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## Determination of sound absorption coefficients of office screens according to ISO 354, SS EN ISO 11654 and NT ACOU 085

*This is a translation from the Swedish original document. 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 screen was tested in different configurations and as a wall absorber.

### Arrival of test objects and date of test

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

### Results

The sound absorption coefficient ( $\alpha_s$ ) and the practical sound absorption coefficient ( $\alpha_p$ ) are given in the enclosures 1 to 10. The weighted sound absorption coefficient ( $\alpha_w$ ) and the sound absorption classes have been calculated according to ISO 11654.

In addition the weighted sound absorption coefficient ( $\alpha_w$ ) 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 results are concluded in table 1 and are valid for the tested objects only.



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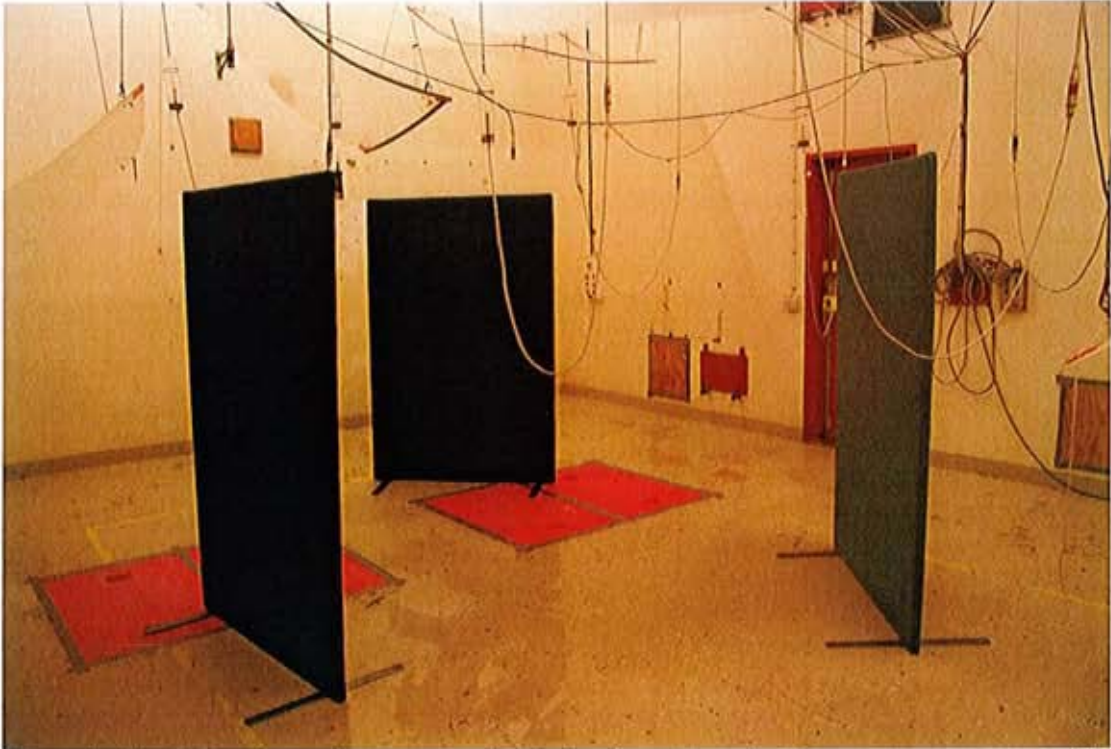
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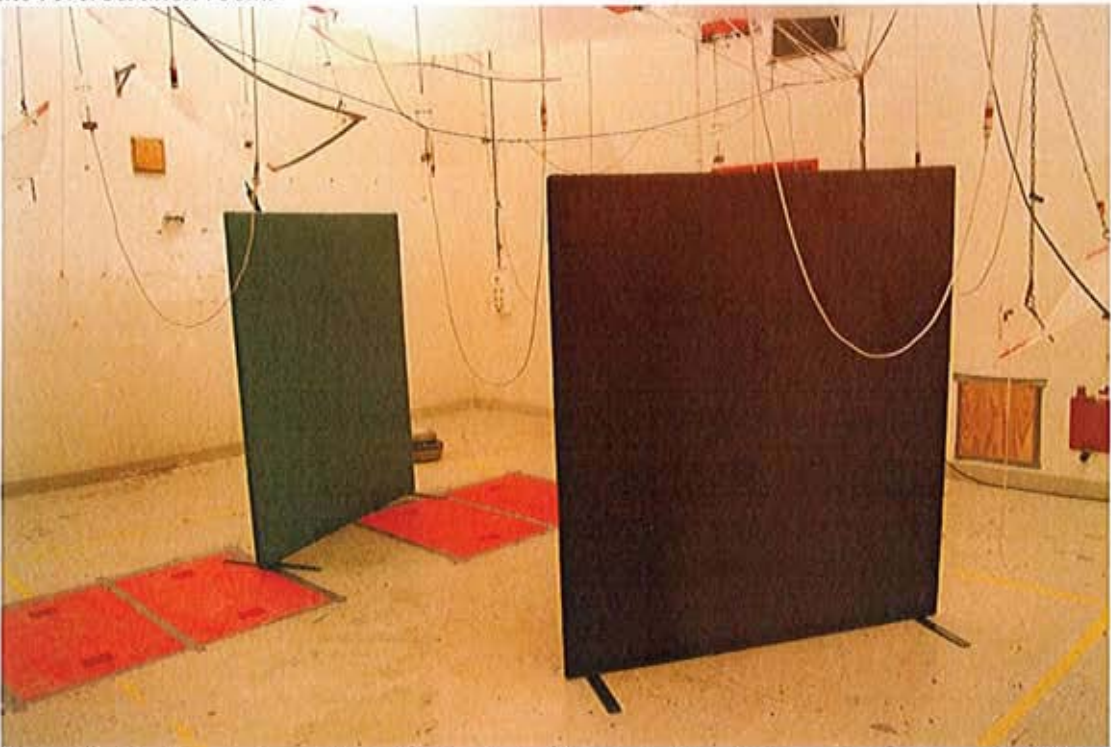
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*Figure 1. The figure shows the test set up in test 1, where three single screens were mounted in the reverberation room.*



*Figure 2. The figure shows the test set up in test 2, where two single screens were mounted in the reverberation room.*

## 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.

The absorption coefficient  $\alpha_S$  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 (m<sup>3</sup>)
- S = Area of the test object (m<sup>2</sup>)
- c = Speed of sound in air (m/s)
- c = 331 + 0.6t
- t = Temperature in the air (°C)
- T<sub>1</sub> = Reverberation time of the room without test object (s)
- T<sub>2</sub> = Reverberation time of the room with test object (s)

### Measurement uncertainty

From a world wide Round Robin<sup>1)</sup>, 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

<sup>1)</sup> 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 m<sup>3</sup> and the total surface area 211 m<sup>2</sup> was used. The suspended diffusers have been arranged according to SS-ISO 354. The reverberation time, T<sub>1</sub>, in the empty room for each test occasion is presented in the enclosures 11 and 12 respectively.

### Mounting

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

**List of instruments**

<b>Instrument</b>	<b>Manufacturer</b>	<b>Type</b>	<b>Serial no</b>
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

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**Energy Technology - Acoustics**



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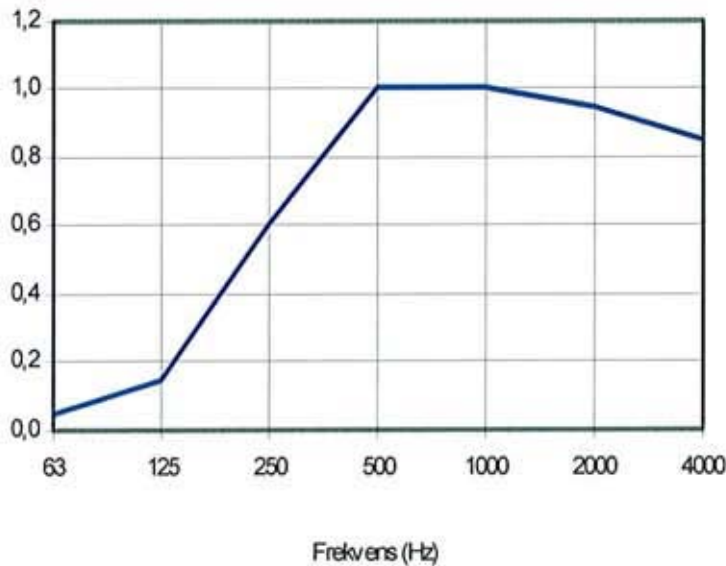
Krister Larsson  
 Technical Manager

## 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  
 Thickness: 40 mm.  
 Panel size: 11220 mm x 1820 mm  
**Date of test** 2010-12-20  
**Conditions** Mounting depth: 60 mm.  
 Surface area: 10,84 m<sup>2</sup>.  
 Room volume: 200 m<sup>3</sup>.  
 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)	$\alpha_p$
63	0,05
125	0,15
250	0,60
500	1,00
1000	1,00
2000	0,95
4000	0,85

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## 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 m <sup>3</sup> and total surface area 211 m <sup>2</sup> . 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 (m <sup>2</sup> ): 10/42.
Conditions	Temperature: 18 °C. Relative humidity: 82 %.
Date of test	December 20, 2010.

Frekvens (Hz)	Efterklangtid, T <sub>1</sub> (s)	Ekvivalent ljudabsorptions- area enligt ISO 354/1985 (m <sup>2</sup> )	Maximalt ekvivalent ljudabsorptions- area enligt ISO 354/1985 (m <sup>2</sup> )
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		

## Measurement of reverberation time T<sub>1</sub> in a reverberation room (empty room)

Client	Götessons Industri AB Fredrik Stjerna
Laboratory Method	Reverberation room with the volume 200 m <sup>3</sup> and total surface area 211 m <sup>2</sup> . 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 (m <sup>2</sup> ): 10/42.
Conditions	Temperature: 18 °C. Relative humidity: 82 %.
Date of test	December 15, 2010.

Frekvens (Hz)	Efterklangtid, T <sub>1</sub> (s)	Ekvivalent ljudabsorptions- area enligt ISO 354/1985 (m <sup>2</sup> )	Maximalt ekvivalent ljudabsorptions- area enligt ISO 354/1985 (m <sup>2</sup> )
50	12,81		
63	13,15		
80	8,47		
100	6,96		
125	5,13	6,31	6,5
160	5,51		
200	6,98		
250	6,52	4,96	6,5
315	6,13		
400	5,70		
500	5,07	6,38	6,5
630	4,90		
800	5,59		
1000	5,63	5,75	7,0
1250	5,41		
1600	4,85		
2000	4,32	7,49	9,5
2500	3,73		
3150	3,26		
4000	2,84	11,39	13,0
5000	2,34		