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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: TLi 386

Date of Measurement: 29 May 2000

Commissioned by: Flexible Products Company,
2050 North Broadway,
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Summary

The reduction of impact sound pressure level (ΔL), the impact isolation class (IIC), the weighted reduction in impact sound pressure level (ΔL_w) and the ΔL_{IIn} value for two combinations of proprietary timber floorcoverings have been measured. The sending room normalised impact sound pressure levels for both floorcoverings are also reported.

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 each surface covering combination compared to the bare test floor. The ΔL_w and ΔL_{IIn} are single number ratings for the improvement in impact sound levels between the bare reference floor and the same floor with the floor covering combination. 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 ISO 717-2:1996. ΔL_{IIn} 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 ISO 717-2:1996. IIC applies to the combination of the floor covering and the 150mm thick concrete test slab, and is calculated according to ASTM E989-89.

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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 140-6:1998(E) *"Measurement of sound insulation in buildings and building elements – Part 6: Laboratory measurement of sound insulation of floors".*

(b) General

Each test-material is installed on 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. Also measured was the sending room reduction in impact sound pressure levels for both floorcoverings.

Description of Materials Tested, and Mounting

Two different specimens were tested, both of which measured 3.68 x 3.22m and covered the entire surface of the standard 150mm concrete slab. The specimens are referred to in this report as:

(a) Strip Floor.

This floor was constructed using F17 45mm x 45mm joists placed at 450mm centres. These joists had 50mm x 90mm pieces of "Impacta Mat" (5mm thick recycled rubber isolation pad) attached at 450mm centres along the joist and held in place with a carpet tack to act as an isolation pad. Victorian Ash tongue and groove flooring measuring 19mm x 80mm was then screwed to the joists creating a floor. A perimeter was added to the floor using the 19mm x 80mm tongue & groove flooring to simulate the floor butting up against a skirting board.

(b) Strip Floor plus Foam.

The 19mm x 80mm flooring was then dismantled and a sheet of styrene 35mm thick was placed between the joists to act as packing. The flooring was then rebuilt and 28kg density Froth-Pak was pumped between the flooring and the styrene. This created a 15mm thick layer of 28kg density Froth-Pak directly attached to the back of the flooring.

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. The diffusion in the chamber has been enhanced by the presence of 10 dissimilar randomly oriented plates with total surface area 42.7 m^2.

Environmental Conditions

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

Temperature	12.2 deg C,
Relative Humidity	79%
Atmospheric pressure	1006 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 the National Measurement Laboratory of CSIRO in March 1997.

(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.

Receiving Room Measurements

Measured Impact Sound Pressure Levels.

Table 1 presents the impact sound pressure level (L_i), corrected for background levels, for the two samples averaged over four different tapping machine positions as measured in the receiving room. The second column of that table gives the receiving room background sound pressure level (L_b).

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 test surface combinations laid over the reference-floor.

	L_b (dB)	L_{io} (dB)	(a) L_i (dB)	(b) L_i (dB)
Frequency (Hz)	Back Ground	Bare Floor	Strip Floor	Strip Floor + foam
100	19.2	63.2	67.9	63.0
125	14.1	66.1	71.4	67.3
160	11.2	68.4	73.0	71.6
200	10.5	71.5	73.8	76.4
250	20.4	75.4	69.6	75.3
315	18.4	76.2	67.5	74.9
400	20.0	77.5	65.7	68.6
500	15.6	74.7	62.9	64.7
630	11.7	76.1	58.5	59.2
800	13.5	76.5	52.8	53.0
1000	9.5	76.5	47.8	49.6
1250	13.8	77.5	45.4	44.9
1600	9.6	76.8	40.8	40.3
2000	9.4	75.9	36.4	35.6
2500	5.5	74.6	34.2	33.1
3150	6.5	73.7	30.1	32.6
4000	8.0	71.3	23.6	26.5
5000	8.6	67.8	19.1	19.8

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, and these corrections are shown in table 2.

Table 2. Corrections to measured impact sound pressure level.

	Size of correction, dB	
Frequency (Hz)	Strip Floor	Strip Floor + foam
4000	0.1	0.1
5000	0.4	0.3

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 3, together with the normalised impact sound pressure level for the test floors.

Table 3. Normalised impact sound pressure levels (dB) for the test floors.

	Normalised Impact SPL (L_n)		
Frequency (Hz)	Bare Floor	(a) Strip Floor	(b) Strip Floor + foam
100	56.2	60.9	56.0
125	59.8	65.1	61.0
160	61.5	66.1	64.7
200	64.8	67.1	69.7
250	68.7	62.9	68.6
315	69.9	61.2	68.6
400	71.4	59.6	62.5
500	68.8	57.0	58.8
630	70.4	52.8	53.5
800	71.1	47.4	47.6
1000	71.6	42.9	44.7
1250	73.1	41.0	40.5
1600	73.0	37.0	36.5
2000	73.1	33.6	32.8
2500	72.6	32.2	31.1
3150	72.2	28.5	31.0
4000	70.3	22.6	25.5
5000	67.6	18.9	19.6

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_{lo}) 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 ISO 717-2:1996(E), have also been determined for the test floors.

Table 4 presents the reduction of impact sound pressure level (ΔL) calculated for each measured third octave frequency band. The third last row of the table gives ΔL_w, the second last row gives ΔL_{lin}, and the final row the IIC for the test floors. The bare floor yielded IIC 28.

Table 4. Reduction of impact sound pressure level (ΔL) for the floor coverings.

	dB Reduction in Impact Levels	
Frequency (Hz)	(a) Strip Floor	(b) Strip Floor + foam
100	-4.7	0.2
125	-5.3	-1.2
160	-4.6	-3.2
200	-2.3	-4.9
250	5.8	0.1
315	8.7	1.3
400	11.8	8.9
500	11.8	10.0
630	17.6	16.9
800	23.7	23.5
1000	28.7	26.9
1250	32.1	32.6
1600	36.0	36.5
2000	39.5	40.3
2500	40.4	41.5
3150	43.6	41.1
4000	47.7	44.8
5000	48.7	48.0
ΔL_w	**16**	**15**
ΔL_{Lin}	**4**	**4**
IIC	**53**	**50**

Sending Room Measurements

Measured Impact Sound Pressure Levels.

Table 5 presents the impact sound pressure levels, corrected for background levels, for the two samples averaged over four different tapping machine positions as measured in the sending room. The second column of that table gives the sending room background sound pressure level which in this instance was the sound generated by the tapping machine operating on a double thickness of carpet. This was done to be able to identify the mechanical noise emitted by the machine as distinct from the impact noise generated by its hammers.

Table 5. Measured impact sound pressure levels, corrected for background levels, averaged over four different tapping machine positions for the test surface combinations.

		Corrected Levels dB	
Frequency (Hz)	(Carpet) Back Ground	Strip Floor	Strip Floor + Foam
100	56.0	90.7	74.1
125	59.4	91.5	80.0
160	63.9	92.7	84.9
200	63.0	93.5	90.7
250	59.7	93.0	92.2
315	62.1	92.1	89.9
400	64.9	90.3	90.2
500	62.8	90.1	89.5
630	59.8	91.8	91.0
800	57.8	92.2	90.7
1000	57.5	91.8	90.2
1250	58.5	90.2	87.1
1600	57.3	87.6	85.5
2000	58.4	85.6	83.7
2500	55.9	82.4	80.9
3150	53.5	80.5	78.1
4000	48.6	78.3	74.7
5000	46.9	74.9	71.5

Background levels

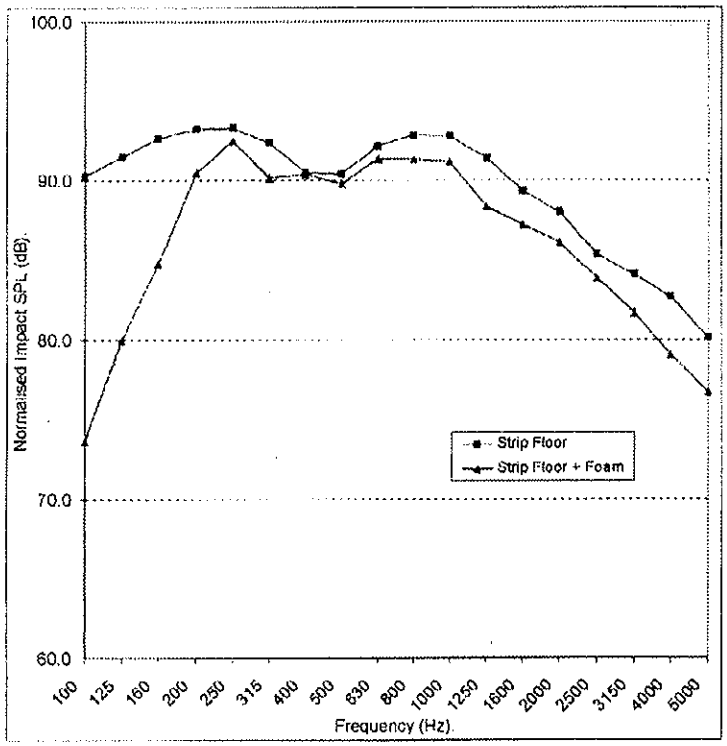
The background sound levels for the tapping machine operating on carpet for all frequency bands were measured and compared against the signal levels generated in the receiving room. Better than 10 dB was achieved for all measured frequencies.

Normalised Impact Sound Pressure Level of Test Floors

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 sending room at each frequency. Accordingly, this information for the two test floors is presented in table 6 and is also presented graphically.

Table 6. Normalised impact sound pressure levels (dB) for the test floors.

	Normalised Impact SPL	
Frequency (Hz)	Strip Floor	Strip Floor + Foam
100	90.3	73.7
125	91.5	80.0
160	92.6	84.8
200	93.3	90.5
250	93.3	92.5
315	92.4	90.2
400	90.5	90.4
500	90.4	89.8
630	92.2	91.4
800	92.9	91.4
1000	92.8	91.2
1250	91.5	88.4
1600	89.4	87.3
2000	88.0	86.1
2500	85.4	83.9
3150	84.1	81.7
4000	82.7	79.1
5000	80.2	76.8



12/10/2000 — Officer conducting measurement

John Davy 12/10/2000 — Checked by