CENTRUM TECHNIKI OKRĘTOWEJ S.A.
Ship Design and Research Centre S.A.

RESEARCH AND DEVELOPMENT DEPARTMENT

ENVIRONMENTAL LABORATORIES DIVISION

VIBROACOUSTIC TESTS LABORATORY

TEST REPORT

No RS-2016/B-503/E

Sound attenuation effectiveness study -
"SOFTBOX SCREEN" for sofas

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Specimen No : ..0.....

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1. Basic data

Tab. 1. Summary of data and test parameters.

Orderer: **PROFIM Sp. z o.o.** ul. Górnicza 8 62-700 Turek	**Order (e-mail) of:** 18.10.2016 **CTO S.A. order number:** 8:561:06:223
Name and type of test piece: "SOFTBOX SCREEN" for sofas	**Delivery date test object:** 25.10.2016, **Date and place of measurement performance:** 23.11.2016, Gdańsk Ship Design and Research Centre Vibroacoustic Tests Laboratory
Manufacturer: PROFIM Sp. z o.o. ul. Górnicza 8 62-700 Turek	**The method of measurement and analysis of the results:** According to the standards: - Standard no.: PN-EN ISO 11821:2005
Designation of the test piece in CTO SA: Test piece no: **LA684**	**Conditions of measurement:** • temperature 8,5 °C • air humidity 71,5 %

Measuring equipment:	**Receiving room**
Microphone	Norsonic type 1225, serial no. 112850
Preamplifier	Norsonic type 1201, serial no. 30610
Calibrator	Norsonic type 1251 Serial no. 33204
Thermohygrometer	EE02-FT01, s/n 30092
Noise sources	Larson Davis, BAS001 no. 1225-DIC08 Larson Davis, BAS002 no. A036
Sound analyzer	Norsonic type Nor-121 Serial no. 31378
Tape measure	Type MN-81-145, RS3/0003

The results of measurements of field measurements for the effectiveness of the acoustic screen:

Measured quantity	**Measured value**
D_p – Sound attenuation	**D_p - Tab. 3, 4, 5**
D_{pA} – Sound attenuation corrected by frequency characteristic A	**D_{pA} – Tab. 6, 7, 8.**

Note 1: Research report and measurement results included are valid only for the tested object.

2. Test method

Measurement of the effectiveness of the sofas screen were carried out according to the standard ISO 11821:2005, using "direct measurement" method. The measurements were carried out using a screen attached to the couch, and again after removing. The method "direct measurement" of the time averaged sound pressure level with a replacement source.

3. Technical description of the object and the measurement environment

Collection of sofas and armchairs SOFTBOX SCREEN with the screens.

Versions:

1CW - chair corner, with wall
11W - armchair with armrests, with wall
2BW - sofa, 2 seats, without armrests, with wall
2RW - sofa, 2 seats, armrest on the right sight, with wall
2LW - sofa, 2 seats, armrest on the left sight, with wall
21W - sofa, 2 seats with armrest, with wall
3BW - sofa, 3 seats, without armrests, with wall
3RW - sofa, 3 seats, armrest on the right sight, with wall
3LW - sofa, 3 seats, armrest on the left sight, with wall
31W - sofa, 3 seats, with armrests, with wall

Frame:

- aluminum; frame composed of legs (cast) and profiles (extrusion)

- wooden; frame with bent and glued elements (beech plywood)

Seat:

Wooden structure equipped with rubber belts + poured polyurethane foam, density 75 kg / m^3

Support:

Metal frame flooded with polyurethane foam, density 60 kg/m^3

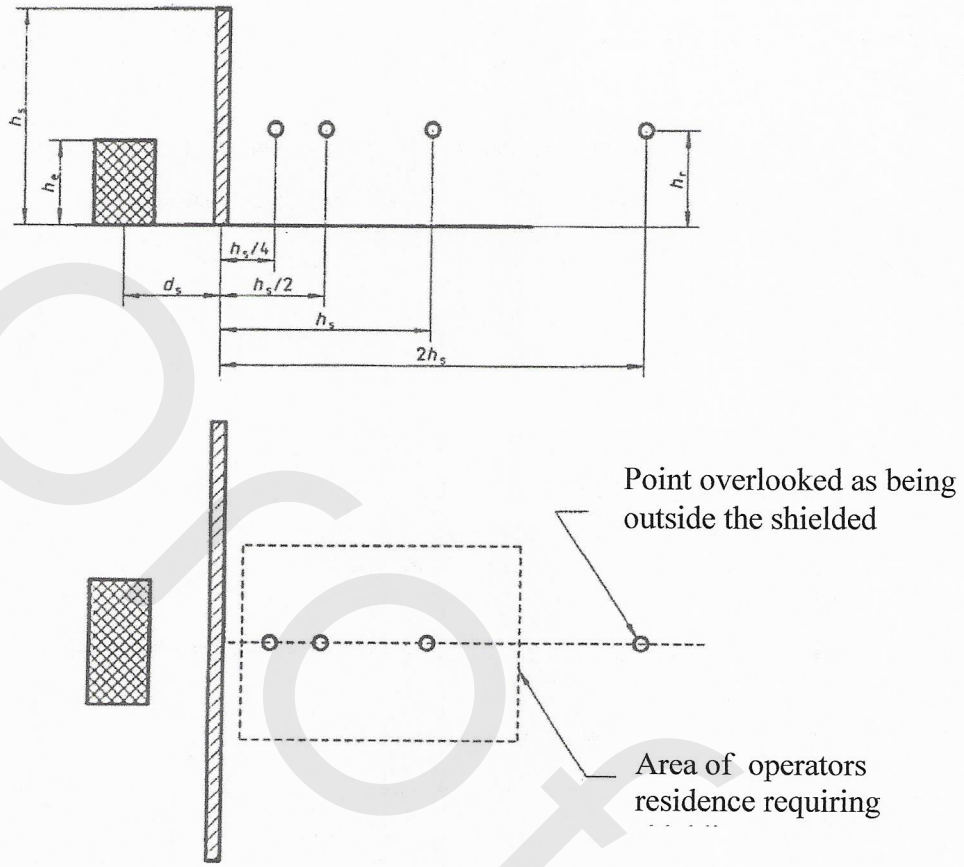
Wall:

The core is made of beech plywood with a thickness of 9mm. Cover is taped by foam to laminate of thickness 3mm

Feet:

- standard - hard foot (for soft floors)
- option - feet with felt insert (for hard floors)

The measurement was performed according to the scheme described in the PN-EN ISO 11821.



h_r - typical value of the operator high (1,55 m ± 0,075 m, unless otherwise specified);
h_e - the height of the sound source (for the substitute source should be equal to the actual source of the sound or greater);
d_s - the distance from the sound source to the screen

Fig. 1. The positions of the measuring points for measurements in the shielding field (source: PN-EN ISO 11821:2005, Figure 2, page 11)

In the examined object a screen height h_s is 123 cm.

The height of the sound source is 110 cm, what corresponds to the natural placement of the conversation sound source (the mouth).

The measuring points according to the scheme set out in the distances:

$h_s/4$ = 31 cm,

$h_s/2$ = 62 cm,

h_s = 123 cm,

2 h_s = 246 cm.

Photos of the screen shows the picture in fig. 2. – fig. 6.

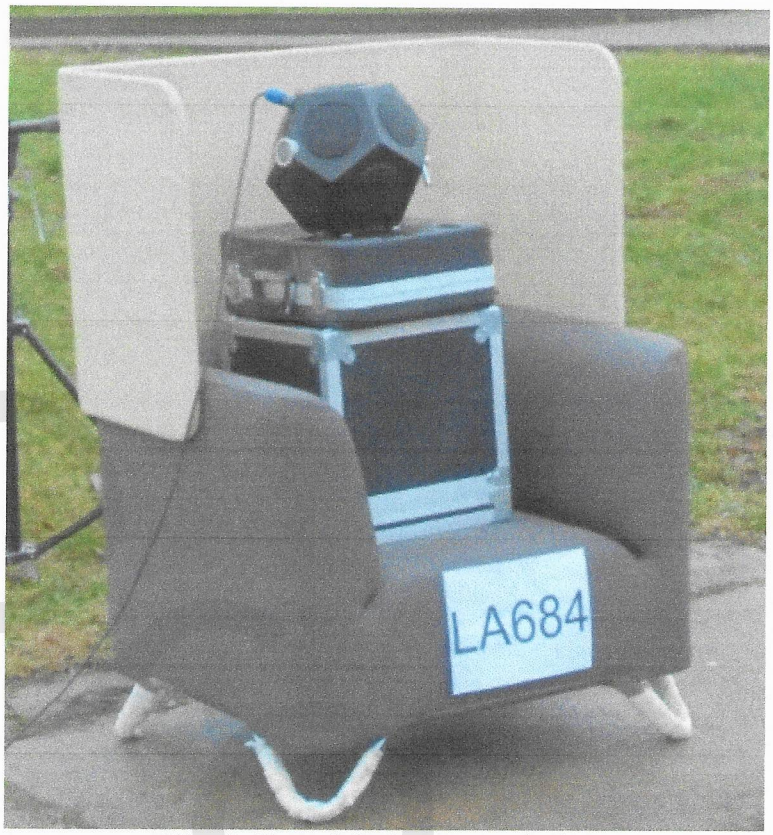


Fig. 2. Tested Sofa – general view

Fig. 3. The microphone position in direction no. 1

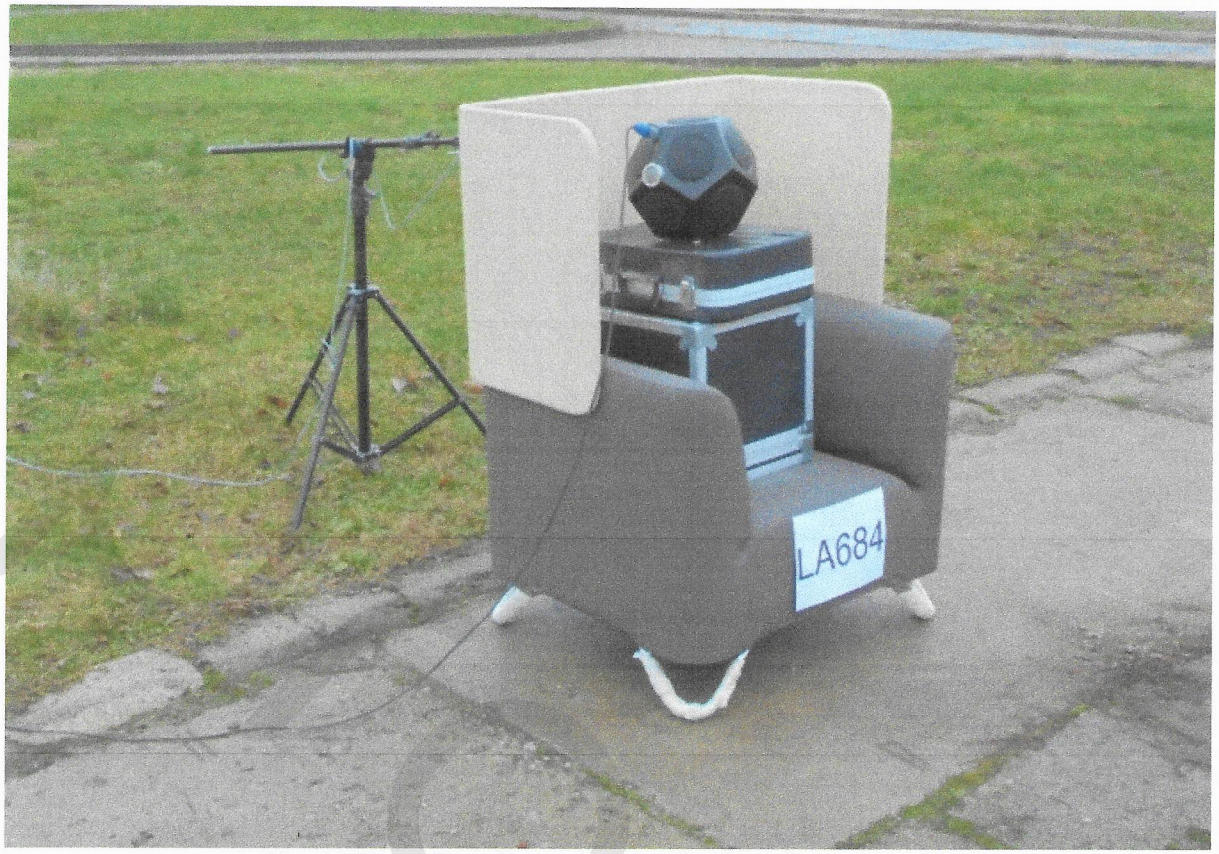


Fig. 4. The microphone position in direction no. 1

Fig. 5. The microphone position in direction no. 3

Fig. 6. The microphone position in direction no. 2

4. Measurements and calculations

Before the measurement the sound analyzer NORSONIC NOR-121, was checked with the acoustic calibrator. The measurement was performed under the following environmental conditions:

- Air temperature: 8,5 ° C,
- Humidity: 71,5%
- Acoustic background measured on the test bench is shown in tab.2.

Tab. 2. Measurement results of the background noise as a function of frequency

Frequency [Hz]	Leq [dB]
50 Hz	54,2
63 Hz	51,8
80 Hz	48,7
100 Hz	48,9
125 Hz	46,0
160 Hz	45,0
200 Hz	44,0
250 Hz	43,5
315 Hz	43,9
400 Hz	43,1
500 Hz	40,5
630 Hz	38,9
800 Hz	40,0
1 kHz	39,1
1.25 kHz	40,2
1.6 kHz	40,1
2 kHz	39,9
2.5 kHz	39,5
3.15 kHz	38,2
4 kHz	37,2
5 kHz	34,3
6.3 kHz	36,5
8 kHz	30,9
10 kHz	23,4

The measurement was performed at the open space over the sound absorbing surface the Vibroacoustic Tests Laboratory CTO S.A. Measurements were made in 3 direction for 1 setup of sound source.

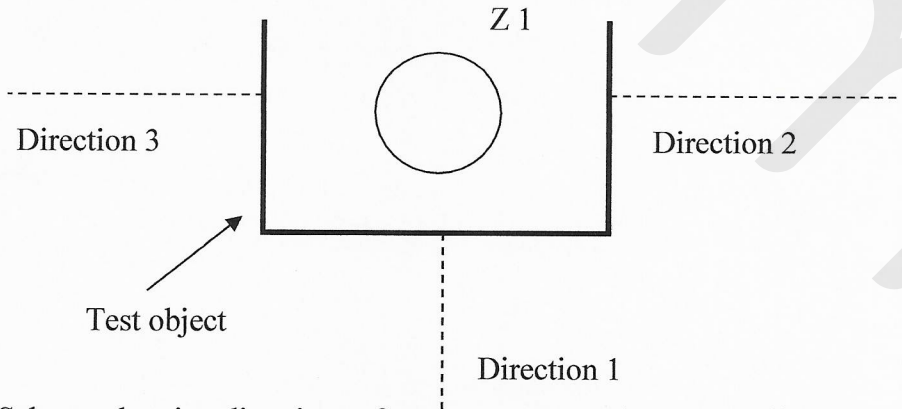


Fig. 7. Scheme showing directions of measurements and corresponding sound source (sound source = Z1)

During the measurement of sound attenuation, sound source type BAS001 and BAS002 Larson Davis were used as the replacement of the large power sound source. In every measurement point, 3 measurement were performed to calculate the average value. The value of measured sound level were 10 dB greaten then the background level, so according to the standard, calculation of background noise correction was not included.

Sound attenuation in octave or third-octave bands measured under field conditions D_p at the microphone position, in accordance with PN-EN ISO 11821 are:

$$D_p = L_{p1} - L_{p2}$$

where:

L_{p1} – sound pressure level in the bands third - octave without a screen

L_{p2} – sound pressure level in the bands third - octave for the screen

Measurements were done for four microphone distances from a screen, as described in the diagram in figure 1. Results of sound attenuation for 1/3 octave bands are shown in tab. 3, 4, 5 in different direction.

Tab. 3. **D_p** Sound attenuation [dB] in band 1/3 octave at different distances from the screen - direction 1

Frequency [Hz]	Sound attenuation D_p in direction 1 [dB]			
	d=0,31m	d=0,62m	d=1,23m	d=2,46m
50 Hz	2,2	0,7	2,1	0,2
63 Hz	2,2	0,8	1,8	-0,1
80 Hz	2,7	1,1	1,4	0,0
100 Hz	2,3	0,9	3,6	0,0
125 Hz	1,0	0,0	7,4	0,4
160 Hz	2,6	-0,1	4,2	5,5
200 Hz	3,4	0,6	2,3	2,0
250 Hz	9,6	7,4	6,5	3,9
315 Hz	8,2	8,2	13,5	5,9
400 Hz	8,4	4,4	7,7	4,8
500 Hz	6,9	6,1	6,7	8,1
630 Hz	12,1	10,1	11,3	8,3
800 Hz	6,6	6,7	10,6	5,3
1 kHz	9,0	8,2	10,8	11,6
1.25 kHz	7,1	4,6	6,9	5,9
1.6 kHz	7,5	4,9	6,1	4,7
2 kHz	11,3	9,1	11,4	11,0
2.5 kHz	14,2	10,6	11,7	9,4
3.15 kHz	12,8	10,9	14,1	10,6
4 kHz	12,2	9,8	13,2	11,2
5 kHz	11,1	9,8	14,7	10,3
6.3 kHz	11,7	10,5	15,8	8,9
8 kHz	10,0	10,7	14,5	10,5
10 kHz	10,4	11,4	14,2	10,0

Tab. 4. Dp Sound attenuation [dB] in band 1/3 octave at different distances from the screen – direction 2

Frequency [Hz]	Sound attenuation D_p in direction 2 [dB]			
	d=0,31m	d=0,62m	d=1,23m	d=2,46m
50 Hz	2,5	1,1	3,7	5,8
63 Hz	3,3	1,8	3,1	6,4
80 Hz	4,7	1,6	2,1	6,6
100 Hz	6,6	2,8	0,9	3,6
125 Hz	5,4	6,1	3,3	1,7
160 Hz	5,7	7,0	12,5	3,0
200 Hz	5,0	4,7	15,0	5,9
250 Hz	8,0	6,4	13,2	3,2
315 Hz	8,6	6,7	8,1	4,2
400 Hz	7,0	6,6	4,4	8,3
500 Hz	6,7	5,4	10,8	6,5
630 Hz	7,5	7,0	11,5	3,4
800 Hz	8,4	7,5	9,6	4,9
1 kHz	11,9	8,5	9,7	14,7
1.25 kHz	7,8	5,3	9,4	11,5
1.6 kHz	10,3	8,6	9,9	12,1
2 kHz	11,5	8,8	10,4	16,0
2.5 kHz	14,8	9,3	11,6	12,7
3.15 kHz	14,1	11,2	14,3	15,6
4 kHz	12,1	8,1	10,9	9,4
5 kHz	12,8	9,8	12,1	12,9
6.3 kHz	13,4	9,4	14,3	9,6
8 kHz	11,6	9,1	13,5	13,4
10 kHz	12,1	9,1	14,0	12,2

Tab. 5. Dp Sound attenuation [dB] in band 1/3 octave at different distances from the screen – direction 3

Frequency [Hz]	Sound attenuation D_p in direction 3 [dB]			
	d=0,31m	d=0,62m	d=1,23m	d=2,46m
50 Hz	2,7	1,4	1,3	5,0
63 Hz	3,6	1,4	2,3	5,7
80 Hz	4,2	1,1	1,1	5,7
100 Hz	5,8	2,1	-0,2	2,6
125 Hz	4,7	6,0	1,7	0,6
160 Hz	5,0	7,3	10,4	2,0
200 Hz	2,8	3,3	15,9	3,8
250 Hz	8,1	6,9	15,2	4,1
315 Hz	9,0	7,3	9,4	4,0
400 Hz	6,8	7,1	4,8	7,5
500 Hz	6,4	5,4	9,0	6,6
630 Hz	8,2	8,0	13,7	4,0
800 Hz	7,8	7,0	8,8	4,4
1 kHz	11,5	8,5	8,6	14,3
1.25 kHz	8,9	5,9	8,2	13,5
1.6 kHz	11,7	9,6	12,1	10,3
2 kHz	13,1	10,5	13,2	11,3
2.5 kHz	12,7	8,7	12,5	9,3
3.15 kHz	18,3	13,7	15,9	13,5
4 kHz	16,6	12,7	17,5	14,2
5 kHz	12,7	13,3	16,0	12,5
6.3 kHz	12,5	10,8	19,9	14,0
8 kHz	12,1	10,6	17,9	16,2
10 kHz	13,4	13,9	15,6	12,6

Sound attenuation corrected frequency characteristic A, measured under field conditions D_{pA} at that microphone position, in accordance with PN-EN ISO 11821 is given by formula:

$$D_{pA} = L_{pA1} - L_{pA2}$$

Where:

L_{pA1} – corrected sound pressure level the A for measurement without a screen

L_{pA2} – corrected sound pressure level the A when measured with a screen

Sound attenuation A corrected frequency characteristic measured under field conditions is shown in table $\mathbf{D_{pA}}$ - table 6, 7, 8.

Tab. 6. Attenuation D_{pA} [dBA]

Sound attenuation D_{pA} in direction 1 [dB]			
d=0,31m	d=0,62m	d=1,23m	d=2,46m
8,6	7,0	9,3	7,5

Tab. 7. Attenuation DpA [dBA]

Sound attenuation D_{pA} in direction 2 [dB]			
d=0,31m	d=0,62m	d=1,23m	d=2,46m
8,4	7,1	9,2	7,4

Tab. 8. Attenuation DpA [dBA]

Sound attenuation D_{pA} in direction 3 [dB]			
d=0,31m	d=0,62m	d=1,23m	d=2,46m
8,4	7,4	9,5	7,2

All results are also shown graphically by means of the graph in figure 8, 9, 10.

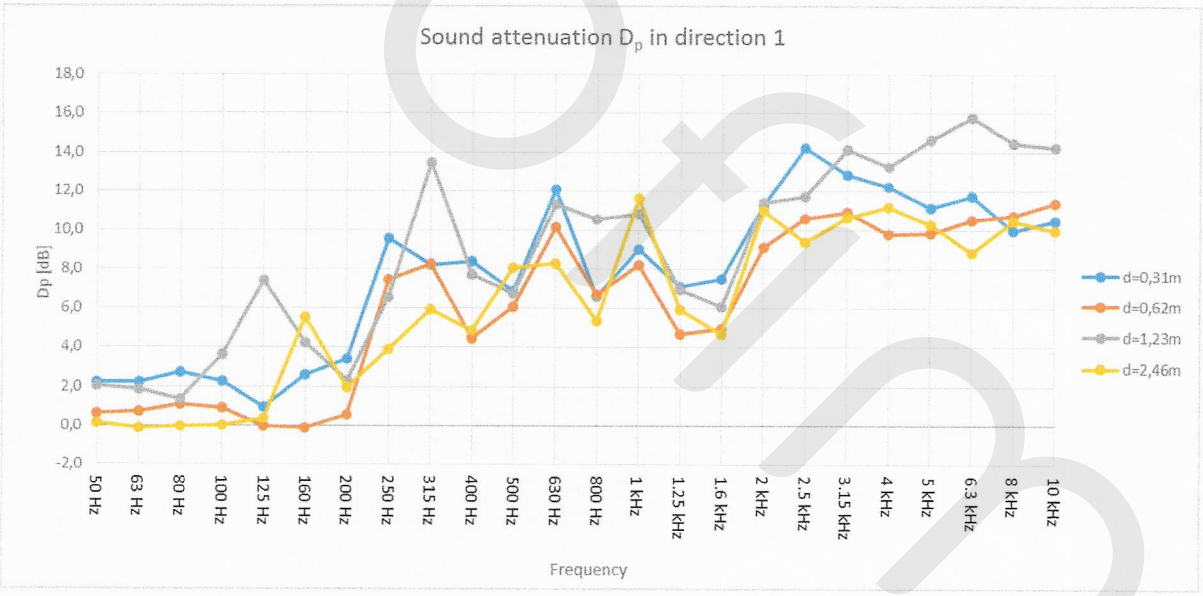


Fig. 8. Graphic representation of the results of the attenuation for sofa "SOFTBOX SCREEN" with a screen– direction 1

Fig. 9. Graphic representation of the results of the attenuation for sofa "SOFTBOX SCREEN" with a screen– direction 2

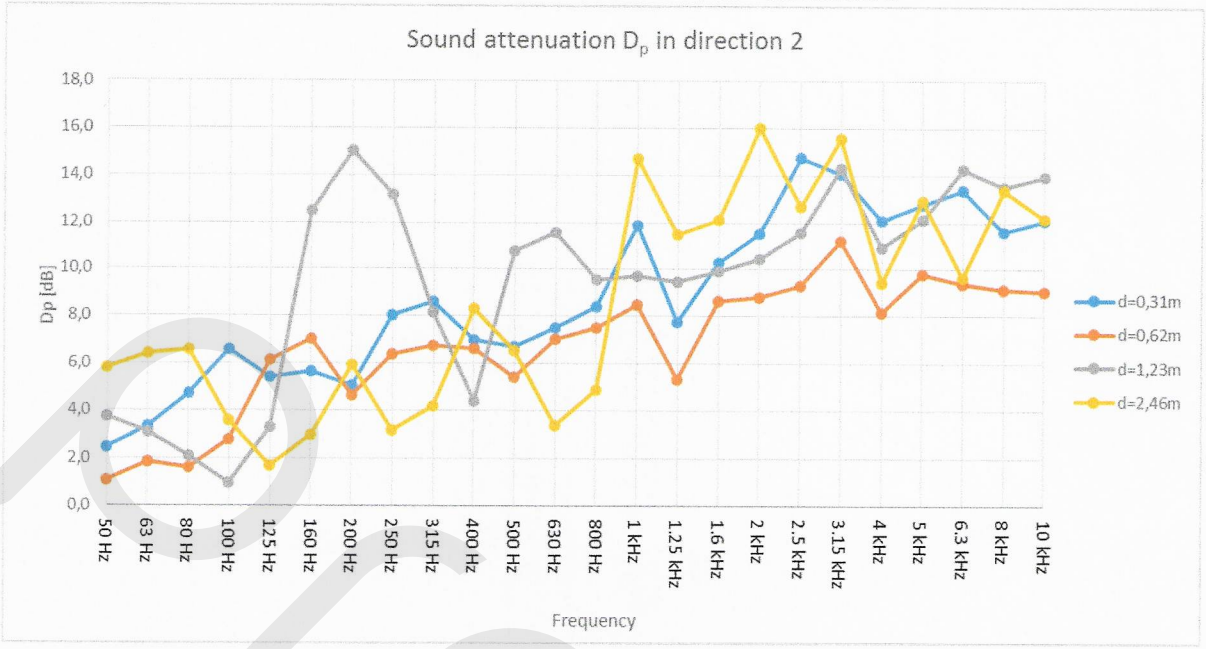
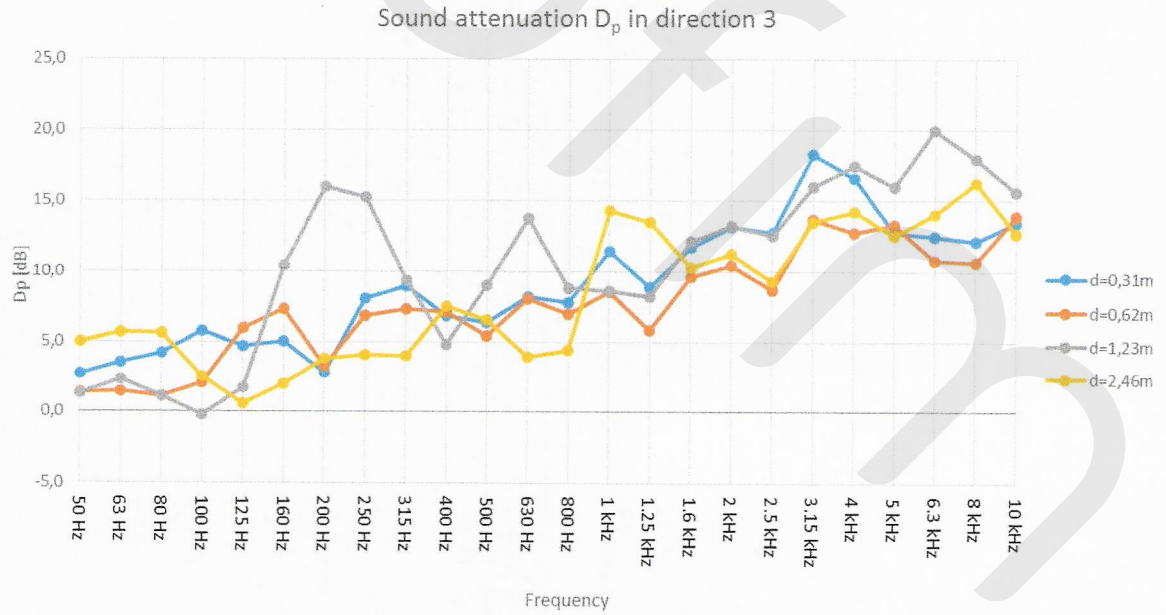


Fig. 10. Graphic representation of the results of the attenuation for sofa "SOFTBOX SCREEN" with a screen – direction 3



5. The uncertainty of measurement

For sound pressure level Leq [dB], measurements were performed with the following accuracy:

Frequency (Hz)	standard deviation [dB]
50 Hz	1,5
63 Hz	1,0
80 Hz	0,5
100 Hz	1,1
125 Hz	0,7
160 Hz	1,5
200 Hz	0,3
250 Hz	0,8
315 Hz	0,4
400 Hz	0,3
500 Hz	0,2
630 Hz	0,1
800 Hz	0,1
1 kHz	0,1
1.25 kHz	0,1
1.6 kHz	0,1
2 kHz	0,1
2.5 kHz	0,1
3.15 kHz	0,1
4 kHz	0,0
5 kHz	0,1
6.3 kHz	0,1
8 kHz	0,1
10 kHz	0,1

Taking order

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