

CENTRUM TECHNIKI OKRĘTOWEJ S.A.

Ship Design and Research Centre S.A.



AB 1241



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RESEARCH AND DEVELOPMENT DEPARTMENT ENVIRONMENTAL LABORATORIES DIVISION

ACOUSTIC LABORATORY

TEST REPORT

No RS-2016/B-019/E

Evaluation of sound absorption coefficient of acoustic panels, manufactured by Creative Design Szymon Rychlik

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Specimen No :

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1. Basic data

Tab. 1. Summary of data and test parameters.

Customer: Creative Design Szymon Rychlik ul. Chodkiewicza 3/118 02-593 Warszawa	Order (e-mail): 19.01.2016 CTO S.A. order number: 8.033.02.223							
Name and type of test object: acoustic panels made of Basotect polyurethane foam	Delivery date of test object: 15.10.2015 and 14.12.2015							
	Date and place of measurements: 26.10.2015 and 29.12.2015 Gdańsk, Ship Design And Research Centre Environmental Laboratories Division Acoustic Laboratory							
	The method of measurement and analysis of the results: According to the standards: • Standard No.: PN-EN ISO 354:2005 • Standard No.: PN-EN ISO 11654:1997							
	Manufacturer: Creative Design Szymon Rychlik ul. Chodkiewicza 3/118 02-593 Warszawa	<table><tr><th>Conditions of measurement</th><th>(start / end) of measurement</th></tr><tr><td>Air humidity</td><td rowspan="3">Detailed results are presented in chapter 5</td></tr><tr><td>Temperature</td></tr><tr><td>Atmospheric pressure</td></tr></table>		Conditions of measurement	(start / end) of measurement	Air humidity	Detailed results are presented in chapter 5	Temperature
Conditions of measurement	(start / end) of measurement							
Air humidity	Detailed results are presented in chapter 5							
Temperature								
Atmospheric pressure								
Designation of the test object in CTO S.A.: LA527; LA560								
Measuring equipment:	Channel 1	Channel 2						
measuring wires	0SvankK3	1SvankK3						
microphone	G.R.A.S. 40AR Serial No. 119088	G.R.A.S. 40AR Serial No. 119096						
preamplifier	G.R.A.S. 26TK Serial No. 210489	G.R.A.S. 26TK Serial No. 210490						
sound analyzer	Norsonic type N-121 Serial No. 31378							
calibrator	Norsonic type 1251 Serial No. 33204							
sound source	Larson Davis BAS001 Serial No. 1225-DIC08							
thermo-hygro-barometer	type LB-706BP, No. 846 type LB-701, No. 3605							
measuring tape	RS/0003							
Sound absorption results:								
Measured value	Actual value							
α_w - sound absorption coefficient	$\alpha_w = 0,75$ for 35mm panels							
	$\alpha_w = 1,00$ for 55mm panels							
Graph of sound absorption as a function of frequency and other relevant information is presented in a form compatible with the PN-EN ISO 354:2005 in chapter 5.								
Attention: Presented values are valid only for the tested object.								

2. Test method

Measurement of sound absorption of Creative Design Szymon Rychlik acoustic panels was performed in reverberation chamber with a volume of 200 m³ in the Ship Design and Research Centre, in Acoustic Laboratory. Chamber specifications are placed in appendix No. 1. Reverberation chamber was tuned to achieve reverberation time required by the PN-EN ISO 354:2005. This was achieved by setting up 3 attenuator – diffusers and 8 diffusers. Their sound absorption area complies with Tab. 2.

Tab. 2. Equivalent sound absorption areas for a 200 m³ reverberation chamber for sound absorption coefficient measurements.

Frequency, Hz	100	125	160	200	250	315	400	500	630	800
A ₁ , m ² - Value measured in laboratory	4,2	4,0	4,6	4,8	5,5	5,6	5,6	5,6	5,8	5,9
A ₁ Max value acc. to norm	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5
Frequency, Hz	1000	1250	1600	2000	2500	3150	4000	5000		
A ₁ , m ² - Value measured in laboratory	6,1	6,3	6,7	7,1	8,0	9,4	11,1	13,6		
A ₁ Max value acc. to norm	7,0	7,5	8,0	9,5	10,5	12,0	13,0	14,0		

Measurements were carried out for 12 microphone – sound source positions. Measurement in each position was repeated 3 times, in accordance with requirements in PN-EN ISO 354:2005. Test object designated as LA527 was mounted directly on the floor of reverberation chamber, at a minimum distance of 1000 mm from the wall, it was type "A" mounting. Test object designated as LA560 was installed in accordance with type "I" mounting (30cm above the floor). In the chamber were hanged 8 diffusers with surface area 16m². Test was carried out using sound analyzer Nor 121 Norsonic, and analysis was performed in NorBuild application. Measurements were performed using methods in accordance with norm PN-EN ISO 354:2005. "Measurement of sound absorption in reverberation chamber."

3. Description of the tested object

Table 3 contains summary of tests of acoustic panels manufactured by Creative Design Szymon Rychlik.

Tab. 3. Summary of tested objects.

Test object name	Designation	Test No.	Delivery date
Acoustic panels - 35mm	LA527	B52701	26.10.2015
Acoustic panels - 55mm	LA560	B56001	29.12.2015

Technical description

Acoustic panels 35mm - Dimensions: 600x600x35mm; Structure: 100% polyester fabric, Basotect polyurethane foam with thickness of 29mm, HDF board with thickness of 6mm

Acoustic panels 55mm - Dimensions: 600x600x55mm; Structure: 100% polyester fabric, Basotect polyurethane foam with thickness of 49mm, HDF board with thickness of 6mm

Photos of Creative Design Szymon Rychlik acoustic panels in reverberation chamber with volume of 200m^3 in Acoustic Laboratory in CTO S.A., are presented in fig. 1. and fig. 2

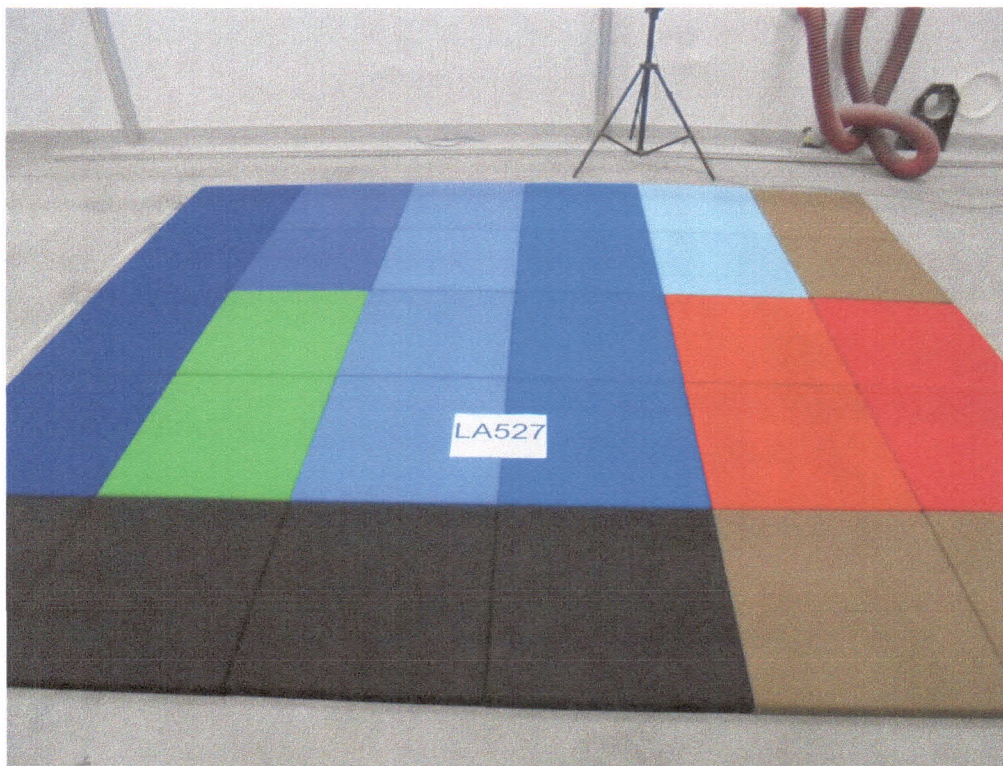


Fig. 1. Test object LA527, Creative Design Szymon Rychlik acoustic panels, in reverberation chamber in Acoustic Laboratory in CTO S.A.



Fig. 2. Test object LA560, Creative Design Szymon Rychlik acoustic panels, in reverberation chamber in Acoustic Laboratory in CTO S.A.

Arrangement of Creative Design Szymon Rychlik acoustic panels in reverberation chamber in CTO S.A is illustrated in fig. 3.

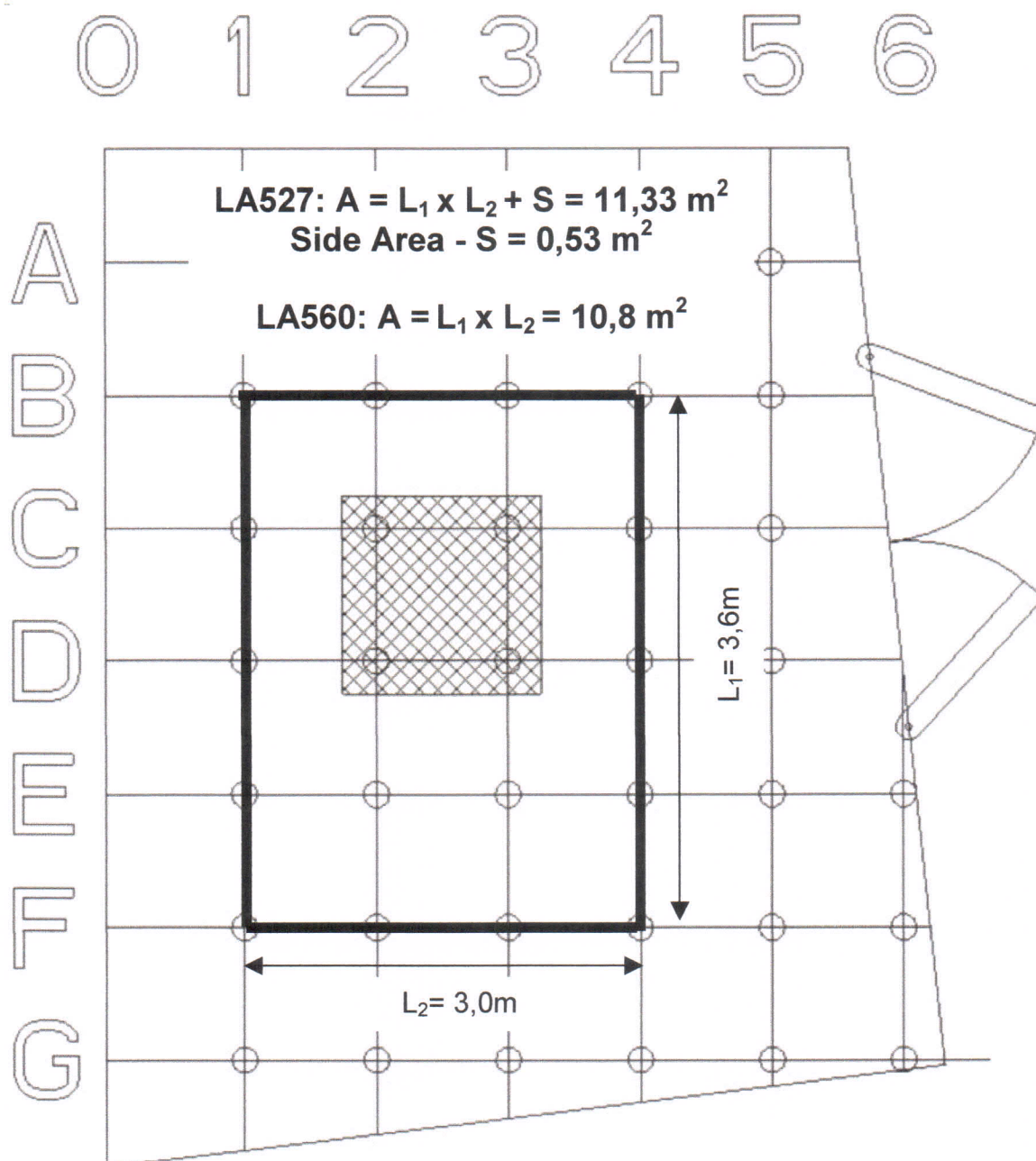


Fig. 3. Arrangement of Creative Design Szymon Rychlik acoustic panels in reverberation chamber in Acoustic Laboratory in CTO S.A.

Tested object designated as LA527 with total area of 11,33m² was placed directly onto the floor of the chamber, at a minimum distance of 1000mm from wall, it was type A mounting. Side area of the test object wasn't covered and it was taken into account in calculations.

Tested object designated as LA560 with total area of 10,80m² was placed 30cm above the floor of reverberation chamber, at a minimum distance of 1000mm from wall, it was type I mounting. Side area of test object was covered with a rack made of HDF boards.

Tab. 4 shows schedule of the study.

Tab. 4. Schedule of the test

Test object designation	Step	Date
LA527	Delivery date	15.10.2015
	Acclimatization	23.10.2015
	Installation	23.10.2015
	Measurement	26.10.2015
	Removal of the test object	27.10.2015
LA560	Delivery date	14.12.2015
	Acclimatization	28.12.2015
	Installation	28.12.2015
	Measurement	29.12.2015
	Removal of the test object	30.12.2015

Test objects were acclimatized in reverberation chamber.

4. Measurement

Study was carried out in accordance with method described in PN-EN ISO 354:2005. Before the measurement, calibration of measuring channels was performed and conditions in reverberation chamber were written down. Test was done with two microphones in 6 positions and 2 positions of sound source. For each arrangement measurement was repeated 3 times. A total of 36 measurements was done for the test.

5. Analysis and summary of the test results

After the test, data from the analyzer were uploaded to NorBuild application and analyzed. The analysis resulted with a graph showing sound absorption as a function of frequency in 1/3 octave band, together with reverberation time. The results are presented in tab. 5 and tab. 6. Sound absorption coefficient and sound absorption class in accordance with norm PN-EN ISO 11654:1997 are also shown in tab. 5 and tab. 6.

Tab. 5. Results of sound absorption measurements for test object LA527 performed in acoustic laboratory in CTO S.A., in accordance with PN-EN ISO 354:2005.

Sound absorption coefficient according to norm PN-EN ISO 354:2005

Sound absorption measurement in reverberation chamber.

Client: Creative Design Szymon Rychlik, ul. Chodkiewicza 3/118, 02-593 Warszawa
Date of Test: 26.10.2015
Test room identification: CTO S.A. Environmental Laboratories Division. Acoustic Laboratory
Test object designation: LA527
Description: Acoustic panels with following dimensions: 600x600x35mm; Structure: 100% polyester fabric, Basotect polyurethane foam with thickness of 29mm, HDF board with thickness of 6mm; Type A Mounting

Surface area of test object: 11,33 m²
 Volume of reverberation chamber: 200,0 m³

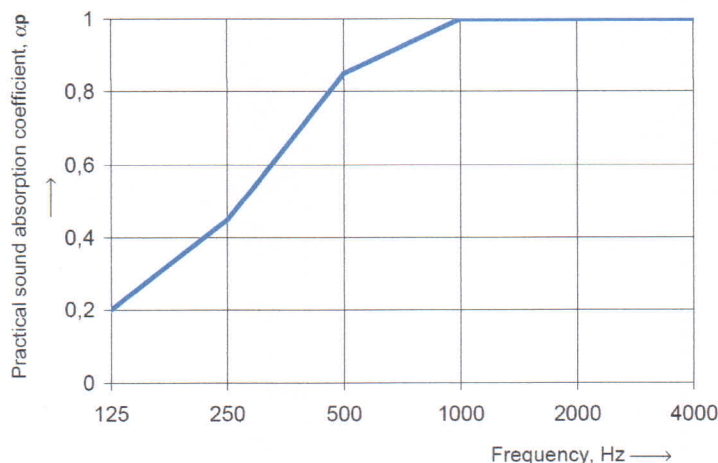
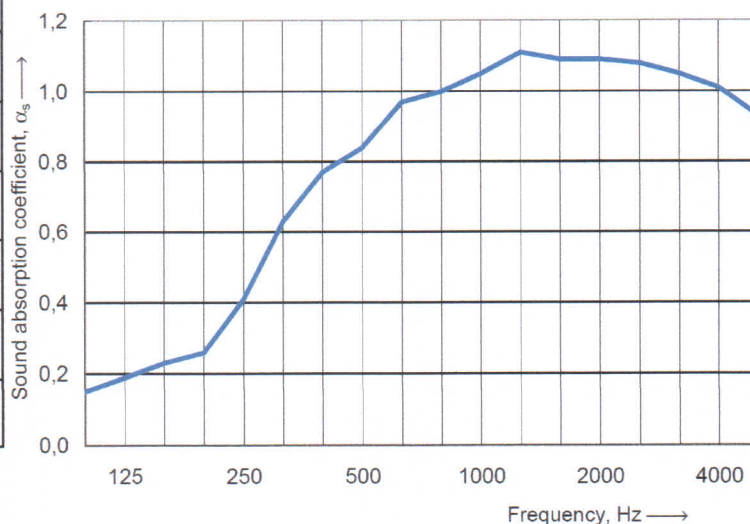
Empty reverberation chamber:

Relative air humidity: 46,8 %
 Air temperature: 19,4 °C
 Barometric pressure: 102,0 kPa

Reverberation chamber with test object:

Relative air humidity: 46,6 %
 Air temperature: 19,3 °C
 Barometric pressure: 102,0 kPa

Frequency f [Hz]	Empty T1 [s]	Object T2 [s]	α_s	α_p	A [m ²]
100	9,32	7,80	0,15		1,7
125	12,39	10,12	0,19	0,20	2,1
160	12,33	8,82	0,23		2,6
200	10,36	6,75	0,26		2,9
250	10,24	6,17	0,41	0,45	4,6
315	7,56	4,71	0,63		7,1
400	6,50	4,09	0,77		8,7
500	6,35	3,32	0,84	0,85	9,5
630	6,10	2,61	0,97		11
800	6,35	2,35	1,00		11,3
1000	6,17	2,19	1,05	1,00	11,9
1250	5,66	1,93	1,11		12,6
1600	5,19	1,84	1,09		12,3
2000	4,86	1,74	1,09	1,00	12,3
2500	4,88	1,68	1,08		12,2
3150	4,38	1,64	1,05		11,9
4000	3,97	1,58	1,01	1,00	11,4
5000	3,53	1,51	0,93		10,5



Sound absorption coefficient according to PN-EN ISO 11654:1997

$\alpha_w = 0,75$

Sound absorption class: **C**

Test number: B52701

Date: 26.10.2015

Signature: Marek Panaś

M. Panaś

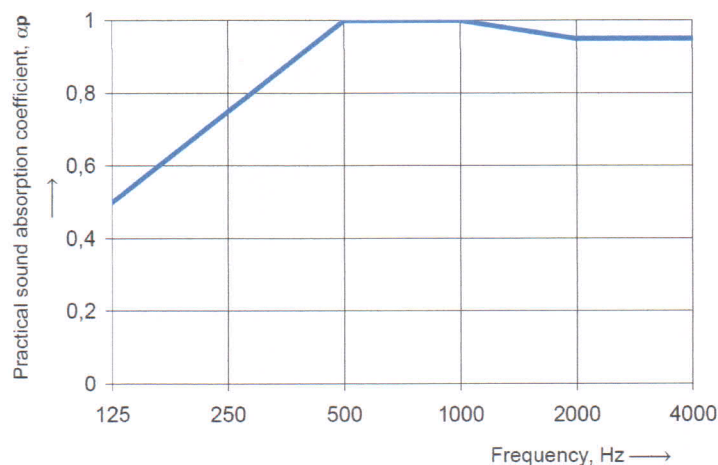
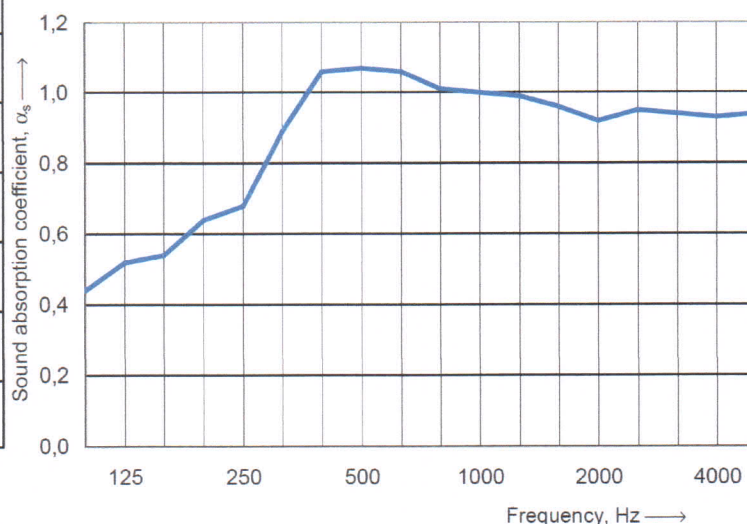
Tab. 6. Results of sound absorption measurements for test object LA560 performed in acoustic laboratory in CTO S.A., in accordance with PN-EN ISO 354:2005.

Sound absorption coefficient according to norm PN-EN ISO 354:2005

Sound absorption measurement in reverberation chamber.

Client:	Creative Design Szymon Rychlik, ul. Chodkiewicza 3/118, 02-593 Warszawa	Date of test:	29.12.2015
Test room identification:	CTO S.A. Environmental Laboratories Division. Acoustic Laboratory		
Test object designation:	LA560		
Description:	Acoustic panels with following dimensions: 600x600x55mm; Structure: 100% polyester fabric, Basotect polyurethane foam with thickness of 49mm, HDF board with thickness of 6mm; Type I Mounting (Height 30cm)		
Surface area of test object:	10,80 m ²	Empty reverberation chamber:	
Volume of reverberation chamber:	200,0 m ³	Relative air humidity:	46,8 %
		Air temperature:	19,0 °C
		Barometric pressure:	102,0 kPa
		Reverberation chamber with test object:	
		Relative air humidity:	37,0 %
		Air temperature:	20,0 °C
		Barometric pressure:	101,0 kPa

Frequency f [Hz]	Empty T1 [s]	Object T2 [s]	α_s	α_p	A [m ²]
100	9,32	4,60	0,44		4,7
125	12,39	4,23	0,52	0,50	5,6
160	12,33	4,18	0,54		5,8
200	10,36	4,13	0,64		6,9
250	10,24	3,66	0,68	0,75	7,3
315	7,56	3,21	0,89		9,6
400	6,50	2,72	1,06		11,5
500	6,35	2,60	1,07	1,00	11,6
630	6,10	2,17	1,06		11,5
800	6,35	1,94	1,01		10,9
1000	6,17	1,92	1,00	1,00	10,8
1250	5,66	1,87	0,99		10,7
1600	5,19	1,88	0,96		10,4
2000	4,86	1,84	0,92	0,95	9,9
2500	4,88	1,85	0,95		10,3
3150	4,38	1,80	0,94		10,2
4000	3,97	1,76	0,93	0,95	10
5000	3,53	1,62	0,94		10,2



Sound absorption coefficient according to PN-EN ISO 11654:1997

 $\alpha_w = 1,00$ Sound absorption class: **A**

Test number: B56001

Date: 29.12.2015

Signature:

Marek Panaś

M. Panaś

1 appendix is attached to this test report:

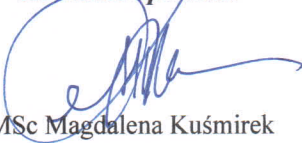
- APPENDIX 1 - Configuration of reverberation chamber

Project Leader
Senior Acoustics Assistant



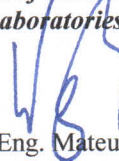
MEng. Marek Panas
MP – initials of report author

Authorised by
Acoustics Specialist



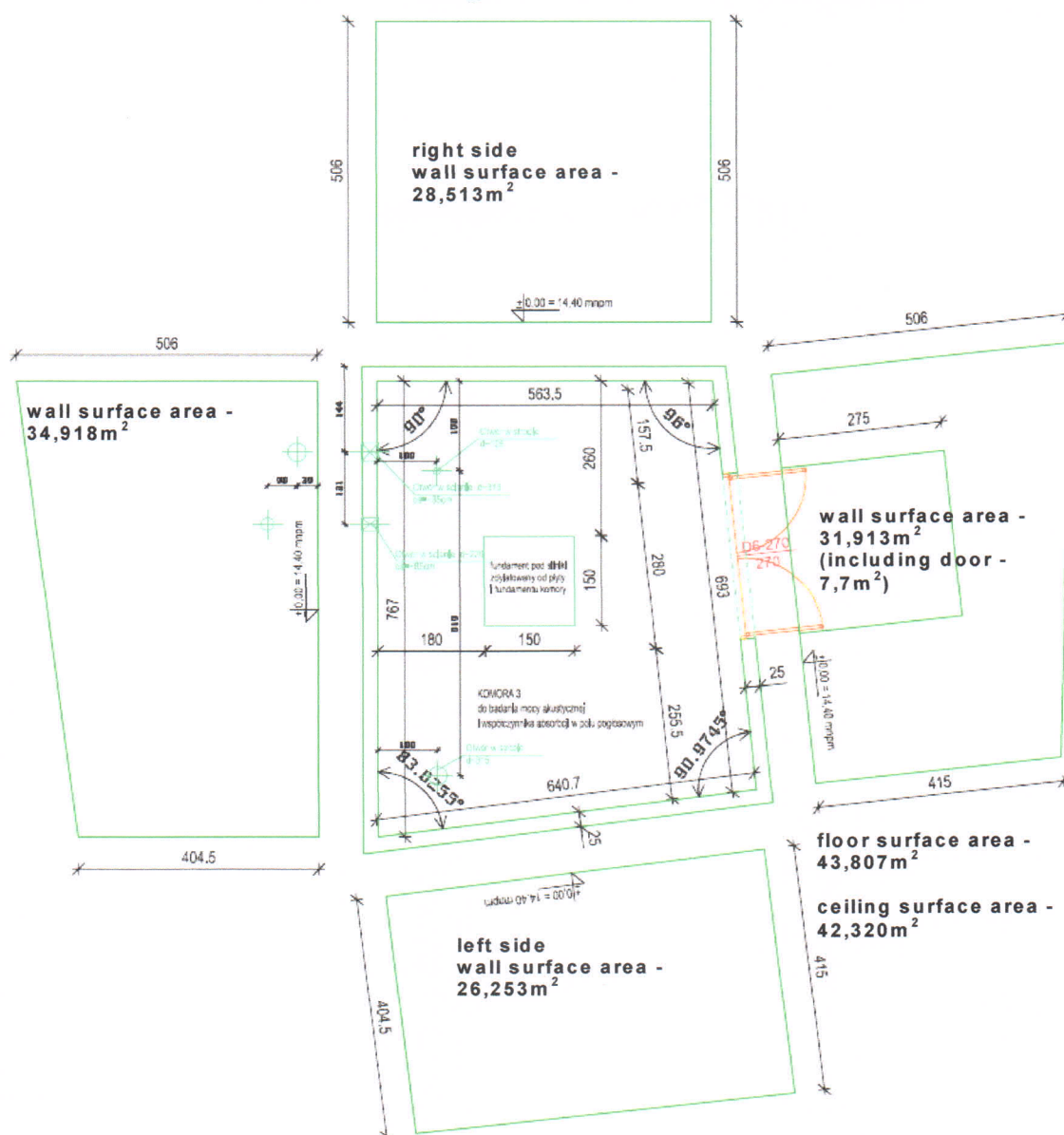
MSc Magdalena Kuśmirek

Supervisor
*Head of the Environmental
Laboratories Division*



Dr Eng. Mateusz Weryk

APPENDIX 1 – Configuration of reverberation chamber



Dimensions of the reverberation chamber for sound absorption coefficient α_s measurements.

Volume and wall surface areas of chamber No. 3			Diagonals of the reverberation chamber No. 3	
	Chamber	No. 3	Chamber No. 3 [m]	
volume	V [m ³]	200,095	10,77	
floor	S1 [m ²]	43,807	10,34	
ceiling	S2 [m ²]	42,320	10,65	
on the right	S3 [m ²]	28,513	10,25	
wall with door	S4 [m ²]	31,913		
on the left	S5 [m ²]	26,253		
opposite of the door	S6 [m ²]	34,918		
	total area [m ²]	207,724		