better the impact noise protection. The value can be reduced, for instance, by laying flooring (such as carpet). The transfer of impact noise can also be reduced by laying the floor on an insulation layer (floating screed).

Impact noise reduction for underfloor installations

Reducing the transfer of impact noise is also relevant when laying underfloor installations. A test institute was therefore engaged to measure the impact noise reduction in selected Hager products. The requested test consisted of the measurement of the vertical spread of the structure-borne sound, in other words the transmission of sound between floors.

The noise impact reduction was measured for the following Hager products:

- Floor channel BKB25085
- Floor channel BKG30060
- Stainless steel cassette EKQ1200LE1

Preliminary tests found that these product dimensions provided the most problematic impact noise reduction measured values.
It can therefore be assumed that all other variants of these underfloor installations also reach the problematic impact noise reduction measured values, at a minimum.

Impact noise measurements in the ceiling test station

Müller-BBM GmbH measured the impact noise reduction in the ceiling test station in accordance with the DIN EN ISO 10140 standard and evaluated the findings in accordance with the ISO 717-2 standard.

Ceiling test station

The ceiling test station consists of two rooms positioned above one another.
In the requested test, the vertical spread of the structure-borne sound, in other words the transmission of sound between floors, is measured.

Test setup

The measurement was performed as follows:

- In a reference area: ceiling slab, insulation, screed, no flooring
- On and next to the test body, in other words the installed products in various configurations (see Table 2 auf Seite 4, Table 3 auf Seite 6, Table 4 auf Seite 8)

Measurement

The measurement test setup is located in the transmission room. A standardised physical noise source, a standard trip hammer, is placed on the test setup (see Figure 1, on left). The standard trip hammer produces impacts that are measured in the room below with continuously moving microphones. This determines the standard noise impact level in the reference area ($L_{n,0,w}$) and for the test body ($L_{n,r,w}$).

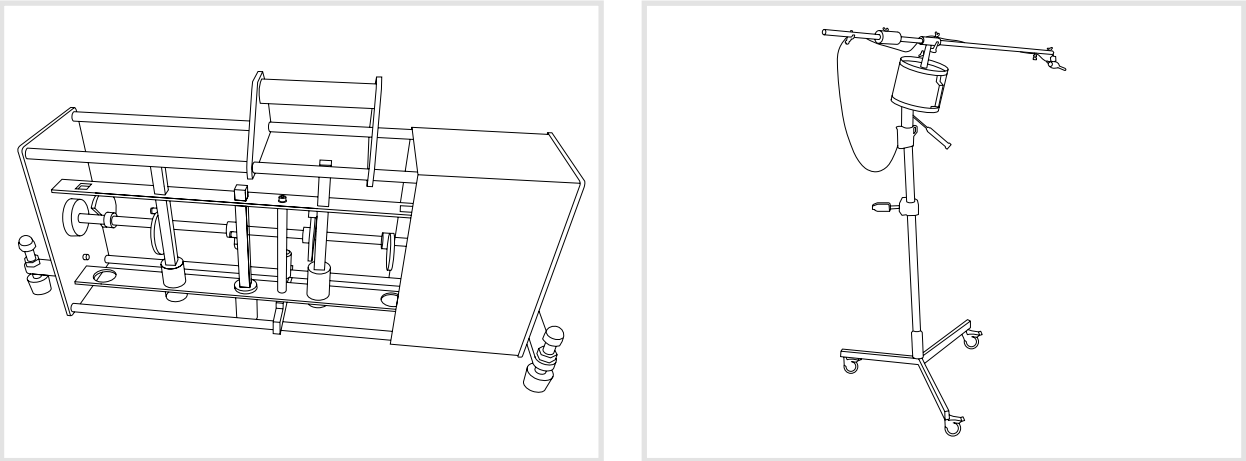

Figure 1: Standard trip hammer (left), microphone (right)

Impact noise reduction ΔL_W:
DL_W impact noise reduction means an improvement of the impact noise insulation in a ceiling slab through ceiling coverings, such as insulation, floor and carpet, for instance.
Impact noise reduction is the difference between the standard noise level of a ceiling slab with and without covering (Ln,0,w - Ln,r,w).

Test and findings

Reference area

The measurements were performed in a reference area consisting of a ceiling slab, thermal insulation and screed. Flooring, such as wood, tiles or carpet, was not used.

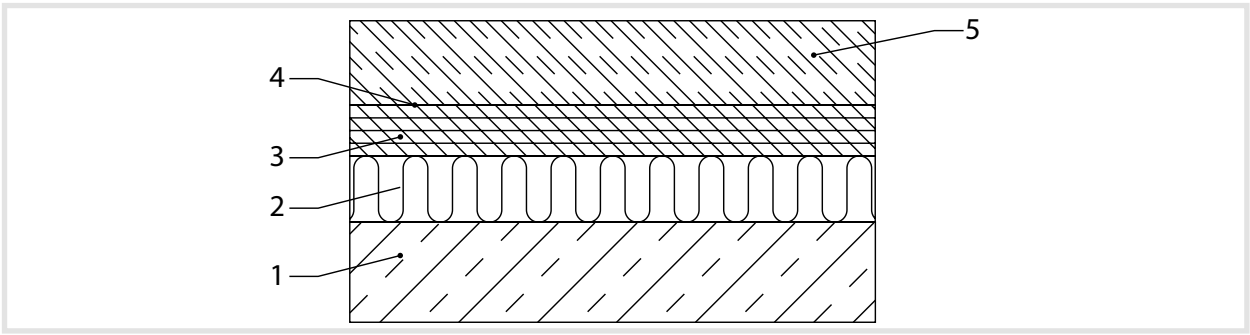

Figure 2: Concept drawing of the reference area test setup in the ceiling test station

(1) Ceiling slab
(2) 40 mm thermal insulation (styrofoam)
(3) 30 mm impact noise insulation
(4) 0.2 mm PE film
(5) 50 mm cement screed

Test setup	Impact noise reduction ΔL_W
Reference area	29 dB

Table 1: Measured value impact noise reduction reference area

Impact noise reduction: example calculation

List of Abbreviations:

- $L_{n,w}$ = evaluated standard noise impact level (e.g. 53 dB for office buildings)
- $L_{n,o,w}$ = evaluated standard noise impact level of the ceiling slabs (76 dB during the test)
- $L_{n,r,w}$ = evaluated standard impact noise level of the reference ceiling with the tested ceiling covering (e.g. 29 dB for finished floor)
- ΔL_w = test body impact noise reduction (e.g. BKG No.A 30 dB)

Example calculation:

The example calculation is based on an assumed evaluated standard noise impact level of the ceiling slabs of 79 dB ($L_{n,o,w}$) and a 30 dB (ΔL_w) noise impact reduction for the test body.

$L_{n,w} = L_{n,o,w} - \Delta L_w$
$L_{n,w} = 76\ dB - 30\ dB$
$L_{n,w} = 46\ dB$

The calculated 46 dB is less than the segment-related noise limit for office buildings of 53 dB (46 dB < 53 dB). In this situation, the construction work therefore complies with the standards.

Floor channel BKB25085

The floor channel BKB (7) in the image was installed on the wall.

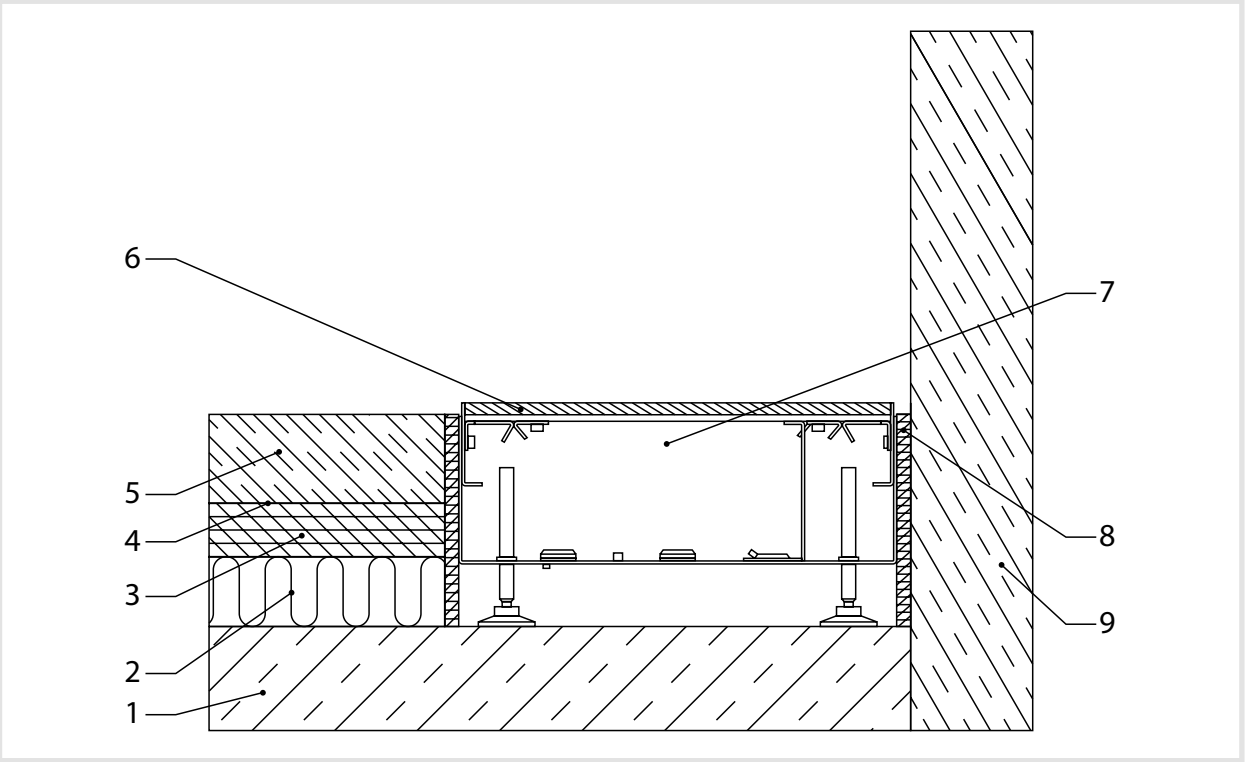

Figure 3: Concept drawing of the floor channel BKB25085 test setup in the ceiling test station

(1) Ceiling slab
(2) 40 mm thermal insulation (styrofoam)
(3) 30 mm impact noise insulation
(4) 0.2 mm PE film
(5) 50 mm cement screed
(6) Flooring (carpet 11 mm, tiles 7 mm, wood 7 mm)
(7) Floor channel BKB
(8) 8 mm edge insulation strips
(9) Wall

Nr.	Test position / type	Levelling feet	Cable	Bolted joint	Floor co-vering	Impact noi-se reduc-tion ΔL_W	Reference area ΔL_W
A	On BKB25085	BKBNSD 80 (insulation: felt)	Yes (50 %)	4 screws + wall plugs	Wood	28 dB	29 dB
B			No			26 dB	
C					Tiles	28 dB	
D					Carpet	30 dB	
E				No	Wood	28 dB	
F	Next to BKB25085				–	31 dB	

Table 2: Measured values impact noise reduction BKB25085

Summary of test results

- Cable installation:
  Cable installation reduce impact noise:
  The impact noise of the "cable installation 50 %" variant is approx. 2 dB above the "no cable installation" variant.
- Floor cover:
  Carpet creates the highest impact noise reduction (ΔL_w = 30 dB).
  On tiles, the impact noise reduction is approx. 2 dB below the measured values with carpet.
  On wood, the impact noise reduction is approx. 4 dB below the measured values with carpet.
- Comparison with/without bolted joints in the ceiling slabs:
  Bolted joints in the ceiling slabs have a negative effect on impact noise reduction:
  The impact noise reduction of the "no bolted joints" variant is approx. 2 dB above the "with bolted joints" variant.
- Impact of the floor channel on the surrounding screed:
  The installation of the floor channel does not have any significant impact on the impact noise reduction of the screed.

Floor channel BKG30060

The floor channel BKG (7) in the image was installed in the room.

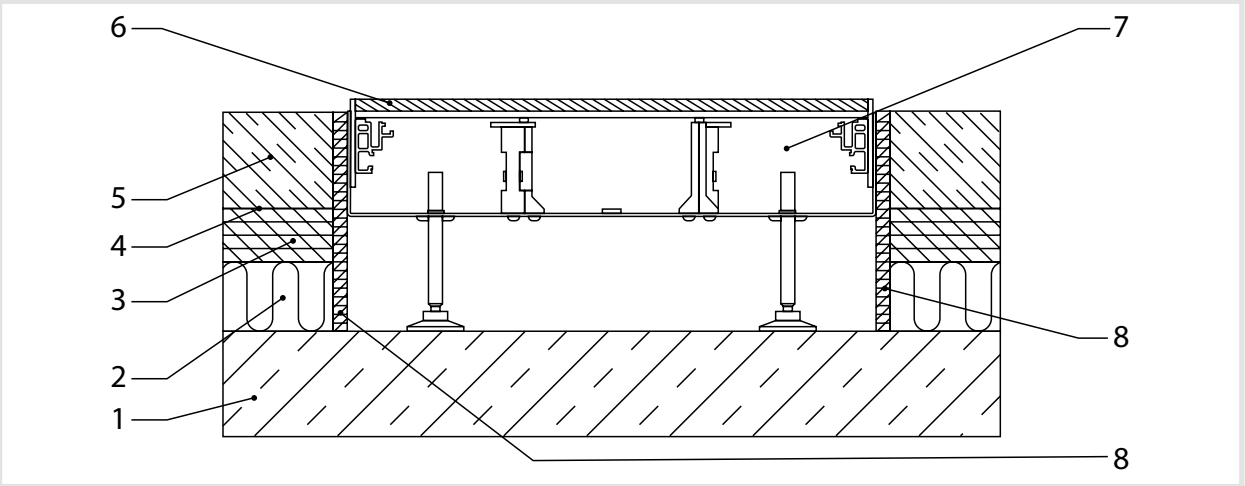

Figure 4: Concept drawing of the floor channel BKG30060 test setup in the ceiling test station

(1) Ceiling slab
(2) 40 mm thermal insulation (styrofoam)
(3) 30 mm impact noise insulation
(4) 0.2 mm PE film
(5) 50 mm cement screed
(6) Flooring (carpet 11 mm, tiles 7 mm, wood 7 mm)
(7) Floor channel BKG
(8) 8 mm edge insulation strips

Nr.	Test position / type	Levelling feet	Cable	Bolted joint	Floor co-vering	Impact noi-se reduction ΔL_W	Reference area ΔL_W
A	On BKG30060	BKBNSD 80 (insulation: felt)	Yes (50 %)	4 screws + wall plugs	Wood	30 dB	29 dB
B			No			28 dB	
C					Tiles	31 dB	
D					Carpet	32 dB	
E				No	Wood	29 dB	
F					Tiles	32 dB	
G					Carpet	32 db	
H	Next to BKG30060				–	32 dB	

Table 3: Measured values impact noise reduction BKG30060

Summary of test results

- Cable installation:
  Cable installation reduce impact noise:
  The impact noise of the "cable installation 50 %" variant was approx. 2 dB above the "no cable installation" variant.
- Floor cover:
  Carpet created the highest impact noise reduction (ΔL_w = 32 dB).
  On tiles, the impact noise reduction was approx. 1 dB below the measured values with carpet.
  On wood, the impact noise reduction was approx. 4 dB below the measured values with carpet.
- Comparison with/without bolted joints in the ceiling slabs:
  Bolted joints in the ceiling slabs have a slightly negative effect on impact noise reduction:
  The impact noise reduction of the "no bolted joints" variant is approx. 1 dB above the "with bolted joints" variant.
- Impact of the floor channel on the surrounding screed:
  The installation of the floor channel does not have any significant impact on the impact noise reduction of the screed.

Stainless steel cassette EKQ1200LE1

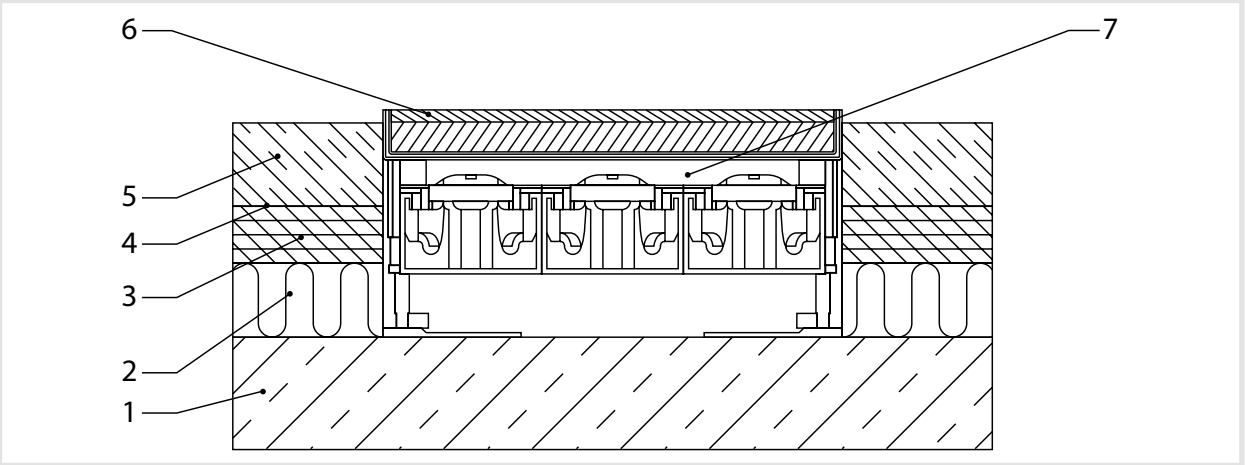

Figure 5: Concept drawing of the stainless steel cassette EKQ1200LE1 test setup in the ceiling test station

(1) Ceiling slab
(2) 40 mm thermal insulation (styrofoam)
(3) 30 mm impact noise insulation
(4) 0.2 mm PE film
(5) 50 mm cement screed
(6) Flooring (carpet 11 mm, tiles 7 mm, wood 7 mm)
(7) Stainless steel cassette with device casing

Nr.	Test position / type	Levelling feet	Equipment	Film	Impact noise reduction ΔL_W	Reference area ΔL_W
A	On EKQ1200LE1	EKNS075 (insulation: none)	3 x GTVR400, 12 electric sockets	Wood	21 dB	29 dB
B				Tiles	21 dB	
C				Carpet	23 dB	
D		EKNS075 (insulation: felt)		Wood	19 dB	
E				Tiles	21 dB	
F				Carpet	23 dB	
G	Next to EKQ1200LE1		No	–	31 dB	

Table 4: Measured values impact noise reduction EKQ1200LE1

Summary of test results

- Floor cover:
  Carpet created the highest impact noise reduction (ΔL_w = 23 dB).
  On tiles, the impact noise reduction was approx. 2 dB below the measured values with carpet.
  On wood, the impact noise reduction was approx. 4 dB below the measured values with carpet.
- Impact of the stainless steel cassette on the surrounding screed:
  The installation of the stainless steel cassette does not have any significant impact on the impact noise reduction of the screed.