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STC: 57

Rw 56 (-3; -9)

LABORATORY MEASUREMENT OF AIRBORNE SOUND TRANSMISSION LOSS

MEASUREMENT NO: TL417a

DATE OF MEASUREMENT: 24 February, 2003

COMMISSIONED BY: Foilboard Australia Pty Ltd, 9 Dissik St, Cheltenham, Victoria, 3192.

SUMMARY

The sound transmission loss (*TL*) of a brick and timber stud wall system, utilising Foilboard Insulation Panels and plasterboard, has been determined.

The measurement was performed in compliance with the requirements of AS 1191-1985 "*Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions*".

The Sound Transmission Class (*STC*) and the Weighted Sound Reduction Index (R_w) of the wall were calculated using the procedures respectively specified by AS 1276-1979 and AS/NZS 1276.1:1999.

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DESCRIPTION OF SPECIMEN

The specimen (Wall "a") consisted of a 110 mm thick clay brick wall, together with a 90 mm timber stud frame (600 mm centres) that was positioned 50 mm from one face of the brick wall. A 15 mm thick product labelled Foilboard Insulation Panel was direct fixed onto the inner side of the timber frame (thereby reducing the actual airgap to 35 mm), whilst direct fixed on the outside of the timber frame was 10 mm thick plasterboard.

Foilboard Insulation Panel is a proprietry product manufactured by Foilboard Australia, and it consists of a polystyrene core with 20 micron thick aluminium foil bonded to both sides. The Foilboard panels were supplied as 2440 mm x 1200 mm x 15 mm thick and had an areal density of 0.27 kg/m^2.

METHOD OF TEST

(a) Specific

The measurement was performed to comply with the requirements of AS 1191-1985 "Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions".

(b) General

The specimen was assembled into an 11.9 m^2 aperture provided in the common wall between a pair of purpose-built reverberation rooms. A steady level of broadband random-noise was generated in one of the rooms, and the resulting sound pressure levels (100 Hz to 5 kHz) were measured in both rooms. The differences between the sound pressure levels in the rooms were converted to transmission loss values by correcting for the sound absorption characteristics of the receiving room.

DESCRIPTION OF TEST FACILITY

The transmission rooms in which the tests were conducted have been designed and built to be structurally independent from one another. This was done to minimise any structure-borne noise, induced by test signals, from outflanking sound passing through test specimens mounted in the aperture within the common wall. The common wall between the rooms consists of two parallel concrete walls (each 305 mm thick) separated by a 50 mm air gap. A steel-lined test-aperture (3.23 m high x 3.68 m wide x 0.51 m deep) has been built into the common wall. To stop the steel aperture from rigidly bridging across the gap between the rooms, a 6 mm cut has been made around its perimeter adjacent to the air gap.

To enhance diffusion of sound, both rooms have an irregular pentagonal floor plan and sloping ceilings, and they each contain randomly oriented diffusing plates. The "source" room (that in which the sound source was placed) has a volume of 203 m^3, and a total surface area of 261 m^2 . The "receiving" room has a volume of 204.5 m^3, and a total surface area of 264.3 m^2. All external surfaces of the reverberation room pair are constructed of 305 mm thickness reinforced concrete, to exclude external noise.

INSTRUMENTATION AND EQUIPMENT

Test Signal, Amplifiers & Loudspeakers

The sound source used was the amplified signal originating from the noise generator built into a Norwegian Electronics type 830 Real Time Analyser. Its random noise output was passed into a Graphic Equaliser (Klark Teknik DN27). The Graphic Equaliser was used to trim the shape of the spectrum such that approximately equal sound levels were achieved across the bands eventually broadcast into the sending room. The broadband output from the graphic equaliser was split into two frequency bands by a custom-built cross-over network. The low frequency bands (100 Hz to 1.6 kHz) were amplified to about 4 V by a Power Amplifier (Crown DC300) and broadcast into the sending room from a 300 mm diameter loudspeaker (Rola 12UX) mounted on a flat 1 m^2 baffle, situated facing into one corner of the test room. The high frequency bands (2 kHz to 5 kHz) were likewise amplified by a Power Amplifier (Crown DC300A) to about 11 V before being delivered into a dodecahedral array of 50 mm diameter loudspeakers (Peerless direct radiator "tweeters").

Microphones, Preamplifiers & Microphone Power Supply

The same single microphone (Brüel & Kjær Type 4166) and preamplifier (Brüel & Kjær Type 2619) mounted at the end of a rotating microphone boom (Brüel & Kjær Type 3923) which had a radius of 1.73 m, was used in each room. This apparatus was moved between the two rooms as required. The microphone boom continuously rotated with a 32 s period during measurements. The microphone was powered from the NE 830 analyser and the sensitivity of the signal channel was adjusted to read absolute dB re 20 μPa prior to measurement in either room by using a Sound Level Calibrator (Brüel & Kjær Type 4230).

Measurement Instrumentation

All microphone signals were analysed using a Norwegian Electronics Type 830 Real Time Analyser.

ENVIRONMENTAL CONDITIONS

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

Temperature	25.1 Deg C,
Relative Humidity	67%
Atmospheric pressure	1011 hPa

MEASUREMENT DETAILS

Measurement of Sound Levels

The sound pressure levels in both rooms were averaged over space (by allowing microphone boom to rotate continuously during measurements), and time (by performing a 192 s integral of the sound level).

Absorption of receiving room

The average reverberation time of the receiving room was determined for each 1/3-octave frequency band. The equivalent absorption area (A) at each frequency was then determined using the equation,

$$A = 0.161\ V / T_{60}$$

where V is the volume of the receiving room (204.5m^3), and T_{60} is the space averaged reverberation time of the room, s. The reverberation time and the equivalent absorption area of the receiving room for the wall are presented in table 1.

Table 1. Equivalent absorption area (A) of receiving room.

Freq, Hz	Reverberation Times (T60), sec	Equiv Absorp. Area (A) of Recvg.room, m^2
100	3.88	8.6
125	5.21	6.4
160	6.78	4.9
200	7.36	4.5
250	6.72	5.0
315	6.36	5.2
400	6.17	5.4
500	5.97	5.6
630	6.11	5.5
800	5.73	5.8
1000	5.20	6.4
1250	4.73	7.0
1600	4.17	8.0
2000	3.68	9.1
2500	3.35	10.0
3150	2.99	11.1
4000	2.62	12.7
5000	2.24	14.9

Correction for Background levels

The background sound levels for all frequency bands were measured and compared against the signal levels reaching the receiving room. Table 2 shows the corrections to the receiving room sound pressure levels for those frequencies with less than the required 10 dB margin above background. The symbol ≥ indicates that the measured Sound Pressure Level was less than the required 5dB above background. In this case 1.7 dB was subtracted from the measured Sound Pressure Level, this being the correction required for a measured Sound Pressure Level of 5 dB above background.

Table 2. Corrections applied to the receiving room sound pressure levels for those frequencies with less than the required 10 dB margin above background.

Freq, Hz	Background Corrections, dB
2000	0.6
2500	0.8
3150	0.6
4000	1.3
5000	≥1.7

Precision of results

Table 3. 95% confidence limits for the repeatability of airborne transmission loss results.

Band centre Frequency. Hz	95% Conf.limit on meas'd TL values (±) dB
100 - 500	0.8
630 - 2500	0.5
3150 - 5000	0.9

Table 3 lists typical 95% confidence limits for the repeatability of airborne transmission loss (TL) results (for any given specimen). These values have been determined using the procedure outlined in AS 1191-1985 Appendix A4.3. (i.e. In a once-off test, eight (8) independent TL measurements were performed on a test wall - which had one strongly absorbent face - and the 95% confidence limits at each frequency were determined.)

ANALYSIS OF MEASUREMENTS

The airborne sound transmission loss is obtained by using the equation:

$$TL = L_{send} - L_{recv} + 10 \, Log_{10}(S/A) \, .$$

In this equation L_{send}, and L_{recv} are the sound pressure levels (SPL's) measured in the sending and receiving rooms respectively, S is the area of the specimen and A is the equivalent absorption area of the receiving room (m^2) as detailed above.

TEST RESULTS

Table 4 presents the airborne transmission loss results. The final two rows in the table give the Sound Transmission Class (STC), the Weighted Sound Reduction Index (R_w) and the Spectral Adaption Terms (C; C_{tr}) as determined respectively by the Australian Standard AS 1276-1979, AS/NZS 1276.1:1999 and ISO-717.1-1996.

Table 4. Test results, STC and R_w ratings and Adaption Terms.

Freq, Hz	Specimen TL, dB
100	30.0
125	33.1
160	38.1
200	40.4
250	46.6
315	47.9
400	54.9
500	58.7
630	61.8
800	64.7
1000	65.8
1250	66.6
1600	70.2
2000	73.8
2500	74.4
3150	71.3
4000	74.1
5000	77.8
STC	**57**
Rw (C; Ctr)	**56 (-3; -9)**

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Officer conducting measurement

23/7 /2003

John Davy
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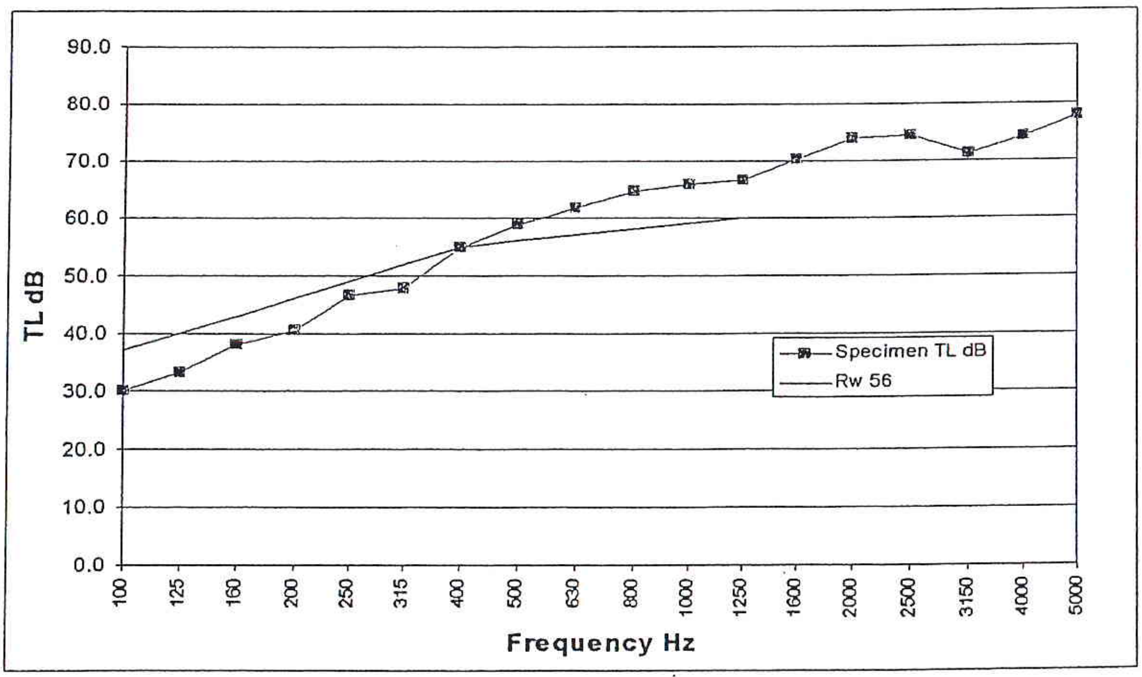
Checked by

Ident: TL417a
Designation: Foilboard Wall "a"
STC: 57
R_w (C; C_{tr}) 56 (-3; -9)

Frequency Hz	Sending SPL dB	Receiving SPL dB	Specimen TL, dB
100	88.6	60.0	30.0
125	89.5	59.1	33.1
160	88.7	54.4	38.1
200	89.2	53.0	40.4
250	88.1	45.3	46.6
315	87.2	42.9	47.9
400	86.9	35.5	54.9
500	88.3	32.9	58.7
630	88.5	30.1	61.8
800	88.6	27.0	64.7
1000	88.8	25.7	65.8
1250	88.8	24.5	66.6
1600	88.5	20.0	70.2
2000	87.2	14.6	73.8
2500	85.5	11.9	74.4
3150	85.2	14.2	71.3
4000	86.7	12.3	74.1
5000	87.3	8.5	≥77.8



Wall (a). Brick wall 110 mm thick, 35 mm cavity, 15 mm Foilboard Insulation Panel direct fixed to 90 mm timber studs, then 10 mm plasterboard direct fixed to the outside of the timber studs.