DELTA Test Report

TEST Reg. no. 100

Measurement of Reduction of Impact Sound Pressure Level for a Junckers Unobat 50 Sports Floor System Installed on a 140 mm Concrete Floor

Client: Junckers Industrier A/S

AV 1131/07
DANAK 100/1074
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19 April 2007

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Title
Measurement of Reduction of Impact Sound Pressure Level for a Junckers Unobat 50 Sports Floor System Installed on a 140 mm Concrete Floor

Journal no.	**Project no.**	**Our ref.**	**Date of test**
AV 1131/07 DANAK 100/1074	A580578	DH/HSO/lm	17 May 2005 & 23 May 2005

Client
Junckers Industrier A/S
Værftsvej
4600 Køge
Denmark

Client ref.
Thomas L. Flindt

Summary

Laboratory measurements of the reduction of impact sound pressure level per one-third octave were carried out according to the test method of EN ISO 140-8:1998 for a Junckers Unobat 50 sports floor system installed on a 140 mm concrete floor.

Test result evaluated according to EN ISO 717-2:1997:

The weighted reduction of impact sound pressure level for the floor system: $\Delta L_w = 18$ dB.

The report contains a description of the test specimen according to the client's specifications, a description of the mounting in the laboratory, and the test results.

The test results per one-third octave are shown in tabular form and graphically on the graph sheet.

Descriptions of test rooms, test procedure, and evaluation methods are found in the Appendix.

Remark

The test results apply only to the object tested.

DELTA, 19 April 2007

Dan Hoffmeyer
Acoustics

1. Introduction

At the request of Junckers Industrier A/S a laboratory measurement was carried out of the reduction of impact sound pressure level for a Junckers Unobat 50 sports floor system installed on a 140 mm standard floor.

2. Description of the Floor System Based on the Client's Specifications

Junckers Unobat 50 sports floor system consists of 22 × 129 mm solid boards with tongue and groove nailed to a resilient substructure of prefabricated battens. Manufactured as a single layer structure of 21 × 50 mm veneered battens, c/c 336 mm, with rubber band premounted in grooves on the underside of the batten.

The construction height is approx. 50 mm.

3. Mounting in the Laboratory

The floor system was installed on a 140 mm concrete floor slab mounted in a 2.99 m × 3.37 m test opening between to reverberant rooms.

The floor was kept clear of the edges of the test opening.

The floor was loaded by 10 uniformly distributed weights (approx. 25 kg each) corresponding to approx. 25 kg /m² in 6 days before the measurements were carried out.

4. Test Method

The measurements were carried out according to the test method of EN ISO 140-8:1998, "Laboratory Measurements of the Reduction of Transmitted Impact Noise by Floor Coverings on a Heavyweight Standard Floor".

The normalized impact sound pressure level of the concrete slab was measured with and without the floor covering.

The measurements were performed using a standardized tapping machine. The sound pressure level in the receiving room was measured using one-third octave band filters.

The test results are the difference between the measured normalized impact sound pressure levels of the standard floor without and with the floor covering.

The measurements were performed in Room 004 and 904, Building 355 at the Technical University of Denmark. A brief description of the reverberant rooms and test procedures is found in the Appendix.

5. Instrumentation

The following instruments were used for the test:

Instrument	Type	A&V No.
Real-Time Frequency Analyzer	B&K 2144	1025L
Tapping Machine	B&K 3204	1250L
Measuring Microphone	B&K 4144	731L
Measuring Microphone	B&K 4144	1256L
Microphone Preamplifier	B&K 2619	857L
Microphone Preamplifier	B&K 2619	1188L
Microphone Power Supply	B&K 2804	620L
Microphone Power Supply	B&K 2804	721L
Sensor for Temperature and Humidity	Elpro Ecolog TH1	1216L
Sound Level Calibrator	B&K 4231	1158L

The instruments used have been tested according to procedures approved by DANAK (Danish Accreditation).

6. Measurement Conditions

Date of tests and temperature and relative humidity in the source room during measurements with the floor covering:

Concrete floor without floor covering: Date of test: 23 May 2005
Concrete floor with the floor covering: Date of test: 17 May 2005, 19 °C, 43 % RH

The floor system was loaded by approx. 25 kg /m² during the measurements.

The tapping machine was placed in six positions on the floor under test.

During the measurements with the floor covering the sound pressure level in the receiving room was less than 6 dB above the total electrical and acoustic background noise level at 5000 Hz. Thus, a precise value of the normalized impact sound pressure level and the reduction of impact sound pressure level at 5000 Hz cannot be determined, and the reported value at this frequency – using a correction corresponding to a difference of 6 dB – is to be

taken as limit of measurement. The value at 5000 Hz does not influence the calculated weighted reduction of impact sound pressure level.

7. Test Results

Reduction of impact sound pressure level according to EN ISO 140-8:1998:

$$\Delta L = L_{n0} - L_n$$

where L_{n0} is the measured normalized impact sound pressure level of the standard floor without floor covering, and

L_n is the measured normalized impact sound pressure level of the standard floor with the floor covering.

The test result, ΔL, per one-third octave from 100 Hz to 5000 Hz is shown in tabular form and graphically on Graph Sheet 1.

The test result, ΔL_w, evaluated according to EN ISO 717-2:1997:

The weighted reduction of impact sound pressure level for the floor covering: $\Delta L_w = 18$ dB

The corresponding spectrum adaptation term: $C_{I\Delta} = -11$ dB

Description of the evaluation methods is found in the Appendix.

8. Measurement Uncertainty

According to DS/ISO 140-2:1992 precision of laboratory measurements expressed as the reproducibility of single-number quantities, including ΔL_w, will normally be in the range of 1 dB to 3 dB.

Normalized impact sound pressure level of the bare concrete floor of the laboratory:

Frequency Hz	L_{n0} dB re 20 μPa per one-third octave
100	63.8
125	66.8
160	68.5
200	70.8
250	72.5
315	73.2
400	73.2
500	74.2
630	74.6
800	74.9
1000	74.6
1250	74.0
1600	73.2
2000	72.8
2500	71.4
3150	70.8
4000	69.8
5000	67.5
$L_{n0,w}$ dB	79

The weighted normalized impact sound pressure level of the reference floor used for the calculations of ΔL_w:

Reference floor without floor covering: $L_{n,r,0,w}$ = 78 dB; $C_{I,r,0}$ = –11 dB
Reference floor with the floor covering: $L_{n,r,w}$ = 60 dB; $C_{I,r}$ = 0 dB

Laboratory Measurement of Reduction of Impact Sound Pressure Level according to EN ISO 140-8:1998

Client: Junckers Industrier A/S, Værftsvej, 4600 Køge, Denmark

Date of test: 17 May 2005 & 23 May 2005

Description of the test specimen: Junckers Unobat 50 sports floor system. 22 mm solid boards nailed to a resilient substructure of prefabricated battens. The floor system had a construction height of approx. 50 mm and was installed on a 140 mm concrete floor.The floor system was loaded by approx. 25 kg /m² during the measurements.

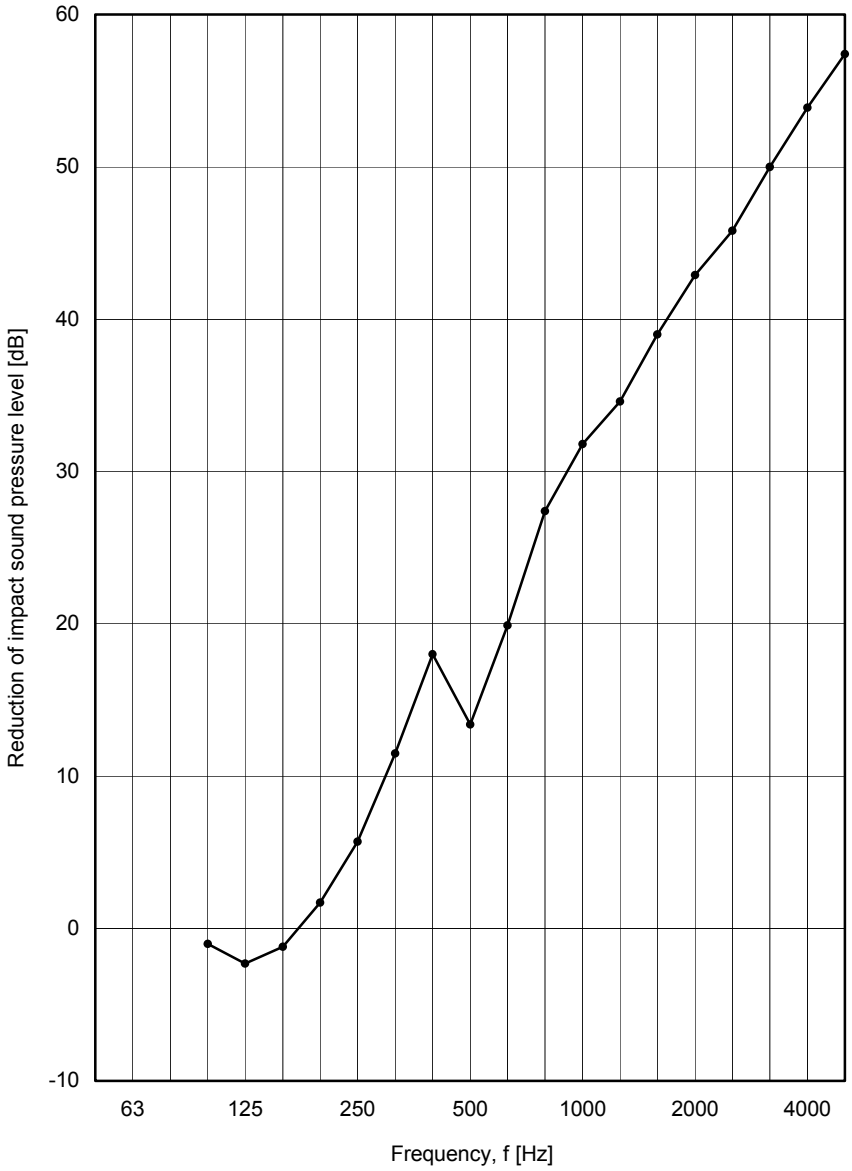
Test specimen mounted by: The client

Air temperature, source room: 19 °C

Air humidity, source room: 43 % RH

Receiving room volume: 243 m³

Frequency f [Hz]	ΔL 1/3-octave [dB]
100	-1.0
125	-2.3
160	-1.2
200	1.7
250	5.7
315	11.5
400	18.0
500	13.4
630	19.9
800	27.4
1000	31.8
1250	34.6
1600	39.0
2000	42.9
2500	45.8
3150	50.0
4000	53.9
5000	57.4



Note:
As the sound pressure level in the receiving room during the measurements with the floor covering at 5000 Hz was less than 6 dB above the background noise level, a precise value of the reduction of impact sound pressure level at this frequency cannot be determined, and the reported value at 5000 Hz is to be taken as limit of measurement. This does not influence the calculated ΔL_w-value.

Weighted reduction of impact sound pressure level according to EN ISO 717-2:1997:

$\Delta L_w = 18$ dB $\quad C_{I,\Delta} = -11$ dB

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

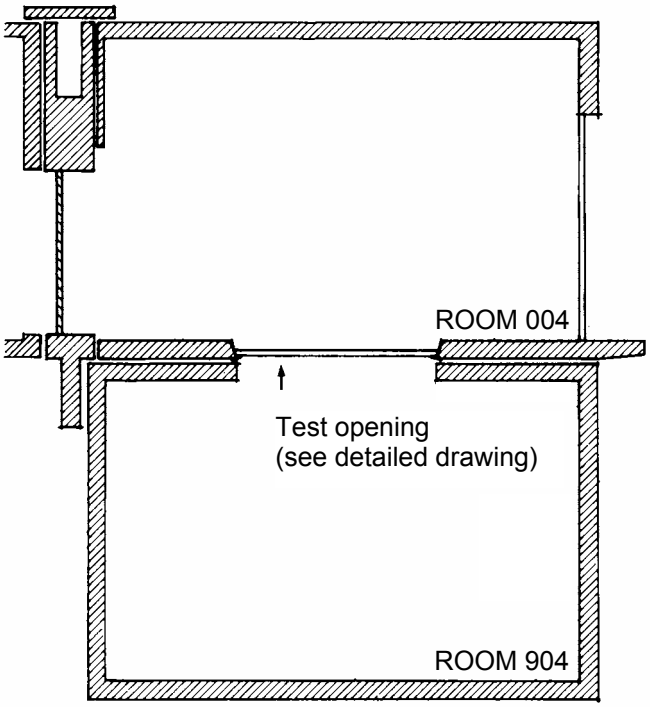
DELTA, 19 April 2007

Dan Hoffmeyer, Acoustics

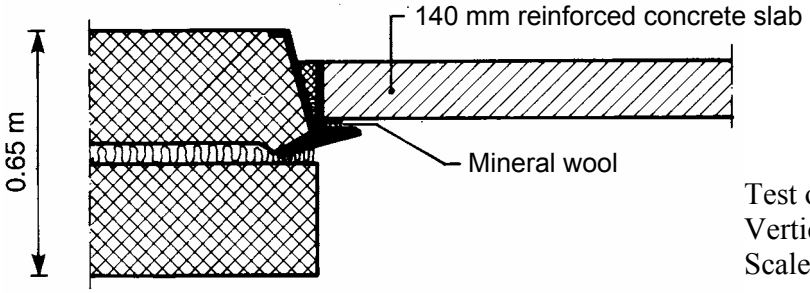
Description of Test Rooms

The measurements are performed in two reverberant rooms (004 and 009), one placed on top of the other. The length, width, and height of the rooms are 7.85 m, 6.25 m and 4.95 m, respectively. The test opening between the rooms is 2.99 m × 3.37 m and has a depth of 0.65 m. In the upper room (004) sound diffusing elements of concrete and of damped steel plate are situated on two of the walls and on the ceiling. The volume of the room is approx. 230 m³. Next to room 004 and connected with this through a 10 m² wide test opening for walls there is a third room (003), the volume of which is approx. 215 m³. In the lower room (904), the volume of which is approx. 245 m³, 20 sheets of 10 mm acrylic (dimensions 0.90 m × 1.2 m) are used as sound diffusing elements.

When measuring the reduction of transmitted impact noise by floor coverings a standard floor, on which the test coverings are to be installed, is mounted in the test opening in the floor of room 004. The standard floor consists of a reinforced concrete slab of a thickness of 140 mm.



Test rooms.
Vertical section.
Scale 1:125.



Test opening with standard floor.
Vertical section.
Scale 1:20.

Test Method

The reduction of impact sound pressure level according to EN ISO 140-8:1998 by a floor or a floor covering measured on a standard floor in the laboratory is defined as the difference between the measured normalized impact sound pressure levels of the standard floor without and with the floor covering.

The normalized impact sound pressure level is defined as the sound pressure level in the receiving room when the floor under test is excited by the standardized tapping machine increased by a correction to a reference equivalent absorption area (10 m²) of the receiving room.

The measurements of the normalized impact sound pressure level are performed using a standardized tapping machine provided with steel hammers and meeting the requirements of EN ISO 140-8:1998 Annex A. The tapping machine is adjusted in such a way that the falling height of the hammers on a even surface corresponds to a free fall from a height of 40 mm.

The tapping machine is placed in six positions on the floor under test, and the sound pressure level in the receiving room is measured in 2 × 6 microphone positions. The measurement is carried out using a real-time frequency analyzer with one-third octave band filters. The sound pressure level of the receiving room is measured simultaneously in two microphone positions, the averaging time being 10 seconds. The total electrical and acoustic background noise level in the receiving room is measured. The sound pressure level in the receiving room is corrected for background noise, if affected. If the sound pressure level in the receiving room is less than 6 dB above the background noise level, this will be stated in the report together with an indication of the validity of the test results.

The equivalent absorption area of the receiving room is determined by means of Sabine's formula by measuring the reverberation time of the room in 6 microphone positions. The measurement of the reverberation time is performed with pink noise emitted by a loudspeaker system placed in a corner of the receiving room. The one-third octave filtered microphone signal is registered during the decay and evaluated in the range approx. 5 dB to approx. 25 dB below the steady-state level.

The normalized impact sound pressure level and the reduction of impact sound pressure level is determined within frequency bandwidths of one-third octave at the following standardized centre frequencies: 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, and 5000 Hz.

$$L_n = L_M + 10 \log_{10} \cdot \frac{A_M}{A_O} \text{ and } A_M = \frac{0.163 \cdot V_M}{T_M}$$

where L_n = Normalized impact sound pressure level with a reference equivalent absorption area of 10 m² [dB re 20 µPa]

L_M = Sound pressure level in the receiving room when the floor under test is excited by the standardized tapping machine [dB re 20 µPa]

A_M = Equivalent sound absorption area in receiving room [m²]
A_0 = Reference equivalent sound absorption area (10 m²)
V_M = Volume of receiving room [m³]
T_M = Reverberation time in receiving room [s]

$$\Delta L = L_{n0} - L_n$$

where ΔL = The reduction of impact sound pressure level resulting from installation of a test floor covering
L_{n0} = The measured normalized impact sound pressure level of the standard floor without floor covering
L_n = The measured normalized impact sound pressure level of the standard floor with the floor covering.

Evaluation Method

To evaluate the normalized impact sound pressure level of a floor the single-number quantity $L_{n,w}$ is used. The value is determined according to EN ISO 717-2:1997.

When determining the evaluation value, $L_{n,w}$, the measured results of the normalized impact sound pressure level per one-third octave from 100 Hz to 3150 Hz are compared with a reference curve, which has a constant value from 100 Hz to 315 Hz, while it falls by 1 dB per one-third octave from 315 Hz to 1000 Hz, and by 3 dB per one-third octave from 1000 Hz to 3150 Hz. The values of the reference curve at the one-third octave centre frequencies are integers. An unfavourable deviation occurs at a certain frequency when the test result exceeds the value of the reference curve. The reference curve is shifted in steps of 1 dB until the sum of unfavourable deviations is as large as possible, but not more than 32.0 dB.

The $L_{n,w}$-value is determined from the shifted reference curve as the value in dB at 500 Hz.

To evaluate the reduction of impact sound pressure level of a floor covering the single-number quantity ΔL_w is used. This value is determined according to EN ISO 717-2:1997 as well.

The weighted reduction of impact sound pressure level, ΔL_w, is calculated as the difference between the $L_{n,w}$-value of an idealized reference floor and the $L_{n,w}$-value of the tested floor covering placed on the reference floor (normalized impact sound pressure level calculated using the measured improvements, ΔL, resulting from installation of the floor covering).

As an additional evaluation method based on a summation of the unweighted linear impact sound level the spectrum adaptation terms C_I for the normalized impact sound pressure level and $C_{I\Delta}$ for the reduction of impact sound pressure level are defined in EN ISO 717-2:1997, Annex A.