

for
Plastal (SBP) Ltd
Alders Way
Paignton
Devon
TQ4 7QE

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**LABORATORY MEASUREMENTS
OF THE
SOUND REDUCTION INDEX
OF
PROFILE 22
PVC WINDOW UNITS**

Report Author : M Sawyer MIOA

ACOUSTICAL INVESTIGATION & RESEARCH ORGANISATION LTD

Duxons Turn
Maylands Avenue
Hemel Hempstead
Hertfordshire
HP2 4SB
Telephone: 01442 247146



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**LABORATORY MEASUREMENTS
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1. INTRODUCTION

Measurements of the Sound Reduction Index (R) were conducted at the AIRO Acoustics Laboratory at Hemel Hempstead, Hertfordshire, in accordance with British Standard BS EN ISO 140 (ref 1). A single figure rating of sound insulation performance, known as the Weighted Sound Reduction Index (R_w), is derived from these measurements in accordance with British Standard BS EN ISO 717 (ref 2).

The measurements were performed on 25 and 26 August 2005 for Plastal (SBP) Ltd.

AIRO is a UKAS accredited testing laboratory No. 0483 and measurements to the above British Standards are included on our schedule of accreditation. UKAS is the United Kingdom Accreditation Service.

2. METHOD OF MEASUREMENT TO BS EN ISO 140-3:1995

The insulation of a specimen against airborne sound is measured under reverberant sound conditions in which sound is incident on one side of the specimen from all directions.

The test specimen is erected in an aperture of approximately 9 square metres between two reverberant chambers which have been constructed to suppress the transmission of sound by flanking paths. To improve the diffusion of the sound fields, both chambers are irregularly shaped and contain several reflecting diffuser panels.

If the test specimen is smaller than the test aperture, the test specimen is installed within a highly insulating infill partition, purpose built within the test aperture. When the test specimen is intended to be openable, then it is opened and closed five times immediately prior to testing.

A steady sound source with a continuous spectrum in the frequency bands of interest is used to drive an omnidirectional loudspeaker which is located sequentially in two positions in the source chamber. Measurements of the sound levels are made simultaneously in both chambers at the one-third octave intervals from 100 Hz to 5000 Hz as prescribed in the Standard (ref 1). The measurements are made with a microphone attached to a rotating microphone boom to obtain a good average of the sound pressure levels in each chamber. Measurements are also made of the noise level in the receiving chamber in the absence of the noise source in order that corrections for background noise may be made if appropriate.

The Sound Reduction Index (R) in decibels (dB) is calculated in each frequency band using the equation:

$$R = L_1 - L_2 + 10 \lg \frac{S}{A} \quad \text{dB} \quad \text{Equation (i)}$$

where: L_1 is the average sound pressure level in the source chamber (dB)

L_2 is the average sound pressure level in the receiving chamber (dB)

S is the area of the test specimen (m^2)

A is the equivalent absorption area in the receiving chamber (m^2)

The equivalent absorption area in the receiving chamber is determined from twelve sets of reverberation time measurements using a microphone connected to a rotating microphone boom. The measurements are made in accordance with International Standard ISO 354:2003 (ref 3) and the value of ' A ' determined using Sabine's formula:

$$A = \frac{0.16 V}{T} \quad \text{m}^2 \quad \text{Equation (ii)}$$

where: V is the volume of the receiving chamber (m^3)

T is the reverberation time of the receiving chamber (seconds)

The Weighted Sound Reduction Index (R_w) in decibels (dB) is calculated by comparing the sixteen values of Sound Reduction Index from 100 Hz to 3150 Hz with a defined reference curve which is incremented until the requirements of BS EN ISO 717-1:1997 are met. Spectrum adaptation terms C and C_{tr} are also calculated.

In this instance the measurement range was extended to include the 50 Hz to 5000 Hz one-third octaves.

3. TEST RESULTS

Test No. L/2987/1 Method : BS EN ISO 140-3:1995 Date : 25 August 2005

3.1 Test Specimen : Profile 22 PVC Window Unit - 4/16/4 Glazing

3.2 Description of Specimen

The specimen was mounted into an 1100 mm wide x 1350 mm high test aperture and comprised a 60 mm deep Profile 22 PVC framed window unit (Frame No. Q031162). The window unit included two side-hung open-out windows supported on projecting stays which closed on double bulb seals via a multi-point locking mechanism. The glazing comprised 4/16/4 sealed units from DB Glass. The window unit was supported within the aperture using straps and sealed at the perimeter with a gunned sealant.

See Data Sheet L/2987/D for drawing.

The estimated mass of the glazing = 20 kg/m²

Chamber Conditions	Source Chamber	Receiving Chamber
Volume	97 m ³	221 m ³
Air Temperature	18°C	19°C
Relative Humidity	75%	75%

Measurements commissioned by : Plastal (SBP) Ltd

Specimen supplied by : Plastal (SBP) Ltd on 23 August 2005

Specimen installed by : AIRO on 25 August 2005

3.3 Results

Frequency Hz	Sound Reduction Index, <i>R</i> (dB)	
	one-third octave	octave
50	25.5	
63	21.0	22.9
80	23.2	
100	20.8	
125	22.5	22.0
160	22.9	
200	17.8	
250	22.8	21.2
315	30.3	
400	35.8	
500	35.5	36.2
630	37.7	
800	37.7	
1000	39.6	38.8
1250	39.2	
1600	38.7	
2000	37.5	37.4
2500	36.4	
3150	35.6	
4000	38.4	37.8
5000	41.0	

These results are plotted on Data Sheet L/2987/1/R

3.4 Single Figure Ratings

The rating standard, BS EN ISO 717-1:1997, identifies a number of single figure ratings for this type of test. The calculated values of these ratings are:

$$R_w (C;C_{tr}) = 36 (-2;-6) \text{ dB}$$

$$C_{50-3150} = -2 \text{ dB}$$

$$C_{tr,50-3150} = -6 \text{ dB}$$

$$C_{50-5000} = -2 \text{ dB}$$

$$C_{tr,50-5000} = -6 \text{ dB}$$

$$C_{100-5000} = -2 \text{ dB}$$

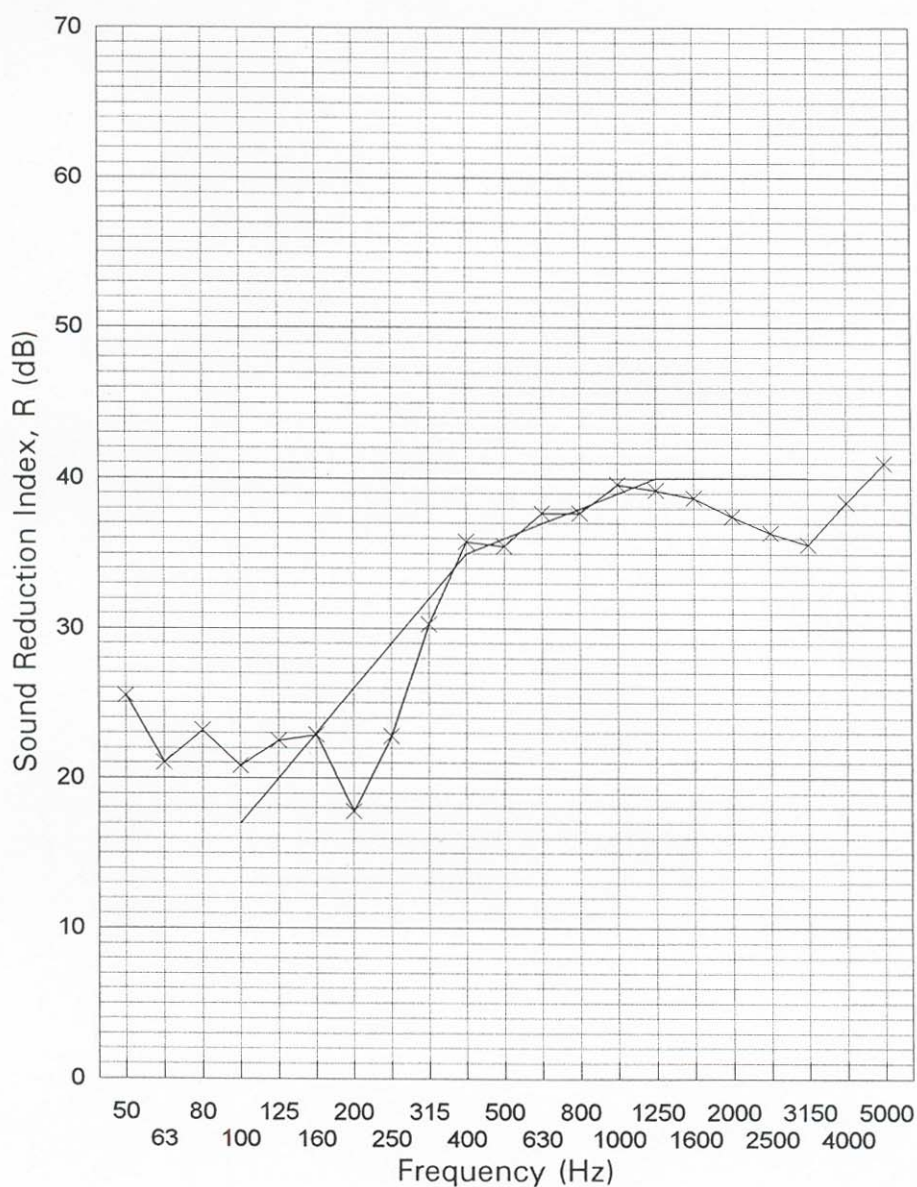
$$C_{tr,100-5000} = -6 \text{ dB}$$

Client

Plastal (SBP) Ltd

Laboratory Measurement of Sound Reduction Index

Profile 22 PVC Window Unit - 4/16/4 Glazing



X—X

Measured value of Sound Reduction Index, R (dB)

—

Reference curve, R_w = 36 dB (BS EN ISO 717-1:1997)

4. TEST RESULTS

Test No. L/2987/2 Method : BS EN ISO 140-3:1995 Date : 26 August 2005

4.1 Test Specimen : Profile 22 PVC Window Unit - 10/8/6.4 Glazing

4.2 Description of Specimen

The specimen was mounted into an 1100 mm wide x 1350 mm high test aperture and comprised a 60 mm deep Profile 22 PVC framed window unit (Frame No. Q031162). The window unit included two side-hung open-out windows supported on projecting stays which closed on double bulb seals via a multi-point locking mechanism. The glazing comprised 10/8/6.4 sealed units from DB Glass, with the 6.4 mm element consisting of 4 mm and 2 mm float glass separated by the laminate membrane. The window unit was supported within the aperture using straps and sealed at the perimeter with a gunned sealant.

See Data Sheet L/2987/D for drawing.

The estimated mass of the glazing = 41 kg/m²

Chamber Conditions	Source Chamber	Receiving Chamber
Volume	97 m ³	221 m ³
Air Temperature	18°C	19°C
Relative Humidity	75%	75%

Measurements commissioned by : Plastal (SBP) Ltd

Specimen supplied by : Plastal (SBP) Ltd on 23 August 2005

Specimen installed by : AIRO and Plastal (SBP) Ltd on 25 August 2005

4.3 Results

Frequency Hz	Sound Reduction Index, <i>R</i> (dB)	
	one-third octave	octave
50	29.0	26.5
63	23.9	
80	28.7	
100	23.9	25.9
125	27.3	
160	27.3	
200	28.0	29.3
250	27.9	
315	35.1	
400	37.0	37.8
500	38.9	
630	37.6	
800	39.8	38.7
1000	38.7	
1250	37.9	
1600	38.1	38.2
2000	37.9	
2500	38.8	
3150	41.0	43.9
4000	45.4	
5000	48.2	

These results are plotted on Data Sheet L/2987/2/R

4.4 Single Figure Ratings

The rating standard, BS EN ISO 717-1:1997, identifies a number of single figure ratings for this type of test. The calculated values of these ratings are:

$$R_w (C;C_{tr}) = 38 (-1;-3) \text{ dB}$$

$$C_{50-3150} = -1 \text{ dB}$$

$$C_{tr,50-3150} = -3 \text{ dB}$$

$$C_{50-5000} = 0 \text{ dB}$$

$$C_{tr,50-5000} = -3 \text{ dB}$$

$$C_{100-5000} = 0 \text{ dB}$$

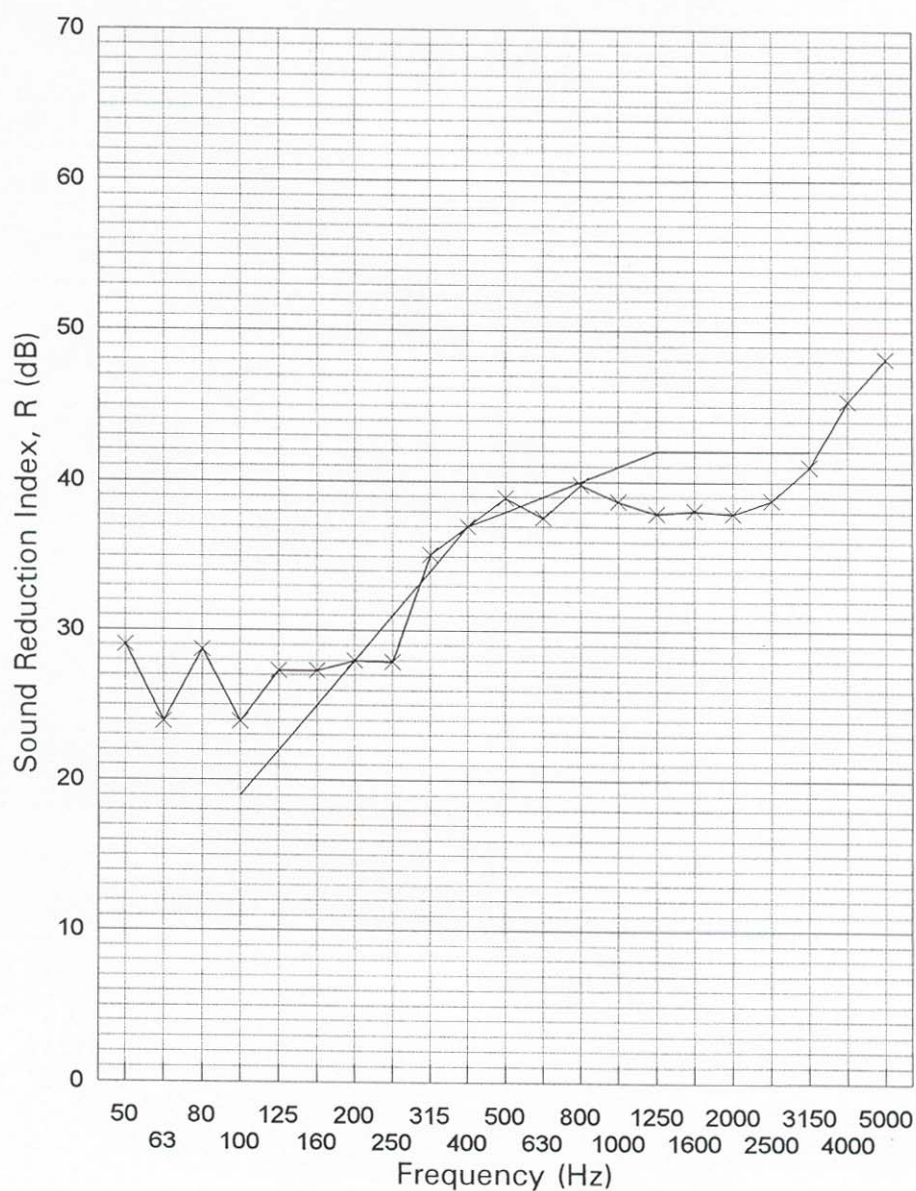
$$C_{tr,100-5000} = -3 \text{ dB}$$

Client

Plastal (SBP) Ltd

Laboratory Measurement of Sound Reduction Index

Profile 22 PVC Window Unit - 10/8/6.4 Glazing



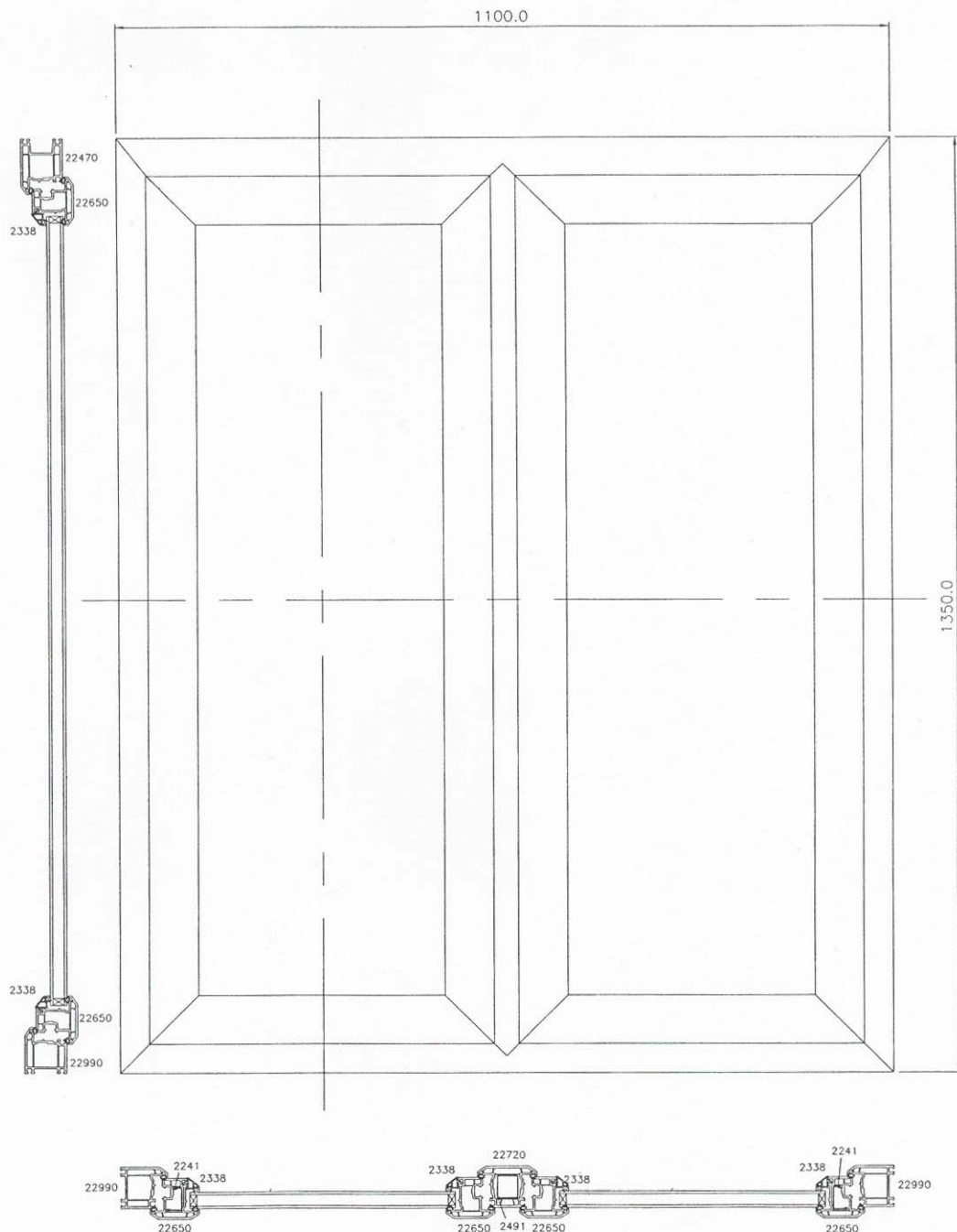
X—X Measured value of Sound Reduction Index, R (dB)

— Reference curve, R_w = 38 dB (BS EN ISO 717-1:1997)

Client Plastal (SBP) Ltd

Drawing of Test Specimen

Profile 22 PVC Window Unit



5. PRACTICAL APPLICATION OF SOUND REDUCTION INDEX

It should be noted that the Sound Reduction Index is a property of the test specimen alone. When the test specimen forms part of an enclosure, the sound insulation obtained will depend on additional factors such as the relative surface areas involved and the nature and acoustic characteristics of the receiving space. Also, in buildings the transmission of sound via alternative paths may not be negligible in comparison with transmission through the test specimen alone, particularly when the Sound Reduction Index of the test specimen is high. Such indirect sound transmission would result in a lower effective insulation.

6. CONCLUSION

This report presents the results of measurements made to determine the Sound Reduction Index (R) at each of the one-third octave band test frequencies and a single figure rating of sound insulation performance, known as the Weighted Sound Reduction Index (R_w). The test specimens comprised Profile 22 PVC framed window units with 4/16/4 and 10/8/6.4 glazing configurations which have achieved the R_w values of 36 and 38 dB respectively.

Report Approved by:



A J Jones BSc PhD CSci CPhys MInstP FIOA
Managing Director

Report Author:



M Sawyer MIOA
Laboratory Supervisor

REFERENCES

1. British Standard BS EN ISO 140
Acoustics - Measurement of sound insulation in buildings and of building elements

BS EN ISO 140-3:1995
Laboratory measurement of airborne sound insulation of building elements
2. British Standard BS EN ISO 717
Acoustics - Rating of sound insulation in buildings and of building elements

BS EN ISO 717-1:1997
Airborne sound insulation
3. International Standard ISO 354:2003
Acoustics - Measurement of sound absorption in a reverberation room

APPENDIX - Schedule of Equipment

Use	Type	Serial No.
Measuring System	Norsonic 840 Real Time Analyzer	16009
	B&K 4165 ½" Condenser Microphone	1471396
	B&K 4165 ½" Condenser Microphone	1471398
	B&K 4165 ½" Condenser Microphone	1471651
	B&K 2669 Microphone Pre-Amplifier	1856926
	B&K 2669 Microphone Pre-Amplifier	2221217
	NEAS 212 Rotating Microphone Boom	12171
	NEAS 212 Rotating Microphone Boom	12172
Calibration	B&K 4228 Pistonphone	1756569