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DETERMINATION OF ACOUSTIC ABSORPTION COEFFICIENT IN LABORATORY CONDITIONS

1 CLIENT

Ewona Finland Oy, Jarmo Koivisto. Tender January 28, 2022. Order February 1, 2022.

2 DESCRIPTION OF THE COMMISSION

Sound absorption coefficient α_s was measured within 100–5000 Hz according to ISO 354:2003. Sound absorption class was determined according to EN ISO 11654:1997.

3 RESULTS

The weighted sound absorption coefficient and the sound absorption class is presented in table 1. Detailed results are presented in Annex 1.

Table 1. The weighted sound absorption coefficient α_w and the sound absorption class with different mounting methods.

Acoustic panels	α_w	Absorption class
Ewona Rimapaneeli 10 mm (1600g) Type A mounting (no airgap behind the specimen)	0.25	E
Ewona Excellence H 40 mm (1200g) Type A mounting (no airgap behind the specimen)	0.90	A
Ewona Excellence H 40 mm (1400g) Type A mounting (no airgap behind the specimen)	0.90	A
Ewona Rimapaneeli 10 mm (1600g) Type E200 mounting (190 mm airgap behind the specimen)	0.85	B
Ewona Excellence H 40 mm (1200g) Type E200 mounting (160 mm airgap behind the specimen)	0,90	A
Ewona Excellence H 40 mm (1400g) Type E200 mounting (160 mm airgap behind the specimen)	0,90	A

4 SIGNATURES



Valtteri Hongisto
Research Group Leader



Jarkko Hakala
Research Engineer

Turku University of Applied Sciences
Acoustic laboratory

ANNEXES

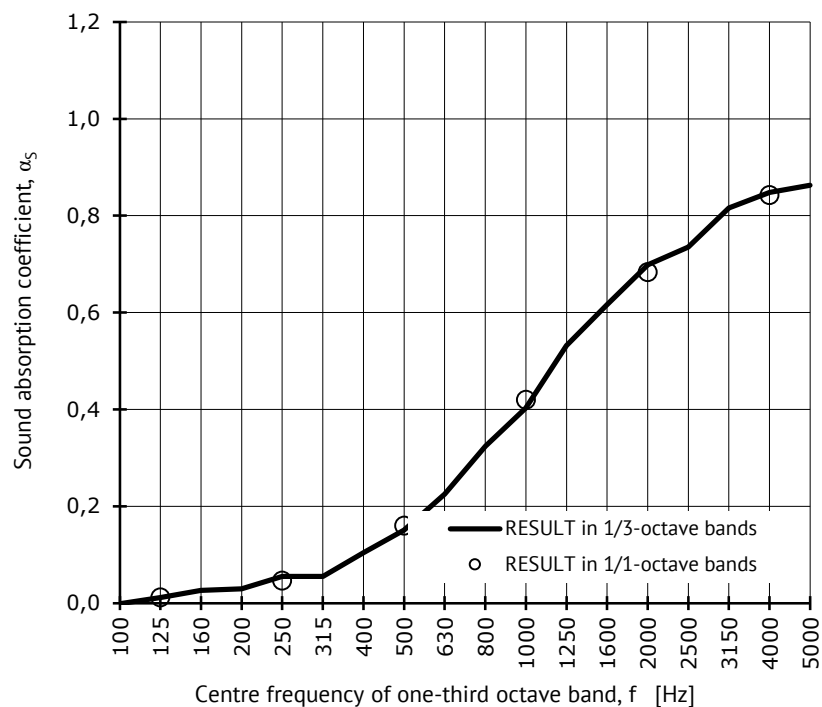
- Annex 1 – Test results (6 pages)
- Annex 2 – Structure drawings (1 page)
- Annex 3 – Mounting of specimen (1 page)
- Annex 4 – Measurement arrangements (1 page)

Determination of acoustic absorption coefficient according to ISO 354:2003 in laboratory conditions

Specimen id: Ewona Rimapaneeli 10 mm (1600g)
Type A mounting (no airgap behind the specimen)
Manufacturer: Ewona Finland Oy
Client: Ewona Finland Oy
Contact person: Jarmo Koivisto
Mounting by: Jarkko Hakala, Juho Virtanen
Test laboratory: Turku University of Applied Sciences, Acoustics Laboratory
Joukahaisenkatu 7, 20520 Turku, Finland

Specimen area: 10,8 m² Test room volume: 201 m³
Temperature of test room: 21 °C (without / with specimen) Room boundary area: 224 m²
Relative humidity: 61 % (without / with specimen) Test date: 8.3.2022
Atmospheric pressure: 102 kPa (without / with specimen) Test file identification: t080322b

f (Hz)	1/3 α_s	1/1 α_s	1/1 α_p
100	0,00		
125	0,01	0,01	0,00
160	0,03		
200	0,03		
250	0,06	0,05	0,05
315	0,06		
400	0,10		
500	0,15	0,16	0,15
630	0,23		
800	0,32		
1000	0,40	0,42	0,40
1250	0,53		
1600	0,62		
2000	0,70	0,68	0,70
2500	0,74		
3150	0,82		
4000	0,85	0,84	0,85
5000	0,86		

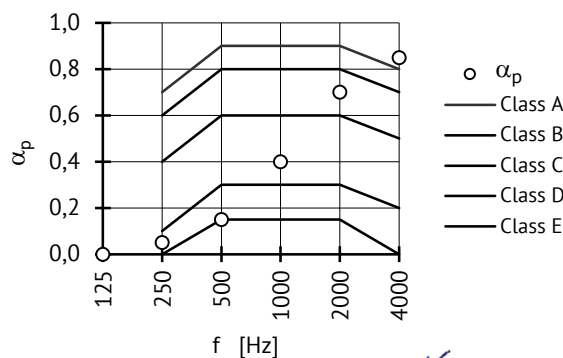


EN ISO 11654:

Weighted sound absorption coefficient α_w
0,25

Absorption class (EN ISO 11654)

E



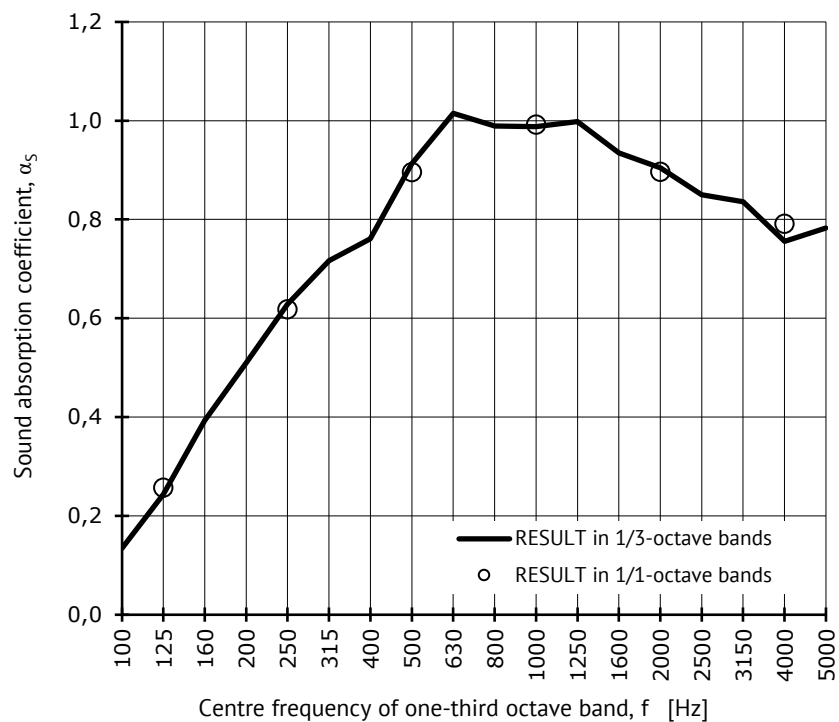
Jarkko Hakala
Jarkko Hakala
Research Engineer
test performer

Determination of acoustic absorption coefficient according to ISO 354:2003 in laboratory conditions

Specimen id: Ewona Excellence H 40 mm (1200g)
Type A mounting (no airgap behind the specimen)
Manufacturer: Ewona Finland Oy
Client: Ewona Finland Oy
Contact person: Jarmo Koivisto
Mounting by: Jarkko Hakala, Juho Virtanen
Test laboratory: Turku University of Applied Sciences, Acoustics Laboratory
Joukahaisenkatu 7, 20520 Turku, Finland

Specimen area: 10,8 m² Test room volume: 201 m³
Temperature of test room: 21 21 °C (without / with specimen) Room boundary area: 224 m²
Relative humidity: 61 62 % (without / with specimen) Test date: 8.3.2022
Atmospheric pressure: 102 102 kPa (without / with specimen) Test file identification: t080322c

f (Hz)	1/3 α_s	1/1 α_s	1/1 α_p
100	0,13		
125	0,24	0,26	0,25
160	0,39		
200	0,51		
250	0,63	0,62	0,60
315	0,72		
400	0,76		
500	0,91	0,90	0,90
630	1,02		
800	0,99		
1000	0,99	0,99	1,00
1250	1,00		
1600	0,93		
2000	0,90	0,90	0,90
2500	0,85		
3150	0,84		
4000	0,76	0,79	0,80
5000	0,78		



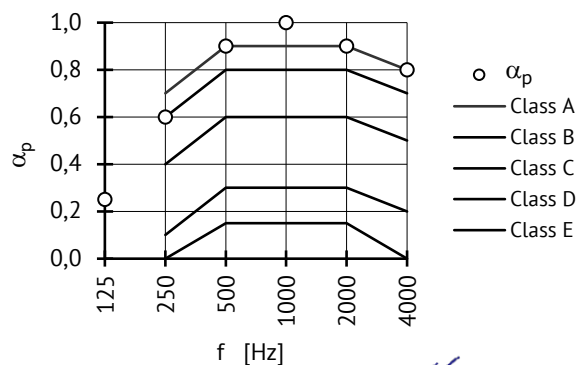
EN ISO 11654:

Weighted sound absorption coefficient α_w

0,90

Absorption class (EN ISO 11654)

A



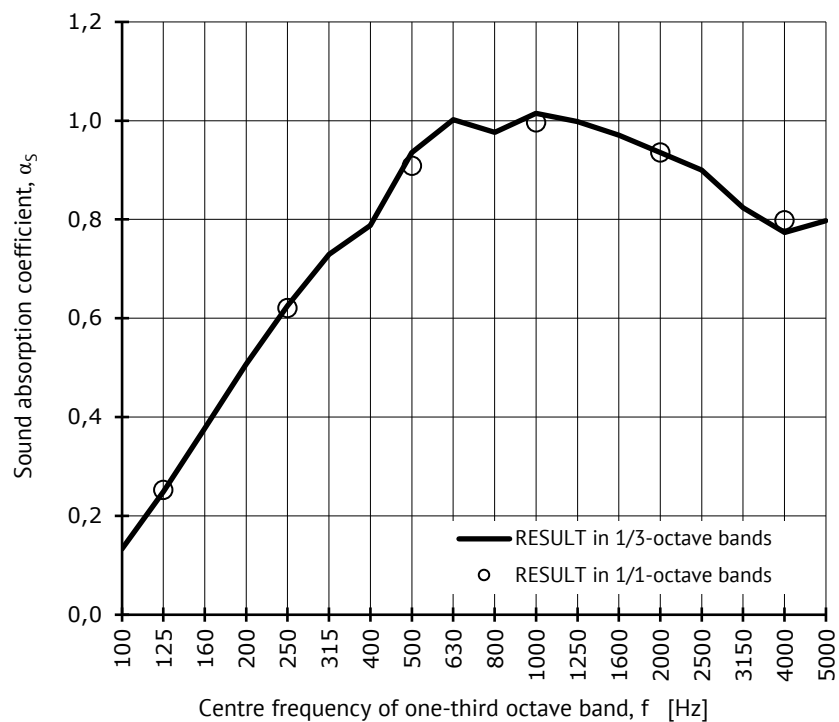
Jarkko Hakala
Jarkko Hakala
Research Engineer
test performer

Determination of acoustic absorption coefficient according to ISO 354:2003 in laboratory conditions

Specimen id: Ewona Excellence H 40 mm (1400g)
Type A mounting (no airgap behind the specimen)
Manufacturer: Ewona Finland Oy
Client: Ewona Finland Oy
Contact person: Jarmo Koivisto
Mounting by: Jarkko Hakala, Juho Virtanen
Test laboratory: Turku University of Applied Sciences, Acoustics Laboratory
Joukahaisenkatu 7, 20520 Turku, Finland

Specimen area: 10,8 m² Test room volume: 201 m³
Temperature of test room: 21 21 °C (without / with specimen) Room boundary area: 224 m²
Relative humidity: 61 64 % (without / with specimen) Test date: 8.3.2022
Atmospheric pressure: 102 102 kPa (without / with specimen) Test file identification: t080322d

f (Hz)	1/3 α_s	1/1 α_s	1/1 α_p
100	0,13		
125	0,25	0,25	0,25
160	0,38		
200	0,51		
250	0,63	0,62	0,60
315	0,73		
400	0,79		
500	0,94	0,91	0,90
630	1,00		
800	0,98		
1000	1,01	1,00	1,00
1250	1,00		
1600	0,97		
2000	0,94	0,94	0,95
2500	0,90		
3150	0,82		
4000	0,77	0,80	0,80
5000	0,80		



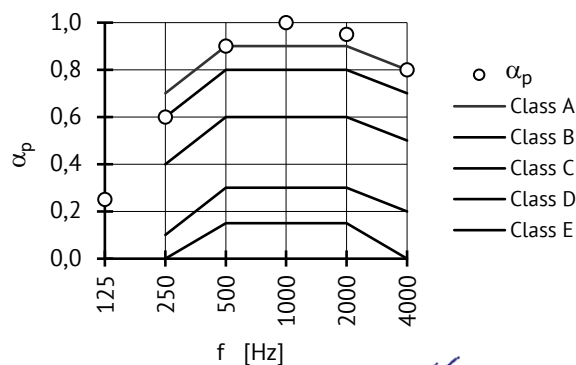
EN ISO 11654:

Weighted sound absorption coefficient α_w

0,90

Absorption class (EN ISO 11654)

A



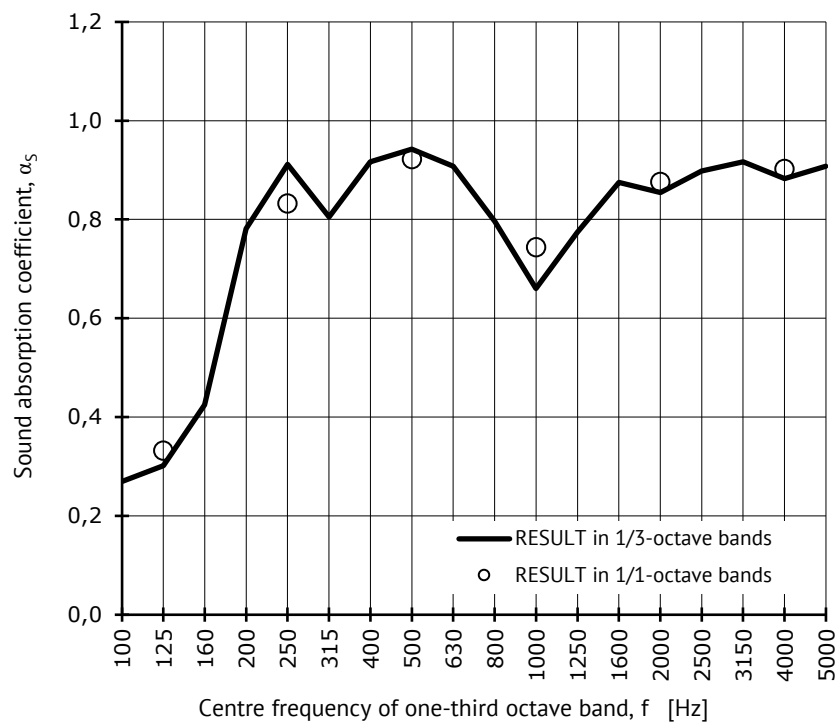
Jarkko Hakala
Jarkko Hakala
Research Engineer
test performer

Determination of acoustic absorption coefficient according to ISO 354:2003 in laboratory conditions

Specimen id: Ewona Rimapaneeli 10 mm (1600g)
Type E200 mounting (190 mm airgap behind the specimen)
Manufacturer: Ewona Finland Oy
Client: Ewona Finland Oy
Contact person: Jarmo Koivisto
Mounting by: Jarkko Hakala, Juho Virtanen
Test laboratory: Turku University of Applied Sciences, Acoustics Laboratory
Joukahaisenkatu 7, 20520 Turku, Finland

Specimen area: 10,8 m² Test room volume: 201 m³
Temperature of test room: 21 20 °C (without / with specimen) Room boundary area: 224 m²
Relative humidity: 61 62 % (without / with specimen) Test date: 8.3.2022
Atmospheric pressure: 102 103 kPa (without / with specimen) Test file identification: t090322c

f (Hz)	1/3 α_s	1/1 α_s	1/1 α_p
100	0,27		
125	0,30	0,33	0,35
160	0,42		
200	0,78		
250	0,91	0,83	0,85
315	0,80		
400	0,92		
500	0,94	0,92	0,90
630	0,91		
800	0,80		
1000	0,66	0,74	0,75
1250	0,77		
1600	0,88		
2000	0,85	0,88	0,90
2500	0,90		
3150	0,92		
4000	0,88	0,90	0,90
5000	0,91		



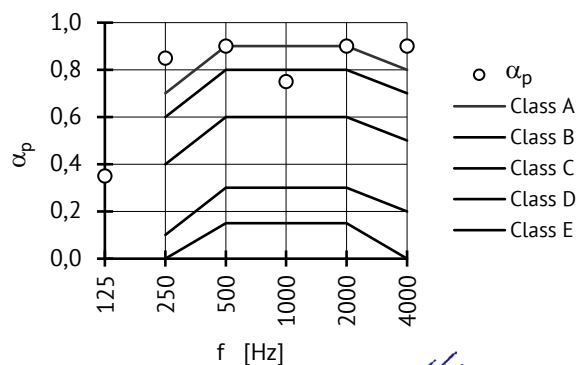
EN ISO 11654:

Weighted sound absorption coefficient α_w

0,85

Absorption class (EN ISO 11654)

B



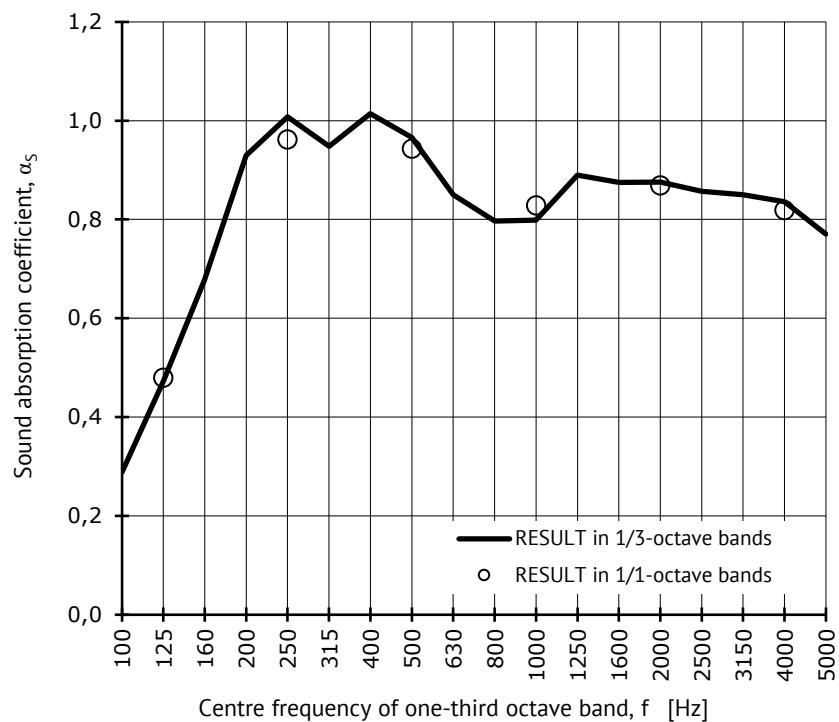
Jarkko Hakala
Jarkko Hakala
Research Engineer
test performer

Determination of acoustic absorption coefficient according to ISO 354:2003 in laboratory conditions

Specimen id: Ewona Excellence H 40 mm (1200g)
Type E200 mounting (160 mm airgap behind the specimen)
Manufacturer: Ewona Finland Oy
Client: Ewona Finland Oy
Contact person: Jarmo Koivisto
Mounting by: Jarkko Hakala, Juho Virtanen
Test laboratory: Turku University of Applied Sciences, Acoustics Laboratory
Joukahaisenkatu 7, 20520 Turku, Finland

Specimen area: 10,8 m² Test room volume: 201 m³
Temperature of test room: 21 20 °C (without / with specimen) Room boundary area: 224 m²
Relative humidity: 61 61 % (without / with specimen) Test date: 8.3.2022
Atmospheric pressure: 102 103 kPa (without / with specimen) Test file identification: t090322b

f (Hz)	1/3 α_s	1/1 α_s	1/1 α_p
100	0,29		
125	0,47	0,48	0,50
160	0,68		
200	0,93		
250	1,01	0,96	0,95
315	0,95		
400	1,01		
500	0,97	0,94	0,95
630	0,85		
800	0,80		
1000	0,80	0,83	0,85
1250	0,89		
1600	0,88		
2000	0,88	0,87	0,85
2500	0,86		
3150	0,85		
4000	0,84	0,82	0,80
5000	0,77		



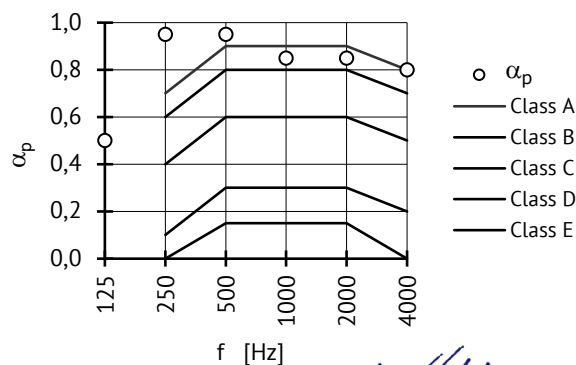
EN ISO 11654:

Weighted sound absorption coefficient α_w

0,90

Absorption class (EN ISO 11654)

A



Jarkko Hakala
Jarkko Hakala

Research Engineer

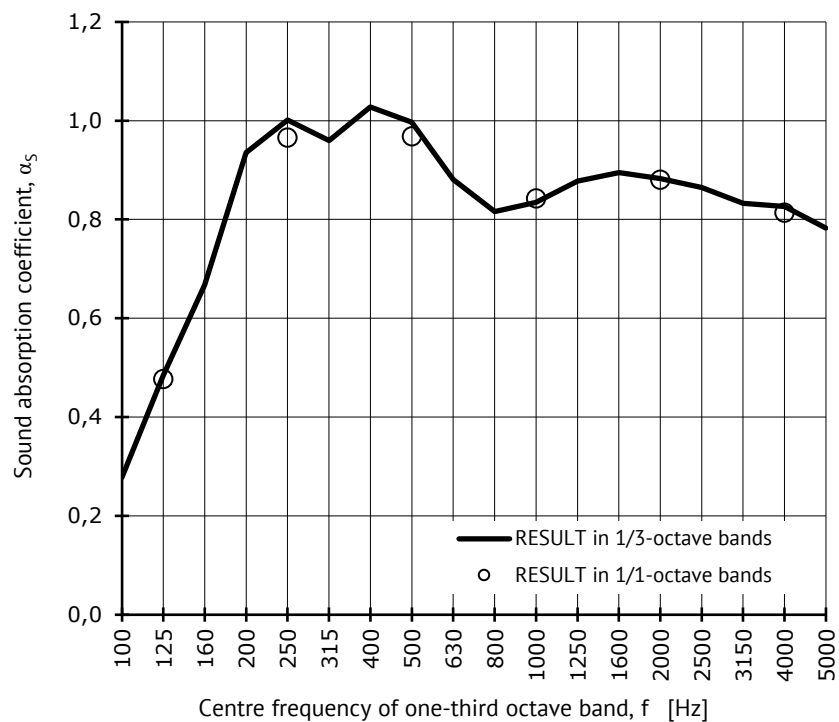
test performer

Determination of acoustic absorption coefficient according to ISO 354:2003 in laboratory conditions

Specimen id: Ewona Excellence H 40 mm (1400g)
Type E200 mounting (160 mm airgap behind the specimen)
Manufacturer: Ewona Finland Oy
Client: Ewona Finland Oy
Contact person: Jarmo Koivisto
Mounting by: Jarkko Hakala, Juho Virtanen
Test laboratory: Turku University of Applied Sciences, Acoustics Laboratory
Joukahaisenkatu 7, 20520 Turku, Finland

Specimen area: 10,8 m² Test room volume: 201 m³
Temperature of test room: 21 20 °C (without / with specimen) Room boundary area: 224 m²
Relative humidity: 61 61 % (without / with specimen) Test date: 8.3.2022
Atmospheric pressure: 102 103 kPa (without / with specimen) Test file identification: t090322a

f (Hz)	1/3 α_s	1/1 α_s	1/1 α_p
100	0,28		
125	0,48	0,48	0,50
160	0,67		
200	0,94		
250	1,00	0,97	0,95
315	0,96		
400	1,03		
500	1,00	0,97	0,95
630	0,88		
800	0,82		
1000	0,83	0,84	0,85
1250	0,88		
1600	0,89		
2000	0,88	0,88	0,90
2500	0,86		
3150	0,83		
4000	0,83	0,81	0,80
5000	0,78		



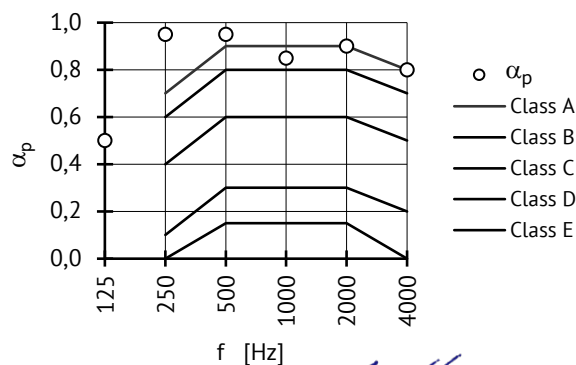
EN ISO 11654:

Weighted sound absorption coefficient α_w

0,90

Absorption class (EN ISO 11654)

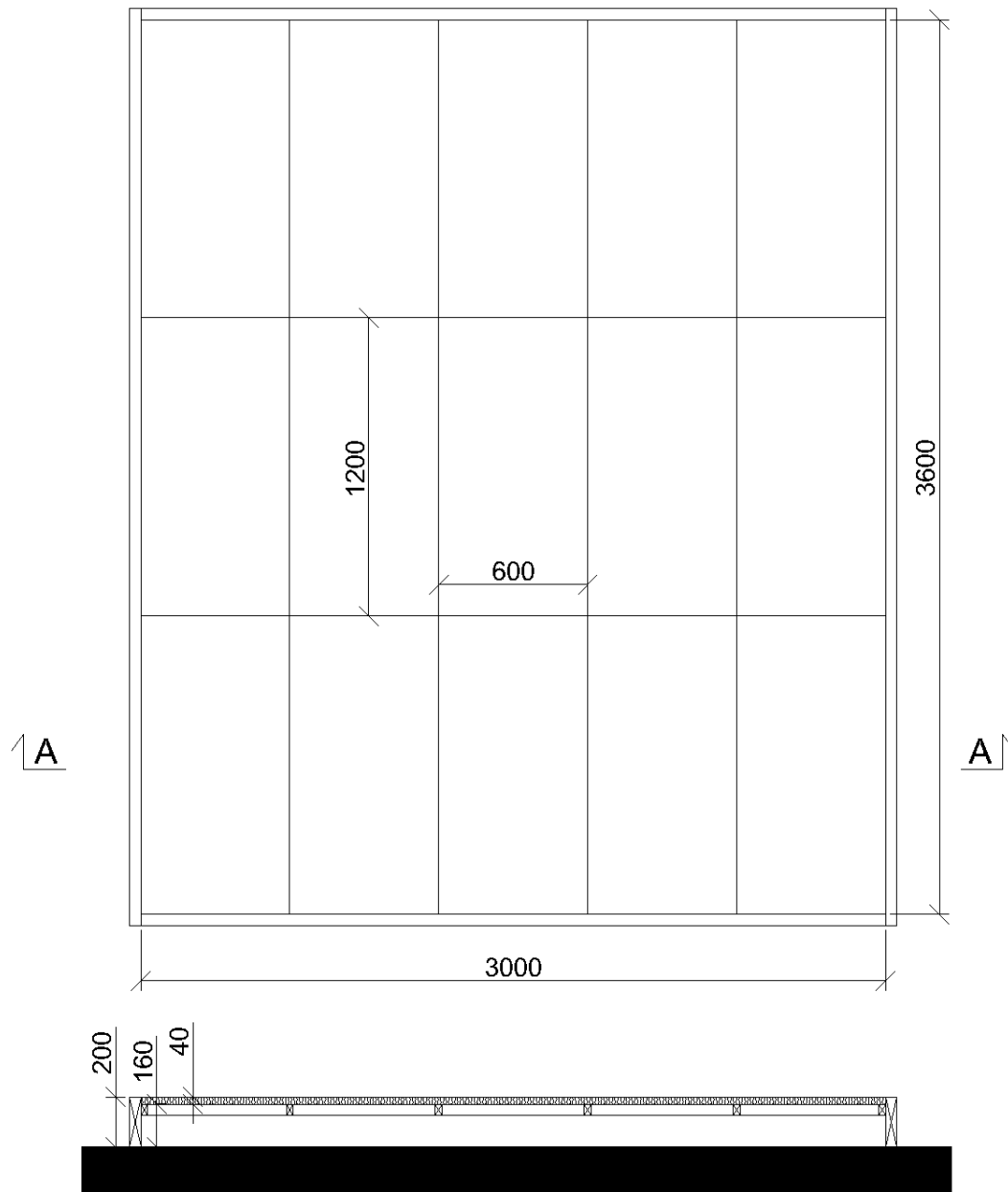
A



Jarkko Hakala

Jarkko Hakala
Research Engineer
test performer

ANNEX 2 – STRUCTURE DRAWINGS



Ewona Excellence H 40 mm, Type E200 mounting
Section A-A

Example of Type E200 mounting. The distance between the visible surface and floor is 200 mm.

ANNEX 3 – MOUNTING OF SPECIMEN

The acoustic panels were mounted on the floor of the reverberation room in conformance with **ISO 354:2003 Annex B**. The acoustic panels were tested with two different mounting methods. Type A mounting (no airgap behind the specimen) and Type E200 mounting (160 mm and 190 mm airgap behind the acoustic panel).

The side edges of the acoustic panel were covered with 12 mm thick wood lath in Type A mounting. Type E200 mounting frame was prefabricated from Kerto S 45 x 200 mm and the inner grid (595 x 595 mm) made from 28 x 45 mm timber. The edges of the acoustic panel were covered with adhesive tape.



Type A mounting. Acoustic panel on the floor.



Type E200 mounting.

ANNEX 4 – MEASUREMENT ARRANGEMENTS

1 Acoustical measurements

The test signal was produced to the test room using three fixed omnidirectional loudspeakers (6 x Seas W12CY001). The test signal (pink noise) was produced by a real time analyzer (Norsonic 121, serialnr. 31416) and amplified with terminal amplifier (QSC 1300 W USA). The sound pressure level in the reverberation room was measured with the condenser microphone (Bruel&Kjær 4190, serialnr. 2322537) and the pre-amplifier (Bruel&Kjær 2669, serialnr. 2298180).

The reverberation time at third-octave bands was measured with the real time analyzer (Norsonic 121, serialnr. 31416) using 20 dB decay range. All frequency bands were measured using 3 fixed source positions and 4 microphone positions. In every position 3 decays were measured. The total number of reverberation time measurements was 36.

The acoustical measurement equipment fulfilled the following IEC standards and grades of accuracy:

IEC 60651	Sound level meters (replaced by IEC 61672)	type 1
IEC 60804	Integrating sound level meters (replaced by IEC 61672)	type 1
IEC 61260	Octave-band and fractional-octave-band filters	class 1
IEC 60942	Sound level calibrators	class 1

The test laboratory operates in conformance with EN/ISO/IEC 17025.

2 Other measurements

The temperature, the ambient atmospheric pressure and the relative humidity of the measurement room were measured using an environmental measurement device (Thermo Recorder TR-73U, serialnr. E00009). The specimen was weighed with a weighing machine (Vetek TI-500 SL, serialnr. 47359). The dimensions of the specimen were measured with a roll meter (Stanley FatMax).

3 The test room

The reverberation room was equipped with five fixed diffuser panels. The positions were selected randomly in respect with altitude, angle and position. The amount of diffusers and their arrangement fulfills the requirements of Annex A in ISO 354. The reverberation time of the empty reverberation room fulfills the requirements of ISO 354 for 200 m³ test room.

4 The uncertainty of sound absorption coefficient

The uncertainty of reproducibility expresses the differences between the laboratories. The procedure to determine uncertainty of sound absorption coefficient in laboratory tests is defined in standard ISO 12999-2:2020. According to the standard, the reproducibility standard deviation varies within the measured frequency range and depends on the value of sound absorption coefficient (Figure below). The reproducibility standard deviation of the weighted sound absorption coefficient α_w is 0.035.

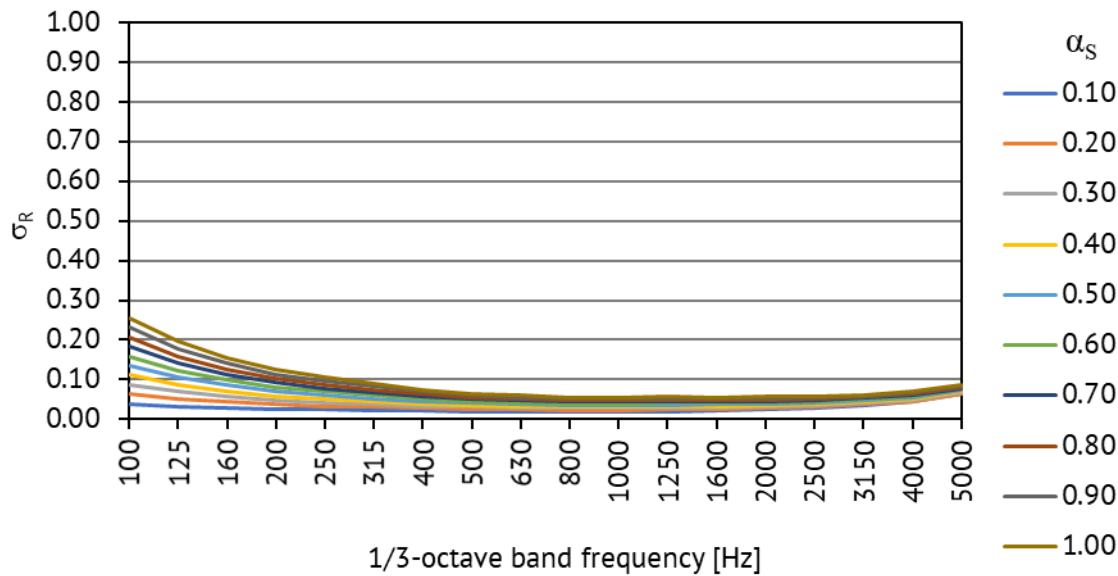


Figure. The reproducibility standard deviation, σ_R , of sound absorption coefficient, α_s , according to ISO 12999-2:2020.

5 References to the ISO standards

Test: ISO 354:2003 (E) Acoustics - Measurement of sound absorption in a reverberation room, International Organization for Standardization, 2003, Genève, Switzerland.

SFS-EN ISO 11654:1997 (E) Acoustics - Sound absorbers for use in buildings - Rating of sound absorption, International Organization for Standardization, 1997, Genève, Switzerland.

SFS-EN ISO 12999-2:2020 (E) Acoustics – Determination and application of measurement uncertainties in building acoustics. Part 2: Sound absorption, International Organization for Standardization, 2020, Genève, Switzerland.