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Determination of sound absorption coefficients in a reverberation room according to EN ISO 354 and EN ISO 11654

(1 appendix)

Client

Swedese Möbeler AB

Test object

Sound absorption panels delivered by Swedese Möbeler AB

Date of test

July 11, 2007

Arrival of test objects

June, 2007

Results

The sound absorption coefficient (α_s) and the practical sound absorption coefficient (α_p) are given in enclosure 1. The weighted sound absorption coefficient (α_w) and the sound absorption classes have been calculated according to EN ISO 11654 and the results are given in table 1.

The results are valid for tested objects only.

Table 1 – Summary of results

Test object:	EN ISO 11654		Enclosure
	Absorption class	α_w	
SONO Thickness: 80 mm. Mounting depth: 80 mm. Mass per square metre: 14,03 kg/m ²	C	0,65(H)	1

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Measurement method

The measurements have been carried out according to En ISO 354 : 2003
4 loudspeakers and 6 microphones have been used giving 24 different combinations. For empty room 3 decays have been used for averaging the time and for test objects 5 decays have been used, for each combination of loudspeaker and microphone.

The absorption coefficient α_s has been evaluated from:

$$\alpha_s = \frac{55.3 V}{c \cdot S} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

where

- V = Volume of the reverberation room (m³)
- S = Area of the test object (m²)
- c = Speed of sound in air (m/s)
- c = 331 + 0.6t
- t = Temperature in the air (°C)
- T₁ = Reverberation time of the room without test object (s)
- T₂ = Reverberation time of the room with test object (s)

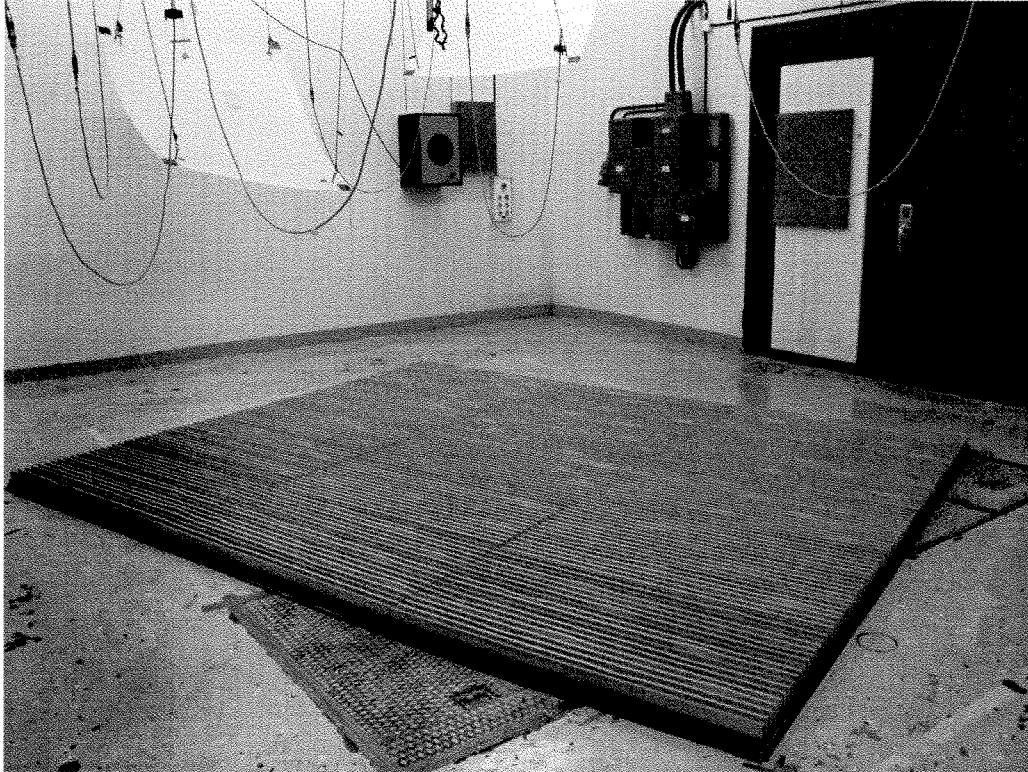
Measurement uncertainty

From a world wide Round Robin¹⁾, in which SP took part, with 23 participating laboratories from 11 countries, the following measurement uncertainty has been calculated

Frequencies (Hz)	Uncertainty
100-630	± 0,15
800-1250	± 0,10
1600-2500	± 0,15
3150-5000	± 0,20

¹⁾ The figures are calculated from twice the standard deviations, rounded to the nearest 0,05. The data from the Round Robin is documented in a letter from the ASTM to the participating laboratories.

Picture 1 – SONO whlt mounting depth 80 mm



Test room

A reverberation room with the dimensions 7,64 m x 6,16 m x 4,25 m giving the volume 200 m³ and the total surface area 211 m² was used.

Mounting

The panels were placed on the floor in a frame with size 3 x 3,6 m. The edges were sealed with a wooden frame and a tape (made of an elastic woven material) to prevent air leakage. The mounting depth is the distance between the floor and the front surface (upper) of the test objects.

List of instruments

Instrument	Manufacturer	Type	Serial no
Microphone	Brüel & Kjaer	4943	2206272
Microphone	Brüel & Kjaer	4943	2206273
Microphone	Brüel & Kjaer	4943	2206274
Microphone	Brüel & Kjaer	4943	2206276
Microphone	Brüel & Kjaer	4943	2206277
Microphone	Brüel & Kjaer	4943	2206278
Microphone Preamplifier	Brüel & Kjaer	2619	726805
Microphone Preamplifier	Brüel & Kjaer	2619	970948
Microphone Preamplifier	Brüel & Kjaer	2619	469905
Microphone Preamplifier	Brüel & Kjaer	2619	726792
Microphone Preamplifier	Brüel & Kjaer	2619	726825
Microphone Preamplifier	Brüel & Kjaer	2619	970968
Microphone Multiplexer	Norsonic	834	10050
Real-Time Analyzer	Norsonic	830	11533
Sound Level Calibrator	Brüel & Kjaer	4230	1410947
Programme	SP	Absorp	960627
Power amplifier	PA1		
Noise generator	NG1 (white noise)		
Loudspeakers	SP	HGT2, HGT7, HGT4, HGTtak	
Hygrometer	Vaisala	HM 132	42154
Temperature meter	Vaisala	HM 132	42154

SP Sveriges Tekniska Forskningsinstitut Energy Technology - Acoustics



Krister Larsson
Technical Manager



Mohammad Jalalian
Technical Officer

Appendix

Appendix 1

Measurement of sound absorption coefficient

Test Measurement of sound absorption coefficient in a reverberation room according to EN ISO 354 and evaluation according to EN ISO 11654

Client Swedese Möbler AB
Jan Berger

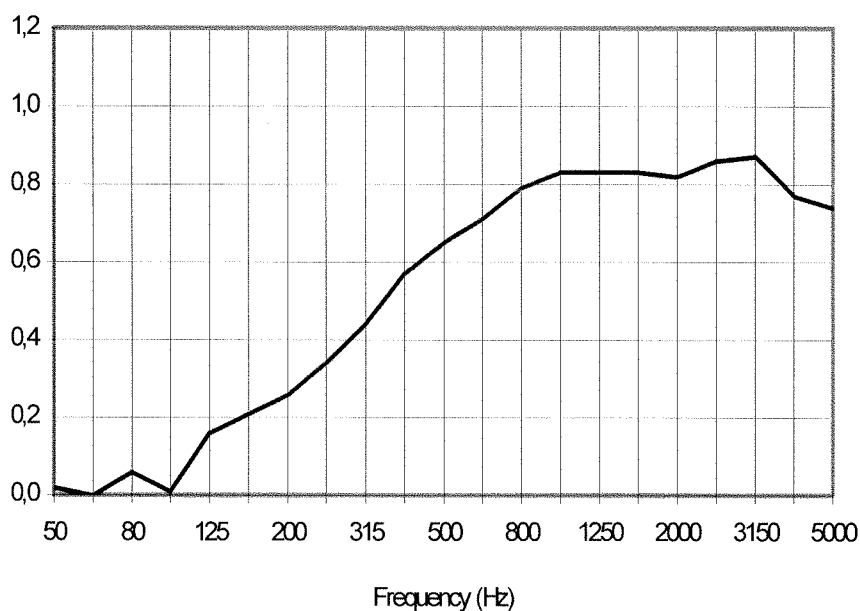
Object SONO
Thickness: 80 mm.
Panel size: 1200 mm x 600 mm.

Date of test July 11, 2007

Conditions Mounting depth: 80 mm.
Surface area: 10,8 m².
Room volume: 200 m³.
Temperature at measurement on object/in empty room: 23/ 23 °C.
Relative humidity at measurement on object/in empty room: 89/ 89 %.

Result Sound absorption class C.
Weighted sound absorption coefficient $\alpha_w = 0,65(\mathbf{H})$.

Sound absorption coefficient



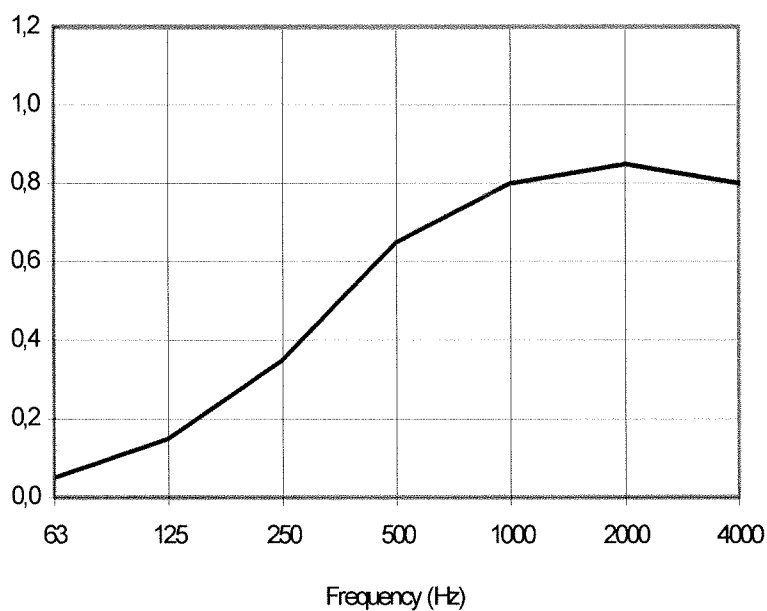
Frequency (Hz)	α_s
50	0,02
63	0,00
80	0,06
100	0,01
125	0,16
160	0,21
200	0,26
250	0,34
315	0,44
400	0,57
500	0,65
630	0,71
800	0,79
1000	0,83
1250	0,83
1600	0,83
2000	0,82
2500	0,86
3150	0,87
4000	0,77
5000	0,74

Appendix 1

Measurement of sound absorption coefficient

Test	Measurement of sound absorption coefficient in a reverberation room according to EN ISO 354 and evaluation according to EN ISO 11654		
Client	Swedese Möbler AB Jan Berger		
Object	SONO Thickness: 80 mm. Panel size: 1200 mm x 600 mm.		
Date of test	July 11, 2007		
Conditions	Mounting depth:	80 mm.	
	Surface area:	10,8 m ² .	
	Room volume:	200 m ³ .	
	Temperature at measurement on object/in empty room:	23/ 23 °C.	
	Relative humidity at measurement on object/in empty room:	89/ 89 %.	
Result	Sound absorption class C . Weighted sound absorption coefficient $\alpha_w = \mathbf{0,65(H)}$.		

Practical sound absorption coefficient



Frequency (Hz)	α_p
63	0,05
125	0,15
250	0,35
500	0,65
1000	0,80
2000	0,85
4000	0,80