Technical Report

INVESTOR IN PEOPLE

Report Number ***C/09/5L/20870/R01***

Date ***4 September 2009***

Project

The Laboratory Determination of The Airborne Sound Transmission of Various Window Systems

Prepared for

Sharps Redmore Partnership Ltd
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By

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UKAS TESTING
0444

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1.0 Summary

Tests have been done in SRL's Laboratory at Holbrook House, Sudbury, Suffolk, to determine the sound reduction index of various window systems in accordance with BS EN ISO 140-3:1995

From these measurements the required results have been derived and are presented in both tabular and graphic form in Datasheets 1 to 10.

The results are given in 1/3rd octave bands over the frequency range 50Hz to 10kHz, which is beyond that required by the test standard. Measurements outside the standard frequency range are not UKAS accredited.

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George Thomson

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Trevor Hickman
Deputy Technical Manager

For and on behalf of
Sound Research Laboratories Limited

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Contents

1.0 Summary

2.0 Details of Measurements

3.0 Description of Test

4.0 Results

Datasheets 1 to 9

Drawings 1 and 2

Appendix 1: Test Procedure

Appendix 2: Measurement Uncertainty

2.0 Details of Measurements

2.1 Location

Sound Research Laboratories Limited
Holbrook House
Little Waldingfield
Sudbury
Suffolk
CO10 OTH

2.2 Test Dates

17 August 2009

2.3 Instrumentation and Apparatus Used

Make	Description	Type
E D I	Microphone Multiplexer	
	Microphone Power Supply Unit	
Norwegian Electronics	Real Time Analyser	830
	Rotating Microphone Boom	231
Brüel & Kjaer	12mm Condenser Microphones	4166
	Windshields	UA0237
	Pre Amplifiers	2639
	Microphone Calibrator	4231
	Omnipower Sound Source	4296
Larson Davis	12mm Condenser Microphone	2560
SRL	Power Amplifiers	
Celestion	Loudspeakers	100w

Douglas Curtis	Rotating Microphone Boom	
Thermo Hygro	Temperature & Humidity Probe	
TOA	Graphic Equalizer	E-1231
	Power Amplifier	DPA-800

2.4 References

BS EN ISO 140-3:1995	Laboratory measurement of airborne sound insulation of building elements
BS EN ISO 717-1:1997	Rating of sound insulation in buildings and of building elements. Airborne Sound Insulation.

2.5 Personnel Present

Tim Redmore	Sharps Redmore Partnership Ltd

3.0 Description of Test

3.1 Description of Sample

Various windows with or without secondary glazing were tested. A test was also done with the glazing removed and the test aperture blanked off with layers of dense plasterboard each side and mineral wool infill.

For test details see Section 4.0 and datasheets 1 to 10.

See drawings 1 and 2 for constructions.

The perimeter of the samples were sealed to the test aperture with mastic.

Sampling plan: Selected at random

Sample condition: New

Details supplied by: Sharps Redmore Partnership Ltd

Samples installed by: Sharps Redmore Partnership Ltd

3.2 Sample Delivery date

17 August 2009

3.3 Test Procedures

The sample was mounted/located and tested in accordance with the relevant standard. The method and procedure is described in Appendix 1. The measurement uncertainty is given in Appendix 2.

4.0 Results

The results of the measurements and subsequent analysis are given in Datasheets 1 to 10 and summarised below.

Results relate only to the items tested.

52mm glazing comprises 14.8mm laminate/24mm argon filled cavity/12.8mm laminate.
48mm glazing comprises 14.4mm laminate/24mm argon filled cavity/8.8mm laminate.
39mm glazing comprises 8.4mm laminate/24mm argon filled acaity/6mm mono.

SRL Test No.	Description in Brief	R_w ($C;C_{tr}$) dB
2	52mm outer glazing only	45 (-1;-4)
3	As test 2 with frame to wall sealed with extra sealant/mastic	44 (-1;-4)
4	48mm outer glazing only	41 (-1;-5)
5	48mm outer glazing with 6mm toughened secondary window with approx 250mm cavity	56 (-2;-6)
6	39mm outer glazing with 6mm secondary glazing as previous test - approx 250mm cavity	55 (-2;-7)
7	39mm outer glazing with 6mm secondary glazing - approx 250mm cavity and 30mm foam added to reveal on all four sides	55 (-2;-7)
8	39mm outer glazing with 14.4mm Iam secondary glazing - approx 250mm cavity and 30mm foam added to reveal on all four sides	56 (-2;-7)
9	52mm outer glazing with 14.4mm Iam secondary glazing - approx 250mm cavity (no foam at reveal)	56 (-1;-5)
10	52mm outer glazing with 6mm secondary glazing - approx 250mm cavity	55 (-1;-5)
11	3 layers of dense plasterboard each side of test opening with 100mm of mineral wool in cavity	64 (-2;-6)

End of Text

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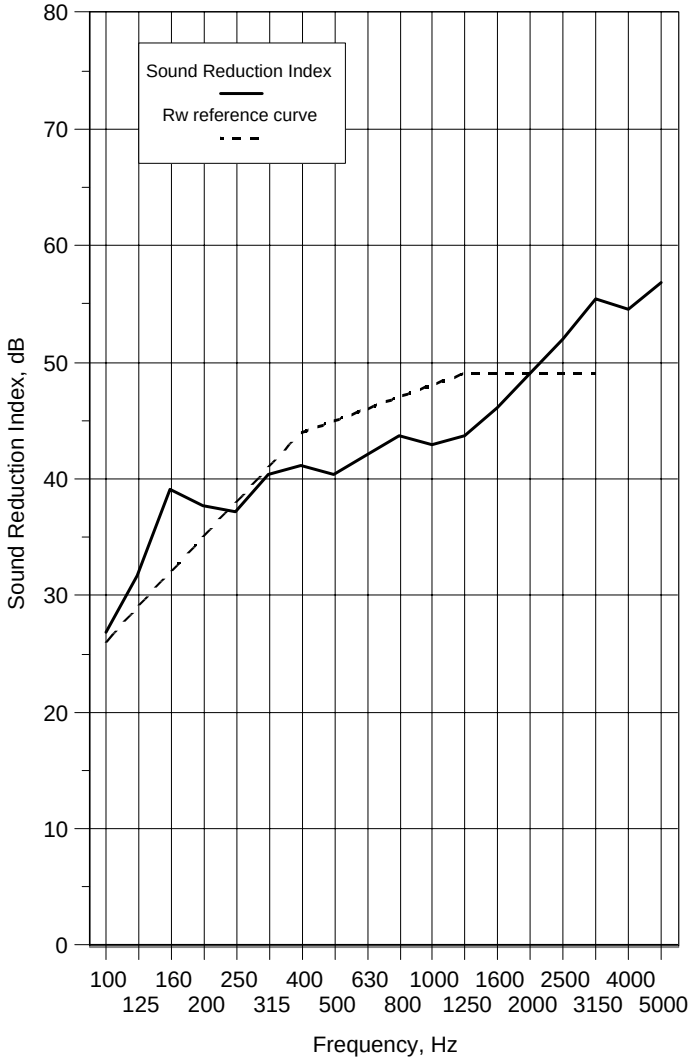
Data Sheet 1

Test Number :	2	**Air temperature:**	21.2 °C
Client:	Sharps Redmore	**Air humidity:**	66 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	52mm glazing (14.8 lam/24 argon/12.8 lam)		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct	1/1 Oct
50+	29.7	
63+	29.6	25.6
80+	22.1	
100	26.8	
125	31.7	30.1
160	39.1	
200	37.7	
250	37.2	38.2
315	40.4	
400	41.1	
500	40.4	41.1
630	42.0	
800	43.7	
1000	42.9	43.4
1250	43.7	
1600	46.1	
2000	49.1	48.4
2500	52.0	
3150	55.4	
4000	54.5	55.5
5000	56.9	
6300+	58.8	
8000+	60.8	60.0
10000+	60.8 *	
Average 100-3150	41.8	



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **45 (-1;-4)** dB

Notes :* designates measurement corrected for background

designates limit of measurement due to background

+ designates frequency beyond standard and not UKAS accredited

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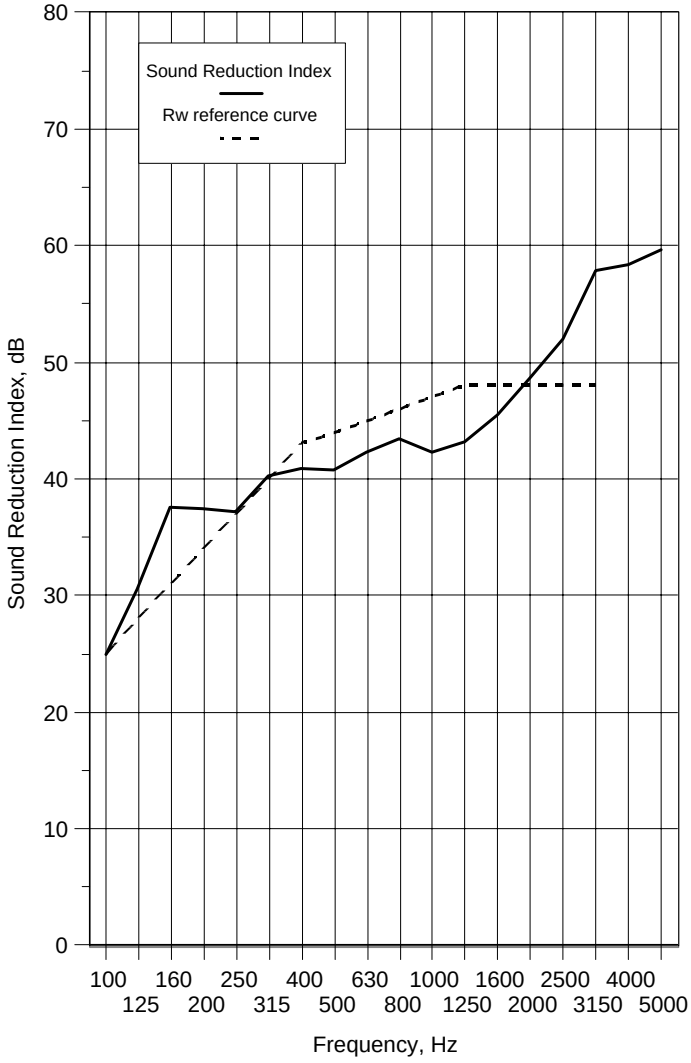
Data Sheet 2

Test Number :	3	**Air temperature:**	21.2 °C
Client:	Sharps Redmore	**Air humidity:**	66 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	As test 2 with frame to wall sealed with extra sealant / mastic		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct	1/1 Oct
50+	28.9	
63+	28.5	24.5
80+	21.0	
100	24.9	
125	30.5	28.4
160	37.6	
200	37.4	
250	37.2	38.1
315	40.3	
400	40.9	
500	40.8	41.3
630	42.3	
800	43.5	
1000	42.3	43.0
1250	43.2	
1600	45.5	
2000	48.7	48.0
2500	52.0	
3150	57.9	
4000	58.4	58.6
5000	59.6	
6300+	59.7	
8000+	61.5	60.9
10000+	61.9 *	
Average 100-3150	41.6	



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **44 (-1;-4)** dB

Notes :* designates measurement corrected for background

designates limit of measurement due to background

+ designates frequency beyond standard and not UKAS accredited

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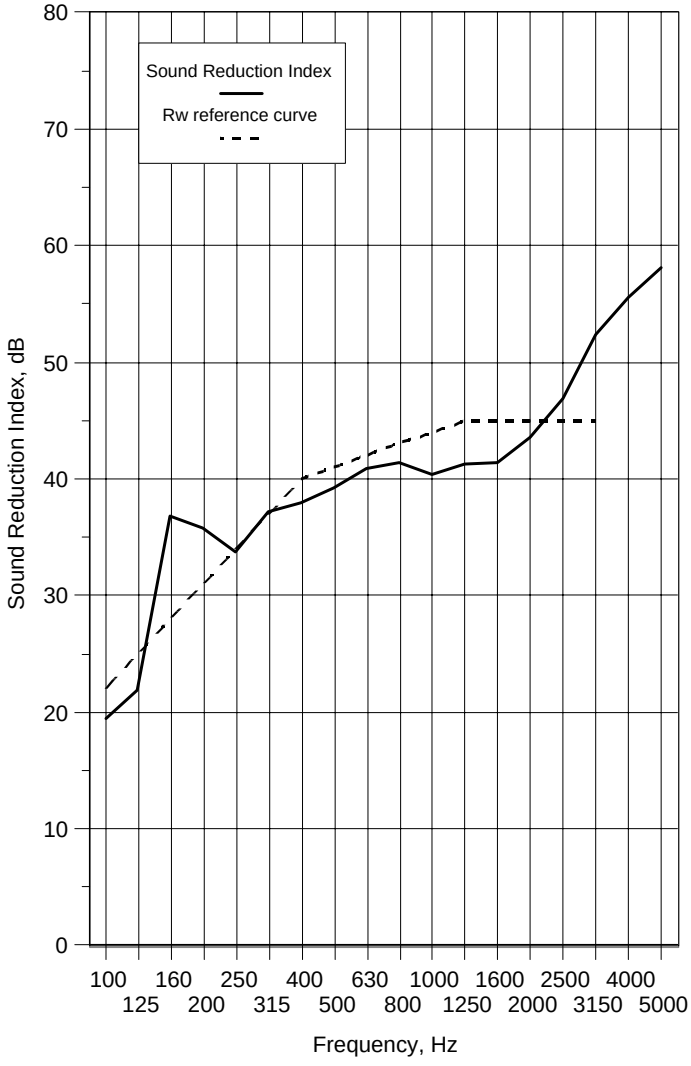
Data Sheet 3

Test Number :	4	**Air temperature:**	21.2 °C
Client:	Sharps Redmore	**Air humidity:**	66 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	48mm glazing (14.4 lam/24 argon/8.8 lam)		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct		1/1 Oct
50+	28.8		27.0
63+	28.5		
80+	24.9		
100	19.4		22.2
125	21.9		
160	36.8		
200	35.8		35.3
250	33.7		
315	37.2		
400	38.0		39.2
500	39.2		
630	40.9		
800	41.4		41.0
1000	40.4		
1250	41.3		
1600	41.4		43.4
2000	43.6		
2500	46.9		
3150	52.4		54.7
4000	55.6		
5000	58.1		
6300+	60.4		61.7
8000+	62.7	*	
10000+	62.5	*	
Average 100-3150	38.1		



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **41 (-1;-5)** dB

Notes :* designates measurement corrected for background

designates limit of measurement due to background

+ designates frequency beyond standard and not UKAS accredited

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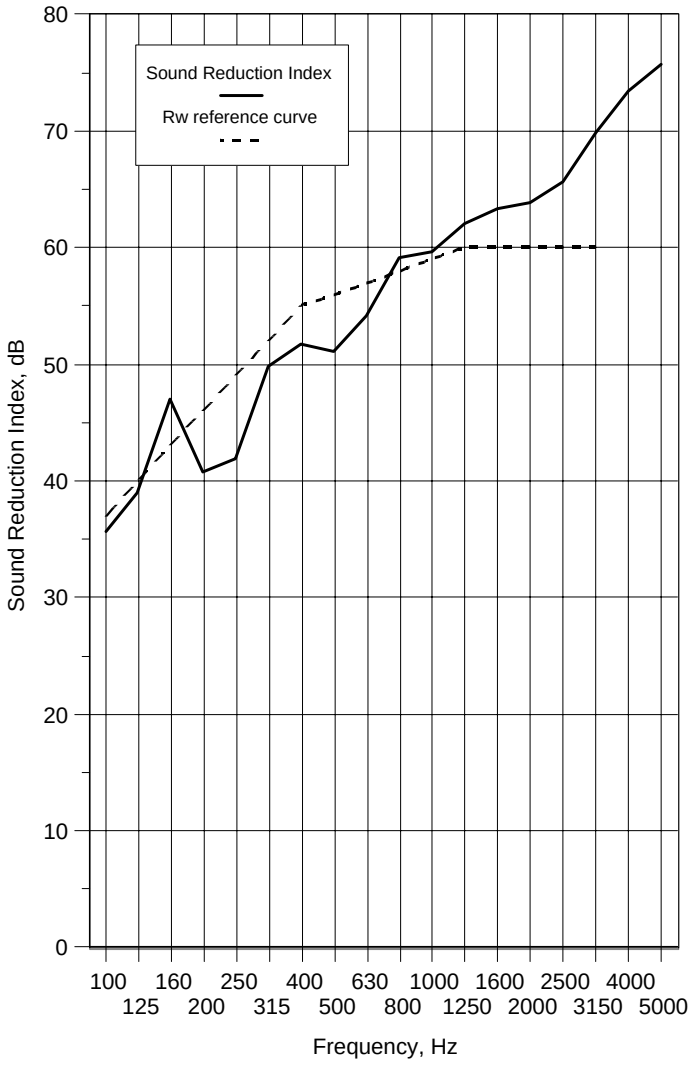
Data Sheet 4

Test Number :	5	**Air temperature:**	21.2 °C
Client:	Sharps Redmore	**Air humidity:**	66 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	48mm glazing (14.4 lam/24 argon/8.8 lam) with 6mm toughened secondary glazing with approx 250mm cavity		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct		1/1 Oct
50+	31.5		
63+	33.9		33.1
80+	34.4		
100	35.7		
125	39.0		38.6
160	47.0		
200	40.8		
250	41.9		42.8
315	49.8		
400	51.7		
500	51.1		52.2
630	54.2		
800	59.1		
1000	59.7		60.1
1250	62.1		
1600	63.4		
2000	63.9		64.2
2500	65.6		
3150	69.9	*	
4000	73.4	*	72.3
5000	75.7	*	
6300+	77.6	#	
8000+	73.3	#	71.6
10000+	68.4	#	
Average 100-3150	53.4		



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **56 (-2;-6)** dB

Notes :* designates measurement corrected for background

designates limit of measurement due to background

+ designates frequency beyond standard and not UKAS accredited

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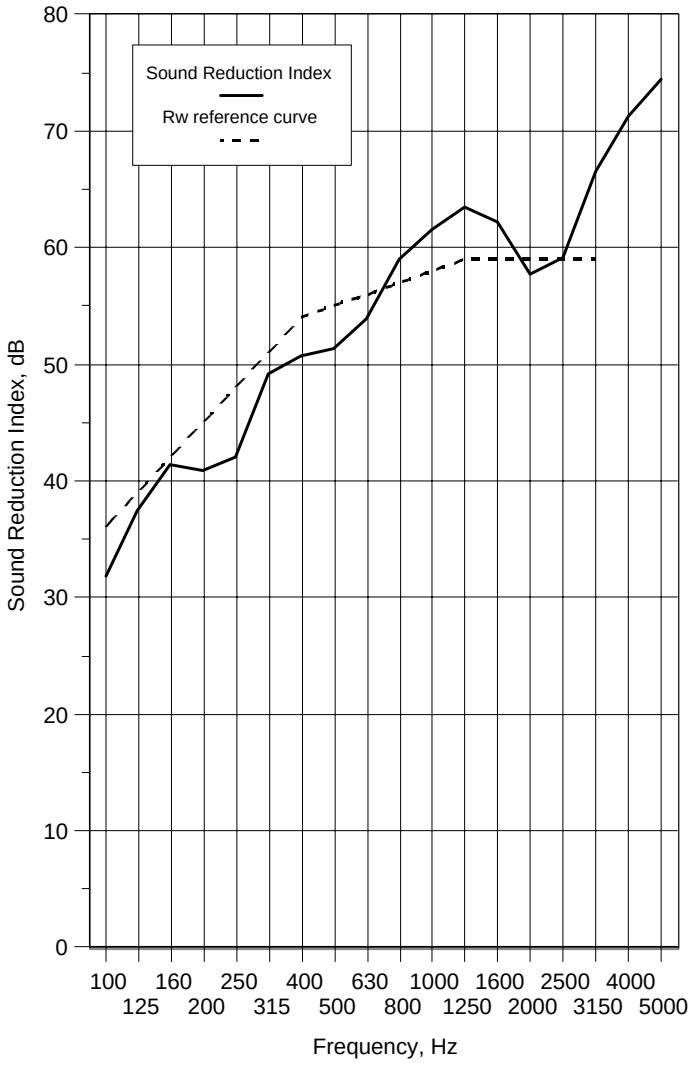
Data Sheet 5

Test Number :	6	**Air temperature:**	21.5 °C
Client:	Sharps Redmore	**Air humidity:**	64 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	39mm glazing (8.4 lam/24 argon/6 mono) with 6mm toughened secondary glazing - approx 250mm cavity		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct		1/1 Oct
50+	31.6		
63+	32.0		31.9
80+	32.2		
100	31.8		
125	37.4		35.2
160	41.4		
200	40.9		
250	42.0		42.8
315	49.2		
400	50.7		
500	51.4		51.8
630	53.9		
800	59.0		
1000	61.6		61.0
1250	63.5		
1600	62.2		
2000	57.7		59.3
2500	59.1		
3150	66.6		
4000	71.2	*	69.6
5000	74.4	*	
6300+	76.9	#	
8000+	72.5	#	70.5
10000+	67.1	*	
Average 100-3150	51.8		



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **55 (-2;-7)** dB

Notes :* designates measurement corrected for background
designates limit of measurement due to background
+ designates frequency beyond standard and not UKAS accredited

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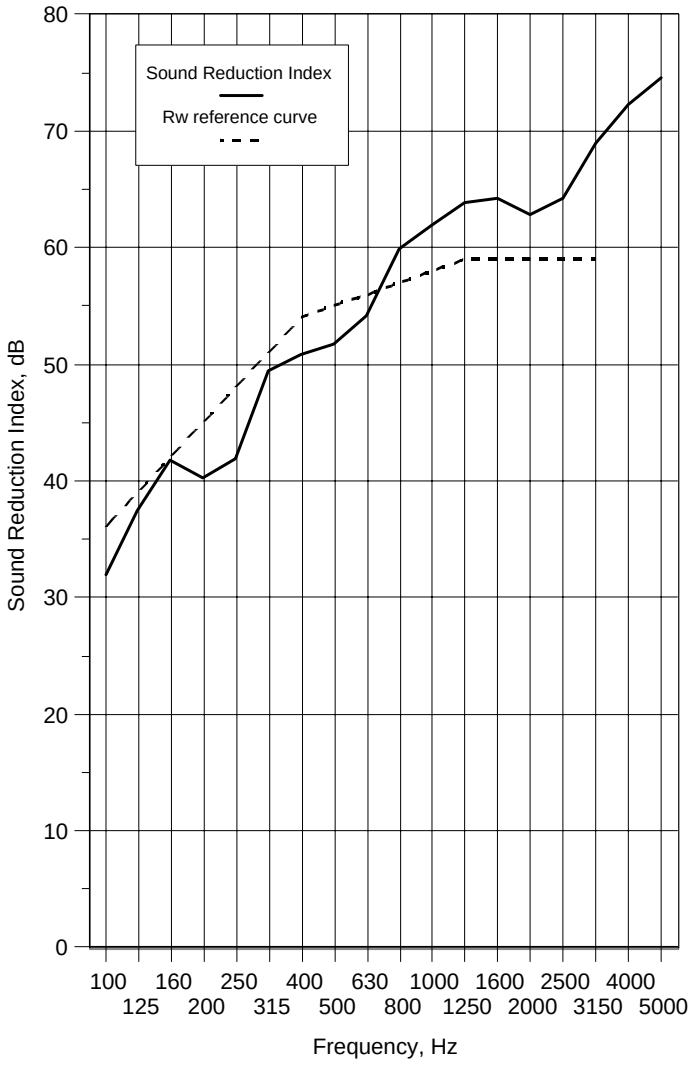
Data Sheet 6

Test Number :	7	**Air temperature:**	21.5 °C
Client:	Sharps Redmore	**Air humidity:**	64 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	39mm glazing (8.4 lam/24 argon/6 mono) with 6mm secondary toughened glazing - approx 250mm cavity & 30mm foam added to reveal on all four sides		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct		1/1 Oct
50+	31.0		
63+	31.9		31.9
80+	33.1		
100	31.9		
125	37.4		35.3
160	41.8		
200	40.3		
250	41.9		42.5
315	49.4		
400	50.9		
500	51.8		52.1
630	54.1		
800	59.9		
1000	61.9		61.5
1250	63.8		
1600	64.2		
2000	62.9		63.7
2500	64.2		
3150	68.9	*	
4000	72.3	*	71.3
5000	74.6	*	
6300+	77.1	#	
8000+	72.8	#	71.2
10000+	68.1	#	
Average 100-3150	52.8		



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **55 (-2;-7)** dB

Notes :* designates measurement corrected for background
designates limit of measurement due to background
+ designates frequency beyond standard and not UKAS accredited

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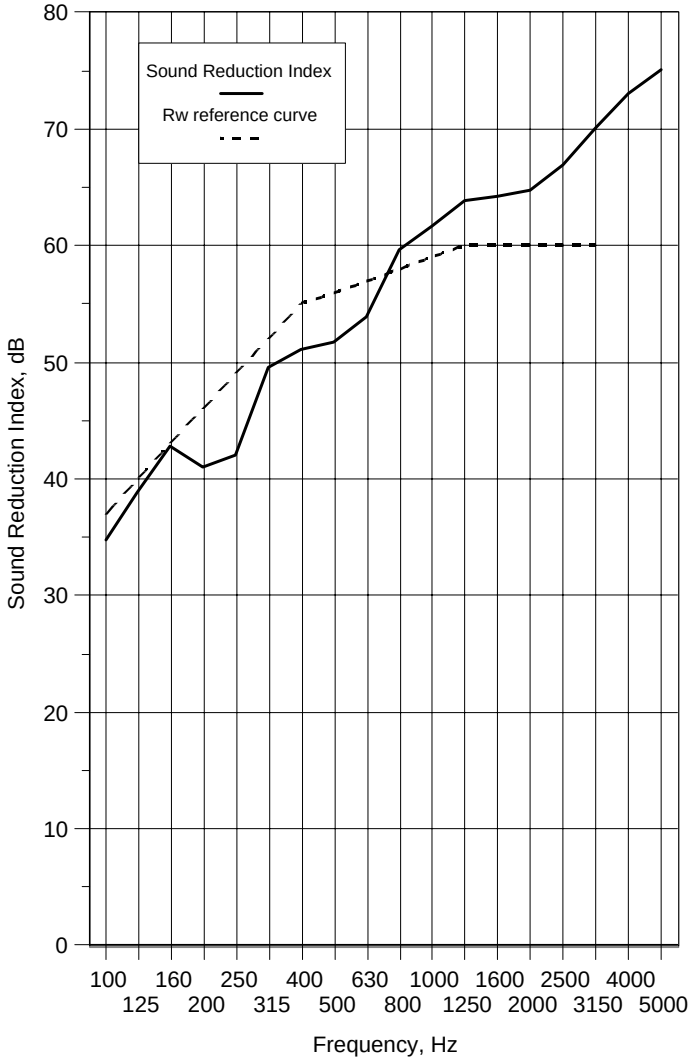
Data Sheet 7

Test Number :	8	**Air temperature:**	21.5 °C
Client:	Sharps Redmore	**Air humidity:**	64 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	39mm glazing (8.4 lam/24 argon/6 mono) with 14.4mm lam secondary glazing - approx 250mm cavity & 30mm foam added to reveal on all four sides		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct		1/1 Oct
50+	31.5		
63+	31.7		32.4
80+	34.8		
100	34.8		
125	38.9		37.7
160	42.8		
200	41.0		
250	42.0		42.9
315	49.6		
400	51.1		
500	51.8		52.1
630	53.9		
800	59.7		
1000	61.7		61.4
1250	63.8		
1600	64.2		
2000	64.7		65.1
2500	66.9		
3150	70.1	*	
4000	73.0	*	72.2
5000	75.1	*	
6300+	77.3	#	
8000+	73.1	#	71.4
10000+	68.3	#	
Average 100-3150	53.6		



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **56 (-2;-7)** dB

Notes :* designates measurement corrected for background
designates limit of measurement due to background
+ designates frequency beyond standard and not UKAS accredited

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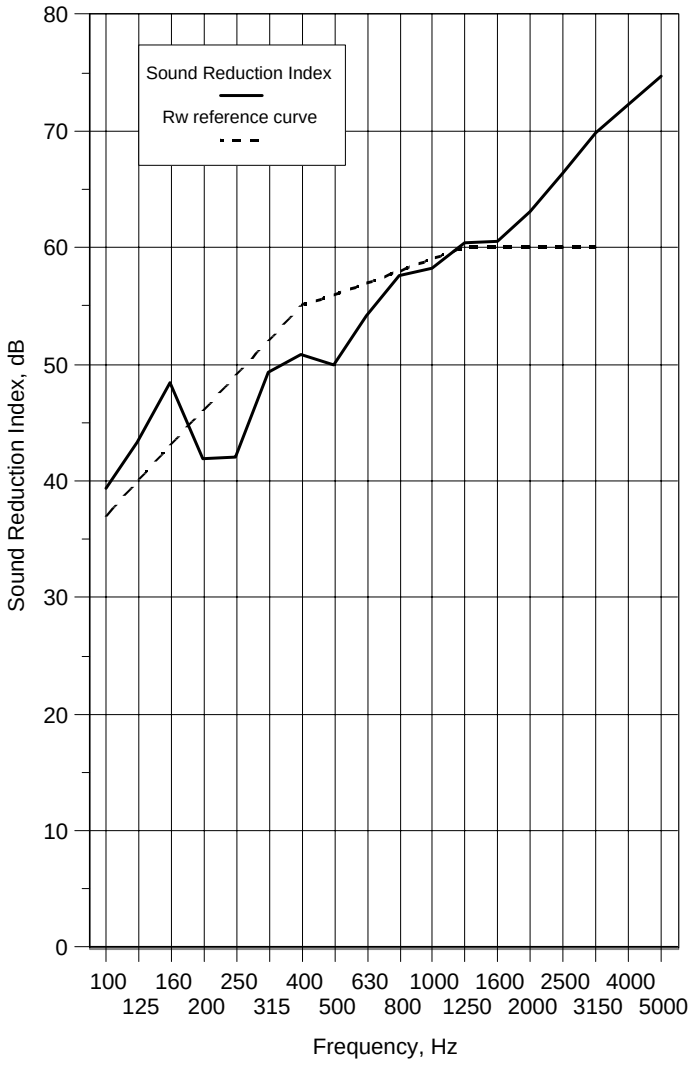
Data Sheet 8

Test Number :	9	**Air temperature:**	21.5 °C
Client:	Sharps Redmore	**Air humidity:**	64 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	52mm glazing (14.8 lam/24 argon/12.8 lam) with 14.4mm lam secondary glazing - approx 250mm cavity, no foam at reveal		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct		1/1 Oct
50+	31.2		33.2
63+	33.4		
80+	36.2		
100	39.4		42.3
125	43.3		
160	48.4		
200	41.9		43.3
250	42.0		
315	49.3		
400	50.9		51.3
500	49.9		
630	54.1		
800	57.6		58.6
1000	58.3		
1250	60.4		
1600	60.5		62.7
2000	63.1		
2500	66.4		
3150	69.9	*	71.9
4000	72.3	*	
5000	74.7	*	
6300+	76.3	*	70.9
8000+	72.6	#	
10000+	67.9	#	
Average 100-3150	53.5		



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **56 (-1;-5)** dB

Notes :* designates measurement corrected for background

designates limit of measurement due to background

+ designates frequency beyond standard and not UKAS accredited

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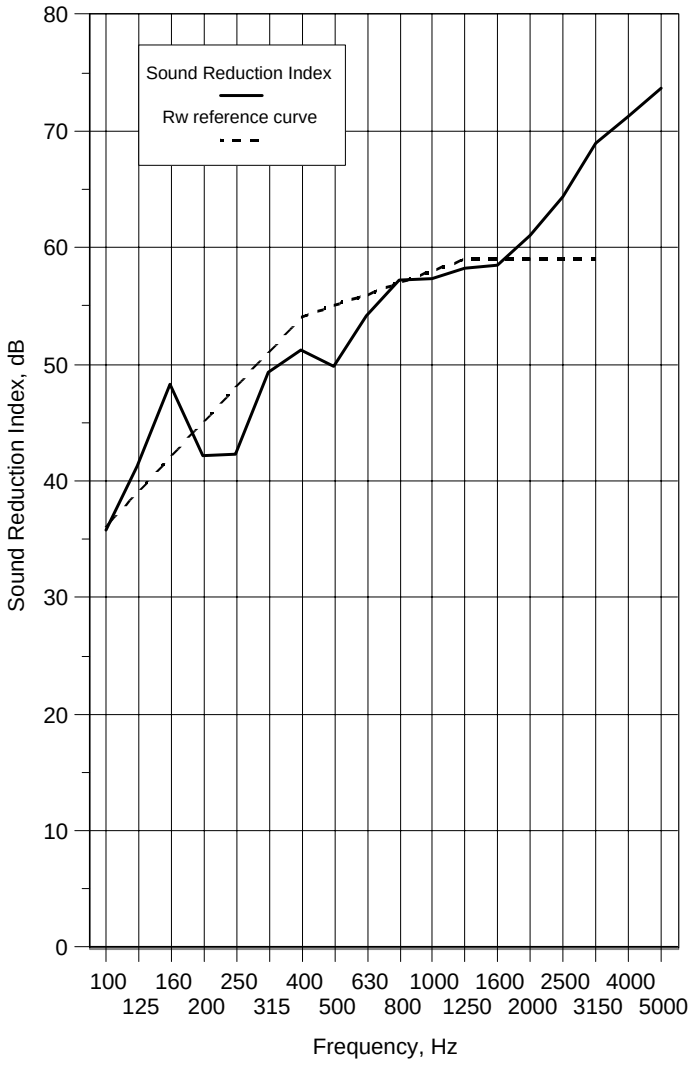
Data Sheet 9

Test Number :	10	**Air temperature:**	21.5 °C
Client:	Sharps Redmore	**Air humidity:**	64 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	52mm glazing (14.8 lam/24 argon/12.8 lam) with 6mm secondary glazing - approx 250mm cavity		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct		1/1 Oct
50+	31.5		
63+	33.3		32.8
80+	33.9		
100	35.8		
125	41.3		39.3
160	48.3		
200	42.2		
250	42.3		43.6
315	49.3		
400	51.2		
500	49.8		51.4
630	54.1		
800	57.2		
1000	57.3		57.6
1250	58.3		
1600	58.5		
2000	61.0		60.7
2500	64.4		
3150	69.0	*	
4000	71.3	*	70.9
5000	73.7	*	
6300+	75.3	*	
8000+	72.3	#	70.7
10000+	67.8	#	
Average 100-3150	52.5		



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **55 (-1;-5)** dB

Notes :* designates measurement corrected for background
designates limit of measurement due to background
+ designates frequency beyond standard and not UKAS accredited

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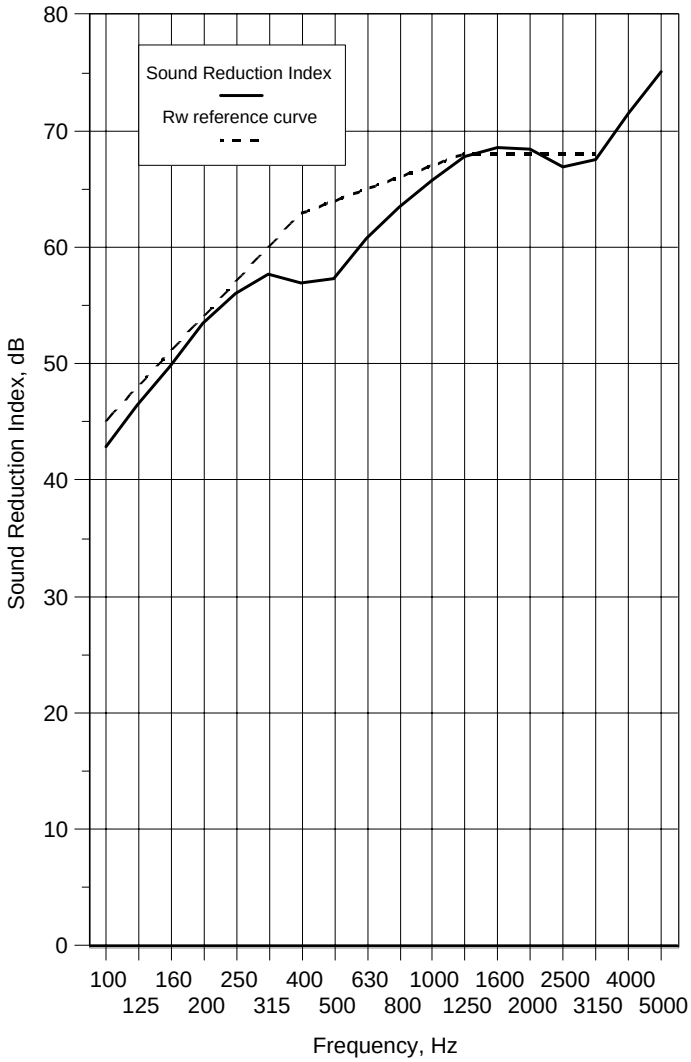
Data Sheet 10

Test Number :	11	**Air temperature:**	21.5 °C
Client:	Sharps Redmore	**Air humidity:**	64 %
Test Date:	17/08/2009	**Receiving room volume:**	50 m3
Sample height:	1.735 m	**Source room volume:**	55 m3
Sample width:	1.105 m		
Product Identification:	Test aperture with 3x layers of 12.5mm heavy plasterboard either side with 100mm mineral wool insulation in cavity		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct		1/1 Oct
50+	32.9		
63+	31.6		33.6
80+	39.9		
100	42.9		
125	46.5		45.5
160	49.8		
200	53.5		
250	56.1		55.4
315	57.7		
400	56.9		
500	57.3		58.0
630	60.8		
800	63.5		
1000	65.8		65.3
1250	67.8	*	
1600	68.5	*	
2000	68.4		67.9
2500	66.9		
3150	67.5		
4000	71.5	*	70.3
5000	75.1	*	
6300+	76.1	*	
8000+	72.6	#	70.9
10000+	67.8	#	
Average 100-3150	59.4		



Rating according to BS EN ISO 717-1:1997

Rw(C;Ctr)= **64 (-2;-6)** dB

Notes :* designates measurement corrected for background

designates limit of measurement due to background

+ designates frequency beyond standard and not UKAS accredited

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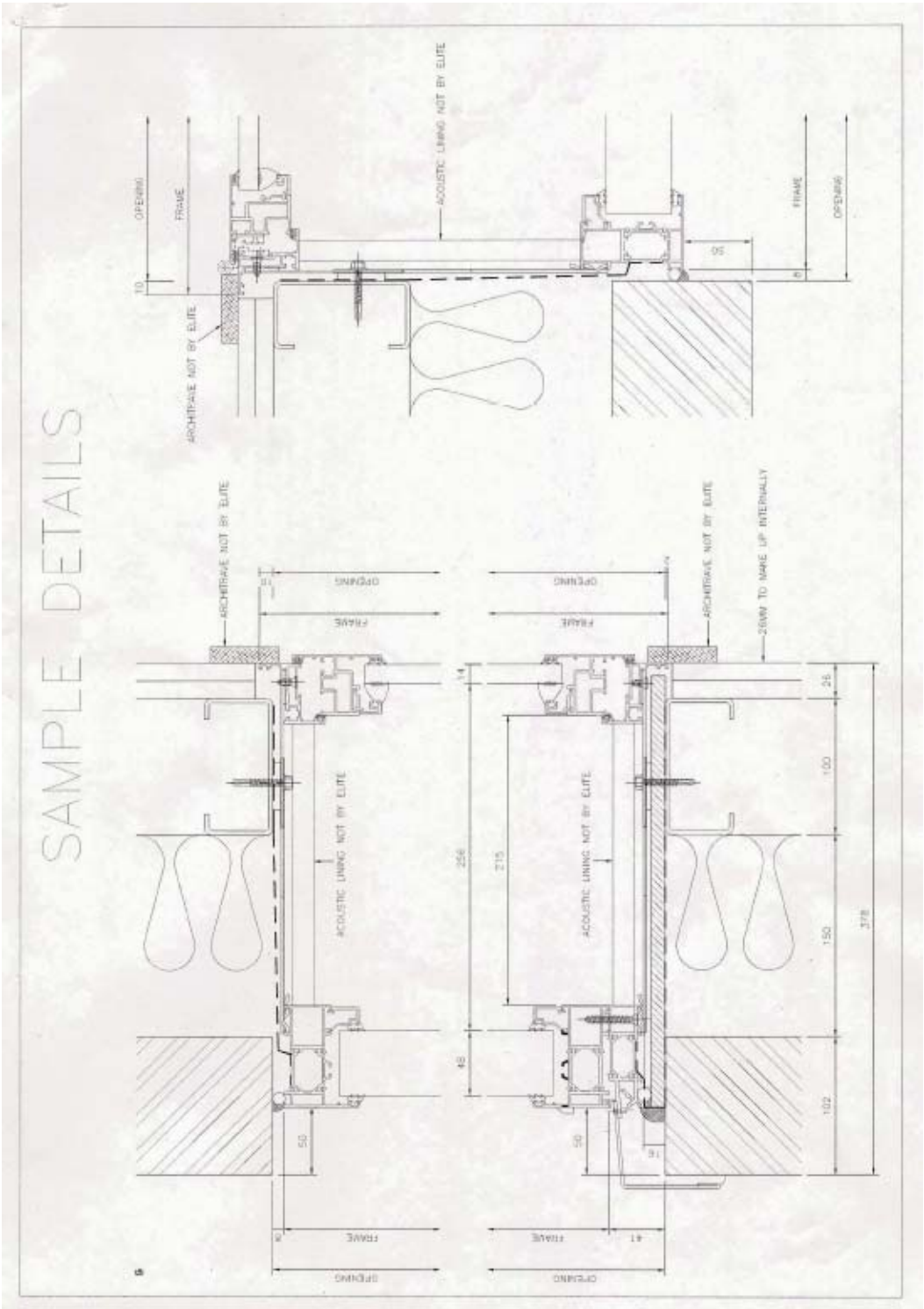
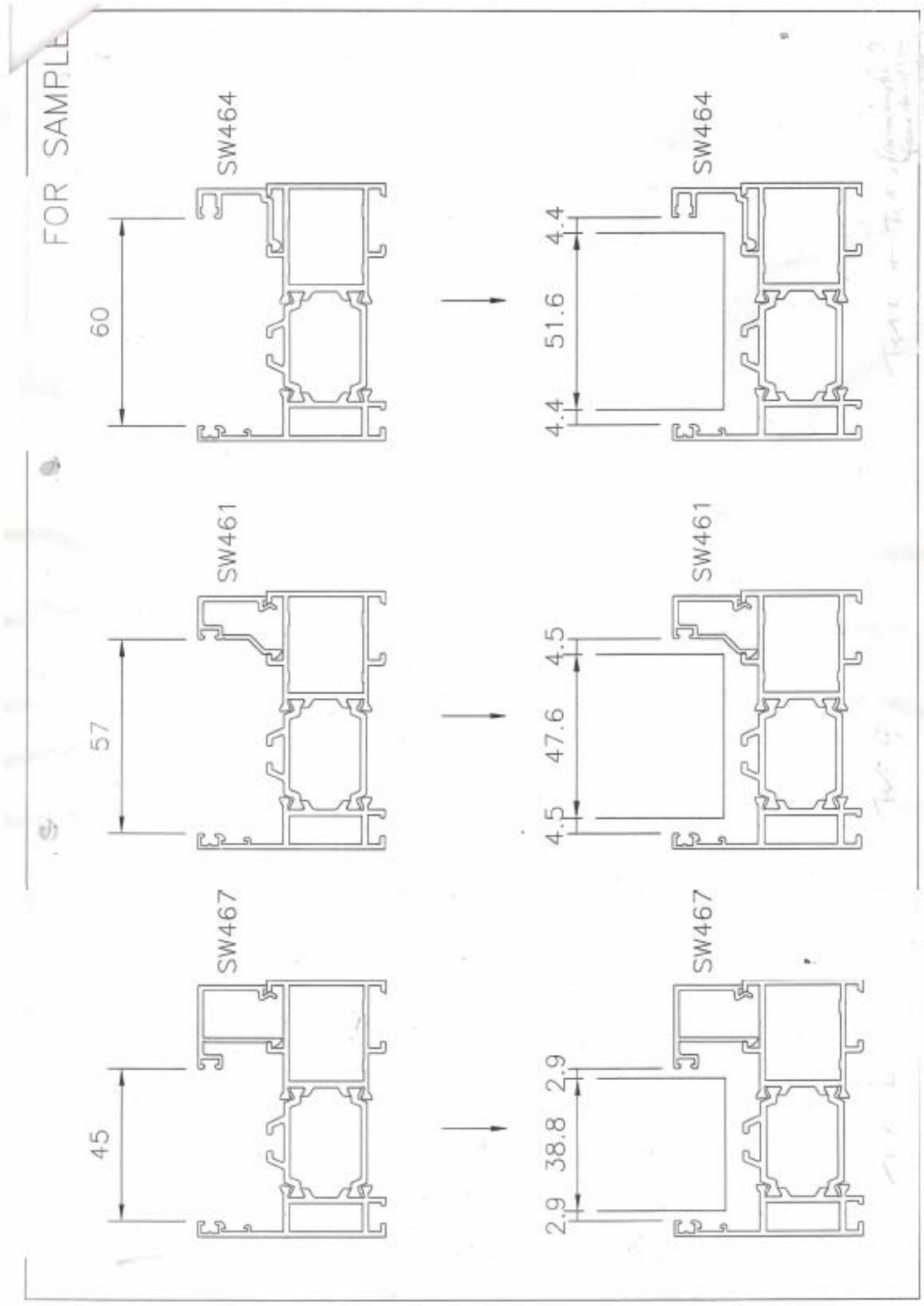
Drawing 1 - General construction with first & secondary glazing installed



Drawing 2 - Different frame & glazing construction



Appendix 1

Test Procedure

Measurement of Sound Transmission in accordance with BS EN ISO 140-3 : 1995 - TP15

In the laboratory, airborne sound transmission is determined from the difference in sound pressure levels measured across a test sample installed between two reverberant rooms. The difference in measured sound pressure levels is corrected for the amount of absorption in the receiving room. The test is done under conditions which restrict the transmission of sound by paths other than directly through the sample. The source sound field is randomly incident on the sample.

The test sample is located and sealed in an aperture within the brick dividing wall between the two rectangular reverberant or acoustically "live" rooms, both of which are constructed from 215mm brick with reinforced concrete floors and roofs. The brick wall has dimensions of 3.9m wide x 2.9m high and forms the whole of the common area between the two rooms.

One of the rooms termed the source room has a volume of 55 cubic metres and is isolated by the use of resilient mountings and seals, from the surrounding structure and the adjoining room. The adjoining receiving room has a volume of 50 cubic metres.

Broad band noise is produced in the source room from an electronic generator, power amplifier and loudspeaker. The resulting sound pressure levels in both rooms are sampled, filtered into one third octave band widths, integrated and averaged by means of a Real Time Analyser using a microphone on an oscillating microphone boom. The value obtained at any particular frequency is known as the equivalent sound pressure level for either source or receiving rooms. The change in level across the test sample is termed the equivalent sound pressure level difference, i.e.

where $D = L_1 - L_2$

D is the equivalent Sound Pressure Level difference in dB

L_1 is the equivalent Sound Pressure Level in the source room in dB

L_2 is the equivalent Sound Pressure Level in the receiving room in dB

The Sound Reduction Index (R) also known by the American terminology Sound Transmission Loss, is defined as the number of decibels by which sound energy randomly incident on the test sample, is reduced in transmitting through it and is given by the formula:

$$R = D + 10\log_{10}\frac{S}{A} \quad \text{..... in decibels}$$

where

S is the area of the sample

A is the total absorption in the receiving room

both dimensions being in consistent units

The Sound Reduction Index is an expression of the laboratory sound transmission performance of a particular element or construction. It is a function of the mass, thickness, sealing method of mounting etc.and is independent of the overall area of the sample.

However, when a sample is installed on site and forms part of an enclosure of building, the sound insulation obtained will be dependent upon its surface area, the larger the area the greater the sound energy transmitted, as well as the absorption in the receiving area. In addition, the overall sound insulation of an enclosure is also determined by the sound transmission through other building elements, some of which may have an inferior performance to the sample. Because of this the potential Sound Reduction Index of a sample is not always fully realised in practice. A further consequence is that the Sound Reduction Index of a particular sample can only successfully be measured in a laboratory because only under such controlled conditions can the sound transmission path be limited to the sample under test.

R_w, C and C_{tr} have been calculated in accordance with the relevant section of BS EN ISO 717-1:1997 from the results of laboratory tests carried out in accordance with BS EN ISO 140-3 : 1995.

Appendix 2

Measurement Uncertainty
BS EN ISO 140-3:1995 - TP15

The following values of uncertainty are based on a standard uncertainty multiplied by a coverage factor of k = 2, which provides a level of confidence of approximately 95%.

Frequency, Hz	Uncertainty, ± dB
100	2.6
125	2.4
160	2.1
200	2.1
250	1.5
315	1.5
400	1.2
500	1.2
800	1.0
1000	1.0
1250	1.0
1600	1.0
2000	1.0
2500	1.0
3150	1.0