Airbourne Sound Transmission Test

Modular Wall systems

1.0 INTRODUCTION AND TEST RESULTS SUMMARY

This National Acoustic Laboratories were commissioned by Modular Wall Systems to measure the acoustical transmission loss of a 75mm thick Kwik-Wall Composite Panels as described in item 2.0 'Test sample' details.

The test sample achieved the following results:

Sound Transmission Class	STC 21
ISO-7171 Sound insulation Rating Rw (C:Ctr)	28 (-4:-6)
Outdoor Indoor Transmission Class	OITC 23
Unweighted average transmission loss value (100Hz - 5kHz)	30dB
A-Weighted average transmission loss value (100Hz - 5kHz)	26dB

2.0 TEST SAMPLE DETAILS

Type of Product	Composite Panels – 75mm thick
Composition	Polyurethane foam core compressed fibre cement outer skins
Test Sample Size	2690mm wide x 1200mm high
Nominal Weight	Polyurethane foam core measured density was approximately 15 ½ kg/cu m
Nominal Thickness	Total thickness of composite panels was 75mm. Compressed fibre cement board outer skins were 4 ½ mm thick
Installation	50mm square timber battens around interior and exterior perimeters of array. Panel joints glued and sealed with polyurethane sealant. Interior and exterior perimeters sealed with general purpose sealant
Test Date	19-Dec-2005

3.0 TEST RATIONAL

The procedure for testing a small test sample building element such as a door or window requires the construction of a specially designed 'filler wall'. This filler wall is constructed in an aperture between two reverberation rooms and tested for acoustic transmission loss. After testing, an opening which is sufficiently large to accommodate the window or door is made in the filler wall (the size of the opening can be varied to suit a particular sample but normally it is 1850 x 1250mm (W x H) for windows and 1850 x 2150mm (W x H) for doors). The perimeter of this opening is lined with a layer of 16mm thick fire rated gypsum plasterboard, a layer of 12mm thick medium density fibreboard (m.d.f.) and a layer of Barium sulphate impregnated vinyl sheet. The small sample is then fitted into the opening and the acoustical integrity of the installation checked before testing.

The filler wall attenuation characteristics are designed to provide a minimum of 10dB greater attenuation than the test sample at all one-third octave frequencies between 80Hz and 5000Hz. This is to ensure an accurate measurement of the test sample according to standard acoustical practice, and to conform with the measurement requirements of AS1191-2002 Acoustics –Method for laboratory measurement of airbourne sound transmission loss of building partitions. The transmission loss characteristics of this wall are presented in item 4.1 Sound Transmission Class of this report.

The second measurement taken is of the test sample fitted within the filler wall as presented in item 4.1 Sound Transmission Class of this report. The difference between the filler wall and filler wall and test sample measurements provide a means of calculating the Sound Transmission Class (STC) rating of the test sample as presented in item 4.1 Sound Transmission Class of this report. Other criteria presented in the report are derived from the two sets of measurement.

4.0 Results

4.1 Sound Transmission Class

A complete set of measurements and calculations for determination of the test sample acoustical transmission loss was calculated and is presented numerically ad graphically on the appended spreadsheets. A summation of one-third octave transmission loss results, rounded to the nearest decibel (as required by AS1191 – 3003), follows.

Transmission Loss Measurement					
1/3 Octave Band Centre Frequency (Hz)	Filler Wall STC 82	Filler wall and Test Sample STC 26	Test Sample STC 21	STC Criterion Value STC 21	Difference (dB)
80	53	25	20	-	-
100	57	21	16	-	-
125	54	25	20	5	-
160	68	25	20	8	-
200	70	26	21	11	-
250	72	29	24	14	-
315	76	31	26	17	-
400	77	32	27	20	-
500	76	32	27	21	-
630	80	32	27	22	-
800	82	30	25	23	-
1000	82	21	16	24	-8
1250	85	29	25	25	-
1600	89	42	37	25	-
2000	85	49	44	25	-
2500	85	52	47	25	-
3150	90	53	48	25	-
4000	94	54	49	25	-
5000	93	54	49	-	-
				SUM	-8

Note 1. The two channel pulse analyser averaging time conforms with the AS1191-2002 requirements of (1/20 the reverberation time of each one-third octave band in the measurement frequency range).

Note 2. Determination of Sound Transmission Class for a test sample requires comparison of the measured sound transmission loss with the value of each transmission class rating listed in the STC tables for each one-third octave band centre frequency, 125Hz to 4000Hz. The STC value, which is expressed as a class rating only (not as decibels) as determined by these tables, is reached when either or both of the following requirements are met.

(a) The test sample transmission loss at any frequency in the range 125Hz to 4000Hz must not lie more than 8dB below that of the STC reference graph value at the same frequency and

(b) The total sum obtained from the addition of unfavourable deficiencies (as defined in the "Rw determination" description), must not add to more than 32dB. They are listed in the STC table above.

Note 3. Refer to the spreadsheet summaries (attached) for decibel precision at the 95% confidence level for each attenuation value. The uncertainties have been calculated on the basis of there being not more than five chances in one hundred

4.2 OUTDOOR-INDOOR TRANSMISSION CLASS

The first column of the Summarised OITC Rating Table lists centre frequencies of the one-third octave bands measured.

The second column specifies levels of the A-Weighted reference spectrum defined by ASTM E1332 which are required to determine OITC. This spectrum has been A-Weighted and then normalized so that its energy summation is 0dB as required by that Standard.

The third column contains transmission loss coefficients for each one-third octave band in the frequency range 80Hz to 4000Hz used to determine test sample OITC rating.

The fourth column represents the difference between column two and three converted to sound energy. The summation of this energy, converted back to decibels is taken as the OITC value of the test sample.

Transmission Loss Measurement			
1/3 Octave Band Centre Frequency (Hz)	Normalised A-Weighted Spectrum (dB)	Test Sample Transmission Loss (dB)	Transmitted Sound Energy (Watts)
80	-19.6	20	1.096E-04
100	-17.2	16	4.786E-04
125	-15.2	20	3.020E-04
160	-15.5	20	2.818E-04
200	-14	21	3.162E-04
250	-13.7	24	1.698E-04
315	-12.7	26	1.349E-04
400	-11.9	27	1.288E-04
500	-10.3	27	1.862E-04
630	-11	27	1.585E-04
800	-10.9	25	2.570E-04
1000	-11.1	16	1.950E-03
1250	-10.5	25	2.818E-04
1600	-11.1	37	1.549E-05
2000	10.9	44	3.326E-06
2500	-11.8	47	1.318E-06
3150	-13.9	48	6.457E-07
4000	15.1	49	3.890E-07
		Sum of total energy =	4.776E-03
		OITC = -10* log (Sum of total energy) = OITC	23.2 23

4.3 ISO-717 SOUND INSULATION RATING

Rw Rating	
Rw	28
C_T	-4
C_{TR}	-6
$C_{T\ (50\text{-}5000)}$	-3
$C_{TR\ (50\text{-}5000)}$	-6

5.0 PROCEDURE FOR MEASURING TEST SAMPLES

The procedural detail requires reverberation room measurements of the following parameters for the filler wall and then for the filler wall with test sample fitted:

- Reverberation time measured in the receive room
- Sound pressure level in the send room and
- Sound pressure level in the receive room

The receive room reverberation time is measured according to the requirements of AS 1045 – 1985 "Acoustics – Measurement of Sound Absorption in a Reverberation Room" . The procedures require twelve measurements of sound pressure levels in the send room and twelve in the receive room for each one-third octave band at different locations in the rooms.

Measurements of twenty four sets of sound decay data in the receive room requires the use of two sounds sources, each positioned at a different location in the room and by moving the microphone through three positions, one for each measurements. A measurement is repeated four times for each combination of microphone and sound source location.

The total number of measurements required to evaluate sound pressure performance of the small test sample therefore comprises forty eight one-third octave sets of recordings in the send and receive rooms for the filler wall and forty eight sets for the filler wall with test sample installed. A set of recordings contains a measurement of the sound pressure level in each one-third octave frequency band between100Hz and 5000Hz (eighteen in total), 80 Hz is added to this for the calculation of OITC. These multiple measurements provide a means of calculating the sound field space-time variation within each room and establishes a basis for determining an estimation of the measurement precision to a confidence level of 95%.

Before testing commences, the measurement microphone in each reverberation room is acoustically calibrated and the acoustical noise floor measured. Acoustical calibration of each microphone is repeated at completion of the testing programme to ensure accuracy of results.

AS1191-2002 and the equivalent standards ISO140-1 and ISO140-3 describes procedures which allow measurements of transmission loss of 10 square metre samples or of smaller size samples such as windows, doors, partitions etc. The procedure for 10 square metre test samples is straightforward and requires only the aforementioned three sets of measurements. The procedure for measurement of smaller test samples, which is discussed in appendix A of AS1191-2002, requires construction and transmission loss measurement of a 10 square metre test wall which has at least 5dB and preferably 10dB more attenuation at each one-third octave band centre frequency in the frequency range to be measured than that of the smaller test sample to be evaluated and a calculation based on relative sizes of the 10 square mere test wall and the small test sample.

OITC is then calculated as required by ASTM E1332-90 by assuming the previously specified spectra and using the transmission loss coefficients obtained in the calculation procedure (refer spreadsheets) and Rw (C;Ctr) calculated according to requirements of ISO 717-1:1996 :Acoustics – rating of sound insulation in buildings and of building elements – Part 1: Airbourne Sound Insulation".

6.0 TEST SAMPLE PERFORMANCE ASSESSMENT

Several criteria are presented in this report to evaluate the acoustical transmission loss of the test sample to satisfy building industry requirements in Australia. Each evaluation is made on an analysis of the calculated difference between the filler wall and the filler wall with test sample fitted.

a. The Internationally used rating of Sound Transmission Class as required by Australian Standards AS1191-202.

b. The Weighted Sound Reduction Index, Rw rating with spectral corrections C and Ctr as discussed in International Standards Organisation document ISO717-1:1996 "Acoustics – rating of sound insulation in buildings and of building elements – part 1: Airbourne Sound Insulation". The ISO Rw rating is relevant where the spectra has low frequency energy content and is similar in application to the American OITC criteria. They differ however in the frequency range of application. Each compares a standardized reference cuve with the measured data over one-third octave bands. The Rw evaluation is carried out using the one-third octave band with centre frequencies ranging from 100Hz to 3150Hz, and the OITC evaluation is carried out using the one-third octave bands in frequency range 80Hz to 4000Hz. The Rw criteria is now largely favoured as a replacement for STC. The OITC evaluation is included in our reports for clients who wish to market their products overseas.

c. Other ratings presented are an evaluation of linear and A-weighted sound transmission loss averaged over the frequency range 100Hz to 5kHz. These are often required for marketing in New Zealand.

7.0 SOUND TRANSMISSION CLASS (STC) RATING

The first criteria presented, Sound Transmission Class (STC), has been an internationally standardized criterion for many years for evaluating noise reducing characteristics of building elements. The test procedure provides a single number which has been considered sufficient to determine transmission loss of building elements such as walls, windows and other small test samples fitted into the walls of the buildings.

This STIC rating criterion was originally developed for acoustical performance evaluation of internal walls and doors in buildings and is based on noise spectra with an energy distribution typical of music and speech. It is now considered to be unsuitable for use where the building element under evaluation is likely to be exposed to low frequency components of noise generated by transportation movement.

Determination of Sound Transmission Class for a test sample requires comparison of the measured sound transmission loss with the value for each transmission class rating listed in the STC tables for each one-third octave band centre frequency, 125Hz to 4000Hz. The STC value, which is expressed as a class rating only (not as decibels) as determined by these tables, is reached when either or both of the following requirements are met:

(a) The test sample transmission loss at any frequency in the range 125Hz to 4000Hz must not lie more than 8dB below that of the STC reference graph value at the same frequency and

(b) The total sum obtained from the addition of unfavourable deficiencies (as defined in the "Rw determination" description), must not add to more than 32dB.

8.1 OITC DETERMINATION

The OITC value for a test sample, as detailed in ASTM E 1332, is obtained by A-Weighting a noise spectrum which was obtained as an average of multiple measurements of aircraft take-off, freeway and railroad passby activities. This standardised noise spectrum is assumed to be in the send room during measurement of transmission loss.

The noise energy from this assumed noise spectra is (theoretically) transmitted through the small test sample, reduced by the transmission loss of the test sample at each one-third octave centre frequency (each transmission loss obtained from the STC measurement) and then summed as the total energy in the receive room.

The total energy is then determined as sound power (decibels re 1 pW) and the resulting numerical value expressed as the OITC value of the sample under test. It should be noted that the OITC rating is considered as a class evaluation and stated numerically in a similar way to the STC value which is also a class evaluation (that is, stated numerically and not as decibels as is sometimes found in literature).

8.2 RW DETERMINATION

The Rw is obtained by comparing the set of test sample transmission loss against a set of reference data specified on table 3 on page 4 of ISO 717-1:1996 (the comparison is made between values specified for each set at each seat at each one-third octave band centre frequency over the frequency range 100Hz to 3150Hz).

The reference data must then be amplitude shifted by the same amount (in single decibel steps) until the sum of unfavourable readings, determined from the data difference at each frequency, is as large as possible but not more than 32dB. The 500Hz value of the reference data minus the number of deciBels the reference data set has been shifted is then referred to as the Rw value for the test sample.

Note 1. An unfavourable difference (deficiency) at any frequency occurs when the test sample transmission loss is less than the value specified for the shifted reference data at the same frequency.

Note 2. The STC rating determination criterion has failure modes of -8dB at any one frequency and/or a deficiency sum of – 32dB, whereas Rw has only a single failure mode, this being a – 32dB deficiency summation over the pass band consisting of 100Hz to 3150Hz one-third octave bands. As a result of this, the Rw rating usually has the same numerical value as the STC rating unless the STC evaluation is a consequence of one or more -8dB deficiencies and any deficiency at 100Hz does not contribute to the Rw failure or at 4kHz to the STC failure.

8.3 C AND CTR DETERMINATION

Rw Corrections are accommodated in ISO 717-1:1996 to account for the type of spectra incident on the high noise side of a test sample. The correction C is applied to Rw spectra which is generated by sources such as transportation which are located close to the building element under test. Such noise sources have a wide energy distribution in their noise spectra. The correction Ctr is applied to pink noise or to spectra which is generated by sources such as transportation, located at a distance. The correction is applied to Rw where spectral energy is mostly concentrated in the low frequency end of the measurement frequency range.

Relevant Spectrum "correction" for different types of noise source (table A.1 of ISO717-1:1996)	
Type of Noise Source	**Relevant Spectrum :Correction" Term**
Living activities (talking, music, radio, TV) Children playing Railway traffic at medium and high speed Highway road traffic > 80km/hour Jet aircraft, short difference Factories emitting mainly medium and high frequency noise	C
Urban road traffic Railway traffic at low speeds Aircraft, propeller driven Jet aircraft, large distance Disco music Factories emitting mainly low and medium frequency noise	Ctr

9.0 TEST ENVIRONMENT

Transmission loss measurement according to the requirements of AS1191 requires the use of two reverberation rooms which conform to the acoustical performance requirements of Annex D, guidelines for the design of reverberation rooms, ISO3741-1999 "Acoustics – Determination of sound power levels of noise sources – Precision methods for broad-band sources in reverberation rooms".

Each test room, designated Reverberation (send) Room and Diffuse Field (receive) Room has a volume of approximately 200 cubic metres and is individually air conditioned by a special purpose acoustically attenuated air conditioning system. During testing, the supply and return air ducts are closed off via both pneumatically and manually operated dampers. The floors have different dimensions and are pentagonally shaped. The ceilings are inclined to the plane of the floor, opposite wall surfaces are different dimensions and inclined at an angle to each other to avoid acoustical coupling between rooms and to minimize the possibility of resonance in each room.

Additional sound diffusion within each of the rooms, to meet diffusivity requirements of ISO 354 – 1985 "Acoustics – Measurement of sound absorption in a reverberation room" is achieved by non-parallel room surfaces together with careful placing of eight 2400mm x 1200mm randomly oriented, freely suspended panels (19mm thick plywood sheets) with a total surface area of 40 square meters. These surfaces are heavily coated with epoxy resin to minimise acoustical absorption. The panels in each room are suspended in accordance with the tuning detail of ISO 354 – 1985 and therefore fully comply with the requirements of Australian Standard AS1045 – 1988.

Acoustical absorption coefficients in each octave band for each room and its diffusers do not exceed the maximum AS1191 requirement of 0.06 and are as follows:

Acoustical Absorption Coefficients						
Frequency	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
Reverberation Room	0.02	0.01	0.02	0.03	0.04	0.06
Diffuse Field Room	0.02	0.02	0.02	0.03	0.04	0.06

Both Reverberation rooms are inside separate isolating rooms, which serve as plenum chambers. This construction ensures freedom from flanking noise transmission problems even when very high acoustical sound pressure levels are generated inside either reverberation room.

The 300m thick walls, floor and ceiling of all three rooms and plenum chambers made from a heavy reinforced, high density concrete. The reverberation rooms are vibrationally suspended on dampened, high tensile springs resting on neoprene rubber. The entire suspension assembly forms a two pole resonant suspension system, which is tuned below 5Hz.

The complete mounting system of springs, dampers and high compliance acoustical seals around the test aperture ensures negligible vibrational coupling between the reverberation rooms or interference from outside vibrational sources for all frequencies within the operating range of the two reverberation rooms. Entry to both reverberation rooms and plenum chambers is by means of double doors.

Each room size, geometry and suspended diffusers ensures that the acoustical performance charecteristics fully meet requirements of Australian Standard AS1191-2002.

A sample testing space of approximately 10 square metres is located within an opening in the common wall between the plenum chambers. This wall is part of the external sound shell construction, it is not a component of either test room and effectively isolates the sample from any vibrational energy, which may be generated inside either reverberation test room.

Exposure of either side of any test sample in this test space to sound field is achieved via apertures in each reverberation room wall which align with the opening in the common wall of the plenum chambers. Acoustical sealing at the location of the openings between the reverberation rooms and the wall holding the test sample is achieved by means of compliant, high transmission loss and vibration isolation gaskets installed between the reverberation rooms and the common wall between the plenum chambers.

When testing small samples a filler wall constructed in the 10 square metre opening in the testing space. An aperture is made in the filler wall, the test sample is then fitted and sealed in the opening. The acoustical integrity of the fitting is then tested.

10.0 FORMULAE

(A) Receive room acoustical absorption

Sound absorption coefficients at each frequency band for the test specimen alpha (A) is determined from the reverberation time measurements according to the following equation:

$$A = \frac{0.16V}{T_{60}} \qquad \ldots\ldots(1)$$

Where

A = the equivalent absorption area in the receiving room

V = the receive room volume (in m^3)

T_{60} = the receive room reverberation time (RT60)

(B) Average sound pressure level

Average sound pressure level (Lp) is determined for each frequency band as follows:

$$L_p = 10\, Log \left[\frac{P_1^2 + P_2^2 + P_3^2 \ldots\ldots\ldots\ldots\ldots. + P_n^2}{np_0^2} \right] \qquad \ldots\ldots(2)$$

Where

L_p = Average sound pressure level (dB)

P_n = sound pressure of the n^{th} measurement (Pascals)

P_o = reference sound pressure (Pascals)

n = number of measurements

(C) Transmission Loss

Since the sound fields in both rooms are diffuse and the environment is free of flanking transmission, sound transmission loss (R) of a test sample for each frequency band is calculated according to the following equation:

$$R = L_{ps} - L_{pr} + 10\, Log \left[\frac{S}{A} \right] \qquad \ldots\ldots(3)$$

Where

R = the sound transmission loss of the test sample

L_{ps} = the average SPL in the source room

L_{pr} = the average SPL in receiving under test

S = the area of the specimen under test

A = the equivalent absorption are in the receiving room

10.0 FORMULAE

(D) Small Test Samples

Test objects comprising a small size test sample mounted in a filler wall are measured according to the small sample method discussed in standard AS1191-2002. The equations used to calculate results are as follows.

Transmission loss coefficients for the small test sample (t_S) are determined from the difference between the filler wall transmission loss (t_f)and the composite wall transmission loss (t_C) according to the following equations:

$$T_f = 10^{\frac{R_f}{10}} \qquad \ldots\ldots(4)$$

$$T_C = 10^{\frac{R_c}{10}} \qquad \ldots\ldots(5)$$

Rearranging the equations produces the transmission loss coefficient for each frequency band as follows:

$$T_S = \frac{T_C S_C - T_f S_f}{S_S} \qquad \ldots\ldots(6)$$

Transmission loss for each frequency band (R2) is determined from this result according to the following equation:

$$R_S = 10Log\frac{1}{T_S} \qquad \ldots\ldots(7)$$

Rearranging the equations produces the transmission loss coefficient for each frequency band as follows:

Transmission loss for each frequency band (R2) is determined from this result according to the following equation:

Where

- t_C = the transmission loss coefficient of the filler wall and the small test sample
- t_f = the transmission loss coefficient of the filler wall
- t_S = the transmission loss coefficient of the small test sample for each frequency band
- R_C = the transmission loss of the filler wall and the small test sample
- R_f = the transmission loss of the filler wall
- R_S = the transmission loss of the small test sample for each frequency band
- S_C = the surface area of the composite wall
- S_f = the surface area of the filler wall
- S_S = the surface area of the wall mounted small test sample

(E) Errors

Errors (95% confidence level) are determined for each frequency band by means of the following equation:

$$\text{Error(95\%confidence)} = \frac{t.sd}{\sqrt{n}} \qquad \ldots\ldots(8)$$

Where

- n = the number of microphone positions sampled
- t = the students t factor
- sd = the standard deviation obtained from the measurement spreadsheet

11.0 INSTRUMENTATION

The following instrumentation is used for acoustical transmission loss measurements. Instrumentation calibration where appropriate has been calibrated according to NATA requirements.

Bruel and Kjaer two channel pulse analyser (assembly 2825, 7521, 2 x 30150), S/N 2005502
Bruel and Kjaer Real Time Frequency Analyser type 2123, S/N 1446593
Bruel and Kjaer cathode follower type 2639, S/N 1391974
Bruel and Kjaer cathode follower type 2660, S/N 1338051
Bruel and Kjaer cathode follower type 2669, S/N 1888716 & S/N 1834203
Bruel and Kjaer microphone type 4144, S/N 563123, S/N 1138528, S/N 439142 & S/N 2118354
Bruel and Kjaer microphone type 4179, S/N 563123, S/N 2245300 & S/N 2245154
Bruel and Kjaer sound level calibrator type 4231, S/N 2095393
Yamanha professional sound sources type S500
Murray 100 watt amplifier type MA534, S/N 15
Bruel and Kjaer sound level calibrator type 4231 S/N 2095393
Vaisala digital barometer type PTB201AD, S/n R3330001
Testo temperature/humidity logger, type 177-HI, S/N 00886924

ATF Report 1825

Client Name: Garden Wall Systems

SAMPLE ONLY

Date Of Test
19-Dec-2005

Test Conditions:

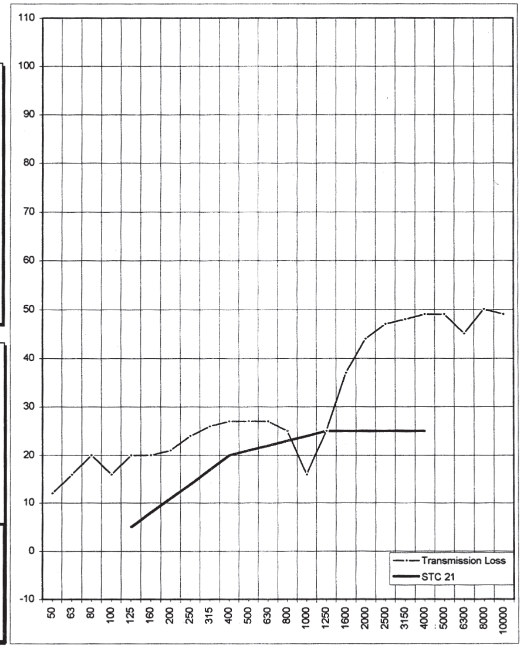
Surface Area Of Test Sample (Sq m):	3.24
Surface Area Of Remaining Filler Wall:	6.73
Total Surface Area Of Test Aperture:	9.97

Frequency	Filler Wall Transmission Loss (dB)	Std Dev	Filler Wall + Sample Transmission Loss	Std Dev	Transmission Coefficient of Filler Wall (τ_f)	Transmission Coefficient of Filler Wall + Sample (τ_c)	Transmission Coefficient of Sample (τ_s)	$1/\tau_s$	Frequency	Calculated 1/3 Octave Transmission Loss (dB)	Precision 95% Confidence Interval (dB)	Frequency	Calculated 1/1 Octave Transmission Loss (dB)
50 Hz	44.54	2.71	16.98	2.91	3.51886E-05	0.020042077	0.061599596	16.23	50 Hz	12.104	3.98		
63 Hz	49.98	2.73	20.83	3.53	1.00554E-05	0.00826236	0.025403721	39.36	63 Hz	15.951	4.47	63 Hz	15.017
80 Hz	53.16	1.86	25.20	2.63	4.82856E-06	0.003023365	0.00929335	107.60	80 Hz	20.318	3.22		
100 Hz	56.57	1.69	21.15	1.86	2.20536E-06	0.007676716	0.023617907	42.34	100 Hz	16.268	2.51		
125 Hz	65.04	1.54	25.00	1.20	3.13307E-07	0.003159526	0.009721719	102.86	125 Hz	20.123	1.95	125 Hz	20.001
160 Hz	67.61	1.37	24.91	1.54	1.73372E-07	0.003229066	0.009935993	100.64	160 Hz	20.028	2.07		
200 Hz	69.59	0.88	26.05	0.85	1.09956E-07	0.002481152	0.007634676	130.98	200 Hz	21.172	1.22		
250 Hz	72.02	0.82	28.70	0.70	6.27638E-08	0.001349933	0.004153829	240.74	250 Hz	23.816	1.08	250 Hz	23.868
315 Hz	75.81	0.59	30.85	0.46	2.62461E-08	0.000821988	0.002529335	395.36	315 Hz	25.970	0.75		
400 Hz	77.42	0.45	31.67	0.40	1.81149E-08	0.000680552	0.00209413	477.53	400 Hz	26.790	0.60		
500 Hz	76.24	0.64	32.14	0.32	2.37522E-08	0.000610373	0.001878165	532.43	500 Hz	27.263	0.71	500 Hz	27.247
630 Hz	80.37	0.35	32.19	0.32	9.17624E-09	0.000604644	0.001860568	537.47	630 Hz	27.304	0.48		
800 Hz	82.16	0.30	29.58	0.32	6.07716E-09	0.001101188	0.003388519	295.11	800 Hz	24.700	0.44		
1000 Hz	82.33	0.26	21.17	0.35	5.84592E-09	0.007635326	0.02349511	42.56	1000 Hz	16.290	0.43	1000 Hz	20.423
1250 Hz	85.32	0.29	29.43	0.31	2.93504E-09	0.001139996	0.003507944	285.07	1250 Hz	24.549	0.42		
1600 Hz	88.67	0.36	41.59	0.27	1.35752E-09	6.92981E-05	0.000213239	4689.58	1600 Hz	36.711	0.45		
2000 Hz	84.98	0.27	48.66	0.28	3.17805E-09	1.36277E-05	4.19279E-05	23850.47	2000 Hz	43.775	0.39	2000 Hz	39.519
2500 Hz	85.07	0.40	51.61	0.32	3.10991E-09	6.89767E-06	2.12188E-05	47128.06	2500 Hz	46.733	0.51		
3150 Hz	90.47	0.26	52.63	0.30	8.9722E-10	5.45959E-06	1.67982E-05	59530.27	3150 Hz	47.747	0.40		
4000 Hz	93.66	0.33	53.68	0.44	4.30618E-10	4.28372E-06	1.31808E-05	75867.88	4000 Hz	48.801	0.55	4000 Hz	49.273
5000 Hz	92.70	0.38	54.05	0.44	5.37192E-10	3.93557E-06	1.21093E-05	82581.33	5000 Hz	49.169	0.58		
6300 Hz	88.34	0.51	49.89	0.62	1.46475E-09	1.02467E-05	3.15276E-05	31718.20	6300 Hz	45.013	0.80		
8000 Hz	87.96	0.58	54.64	0.90	1.59844E-09	3.43841E-06	1.05772E-05	94542.73	8000 Hz	49.756	1.07	8000 Hz	46.875
10000 Hz	82.47	0.86	53.81	1.00	5.65989E-09	4.1581E-06	1.27834E-05	78226.52	10000 Hz	48.934	1.32		

Sample Under Test:
75mm thick composite panel comprising polystyrene foam core with 4½mm thick compressed fibre cement board outer skins.

Arithmetic Average of Transmission Loss From 100hz to 5kHz

Unweighted Average	A-Weighted Average
30	26



Results (Incorporating AS1191-1985 Compliant Measurements)

Frequency		Rounded 1/3 octave Transmission Loss Values (dB)	STC 21 Curve	Transmission Loss to STC Difference
50		12		
63		16		
80		20		
100	(AS1191)	16		
125	(AS1191)	20	5	-
160	(AS1191)	20	8	-
200	(AS1191)	21	11	-
250	(AS1191)	24	14	-
315	(AS1191)	26	17	-
400	(AS1191)	27	20	-
500	(AS1191)	27	21	-
630	(AS1191)	27	22	-
800	(AS1191)	25	23	-
1000	(AS1191)	16	24	-8
1250	(AS1191)	25	25	-
1600	(AS1191)	37	25	-
2000	(AS1191)	44	25	-
2500	(AS1191)	47	25	-
3150	(AS1191)	48	25	-
4000	(AS1191)	49	25	-
5000	(AS1191)	49		Sum
6300		45		-8
8000		50		
10000		49		

The Sound Transmission Class Of This Sample is:

STC 21

OITC Rating

Frequency	Normalised A-Weighted Reference Noise Spectrum (dB)	Sound Energy (W/m2)
80 Hz	-19.6	1.096E-04
100 Hz	-17.2	4.786E-04
125 Hz	-15.2	3.020E-04
160 Hz	-15.5	2.818E-04
200 Hz	-14	3.162E-04
250 Hz	-13.7	1.698E-04
315 Hz	-12.7	1.349E-04
400 Hz	-11.9	1.288E-04
500 Hz	-10.3	1.862E-04
630 Hz	-11	1.585E-04
800 Hz	-10.9	2.570E-04
1000 Hz	-11.1	1.950E-03
1250 Hz	-10.5	2.818E-04
1600 Hz	-11.1	1.549E-05
2000 Hz	-10.9	3.236E-06
2500 Hz	-11.8	1.318E-06
3150 Hz	-13.9	6.457E-07
4000 Hz	-15.1	3.890E-07
	Sum	4.776E-03
	-10*LOG(Sum)	23.21

The Outdoor Indoor Transmission Class is:

OITC 23

1/1 Octave

Frequency	Rounded 1/1 octave Transmission Loss Values (dB)
63 Hz	15
125 Hz	20
250 Hz	24
500 Hz	27
1000 Hz	20
2000 Hz	40
4000 Hz	49
8000 Hz	47

R_w Rating

R_W = 28

C_T = -4

C_{TR} = -6

$C_{T\,(50\text{-}5000)}$ = -3

$C_{TR\,(50\text{-}5000)}$ = -6

$R_W(C_T; C_{TR};)$ is

28 (-4 ; -6)

$R_W(C_T; C_{TR}; C_{(50\text{-}5000)}; C_{TR\,(50\text{-}5000)})$ is:

28 (-4 ; -6 ; -3 ; -6)

ATF1825-Transmission Loss Of Small Sample-Garden Wall Systems-19-12-2005.xls/Sample Results

Signatory: ....

G. Colin-Thome

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Date: 21.2.06