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Determination of sound absorption coefficients of office screens according to ISO 354, SS EN ISO 11654, NT ACOU 085 and SS-25269 (4 appendices)

This report is a translation of the Swedish original document PX07949 D/Rev 1. In the event of any dispute as to the content of the document, the Swedish text shall take precedence.

Client

Götessons Industri AB

Assignment

SP has on assignment from Götessons Industri AB carried out accredited sound absorption measurements of office screens of type ScreenIT.

The test object consist of two screens which were mounted towards each other with 30 mm air gap between the screens.

Arrival of test objects and date of test

The test object arrived to SP on December 15, 2010 and the test was carried out on December 20, 2010.

Results

The sound absorption coefficient (α_s) and the practical sound absorption coefficient (α_p) are given in the enclosures 1 and 2. The weighted sound absorption coefficient (α_w) and the sound absorption classes have been calculated according to ISO 11654.

In addition the weighted sound absorption coefficient (α_w) and the sound absorption class according to NT ACOU 085 is presented. This standard will in the near future be revised in order to be conformal to ISO. For comparison purposes the ISO method is recommended to use.

The equivalent sound absorption area (A_{obj}) is given in enclosure 3, calculated according to proposal to Swedish standard SS-25269. The equivalent sound absorption area (A_{obj}) in octave bands are given in table 1. Octave band values are calculated as arithmetic averages of the three third octave band values in the band of interest. The measurement is made on two objects with different dimensions, which is a deviation from the standard. The sound absorption area A_{obj} is only applicable on the larger object.

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The results are concluded in table 1 and 2 and are valid for the tested object only.

Table 1 – Summary of results

Test object: ScreenIT	ISO 11654		NT ACOU 085		Encl.
	Abs. class	α_w	Abs. class	α_w	
Two screens were mounted towards each other with 30 mm air gap between the screens.	A	0,9	A	0,9	1-2

Table 2 – Summary of results according to proposal to Swedish standard SS-25269, only applicable on the larger object.

Test object: ScreenIT	Equivalent sound absorption area per test object in octave bands, (A_{obj} m ² Sabine)						Encl.
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
Two screens were mounted towards each other with 30 mm air gap between the screens.	2,0	3,5	5,1	5,4	5,0	4,5	3

Test object

The material descriptions of the test object including the area mass are presented in table 3 below.

Table 3 – Material descriptions and the area mass of the test objects.

Screen description	Material description	Area mass
Frame:	30 mm x 4 mm aluminium.	
Absorber:	30 mm polyester.	1,21 kg/m ²
Surface:	5 mm polyether and polyester fabric as surface.	0,88 kg/m ²

In table 4 the dimensions on the test object, the number of screens which were mounted in the reverberation room during the test, the masses and the calculated surface area are reported. The calculated surface area is expressed as the two sided area of the test object, included the edges. The inner sides of each screens have not been counted.

Table 4 – Description of the test objects.

	Dimension	Number of screens	Surface area ¹⁾	Mass of the screen	Figure in report
ScreenIT	1220 mm x 1820 mm x 40 mm	2	11,1 m ²	10,4 kg	1
	1620 mm x 1820 mm x 40 mm	2		12,9 kg	

¹⁾ The surface area should be between 10 m² and 12 m² according to the standard.

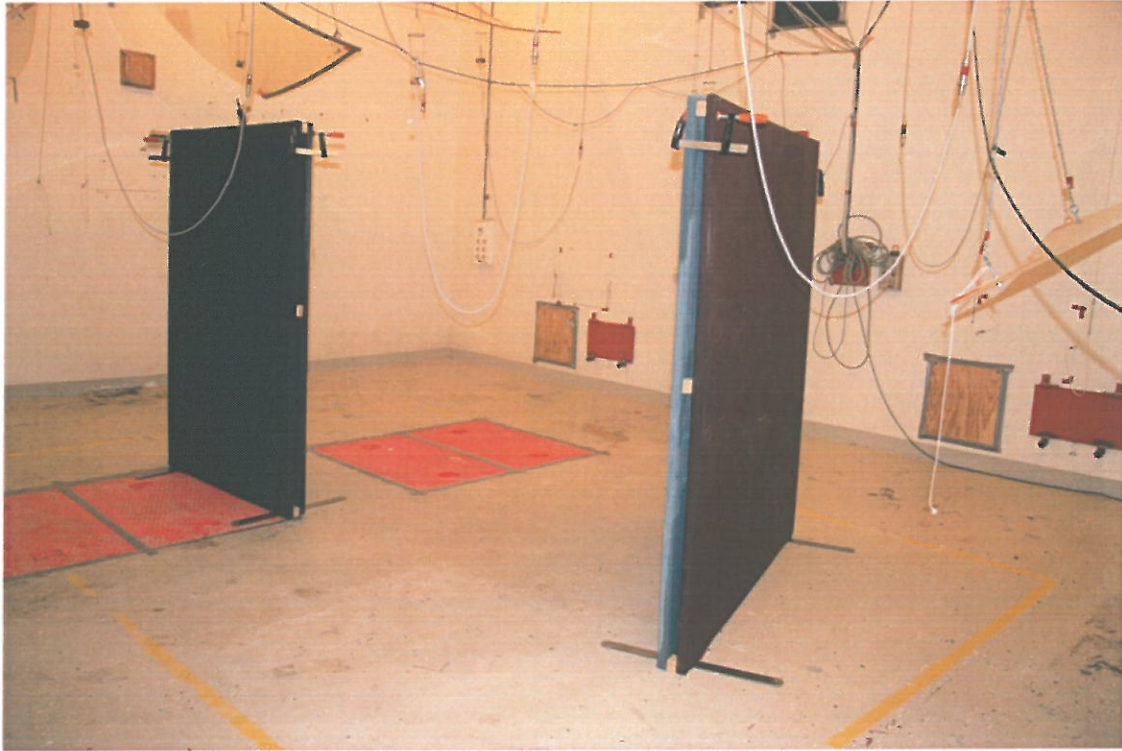


Figure 1. The figure shows the test set up, where two couples of screens were mounted toward each other with 30 mm air gap between the screens.

Measurement method

The measurements have been carried out according to ISO 354:2003, which SP is accredited for. The method is valid as European standard according to EN ISO 354 and as Swedish standard according to SS-EN ISO 354. The evaluation has been carried out according to ISO 11654, which SP is accredited for. The method is valid as European standard according to EN ISO 11654 and as Swedish standard according to SS-EN ISO 11654. 4 loudspeaker positions and 6 microphone positions have been used giving 24 different combinations for the reverberation time measurements. 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. In addition the sound absorption has been evaluated according to NT ACOU 085 and proposal to Swedish standard SS-25269.

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.

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. The suspended diffusers have been arranged according to SS-ISO 354. The reverberation time, T₁, in the empty room is presented in enclosure 4.

Mounting

The office screen elements were positioned in the reverberation room according to SS 025261 as shown in figure 1. They were at least 2 m apart and their distance to the nearest wall was at least 1 m.

List of instruments

Instrument	Manufacturer	Type	Serial no
Microphone	Brüel & Kjaer	4943	2479445
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	726624
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	1411048
Programme	SP	Absorp 960627	
Power amplifier	PA1		
Noise generator	NG1 (white noise)		
Loudspeakers	SP	HGT2, HGT7, HGT4, HGTak	
Hygrometer/ Temperature meter	Testo	615	502962

**SP Technical Research Institute of Sweden
 Energy Technology - Acoustics**

Performed by

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Examined by

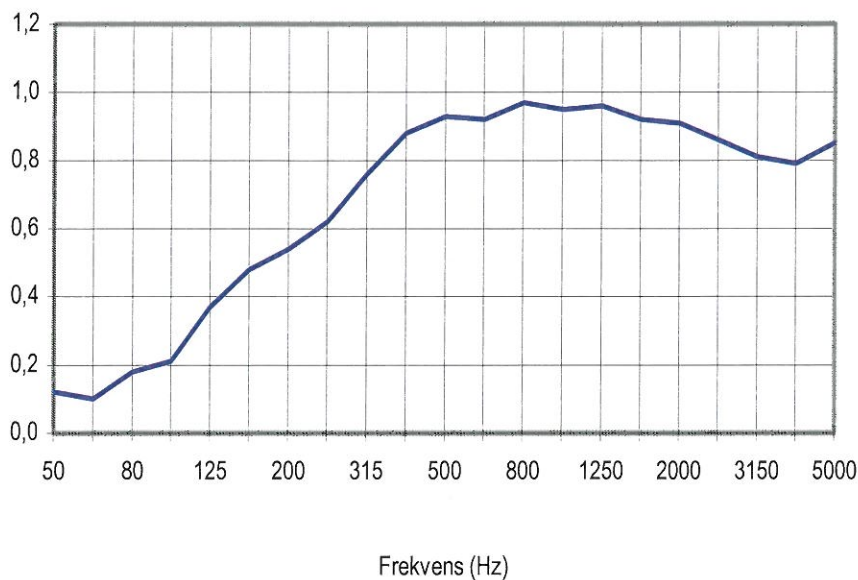
Geir Andresen

Appendices

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	Götessons Industri AB Fredrik Stjerna
Object	ScreenIT. Two screens were mounted towards each other with 30 mm air gap between the screens. Thickness: 40 mm. Panel size: 1,220 mm x 1,820 mm and 1620 mm x 1820 mm.
Date of test	2010-12-20
Conditions	Surface area: 11,13 m ² . Room volume: 200 m ³ . Temperature at measurement on object/in empty room: 18/ 18 °C. Relative humidity at measurement on object/in empty room: 84/ 82 %.
Result	Sound absorption class A . Weighted sound absorption coefficient $\alpha_w = 0,9$.

Sound absorption coefficient



Frekvens (Hz)	α_s
50	0,12
63	0,10
80	0,18
100	0,21
125	0,37
160	0,48
200	0,54
250	0,62
315	0,76
400	0,88
500	0,93
630	0,92
800	0,97
1000	0,95
1250	0,96
1600	0,92
2000	0,91
2500	0,86
3150	0,81
4000	0,79
5000	0,85

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 Götessons Industri AB
Fredrik Stjerna

Object ScreenIT. Two screens were mounted towards each other with 30 mm air gap between the screens.

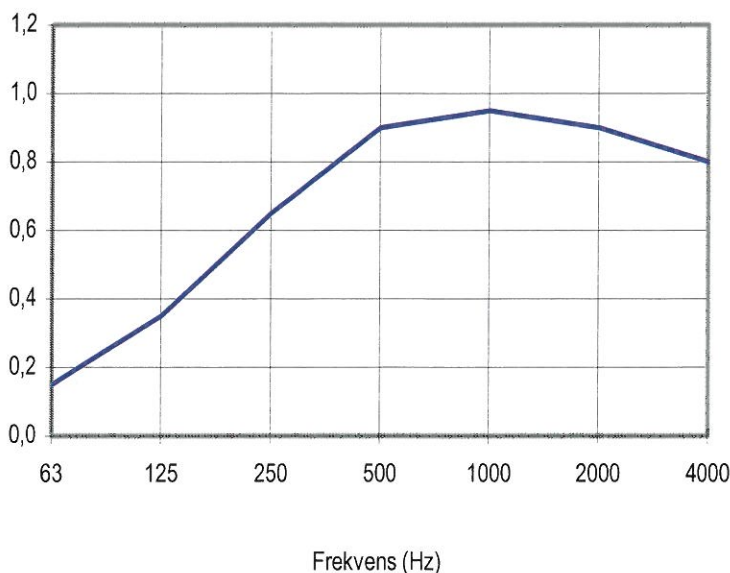
Thickness: 40 mm.
Panel size: 1,220 mm x 1,820 mm and 1620 mm x 1820 mm.

Date of test 2010-12-20

Conditions Surface area: 11,13 m².
Room volume: 200 m³.
Temperature at measurement on object/in empty room: 18/ 18 °C.
Relative humidity at measurement on object/in empty room: 84/ 82 %.

Result Sound absorption class **A**.
Weighted sound absorption coefficient $\alpha_w = 0,9$.

Practical sound absorption coefficient



Frekvens (Hz)	α_p
63	0,15
125	0,35
250	0,65
500	0,90
1000	0,95
2000	0,90
4000	0,80

Measurement of sound absorption area

Test Measurement of sound absorption area in a reverberation room according to EN ISO 354 and evaluation according to proposal to Swedish standard SS-25269. The measurement is made on two objects with different dimensions and the sound absorption area A_{obj} is only applicable on the larger object.

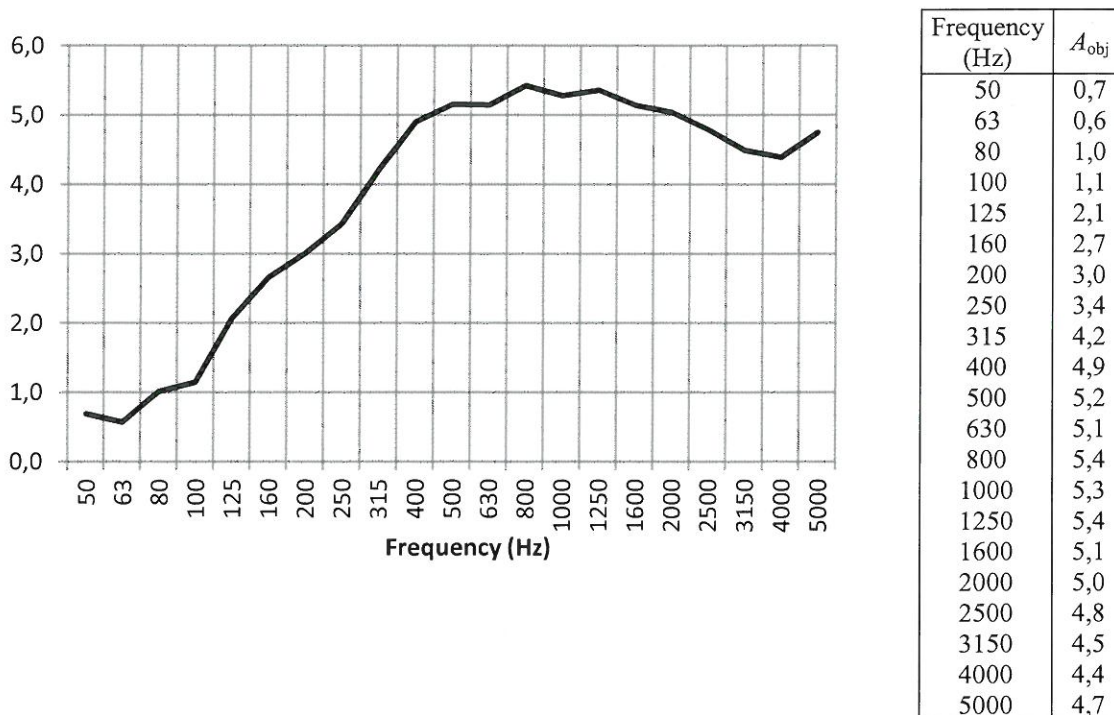
Client Götessons Industri AB
Fredrik Stjerna

Object ScreenIT. Two screens were mounted towards each other with 30 mm air gap between the screens.
 Thickness: 40 mm.
 Panel size: 1,220 mm x 1,820 mm and 1620 mm x 1820 mm.
 Number of objects: 2

Date of test 2010-12-20

Conditions Surface area: 11,13 m².
 Room volume: 200 m³.
 Temperature at measurement on object/in empty room: 18/ 18 °C.
 Relative humidity at measurement on object/in empty room: 84/ 82 %.

Equivalent sound absorption area per object (m² Sabine)



Measurement of reverberation time T1 in a reverberation room (empty room)

Client Götessons Industri AB
 Fredrik Stjerna

Laboratory Method Reverberation room with the volume 200 m³ and total surface area 211 m². The measurements has been carried out according to ISO 354/1985. 4 (Philips AD 12100/HP8) and 6 microphones (Brüel & Kjaer 4166) have been used giving 24 different combinations. Integration time ($T/20$), 3 decays have been recorded for each microphone and loudspeaker combination. Ensemble averaging has been used. Diffusers number/total area (m²): 10/42.

Conditions Temperature: 18 °C.
 Relative humidity: 82 %.

Date of test December 20, 2010.

Frequency (Hz)	Reverberation time, T ₁ (s)	Equivalent sound absorption area according to ISO 354/1985 (m ²)	Maximum equivalent sound absorption area according to ISO 354/1985 (m ²)
50	12,02		
63	12,97		
80	9,51		
100	7,51		
125	5,21	6,21	6,5
160	5,54		
200	6,94		
250	6,45	5,02	6,5
315	6,34		
400	5,88		
500	5,13	6,30	6,5
630	4,98		
800	5,64		
1000	5,74	5,64	7,0
1250	5,41		
1600	4,86		
2000	4,34	7,45	9,5
2500	3,74		
3150	3,26		
4000	2,84	11,38	13,0
5000	2,34		