

Certificate of Calibration for G.R.A.S. IEC 60711 & 60318-4 Ear Simulator RA0045

This calibration is performed by comparison with measurement reference standard:

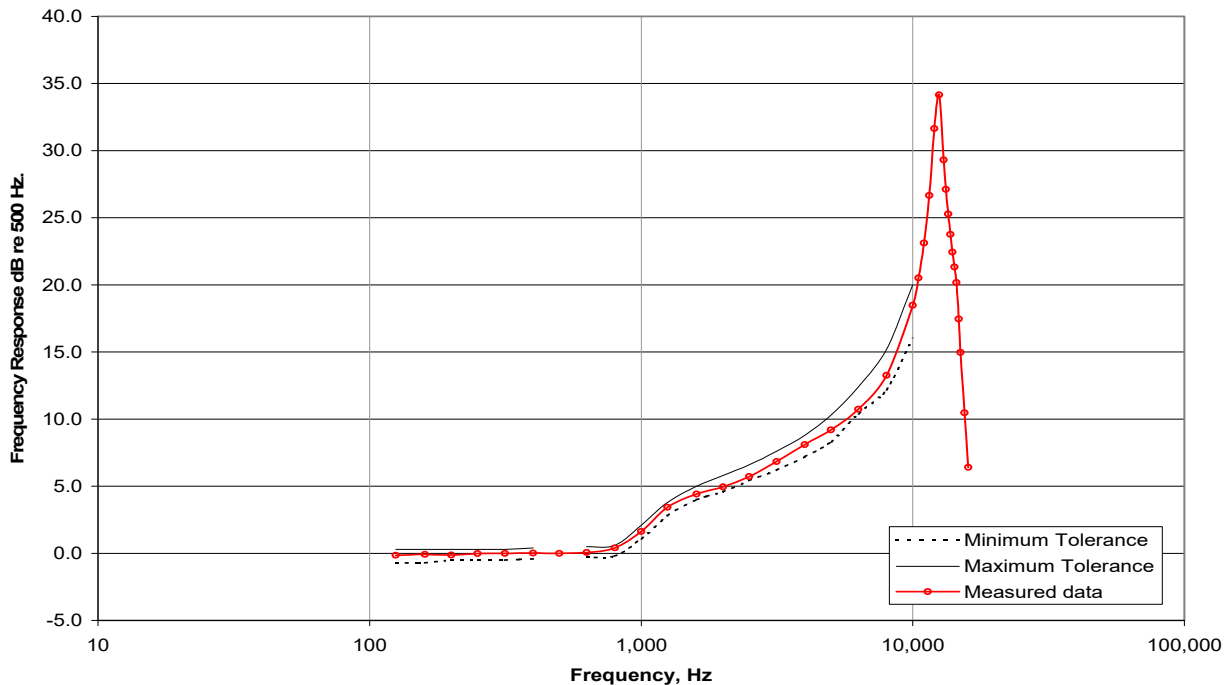
REFERENCE STANDARDS	
Type No.	4134/UA0825
Serial No.	1866523
Calibrated by	DANAK
Cal Date	28 OCT 2020
Due Date	28 OCT 2022

Type no.	RA0045
Serial no.	216172
With built in microphone	40AG
Microphone serial no.	197928
With preamplifier type no.	N/A
Preamplifier Serial no.	N/A
Submitted by	Odin Metrology, Inc.
	Thousand Oaks, CA 91320
Purchase order no.	N/A
Asset no.	N/A

- a) Estimated uncertainty of comparison: ± 0.065 dB
- b) Estimated uncertainty of 4134: ± 0.04 dB
- c) Total uncertainty: $\sqrt{a^2 + b^2} = \pm 0.076$ dB
- d) Expanded uncertainty (coverage factor $k = 2$ for 95% confidence level): ± 0.15 dB

PERFORMANCE DATA		
Open circuit sensitivity at 1,013 hPa, 23°C, 50% RH, 251.2 Hz	-36.89	dB re 1 V/Pa
	14.31	mV/Pa
System sensitivity (with preamplifier) at 251.2 Hz	N/A	dB re 1 V/Pa
	N/A	mV/Pa

**Ear Simulator Frequency Response: Type RA0045
S/N 216172 : Measured 23 Apr 2021**



Calibration performed by

Harold Lynch

Harold Lynch, Service Manager

CONDITION OF TEST		
Ambient Pressure	989.76	hPa
Temperature	23	°C
Relative Humidity	36	%
Polarization Voltage	200	V
Frequency	251.2	Hz
Date of Calibration	23 APR 2021	
Re-calibration due on	23 APR 2022	

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The calibration data is both "as found" and "as final." At the time of calibration this microphone was found to be **within** the manufacturer's specifications. Calibration Procedure: **OM-P-1008-Microphone Rev. 1.2 20130618 and OM-P-1017-IEC 711 Couplers Rev. 1.7 20170315.**

This calibration is traceable to DANAK/DPLA No. **M2.10-1423-3.1** and through inter-laboratory comparisons to NIST Test Number: **683/289533-17.** *See page 2 Traceability.

Instrumentation used for calibration of microphones

<u>Instrument Type</u>	<u>Type no.</u>	<u>Serial no.</u>	<u>Cal. Date</u>	<u>Cal. Due</u>	<u>Cal. by</u>
Precision Barometer	Druck 141	299/95-10	07 DEC 2020	07 DEC 2021	CMI
B&K Sine/Random Generator	1049	1464545	05 JUN 2020	05 JUN 2021	HL
Measuring Amplifier	2636	1324114	29 MAY 2020	29 MAY 2021	HL
Preamplifier	2639	1595652	17 JUN 2020	17 JUN 2021	HL
Preamplifier	2669	2145792	02 DEC 2020	02 DEC 2021	HL
Preamplifier	26AG	201377	03 SEP 2020	03 SEP 2021	HL
Multimeter	34401A	MY45001930	07 NOV 2020	07 NOV 2021	PMI
Multimeter	34401A	US36009807	10 SEP 2020	10 SEP 2021	PMI
Microphone	4134/JA0825	1866523	28 OCT 2020	28 OCT 2022	DANAK
Pistonphone	4220	1404269	24 NOV 2020	24 NOV 2021	TE
Multitone Calibrator	4226	3274134	30 NOV 2020	30 NOV 2021	HL
Precision Attenuator	5936	1637820	07 SEP 2020	07 SEP 2021	HL
Polarization Voltmeter	WB0781	21	03 SEP 2020	03 SEP 2021	HL

Calibration of reference microphones 4160 serial numbers 991820 and 991821, and standard pistonphones 4220 serial numbers 1048473, 1510240, 4228 serial number 1048747 with 40 cm³ volume are calibrated traceable to NIST with NIST test number **683/289533-17**.

The verification/calibration listed on page 1 of this document was performed on a test system which conforms to and operates under the requirements of **ANSI/NCSL Z540-1** which also covers the requirements for **MIL STD 45662A**, **ISO 17025**, and ISO 9001:2015 NQA certification no.: **11252**.

*Traceability to NIST by NIST calibration of Transfer Standard Microphone is used to verify consistency between DANAK/DPLA and NIST calibrations.

This page revised: Rev. 27.1, 20210317

Odin Metrology Inc.

Calibration of Brüel & Kjær Instruments
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IEC 60711 Ear Simulator Type RA0045

Serial# 216172

ID# N/A

Certificate# OM2021-6

Measured with

Microphone 40AG# 197928 Preamplifier 2669 2145792

See Below for Frequency Response Tabulation including tolerances

Frequency (Hz)	Nominal Value (dB)	IEC 60711 Tolerance (dB)		Data Found (dB)	Pass/Fail	Data Found (dB)
		Minimum	Maximum	Re. 500 Hz		Re. 1000 Hz
100	-0.2	-0.8	0.2	-0.22	Pass	-1.85
125	-0.2	-0.7	0.3	-0.14	Pass	-1.77
160	-0.1	-0.7	0.3	-0.08	Pass	-1.71
200	-0.1	-0.5	0.3	-0.12	Pass	-1.75
250	-0.1	-0.5	0.3	-0.01	Pass	-1.64
315	0.0	-0.5	0.3	0.01	Pass	-1.62
400	0.1	-0.4	0.4	0.02	Pass	-1.61
500	REF			0.00	Pass	-1.63
630	0.1	-0.3	0.5	0.07	Pass	-1.56
800	0.2	-0.2	0.6	0.41	Pass	-1.22
1,000	1.6	1.1	2.1	1.63	Pass	0.00
1,250	3.3	2.8	3.8	3.43	Pass	1.80
1,600	4.5	4.0	5.0	4.42	Pass	2.79
2,000	5.2	4.6	5.8	4.95	Pass	3.32
2,500	6.0	5.4	6.6	5.72	Pass	4.09
3,150	6.9	6.2	7.6	6.84	Pass	5.21
4,000	8.0	7.2	8.8	8.11	Pass	6.48
5,000	9.3	8.3	10.3	9.20	Pass	7.57
6,300	11.4	10.4	12.4	10.73	Pass	9.10
8,000	13.7	12.2	15.2	13.27	Pass	11.64
10,000	18.0	16.0	20.0	18.48	Pass	16.85
10,500				20.52		18.89
11,000				23.12		21.49
11,500				26.67		25.04
12,000				31.65		30.02
12,500				34.16		32.53
13,000				29.32		27.69
13,250				27.11		25.48
13,500				25.28		23.65
13,750				23.76		22.13
14,000				22.45		20.82
14,250				21.33		19.70
14,500				20.17		18.54
14,750				17.47		15.84
15,000				14.96		13.34
15,500				10.47		8.84
16,000				6.41		4.78

Measurements were also made at these additional frequencies as requested. Note however that no tolerances are defined for these frequencies and these data are provided for reference only.

750	0.26	-1.37
1,500	4.26	2.63
2,250	5.31	3.69
3,000	6.60	4.97
4,500	8.69	7.06
6,000	10.35	8.73
9,000	15.44	13.81

Customer Odin Metrology, Inc.

Purchase Order# N/A

Date 23-Apr-21

Performed by: HL

Environmental Conditions:

Temperature 23 deg C

Pressure 989.76 hPa

Relative Humidity 36%