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MEASUREMENT OF SPEECH LEVEL REDUCTION OF AN ACOUSTIC BOOTH

1 CLIENT

Vetrom Oy, Jouko Urpolahti. Tender November 29, order November 30, 2021.

2 DESCRIPTION OF THE COMMISSION

The test specimen was BLOCKO OPEN design acoustic booth. Speech level reduction $D_{S,A}$ [dB] was measured for specimen within 125-8000 Hz according to ISO 23351-1:2020.

3 RESULTS

The speech level reduction $D_{S,A}$ was 2.9 dB according to ISO 23351-1:2020. The results are presented in detail in Annex 1.

4 SIGNATURES

Valtteri Hongisto
Research Group Leader

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Specialized Research Scientist

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Acoustics Laboratory

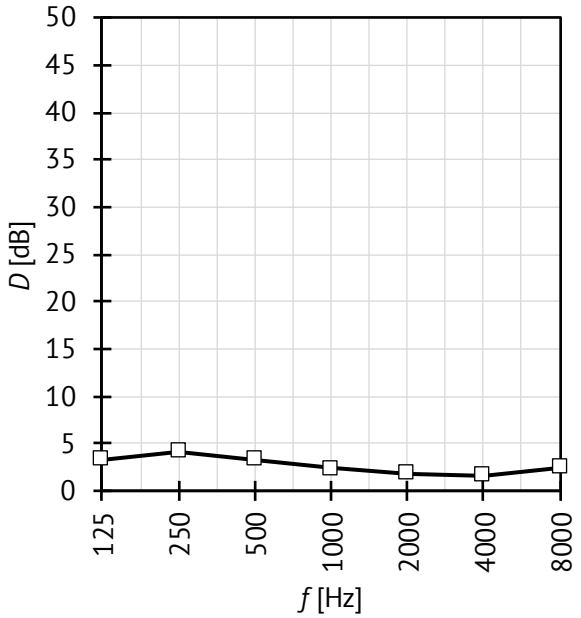
ANNEXES

1. Test results (1 page)
2. Mounting of specimen (1 page)
3. Measurement arrangements (2 pages)

Determination of speech level reduction according to ISO 23351-1:2020

Product:	BLOCKO OPEN design
Operating condition:	Normal use
Manufacturer:	Vetrom Oy, Pori, Finland
Test laboratory:	Turku University of Applied Sciences, Acoustics Laboratory //akustiikka.turkuamk.fi
Name of the operator:	Jukka Keränen (Specialized Research Scientist)
Test date:	December, 10, 2021

f [Hz]	***D*** [dB]
125	3.3
250	4.2
500	3.4
1000	2.4
2000	1.9
4000	1.7
8000	2.5
$D_{S,A}$ [dB]	**2.9**



f [Hz] is the 1/1-octave frequency band
D [dB] is the level reduction
$D_{S,A}$ [dB] is the speech level reduction

2 Mounting of specimen

Measurements were conducted in a reverberation room (Volume 201 m^3). The specimen was in two different positions in the reverberation room during the measurements. The distance from the walls to the specimen surface was over 1.0 m. The depth of the specimen was 1100 mm and outer diameter of the circular shape 2155 mm.

Figure A3.1. The test specimen mounted in position 1 (left) and in position 2 (right) in the reverberation room. The sound source was a mouth simulator (Brüel&Kjær 4227) that has similar sound directivity as a speaking person.

Figure A3.2. The sound source in position 2 in the empty reverberation room without test specimen.

3 Measurement arrangements

1 Background

The purpose of ISO 23351-1:2020 measurement method is to determine the sound level reduction, D [dB], produced by the furniture, i.e. the difference between the sound power level of pink noise radiated by a hypothetic reference box enclosing the furniture without the furniture, $L_{W,P,1}$, and with the furniture, $L_{W,P,2}$. The sound power level is measured according to ISO 3741:2010 in octave bands 125-8000 Hz. Then, the sound power level of speech with the furniture, $L_{W,S,2}$, is determined by $L_{W,S,2} = L_{W,S,1} - D$, where $L_{W,S,1}$ is the standardized sound power level of normal effort speech according to ISO 3382-3:2012. The assumed octave-band sound power levels of speech are average values for male and female speakers using normal voice effort. The result is given as a speech level reduction, $D_{S,A}$, which is the sound level reduction of A-weighted sound power level of speech produced by the furniture $D_{S,A} = L_{W,S,A,1} - L_{W,S,A,2}$, where $L_{W,S,A,1}$ and $L_{W,S,A,2}$ are the total A-weighted sound power levels determined from the linear octave band sound power levels of speech, $L_{W,S,1}$ and $L_{W,S,2}$, respectively. Speech level reduction $D_{S,A}$ does not significantly depend on the surrounding space. It is measured in the reverberation room and represents the worst-case scenario in a very reverberant sound field. In situ, e.g. in open-plan offices, the sound field is usually less reverberant, and the achieved speech level reduction can be higher, depending on the sound absorbing properties of the space, where the furniture is placed.

2 Acoustical measurements

The sound level reduction of the furniture was measured in two positions. The pink noise test signal was produced with the signal generator (NTI Audio MR Pro) and the power amplifier (Brüel&Kjær 2716C, serialnr: 2604327), and the artificial mouth simulator (Brüel&Kjær 4227, serialnr: 2233291). The level of the pink noise was adjusted at least 10 dB above the background noise level of the room. The artificial mouth simulator (louspeaker) was placed in the position of a sitting occupant. The main axis of the loudspeaker pointed towards the opposite seat behind the table. The sound pressure level in the reverberation room (outside the furniture) was measured using a real time analyzer (Soundbook MK2, serialnr. #07351), rotating microphone boom (Brüel&Kjær 3923, serialnr: 1357240), microphone (Brüel&Kjær 4165, serialnr. 1829762) and preamplifier (Brüel&Kjær 2669, serialnr. -). The averaging time was 64 seconds. The measurement system was calibrated before and after the measurements using the sound level calibrator (Brüel&Kjær 4231, serialnr: 2376479). The measurements were repeated in the empty reverberation room, i.e., without the furniture using, exactly, the same sound source and microphone positions and settings.

For the reverberation time measurement in the reverberation room, the pink noise test signal was produced with the real time analyzer (Soundbook MK2) and amplified with the power amplifier (QSC 1300 W USA) for three omnidirectional loudspeakers (6 x Seas W12CY001). The microphone was placed in four positions. The reverberation time was determined in conformance with ISO 3382-2:2008 using averaged decays from the decay range from −5 to -25 dB in each measurement. The sound analysis was made with the real time analyzer (Soundbook MK2)

The acoustical measurement equipment fulfilled the following IEC standards and grades of accuracy:

IEC 61672-1	Sound level meters – Part 1: Specifications	class 1
IEC 61672-2	Sound level meters – Part 2: Pattern evaluation tests	class 1
IEC 61672-3	Sound level meters – Part 3: Periodic tests	class 1
IEC 61260	Octave-band and fractional-octave-band filters	class 1
IEC 60942	Sound level calibrators	class 1

3 Other measurements

The temperature and the relative humidity of the reverberation room were measured using an environmental measurement device (Thermo Recorder TR-73U). These have no significant effect on the results in normal indoor conditions.
The dimensions of the specimen, positions of sound source, and measurement points were measured with a roll meter (Stanley Fat Max) and laser distance meter (Bosch GLM 500).

4 Test room

The dimensions of the reverberation room are 9.90 m, 5.68 m, and 3.57 m and the volume 201 m^3. The room is equipped with five fixed diffuser panels. The positions have been selected randomly in respect with altitude, angle, and position.

5 References to the ISO standards

ISO 3741:2010 (E) Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for reverberation test rooms, International Organization for Standardization, 2010, Genève, Switzerland.
ISO 3382-2:2008 (E) Acoustics – Measurement of room acoustic parameters – Part 2: Reverberation time in ordinary rooms, International Organization for Standardization, 2008, Genève, Switzerland.
ISO 3382-3:2012 (E) Acoustics – Measurement of room acoustic parameters – Part 3: Open plan offices, International Organization for Standardization, 2012, Genève, Switzerland.
ISO 23351-1:2020 (E) Acoustics – Measurement of speech level reduction of furniture ensembles and enclosures – Part 1: Laboratory method, International Organization for Standardization, 2020, Genève, Switzerland.