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Client Report

B-3135.1

Airborne and Impact Sound Transmission Measurements Performed on Specimen B3135-1

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Airborne and Impact Sound Transmission Measurements Performed on Specimen B3135-1

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9 pages
Copy No. 4 of 4 copies

INTRODUCTION

Airborne and impact sound transmission measurements were performed on a wood joist floor assembly with a topping which comprised a parquet/plywood assembly, 8 mm Duraflex and 25 mm gypsum concrete. For report purposes, this specimen is identified as Specimen B3135-1. A complete description of the floor assembly is outlined in this report (see Specimen Description Section).

FACILITIES AND EQUIPMENT

The acoustics floor test facility comprises two reverberation rooms with a moveable test frame between the two rooms. Both rooms have a volume of 175 m^3.

Measurements are controlled by a desktop PC-type computer interfaced to a Norwegian Electronics type 830 real time analyser. Each room has a calibrated Bruel & Kjaer condenser microphone cartridge-type 4166 that is moved under computer control to nine positions used for the acoustical measurements. Each room has four loudspeakers driven by separate amplifiers and noise sources. To increase the randomness of the sound field, there are also fixed diffusing panels in each room.

TEST PROCEDURE

Airborne Sound Transmission Loss

Airborne sound transmission measurements were conducted in accordance with the requirements of ASTM E90-90, "Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions", and of ISO 140/III 1978(E), "Laboratory Measurement of Airborne Sound Insulation of Building Elements".

The Sound Transmission Class (STC) was determined in accordance with ASTM E413-87, "Classification for Rating Sound Insulation". The Weighted Sound Reduction Index (R_w) was determined in accordance with ISO 717, "Rating of Sound Insulation in Buildings and of Building Elements, Part 1: Airborne Sound Insulation in Buildings and of Interior Building Elements".

One-third octave band sound pressure levels were measured for 32 seconds at each microphone position and then averaged to get the average sound pressure level in the room. Five sound decays were averaged to get the reverberation time at each microphone position in the receiving room. These times were averaged to get the spatial average reverberation times for the room.

The space average sound pressure levels of both the source and receiving rooms and the spatial average reverberation times of the receiving room were used to calculate sound transmission loss values.

Airborne sound transmission loss tests were performed in the forward (receiving room is the lower room) and reverse (receiving room is the upper room) directions. Results presented in this report are the average of the tests in these two directions.

A complete description of the test procedure, information on the flanking limit of the facility and reference specimen test results are available on request.

The measured temperature and relative humidity in the upper chamber during testing was 21.6°C and 21.8%, respectively. The measured temperature and relative humidity in the lower chamber during testing 20.3°C and 28.2%, respectively.

TEST PROCEDURE

Impact Sound Transmission

Impact sound transmission measurements were made in accordance with ASTM E492-90, "Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine". This test used the standard tapping machine and the prescribed four impact positions on the floor. The Impact Insulation Class (IIC) was determined in accordance with ASTM E989-89, "Standard Classification for Determination of Impact Insulation Class (IIC)".

These measurements are also in accordance with ISO 140-6, "Laboratory Measurements of Impact Sound Insulation of Floors", except that the tapping machine positions are not randomly selected. This difference is believed to be insignificant. The Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) was determined in accordance with ISO 717, "Rating of Sound Insulation in Buildings and of Building Elements - Part 2: Impact Sound Insulation".

One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in the receiving room and then averaged to get the average sound pressure level in the room. Five sound decays were averaged to get the reverberation time at each microphone position in the receiving room. These times were averaged to get the spatial average reverberation times for the room.

The space average sound pressure levels and the spatial average reverberation times of the receiving room were used to calculate impact transmission values. For impact sound transmission, the lower room is the receiving room.

A complete description of the test procedure is available on request.

MOUNTING OF SPECIMEN

The test specimen was mounted in the IRC acoustical floor test opening which measures 4.70 m x 3.78 m. The area used for the calculations of impact transmission and airborne sound transmission loss was 17.85 m^2.

SPECIMEN DESCRIPTION

Construction on the floor assembly began on 15-Apr-99. The airborne sound transmission loss tests were performed on 13-May-99. The floor assembly comprised the following elements, listed from top to bottom.

Table 1: Element breakdown of Specimen B3135-1.

Element	Surface weight (kg/m^2)	Mass (kg)
29 mm parquet/plywood assembly	15.4	306.8
8 mm Duracoustic	3.0	60.8
25 mm gypsum concrete	46.7	919.1
19 mm plywood	8.5	170.3
38 mm x 235 mm wood joists (including headers, trimmers and cross bridging), 406 mm oc		248.7
152 mm glass fibre batts	1.7	30.6
13 mm resilient channels, 610 mm oc		8.3
15.9 mm fire-rated gypsum board	11.1	196.4
TOTAL		**1941.0**

Total thickness: 344.9 mm

Wood joists measuring 38 mm x 235 mm in depth, spaced 406 mm on center were installed in the test frame. The framing had 19 mm x 64 mm pieces of wood cross bridging at mid-span. Resilient channels were installed on the underside of the joists spaced 610 mm on center. A single layer of 15.9 mm fire-rated gypsum board was attached to the resilient channels. The gypsum board screws were spaced 305 mm on center.

152 mm thick R20 glass fibre batts were installed in the joist cavities. Each batt measured 381 mm x 1194 mm x 152 mm.

19 mm plywood was installed on top of the joists with screws spaced 152 mm on center along the edges of each sheet and 305 mm on center in the field of each sheet.

25 mm of Duracap 2000 gypsum concrete was poured on the plywood subfloor on 28-Apr-99. Once the gypsum concrete had cured, pieces of 8 mm thick shredded rubber material, identified by the client as "Duracoustic", were installed directly on top of the gypsum concrete. The "Duracoustic" was installed with the rubber side against the gypsum concrete. A pre-assembled parquet/plywood assembly was laid on top of the "Duracoustic" layer.

The pre-assembled parquet/plywood assembly comprised two layers of 9.5 mm plywood with a layer of 8 mm parquet flooring glued on top. The two layers of plywood were glued and screwed together with 16 mm wood screws in the corners of each sheet and 305 mm on center. The face layer of plywood was installed perpendicular to the base layer. The parquet flooring was installed according to the manufacturer's instructions.

RESULTS

Results of the airborne sound transmission loss measurements of Specimen B3135-1 are given in Table 2 and Figure 1. Results of the impact sound transmission measurements of this floor construction are given in Table 3 and Figure 2.

Certain values in the tables are marked. The values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values provide an estimate of the lower limit of airborne sound transmission loss or impact transmission. These values do not limit the single number ratings. The values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-97 or ASTM E492-90.

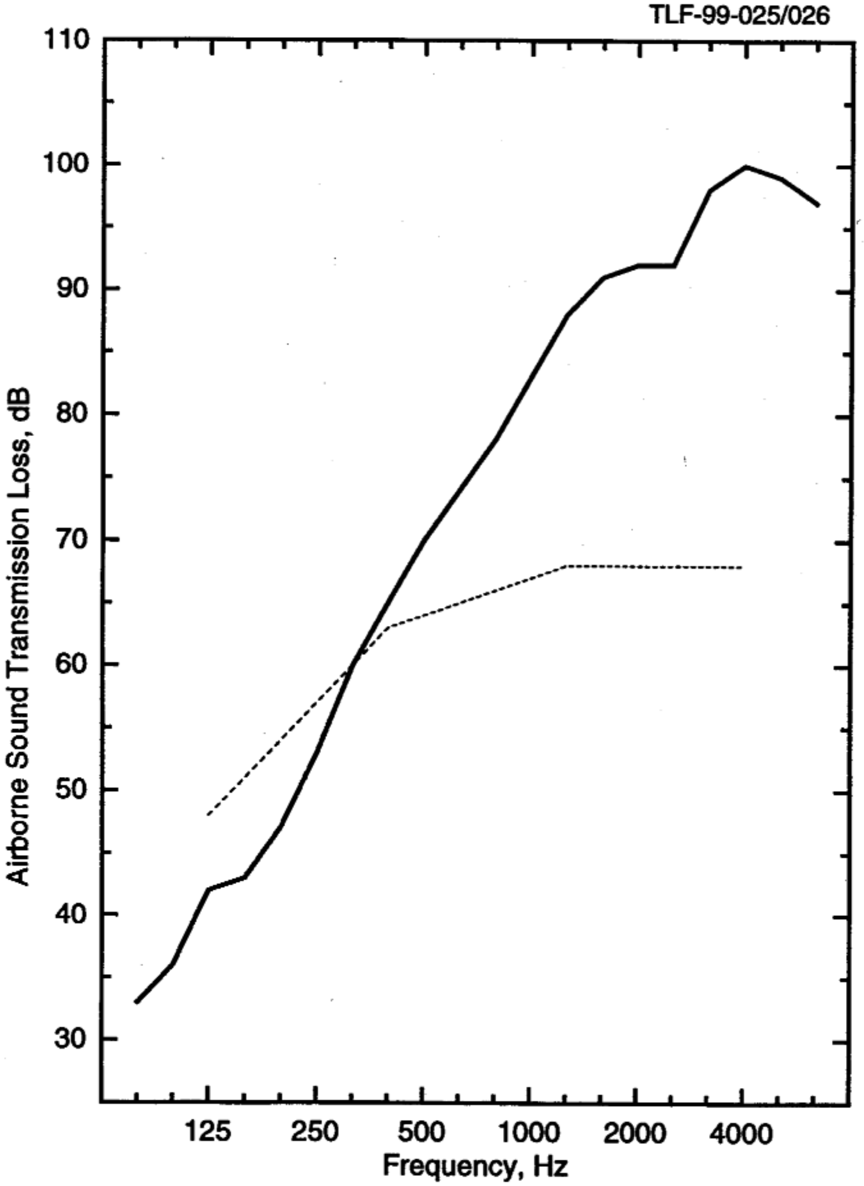
Table 2: Airborne sound transmission loss measurements of Specimen B3135-1, TLF-99-025/026.

Frequency (Hz)	Airborne Sound Transmission Loss (dB)	95% Confidence Limit[1]	Deviation Below the STC Contour
80	33	±2.4	
100	36	±1.5	
125	42	±1.1	6
160	43	±0.9	8
200	47	±0.9	7
250	53	±0.6	4
315	60	±0.5	
400	65	±0.5	
500	70	±0.5	
630	74 c	±0.4	
800	78	±0.3	
1000	83 c	±0.3	
1250	88 *	±0.4	
1600	91 *	±0.4	
2000	92 c	±0.3	
2500	92 c	±0.4	
3150	98 *	±0.4	
4000	100 *	±0.3	
5000	99 *	±0.4	
6300	97 *	±0.5	
Sound Transmission Class (STC)[2] = 64			
Weighted Sound Reduction (R_W)[3] = 63			

[1] Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty. By correctly performing a number of measurements, the uncertainties can be reduced and upper and lower limits assigned to the probable error in the measurement. These limits are called confidence limits. Thus where a quantity (Q) has associated with it a confidence limit ±C, then one can say with 95% confidence that the true quantity is in the interval Q - C to Q + C.

[2] Sound Transmission Class (STC) calculated according to ASTM E413-94.

[3] Weighted Sound Reduction (R_w) calculated according to ISO 717.



Frequency (Hz)	Airborne Sound Transmission Loss (dB)	
80	33	
100	36	
125	42	
160	43	
200	47	
250	53	
315	60	
400	65	
500	70	
630	74	c
800	78	
1000	83	c
1250	88	*
1600	91	*
2000	92	c
2500	92	c
3150	98	*
4000	100	*
5000	99	*
6300	97	*

STC 64

Figure 1: Airborne sound transmission loss measurements of a Specimen B3135-1. The solid line is the experimental data and the dotted line is the STC 64 contour.

Table 3: Impact sound transmission measurements of Specimen B3135-1, IIF-99-009.

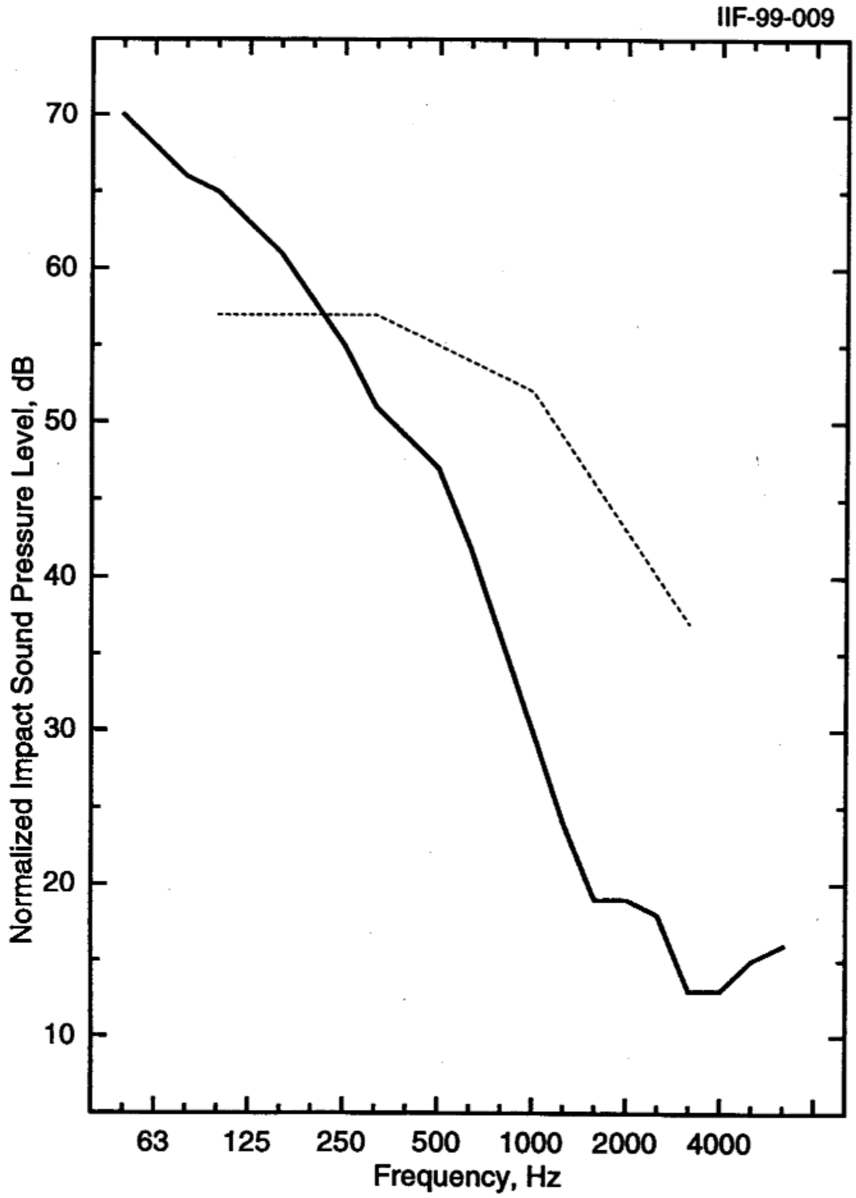
Frequency (Hz)	Normalized Impact Sound Pressure Level (dB)	95% Confidence Limit[1]	Deviation Above the IIC Contour
50	70	±1.7	
63	68	±1.7	
80	66	±1.2	
100	65	±0.8	8
125	63	±0.7	6
160	61	±0.5	4
200	58	±0.5	1
250	55	±0.3	
315	51	±0.2	
400	49	±0.2	
500	47	±0.2	
630	42	±0.2	
800	36	±0.1	
1000	30	±0.1	
1250	24	±0.1	
1600	19 c	±0.1	
2000	19 c	±0.1	
2500	18 c	±0.2	
3150	13 *	±0.8	
4000	13 *	±1.2	
5000	15 *	±1.3	
6300	16 *	±1.3	

Impact Insulation Class (IIC)[4] = 55

Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$)[5] = 52

[4] Impact Insulation Class (IIC) calculated according to ASTM E989-89.

[5] Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) calculated according to ISO ISO 717.



Frequency (Hz)	Normalized Impact Sound Pressure Level (dB)	
50	70	
63	68	
80	66	
100	65	
125	63	
160	61	
200	58	
250	55	
315	51	
400	49	
500	47	
630	42	
800	36	
1000	30	
1250	24	
1600	19	c
2000	19	c
2500	18	c
3150	13	*
4000	13	*
5000	15	*
6300	16	*

IIC 55

Figure 2: Impact sound transmission measurements of Specimen B3135-1. The solid line is the experimental data and the dotted line is the IIC 55 contour.

NOTES ON THE SIGNIFICANCE OF TEST RESULTS

Sound Transmission Class And Weighted Sound Reduction Index

The Sound Transmission Class (STC) and Weighted Sound Reduction Index (R_w) are single-figure rating schemes intended to rate the acoustical performance of a partition element under typical conditions involving office or dwelling separation. The higher the value of either rating, the better the floor performance. Thus, the rating is intended to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, office machines and similar sources of noise characteristic of offices and dwellings. In applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers, aircraft noise, motor vehicle noise), the STC and R_w are of limited use. Generally, in such applications it is desirable to consider explicitly the noise spectra and the insulation requirements.

Impact Insulation Class And Weighted Normalized Impact Sound Pressure Level

The Impact Insulation Class (IIC) and the Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) are single-figure rating schemes intended to rate the effectiveness of floor-ceiling assemblies at preventing the transmission of impact sound from the standard tapping machine. The higher the value of the rating, the better the floor performance.