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WEATHERILL
BROTHERS LTD

Newgreen Business Park, Norwich Road, Watton, Norfolk IP25 6HW
[redacted]

Our ref; *WS0417MW10*
Your ref; *Repeat*

06 December 2010

Mr P Moore
The Fox at Patching
Arundel Road
PATCHING
West Sussex
BN133UJ
Tel; 01903 871299
Fax; 01903 871299
Email;

Dear ~~Mr/Mrs~~ Paul .

QUOTATION

Thank you for your enquiry, we have pleasure in quoting as follows;

To manufacture;
SOUND REDUCING INNER SKIN FOR TRADITIONAL MARQUEE *
60' X 40' Top & Part Wallings –
2 off 40'x20' Gable Ends/1 off 40'x20' Middle Section
8 off 20'x7' Wallings
Manufactured in FERRARI STAMOID 4635. Fire Retardant to BS. £11,400.00 + VAT

To Deliver/Install within Marquee £850.00 + VAT

*WITHIN OUR EXPERIENCE THIS WOULD REDUCE THE SOUND OMISSIONS IN THE REGION OF 30% BUT REGRET, CANNOT GUARENTEE THIS TO BE AN ACCURATE ESTIMATION

To Supply/Install;
SOLID WINDOW WALLINGS AND FRENCH DOORS
ALONG 40' END OF MARQUEE
1 set 1600mm wide x 2080mm high uPVC French doors
7 off 1600mm x 2080mm uPVC Infil Panels (NON OPENING) £3220.00 + VAT

Cont'd .....

Performance Textiles Association

[redacted]

adrian james acoustics limited
Octagon Business Park, Hospital Road
Little Plumstead, Norwich, Norfolk NR13 5FH, UK
[redacted]

TECHNICAL MEMORANDUM

Project	10381 Marquee sound insulation measurements		
Memo to	Mark Weatherill, Weatherill Brothers Ltd		
Date	6 January 2010	**Memo No**	M001A
From	Ian Rees MIOA	**Checked by**	Adrian James FIOA
Filename	10381-M001A.doc		

MARQUEE SOUND INSULATION MEASUREMENTS

1 INTRODUCTION

We have been appointed by Weatherill Brothers Ltd to measure the airborne sound insulation of a marquee lined internally with a Ferrari Stamoid 4802FR dense foam lining.

This technical memorandum sets out the results of our noise measurements and assessment. The structure of this memorandum is as follows:

- Section 2 sets out our methodology for the noise measurement and assessment.
- Section 3 contains the results of our measurements and discussion of these.
- Section 4 summarises our conclusions.

Knowledge of technical acoustic terms is not needed to understand the conclusions of this report, but to understand how they are reached some understanding of acoustic terminology is helpful. Hence,

- Appendix A explains the technical terms used in this report.
- Appendix B shows a plan of the test arrangement.
- Appendix C details the test conditions and measuring equipment used.

Recommendations given in this report are for acoustic purposes only. It is the Client's responsibility to ensure that any measures adopted for acoustic purposes comply with other requirements and regulations, including (but not limited to) those relating to safety and control of fire.

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2 MEASUREMENT METHODOLOGY

2.1 General procedure

The measurements were taken on 30 November 2009. Details of the equipment used for the measurements are contained in Appendix C. The test arrangement is shown in Appendix B.

A small marquee with a Ferrari Stamoid 4802FR sound insulating lining was erected on a large flat lawn. The lawn was bordered by tall trees and hedges, but these were located at least 10 metres from the test area. Due to limited availability of materials, only half of the marquee area could be fully enclosed with the sound insulating lining. Access to the marquee was via a standard opening flap, which was closed with rope loop fastenings during measurements.

A noise source comprising two loudspeakers set back-to-back at a height of 0.8m from the ground was positioned within the lined portion of the marquee. The source noise was generated by a dedicated pink noise source, playing through the loudspeakers. When tested for steadiness of sound prior to the sound insulation measurements, fluctuations over consecutive 30 second measurements were found to be less than 1.0 dB in any one-third octave band.

2.2 Measurements of break-out noise

The sound level meter was positioned outside the marquee on a fixed tripod at a height of 1.5m from the ground and a distance of 20m from the noise source. Break-out noise from the marquee was measured at this position. Measurements were taken in octave bands in terms of $L_{eq,60\ seconds}$. This measurement was repeated with the sound insulating lining removed and then again once the marquee had been dismantled.

2.3 Measurements of background noise

The main source of ambient noise was traffic on the dual carriageway approximately 150m from the test area. Background noise measurements were taken in octave bands in terms of $L_{eq,60\ seconds}$ after each break-out noise measurement with the test noise source turned off.

2.4 Measurements of reverberation time

The reverberation time in the marquee was measured using an impulsive noise source from balloon bursts and analysed using the real-time analyser described in Appendix C. Three fixed noise source and microphone positions were used and the results were arithmetically averaged.

2.5 Calculations

The insertion loss of the marquee was determined in octave bands by comparing break-out noise levels from the marquee to those from the noise source in free field once the marquee had been removed. The *apparent sound reduction index* R' of the marquee in octave bands was then estimated from the insertion loss values and measured reverberation times in the marquee.

The *weighted apparent sound reduction index* R'_w was determined using the procedure described in BS EN ISO 717-1. This compares the measured level difference (corrected for ambient noise, marquee dimensions and reverberation time) at each

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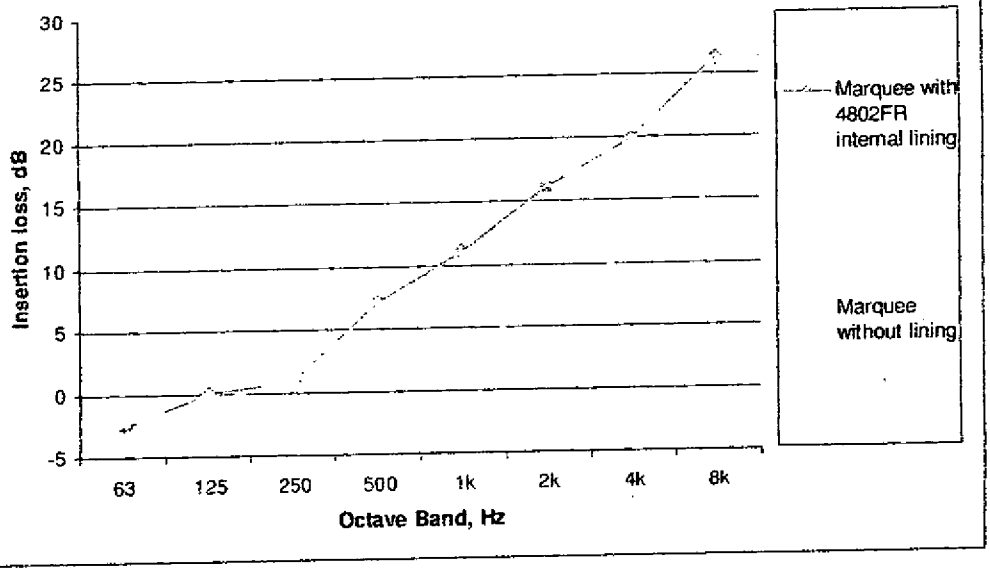
frequency with a reference curve. The reference curve is shifted in steps of 1 dB towards the measured curve until the sum of unfavourable deviations in the 5 octave bands is as close as possible (but not more than) 10 dB.

3 RESULTS, DISCUSSION AND CONCLUSIONS

3.1 Results

Figure 1 shows the calculated insertion loss values for the marquee with and without lining.

Figure 1 - Insertion loss of lined and unlined marquee



Octave band (Hz)	Insertion loss (dB)							
	63	125	250	500	1k	2k	4k	8k
Marquee with 4082FR internal lining	-2.6	-0.1	0.8	7.2	11.0	16.0	19.7	26.2
Marquee without lining	-2.1	-0.7	1.2	3.3	2.9	7.3	10.9	15.9

Figure 2 shows the estimated apparent sound reduction index R' values for the marquee with and without lining. These correspond to weighted values of 16dB R'_w with the Ferrari Stamoid 4802FR lining and 11dB R'_w in the unlined marquee.

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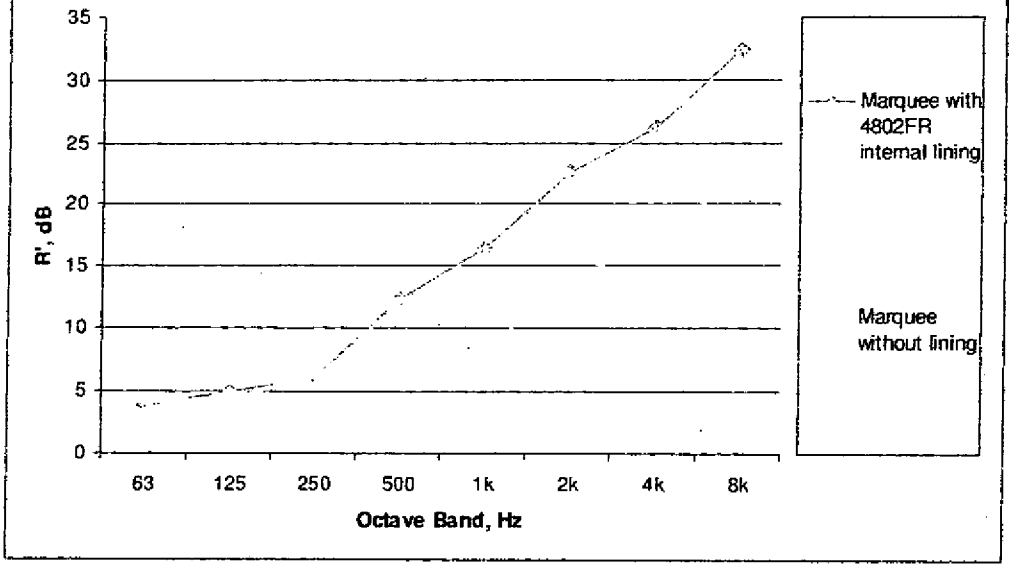
Figure 2 - Apparent sound reduction index of lined and unlined marquee



Octave band (Hz)	Apparent sound reduction index R' (dB)								R',w
	63	125	250	500	1k	2k	4k	8k	
Marquee with 4082FR internal lining	3.8	4.8	6.0	12.3	16.4	22.4	26.1	32.3	16
Marquee without lining	4.3	4.3	6.4	8.5	8.3	13.7	17.3	22.3	11

3.2 Discussion of results

The results indicate that the sound insulating lining provides a substantial reduction in noise break-out levels at mid- and high frequencies when compared to a standard unlined marquee. This confirms our subjective impression noted on site. There was little measurable improvement at low frequencies. In the test marquee, the internal lining was spaced approximately 25 – 50mm from the outer skin of the marquee around the walls, and approximately 300mm on average below the roof of the marquee. In larger marquees, it is expected that the gap between the wall linings would be slightly larger, approximately 50 – 60mm, due to the larger framing elements required. The void below the roof would also be substantially larger and may be as much as 1200mm. Greater separation between the inner and outer linings of the marquee may provide a degree of improvement in sound insulation at mid-frequencies.

It should be noted that as indicated in Figure 1, low frequency break-out noise from marquees can actually be higher than that from an equivalent sound source out in the open, due to reverberant noise build-up within the marquee and the low standard of sound insulation of the marquee walls. Reverberant noise build-up within the marquee

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can be reduced by using an internal dress lining of cotton or similar acoustically absorbent material.

4 SUMMARY OF CONCLUSIONS

- We have taken noise break-out measurements on a small marquee to determine the sound insulation of the marquee walls with and without a sound insulating internal lining.
- The measured values correspond to weighted values of 16dB R'_w with the Ferrari Stamoid 4802FR lining and 11dB R'_w in the unlined marquee.
- Noise break-out levels from the lined marquee were significantly lower than those from the unlined marquee at mid- and high frequencies, but showed little change at low frequencies.

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APPENDIX A - TECHNICAL TERMS AND UNITS USED IN THIS REPORT

Decibel (dB) - This is the unit used to measure sound level. The range of human hearing from the quietest detectable sound to the threshold of pain is very large. If a normal linear scale of measurement were used, it would have to range from 20 µPa to 200,000,000 µPa. Using such large figures would be unmanageable and for this reason sound pressure levels are expressed on a logarithmic scale, which corresponds to the almost logarithmic response of the ear and which compresses the range to a manageable 0dB to140dB.

Sound Pressure Level (Lp or SPL) - This is a function of the source and its surroundings and is a measure in decibels of the total instantaneous sound pressure at a point in space. The SPL can vary both in time and in frequency. Different measurement parameters are therefore required to describe the time variation and frequency content of a given sound. These are described below.

Frequency - This refers to the number of complete pressure fluctuations or cycles that occur in one second. Frequency is measured in Hertz (Hz). The rumble of thunder has a low frequency, while a whistle has a high frequency. The sensitivity of the ear varies over the frequency range and is most sensitive between 1KHz and 5KHz.

Octave and One-Third Octave Bands - The human ear is sensitive to sound over a frequency range of approximately 20 Hz to 20,000 Hz and is more sensitive to medium and high frequencies than to low frequencies. To define the frequency content of a sound, the spectrum is divided into frequency bands, the most common of which are octave bands. Each band is referred to by its centre frequency, and the centre frequency of each band is twice that of the band below it. Where it is necessary for a more detailed analysis octave bands may be divided into one-third octave bands.

'A' Weighting - The sensitivity of the human ear varies with frequency, some frequencies sound louder than others. The 'A'-weighting curve represents the non-linear frequency response of the human ear and is incorporated in an electronic filter used in sound level meters. Measurements using an 'A'-weighting filter makes the meter more sensitive to the middle range of frequencies, which approximates to the response of the ear and the subjective loudness of the sound. Sound level measurements using 'A'-weighting will include the subscript A, e.g. dB(A).

Statistical Analysis - These figures are normally expressed as LN, where L is the sound pressure level in dB and N is the percentage of the measurement period. The LN figure represents the sound level that is exceeded for that percentage of the measurement period. L90 is commonly used to give an indication of the background level or the lowest level during the measurement period. L10 may be used to measure road traffic noise. See Figure 1.

Leq,T - The equivalent continuous sound level is used to measure sound that varies with time. The Leq,T is the notional equivalent steady sound level, which contains the same acoustic energy as the actual varying sound level over the period of measurement. Because the averaging process used is logarithmic, the Leq,T level tends to be dominated by the higher sound levels measured. See Figure 1.

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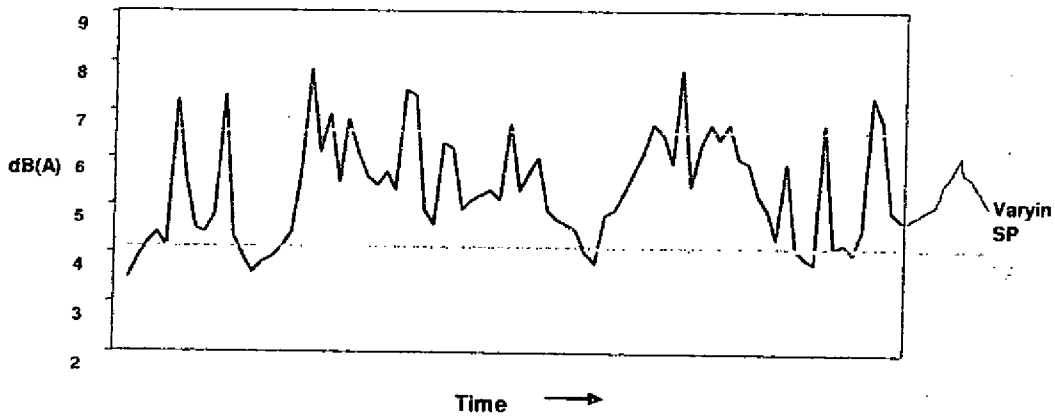
Figure 1 - Time Varying Sound and Equivalent Continuous Sound Level



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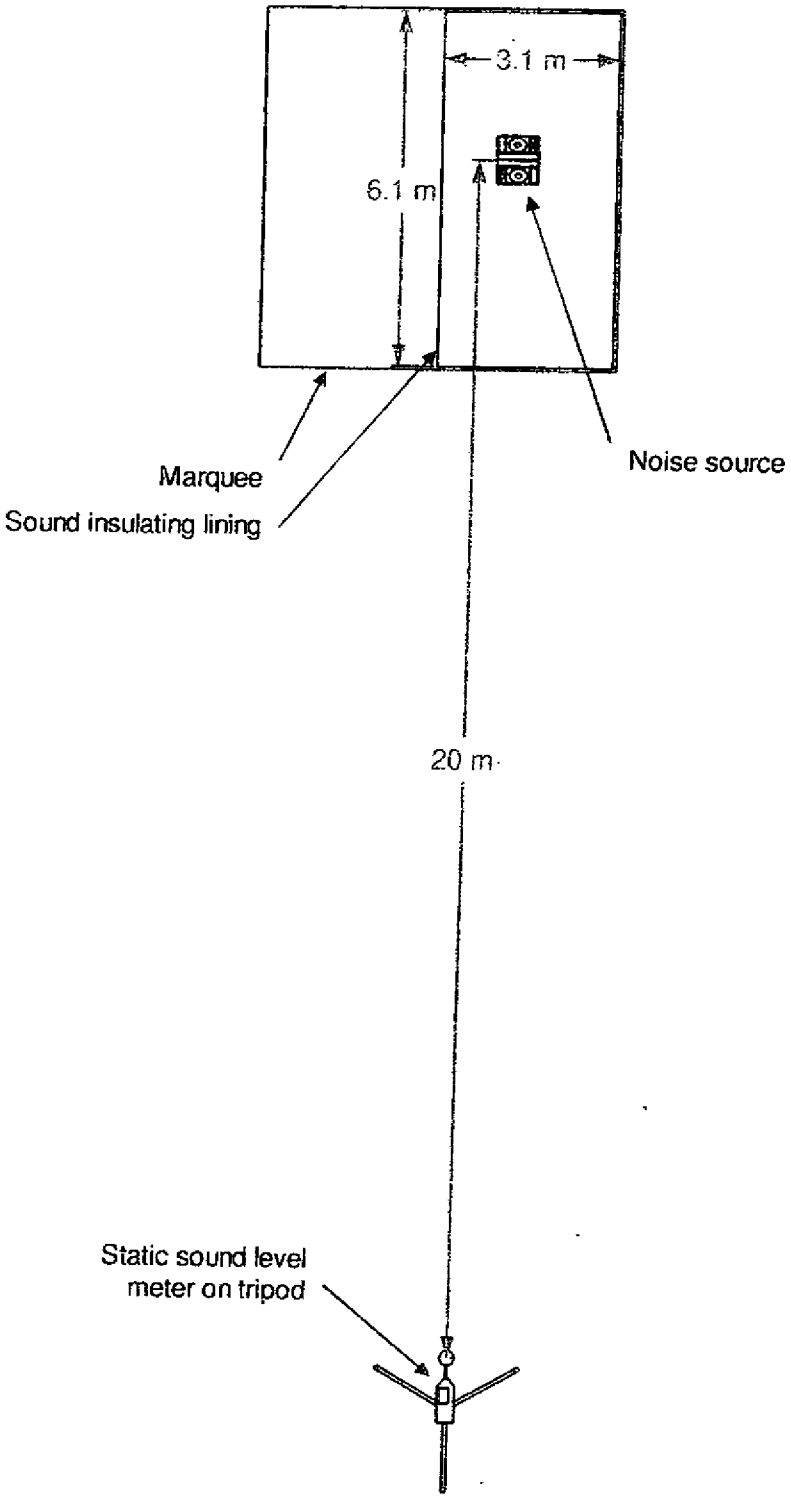
APPENDIX B – MEASUREMENT ARRANGEMENT PLAN



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APPENDIX C – MEASURING EQUIPMENT AND CALIBRATION

Job reference and title	10381 – Marquee sound insulation measurements
Measurement location	Large garden lawn
Date	30 November 2009

Measuring equipment used:

Equipment description / serial number	Type number	Manufacturer	Date of calibration expiration	Calibration certificate number
Precision sound level meter serial no. 31634	118	Norsonic	13/11/2010	4467
Microphone serial no. 59999	1225	Norsonic	13/11/2010	4465
Microphone calibrator serial no. 31279	1251	Norsonic	14/11/2010	4468
Audio signal generator	MR1	Neutrik	N/A	N/A
Active loudspeaker x 2	MAK-12P	Stage Line	N/A	N/A

Weather conditions:	Damp, approximately 70 - 80% cloud cover Wind: Moderate, approximately 4 – 5 m/s Temperature: 6°C
Calibration level:	113.8 dB @ 1 kHz
Person in charge of measurements:	Ian Rees MIOA
Other persons present:	-
Principal sound source:	Noise source built into custom loudspeaker
Background noise sources:	Distant traffic, birdsong, wind through trees
Measurement parameters:	Third-octave band $L_{eq,\ 60\ seconds}$, Reverberation time

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Report Status

Revision	Date	Prepared by	Checked by
-	2 December 2009	Ian Rees MIOA	Andy Thompson MIOA
A	6 January 2010	Ian Rees MIOA	Adrian James FIOA

Disclaimer

This report was completed by Adrian James Acoustics Ltd on the basis of a defined programme of work and terms and conditions agreed with the Client. The report has been prepared with all reasonable skill, care and diligence within the terms of the Contract with the Client and taking into account the project objectives, the agreed scope of works, prevailing site conditions and the degree of manpower and resources allocated to the project. Recommendations in this report are for acoustics purposes only, and it is the responsibility of the Project Manager or Architect to ensure that all other requirements are met including (but not limited to) structure, fire and Building Controls.

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