

TEST REPORT No. GLA-1552.1 / 21 E**Sponsor:****Narbutas International, UAB**
Ukmerges st. 308
12110 Vilnius, Lithuania**Manufacturer:****Narbutas International, UAB**
Ukmerges st. 308
12110 Vilnius, Lithuania**Test specimen:****MODUS - Acoustic panels****Specimen delivered by: Manufacturer****Delivery Date:**

27.07.2021

Test Date:

06.08.2021

Test method:

PN-EN ISO 354:2005 Acoustics: Measurement of sound absorption in a reverberation room

Tested parameters:Sound absorption coefficient α_s .Practical sound absorption coefficient α_p Single rating α_w according to: PN-EN ISO 11654:1999 Acoustics.
Sound absorbers use in buildings. Rating of
sound absorptionCopy No. 1

The test report consists of 8 pages.

The report was printed in 3 copies. Copies No. 1-2 - for the Client, copy 3 - a/a.

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1. TEST SPECIMEN

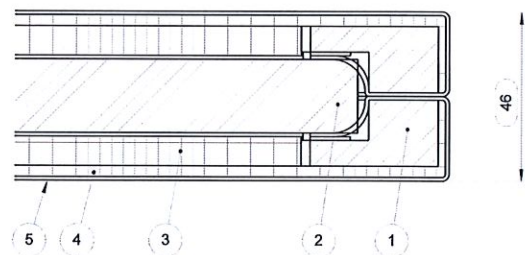
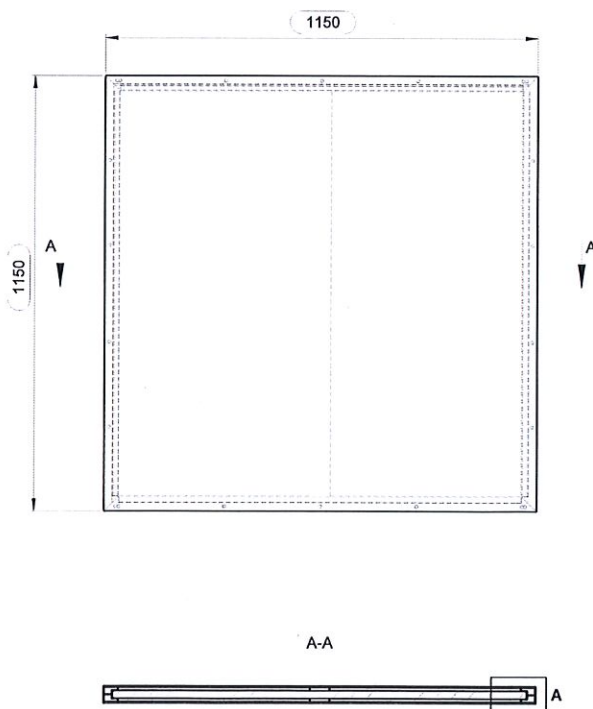
1.1 Description of test specimen:

The aim of acoustic test was measurement of sound absorption of the acoustic panels "MODUS".

A single panel was built from a wooden frame filled with a sound absorbing material, 46 mm thickness (three layers of foam). The wooden frame was made of plywood slats with a cross section of 35 x 18 mm. The frame was covered with fabric.

Technical data sheet of panel "MODUS"

Core	Polyurethane acoustic foam thickness 20 mm + Polyurethane foam type HR3030 2 x 10 mm + Polyurethane foam type VB 2240 2 x 3 mm
Dimensions (length x width)	1150 x 1150 mm
Thickness	46 mm
Decorative material	Fabric
Surface mass	is about 4,2 kg/ m ²



1. Plywood frame
2. Acoustic foam, 20 mm
3. Foam, 10 mm
4. Foam, 3 mm
5. Fabric

No.	Name	Quantity
1	Plywood frame, 18 mm thickness	2
2	Acoustic foam, 20 mm	1
3	Foam, HR3030, 10 mm	4
4	Foam, VB2240, 3 mm	2
5	Fabric	1

Name	Packet	Order no.
MODUS acoustic panel, 1150x1150x46	NI00161G03-YE2	
	Material	Version

Drawing was delivered by sponsor

Figure. 1. The view of decorative panel "MODUS"

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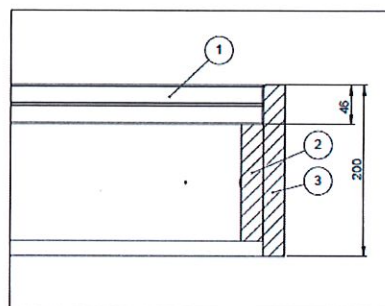
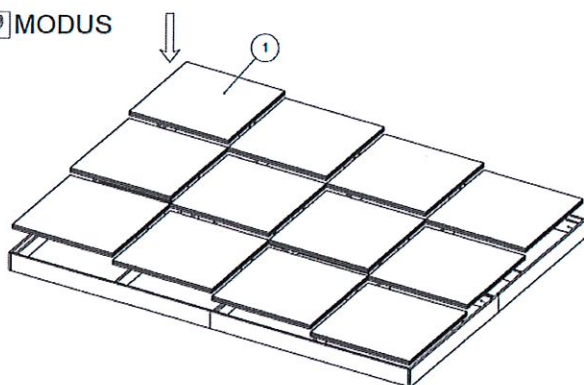
1.2 The area of test specimen:

15,85 m² (the dimension of test specimen 3,45 m x 4,595 m).
12 acoustic panel was used.

1.3 The way of mounting of the test specimen:

The test specimen was putted on the floor in the reverberation room. The mounting type E-200 in accordance with Appendix B of standard PN-EN ISO 354:2005.

9 MODUS



- 1. MODUS screen, 1150x1150x46 mm 12
- 2. Mini frame, 2300x1725x136 mm 4
- 3. Outline frame, side part, 2300x200x25 mm 4

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Figure. 2. The sketch of type of mounting E-200 of panel "MODUS"

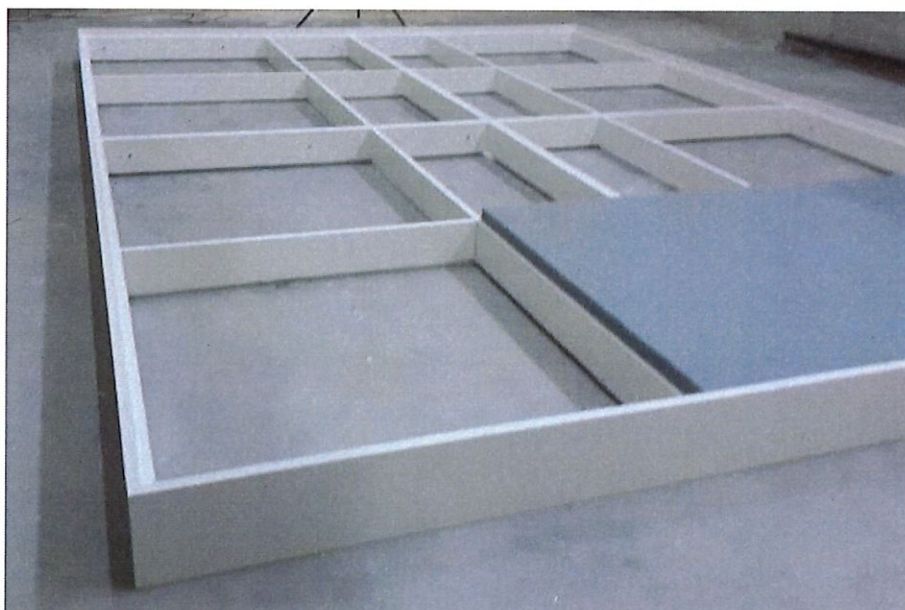


Figure. 3. Photo is presented the way of mounting of test specimen in the reverberation room.
Photo Gryfitlab LA



Figure. 4. Photos are presented the way of mounting of test specimen in the reverberation room. (12 panels were used). Photo Gryfitlab LA

1.4 The measurement conditions:

The test specimen was positioned on the floor that any edge of test specimen were not close than 1 m from the wall of the reverberation room. The measurement conditions is shown in Figure 5.

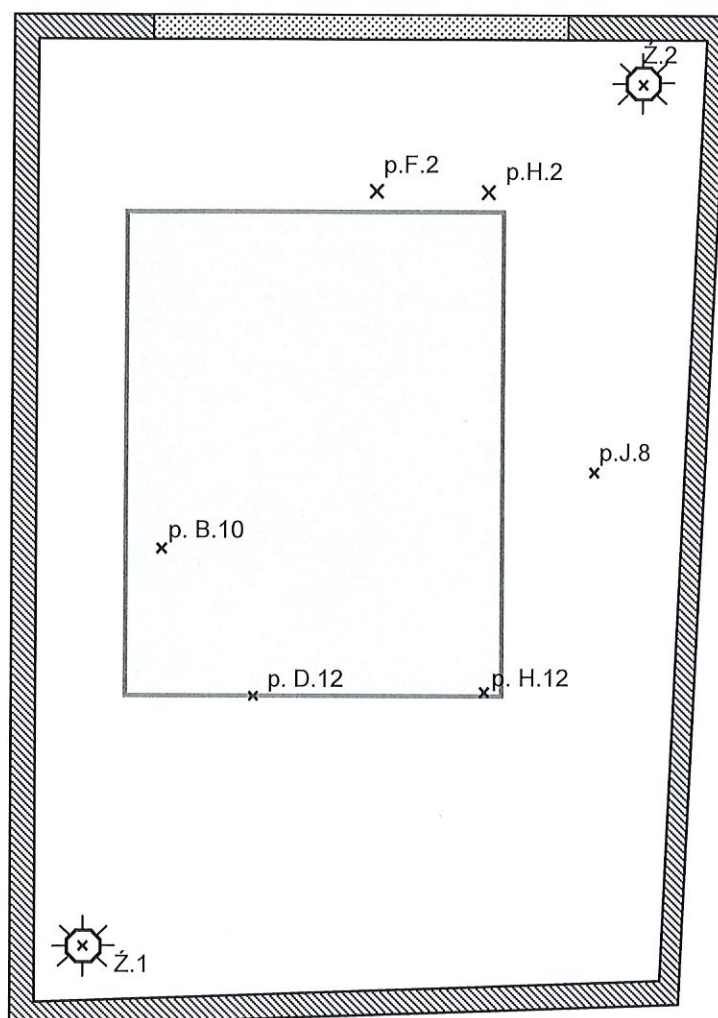


Figure. 5. The cross section of the reverberation room with the test specimen

2. REVERBERATION ROOM

Volume – $V = 324 \text{ m}^3$.

Total surface (walls, floor and ceiling) – $S_t = 291,5 \text{ m}^2$.

The reverberation chamber dimensions (length x width x height) – $9,6 \times 6,7 \times 5,5 \text{ m}$.

No walls of the room are parallel to each other. Also the ceiling is not parallel to the floor.

3. TEST EQUIPMENT

Microphone: condenser microphone type SV 22, serial no. 4012883, BSWA Technology.

Preamplifier: type SV 12L, serial no. 17873, producer Svantek.

Sound analyzer: type SVAN 948, serial no. 12641, producer Svantek.

Calibrator: type SV-35, serial no. 58156, producer Svantek.

Amplifier with noise generator: power amplifier type RMX3051, producer QSC Audio.

Sound source: omnidirectional sound source.

Thermohygrobrometer: type C4130 serial No. 149000370, producer Comet, PP-LA-122.

4. CERTIFICATES OF PERIODIC INSPECTION OF MEASUREMENT SYSTEM

Measurement system: Analyzer+ Preamplifiers + Microphones – calibration report No. 2052 / 1a / 2020; 2052 / 1b / 2020 in HAIK Laboratory.

Calibrator: – calibration report No. 00020818/01/2021 in Svantek laboratory.

5. MEASUREMENT RESULTS

The sound absorption coefficient α_s , was determined in one third-octave bands between 100 Hz and 5000 Hz according to PN-EN ISO 354:2005. (test results is shown in figure 7).

In addition to the sound absorption coefficient the following characteristic values were determined according to PN-EN ISO 11654:1999.

- Weighted sound absorption coefficient α_w , as single value,
- Practical sound absorption coefficient α_p , in octave bands,
- Class of absorption.

In the below table are sound absorption performance of **MODUS - Acoustic panels** manufactured by **Narbutas International, UAB**.

Tab.1 The acoustic performance for test specimen No. GLA-1552.1/ 21 **MODUS - Acoustic panel** the mounting type E-200

Practical sound absorption coefficient	Frequency (Hz)						Single rating
	125	250	500	1000	2000	4000	α_w
α_p	0,7	1,00	0,95	0,95	0,85	0,85	0,95

Sound absorption class: A

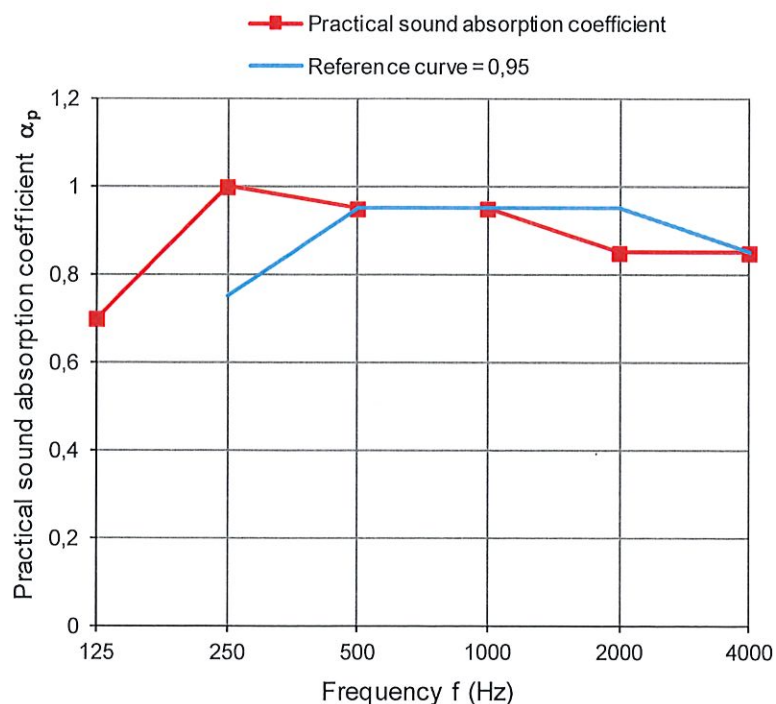


Figure 6 Practical sound absorption coefficient of test specimen No. GLA-1552.1/ 21.

Sound Absorption Coefficient

PN-EN ISO 354:2005 (EN ISO 354:2003) Measurement of sound absorption in a reverberation room

Client: **Narbutas International, UAB**
Address: **Ukmerges st. 308 12110 Vilnius, Lithuania**

Measurement date: **06.08.2021**

Test Specimen: **MODUS Acoustic panel**

Dimensions of panel: 1150 x 1150 x 46 mm
(length x width x thickness)

Type of mounting the test specimen in the reverberation room:
E-200

Reverberation room:

Volume of reverberation room $V = 324 \text{ m}^3$

Surface of all partitions reverberation room $S_t = 291,5 \text{ m}^2$

Number of Diffusers: **6**

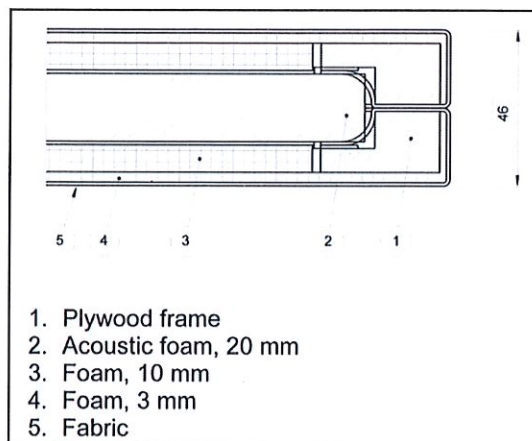
Test specimen area: **15,85 m²**

Air temperature of empty room T_1 : **22,8 °C**

Air temperature of room with object T_2 : **22,6 °C**

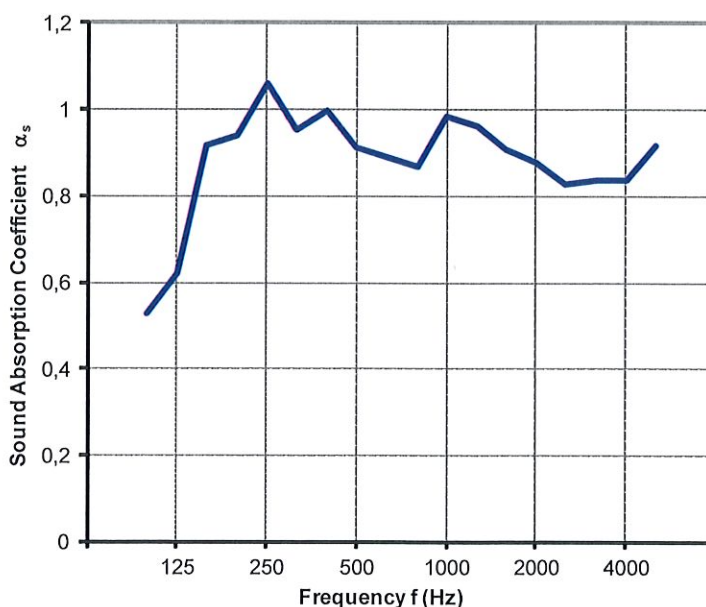
Relative humidity in empty room T_1 : **56 %**

Relative humidity; object in room T_2 : **55 %**



cross section of MODUS

Frequency	Reverberation time empty room	Reverberation time filled room	Sound Absorption Coefficient	
f	T1	T2	α_s	α_p
(Hz)	(s)	(s)		
100	5,77	2,99	0,53	0,70
125	5,44	2,68	0,62	
160	5,70	2,20	0,92	
200	6,11	2,22	0,94	1,00
250	6,67	2,12	1,06	
315	6,94	2,30	0,96	
400	6,24	2,15	1,00	0,95
500	5,96	2,24	0,91	
630	5,91	2,27	0,89	
800	5,59	2,25	0,87	0,95
1000	5,15	2,03	0,98	
1250	4,70	1,97	0,96	
1600	4,16	1,93	0,91	0,85
2000	3,69	1,86	0,88	
2500	3,09	1,74	0,83	
3150	2,71	1,61	0,84	0,85
4000	2,25	1,43	0,84	
5000	1,89	1,24	0,92	
PN-EN ISO 11654:1999				
$\alpha_w = 0,95$				
Sound absorption class: A				



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Date: 6 August 2021

Signature: Krzysztof Mech

Figure. 7 Measurement results of the test specimen No. GLA-1552.1/ 21

6. THE PRECISION OF THE MEASUREMENTS

Accuracy of measurement reverberation time.

The standard deviation of reverberation time T_{20} , evaluated over a 20 dB decay range can be estimated by following formula (PN-EN ISO 354: 2005 – point 8.2.2).

$$\varepsilon_{20}(T) = T \sqrt{\frac{2,42 + 3,59 / N}{f T}}$$

$\varepsilon_{20}(T)$ - The standard deviation of reverberation time T_{20} ,
 T - the measured reverberation time; T_1 time for the empty room, T_2 time for the fitted room (s),
 f - the centre frequency of one-third-octave band (Hz),
 N - the number of decay curves evaluated.

Accuracy of measurement sound absorption coefficient.

The standard deviation of sound absorption coefficient $\varepsilon(\alpha)$, can be estimated by following formula

$$\varepsilon(\alpha) = \frac{55,3 \cdot V}{c \cdot S} \sqrt{\left(\frac{\partial \alpha}{\partial T_2} \varepsilon_{T_2}\right)^2 + \left(\frac{\partial \alpha}{\partial T_1} \varepsilon_{T_1}\right)^2} = \frac{55,3 \cdot V}{c \cdot S} \sqrt{\left(-\frac{1}{T_2^2} \varepsilon_{T_2}\right)^2 + \left(-\frac{1}{T_1^2} \varepsilon_{T_1}\right)^2}$$

V - the volume of reverberation room (m^3),
 c - the speed of sound (m/s),
 S - the area of test specimen (m^2).

Tab. 2 The standard deviation of sound absorption coefficient $\varepsilon(\alpha)$ for test specimen
No. GLA-1552.1/ 21

f	Empty room		Fitted room		Accuracy
	T1	ε_{T1}	T2	ε_{T2}	
Hz	s		s		$\varepsilon(\alpha)$
100	5,77	0,38	2,99	0,27	0,11
125	5,44	0,33	2,68	0,23	0,11
160	5,70	0,30	2,20	0,19	0,13
200	6,11	0,28	2,22	0,17	0,12
250	6,67	0,26	2,12	0,15	0,11
315	6,94	0,24	2,30	0,14	0,09
400	6,24	0,20	2,15	0,12	0,09
500	5,96	0,17	2,24	0,11	0,07
630	5,91	0,15	2,27	0,10	0,06
800	5,59	0,13	2,25	0,08	0,06
1000	5,15	0,11	2,03	0,07	0,06
1250	4,70	0,10	1,97	0,06	0,06
1600	4,16	0,08	1,93	0,06	0,05
2000	3,69	0,07	1,86	0,05	0,05
2500	3,09	0,06	1,74	0,04	0,05
3150	2,71	0,05	1,61	0,04	0,05
4000	2,25	0,04	1,43	0,03	0,05
5000	1,89	0,03	1,24	0,02	0,06

Responsible for preparation of
the test report:

Robert Dypicz, MSc

Responsible for authorization of the test
report:

Krzysztof Mech, PhD

Report issue date:

10 September 2021