

UAB "Narbutas International"
Ukmergės st. 308
LT-12110 Vilnius
Lithuania

Determination of equivalent sound absorption area in a reverberation room according to ISO 354 and SS-ISO 20189

(4 appendices)

Client

UAB Narbutas International

Test object

Four different desk screens delivered by UAB, Narbutas International was tested. The tested desk screens was called as follows:

- Quadrangle acoustic side screen of type FONO for an 800 mm deep desk
- Acoustic front screen of type FONO for a 1000 mm long desk
- Acoustic front screen of type FONO for a 1600 mm long desk
- Acoustic front screen of type FONO for a 2000 mm long desk

The area masses of the panels (measured from one panel per test object) were measured to:

- FONO for a 800 mm: 11.0 kg/m².
- FONO for a 1000 mm: 10.2 kg/m².
- FONO for a 1600 mm: 10.0 kg/m².
- FONO for a 2000 mm: 10.7 kg/m².

All information about the test object is according to information from the client. The area mass of the test object was measured by RISE.

Pictures of the test objects and mounting are given in the report.

Arrival of test objects and date of tests

The test objects arrived Sep 11th, 2025, and the measurements were carried out on Sep 12th, 2025.

Results

A summary of the test results is presented in table Table 1. The octave band values are calculated as arithmetic averages of the three third octave band values in the band of interest, according to SS-ISO 20189.

FONO for 800 mm deep desk where tested with 6 test objects placed in the room.

RISE Research Institutes of Sweden AB

Postal address
Box 857
501 15 BORÅS
SWEDEN

Office location
Brinellgatan 4
504 62 Borås
SWEDEN

Phone / Fax / E-mail
+46 10-516 50 00
+46 33-13 55 02
info@ri.se

Confidentiality level
C2 - Internal

This report may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.



Accred. No. 1002
Testing
ISO/IEC 17025

FONO for 1000-2000 mm long desk where tested with 4 test objects placed in the room.

Complete results of the equivalent sound absorption area (A_{obj}) are given in enclosures 1 to 4.

The results are valid for the tested items only.

Table 1– *Summary of results*

Test Object:	Equivalent sound absorption area per test object in octave bands, (A_{obj} m ²)						Enclosure
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
Quadrangle acoustic side screen of type FONO for an 800 mm deep desk	0.1 ²⁾	0.4	0.6	0.7	0.9	1.0	1
Acoustic front screen of type FONO							
For 1000 mm long desk	0.3 ¹⁾	0.4	0.8	1.0	1.1	1.3	2
For 1600 mm long desk	0.5	0.8	1.3	1.5	1.7	1.8	3
For 2000 mm long desk	0.6	0.9	1.6	1.9	2.2	2.5	4

- 1) The measurable change in the equivalent sound absorption area of the room was not fulfilled in the one-third octave bands at and below 100 Hz.
- 2) The measurable change in the equivalent sound absorption area of the room was not fulfilled in the one-third octave bands at and below 125 Hz.

Measurement method

The measurements have been carried out according to SS-ISO 20189:2019 and SS-EN ISO 354:2003, which is equivalent to the international standards ISO 20189:2018 and ISO 354:2023. RISE is accredited for the Swedish versions of the standards. The evaluation has been carried out according to SS-EN ISO 354.

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.

The equivalent sound absorption area per object A_{obj} has been evaluated from:

$$A_{obj} = \frac{55.3 * V}{c * n} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

where

- V = Volume of the reverberation room (m³)
- n = Number of test objects
- 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)

The reverberation time of the empty room in each frequency band is expressed by the arithmetic mean of the total number of reverberation time measurements made in that frequency band. In table Table 2 the reverberation time for the empty room, T_1 , is given.

Table 2 – *The reverberation time of the empty room, T_1 .*

Frequency [Hz]	Sep. 12 T1
	[s]
50	12,38
63	14,81
80	11,60
100	9,12
125	7,47
160	6,41
200	6,94
250	6,43
315	6,26
400	5,65
500	5,19
630	5,06
800	5,44
1000	5,59
1250	5,35
1600	4,91
2000	4,42
2500	3,84
3150	3,50
4000	3,08
5000	2,57

Deviation from the standard

The measurements have been conducted in conformity with the requirements in the standard SS-EN ISO 354:2003, except for the following deviations:

- The measurable change in the equivalent sound absorption area of the room was not fulfilled in the one-third octave bands at and below 100 Hz and 125 Hz respectively. The relevant deviation for each measurement is noted in table Table 1.

Measurement uncertainty

The measurement uncertainty in table Table 3 has been calculated from a world-wide Round Robin, in which RISE took part in 2022 together with 16 other laboratories. The uncertainty U is defined here as twice the standard deviation for Reproducibility, $U = 2 \times S_R$, rounded to the nearest 0,05. The data from the Round Robin is documented in a report from the test organizers to the participating laboratories.

Table 3 – *The reverberation time uncertainty of the empty reverberation room*

Frequencies (Hz)	Uncertainty
100 – 315	± 0,05
400 – 1000	± 0,10
1250 - 2500	± 0,15
3150-5000	± 0,10

Pictures of the test object



Figure 1. *Quadrangle acoustic side screen of type FONO for an 800 mm deep desk mounted in the reverberation chamber.*



Figure 2. *Acoustic front screen of type FONO for a 1000 mm long desk mounted in the reverberation chamber.*

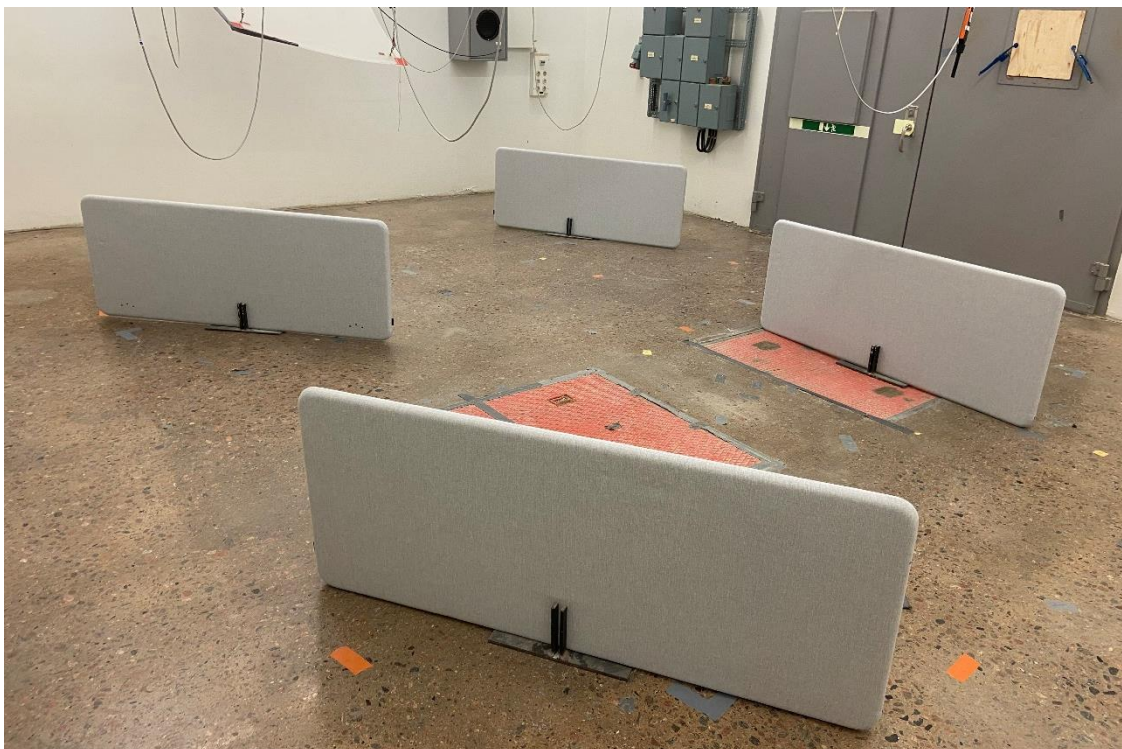


Figure 3. *Acoustic front screen of type FONO for a 1600 mm long desk mounted in the reverberation chamber.*



Figure 4. *Acoustic front screen of type FONO for a 2000 mm long desk mounted in the reverberation chamber.*

Test room

The Reverberation chamber at RISE AB Borås, 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 as test room.

Mounting

The panels were placed randomly as individual objects at least 2 m apart. They were placed at least 1 m from the walls and non-parallel to the walls.

Instrumentation

Instrument	Manufacturer	Type.	Serial no.
Microphone (6 pcs)	Brüel & Kjaer	4943	BX32058
	Brüel & Kjaer	4943	503326
	Brüel & Kjaer	4943	500047
	Brüel & Kjaer	4943	503325
	Brüel & Kjaer	4943	503323
	Brüel & Kjaer	4943	503322
Microphone Preamplifier (6 pcs)	Brüel & Kjaer	2619	502246
	Brüel & Kjaer	2619	502244
	Brüel & Kjaer	2619	502259
	Brüel & Kjaer	2619	502255
	Brüel & Kjaer	2619	502225
	Brüel & Kjaer	2619	502220
Analyzer	Norsonic	850	BX41346
software	Norsonic	ver.3.2	
Hygrometer/ Temperature meter	Testo	605i	BX80648
Barometer	Vaisala	PTU303	
Loudspeakers	SP	HGT2, HGT7, HGT4, HGTtak	
Weight scale	Stathmos	490 19SB	502624

RISE AB disclaims responsibility for the accuracy, completeness and topicality of information, test objects and documents provided by the client. The client is solely responsible for ensuring that the information, test objects, and documents are current, accurate and complete.

RISE Research Institutes of Sweden AB

Building physics & sustainable buildings - Building physics testing

Performed by

Pontus Gräsberg

Pontus Gräsberg

Examined by

Geir Andresen

Geir Andresen

Appendices

Appendix 1

Equivalent sound absorption area according to SS-ISO 20189

Measurement of sound absorption in a reverberation room

Client: UAB Narbutas International

Date of test: 2025-09-12

Description: 6 pcs randomly distributed in reverberation chamber with >2m distance between test objects

Object: Quadrangle acoustic side screen of type FONO for a 800 mm deep desk

Empty reverberation room:

Relative humidity: 81,5 %

Temperature: 21,3 °C

Barometric pressure: 986,1 kPa

Reverberation room with object

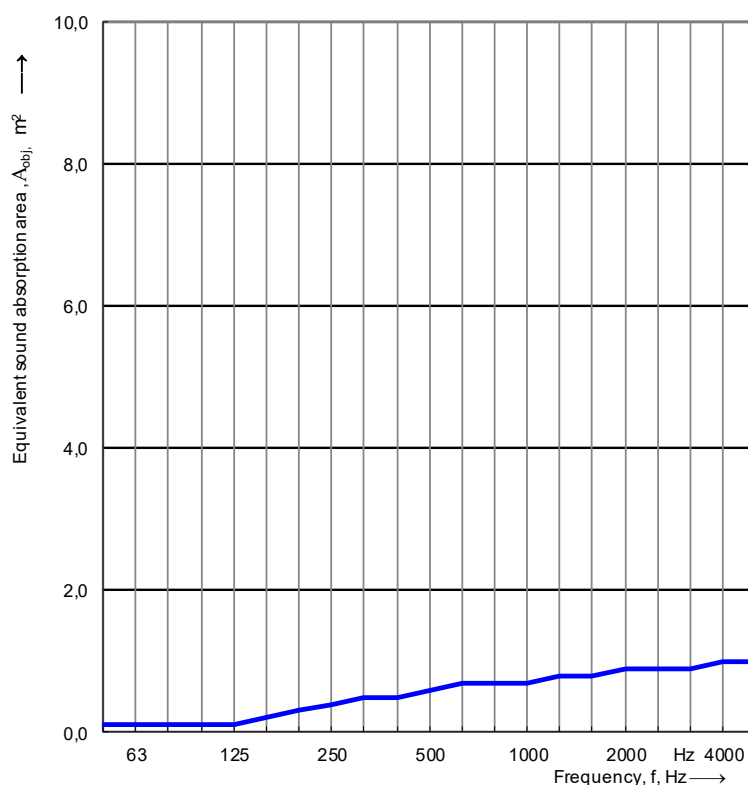
Relative humidity: 81,5 %

Temperature: 21,6 °C

Barometric pressure: 986,9 kPa

Room volume: 200,0 m³Total room area S_t: 211,4 m²

Frequency f [Hz]	A _{obj} per object	
	1/3 octave [m ²]	1/1 octave [m ²]
50	0,1	0,1
63	0,1	
80	0,1	
100	0,1	0,1
125	0,1	
160	0,2	
200	0,3	0,4
250	0,4	
315	0,5	
400	0,5	0,6
500	0,6	
630	0,7	
800	0,7	0,7
1000	0,7	
1250	0,8	
1600	0,8	0,9
2000	0,9	
2500	0,9	
3150	0,9	1,0
4000	1,0	
5000	1,0	



Appendix 2

Equivalent sound absorption area according to SS-ISO 20189

Measurement of sound absorption in a reverberation room

Client: UAB Narbutas International

Date of test: 2025-09-12

Description: 4 pcs randomly distributed in reverberation chamber with >2m distance between test objects

Object: Acoustic front screen of type FONO for a 1000 mm long desk

Empty reverberation room:

Relative humidity: 81,5 %

Temperature: 21,3 °C

Barometric pressure: 986,1 kPa

Reverberation room with object

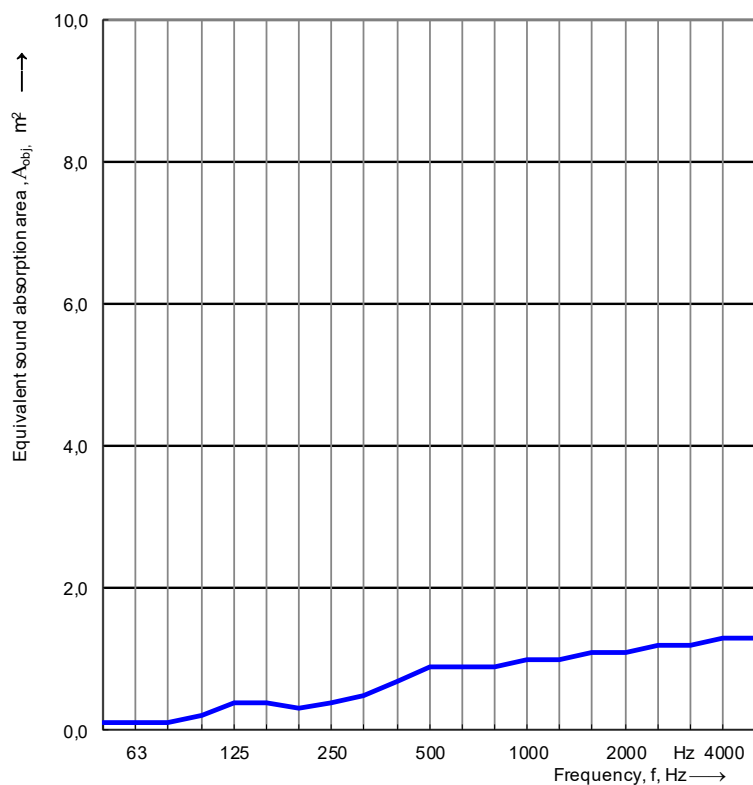
Relative humidity: 79,8 %

Temperature: 21,6 °C

Barometric pressure: 986,1 kPa

Room volume: 200,0 m³Total room area S_t: 211,4 m²

Frequency f [Hz]	A _{obj} per object	
	1/3 octave [m ²]	1/1 octave [m ²]
50	0,1	0,1
63	0,1	
80	0,1	
100	0,2	0,3
125	0,4	
160	0,4	
200	0,3	0,4
250	0,4	
315	0,5	
400	0,7	0,8
500	0,9	
630	0,9	
800	0,9	1,0
1000	1,0	
1250	1,0	
1600	1,1	1,1
2000	1,1	
2500	1,2	
3150	1,2	1,3
4000	1,3	
5000	1,3	



Appendix 3

Equivalent sound absorption area according to SS-ISO 20189

Measurement of sound absorption in a reverberation room

Client: UAB Narbutas International

Date of test: 2025-09-12

Description: 4 pcs randomly distributed in reverberation chamber with >2m distance between test objects

Object: Acoustic front screen of type FONO for a 1600 mm long desk

Empty reverberation room:

Relative humidity: 81,5 %

Temperature: 21,3 °C

Barometric pressure: 986,1 kPa

Reverberation room with object

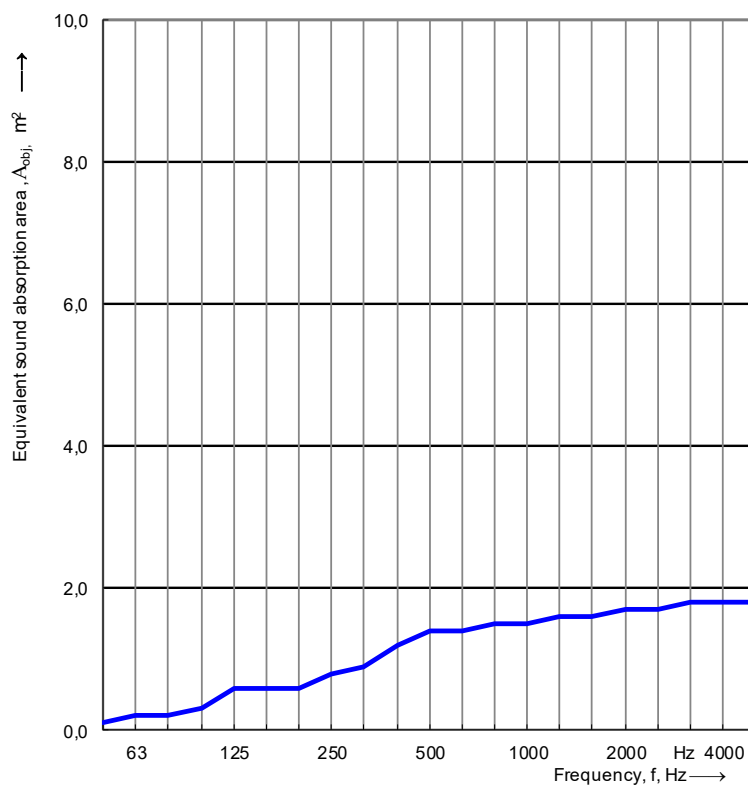
Relative humidity: 81,8 %

Temperature: 21,3 °C

Barometric pressure: 986,9 kPa

Room volume: 200,0 m³Total room area S_t: 211,4 m²

Frequency f [Hz]	A _{obj} per object	
	1/3 octave [m ²]	1/1 octave [m ²]
50	0,1	0,2
63	0,2	
80	0,2	
100	0,3	0,5
125	0,6	
160	0,6	
200	0,6	0,8
250	0,8	
315	0,9	
400	1,2	1,3
500	1,4	
630	1,4	
800	1,5	1,5
1000	1,5	
1250	1,6	
1600	1,6	1,7
2000	1,7	
2500	1,7	
3150	1,8	1,8
4000	1,8	
5000	1,8	



Appendix 4

Equivalent sound absorption area according to SS-ISO 20189

Measurement of sound absorption in a reverberation room

Client: UAB Narbutas International Date of test: 2025-09-12
Description: 4 pcs randomly distributed in reverberation chamber with >2m distance between test objects

Object: Acoustic front screen of type FONO for a 2000 mm long desk

Empty reverberation room:

Relative humidity: 81,5 %

Temperature: 21,3 °C

Barometric pressure: 986,1 kPa

Reverberation room with object

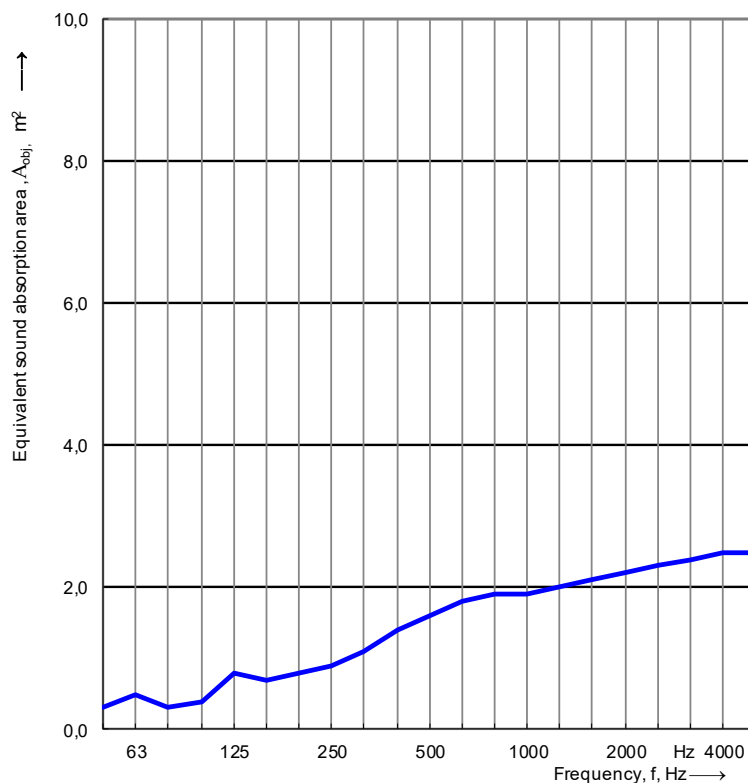
Relative humidity: 79,3 %

Temperature: 21,7 °C

Barometric pressure: 986,9 kPa

Room volume: 200,0 m³Total room area S_T: 211,4 m²

Frequency f [Hz]	A _{obj} per object	
	1/3 octave [m ²]	1/1 octave [m ²]
50	0,3	0,4
63	0,5	
80	0,3	
100	0,4	0,6
125	0,8	
160	0,7	
200	0,8	0,9
250	0,9	
315	1,1	
400	1,4	1,6
500	1,6	
630	1,8	
800	1,9	1,9
1000	1,9	
1250	2,0	
1600	2,1	2,2
2000	2,2	
2500	2,3	
3150	2,4	2,5
4000	2,5	
5000	2,5	



Verification

Document ID 09222115557557233594

Document

O100282-1326443 Report

Main document

11 pages

Initiated on 2025-09-17 14:01:27 CEST (+0200) by Pontus

Gräsberg (PG)

Finalised on 2025-09-22 07:38:47 CEST (+0200)

Signatories

Pontus Gräsberg (PG)

RISE Research Institutes of Sweden AB

Company reg. no. 556464-6874

pontus.grasberg@ri.se

+46 10 516 68 17



Signed 2025-09-22 07:38:47 CEST (+0200)

Geir Andresen (GA)

RISE

geir.andresen@ri.se



Signed 2025-09-17 14:36:25 CEST (+0200)

This verification was issued by Scrive. For more information/evidence about this document see the concealed attachments. Use a PDF-reader such as Adobe Reader that can show concealed attachments to view the attachments. Please observe that if the document is printed, the integrity of such printed copy cannot be verified as per the below and that a basic print-out lacks the contents of the concealed attachments. The digital signature (electronic seal) ensures that the integrity of this document, including the concealed attachments, can be proven mathematically and independently of Scrive. For your convenience Scrive also provides a service that enables you to automatically verify the document's integrity at: <https://scrive.com/verify>

