Brüel & Kjær

The Calibration Laboratory
Skodsborgvej 307, DK-2850 Nærum, Denmark

DANAK
CAL Reg.nr. 307

CERTIFICATE OF CALIBRATION

No: CDK1301400

CALIBRATION OF

Microphone: Brüel & Kjær Type 4189 No: 2621142 Id: 124189016

CUSTOMER

Brüel & Kjær Sound & Vibration Measurement A/S
Skodsborgvej 307
DK-2850 Nærum
Denmark

CALIBRATION CONDITIONS

Preconditioning: 4 hours at 23°C ± 3°C

Environment conditions: Pressure: 102.72 kPa. Humidity: 40 % RH. Temperature: 22.9 °C.

SPECIFICATIONS

The Microphone Brüel & Kjær Type 4189 has been calibrated in accordance with the requirements as specified in IEC61094-1/4/5/6. The accreditation assures the traceability to the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Microphone Calibration System type 9721, version 5.1.1 by using procedure P_4189_A10-a.

RESULTS

Calibration Mode: **Calibration as received.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of calibration: 2013-12-10

Date of issue: 2013-12-10

Helle Hansen
Calibration Technician

Susanne Jørgensen
Approved Signatory

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1. Visual Inspection

OK.

2. Comments

3. Calibration Equipment

	Instrument	Inventory No.
PULSE Analyzer	Brüel & Kjær, Type 3560-C	123560024
W.S Microphone	Brüel & Kjær, Type 4192	124192019
W.S Preamplifier Insert	Brüel & Kjær, Type 2673	122673023
D.U.T Preamplifier Insert	Brüel & Kjær, Type 2673	122673024
Preamplifier	Brüel & Kjær, Type 2669	122669071
Microphone Calibration Module	Brüel & Kjær, Type 5001	155001001
Comparison Coupler	Brüel & Kjær, Type WA0817	150561001
Reference Microphone No. 1	Brüel & Kjær, Type 4180	124180025

4. Results

Reference conditions: Pressure: 101.3k Pa. Humidity: 50 % RH. Temperature: 23 °C

	dB re. 1V/Pa	Limit
Nominal sensitivity:	-26.00	± 1.50 dB

	dB re. 1V/Pa	mV/Pa
Sensitivity at calibration conditions:	-26.58	46.91
Sensitivity at reference conditions:	-26.56	46.98

	Value	Unit
Sensitivity type:	Open-circuit	
Uncertainty:	0.11	dB
Correction factor K:	0.56	dB
Calibration frequency:	251.19	Hz
Polarization Voltage:	0	Volt

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5. Normalized Frequency Response

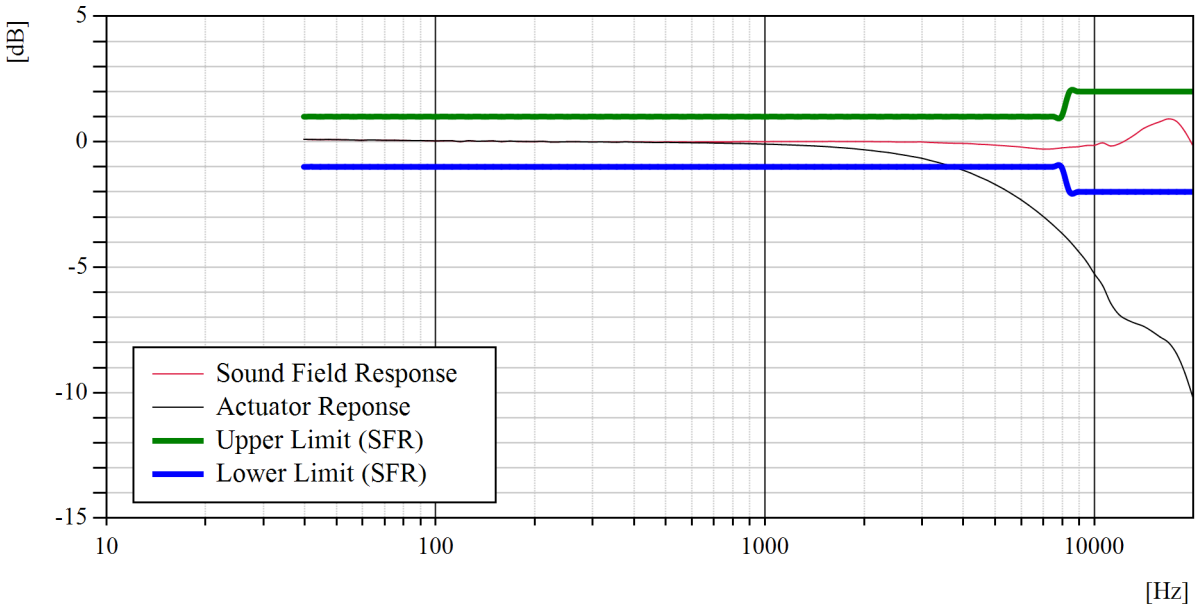
Normalization Frequency: 251.19 Hz

Actuator Response is valid at Calibration Conditions.

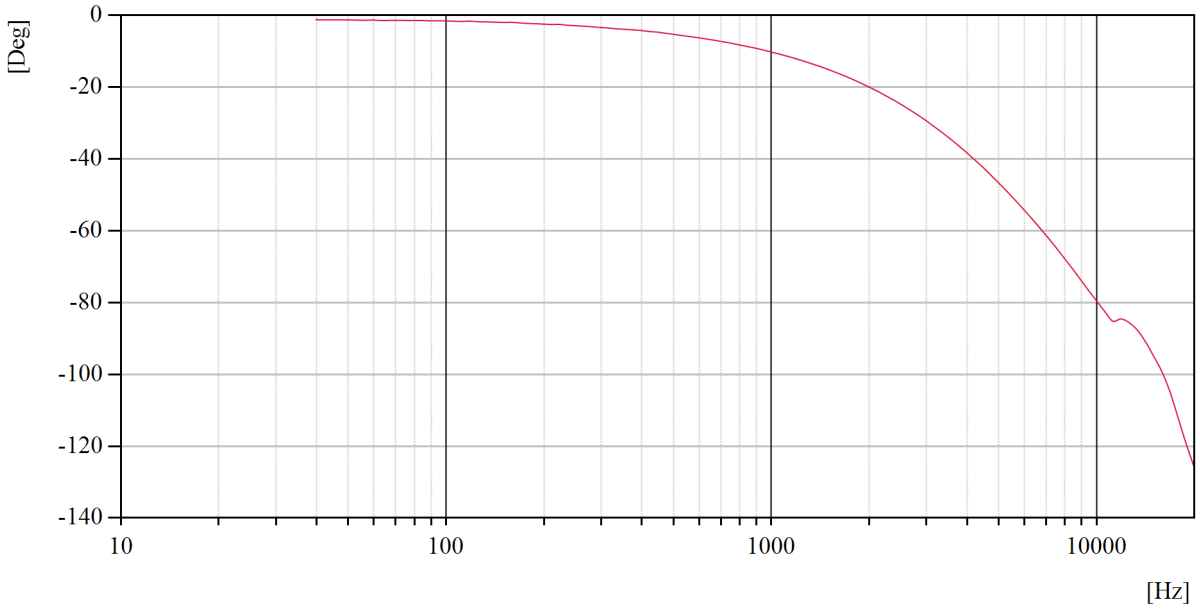
Applied Sound Field Correction: **Free-field Correction with Grid, 0 deg.**

Used sound field corrections are values stated by the manufacturer.
The Sound Field Measurement Uncertainty is calculated as a combination of the actuator measurement uncertainty and sound field corrections uncertainty values stated by the manufacturer.
Measurement not covered by the scope of accreditation is marked with *.

Normalized Frequency Response



Actuator Phase Response (not accredited) *



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CERTIFICATE OF CALIBRATION

Frequency [Hz]	Upper Limit [dB]	Lower Limit [dB]	Actuator Response [dB]	Free-field Response with Grid, 0 deg. [dB]	Sound Field Measurement Uncertainty [dB]	*Actuator Phase Response ** *[Deg]*	Status
39.8	1.00	-1.00	0.10	0.10	0.16	*-1.2*	
42.2	1.00	-1.00	0.09	0.09	0.16	*-1.3*	
44.7	1.00	-1.00	0.09	0.09	0.16	*-1.3*	
47.3	1.00	-1.00	0.09	0.09	0.16	*-1.2*	
50.1	1.00	-1.00	0.09	0.08	0.16	*-1.3*	
53.1	1.00	-1.00	0.08	0.08	0.16	*-1.3*	
56.2	1.00	-1.00	0.07	0.07	0.16	*-1.3*	
59.6	1.00	-1.00	0.06	0.06	0.16	*-1.3*	
63.1	1.00	-1.00	0.08	0.07	0.12	*-1.4*	
66.8	1.00	-1.00	0.07	0.06	0.12	*-1.4*	
70.8	1.00	-1.00	0.06	0.06	0.12	*-1.4*	
75.0	1.00	-1.00	0.06	0.06	0.12	*-1.4*	
79.4	1.00	-1.00	0.05	0.05	0.12	*-1.4*	
84.1	1.00	-1.00	0.05	0.05	0.12	*-1.4*	
89.1	1.00	-1.00	0.05	0.05	0.12	*-1.5*	
94.4	1.00	-1.00	0.04	0.04	0.12	*-1.5*	
100.0	1.00	-1.00	0.04	0.03	0.12	*-1.5*	
105.9	1.00	-1.00	0.04	0.04	0.12	*-1.6*	
112.2	1.00	-1.00	0.04	0.04	0.12	*-1.7*	
118.9	1.00	-1.00	0.01	0.01	0.12	*-1.6*	
125.9	1.00	-1.00	0.04	0.04	0.09	*-1.8*	
133.4	1.00	-1.00	0.02	0.02	0.09	*-1.8*	
141.3	1.00	-1.00	0.03	0.02	0.09	*-1.9*	
149.6	1.00	-1.00	0.03	0.03	0.09	*-1.9*	
158.5	1.00	-1.00	0.01	0.01	0.09	*-1.9*	
167.9	1.00	-1.00	0.03	0.03	0.09	*-2.1*	
177.8	1.00	-1.00	0.01	0.01	0.09	*-2.2*	
188.4	1.00	-1.00	0.01	0.01	0.09	*-2.3*	
199.5	1.00	-1.00	0.01	0.00	0.09	*-2.4*	
211.3	1.00	-1.00	0.02	0.02	0.09	*-2.5*	
223.9	1.00	-1.00	-0.01	-0.01	0.09	*-2.5*	
237.1	1.00	-1.00	-0.01	-0.01	0.09	*-2.8*	
251.2	1.00	-1.00	0.00	0.00	0.00	*-2.9*	
266.1	1.00	-1.00	0.00	0.00	0.09	*-3.0*	
281.8	1.00	-1.00	0.00	0.00	0.09	*-3.2*	
298.5	1.00	-1.00	-0.01	-0.01	0.09	*-3.3*	
316.2	1.00	-1.00	-0.01	0.00	0.09	*-3.5*	
335.0	1.00	-1.00	-0.01	-0.01	0.09	*-3.7*	
354.8	1.00	-1.00	-0.02	-0.01	0.09	*-3.9*	
375.8	1.00	-1.00	0.00	0.00	0.09	*-4.0*	
398.1	1.00	-1.00	-0.02	-0.01	0.09	*-4.2*	
421.7	1.00	-1.00	-0.02	-0.01	0.09	*-4.5*	
446.7	1.00	-1.00	-0.03	-0.01	0.09	*-4.6*	

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473.2	1.00	-1.00	-0.03	-0.02	0.09	*-5.0*	
501.2	1.00	-1.00	-0.02	0.00	0.09	*-5.3*	
530.9	1.00	-1.00	-0.03	-0.01	0.09	*-5.6*	
562.3	1.00	-1.00	-0.03	-0.01	0.09	*-5.9*	
595.7	1.00	-1.00	-0.04	-0.01	0.09	*-6.2*	
631.0	1.00	-1.00	-0.04	-0.01	0.09	*-6.5*	
668.3	1.00	-1.00	-0.04	0.00	0.09	*-6.9*	
707.9	1.00	-1.00	-0.05	-0.01	0.09	*-7.3*	
749.9	1.00	-1.00	-0.06	0.00	0.09	*-7.7*	
794.3	1.00	-1.00	-0.07	0.00	0.09	*-8.2*	
841.4	1.00	-1.00	-0.07	0.01	0.09	*-8.6*	
891.3	1.00	-1.00	-0.07	0.01	0.09	*-9.1*	
944.1	1.00	-1.00	-0.08	0.00	0.09	*-9.6*	
1000.0	1.00	-1.00	-0.10	0.00	0.09	*-10.2*	
1059.3	1.00	-1.00	-0.10	0.01	0.10	*-10.8*	
1122.0	1.00	-1.00	-0.12	0.01	0.10	*-11.4*	
1188.5	1.00	-1.00	-0.13	0.01	0.10	*-12.0*	
1258.9	1.00	-1.00	-0.14	0.01	0.10	*-12.7*	
1333.5	1.00	-1.00	-0.15	0.01	0.10	*-13.5*	
1412.5	1.00	-1.00	-0.17	0.01	0.10	*-14.2*	
1496.2	1.00	-1.00	-0.19	0.01	0.10	*-15.1*	
1584.9	1.00	-1.00	-0.21	0.01	0.10	*-15.9*	
1678.8	1.00	-1.00	-0.23	0.01	0.10	*-16.8*	
1778.3	1.00	-1.00	-0.25	0.01	0.10	*-17.8*	
1883.7	1.00	-1.00	-0.28	0.01	0.10	*-18.8*	
1995.3	1.00	-1.00	-0.32	0.01	0.10	*-19.9*	
2113.5	1.00	-1.00	-0.35	0.01	0.14	*-21.0*	
2238.7	1.00	-1.00	-0.39	0.00	0.14	*-22.3*	
2371.4	1.00	-1.00	-0.43	0.00	0.14	*-23.5*	
2511.9	1.00	-1.00	-0.48	-0.01	0.14	*-24.8*	
2660.7	1.00	-1.00	-0.54	-0.01	0.14	*-26.2*	
2818.4	1.00	-1.00	-0.59	-0.01	0.14	*-27.7*	
2985.4	1.00	-1.00	-0.65	-0.01	0.14	*-29.2*	
3162.3	1.00	-1.00	-0.74	-0.03	0.14	*-30.9*	
3349.7	1.00	-1.00	-0.82	-0.04	0.14	*-32.6*	
3548.1	1.00	-1.00	-0.91	-0.05	0.14	*-34.4*	
3758.4	1.00	-1.00	-1.02	-0.06	0.14	*-36.2*	
3981.1	1.00	-1.00	-1.13	-0.06	0.14	*-38.2*	
4217.0	1.00	-1.00	-1.25	-0.07	0.17	*-40.2*	
4466.8	1.00	-1.00	-1.40	-0.10	0.17	*-42.2*	
4731.5	1.00	-1.00	-1.54	-0.11	0.17	*-44.5*	
5011.9	1.00	-1.00	-1.71	-0.14	0.17	*-46.7*	
5308.8	1.00	-1.00	-1.88	-0.16	0.17	*-49.1*	

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5623.4	1.00	-1.00	-2.08	-0.18	0.17	*-51.5*	
5956.6	1.00	-1.00	-2.29	-0.21	0.17	*-54.0*	
6309.6	1.00	-1.00	-2.52	-0.24	0.17	*-56.5*	
6683.4	1.00	-1.00	-2.77	-0.27	0.17	*-59.1*	
7079.5	1.00	-1.00	-3.03	-0.30	0.17	*-61.8*	
7498.9	1.00	-1.00	-3.32	-0.28	0.17	*-64.6*	
7943.3	1.00	-1.00	-3.63	-0.25	0.17	*-67.6*	
8414.0	2.00	-2.00	-3.96	-0.22	0.37	*-70.4*	
8912.5	2.00	-2.00	-4.34	-0.20	0.37	*-73.5*	
9440.6	2.00	-2.00	-4.75	-0.15	0.37	*-76.6*	
10000.0	2.00	-2.00	-5.26	-0.14	0.37	*-79.5*	
10592.5	2.00	-2.00	-5.72	-0.04	0.37	*-82.4*	
11220.2	2.00	-2.00	-6.44	-0.17	0.37	*-85.2*	
11885.0	2.00	-2.00	-6.89	-0.08	0.37	*-84.5*	
12589.3	2.00	-2.00	-7.10	0.09	0.37	*-85.6*	
13335.2	2.00	-2.00	-7.24	0.30	0.37	*-87.6*	
14125.4	2.00	-2.00	-7.36	0.54	0.37	*-90.8*	
14962.4	2.00	-2.00	-7.55	0.68	0.37	*-94.8*	
15848.9	2.00	-2.00	-7.78	0.80	0.37	*-99.1*	
16788.0	2.00	-2.00	-8.00	0.91	0.50	*-104.6*	
17782.8	2.00	-2.00	-8.45	0.81	0.50	*-111.9*	
18836.5	2.00	-2.00	-9.21	0.41	0.50	*-119.2*	
19952.6	2.00	-2.00	-10.22	-0.17	0.50	*-125.8*	

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DANAK

The Danish Accreditation and Metrology Fund - DANAK - is managing the Danish accreditation scheme based on a contract with the Danish Safety Technology Authority under the Danish Ministry of Economics and Business Affairs who is responsible for the legislation on accreditation in Denmark.

The fundamental criteria for accreditation are described in DS/EN ISO/IEC 17025: "General requirements for the competence of testing and calibration laboratories", and in DS/EN ISO/IEC 15189 "Medical laboratories – Particular requirements for quality and competence" respectively. DANAK uses guidance documents to clarify the requirements in the standards, where this is considered to be necessary. These will mainly be drawn up by the "European co-operation for Accreditation (EA)" or the "International Laboratory Accreditation Co-operation (ILAC)" with a view to obtaining uniform criteria for accreditation worldwide. In addition, the Danish Safety Technology Authority issues Technical Regulations prepared by DANAK with specific requirements for accreditation that are not contained in the standards.

In order for a laboratory to be accredited it is, among other things, required:

- *that the laboratory and its personnel are free from any commercial, financial or other pressures, which might influence their impartiality;*
- *that the laboratory operates a documented management system, and has a management that ensures that the system is followed and maintained;*
- *that the laboratory has at its disposal all items of equipment, facilities and premises required for correct performance of the service that it is accredited to perform;*
- *that the laboratory has at its disposal personnel with technical competence and practical experience in performing the services that they are accredited to perform;*
- *that the laboratory has procedures for traceability and uncertainty calculations;*
- *that accredited testing, calibration or medical examination are performed in accordance with fully validated and documented methods;*
- *that accredited services are performed and reported in confidentiality with the customer and in compliance with the customer's request;*
- *that the laboratory keeps records which contain sufficient information to permit repetition of the accredited test, calibration or medical examination;*
- *that the laboratory is subject to surveillance by DANAK on a regular basis;*

Reports carrying DANAK's accreditation mark are used when reporting accredited services and show that these have been performed in accordance with the rules for accreditation.