# Technical Report

INVESTOR IN PEOPLE

***Report Number C/06/5L/3676/1a***
***(supersedes report number C/06/5L/3676/1 due to changes in product description)***

***Date 11 July 2007***

## *Project*

**The Laboratory Determination of The Reduction of Transmitted Impact Noise of Various Floor Coverings**

## *Prepared for*

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## 1.0 Summary

Tests have been done in SRL's Laboratory at Holbrook House, Sudbury, Suffolk, to determine the reduction of transmitted impact sound of various floor coverings in accordance with BS EN ISO 140-8:1998

From these measurements the required results have been derived and are presented in both tabular and graphic form in Data Sheets 1 to 6.

The results are given in 1/3rd octave bands over the frequency range 100Hz to 5kHz.

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**Gareth Young**
Project Engineer

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**Allen Smalls**
Quality Manager
Laboratory Manager

For and on behalf of
Sound Research Laboratories Ltd

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# 2.0 Details of Measurements

## 2.1 Location

Sound Research Laboratories Ltd
Holbrook House
Little Waldingfield
Sudbury
Suffolk
CO10 OTH

## 2.2 Test Dates

26 January, 9 February & 3 May 2007

## 2.3 Instrumentation and Apparatus Used

| Make | Description | Type |
|---|---|---|
| E D I | Microphone Multiplexer | |
| | Microphone Power Supply Unit | |
| Norwegian | Tapping Machine | 211 |
| Electronics | Real Time Analyser | 830 |
| Brüel & Kjaer | 12mm Condenser Microphones | 4166 |
| | Windshields | UA0237 |
| | Pre Amplifiers | 2639 |
| | Microphone Calibrator | 4231 |
| Larson Davis | 12mm Condenser Microphone | 2560 |
| SRL | Power Amplifiers | |
| Celestion | Loudspeakers | 100w |

| | | |
|---|---|---|
| Thermo Hygro | Temperature & Humidity Probe | |
| TOA | Graphic Equalizer | E-1231 |

## 2.4 References

| | |
|---|---|
| BS EN ISO 140-8:1998 | Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor |
| BS EN ISO 717-1:1997 | Rating of sound insulation in buildings and of building elements. Airborne Sound Insulation. |

# 3.0 Description of Test

## 3.1 Description of Sample

Three flooring samples were tested as identified below.

Test A1 - Wood/Cork Laminate (12mm) loose laid on nominal 2.5mm dimpled cork underlay. Unloaded.

Test A2 - Wood/Cork Laminate (12mm) loose laid on nominal 2.5mm dimpled cork underlay. Loaded.

Test A3 - Wood floor (10mm) adhered to 3mm cork underlay with Acrylic glue (nominal 0.5mm). Unloaded.

Test A4 - Wood floor (10mm) adhered to 3mm cork underlay with Acrylic glue (nominal 0.5mm). Loaded.

Test A5 - Ceramic tiles (8.5mm) adhered to 5mm cork underlay with flexible cement glue (nominal 6mm). Unloaded.

Test A6 - Ceramic tiles (8.5mm) adhered to 5mm cork underlay with flexible cement glue (nominal 6mm). Loaded.

Sampling plan: Complete rolls of underlay supplied - sample from both ends of roll.
Wood, laminate & ceramic tiles - selected from top of pile.

Sample condition: New.

Details supplied by Amorim.

Sample installed by Amorim/SRL.

## 3.2 Sample Delivery date

23 January 2007

## 3.3 Test Procedures

The sample was mounted/located and tested in accordance with the relevant standard. The method and procedure is described in Appendix 1.

## 4.0 Results

The results of the measurements and subsequent analysis are given in Data Sheets 1 to 6 and summarised below.

Results relate only to the items tested.

| SRL Test No. | Description in Brief | $\Delta L_w$ |
|---|---|---|
| A1 | Wood/Cork Laminate - Unloaded | 20 |
| A2 | Wood/Cork Laminate - Loaded | 20 |
| A3 | Wood Floor - Unloaded | 26 |
| A4 | Wood Floor - Loaded | 24 |
| A5 | Ceramic - Unloaded | 16 |
| A6 | Ceramic - Loaded | 16 |

*End of Text*

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**Data Sheet 1**

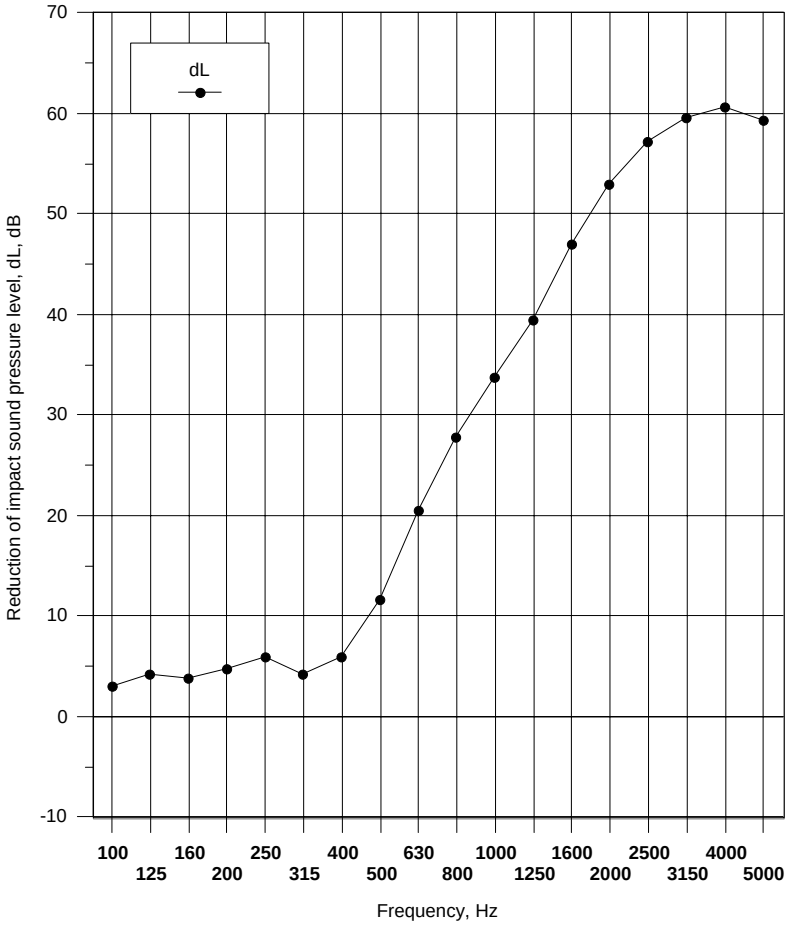
**Reduction of impact sound pressure level according to BS EN ISO 140-8 : 1998**

**Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor**

| | | | |
|---|---|---|---|
| **Test Number:** | A1 | **Air temp. in the source room:** | 17.7 deg.C |
| **Test Date:** | 26/01/2007 | **Air humidity in the source room:** | 39 % |
| **Client:** | Corticeira Amorim - Industria, S.A. | **Receiving room volume:** | 300 m3 |
| **Method of mounting:** | Loose laid | **Sample mass:** | 10.48 kg/m2 |
| | | **Thickness:** | 14.5 mm |
| | | The sample did not suffer visible damage during the test | |

**Production identification:** Wood / Cork laminate
Unloaded

| Freq f Hz | Ln,0 Third octave dB | **dL Third octave dB** |
|---|---|---|
| 100 | 67.4 | **3.0** |
| 125 | 69.5 | **4.2** |
| 160 | 70.1 | **3.9** |
| 200 | 69.4 | **4.8** |
| 250 | 70.5 | **6.0** |
| 315 | 71.3 | **4.3** |
| 400 | 72.9 | **5.9** |
| 500 | 72.8 | **11.7** |
| 630 | 73.1 | **20.5** |
| 800 | 73.5 | **27.8** |
| 1000 | 73.9 | **33.8** |
| 1250 | 74.6 | **39.5** |
| 1600 | 75.3 | **47.0** |
| 2000 | 75.8 | **53.0 *** |
| 2500 | 76.6 | **57.2 *** |
| 3150 | 76.7 | **59.6 *** |
| 4000 | 76.4 | **60.7 *** |
| 5000 | 74.1 | **59.3 #** |




Ln,0 : Is the normalised impact sound pressure level of the bare heavyweight test floor.
dL : Is the reduction of impact sound pressure level resulting from the installation of the test floor covering.
* Denotes results corrected for background # Denotes results at background

Rating according to BS EN ISO 717-2:1997

**Weighted reduction of impact sound pressure level of sample and (spectrum adaptation term) =** **dLw (Cld) = 20 (-11) dB**
Weighted normalised impact sound pressure level of bare reference floor and (spectrum adaptation term) = Ln,r,0,w (CI,r,0) = 78 (-11) dB
Weighted normalised impact sound pressure level of reference floor with sample and (spectrum adaptation term) = Ln,r,w (CI,r) = 58 (-0) dB

These results are based on a test made with an artificial source under laboratory conditions (engineering method). v1.7

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**Data Sheet 2**

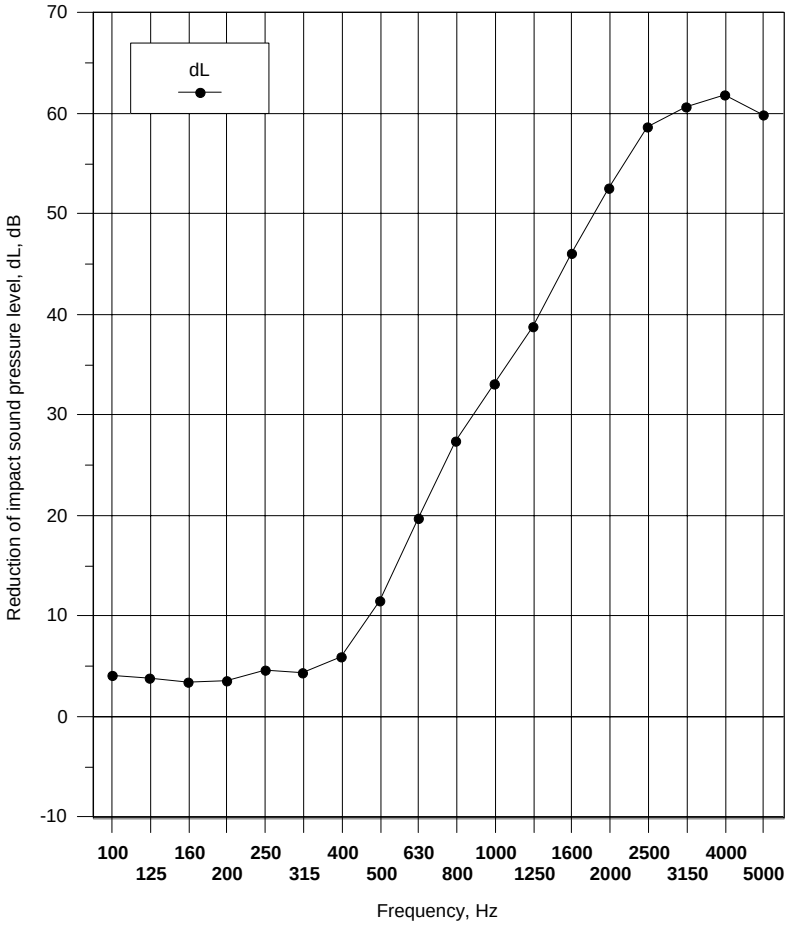
**Reduction of impact sound pressure level according to BS EN ISO 140-8 : 1998**

**Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor**

| | | | |
|---|---|---|---|
| **Test Number:** | A2 | **Air temp. in the source room:** | 17.1 deg.C |
| **Test Date:** | 26/01/2007 | **Air humidity in the source room:** | 39 % |
| **Client:** | Corticeira Amorim - Industria, S.A. | **Receiving room volume:** | 300 m3 |
| **Method of mounting:** | Loose laid | **Sample mass:** | 10.48 kg/m2 |
| | | **Thickness:** | 14.5 mm |
| | | The sample did not suffer visible damage during the test | |

**Production identification:** Wood / Cork laminate
Loaded

| Freq f Hz | Ln,0 Third octave dB | **dL Third octave dB** |
|---|---|---|
| 100 | 67.4 | **4.1** |
| 125 | 69.5 | **3.8** |
| 160 | 70.1 | **3.5** |
| 200 | 69.4 | **3.6** |
| 250 | 70.5 | **4.6** |
| 315 | 71.3 | **4.4** |
| 400 | 72.9 | **5.9** |
| 500 | 72.8 | **11.5** |
| 630 | 73.1 | **19.7** |
| 800 | 73.5 | **27.4** |
| 1000 | 73.9 | **33.1** |
| 1250 | 74.6 | **38.8** |
| 1600 | 75.3 | **46.1** |
| 2000 | 75.8 | **52.6 *** |
| 2500 | 76.6 | **58.7 *** |
| 3150 | 76.7 | **60.7 *** |
| 4000 | 76.4 | **61.9 #** |
| 5000 | 74.1 | **59.9 #** |




Ln,0 : Is the normalised impact sound pressure level of the bare heavyweight test floor.
dL : Is the reduction of impact sound pressure level resulting from the installation of the test floor covering.
* Denotes results corrected for background # Denotes results at background

Rating according to BS EN ISO 717-2:1997

**Weighted reduction of impact sound pressure level of sample and (spectrum adaptation term) = dLw (Cld) = 20 (-11) dB**

Weighted normalised impact sound pressure level of bare reference floor and (spectrum adaptation term) = Ln,r,0,w (CI,r,0) = 78 (-11) dB

Weighted normalised impact sound pressure level of reference floor with sample and (spectrum adaptation term) = Ln,r,w (CI,r) = 58 (0) dB

These results are based on a test made with an artificial source under laboratory conditions (engineering method). v1.7

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**Data Sheet 3**

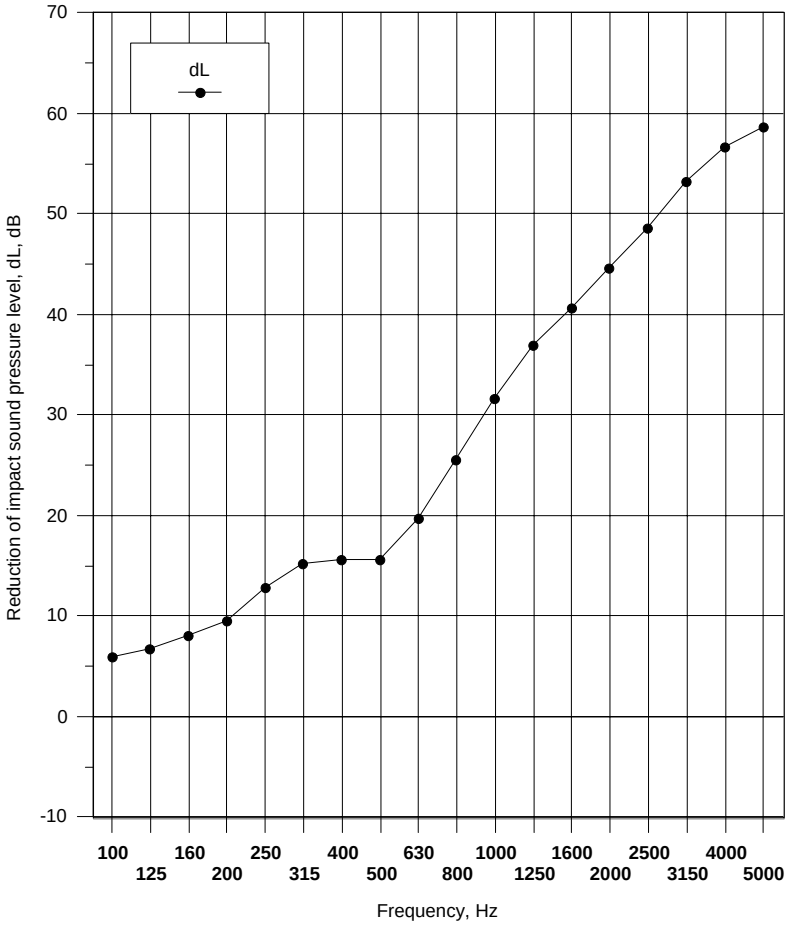
**Reduction of impact sound pressure level according to BS EN ISO 140-8 : 1998**

**Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor**

| | | | |
|---|---|---|---|
| **Test Number:** | A3 | **Air temp. in the source room:** | 11.8 deg.C |
| **Test Date:** | 09/02/2007 | **Air humidity in the source room:** | 51 % |
| **Client:** | Corticeira Amorim - Industria, S.A. | **Receiving room volume:** | 300 m3 |
| **Method of mounting:** | Adhered | **Sample mass:** | 4.76 kg/m2 |
| | | **Thickness:** | 13 mm |
| | | The sample did not suffer visible damage during the test | |

**Production identification:** Wood Floor - Unloaded
Adhered to cork underlay

| Freq f Hz | Ln,0 Third octave dB | **dL Third octave dB** |
|---|---|---|
| 100 | 67.4 | **6.0** |
| 125 | 69.5 | **6.8** |
| 160 | 70.1 | **8.1** |
| 200 | 69.4 | **9.5** |
| 250 | 70.5 | **12.9** |
| 315 | 71.3 | **15.2** |
| 400 | 72.9 | **15.6** |
| 500 | 72.8 | **15.6** |
| 630 | 73.1 | **19.8** |
| 800 | 73.5 | **25.5** |
| 1000 | 73.9 | **31.7** |
| 1250 | 74.6 | **37.0** |
| 1600 | 75.3 | **40.7** |
| 2000 | 75.8 | **44.6** |
| 2500 | 76.6 | **48.6** |
| 3150 | 76.7 | **53.3 *** |
| 4000 | 76.4 | **56.7 *** |
| 5000 | 74.1 | **58.7 #** |




Ln,0 : Is the normalised impact sound pressure level of the bare heavyweight test floor.
dL : Is the reduction of impact sound pressure level resulting from the installation of the test floor covering.
* Denotes results corrected for background # Denotes results at background

Rating according to BS EN ISO 717-2:1997

| | |
|---|---|
| **Weighted reduction of impact sound pressure level of sample and (spectrum adaptation term) =** | **dLw (Cld) = 26 (-12) dB** |
| Weighted normalised impact sound pressure level of bare reference floor and (spectrum adaptation term) = | Ln,r,0,w (CI,r,0) = 78 (-11) dB |
| Weighted normalised impact sound pressure level of reference floor with sample and (spectrum adaptation term) = | Ln,r,w (CI,r) = 52 (1) dB |

These results are based on a test made with an artificial source under laboratory conditions (engineering method). v1.7

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**Data Sheet 4**

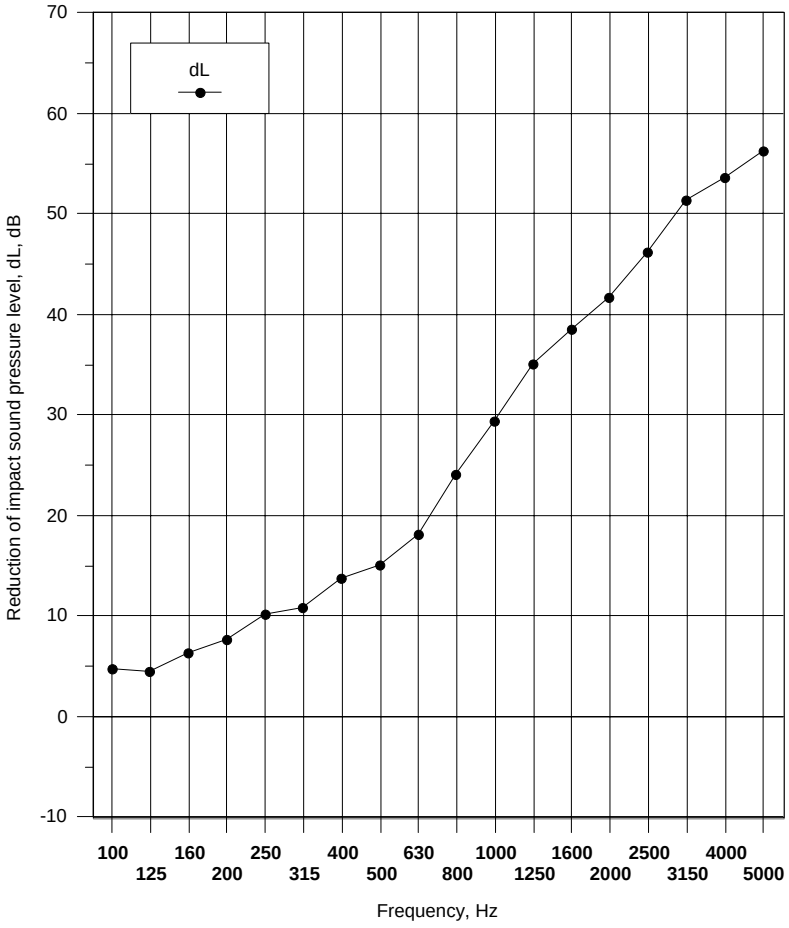
**Reduction of impact sound pressure level according to BS EN ISO 140-8 : 1998**

**Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor**

| | | | |
|---|---|---|---|
| **Test Number:** | A4 | **Air temp. in the source room:** | 11.8 deg.C |
| **Test Date:** | 09/02/2007 | **Air humidity in the source room:** | 51 % |
| **Client:** | Corticeira Amorim - Industria, S.A. | **Receiving room volume:** | 300 m3 |
| **Method of mounting:** | Adhered | **Sample mass:** | 4.76 kg/m2 |
| | | **Thickness:** | 13 mm |
| | | The sample did not suffer visible damage during the test | |

**Production identification:** Wood Floor - Loaded
Adhered to cork underlay

| Freq f Hz | Ln,0 Third octave dB | **dL Third octave dB** |
|---|---|---|
| 100 | 67.4 | **4.8** |
| 125 | 69.5 | **4.5** |
| 160 | 70.1 | **6.3** |
| 200 | 69.4 | **7.7** |
| 250 | 70.5 | **10.2** |
| 315 | 71.3 | **10.9** |
| 400 | 72.9 | **13.8** |
| 500 | 72.8 | **15.1** |
| 630 | 73.1 | **18.2** |
| 800 | 73.5 | **24.1** |
| 1000 | 73.9 | **29.4** |
| 1250 | 74.6 | **35.1** |
| 1600 | 75.3 | **38.6** |
| 2000 | 75.8 | **41.7** |
| 2500 | 76.6 | **46.2** |
| 3150 | 76.7 | **51.4** |
| 4000 | 76.4 | **53.6 *** |
| 5000 | 74.1 | **56.3 *** |




Ln,0 : Is the normalised impact sound pressure level of the bare heavyweight test floor.
dL : Is the reduction of impact sound pressure level resulting from the installation of the test floor covering.
* Denotes results corrected for background # Denotes results at background

Rating according to BS EN ISO 717-2:1997

**Weighted reduction of impact sound pressure level of sample and (spectrum adaptation term) = dLw (Cld) = 24 (-12) dB**

Weighted normalised impact sound pressure level of bare reference floor and (spectrum adaptation term) = Ln,r,0,w (CI,r,0) = 78 (-11) dB

Weighted normalised impact sound pressure level of reference floor with sample and (spectrum adaptation term) = Ln,r,w (CI,r) = 54 (1) dB

These results are based on a test made with an artificial source under laboratory conditions (engineering method). v1.7

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**Data Sheet 5**

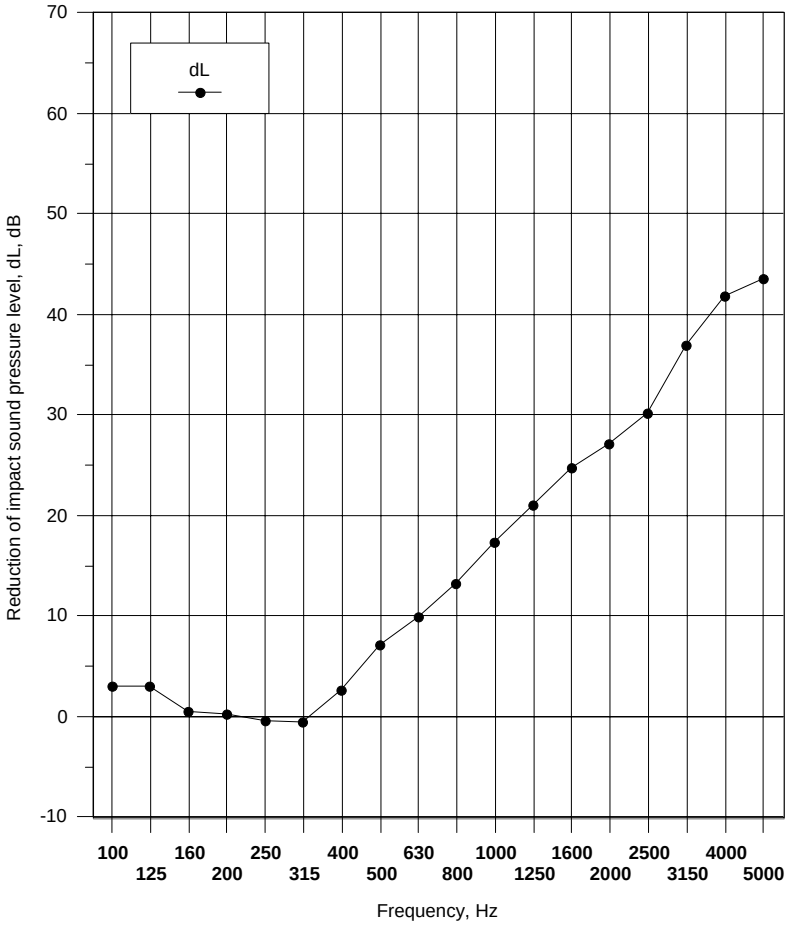
**Reduction of impact sound pressure level according to BS EN ISO 140-8 : 1998**

**Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor**

| | | | |
|---|---|---|---|
| **Test Number:** | A5 | **Air temp. in the source room:** | 16.8 deg.C |
| **Test Date:** | 03/05/2007 | **Air humidity in the source room:** | 50 % |
| **Client:** | Corticeira Amorim - Industria, S.A. | **Receiving room volume:** | 300 m3 |
| **Method of mounting:** | Adhered | **Sample mass:** | 26.38 kg/m2 |
| | | **Thickness:** | 19.5 mm |
| | | The sample did not suffer visible damage during the test | |

**Production identification:** Ceramic Floor - Unloaded
Adhered to cork underlay

| Freq f Hz | Ln,0 Third octave dB | **dL Third octave dB** |
|---|---|---|
| 100 | 67.4 | **3.1** |
| 125 | 69.5 | **3.1** |
| 160 | 70.1 | **0.5** |
| 200 | 69.4 | **0.2** |
| 250 | 70.5 | **-0.4** |
| 315 | 71.3 | **-0.5** |
| 400 | 72.9 | **2.6** |
| 500 | 72.8 | **7.1** |
| 630 | 73.1 | **9.9** |
| 800 | 73.5 | **13.3** |
| 1000 | 73.9 | **17.3** |
| 1250 | 74.6 | **21.1** |
| 1600 | 75.3 | **24.8** |
| 2000 | 75.8 | **27.1** |
| 2500 | 76.6 | **30.2** |
| 3150 | 76.7 | **36.9** |
| 4000 | 76.4 | **41.8** |
| 5000 | 74.1 | **43.6** |




Ln,0 : Is the normalised impact sound pressure level of the bare heavyweight test floor.
dL : Is the reduction of impact sound pressure level resulting from the installation of the test floor covering.
* Denotes results corrected for background # Denotes results at background

Rating according to BS EN ISO 717-2:1997

**Weighted reduction of impact sound pressure level of sample and (spectrum adaptation term) =** **dLw (Cld) = 16 (-11) dB**
Weighted normalised impact sound pressure level of bare reference floor and (spectrum adaptation term) = Ln,r,0,w (CI,r,0) = 78 (-11) dB
Weighted normalised impact sound pressure level of reference floor with sample and (spectrum adaptation term) = Ln,r,w (CI,r) = 62 (-0) dB

These results are based on a test made with an artificial source under laboratory conditions (engineering method). v1.7

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**Data Sheet 6**

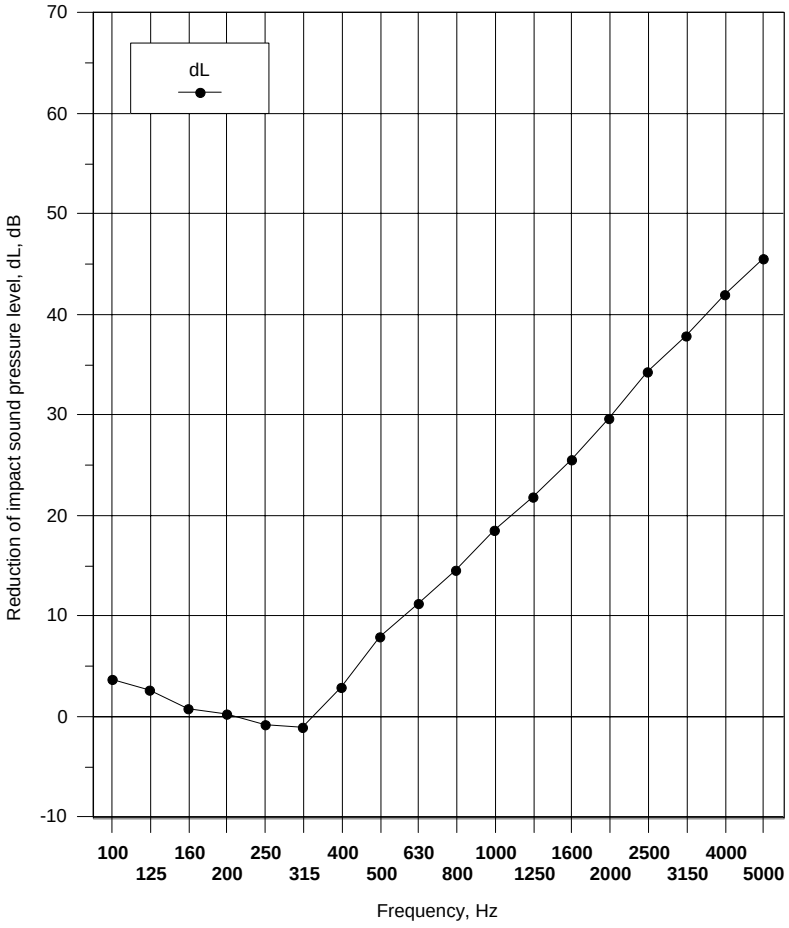
**Reduction of impact sound pressure level according to BS EN ISO 140-8 : 1998**

**Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor**

| | | | |
|---|---|---|---|
| **Test Number:** | A6 | **Air temp. in the source room:** | 16.8 deg.C |
| **Test Date:** | 03/05/2007 | **Air humidity in the source room:** | 50 % |
| **Client:** | Corticeira Amorim - Industria, S.A. | **Receiving room volume:** | 300 m3 |
| **Method of mounting:** | Adhered | **Sample mass:** | 26.38 kg/m2 |
| | | **Thickness:** | 19.5 mm |
| | | The sample did not suffer visible damage during the test | |

**Production identification:** Ceramic Floor - Loaded
Adhered to cork underlay

| Freq f Hz | Ln,0 Third octave dB | **dL Third octave dB** |
|---|---|---|
| 100 | 67.4 | **3.7** |
| 125 | 69.5 | **2.7** |
| 160 | 70.1 | **0.8** |
| 200 | 69.4 | **0.3** |
| 250 | 70.5 | **-0.8** |
| 315 | 71.3 | **-1.0** |
| 400 | 72.9 | **2.9** |
| 500 | 72.8 | **8.0** |
| 630 | 73.1 | **11.3** |
| 800 | 73.5 | **14.6** |
| 1000 | 73.9 | **18.6** |
| 1250 | 74.6 | **21.9** |
| 1600 | 75.3 | **25.6** |
| 2000 | 75.8 | **29.7** |
| 2500 | 76.6 | **34.3** |
| 3150 | 76.7 | **37.9** |
| 4000 | 76.4 | **42.0** |
| 5000 | 74.1 | **45.5** |




Ln,0 : Is the normalised impact sound pressure level of the bare heavyweight test floor.
dL : Is the reduction of impact sound pressure level resulting from the installation of the test floor covering.
* Denotes results corrected for background # Denotes results at background

Rating according to BS EN ISO 717-2:1997

**Weighted reduction of impact sound pressure level of sample and (spectrum adaptation term) = dLw (Cld) = 16 (-11) dB**

Weighted normalised impact sound pressure level of bare reference floor and (spectrum adaptation term) = Ln,r,0,w (CI,r,0) = 78 (-11) dB

Weighted normalised impact sound pressure level of reference floor with sample and (spectrum adaptation term) = Ln,r,w (CI,r) = 62 (-0) dB

These results are based on a test made with an artificial source under laboratory conditions (engineering method). v1.7

# Appendix 1

## Test Procedure

**Measurement of the reduction of transmitted impact noise by a floor covering in accordance with BS EN ISO 140-8: 1998**
**Categories II and III (large specimens and stretched materials) - TP13**

In the laboratory, impact sound reduction is determined from the difference a sample floor covering makes to the sound pressure levels generated by a standard impact machine. The impact machine, known as a tapping machine, is operated standing first on a concrete slab and then on the test sample installed on that slab. The test sample is installed on top of the roof of a reverberation room, which is acoustically "live", and the sound pressure levels are measured in that room. The test is done under conditions which restrict the transmission of sound other than directly through the sample and test slab. The measured sound pressure levels are corrected for the amount of sound absorption in the reverberation room.

The reverberation room, which has a volume of 300 cubic metres, is constructed from 215mm brick which is internally plastered with a reinforced concrete roof and floor. The room is isolated from the surrounding structure by resilient mountings and seals, ensuring good acoustic isolation. Reverberation time measurements are done to calibrate the reverberation room.

With the tapping machine operating on the bare concrete roof slab, the resulting sound pressure levels in the room are sampled using a spaced array of microphones connected to a real time analyser. The signal is filtered into one-third octave bandwidths, integrated and averaged. Six microphones are used with minimum separating distances as follows:

- 0.7m between microphone positions
- 0.7m between any microphone position and room boundaries or diffusers
- 1.0m between any microphone position and the upper floor being excited by the tapping machine

The procedure is repeated with the tapping machine at three further positions. The individual values for the different positions are arithmetically averaged to give the impact sound pressure level ($L_{i,o}$). This is corrected to a reference room absorption, referred to as normalising, to give the normalised impact sound pressure levels ($L_{n,o}$) for the bare concrete slab.

$$L_{n,o} = L_{i,o} + 10\log\frac{A}{Aref} \text{ in decibels}$$

Where A is the actual absorption of the test chamber $A_{ref}$ is the reference room absorption of $10m^2$.

The test sample, which is at least $10m^2$ in area, is placed on top of the concrete slab. The whole procedure is then repeated, with the tapping machine at four different locations, to obtain the normalised impact sound pressure levels with covering ($L_i$) and the corresponding normalised levels ($L_n$).

The reduction of impact sound pressure level (improvement of impact sound insulation) $\Delta L$, for a given frequency band is determined as follows:

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

The Weighted Impact Sound Improvement Index $\Delta L_w$, is a single figure rating of impact sound reduction and is calculated in accordance with BS EN ISO 717-2:1997.

The impact sound pressure levels for the test floor with test sample, depend to small extent on the particular test floor itself. To standardise these levels they are adjusted by calculation to what they would be if the bare concrete slab were replaced by a reference floor. The impact sound pressure levels that would be produced on the bare reference floor ($L_{n,o}$) are defined in BS EN ISO 717-2:1997. Using these, the impact sound pressure levels for the sample on the reference floor ($L_{n.r}$) and the corresponding weighted level ($L_{n,w,r}$) are calculated in accordance with the same standard.

**Optional Procedure for Category II Samples**

The assembled floor covering may be tested under load. To simulate normal furnishing, weights are uniformly distributed over the sample floor, at least one for each square meter of sample area. The average load over the sample is between 20 and $25kg/m^2$. The thickness of the floor sample under load is noted.

Measurements under load may be done as an alternative or in addition to measurements on the unloaded sample.

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# Appendix 2

## Measurement Uncertainty
## BS EN ISO 140-8:1998 -TP13

The following values of uncertainty are based on a standard uncertainty multiplied by a coverage factor of k = 2, which provides a level of confidence of approximately 95%.

| Frequency, Hz | Uncertainty, ± dB |
|---|---|
| 100 | 1 |
| 125 | 1 |
| 160 | 1 |
| 200 | 1 |
| 250 | 1 |
| 315 | 0.7 |
| 400 | 0.7 |
| 500 | 0.7 |
| 630 | 0.7 |
| 800 | 1 |
| 1000 | 1 |
| 1250 | 1 |
| 1600 | 1.2 |
| 2000 | 1.8 |
| 2500 | 1.8 |
| 3150 | 1.8 |