

Certificate of Calibration for Brüel & Kjær 1/2" Microphone

This calibration is performed by comparison with measurement reference standard microphone:

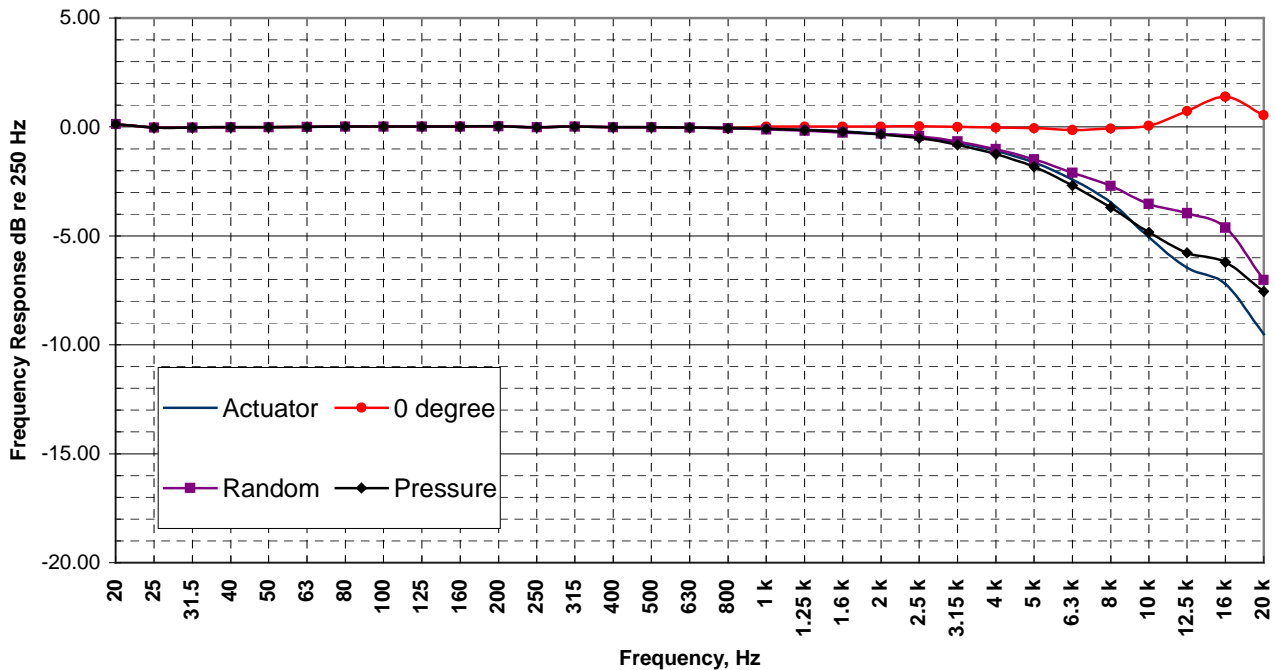
Type no. **4189**
 Serial no. **2048567**
 With preamplifier type no. **N/A**
 Preamplifier Serial no. **N/A**
 Submitted by **Odin Metrology, Inc.**
 Purchase order no. **N/A**
 Asset no. **N/A**

REFERENCE STANDARDS	
Type No.	4134/JA0825
Serial No.	1866524
Calibrated by	DANAK
Cal Date	06 SEP 2011
Due Date	06 SEP 2013

PERFORMANCE DATA		
Open circuit sensitivity at 1,013 hPa, 23°C, 50% RH, 251.2 Hz	-25.69	dB re 1 V/Pa
	51.97	mV/Pa
Open circuit correction factor K_0	-0.3	dB
System sensitivity (with preamplifier) at 251.2 Hz	N/A	dB re 1 V/Pa
	N/A	mV/Pa
Correction factor K	N/A	dB

- a) Estimated uncertainty of comparison: ± 0.05 dB
- b) Estimated uncertainty of reference microphone: ± 0.04 dB
- c) Total uncertainty: $\sqrt{a^2 + b^2} = \pm 0.064$ dB
- d) Expanded uncertainty (coverage factor $k = 2$ for 95% confidence level): ± 0.13 dB

Microphone Frequency Response Type 4189
S/N 2048567 : Measured 30 Apr 2012



Calibration performed by

Torben Ehlert, Quality Assurance Manager

CONDITION OF TEST		
Ambient Pressure	987.04	hPa
Temperature	23	°C
Relative Humidity	38	%
Polarization Voltage	0	V
Frequency	251.2	Hz
Date of Calibration	30 APR 2012	
Re-calibration due on	30 APR 2013	

ODIN METROLOGY, INC.
 3533 OLD CONEJO ROAD, SUITE 125
 THOUSAND OAKS, CA 91320
 PHONE: (805) 375-0830; FAX: (805) 375-0405

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.

This calibration is traceable to NIST Test Number: **822/279494-10, D1295.**

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>
B&K Sine/Random Generator	1049	1464545	20 JUN 11	20 JUN 12	HL
Precision Barometer	141	299/95-10	23 NOV 11	23 NOV 12	CMI
Measuring Amplifier	2636	1324114	26 MAY 11	26 MAY 12	HL
Preamplifier	2639	1202131	30 JUN 11	30 JUN 12	HL
Preamplifier	2645	1097320	29 AUG 11	29 AUG 12	HL
Multimeter	34401A	US36009807	19 JUL 11	19 JUL 12	Agilent
Multimeter	34401A	MY41029778	26 AUG 11	26 AUG 12	Agilent
Pistonphone	4220/40cc	1048747	30 AUG 11	30 AUG 12	TE
Multitone Calibrator	4226	2141942	01 DEC 11	01 DEC 12	HL
Precision Attenuator	5936	1637820	30 AUG 11	30 AUG 12	HL
Polarization Voltmeter	WB0781	04	07 SEP11	07 SEP12	HL

Calibration of reference microphones 4160 serial numbers 991820, 991821, and 1054926, and standard pistonphones 4220 serial numbers 1048473, 1048795, 1510240, 4228 serial number 1048747 with 40 cm³ volume are calibrated traceable to NIST with NIST test number **822/279494-10, D1295**

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 9001:2008 NQA certification no.: **11252**.

Procedure: Odin Metrology, Inc. standing microphone calibration procedure.

This page revised: 01 December, 2011

Odin Metrology, Inc.

Calibration of Brüel & Kjær Instruments
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Certificate #. 19093-4 for 4189 serial # 2048567

Tabulation for Electrostatic Actuator Response with Free Field Corrections for 4189 Microphone

For: Odin Metrology, Inc.
 Purchase Order# 5004071315 Measurements Performed on 30-Apr-2012
 Environmental Conditions: Temp 23 deg C, Relative Humidity: 38%, Ambient Press: 987.04 hPa
 Performed by: TE

Indicated Plot Frequency	Frequency Response with Grid and for				Actual 1/3 Octave Test Frequency
	Actuator	0 degree	Random	Pressure	
20	0.12	0.12	0.12	0.12	19.95
25	-0.03	-0.03	-0.03	-0.03	25.12
31.5	-0.03	-0.03	-0.03	-0.03	31.62
40	-0.02	-0.02	-0.02	-0.02	39.81
50	-0.01	-0.01	-0.01	-0.01	50.12
63	0.00	0.00	0.00	0.00	63.10
80	0.01	0.01	0.01	0.01	79.43
100	0.01	0.01	0.01	0.01	100.00
125	0.01	0.01	0.01	0.01	125.89
160	0.01	0.01	0.01	0.01	158.49
200	0.02	0.02	0.02	0.02	199.53
250	-0.01	-0.01	-0.01	-0.01	251.19
315	0.01	0.01	0.01	0.01	316.23
400	-0.02	-0.02	-0.02	-0.02	398.11
500	-0.01	-0.01	-0.01	-0.01	501.19
630	-0.03	-0.03	-0.03	-0.03	630.96
800	-0.06	-0.06	-0.06	-0.06	794.33
1 k	-0.09	0.01	-0.11	-0.09	1000.00
1.25 k	-0.14	0.01	-0.17	-0.14	1258.93
1.6 k	-0.20	0.02	-0.26	-0.22	1584.89
2 k	-0.31	0.01	-0.32	-0.34	1995.26
2.5 k	-0.46	0.02	-0.42	-0.51	2511.89
3.15 k	-0.72	0.00	-0.68	-0.81	3162.28
4 k	-1.10	-0.04	-1.01	-1.25	3981.07
5 k	-1.63	-0.05	-1.49	-1.84	5011.87
6.3 k	-2.42	-0.14	-2.11	-2.69	6309.57
8 k	-3.46	-0.08	-2.71	-3.70	7943.28
10 k	-5.06	0.06	-3.53	-4.84	10000.00
12.5 k	-6.46	0.73	-3.96	-5.78	12589.25
16 k	-7.20	1.39	-4.62	-6.21	15848.93
20 k	-9.51	0.54	-7.03	-7.54	19952.62

Microphone Frequency Response Type 4189
S/N 2048567 : Measured 30 Apr 2012

