ACOUSTICS
NOISE CONTROL
BUILDING PHYSICS
ENVIRONMENTAL TECHNOLOGY

ADVIESBUREAU PEUTZ & ASSOCIES

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Report

Laboratory for Acoustics
Determination of the sound insulation of a steel sheet 0.8 mm thick without and with various **cladding materials made by Armacell GmbH**

Report number A 1101-1E dd. 4 October 2001

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Report number:	A 1101-1E
Date:	4 October 2001
Ref.:	TS/LvB/Lvl/A 1101-1E-RA

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ADVIESBUREAU PEUTZ & ASSOCIES

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1. INTRODUCTION

At the request of Armacell GmbH at D-48153 Münster sound insulation measurements have been carried out on

a steel sheet 0.8 mm thick
without and with various cladding materials
made by Armacell GmbH

in the Laboratory for Acoustics of "Adviesbureau Peutz & Associés B.V.", Mook, The Netherlands (see figure 1)

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For this type of measurements the Laboratory for Acoustics has been accredited by the Dutch "Stichting Raad voor Accreditatie". The accreditation has been registered in the "STERLAB" register for testing laboratories in the Netherlands.

2. NORMS AND GUIDELINES

The measurements have been carried out according to the Quality Manual of the Laboratory for Acoustics and to:

ISO 140-3:1995 Acoustics - Measurements of sound insulation in buildings and of building elements: Part 3: Laboratory measurements of airborne sound insulation of building elements

NOTE: this international standard has been accepted within all EU-countries as European Norm EN ISO 140-3:1995

Various other related norms:

ISO 140-1:1997 Acoustics - Measurement of sound insulation of building elements - Part 1: Requirements for laboratory test facilities with suppressed flanking transmission

NOTE: this international standard has been accepted within all EU-countries as European Norm EN ISO 140-1:1997

ISO 140-2:1991 Acoustics - Measurement of sound insulation of building elements - Part 2: Determination, verification and application of precision data

NOTE: this international standard has been accepted within all EU-countries as European Norm EN 20140-2:1993

ISO 717-1:1996 Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation

NOTE: this international standard has been accepted within all EU-countries as European Norm EN ISO 717-1:1996

3. TESTED CONSTRUCTIONS

The steel sheet of 0.8 mm thick with a mass of 6.31 kg/m^2 (measured) to be tested has been placed into a test opening of (h x w) 1250 x 1500 mm between two test rooms, see figure 2.

The joints between the steel sheet under test and the perimeter of the test opening has been sealed carefully.

The description of the cladding material applied to the steel sheet at different times has been delivered by the principal. The date have been completed with observations of the Laboratory where applicable.

Different cladding materials have been tested:

- a self-adhesive "lamella mat" type 133EF manufactured by Rockwool (NL), 25 mm thick with a mass of 1.25 kg/m^2 (measured)
- Armaduct 15 mm (made by Armacell GmbH) with added 2 mm PVC-foil, total mass 4.33 kg/m^2 (measured),
- Armaduct 20 mm (made by Armacell GmbH) total mass 0.92 kg/m^2 (measured),
- Armaduct 10 mm (made by Armacell GmbH) total mass 0.57 kg/m^2 (measured)

4. MEASUREMENTS

4.1. Method

The tests were conducted in accordance with the provisions of the test method ISO 140-3 in the acoustical laboratory of Adviesbureau Peutz & Associés BV in Mook. A detailed description of the test set up has been given in the figure 2 of this report.

The construction to be tested is placed into a test opening between two measuring rooms. In one of the rooms (the so-called source room) broad-band noise is generated by loudspeakers.

In this source room as well as in the adjacent room (the "receiving room") the resulting sound pressure level is measured by means of a continuous rotating boom, so the (time- and space-) averaged sound pressure level is determined.

The reverberation time of the receiving room is also measured.

The instruments and the method used meet the requirements of ISO 140-3

As allowed by the test method the test procedure is repeated reversing the source and receiving rooms. The reported value of each sound insulation is the arithmetic average of the two results.

In ISO 140-3 the airborne sound insulation of an object is defined as the "sound reduction index R" to be evaluated according to formula 1 and expressed in dB:

$$R = L_1 - L_2 + 10 \lg\left(\frac{S}{A}\right) \qquad (1)$$

in which:

L_1	=	sound pressure level in the source room	[dB]
L_2	=	sound pressure level in the receiving room	[dB]
S	=	area of the object to be tested	[m^2]
A	=	equivalent sound absorption [m^2] in the receiving room according to:	

$$A = \frac{0.16 \cdot V}{T} \qquad (2)$$

in which :

V	=	volume of the receiving room	[m^3]
T	=	reverberation time in the receiving room	[s]

4.2. Accuracy

The accuracy of the airborne sound insulation as calculated can be expressed in terms of repeatability (tests within one laboratory) and reproducibility (between various laboratories).

4.2.1. Repeatability r

When: - two tests are performed on identical test material - within a short period of time - by the same person or team - using the same instrumentation - under unchanged environmental conditions - the probability will be 95% that the difference between the two test results will be less than or equal to r.

In order to evaluate the repeatability r for the sound insulation measurements performed in the laboratories of "Adviesbureau Peutz & Associés" in Mook eight series of measurements have been carried out according to ISO 140-2. From the results of those measurements the repeatability r has been calculated. It was found that for the frequency range from 100 to 250 Hz the repeatability r is 2.0 dB as a maximum. For the frequency range 315 to 3150 Hz the repeatability r is 1.3 dB as a maximum.

The repeatability r regarding the single-figure rating R_w is 0.7 dB as a maximum. As ISO 717-1 prescribes rounding of the R_w-values to the nearest dB repeatability r of 1 dB is applicable for the R_w-value.

From these results it may be concluded that the repeatability r as found satisfies the demands of ISO 140-2.

4.2.2. Reproducibility R

When: - two tests are performed on identical test material - in different laboratories - by different person(s) - under different environmental conditions - the probability will be 95% that the difference between the two test results will be less than or equal to R

In ISO 140-2 there is a statement on the reproducibility R to be expected, based on the results of various inter-laboratory tests. The reproducibility of the single figure rating R_w is about 3 dB.

4.3. Environmental conditions during the tests

room	Temperature [°C]	relative humidity [%]
2	19	75
3	19	75

4.4. Results

The results of the measurements are given in table I and in figures 3 to 7

Table I: results of the measurements of the 0.8 mm steel sheet

Cladding	SOUND REDUCTION INDEX R [dB]									
	None		Lamella mat Rockwool 133EF 25 mm		Armaduct 15mm + PVC foil 2 mm		Armaduct 20 mm		Armaduct 10mm	
Mass [kg/m^2]	6.31		6.31+1.25		6.31+ 4.33		6.31+ 0.92		6.31+ 0.57	
Figure	3		4		5		6		7	
Frequency [Hz]	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.
100	14.7		16.5		18.8		16.7		16.8	
125	16.2	15.8	18.7	17.7	20.8	19.9	17.9	17.4	17.8	17.4
160	16.6		18.3		20.4		17.7		17.7	
200	17.4		18.7		21.1		18.3		18.2	
250	19.1	18.8	19.8	19.7	22.5	22.3	19.8	19.6	19.6	19.5
315	20.6		20.7		23.6		21.2		21.3	
400	22.8		22.8		25.3		22.8		23.2	
500	24.1	24.2	23.3	23.3	25.9	25.8	23.6	23.6	24.5	24.5
630	26.3		23.8		26.2		24.5		26.3	
800	28.6		24.5		27.2		25.3		27.8	
1000	30.6	30.2	25.8	26.2	30.0	29.6	26.1	26.3	29.1	28.8
1250	32.3		29.7		34.0		27.9		29.6	
1600	33.8		34.6		38.7		31.2		29.5	
2000	35.2	35.0	39.2	37.8	42.9	41.6	35.7	34.2	30.4	30.6
2500	36.5		45.0		46.7		40.0		32.6	
3150	38.3		50.5		49.2		43.2		35.1	
4000	40.1	39.7	53.7	52.8	51.6	51.2	45.9	45.5	38.0	37.4
5000	41.3		55.7		54.1		49.7		41.2	
$R_w(C;C_{tr})$	29(-1;-4) dB		28(-1;-3) dB		31(-1;-4) dB		28(-1;-3) dB		28(0;-3) dB	

In the tables and graphs the values of the insulation found are presented in 1/3 octave bands.

From these values the weighted sound reduction index R_w according to ISO 717-1 including the spectrum adaptation terms C and C_{tr} have been calculated and stated.

Th. Scheers
Leader of the Laboratory

Mook,
ir. M.L.S Vercammen
manager

This report contains: 8 page(s) and 7 figures

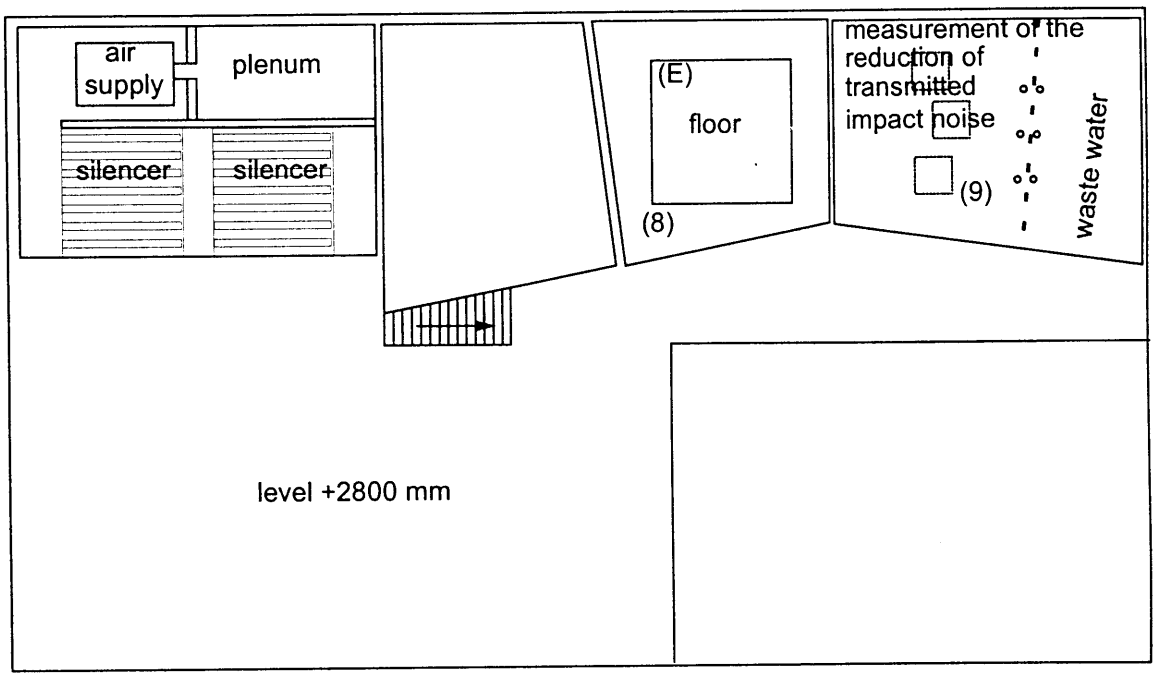
LABORATORY FOR ACOUSTICS

PEUTZ

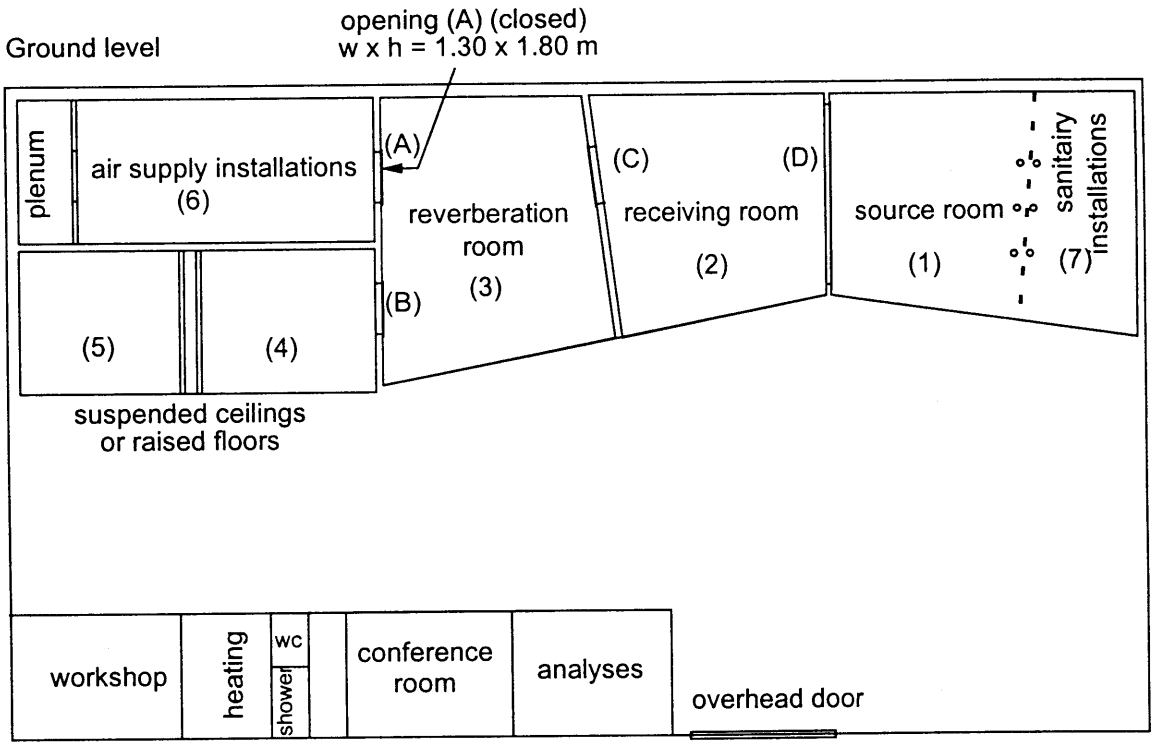
ADVIESBUREAU PEUTZ & ASSOCIES B.V.
Lindenlaan 41, NL-6584 AC MOLENHOEK (LB), NETHERLANDS

OVERVIEW

Story



Ground level



TEST OPENINGS (w x h in mm)
(B) 1000 x 2200
(C) 1500 x 1250
(D) 4300 x 2800
(E) 4000 x 4000

0 1 2 3 4 5 m
scale

figure 1.

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Lindenlaan 41, NL-6584 AC MOLENHOEK (LB), NETHERLANDS

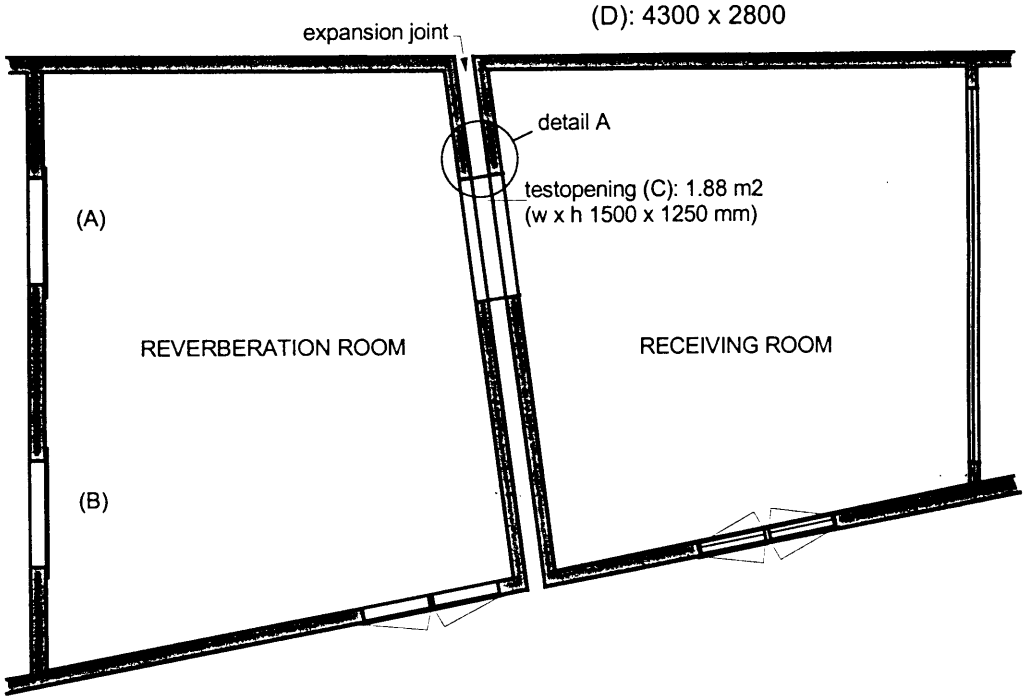
SOUND INSULATION TEST FACILITIES

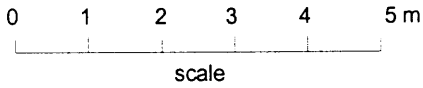
The testrooms meet the requirements of ISO 140-1
Additional data:

volume of the receiving room: 115 m^3
volume of the reverberation room: 214 m^3
area of the test specimen: 1.88 m^2

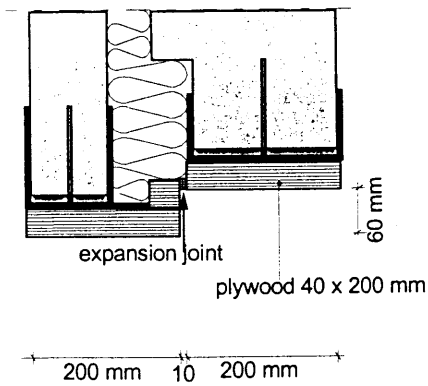
Both rooms are isolated for vibrations by using a so called room-in-room construction. Flanking transmission is thus minimised.

closed other testopenings
(nominal width x height in mm)
(A): 1300 x 1800
(B): 1000 x 2200
(D): 4300 x 2800





detail A



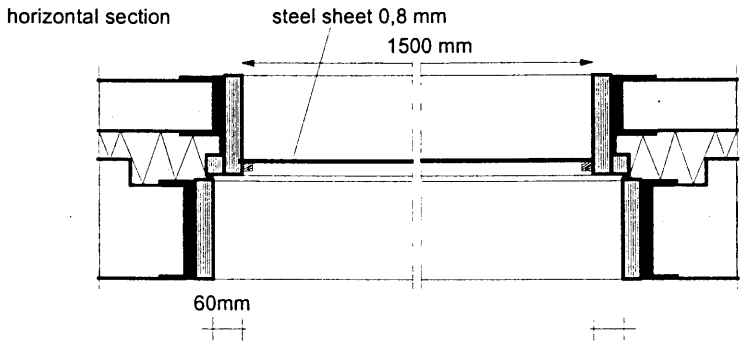
LABORATORY FOR ACOUSTICS

PEUTZ

QUALIFIED BY STERLAB Reg. Nr L334

MEASUREMENT OF THE SOUND INSULATION ACCORDING TO ISO 140-3:1995
principal: Armacell GmbH

construction tested: #1: STEEL SHEET 0.8 mm thick



volume sending room: 214 m^3

volume receiving room: 115 m^3

surface area tested partition: 1.88 m^2

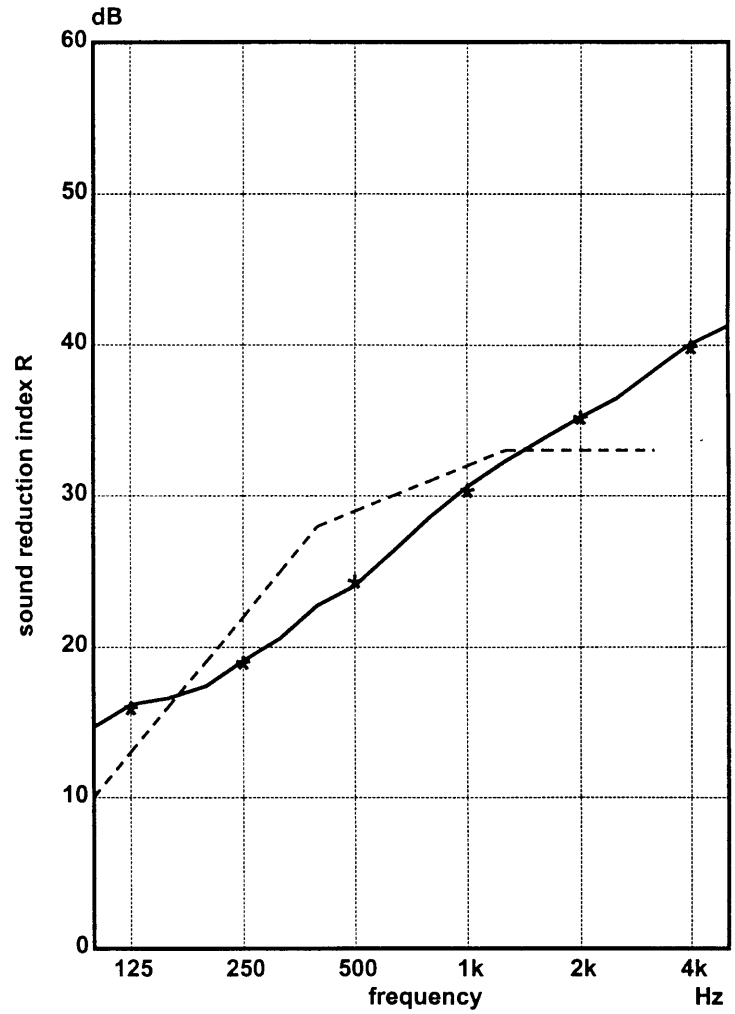
mass tested partition: 6.31 kg/m^2

measured at: laboratory conditions

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:1996
$R_w(C;C_{tr})$ = 29(-1;-4) dB



	14.7	17.4	22.8	28.6	33.8	38.3
1/3 oct.	16.2	19.1	24.1	30.6	35.2	40.1 dB
	16.6	20.6	26.3	32.3	36.5	41.3
1/1 oct.	15.8	18.8	24.2	30.2	35.0	39.7 dB

* 1/1 oct.
——— 1/3 oct.
- - - - - ref. curve (ISO 717)

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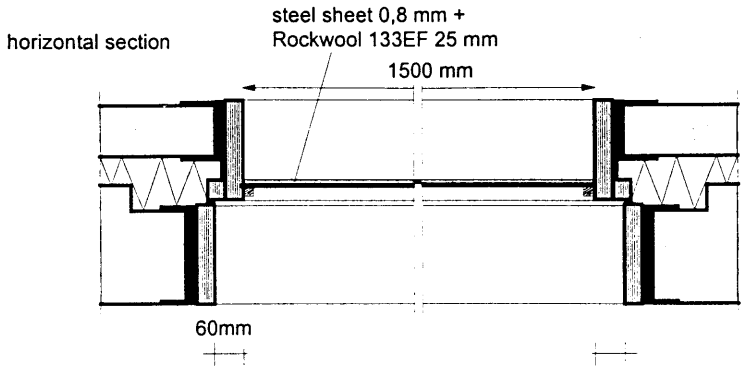
LABORATORY FOR ACOUSTICS

PEUTZ

MEASUREMENT OF THE SOUND INSULATION ACCORDING TO ISO 140-3:1995
principal: Armacell GmbH

QUALIFIED BY STERLAB Reg. Nr L334

construction tested: #2: STEEL SHEET 0.8mm + Rockwool 133EF 25 mm glued together



volume sending room: 214 m^3

volume receiving room: 115 m^3

surface area tested partition: 1.88 m^2

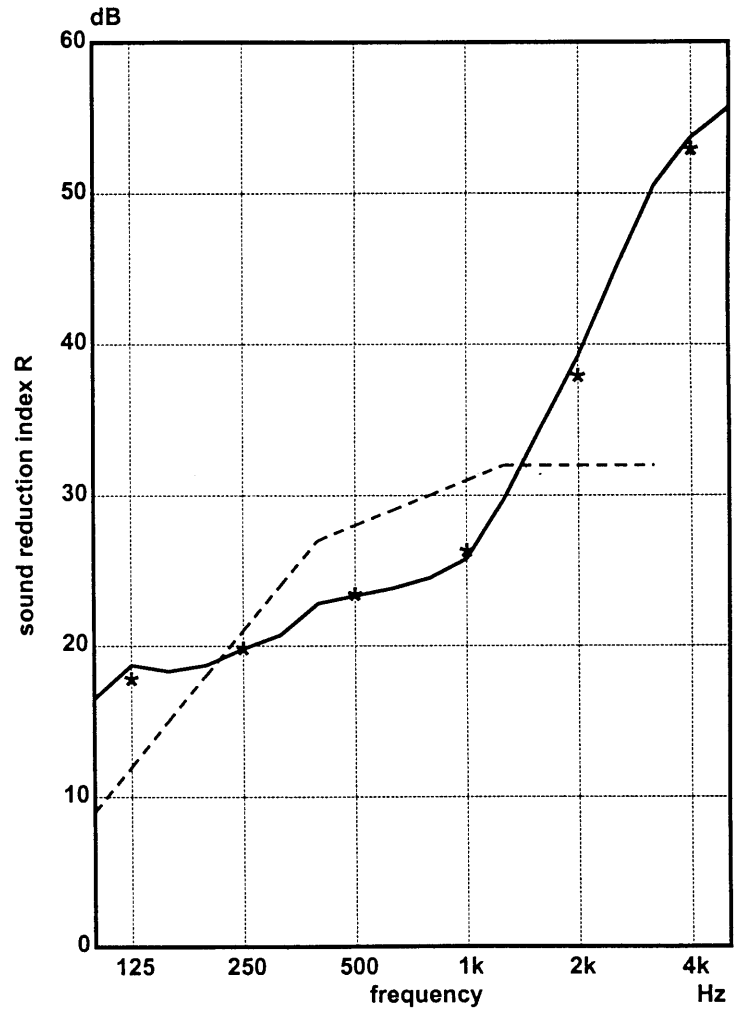
mass tested partition: 7.56 kg/m^2

measured at: laboratory conditions

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:1996
$R_w(C;C_{tr})$ = 28(-1;-3) dB



	16.5	18.7	22.8	24.5	34.6	50.5	
1/3 oct.	18.7	19.8	23.3	25.8	39.2	53.7	dB
	18.3	20.7	23.8	29.7	45.0	55.7	
1/1 oct.	17.7	19.7	23.3	26.2	37.8	52.8	dB

* 1/1 oct.
——— 1/3 oct.
- - - - - ref. curve (ISO 717)

Mook, 01-10-2001

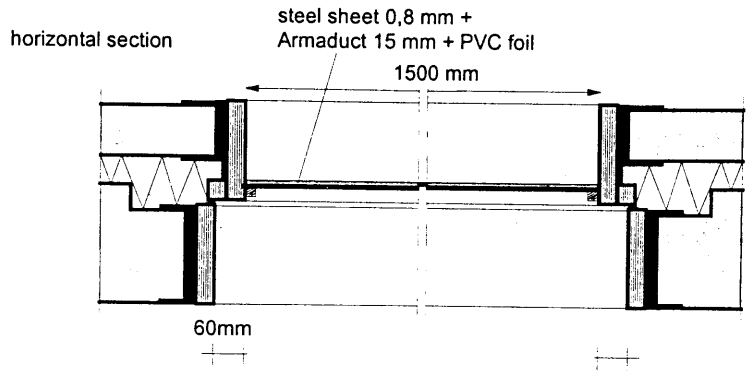
LABORATORY FOR ACOUSTICS

PEUTZ

MEASUREMENT OF THE SOUND INSULATION ACCORDING TO ISO 140-3:1995
principal: Armacell GmbH

QUALIFIED BY STERLAB Reg. Nr L334

construction tested: #3: STEEL SHEET 0.8 mm + Armaduct 15mm + PVC foil 2 mm glued together



volume sending room: 214 m^3

volume receiving room: 115 m^3

surface area tested partition: 1.88 m^2

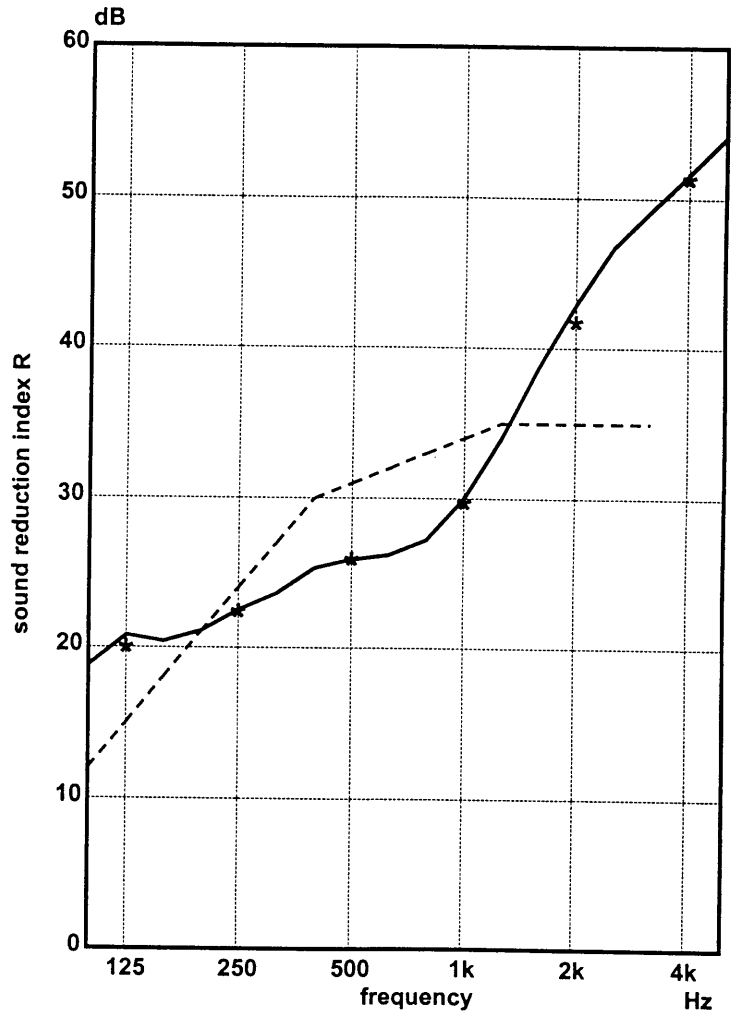
mass tested partition: 10.64 kg/m^2

measured at: laboratory conditions

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:1996
$R_w(C;C_{tr})$ = 31(-1;-4) dB



		18.8	21.1	25.3	27.2	38.7	49.2
1/3 oct.		20.8	22.5	25.9	30.0	42.9	51.6 dB
*	1/1 oct.	20.4	23.6	26.2	34.0	46.7	54.1
———	1/3 oct.						
- - - - -	ref. curve (ISO 717)						
1/1 oct.		19.9	22.3	25.8	29.6	41.6	51.2 dB

Mook, 01-10-2001

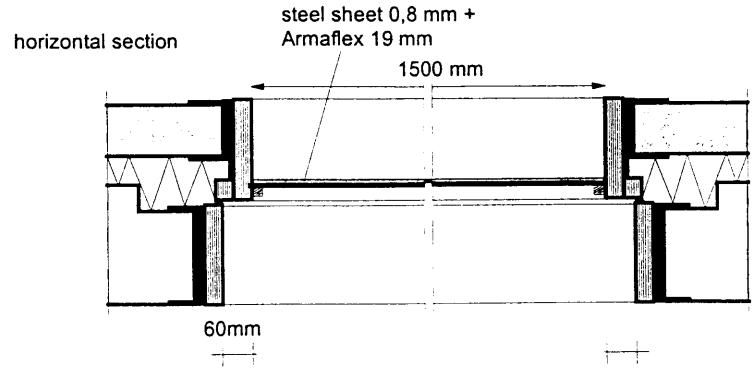
LABORATORY FOR ACOUSTICS

PEUTZ

QUALIFIED BY STERLAB Reg. Nr L334

MEASUREMENT OF THE SOUND INSULATION ACCORDING TO ISO 140-3:1995
principal: Armacell GmbH

construction tested: #4. STEEL SHEET 0.8mm + Armaduct 20 mm glued together



volume sending room: 214 m^3

volume receiving room: 115 m^3

surface area tested partition: 1.88 m^2

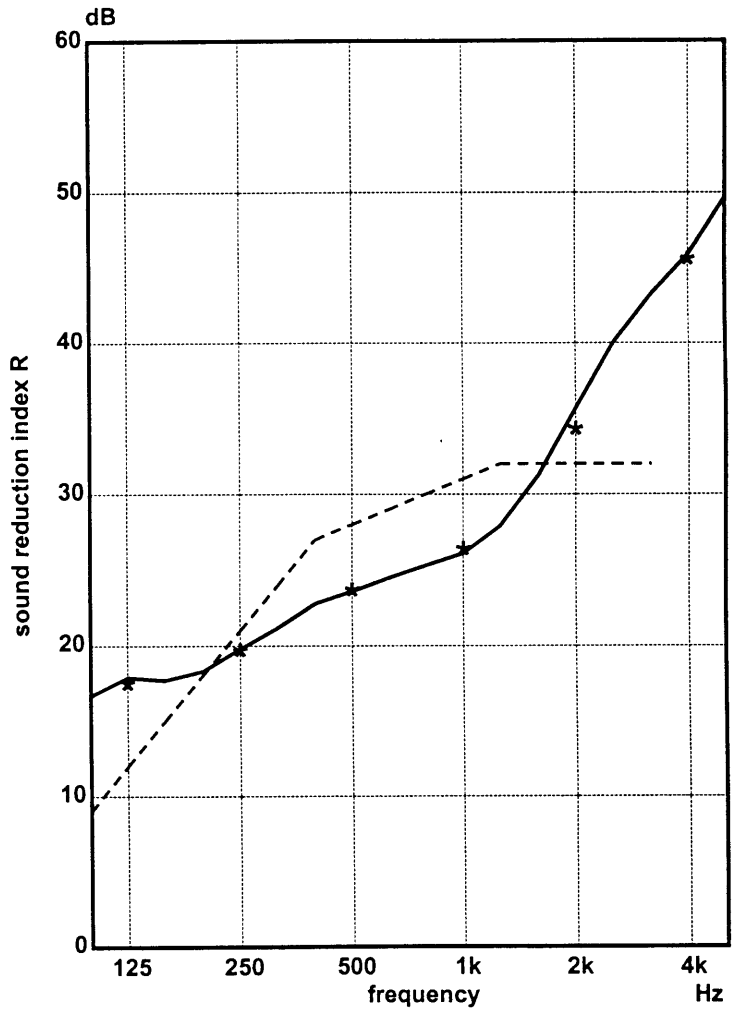
mass tested partition: 7.23 kg/m^2

measured at: laboratory conditions

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:1996
$R_w(C;C_{tr})$ = 28(-1;-3) dB



	16.7	18.3	22.8	25.3	31.2	43.2
1/3 oct.	17.9	19.8	23.6	26.1	35.7	45.9 dB
	17.7	21.2	24.5	27.9	40.0	49.7
1/1 oct.	17.4	19.6	23.6	26.3	34.2	45.5 dB

* 1/1 oct.
——— 1/3 oct.
- - - - - ref. curve (ISO 717)

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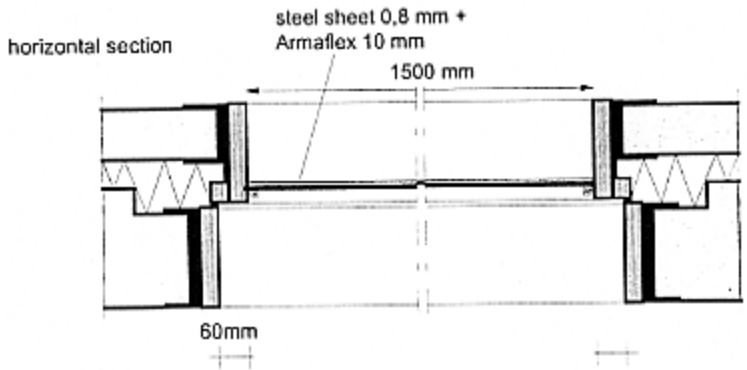
MEASUREMENT OF THE SOUND INSULATION ACCORDING TO ISO 140-3:1995
principal: Armacell GmbH

QUALIFIED BY STEELAB Reg. Nr L334

construction tested: #5: STEEL SHEET 0.8 mm + Armaduct 10 mm glued together



volume sending room: 214 m^3

volume receiving room: 115 m^3

surface area tested partition: 1.88 m^2

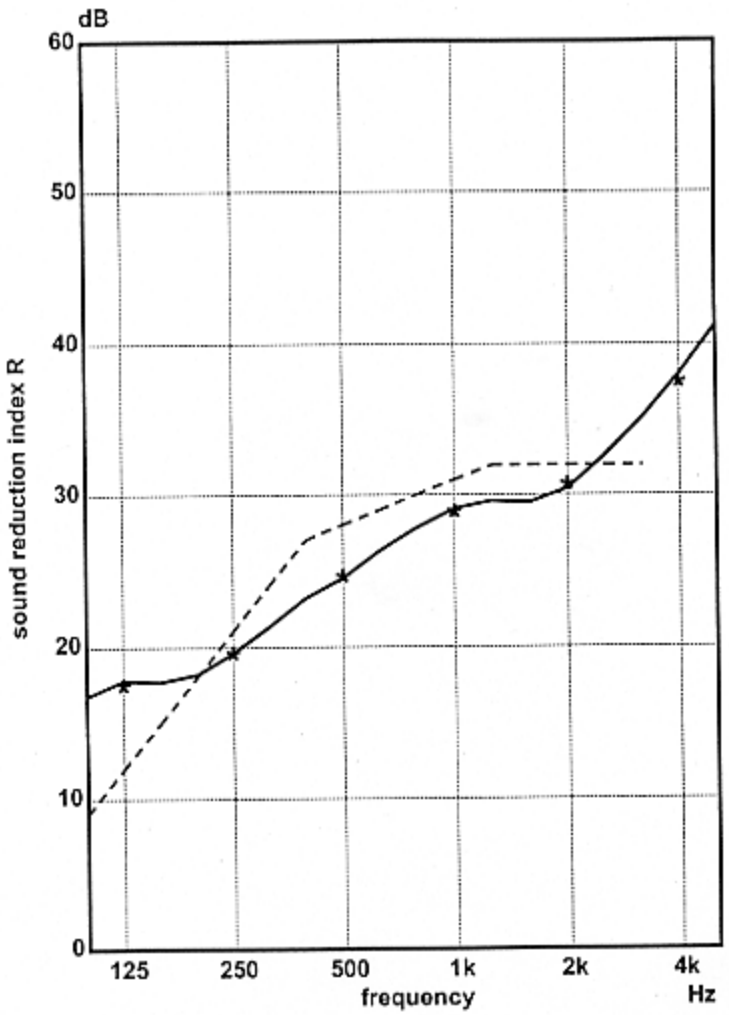
mass tested partition: 6.88 kg/m^2

measured at: laboratory conditions

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:1996
$R_w(C;C_{tr})$ = 28(0;-3) dB



	16.8	18.2	23.2	27.8	29.5	35.1
1/3 oct.	17.8	19.6	24.5	29.1	30.4	38.0 dB
	17.7	21.3	26.3	29.6	32.6	41.2
1/1 oct.	17.4	19.5	24.5	28.8	30.6	37.4 dB

* 1/1 oct.
——— 1/3 oct.
- - - - - ref. curve (ISO 717)

Mook, 01-10-2001