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UKAS TESTING 1262

TEST REPORT No : AT/01/42 **DATE OF ISSUE : 18 September 2001**

INTERNATIONAL STANDARD METHOD FOR MEASUREMENT OF AIRBORNE SOUND INSULATION OF BUILDING ELEMENTS BS EN ISO 140-3 : 1995

CLIENT:	Kingspan Insulation Limited Pembridge Leominster Herefordshire HR6 9LA
JOB NUMBER:	A01/36
TEST SAMPLE:	Structural Insulation Panel (SIP)
MANUFACTURER:	Kingspan Insulation Limited
DATE RECEIVED:	17 September 2001
DATE OF TEST:	17 September 2001

Signed:..... D J M°Caul

Approved:..... Dr D J Saunders

THE QUEEN'S ANNIVERSARY PRIZES FOR HIGHER AND FURTHER EDUCATION 2000

School of Acoustics and Electronic Engineering
Head of School: D J Saunders BSc PhD CEng FIOA

1 TEST SAMPLES

1.1 Description of Test Samples

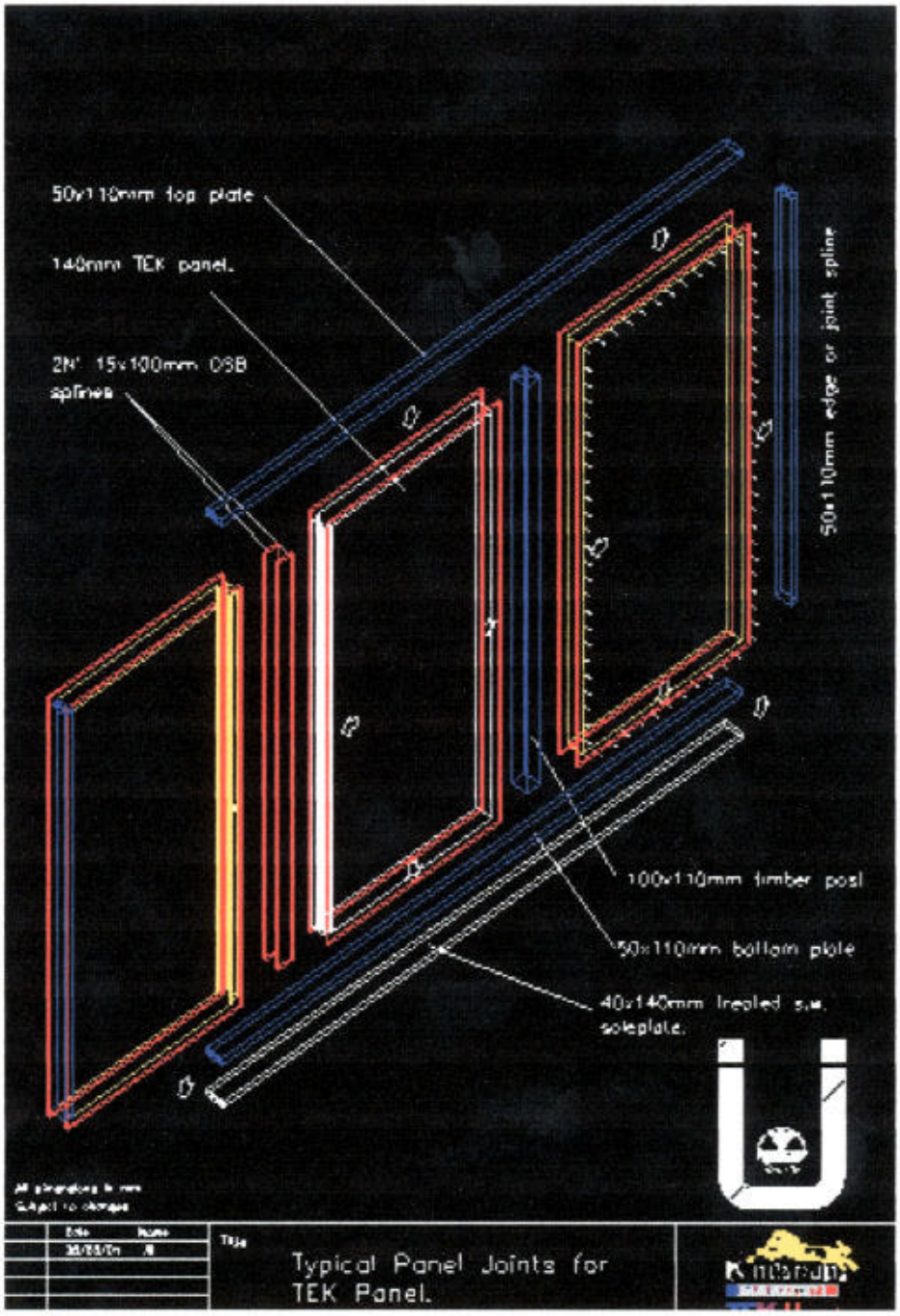
Test Ref: TL/01/09/11

140mm structural insulated panel (SIP). 2 x 15mm OSB3. Rigid urethane core. Decorators caulk around perimeter. OSB oriented strand board.

1.2 Sectional Drawings

A sectional drawing as provided by client can be found on the following page.

Test ref: TL/01/09/11



2 DESCRIPTION OF TEST PROCEDURE

The test procedure adopted follows that detailed in BS EN ISO 140: Part 3: 1995, "Laboratory measurements of airborne sound insulation of building elements".

The measurements are performed in the large transmission suite at the University of Salford. The suite comprises two structurally isolated reverberant rooms with a test opening between them in which the test specimen is inserted. The vertical sides of the test aperture are made from dense brick, whilst the base and soffit are made from reinforced concrete. Both rooms have been designed with hard surfaces and non-parallel walls. The smaller source room has 4 plywood diffusers and the larger receiving room has 11 plywood diffusers, to increase the diffusivity of the sound field in these areas.

The test involves producing a known sound field in the source room and measuring the resultant sound level difference between the source room and the receiving room with the specimen installed in the test aperture. This level difference is then corrected so as to take into account the equivalent absorption area of the receiving room.

The Sound Reduction Index, R, is defined in BS EN ISO 140: Part 3: 1995 as:

$$R = L_1 - L_2 + 10\log_{10}\frac{S}{A}\ dB \qquad (1)$$

where:

L_1 is the average sound pressure level in the source room (dB)

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

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

A is the equivalent absorption area of the receiving room (m^2)

2.1 Generation of Sound Field in the Source Room

Wide band, random noise from the generator in the real time analyser was amplified and reproduced in the source room using alternately one of two fixed loudspeaker systems, (**La** and **Lb**). Omni-directional loudspeakers were used. The output of the generator was set so that the sound pressure level in the receiving room was at least 15dB higher than the background level in any frequency band. The loudspeakers were positioned in the corners of the room and at such a distance from the test specimen that the direct radiation upon it was not dominant.

2.2 Frequency Range of Measurements

The sound pressure levels were measured using one-third octave band filters. Measurements covered all the one-third octave bands having centre frequencies in the range from 100Hz to 5000Hz,

2.3 Measurement of Sound Pressure Levels

Sound pressure levels were measured simultaneously in the source and receiving rooms using loudspeaker **La** as the sound source. Measurements were recorded at 6 fixed microphone positions in each room, using an averaging time of 16 seconds and the average level in each room was calculated on an energy basis in each one-third octave frequency band. The procedure was then repeated with loudspeaker **Lb** as the sound source. The overall average level difference in each frequency band was then calculated as the arithmetic average of the two sets of results.

For each set of microphone/loudspeaker positions, the distances separating microphones from other microphones, room boundaries and diffusers, were greater than 0.7m and the distances separating microphones from the sound source and the test specimen were greater than 1m.

2.4 Measurement and Evaluation of the Equivalent Absorption Areas

The correction term of equation (1) containing the equivalent absorption area was evaluated from the reverberation time and calculated using Sabine's formula:

$$A = \frac{0.163\ V}{T} \qquad (2)$$

where:

V is the volume of the receiving room (m^3)

T is the reverberation time (s)

The reverberation time of the receiving room was measured using a decay technique. The decays were produced by exciting the room with wide band random noise and stopping the excitation once the room became saturated. The resulting decaying sound field was monitored at 6 fixed microphone positions using a one-third octave band real time analyser. The sound spectrum was sampled at 32 millisecond intervals and stored in memory. Five decays were measured at each microphone position and averaged. The time taken for the sound to decay by 30dB was measured and doubled to give the reverberation time. The measurements were repeated using an alternative sound source. The results from each set of positions were averaged (ie 60 reverberation decays at each frequency).

3 EQUIPMENT

	Departmental Record No
Norwegian Electronics ⅓ octave band real time analyser type 840 with in-built random noise generator	RTA2
Quad 510 power amplifier	PA7
2 off omni-directional broadband loudspeakers (source room)	LS10 – LS11
2 off broadband loudspeakers (receiving room)	LS3-LS4
6 off G.R.A.S. random incidence condenser microphones type 40AP in the source room	SRM1-SRM5 SRM18
5 off G.R.A.S. random incidence condenser microphones type 40AP in the receiving room	RRM7-RRM10 RRM19
1 off Bruel &Kjaer random incidence condenser microphone type 4166 in the receiving room	RRM6
2 off Norsonic Multiplexers type 834A	MP1-MP2
HP Brio Pentium personal computer and related peripheral equipment (printer, plotter, monitor etc.)	COM6
Yamaha GQ1031BII graphic equalizer	GE1

4 RESULTS

The sound reduction indices at one-third octave band intervals, (R), are given in the tables overleaf.

Source room volume:	112m^3
Receiving room volume:	225m^3
Sample sizes:	2400mm x 3600mm
Temperature in source room	See individual results sheet for details
Temperature in receiving room	See individual results sheet for details
Relative humidity in source room:	See individual results sheet for details
Relative humidity in receiving room	See individual results sheet for details

Also given in the attached tables and computed from the one-third octave band sound reduction indices, the weighted sound reduction index Rw calculated according to ISO 717/1-1982.

ISO 140-3:1995 Laboratory measurements of airborne sound insulation of building elements

Client: Kingspan Insulation Limited, Pembridge, Leominster, Herefordshire

Manufacturer Structural Insulated Panel (SIP)
Test specimen mounted by: Client
Product identification: SIP

Measurement procedure: ISO 140-3:1995 Test procedure: ISO 717-1:1996

Mass per unit: 662 - 692 kg/m3 Size: 8.64 m²

Temperature [°C]: 23 Humidity [%]: 40

Test room identification: Small rev room / Large rev room
Source room Volume: 125 m³
Receiving room Volume: 225 m³
Date of test: 17.09.01

Weighted Sound reduction $R_w(C,C_{tr})$ = 31 (-3; -5) dB

Sum of unfavourable deviations: 30.0 dB
Max. unfavourable deviation: 13.8 dB at 500 Hz

$C_{50\text{-}3150}$: ---
$C_{tr50\text{-}3150}$: ---
$C_{50\text{-}5000}$: ---
$C_{tr50\text{-}5000}$: ---
$C_{100\text{-}5000}$: -2 dB
$C_{tr100\text{-}5000}$: -5 dB

Frequency [Hz]	R [dB]	L1 [dB]	L2 [dB]	T [s]	Corr. [dB]	u.Dev. [dB]	
100	25.5	87.6	65.7	9.48	3.6	-.-	
125	24.1	88.8	67.5	7.89	2.8	-.-	
160	24.0	87.6	65.4	6.37	1.8	-.-	
200	24.7	84.7	61.8	6.30	1.8	-.-	
250	24.5	87.0	64.0	5.85	1.5	-.-	
315	24.6	89.4	65.8	5.21	1.0	2.4	
400	20.5	88.3	68.8	5.20	1.0	9.5	
500	17.2	88.6	72.5	5.33	1.1	13.8	
630	27.7	89.7	63.7	6.13	1.7	4.3	
800	35.9	89.6	55.2	5.92	1.5	-.-	
1000	38.9	88.0	50.6	5.89	1.5	-.-	
1250	37.9	88.2	51.4	5.35	1.1	-.-	
1600	37.4	88.0	51.1	4.70	0.5	-.-	
2000	36.1	87.1	51.0	4.18	0.0	-.-	
2500	37.0	87.1	49.6	3.68	-0.5	-.-	
3150	41.6	86.3	43.5	3.14	-1.2	-.-	
4000	45.4	85.9	38.4	2.57	-2.1	-.-	
5000	48.4	85.3	33.7	2.00	-3.2	-.-	

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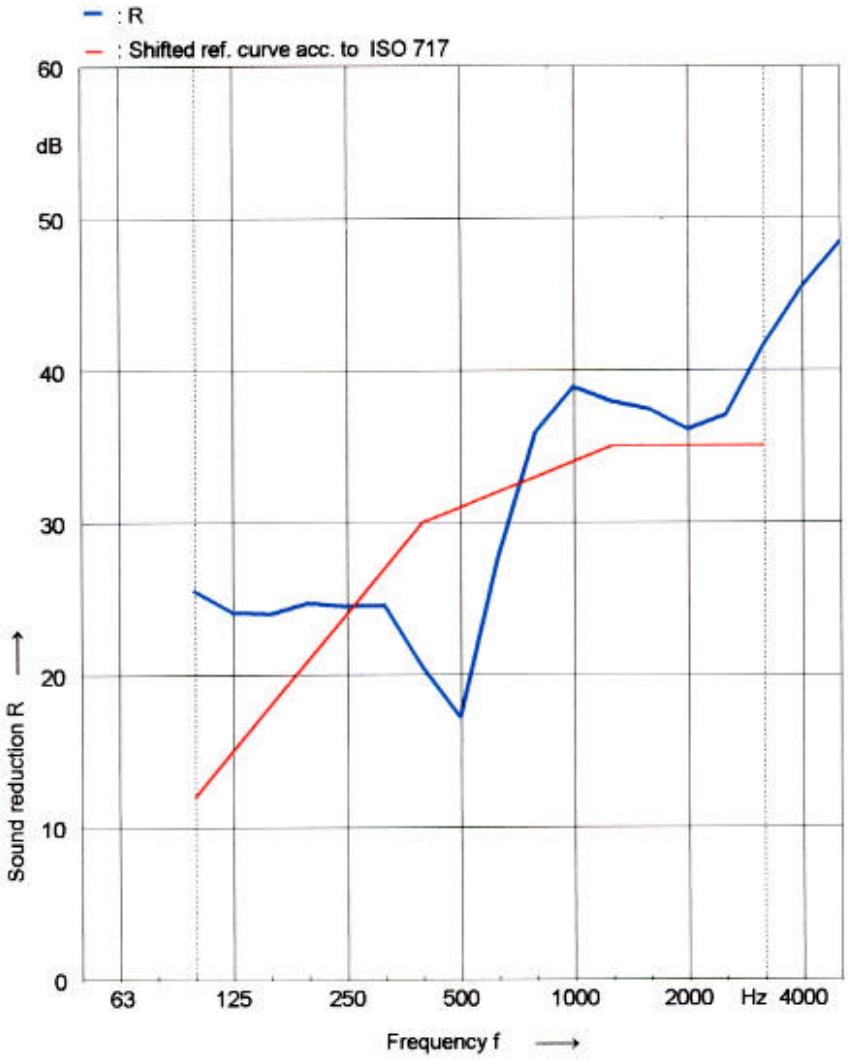
Sound Reduction ISO 140/717 (1982)

Client: Kingspan Insulation Limited, Pembridge
Test specimen mounted by: Client
Description of the specimen:
140mm structural insulated panel (SIP)
2 x 15mm OSB3
Rigid urethane core.
Decorators caulk around perimeter.

Product identification: SIP
Test room identification: Small rev room / Large rev room
Date of test: 17.09.01

Size: 8.64 m²
Mass per unit: 662 - 692 kg/m3
Temperature [°C]: 23
Humidity [%]: 40
Source room Volume: 125 m³
Receiving room Volume: 225 m³

Frequency [Hz]	R 1/3 oct. [dB]
50	-.-
63	-.-
80	-.-
100	25.5
125	24.1
160	24.0
200	24.7
250	24.5
315	24.6
400	20.5
500	17.2
630	27.7
800	35.9
1000	38.9
1250	37.9
1600	37.4
2000	36.1
2500	37.0
3150	41.6
4000	45.4
5000	48.4



Rating according to ISO 717-1
$R_w(C;C_{tr})$ = 31 (-3; -5) dB

$C_{50\text{-}315o}$: ---
$C_{tr50\text{-}315o}$: ---
$C_{50\text{-}5000}$: ---
$C_{tr50\text{-}5000}$: ---
$C_{100\text{-}5000}$: -2 dB
$C_{tr100\text{-}5000}$: -5 dB

Evaluation based on laboratory measurement results obtained by an engineering method

University of Salford School of Acoustics and Electronic Engineering

No. of test report: TL-01-09-11

Signature: