CENTRUM TECHNIKI OKRĘTOWEJ S.A.

SHIP DESIGN AND RESEARCH CENTRE S.A.

CTO S.A.

RESEARCH AND DEVELOPMENT DEPARTMENT

ENVIRONMENTAL LABORATORIES DIVISION

ACOUSTIC LABORATORY

TEST REPORT

N° RS-2014/B-194/E

Sound attenuation effectiveness study -
"Vancouver Lite with screen" sofas

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Contents:

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:** 24.04.2014 **CTO S.A. order number:** 8-481-01-223
Name and type of test piece: Sofa "Vancouver Lite" with screen	**Delivery date test object:** 08.05.2014 **Date and place of measurement performance:** 20.05.2014, Gdańsk Ship Designe And Research Centre S.A.
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 11821:1997 - Standard no.: PN-EN ISO 354:2005
Designation of the test piece in CTO SA: Test piece no: LA325	**Conditions of measurement:** • temperature 20,6 °C • air humidity 54,9 %

Measuring equipment:	**Receiving room**
Microphon	Norsonic type 1225, serial no. 112850
Preamplifier	Norsonic type 1201, serial no. 30610
Calibrator	Norsonic type 1251 Serial no. 33204
Termohigrometr	GFTB 100, Serial no. 122158
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**
$\mathbf{D_p}$ – Sound attenuation	$\mathbf{D_p}$ **- Tab. 4.**
$\mathbf{D_{pA}}$ – Sound attenuation corrected frequency characteristic A	$\mathbf{D_{pA}}$ **– Tab. 5.**

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

2. Test method

Measurement of the effectiveness of the screen sofas were carried out according to the standard ISO 11821:1997 using direct measurement method. The measurements were carried out using a screen attached to the couch and after removing. The method of 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 Vancouver Lite with the screens.

Versions:

VL1 H/VL1 V - chair

VL2 H/VL2 V - sofa, 2 seats

VL2 5 H/VL2, 5 V - sofa, 2.5 seats

Frame:

H - version on the legs, leg made from steel 40x40mm; height of the legs 13 cm

V - version on metal runners; skid plate thickness 6 mm; height skids 13 cm

Feet:

Version H - feet in hard plastic; Felt footer option.

Version V - glued felt pads attached to each model.

Seat:

Made of foam cut from the block having a density of 40 kg/m^3.

The screen: The core is made of OSB panels with a thickness of 8mm.

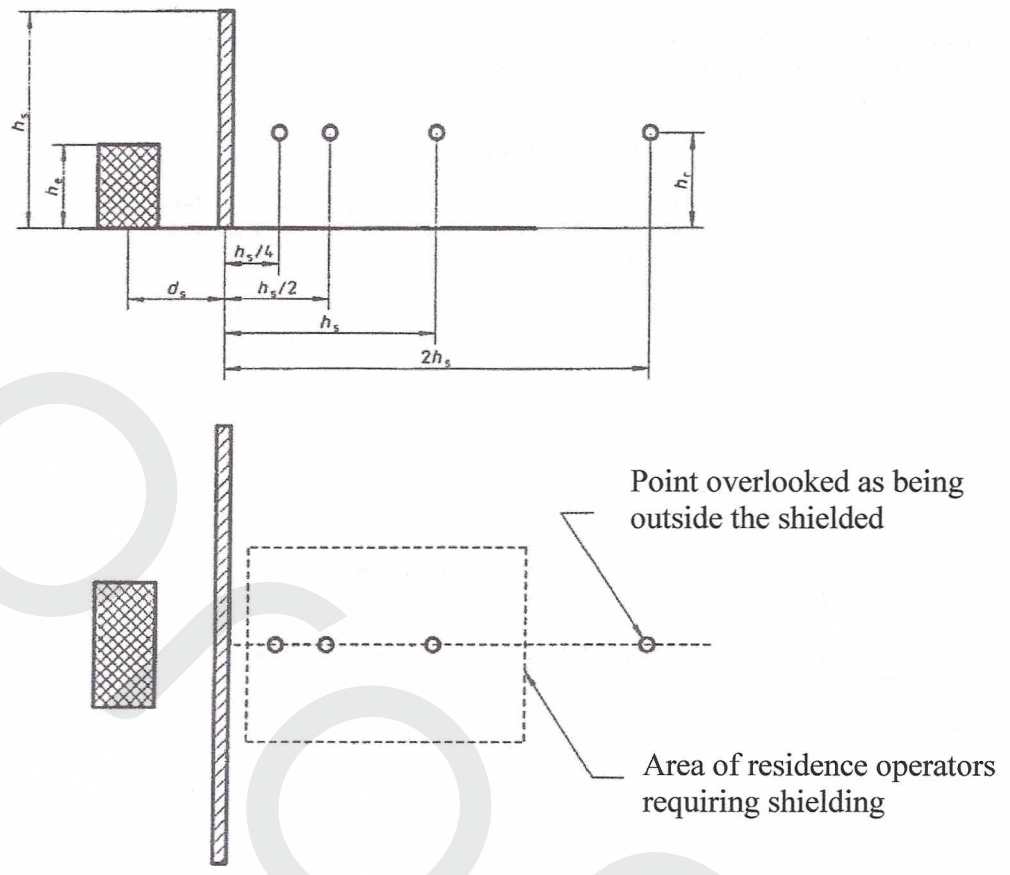
Coating T35 kg/m^3 is made from foam having a thickness of 5mm, upholstered fabric.

Back:

Made of foam cut from the block having a density of 25 kg/m^3.

Gross weight: • VL1 H - 26.5 kg
• VL1 V - 30.5 kg
• VL2 H - 38.0 kg
• VL2 V - 42.0 kg
• VL2, 5 H - 42.0 kg
• VL2, 5 V - 46.0 kg
Net weight: • VL1 H - 23.5 kg
• VL1 V - 27.5 kg
• VL2 H - 32.0 kg
• VL2 V - 36.0 kg
• VL2, 5 H - 36.0 kg
• VL2, 5 V - 40.0 kg

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



h_r - typical value of the operator (1,55 m ± 0,075 m, unless otherwise specified);
h_e - the height of the sound source (the source of a surrogate 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 140 cm.

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

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

$h_s/4 = 35$ cm,

$h_s/2 = 70$ cm,

$h_s = 140$ cm,

$2\ h_s = 280$ cm.

Photos of the screen shows the picture in fig. 2. – fig. 5.

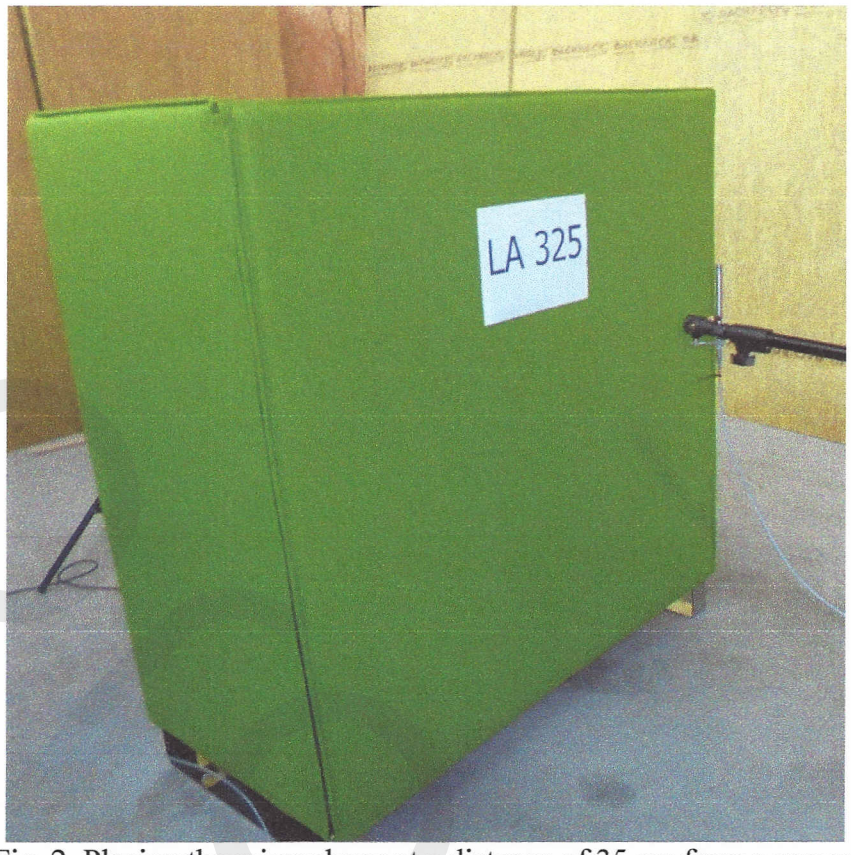


Fig. 2. Placing the microphone at a distance of 35 cm from a screen

Fig. 3. Placing the microphone at a distance of 140 cm from a screen

Fig. 4. Placing the microphone at a distance of 140 cm from the sofa without a screen

Fig. 5. Placing the sound source on the sofa at a height of 110 cm

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: 20.6 ° C,
- Humidity: 54.9%
- Background acoustic spaces on the test bench is shown in tab.2.
- Reverberation time on the test are shown in tab. 3.

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

Frequency (Hz)	Sound pressure level
(Hz)	Leq (dB)
50	37,0
63	24,6
80	20,8
100	20,7
125	16,6
160	16,2
200	17,2
250	15,5
315	15,3
400	15,0
500	15,6
630	13,9
800	14,3
1000	16,4
1250	17,3
1600	14,5
2000	15,7
2500	15,8
3150	14,9
4000	15,2
5000	16,1
6300	16,5
8000	17,4
10000	18,6
SUM (dBA)	28,6

Tab. 3. Results of reverberation time on the test as a function of frequency

Frequency (Hz)	Reverberation time
(Hz)	t (s)
50	1,3
63	1,6
80	1,6
100	1,5
125	1,6
160	1,3
200	1,2
250	1,0
315	1,0
400	0,9
500	0,9
630	0,9
800	0,9
1000	0,9
1250	1,0
1600	1,0
2000	1,0
2500	1,0
3150	0,9
4000	0,9
5000	0,8
6300	0,7
8000	0,7
10000	0,6

The measurement was performed at the main hall of the Acoustical Laboratory CTO S.A., in which the surfaces surrounding the test bed lined with slabs of mineral wool to approximate the prevailing conditions during the measurement to the free-field conditions. Floor area and ceiling height of 8 m above the floor were reflective surfaces.

When measuring sound attenuation, one used actual source of high power type BAS001 BAS002 Larson Davis production. At each of there point were performed 3 measurements, which were used for further calculations the average value. Sound level values relative to the values of the background noise are greater than 10 dB, which is why in further calculations in accordance with the standard there are none background noise corrections.

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

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

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

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

Measurements were done for four microphone distance from a screen, as described in the diagram in figure 1 results in sound attenuation bands third octave shown in tab. 4.

Tab. 4. $\mathbf{D_p}$ Sound attenuation [dB] in band 1/3 octave at different distances from the screen

Sound attenuation D_p				
Frequency (Hz)	at a distance of 35 cm	at a distance 70 cm	at a distance 140 cm	at a distance 280 cm
(Hz)	[dB]	[dB]	[dB]	[dB]
50	2	0	0	0
63	3	-1	-1	-2
80	2	-1	-4	-6
100	1	-1	-2	-3
125	4	-1	3	-6
160	4	0	-1	3
200	3	3	1	0
250	9	6	5	5
315	13	10	8	8
400	13	9	10	7
500	9	8	4	6
630	13	8	8	5
800	15	12	7	2
1000	14	11	7	5
1250	11	7	3	2
1600	12	10	8	6
2000	12	6	5	2
2500	14	8	5	3
3150	12	10	7	4
4000	12	9	6	4
5000	14	8	6	5
6300	17	11	8	4
8000	12	8	7	4
10000	12	8	4	5
SUM (dBA)	12	9	7	5

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

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

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 5.

Tab. 5. Attenuation $\mathbf{D_{pA}}$ **[dBA]**

Sound attenuation D_{pA}			
at a distance of 35 cm	at a distance 70 cm	at a distance 140 cm	at a distance 280 cm
[dBA]	[dBA]	[dBA]	[dBA]
12	**9**	**7**	**5**

All results are also shown graphically by means of the graph in figure 6.

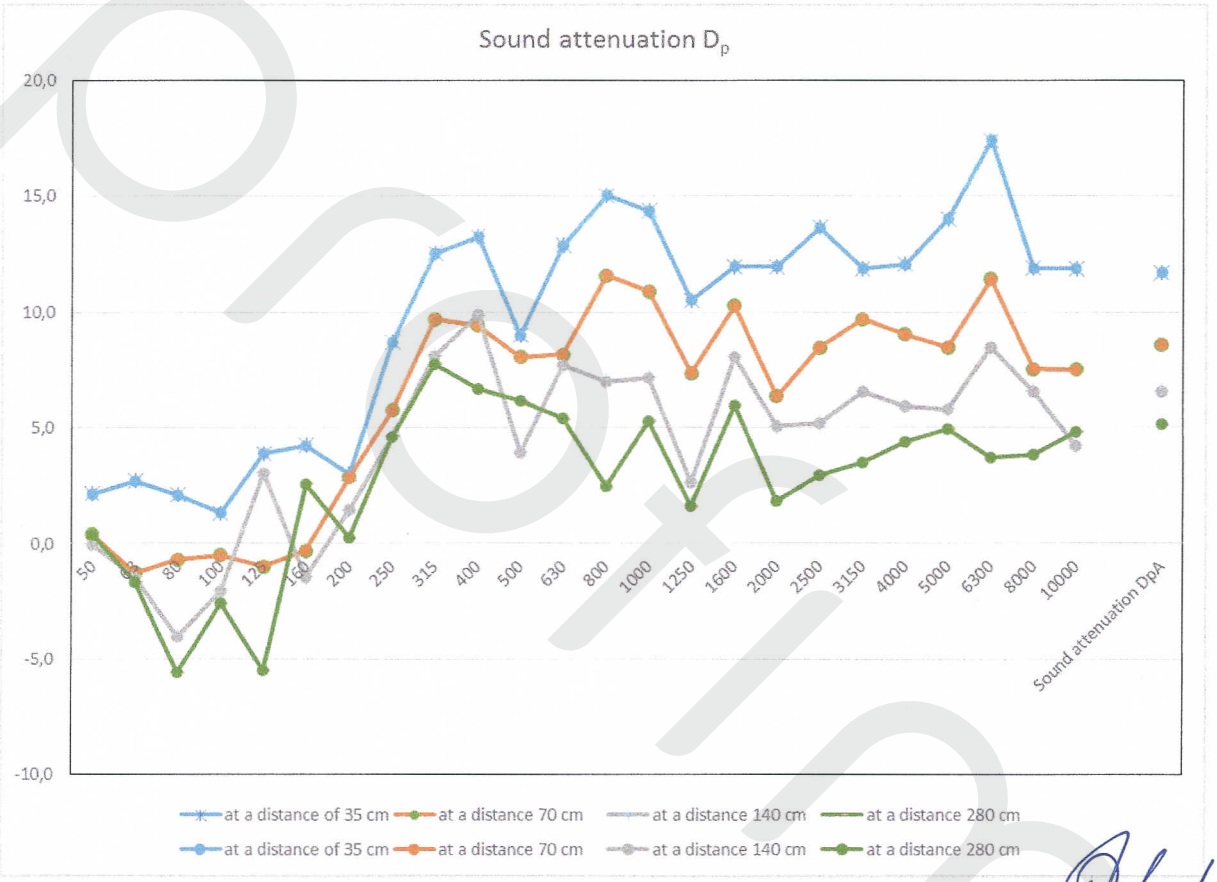


Fig. 6. Graphical representation of the results of the suppression of the sofa "Vancouver Lite with a screen"

5. The uncertainty of measurement

Measurements were performed with the following accuracy:

For sound pressure level L_{eq} [dB]

Frequency (Hz)	Standard deviation
(Hz)	Leq [dB]
50	1,9
63	1,0
80	0,5
100	1,1
125	0,7
160	0,3
200	1,0
250	0,2
315	0,2
400	0,2
500	0,1
630	0,1
800	0,1
1000	0,1
1250	0,1
1600	0,0
2000	0,0
2500	0,1
3150	0,1
4000	0,1
5000	0,1
6300	0,1
8000	0,0
10000	0,1
SUM (dBA)	0,1

The standard deviation for the reverberation time t_{20} [s] is:

Frequency (Hz)	Standard deviation reverberation time
(Hz)	t_{20} [s]
50	0,55
63	0,36
80	0,42
100	0,34
125	0,25
160	0,27
200	0,16
250	0,14
315	0,12
400	0,08
500	0,10
630	0,09
800	0,09
1000	0,09
1250	0,10
1600	0,11
2000	0,12
2500	0,14
3150	0,11
4000	0,08
5000	0,08
6300	0,07
8000	0,06
10000	0,05

Taking order	Authorised by	Head of the Environment Laboratory Division
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