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LABORATORY MEASUREMENT

OF

THE REDUCTION OF TRANSMITTED IMPACT SOUND PRESSURE LEVELS BY A FLOOR COVERING ON A HEAVYWEIGHT STANDARD FLOOR

MEASUREMENT NO: INR163 – A1

DATE OF MEASUREMENT: 20th – 22nd April, 2009

COMMISSIONED BY: A1 Rubber Pty Ltd

Summary

The reduction of impact sound pressure level (ΔL), the impact isolation class (IIC), $L_{n,w}$ and C_I, the weighted reduction in impact sound pressure level (ΔL_w) and the ΔL_{lin} value for three (3) different floor covering systems (tiled or rubber) have been measured.

The ΔL values reported are the decibel reductions in normalized impact sound pressure level (L_n) measured in a reverberant room beneath the test floor, achieved by the floor covering material compared to the bare test floor. The ΔL_w and ΔL_{lin} are single number ratings for the improvement in impact sound levels between the bare reference floor and the same floor with the floor covering material. ΔL_w is the difference between $L_{n,w}$ for the bare reference floor and $L_{n,w}$ for the reference floor plus the floor covering, as defined in AS ISO 717.2-2004. ΔL_{lin} is the difference between $L_{n,sum}$ for the bare reference floor and $L_{n,sum}$ for the reference floor plus the floor covering combination, as defined in AS ISO 717.2-2004. IIC (ASTM E989-89), $L_{n,w}$ and C_I AS ISO 717.2-2004 apply to the combination of the floor covering and the 150mm thick concrete test slab.

Method of Testing

(a) Specific

The measurement complies with the requirements of ISO 140-8:1997(E) *"Measurement of sound insulation in buildings and building elements – Part 8: Laboratory measurement of the reduction in transmitted impact noise by floor coverings on a standard floor"*. It also complies with ISO 140-6 *"Measurement of sound insulation in buildings and building elements – Part 6: Laboratory measurement of sound insulation of floors"*.

(b) General

The test-material is installed onto a standard test-floor, this being a 150mm reinforced concrete slab satisfying the requirements of ISO 140-8. A standard tapping-machine is operated on the test-material, and again on the bare-floor. The reduction in the sound pressure levels produced in a chamber beneath the floor is reported. Measurements for the floor covering are made at four different tapping machine positions on the standard test-floor and the average results reported.

Description of Materials Tested, and Mounting

The floor-covering systems, each with the dimensions of 3.6m x 3.2m, were tested on a 150mm thick concrete slab. The systems comprised, from the top down:

<u>(a) Test "a".</u> 3 mm Commercial Rubber Flooring.

- A1 Rubber - 3mm thick Jazz/Duralast Commercial Rubber Flooring
- Glued using SikaSense 4450 to:
- 150 mm thick concrete slab

<u>(b) Test "b".</u> Direct Stick Tile System.

- 200 mm x 200 mm x 8 mm thick Porcelain Ceramic Tile
- Grouted with MCB POLYBLEND G -15
- Glued using MCB A-100: MCB A -80: Prohesive ULTRA PRO to:
- A1 Rubber AcoustaMat 10 mm thickness 850 kg/m^3
- Glued using MCB Eco Silent Mat Adhesive to:
- 150 mm thick concrete slab

<u>(c) Test "c".</u> Direct Stick Tile System.

- 200 mm x 200 mm x 8 mm thick Porcelain Ceramic Tile
- Grouted with MCB POLYBLEND G -15
- Glued using MCB A-100: MCB A -80: Prohesive ULTRA PRO to:
- A1 Rubber AcoustaMat 3 mm thickness 850 kg/m^3
- Glued using MCB Eco Silent Mat Adhesive to:
- 150 mm thick concrete slab

Description of Test Floor and Test Facility

The standard floor used was a reinforced concrete floor with dimensions 3.66 m x 3.20 m x 0.150 m - this is in accordance with the requirements of ISO 140-8.

The tests were conducted with the standard floor-slab placed in an aperture between two purpose-built concrete rooms, all the bounding surfaces of which are 305 mm in thickness. The rooms were designed and built to minimise any structure-borne noise (induced by test signals) from outflanking sound passing through the test specimen.

The "sending" and the "receiving" rooms are both pentagonal in shape; the receiving room has a volume of 105 m^3 and a floor area of 32 m^2.

Environmental Conditions

The environmental conditions existing in the chambers during the testing were:

Temperature	17.5 – 18.0 deg C,
Relative Humidity	60 – 68 %
Atmospheric pressure	1018 - 1023 hPa

Measuring Equipment

(a) Tapping Machine

The tapping-machine employed was a Brüel & Kjær type 3204. (A rotating cam allows five, 500 gm, steel hammer-heads to be raised, then dropped under gravity through 40 mm, at a rate of 10 impacts/s). The tapping machine fulfils the requirements of ISO 140.

(b) Microphone

The microphone used was a Brüel & Kjær type 4166 mounted on a Brüel & Kjær type 2619 preamplifier and was mounted at end of a rotating boom of radius 1.73 m which had a rotation period of 32 s.

(c) Calibration of Microphone Sensitivity

The gain of the microphone was adjusted to read absolute dB re 20 μPa prior to measurement by using a Brüel & Kjær type 4220 pistonphone. The pistonphone was calibrated by a NATA registered laboratory on 20 April 2007.

(d) Analysis Equipment

Microphone signals were analysed using a Norwegian Electronics type 830 Real-Time-Analyser (RTA). This enables measurements in each of the standard 1/3-octave bands simultaneously, and also can perform internal averaging of repeated measurements. The measured levels reported below are each the result of internally averaging 4 x 32 s integrals in the 100 Hz to 5000 Hz bands.

The reverberation times in the receiving room were measured by overlaying 60 decays using the internal program of the RTA.

Measured Impact Sound Pressure Levels

Table 1 presents the impact sound pressure level (L_i), corrected for background levels, for the Bare Floor (L_{io}) and each specimen averaged over four different tapping machine positions as measured in the receiving room.

Table 1. Measured impact sound pressure level (L_i), corrected for background levels, averaged over four different tapping machine positions for the reference-floor and the floor-coverings laid over the reference-floor.

	Lio (dB)	Li (dB)		
Freq (Hz)	Bare Floor	(a) Test "a"	(b) Test "b"	(c) Test "c"
100	65.3	63.7	62.8	62.9
125	69.6	67.8	66.5	65.8
160	72.0	69.4	69.0	69.6
200	75.4	75.3	74.7	75.6
250	77.9	75.3	74.5	75.8
315	80.1	76.2	75.0	74.9
400	77.3	73.4	72.0	74.2
500	77.3	72.7	70.4	72.5
630	78.4	71.9	68.5	71.5
800	78.4	69.4	66.3	68.2
1000	79.3	68.3	65.1	65.7
1250	79.6	65.5	63.1	63.8
1600	79.3	59.0	59.0	62.8
2000	78.5	50.5	54.2	58.5
2500	76.9	39.1	49.3	53.3
3150	75.5	32.8	46.8	48.0
4000	72.9	25.7	40.6	43.1
5000	70.0	19.2	34.7	35.8

Correction for Background Sound Pressure Level

ISO 140-6 & 8 both require the measured impact sound pressure level to be corrected if it is close to the background sound pressure level. No background corrections were necessary.

Normalised Impact Sound Pressure Level of Bare Floor

ISO 140-6 & 8 both require the reporting of the normalised impact sound pressure level for the bare floor, L_{no}. The normalised impact sound pressure levels are the levels that would be measured if exactly 10 m^2 of sound absorption was present in the receiving room at each frequency. Accordingly, this information is presented in Table 2, together with the normalised impact sound pressure level for the test floors.

Table 2. Normalised impact sound pressure levels (dB) for the test floors.

	Normalised Impact Sound Pressure Level (L_n)			
Freq (Hz)	Bare Floor	(a) Test "a"	(b) Test "b"	(c) Test "c"
100	57.0	55.4	54.6	54.9
125	61.1	59.3	57.9	57.7
160	63.1	60.5	60.2	61.8
200	67.4	67.3	66.7	67.6
250	70.2	67.6	66.8	68.3
315	73.1	69.2	68.0	68.1
400	70.7	66.8	65.2	67.5
500	71.1	66.5	64.1	66.2
630	72.4	65.9	62.4	65.5
800	72.7	63.7	60.5	62.5
1000	74.1	63.1	59.8	60.5
1250	74.8	60.7	58.3	59.0
1600	75.1	54.8	54.8	58.7
2000	75.0	47.0	50.7	55.2
2500	74.2	36.4	46.6	50.7
3150	73.5	30.8	44.9	46.1
4000	71.5	24.3	39.4	41.9
5000	69.5	18.7	34.4	35.5

Results

The reduction of impact sound pressure level (ΔL), (i.e. the improvement in impact sound insulation) is given by the simple difference between the sound pressure level (L_{io}) measured for the bare floor, and the (L_i) measured for the test floors, corrected where appropriate for background levels. The impact isolation class (IIC) on the 150mm thick test slab, as defined in ASTM E989-89, the weighted reduction in impact sound pressure level ΔL_w, and ΔL_{lin}, as defined in AS ISO 717.2-2004, have also been determined for the test floors.

Table 3 presents the reduction of impact sound pressure level (ΔL) calculated for each measured third octave frequency band. The last five rows of the tables give ΔL_w, ΔL_{lin}, IIC, $L_{n,w}$ and C_I respectively for the test floors.

The bare floor yielded IIC 26, $L_{n,w}$ 81 and C_I -12.

Table 3. Reduction of impact sound pressure level (ΔL) for the test floors.

	Reduction in Impact Sound Pressure Level, ΔL (dB)		
Freq (Hz)	(a) Test "a"	(b) Test "b"	(c) Test "c"
100	1.6	2.5	2.4
125	1.8	3.1	3.8
160	2.6	3.0	2.4
200	0.1	0.7	-0.2
250	2.6	3.4	2.1
315	3.9	5.1	5.2
400	3.9	5.3	3.1
500	4.6	6.9	4.8
630	6.5	9.9	6.9
800	9.0	12.1	10.2
1000	11.0	14.2	13.6
1250	14.1	16.5	15.8
1600	20.3	20.3	16.5
2000	28.0	24.3	20.0
2500	37.8	27.6	23.6
3150	42.7	28.7	27.5
4000	47.2	32.3	29.8
5000	50.8	35.3	34.2
ΔL_w	**16**	**17**	**16**
ΔL_{lin}	**6**	**7**	**6**
IIC	**47**	**48**	**46**
$L_{n,w}$	**63**	**62**	**64**
C_I	**-2**	**-2**	**-3**

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Officer conducting measurement Checked by