

Report

Laboratory for Acoustics

Determination of the insertion loss of **heat exchangers, type RS 300 and type RS 160, manufactured by Recair B.V.**

Report number A 1779-1E-RA d.d. December 9, 2011

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Report number: A 1779-1E-RA

Date: April 28, 2011 (translated December 9, 2011)

Ref.: TS/YW/ /A 1779-1E-RA

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BTW: NL004933837B01
KvK: 12028033

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1. INTRODUCTION

At the request of Recair B.V. based in Waalwijk (the Netherlands) measurements have been carried out in order to determine the insertion loss of

heat exchangers, type RS 300 and type RS 160, manufactured by Recair B.V.

in the Laboratory for Acoustics of Peutz bv, at Mook, The Netherlands (see figure 1).

The measurements have been carried out according to ISO 7235.

2. STANDARDS AND GUIDELINES

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

ISO 7235:2003 "Acoustics - Laboratory measurement procedures for ducted silencers and air-terminal units - Insertion loss, flow noise and total pressure loss"

3. TESTED CONSTRUCTION

The data presented here have been received from the principal or obtained by own observations.

The dimensions and some pictures from the examined heat exchangers are given in figure 3 and 4, which belongs to this report.

The following 2 heat exchangers have been tested:

Image 1: heat exchanger, type RS 300

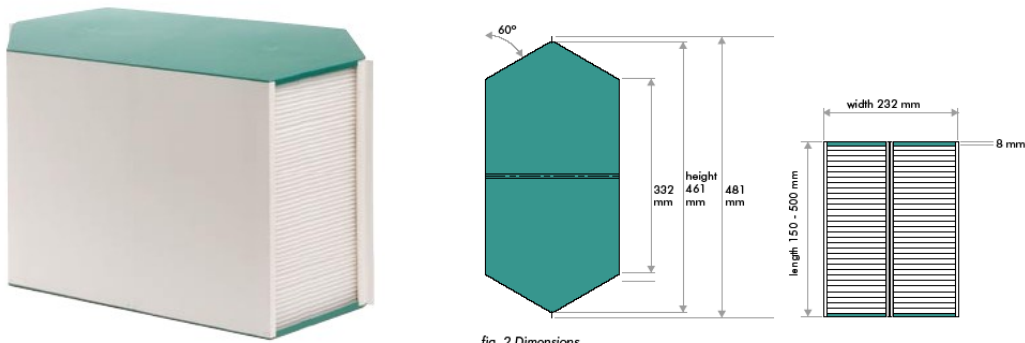


fig. 2 Dimensions.

Image 2: heat exchanger, type RS 160

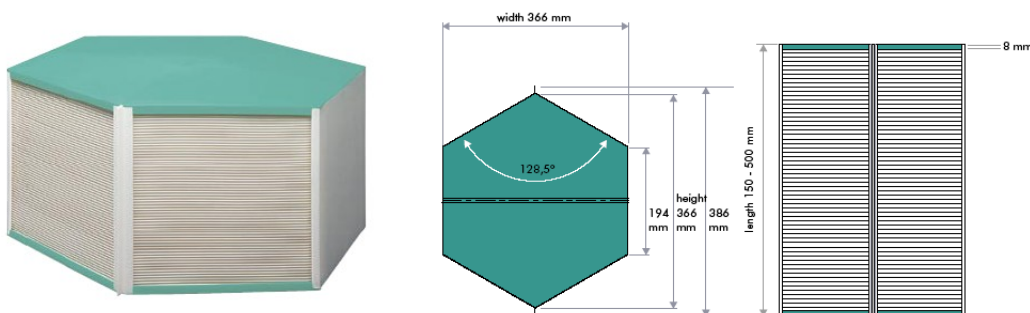


fig. 2 Dimensions.

The results as presented here relate only to the tested items and laboratory conditions as described in this report. The laboratory can make no judgement about the representativity of the tested samples.

4. MEASUREMENTS

4.1. Method

The test was conducted in accordance with the in the ISO 7235 described reverberation room method.

The heat exchangers were mounted in a measurement set-up as given in figure 3. Noise is introduced in the measuring duct using a loudspeaker system which is mounted at one end of this duct in ventilation room (6). The other end of the duct leads into the reverberation room (3). The sound pressure level in the reverberation room caused by the loudspeaker is measured in two situations:

- with the specimen to be tested installed in the measuring duct
- without the specimen. Instead of the specimen a substitution duct (dummy) with the same dimensions (length, diameter) is installed in the measuring duct

A microphone on a rotating boom is used in the reverberation room in order to measure the noise radiated from the measurement duct. The reverberation time of the room is also determined. From each set of measurements (sound pressure level and reverberation time) the sound power level L_w radiated into the reverberation room is calculated according to ISO 3741¹. The insertion loss D_i is now calculated as

$$D_i = L_{wII} - L_{wI} \quad (1)$$

in which:

L_{wI} = the sound power level in the reverberation room, with heat exchanger [dB]

L_{wII} = the sound power level in the reverberation room, without heat exchanger
(with a substitution duct) [dB]

The insertion loss is determined from 50 up to and including 10kHz.

4.2. Results

The results of the measurements are given in table 1 and in figure 5 and 6.

The accuracy of the measurements is in accordance to the requirements as described in the ISO 7235. In the table and the figures the results were presented for each frequency band. From those values the following one-figure ratings have been calculated and stated

- the "weighted sound reduction index $D_{i,w}$ " according to ISO 717-1

¹ For this type of measurements the Laboratory for Acoustics has been accredited by the Dutch Council for Accreditation (RvA) as a test laboratory, registration number L334.

Table 1 results

type figure	Insertion loss D_i			
	RS 300		RS 160	
	5		6	
frequency [Hz]	1/3 oct.	1/1 oct.	1/3 oct.	1/1 oct.
50	-6,3		-6,0	
63	6,3	-2,1	2,0	-2,8
80	4,1		-0,5	
100	4,2		-2,2	
125	-0,9	0,9	-2,5	-1,2
160	0,8		2,5	
200	2,9		5,6	
250	3,5	3,1	4,9	3,9
315	2,8		2,0	
400	6,7		13,1	
500	3,3	5,2	11,9	14,1
630	6,3		24,0	
800	9,0		17,1	
1000	4,8	5,8	7,4	6,1
1250	4,9		2,7	
1600	7,4		6,7	
2000	9,5	8,9	6,6	7,7
2500	10,2		11,3	
3150	13,1		15,1	
4000	13,3	13,9	18,3	17,2
5000	16,0		19,6	
6300	22,5		19,8	
8000	25,3	23,6	20,9	20,2
10000	23,4		20,0	
$D_{i,w}$	7 dB		8 dB	

Note: According to ISO 7235 it is recommended to mark that strictly speaking the insertion loss is valid for the test object together with the transitions since the effects of the transitions cannot always be neglected.

Mook,

Th. Scheers
Laboratory Supervisor

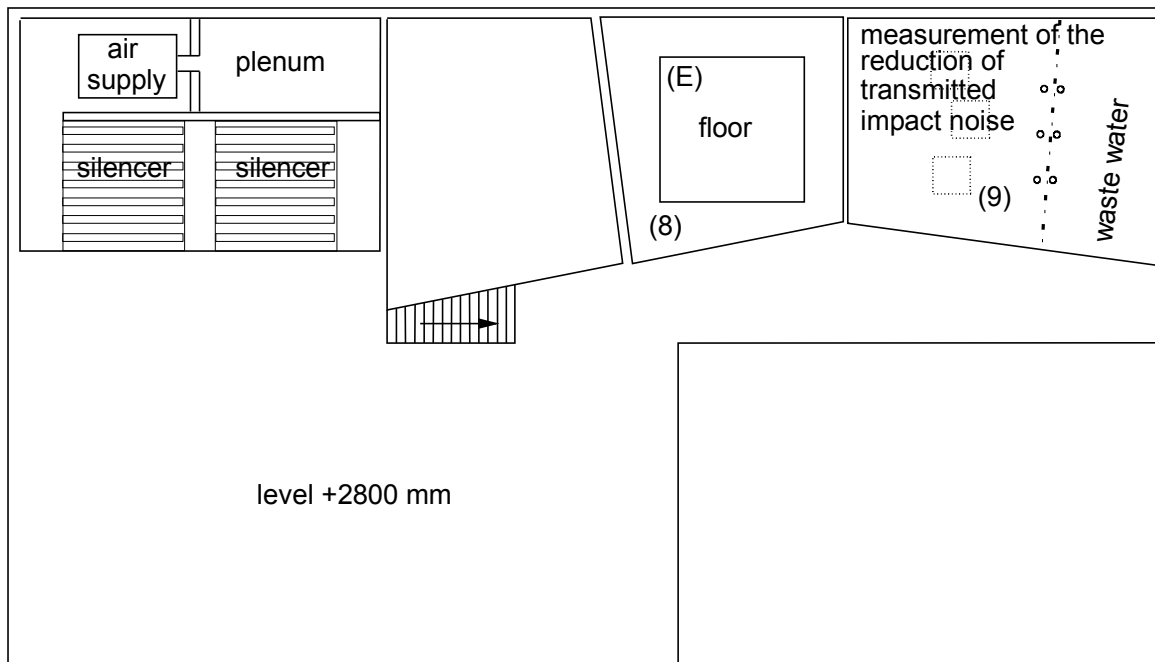
ir. M.L.S. Vercammen
Manager

This report contains: 7 pages and 6 figures.

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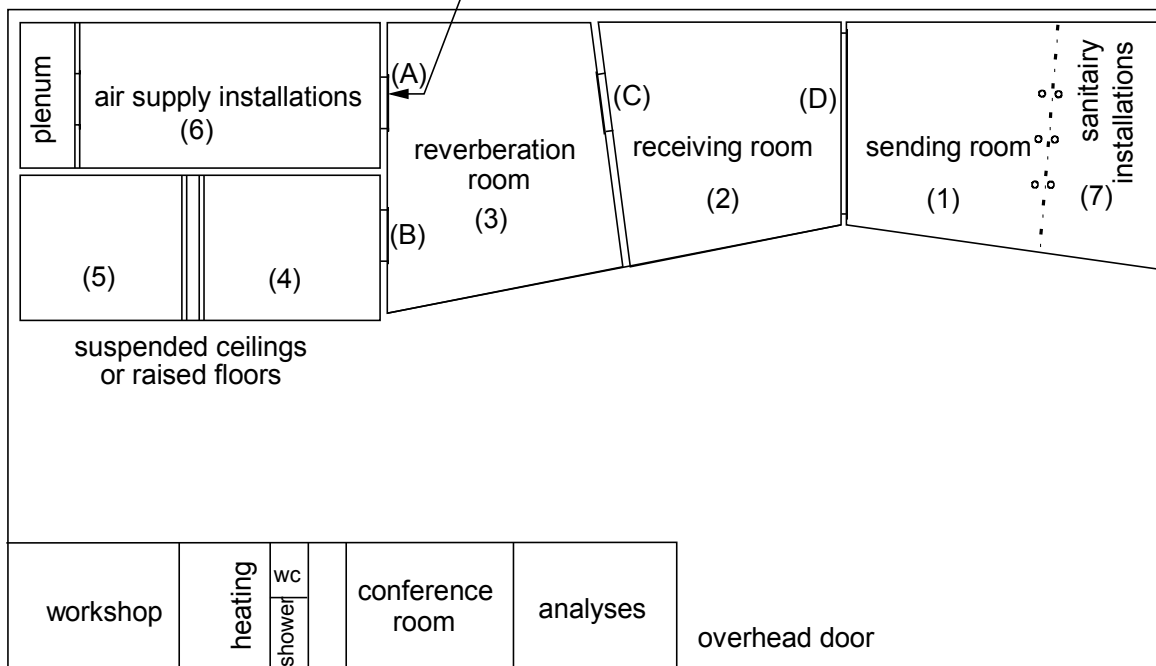
OVERVIEW

Story



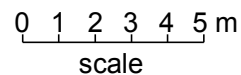
Ground level

opening (A) (closed)
w x h = 1300 x 1905 mm



TEST OPENINGS (w x h in mm)

- (B) 1000 x 2200
- (C) 1500 x 1250
- (D) 4300 x 2800
- (E) 4000 x 4000



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REVERBERATION ROOM

De reverberation room meets the requirements of ISO 354:1985.

additional data:

volume : 214 m³

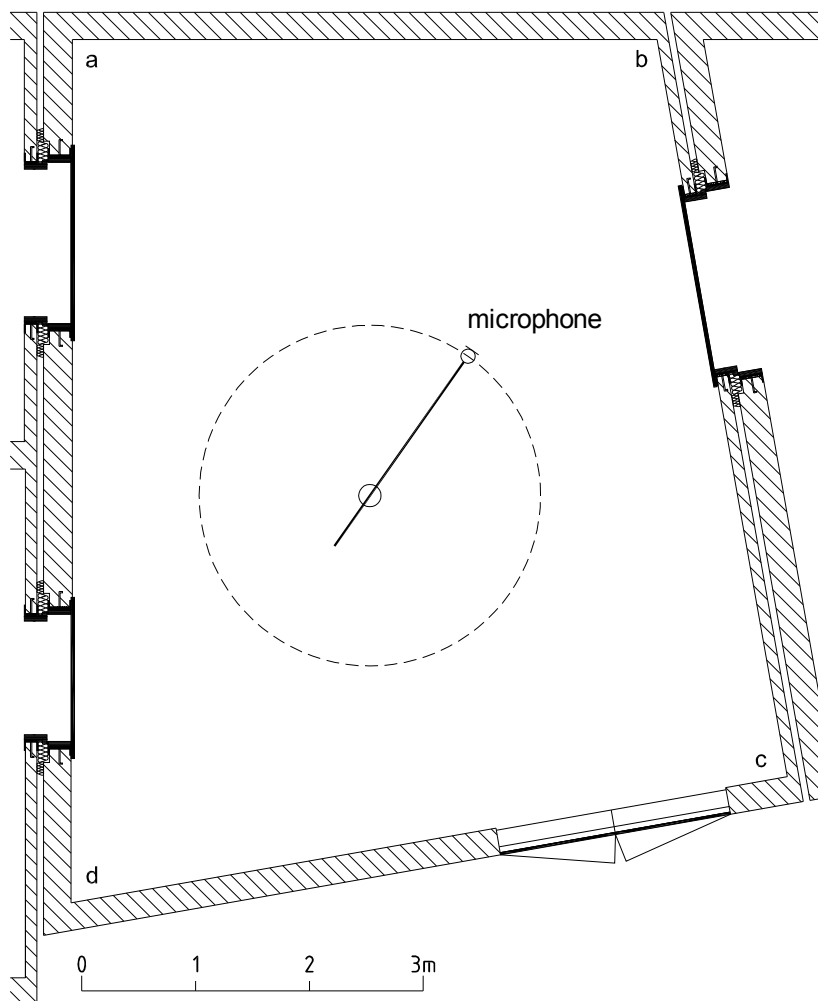
total area S_t (walls, floor and ceiling) : 219 m²

diffusion: by the shape of the room and by adding a number of curved reflecting elements with a total area of approx. 13 m² a sufficient diffusion has been gained.

qualification: this reverberation room is qualified cf. Annex A and Annex E of ISO 3741:1999.

reverberation times of room (1) measured at 02-04-2008

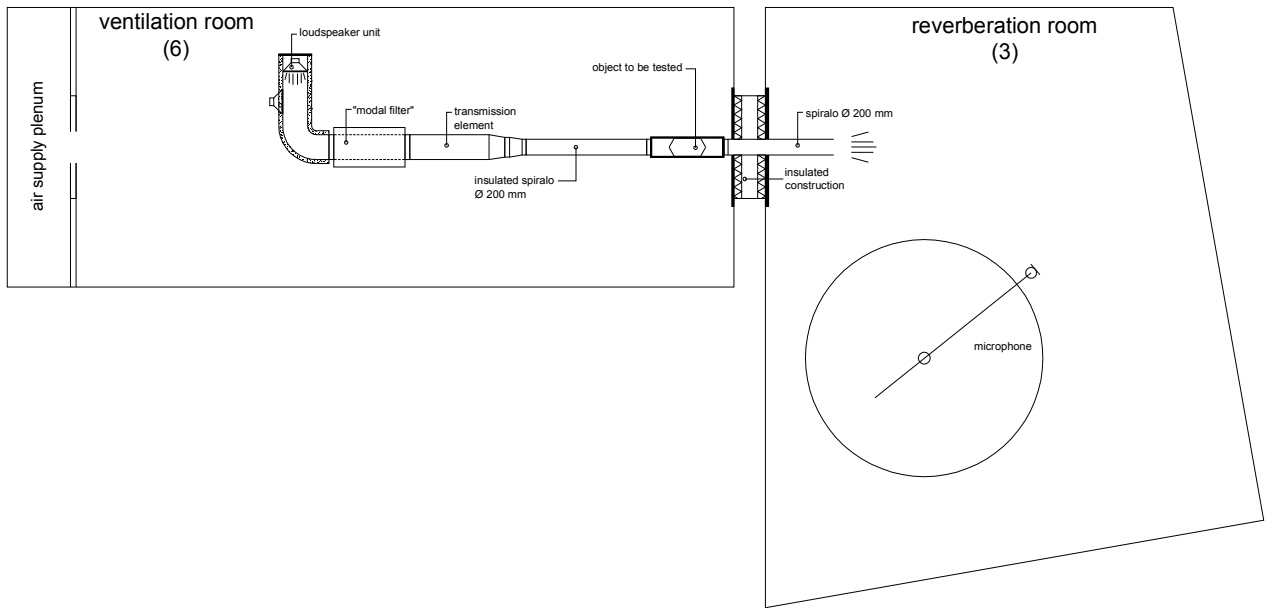
frequency (1/1 oct.)	125	250	500	1000	2000	4000	Hz
reverberation time	2,04	2,50	2,87	3,05	2,72	2,04	sec.



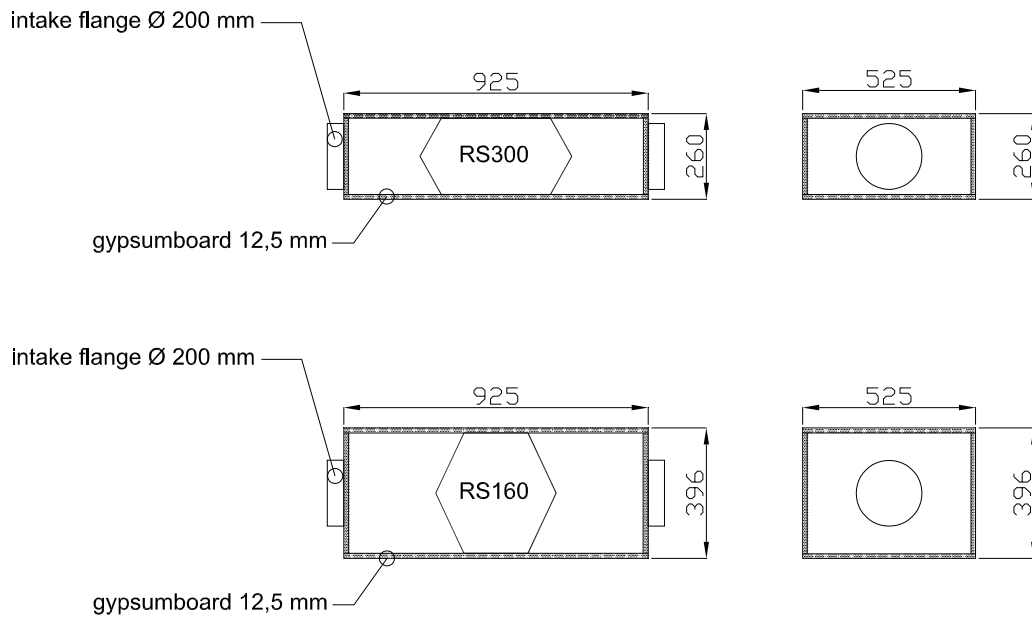
(closed) testopenings
(width x height)
(A) 1300 x 1800 mm
(B) 1000 x 2200 mm
(C) 1500 x 1250 mm

height at:
a: 5573 mm
b: 5102 mm
c: 5000 mm
d: 5580 mm

Measurement set-up



invested heat-exchangers:



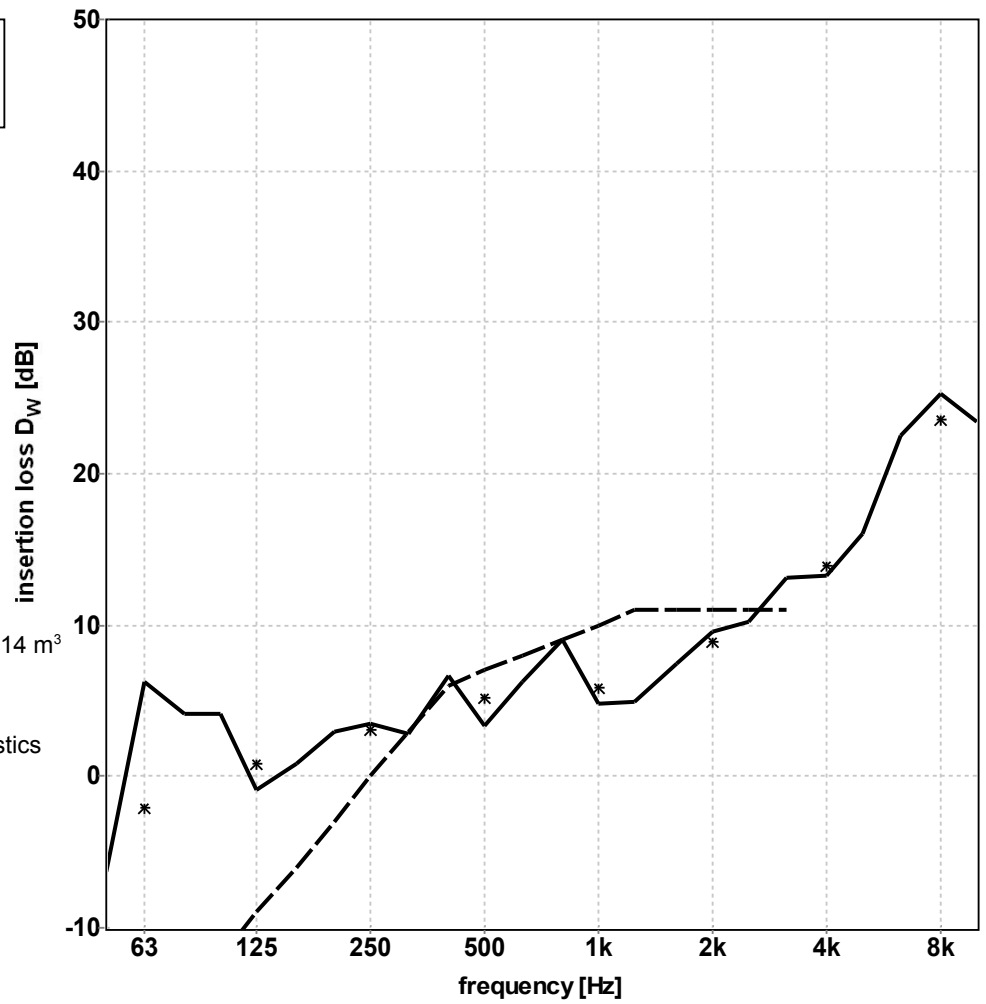
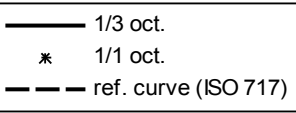
Pictures of the measurement configuration



MEASUREMENT OF THE INSERTION LOSS D_i ACCORDING TO ISO 7235:2003

principal: Recair B.V.

construction tested: heat exchanger, type RS 300



volume measuring room: 214 m³

measured at:
Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:1996

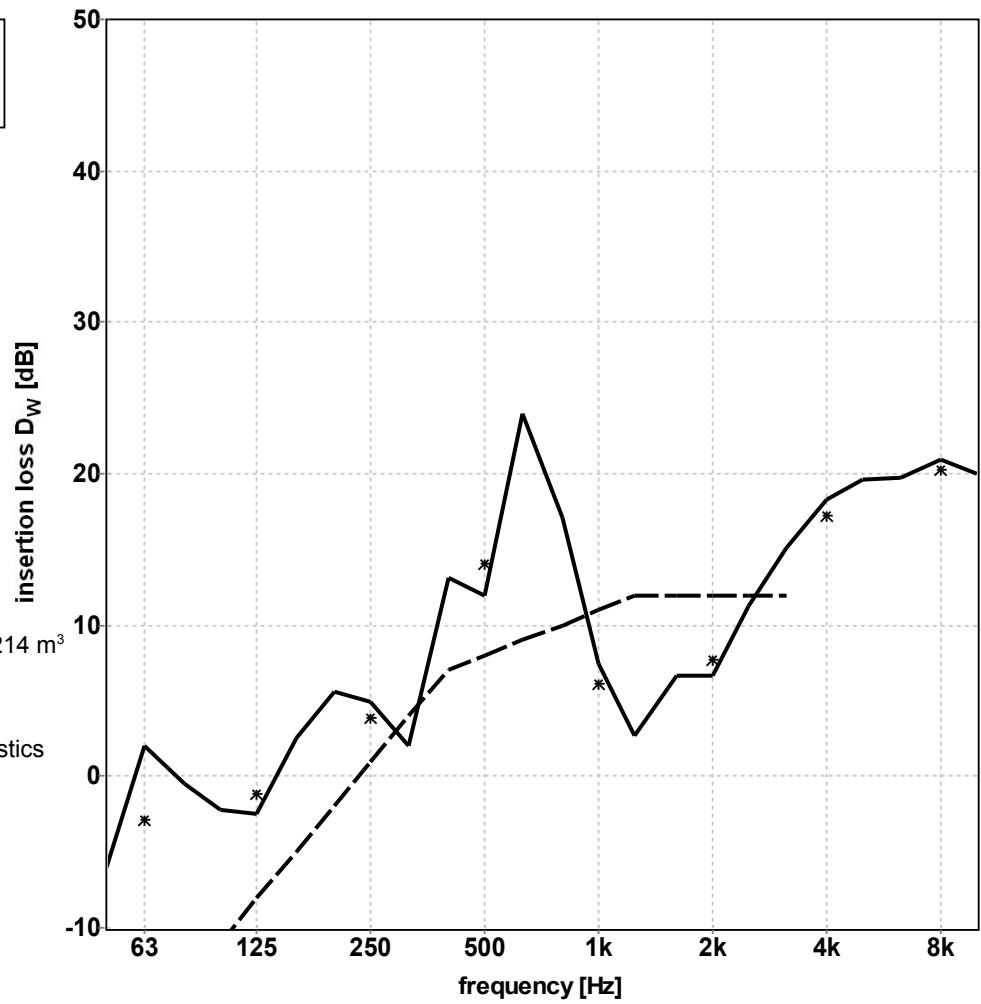
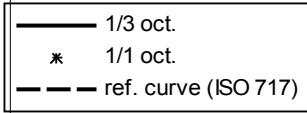
$D_{lw} = 7$ dB

	63	125	250	500	1k	2k	4k	8k	
1/3 oct.	-6,3 6,3 4,1	4,2 -0,9 0,8	2,9 3,5 2,8	6,7 3,3 6,3	9,0 4,8 4,9	7,4 9,5 10,2	13,1 13,3 16,0	22,5 25,3 23,4	dB
1/1 oct.	-2,1	0,9	3,1	5,2	5,8	8,9	13,9	23,6	dB

MEASUREMENT OF THE INSERTION LOSS D_i ACCORDING TO ISO 7235:2003

principal: Recair B.V.

construction tested: heat exchanger, type RS 160



volume measuring room: 214 m³

measured at:
Peutz Laboratory for Acoustics

signal: broad-band noise

bandwidth: 1/3 octave

ISO 717-1:1996

$D_i = 8$ dB

	63	125	250	500	1k	2k	4k	8k	
1/3 oct.	-6,0	-2,2	5,6	13,1	17,1	6,7	15,1	19,8	
	2,0	-2,5	4,9	11,9	7,4	6,6	18,3	20,9	dB
	-0,5	2,5	2,0	24,0	2,7	11,3	19,6	20,0	
1/1 oct.	-2,8	-1,2	3,9	14,1	6,1	7,7	17,2	20,2	dB

publication is permitted for the entire page only

Mook, 02-04-2008