INTRODUCTION

Airborne sound transmission and sound absorption measurements were performed on one set of panels. For report purposes, this specimen is identified as Specimen B3410-1. A complete description of the tests procedure is outlined in the Test Procedure Section.

SPECIMEN DESCRIPTION

Construction on the wall assembly began on 14-Apr-04. The airborne sound transmission loss tests were performed on 14-Apr-04 and the sound absorption test was performed on 13-Apr-04.

Specimen B3410-1

The specimen comprised sound barrier panels measuring 3658 mm wide by 152 mm high. The specimen for the airborne sound transmission loss test comprised 16 panels and for the sound absorption test, 10 panels. As identified by the client the sound barrier panels are made of hollow pvc with a polystyrene insert inside the panels. The panels had a measured thickness of 70 mm and a weight of 11.7 kg per panel.

Airborne Sound Transmission Loss

The 3.66 m x 2.35 m test specimen was mounted in the IRC acoustical wall test opening which measures 3.66 m x 2.44 m. The 16 sound barrier panels were joined together with a tongue and groove joint and fitted into “U” channel end caps. A piece of gypsum board and backer rod was installed at the top of the specimen to fill the gap in between the wall test frame and the specimen. The perimeter of the specimen was then sealed to the wall test frame with caulking and metal tape. The area used for the calculations of transmission loss was 8.60 m^2.

Figure 1: The specimen B3410-1 installed in the wall test frame.

Sound Absorption

During the measurements, the test specimen was placed directly on the floor of the 250 m^3 reverberation chamber to form a specimen measuring 2.44 m x 2.74 m comprised of 10 sound barrier panels. The specimen was in an upright position so that both surfaces are exposed to the sound field. The sides of the specimen were covered with an end cap. This mounting is defined as a Type K mount in ASTM E795, Standard Practices for Mounting Test Specimens during Sound Absorption Tests. The specimen was tested in one position in the reverberation chamber. The area used for the calculation of absorption coefficients was 11.15 m^2.

Figure 2: The specimen B3410-1 in the reverberation chamber.

The measured temperature and relative humidity in the large chamber during testing were 23.6°C and 47.1%, respectively. The measured temperature and relative humidity in the small chamber during testing were 20.7°C and 39.2%, respectively.

RESULTS

Results of the airborne sound transmission loss measurements of Specimen B3410-1 are given in Table 1 and Figure 3. The results of the absorption test are presented in Table 2 and Figure 4.

Certain values in the tables are marked.

- 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.
- Where marked values limit the estimate of single number ratings, this will be explicitly stated in the following sections.

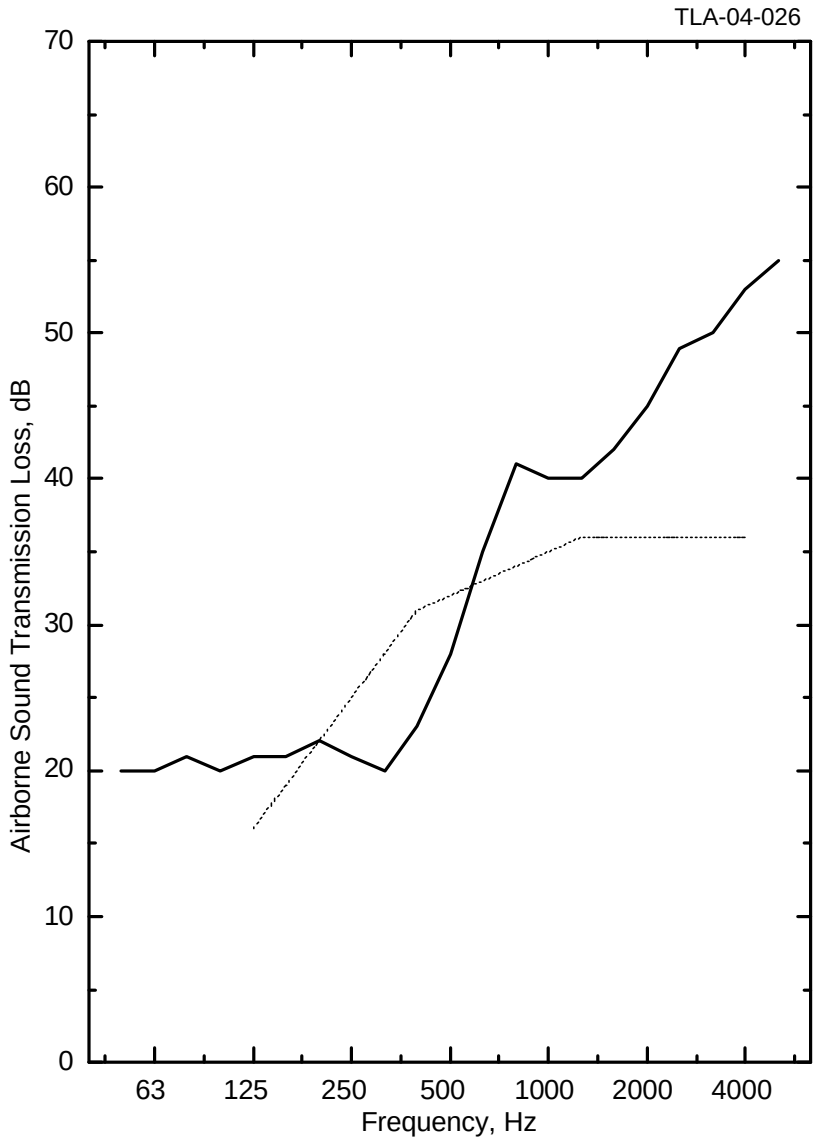
Table 1: Airborne sound transmission loss measurements of Specimen B3410-1, TLA-04-026.

Frequency (Hz)	Airborne Sound Transmission Loss (dB)	95% Confidence Limit[1]	Deviation Below the STC Contour
50	20 c		
63	20		
80	21		
100	20		
125	21	±2.1	
160	21	±1.4	
200	22	±1.1	
250	21	±0.8	4
315	20	±0.7	8
400	23	±0.6	8
500	28	±0.5	4
630	35	±0.6	
800	41	±0.4	
1000	40	±0.3	
1250	40	±0.4	
1600	42	±0.4	
2000	45	±0.4	
2500	49	±0.5	
3150	50	±0.6	
4000	53	±0.7	
5000	55		
Sound Transmission Class (STC)[2] = 32			
Weighted Sound Reduction (R_W)[3] = 32			

[1] Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty. By using enough microphone and loudspeaker positions, the uncertainty can be reduced and upper and lower limits assigned to the probable error in the measurement. These limits are called 95% confidence limits. They are calculated for each test according to the procedures in ASTM E90 and E492 and must be less than upper limits given in the standards. These confidence limits do not relate directly to the variation expected when a nominally identical specimen is built, installed and tested (repeatability). Nor do they relate to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility).

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

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



Frequency (Hz)	Airborne Sound Transmission Loss (dB)
50	20 c
63	20
80	21
100	20
125	21
160	21
200	22
250	21
315	20
400	23
500	28
630	35
800	41
1000	40
1250	40
1600	42
2000	45
2500	49
3150	50
4000	53
5000	55

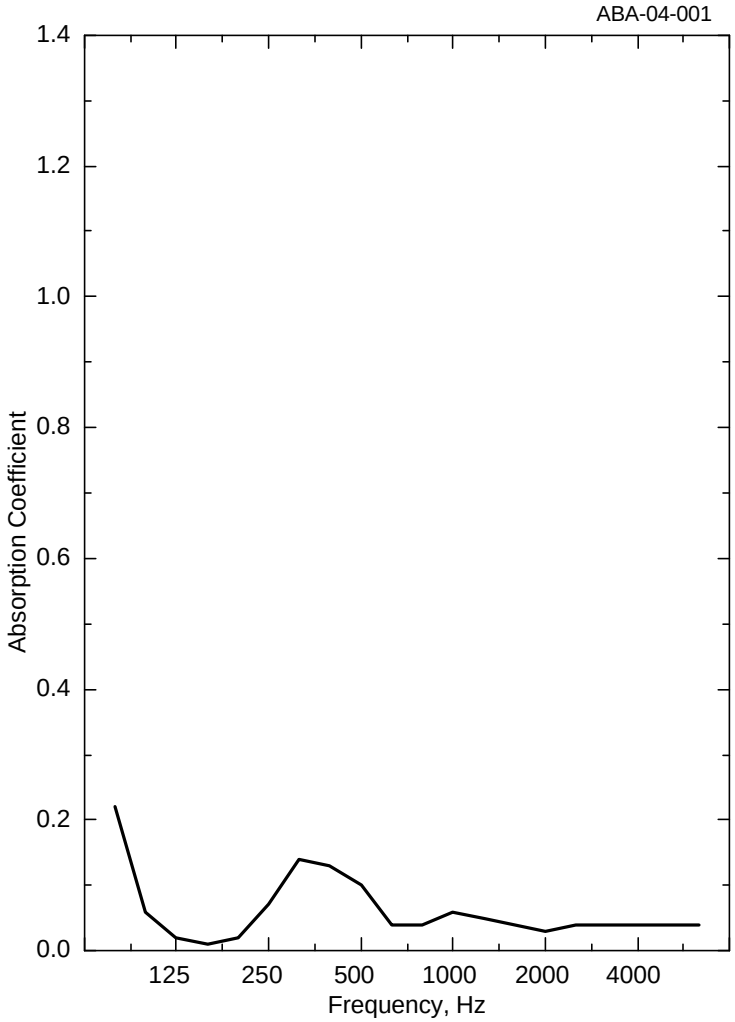
STC 32

Figure 3: Airborne sound transmission loss measurements of Specimen B3410-1. The solid line is the experimental data and the dotted line is the STC 32 contour.

Table 2: Sound absorption measurement results of Specimen B3410-1, ABA-04-001.

Frequency (Hz)	Sound Absorption Coefficients	95% Confidence Limits[1]
80	0.22	±0.03
100	0.06	±0.02
125	0.02	±0.02
160	0.01	±0.02
200	0.02	±0.02
250	0.07	±0.02
315	0.14	±0.01
400	0.13	±0.01
500	0.10	±0.01
630	0.04	±0.01
800	0.04	±0.01
1000	0.06	±0.01
1250	0.05	±0.01
1600	0.04	±0.01
2000	0.03	±0.01
2500	0.04	±0.02
3150	0.04	±0.02
4000	0.04	±0.00
5000	0.04	±0.00
6300	0.04	±0.00
Sound Absorption Average (SAA)[4] = 0.06		
Noise Reduction Coefficient (NRC)[5] = 0.05		

[4] Sound Absorption Average (SAA) calculated according to ASTM C423.
[5] Noise Reduction Coefficient (NRC) calculated according to ASTM C423.



Frequency (Hz)	Sound Absorption Coefficients
80	0.22
100	0.06
125	0.02
160	0.01
200	0.02
250	0.07
315	0.14
400	0.13
500	0.10
630	0.04
800	0.04
1000	0.06
1250	0.05
1600	0.04
2000	0.03
2500	0.04
3150	0.04
4000	0.04
5000	0.04
6300	0.04
SAA	0.06

Figure 4: Sound absorption measurement of Specimen B3410-1.

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.

Extended Frequency Range

Standard test procedures require measurements in 1/3-octave bands over a specified frequency range (125 to 4000 Hz for ASTM E90 and 100 to 3150 Hz for ASTM E492). Within those ranges, reproducibility has been assessed by inter-laboratory round robin studies. The standards recommend making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the standard ranges has not been established, and is expected to depend on laboratory-specific factors such as room size and specimen dimensions.

Sound Absorption Coefficients and Noise Reduction Coefficient

Sound absorption for a specimen is measured in metric sabins. One metric sabin may be thought of as one square metre of perfect absorber. Sound absorption coefficients are derived by dividing the sound absorption of the complete specimen (metric sabins) at each frequency by the total surface area of a specimen in square metres. Diffraction effects usually cause the effective area of a specimen to be greater than its geometrical area thereby increasing the

measured absorption coefficient. When the coefficients are large, the measured values may exceed unity. Since this effect is not totally understood, no adjustments to the measured coefficients are made.

The single number rating, Sound Absorption Average (SAA), is the average of the sound absorption coefficients of a material for the one-third octave bands from 200 through 2500 Hz, inclusive, rounded to the nearest multiple of 0.01. The Noise Reduction Coefficient (NRC), is the average of the sound absorption coefficients of a material for 250, 500, 1000 and 2000 Hz rounded to the nearest multiple of 0.05. The *higher* the SAA or NRC value, the better the material performance.

FACILITIES AND EQUIPMENT

The acoustics wall test facility comprises two reverberation rooms with a moveable test frame between the two rooms. For transmission loss measurements, one room has a volume of 138 m^3. The volume of the other room is 250 m^3. For absorption measurements, the 250 m^3 reverberation chamber is used.

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 with a type 4166 cartridge 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 E90-99, “Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions”, and of ISO 140-3:1995, “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 717-1:1996, “Rating of Sound Insulation in Buildings and of Building Elements, Part 1: Airborne Sound Insulation”.

One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in each 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 average reverberation times for the room.

The average sound pressure levels of both the source and receiving rooms and the 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.

Sound Absorption

Sound absorption measurements were conducted in accordance with the requirements of ASTM C423, “Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method”.

Mean empty room reverberation times were obtained by averaging the measurements of ten decays at each of nine microphone positions. Similarly, mean reverberation times were obtained for each of three positions of the test specimen. The average of the reverberation times for the three specimen positions and the mean empty room reverberation times were then used to calculate the absorption coefficient in each one-third octave band. A complete description of the test procedure is available on request.