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Bauaufsichtlich anerkannte Stelle
für Prüfung, Überwachung und
Zertifizierung
Zulassung neuer Baustoffe, Bauteile
und Bauarten

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Test report P-BA 113/2024e

Speech level reduction of a phone booth according to ISO 23351-1

Client: Berlin Acoustics
Torstraße 164
10115 Berlin

Test specimen: Phone booth "Berlin Acoustics Focus", by Berlin Acoustics (test object S12255-02).

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Assembly and date of the measurements:

Delivery:	04 June 2024 by the client
Assembly:	04 June 2024 by the client
Test:	04 June 2024

Stuttgart, 09 July 2024

Test engineer:

M.Sc. T. Busse

Head of the test laboratory:

M.BP. Dipl.-Ing. (FH) S. Öhler

The test was carried out in laboratory facilities of the IBP which is accredited according to DIN EN ISO/IEC 17025:2018 by the DAkkS. The accreditation certificate is D-PL-11140-11-00.

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Speech level reduction according to ISO 23351-1		**P-BA 113/2024e**
Client:	Berlin Acoustics 10115 Berlin	**Results 1**

Test specimen: Phone booth "Berlin Acoustics Focus", by Berlin Acoustics (test object S12255-02).

Test setup: The phone booth "Berlin Acoustis Focus" by Berlin Acoustics was analysed.
The booth was set up loosely in the reverberation room and connected to the power supply (Schuko plug). The ventilation and lighting were in operation during the measurement. The door was closed during the measurement.

For sound excitation, an omnidirectional loudspeaker (source) was located in the centre of the cabin at a height of approx. 1.55 m (standing person). A power amplifier was located on the floor of the cabin and was connected to the source. A pink noise signal was used as the excitation signal. A permanently installed socket in the cabin was used for the power supply.

For further details, see Table 1 and Figure 1.

Test method: The measurements were carried out according to ISO 23351-1 in a reverberation chamber (precision method) (description in Appendix F16).

Test facility Reverberation chamber P20, test chamber with reverberant surfaces (further description in appendix P20).

Test conditions: Temperature 23.0 ± 0.3°C, static air pressure 979 ± 1 hPa and relative humidity 52 ± 2 %.

Results

Phone booth "Berlin Acoustics Focus", by Berlin Acoustics (test object S12255-02), S-No. n.a., year of manufacture n.a.	
Test setup	**Speech level reduction $D_{S,A}$ [dB]**
Person standing	28.2

Explanation of the measurement uncertainty and the single number quantities of the speech level reduction see Annex E6

Classification according to speech level reduction $D_{S,A}$ according to ISO 23351-1, Annex D

Class	A+	A	**B**	C	D	-
$D_{S,A}$ [dB]	>33	>30	**>25**	>20	>15	≤15

Test date: 04 June 2024

Comments: -

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Stuttgart, 09 July 2024
Head of the test laboratory:

Detailed results: Speech level reduction according to ISO 23351-1	P-BA 113/2024e
Client: Berlin Acoustics 10115 Berlin	**Table 1**

Test specimen:

Phone booth "Berlin Acoustics Focus", by Berlin Acoustics (test object S12255-02).

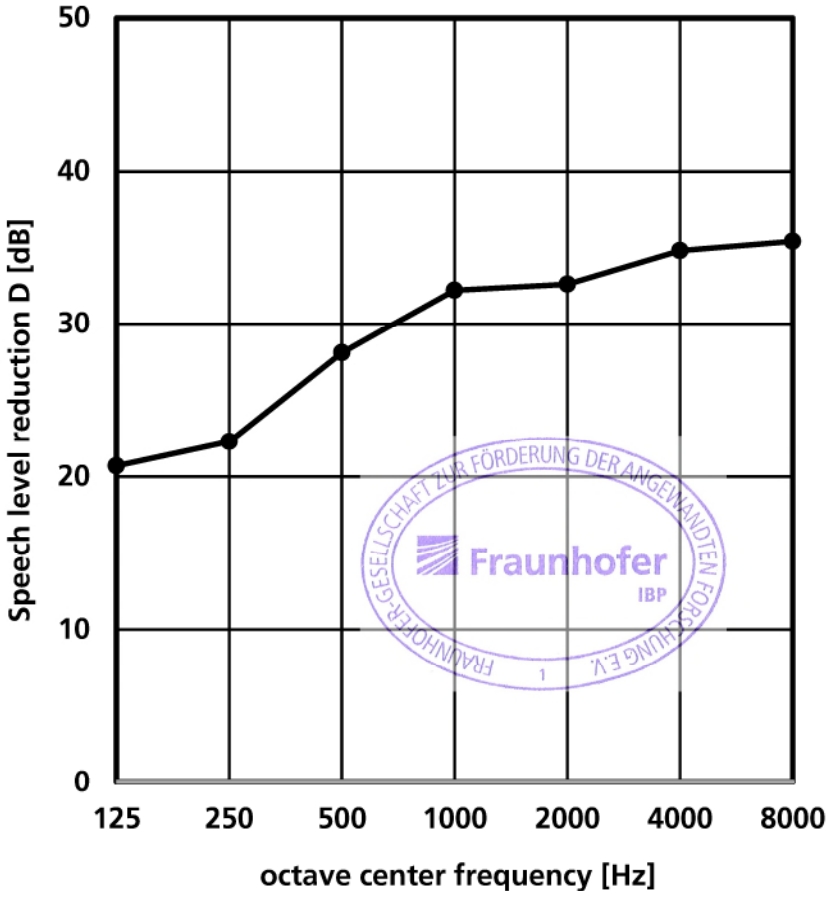
For further details on the test object, see result sheet 1 and Figure 1.

Operating status:
Ventilation and lighting on, door closed

Test date: 04.06.2024

Test facility: Prüfstand P20
Volume: V = 392 m³
air temp.: 23.0 ± 0.3°C
air stat. pres.: 979 ± 1 hPa
rel. hum.: 52 ± 2 %

f [Hz]	D [dB]
125	20.7
250	22.3
500	28.1
1000	32.2
2000	32.6
4000	34.8
8000	35.4



Speech level reduction according to ISO 23351-1

$D_{s,A}$ = 28.2 dB

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Presentation of the test object

P-BA 113/2024e

Figure 1

Client: Berlin Acoustics
10115 Berlin

Test specimen:
Phone booth "Berlin Acoustics Focus", by Berlin Acoustics (test object S12255-02).

The booth housing is made of wood and stands on four adjustable feet. On the inside, the walls and ceiling are equipped with full-surface absorbers bonded with non-woven fabric. There are narrow air slits on the sides of the booth floor. The air is drawn in at an opening in the ceiling with the aid of fans and blown out at the top. There are two exhaust air openings on the top for this purpose. A full-surface glass door is mounted on the front to allow access to the phone booth. A surrounding rubber lip is installed in the door hinge, on the two side panels and the ceiling. When the glass door is closed, there is a further ventilation slot towards the floor of the booth. A wall shelf is mounted on the side of the phone box, a socket on the rear wall and a sensor and lighting integrated into the ceiling Power is supplied via a cable with a Schuko plug.

The external dimensions of the booth are (L/W/H) 99 cm / 97 cm / 216 cm, without door handle.

Picture of the tested booth in the test facility.

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Explanations to the single number quantities

Explanation to the speech level reduction stated in the test report:

In this test report, single number quantities for the speech level reduction according to ISO 23351-1:2020 are given in the form $D_{S,A}$ = 28.4 dB (example value).

The accuracy of the method described in this standard was determined in an experimental round robin test. Eight laboratories from six countries tested two products. Product A was a furniture set (a workstation) with an mean value of $D_{S,A}$ = 4.2 dB. Product B was an enclosure (a telephone booth) with a mean value of $D_{S,A}$ = 28.7 dB. The tests were carried out in accordance with this document. The results of the measurements showed the following accuracy:

Product type (level range)	Standard deviation of the reproducibility s_R [dB]	Standard deviation of the repeatability s_r [dB]
Furniture set, partial enclosure ($D_{S,A} \leq 10$ dB)	0.6	0.1
Enclosure ($D_{S,A} > 10$ dB)	1.1	0.2

Test Method

The measurement of the speech level reduction was carried out in accordance with ISO 23351-1:2020 and results from the difference in the sound power level of a reference sound source with and without furniture group or enclosure. The position of the reference sound source in the reverberation chamber remains unchanged during the measurements with and without the test object. When measuring with enclosures, the reference sound source is located inside the furniture. The measurement is repeated at two different positions of the furniture group/enclosure in the reverberation chamber and the results are averaged.

The measurements of the sound power levels according to ISO 3741:2010 in the reverberation chamber are carried out using the direct method. The sound power levels with and without the test object are derived from the acoustic measurement parameters of the reverberation times and the sound pressure level of the reference sound source. The reverberation chamber and the measurement set-up are described in Annex P20. The measurements were carried out in third octaves at six fixed microphone positions. The measurement results were averaged energetically and converted into octaves for further calculations.

The level reduction was determined according to the following relationship:

$$D_i = L_{W,P,1,i} - L_{W,P,2,i}$$

Where:

D_i	=	Sound level reduction	[dB]
$L_{W,P,1,i}$	=	Sound power level without test object (furniture group / enclosure)	[dB]
$L_{W,P,2,i}$	=	Sound power level with test object (furniture group / enclosure)	[dB]

The frequency-dependent level reduction D_i is used to determine the speech level reduction. The calculation is based on a mathematical transformation in which the sound power level is replaced by the normalised sound power level of the speech $L_{W,S,1,i}$, see Table 1. The sound power $L_{W,S,2,i}$ emitted by the test object is calculated as follows:

$$L_{W,S,2,i} = L_{W,S,1,i} - D_i \quad \text{[dB]}$$

	1/1 oktave Band f in [Hz]						
	125	250	500	1 000	2 000	4 000	8 000
$L_{W,S,1,i}$ *[dB re 1 pW]*	60,9	65,3	69,0	63,0	55,8	49,8	44,5

Table 1: Unweighted normalised sound power level of speech $L_{W,S,1,i}$

The single number quantity of the speech level reduction $D_{S,A}$ is calculated from the difference between the A-weighted single-number quantity of the radiated sound power of the test object $L_{W,S,A,2}$ and the A-weighted single-number quantity of the normalised sound power level of the speech $L_{W,S,A,1}$.

$$D_{S,A} = L_{W,S,A,1} - L_{W,S,A,2} \quad \text{[dB]}$$

The determined speech level reduction can be classified according to Annex D of ISO 23351-1 as:

Class	**A+**	**A**	**B**	**C**	**D**	**-**
$D_{S,A}$ [dB]	>33	>30	>25	>20	>15	≤15

Table 2: Classification according to speech level reduction $D_{S,A}$

Measurement equipment

Measurement equipment used:

Analyzer:	Sinus Soundbook_MK2_8L G S/N 07318
Software:	Sinus Samurai Ver. 3.4.x
Microphone-set:	G.R.A.S. 46AE S/N 294216
Microphone-set:	G.R.A.S. 46AE S/N 88721
Microphone-set:	G.R.A.S. 46AE S/N 294218
Microphone-set:	G.R.A.S. 46AE S/N 294219
Microphone-set:	G.R.A.S. 46AE S/N 294220
Microphone-set:	G.R.A.S. 46AE S/N 294257
Calibrator:	Larson Davis CAL200 S/N 13583
Amplifier:	Klein & Hummel AK 120 S.Nr. 2078
Loudspeaker:	Lanny MLS 87

The used analyser is a type-approved Class 1 sound level meter. All measurement devices are tested frequently by internal and external testing laboratories, are calibrated and if necessary gauged.

Test facility

The measurements were performed in the reverberation room P20 of the Fraunhofer Institute for Building Physics. The test faciliy meets the requirements of DIN EN ISO 354. Walls and ceilings are made of concrete.

Geometry of the reverberation room

Width:	7.05 m ... 7.75 m
Length:	7.86 m ... 8.46 m
Height:	5.92 m ... 7.08 m
Volume:	392 m³
Surface:	322 m²
Angle between opposite walls:	approx. 5°,
Angle between floor and ceiling	approx. 8°.
10 diffusors à	1.60 m x 1.25 m
5 diffusors à	1.25 m x 1.25 m
Overall surface (one-side) of the diffusors:	27.8 m²
Material:	composite sheet, slightly curved

Measuring equipment

For the measurement of the reverberation time the average of three positions of the loudspeaker (corners of the room) with 4 microphone positions each or of two positions of the loudspeaker (corners of the room) with 6 microphone positions each was used. At least 3 reverberation time evaluations per microphone position were measured when pink noise was used. The microphones were placed from 1.75 m to 2.25 m above floor level, distributed in a random pattern around the sample with a distance to each other ≥1,5 m and ≥2 m to the source (≥1,2 m distance to the test specimen, diffusors and room surface).

Ground plan and sectional view of the test facility