Brüel & Kjær

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

DANAK
CAL Reg.nr. 307

CERTIFICATE OF CALIBRATION

No: C1109753

CALIBRATION OF

Sound Level Meter:	Brüel & Kjær Type 3050-A-040	No: 3050-100751	Id: -
Microphone:	Brüel & Kjær Type 4189	No: 2621142	
Preamplifier:	Brüel & Kjær Type 2669	No: 2679073	
Supplied Calibrator:	None		
Software version:	LabShop 16.1.0.84	Pattern Approval:	PENDING
Instruction manual:	BE-1631		

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: *See actual values in **Environmental conditions** sections.*

SPECIFICATIONS

The Sound Level Meter Brüel & Kjær Type 3050-A-040 has been calibrated in accordance with the requirements as specified in IEC61672-1:2002 class 1. Procedures from IEC 61672-3:2006 were used to perform the periodic tests. The accreditation assures the traceability to the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System 3630 with application software type 7763 (version 4.5 - DB: 4.50) by using procedure LAN-XI 4189.

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: 2011-12-09

Date of issue: 2011-12-12

Steen Vodstrup Andersen
Calibration Technician

Henning Ploug
Approved Signatory

1. Calibration Note

n/a

2. Summary

4.1. Preliminary inspection	Passed
4.2. Environmental conditions, Prior to calibration	Passed
4.3. Channel information	Passed
4.4. Reference information	Passed
4.5. Indication at the calibration check frequency	Passed
4.6. Self-generated noise, Microphone installed	Passed
4.7. Acoustical signal tests of a frequency weighting, C weighting	Passed
4.8. Self-generated noise, Electrical	Passed
4.9. Electrical signal tests of frequency weightings, A weighting	Passed
4.10. Electrical signal tests of frequency weightings, C weighting	Passed
4.11. Electrical signal tests of frequency weightings, Z weighting	Passed
4.12. Frequency and time weightings at 1 kHz	Passed
4.13. Level linearity on the reference level range, Upper	Passed
4.14. Level linearity on the reference level range, Lower	Passed
4.15. Toneburst response, Time-weighting Fast	Passed
4.16. Toneburst response, Time-weighting Slow	Passed
4.17. Toneburst response, Leq	Passed
4.18. Peak C sound level, 8 kHz	Passed
4.19. Peak C sound level, 500 Hz	Passed
4.20. Overload indication	Passed
4.21. Environmental conditions, Following calibration	Passed

The sound level meter submitted for periodic testing successfully completed the class 1 tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed.
However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2002 because evidence was not publicly available, from an independent testing organization responsible pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002 and because the periodic test of IEC 61672-3:2006 cover only a limited subset of the specifications in IEC 61672-1:2002.

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3. Instruments

	Instrument	Inventory No.
Adaptor	Brüel & Kjær, Type WA-0302-B 15 pF	150503006
Generator	Brüel & Kjær, Type 3560	123560013
Voltmeter	Agilent, Type 34970A	142101015
AmplifierDivider	Brüel & Kjær, Type 3111	123111003
Calibrator	Brüel & Kjær, Type 4226	124226018

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4. Measurements

4.1. Preliminary inspection

Visually inspect instrument, and operate all relevant controls. (section 5)

Routine Passed

4.2. Environmental conditions, Prior to calibration

Actual environmental conditions prior to calibration. (section 7)

	Measured	
	[Deg C/ kPa / %RH]	
Air temperature	23.20	
Air pressure	98.33	
Relative humidity	47.00	

4.3. Channel information

Number of channel being calibrated.

Signal number	1	
Channel information	0	

4.4. Reference information

Information about reference range, level and channel. (section 19.h + 19.m)

	Value	
	[dB]	
Reference sound pressure level	94	
Reference level range	135	
Channel number	0	

4.5. Indication at the calibration check frequency

Measure and adjust sound level meter using the supplied calibrator. (section 9 + 19.m)

	Measured	Uncertainty	
	[dB / Hz]	[dB / Hz]	
Initial indication (in-house calibrator)	93.55	0.20	
Calibration check frequency (in-house calibrator)	1000.00	1.00	
Adjusted indication (in-house calibrator)	94.21	0.20	

4.6. Self-generated noise, Microphone installed

Self-generated noise measured with microphone submitted for periodic testing. Averaging time is 30 seconds. An anechoic chamber is used to isolate environmental noise. (section 10.1)

	Max	Measured	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	
A weighted	17.20	15.86	-1.34	1.00	
Monitor Level	20.20	12.10	-8.10	1.00	

4.7. Acoustical signal tests of a frequency weighting, C weighting

Frequency weightings measured acoustically with a calibrated multi-frequency sound calibrator. Averaging time is 10 seconds, and the result is the average of 2 measurements. (section 11)

	Coupler Pressure Lc	Mic. Correction C4226	Body Influence	Expected	Measured	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
1000Hz, Ref. (1st)	94.30	0.10	0.00	94.20	94.22	94.22	-1.1	1.1	0.02	0.20	
1000Hz, Ref. (2nd)	94.30	0.10	0.00	94.20	94.22	94.22	-1.1	1.1	0.02	0.20	
1000Hz, Ref. (Average)	94.30	0.10	0.00	94.20	94.22	94.22	-1.1	1.1	0.02	0.20	
125.89Hz (1st)	94.28	0.00	0.00	94.10	94.16	94.16	-1.5	1.5	0.06	0.20	
125.89Hz (2nd)	94.28	0.00	0.00	94.10	94.16	94.16	-1.5	1.5	0.06	0.20	
125.89Hz (Average)	94.28	0.00	0.00	94.10	94.16	94.16	-1.5	1.5	0.06	0.20	
3981.1Hz (1st)	94.23	0.90	0.00	92.55	92.40	92.40	-1.6	1.6	-0.15	0.30	
3981.1Hz (2nd)	94.23	0.90	0.00	92.55	92.40	92.40	-1.6	1.6	-0.15	0.30	
3981.1Hz (Average)	94.23	0.90	0.00	92.55	92.40	92.40	-1.6	1.6	-0.15	0.30	
7943.3Hz (1st)	93.98	2.80	0.00	88.20	87.72	87.72	-3.1	2.1	-0.48	0.40	
7943.3Hz (2nd)	93.98	2.80	0.00	88.20	87.72	87.72	-3.1	2.1	-0.48	0.40	
7943.3Hz (Average)	93.98	2.80	0.00	88.20	87.72	87.72	-3.1	2.1	-0.48	0.40	

4.8. Self-generated noise, Electrical

Self-generated noise measured in most sensitive range, with electrical substitution for microphone, according to manufactures specifications.

Exceedance of the measured level above the corresponding level given in the instruction manual does not, by itself, mean that the performance of the sound level meter is no longer acceptable for many practical applications. (section 10.2)

	Max	Measured	Uncertainty	
	[dB]	[dB]	[dB]	
A weighted	13.20	9.75	0.30	
C weighted	20.60	11.93	0.30	
Z weighted	20.60	15.53	0.30	

4.9. Electrical signal tests of frequency weightings, A weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (section 12)

	Input Level	Expected	Measured	Acoustical Resp.	Body Influence	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dBV]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
1000Hz, Ref.	-30.12	90.00	90.00	0.00	0.00	90.00	-1.1	1.1	0.00	0.12	
63.096Hz	-3.92	90.00	90.05	0.00	0.00	90.05	-1.5	1.5	0.05	0.12	
125.89Hz	-14.02	90.00	90.02	0.00	0.00	90.02	-1.5	1.5	0.02	0.12	
251.19Hz	-21.52	90.00	89.98	0.00	0.00	89.98	-1.4	1.4	-0.02	0.12	
501.19Hz	-26.92	90.00	89.98	0.00	0.00	89.98	-1.4	1.4	-0.02	0.12	
1995.3Hz	-31.32	90.00	90.01	0.00	0.00	90.01	-1.6	1.6	0.01	0.12	
3981.1Hz	-31.12	90.00	89.95	0.00	0.00	89.95	-1.6	1.6	-0.05	0.12	
7943.3Hz	-29.02	90.00	89.96	0.00	0.00	89.96	-3.1	2.1	-0.04	0.12	
15849Hz	-23.52	90.00	89.99	0.00	0.00	89.99	-17.0	3.5	-0.01	0.12	

4.10. Electrical signal tests of frequency weightings, C weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (section 12)

	Input Level	Expected	Measured	Acoustical Resp.	Body Influence	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dBV]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
1000Hz, Ref.	-30.12	90.00	90.00	0.00	0.00	90.00	-1.1	1.1	0.00	0.12	
63.096Hz	-29.32	90.00	90.01	0.00	0.00	90.01	-1.5	1.5	0.01	0.12	
125.89Hz	-29.92	90.00	90.03	0.00	0.00	90.03	-1.5	1.5	0.03	0.12	
251.19Hz	-30.12	90.00	89.99	0.00	0.00	89.99	-1.4	1.4	-0.01	0.12	
501.19Hz	-30.12	90.00	90.03	0.00	0.00	90.03	-1.4	1.4	0.03	0.12	
1995.3Hz	-29.92	90.00	90.03	0.00	0.00	90.03	-1.6	1.6	0.03	0.12	
3981.1Hz	-29.32	90.00	89.96	0.00	0.00	89.96	-1.6	1.6	-0.04	0.12	
7943.3Hz	-27.12	90.00	89.96	0.00	0.00	89.96	-3.1	2.1	-0.04	0.12	
15849Hz	-21.62	90.00	89.96	0.00	0.00	89.96	-17.0	3.5	-0.04	0.12	

4.11. Electrical signal tests of frequency weightings, Z weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (section 12)

	Input Level	Expected	Measured	Acoustical Resp.	Body Influence	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dBV]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
1000Hz, Ref.	-30.12	90.00	90.00	0.00	0.00	90.00	-1.1	1.1	0.00	0.12	
63.096Hz	-30.12	90.00	89.99	0.00	0.00	89.99	-1.5	1.5	-0.01	0.12	
125.89Hz	-30.12	90.00	89.99	0.00	0.00	89.99	-1.5	1.5	-0.01	0.12	
251.19Hz	-30.12	90.00	89.99	0.00	0.00	89.99	-1.4	1.4	-0.01	0.12	
501.19Hz	-30.12	90.00	89.99	0.00	0.00	89.99	-1.4	1.4	-0.01	0.12	
1995.3Hz	-30.12	90.00	90.00	0.00	0.00	90.00	-1.6	1.6	0.00	0.12	
3981.1Hz	-30.12	90.00	89.98	0.00	0.00	89.98	-1.6	1.6	-0.02	0.12	
7943.3Hz	-30.12	90.00	89.97	0.00	0.00	89.97	-3.1	2.1	-0.03	0.12	
15849Hz	-30.12	90.00	89.98	0.00	0.00	89.98	-17.0	3.5	-0.02	0.12	

4.12. Frequency and time weightings at 1 kHz

Frequency and time weighting measured at 1 kHz with electrical signal in reference range. Measured relative to A-weighted and Fast response. (section 13)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
LAF, Ref.	94.00	94.00	-0.4	0.4	0.00	0.12	
LCF	94.00	93.99	-0.4	0.4	-0.01	0.12	
LZF	94.00	93.99	-0.4	0.4	-0.01	0.12	
LAS	94.00	93.99	-0.4	0.4	-0.01	0.12	
LAeq	94.00	93.98	-0.4	0.4	-0.02	0.12	

4.13. Level linearity on the reference level range, Upper

Level linearity in reference range, measured at 8 kHz until overload. (section 14)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
94 dB	94.00	94.00	-1.1	1.1	0.00	0.12	
99 dB	99.00	99.00	-1.1	1.1	0.00	0.12	
104 dB	104.00	104.00	-1.1	1.1	0.00	0.12	
109 dB	109.00	109.00	-1.1	1.1	0.00	0.12	
114 dB	114.00	114.01	-1.1	1.1	0.01	0.12	
119 dB	119.00	119.01	-1.1	1.1	0.01	0.12	
124 dB	124.00	124.01	-1.1	1.1	0.01	0.12	
129 dB	129.00	129.02	-1.1	1.1	0.02	0.12	
130 dB	130.00	130.02	-1.1	1.1	0.02	0.12	
131 dB	131.00	131.02	-1.1	1.1	0.02	0.12	
132 dB	132.00	132.02	-1.1	1.1	0.02	0.12	
133 dB	133.00	133.02	-1.1	1.1	0.02	0.12	
134 dB	134.00	134.02	-1.1	1.1	0.02	0.12	
135 dB	135.00	135.02	-1.1	1.1	0.02	0.12	
136 dB	136.00	136.01	-1.1	1.1	0.01	0.12	

4.14. Level linearity on the reference level range, Lower

Level linearity in reference range, measured at 8 kHz down to lower limit, or until underrange. (section 14)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
94 dB	94.00	94.00	-1.1	1.1	0.00	0.12	
89 dB	89.00	88.99	-1.1	1.1	-0.01	0.12	
84 dB	84.00	83.98	-1.1	1.1	-0.02	0.12	
79 dB	79.00	78.94	-1.1	1.1	-0.06	0.12	
74 dB	74.00	73.94	-1.1	1.1	-0.06	0.12	
69 dB	69.00	68.94	-1.1	1.1	-0.06	0.12	
64 dB	64.00	63.94	-1.1	1.1	-0.06	0.12	
59 dB	59.00	58.94	-1.1	1.1	-0.06	0.12	
54 dB	54.00	53.94	-1.1	1.1	-0.06	0.12	
49 dB	49.00	48.94	-1.1	1.1	-0.06	0.12	
44 dB	44.00	43.92	-1.1	1.1	-0.08	0.12	
39 dB	39.00	38.93	-1.1	1.1	-0.07	0.30	
35 dB	35.00	34.94	-1.1	1.1	-0.06	0.30	
34 dB	34.00	33.95	-1.1	1.1	-0.05	0.30	
33 dB	33.00	32.95	-1.1	1.1	-0.05	0.30	
32 dB	32.00	31.96	-1.1	1.1	-0.04	0.30	
31 dB	31.00	30.97	-1.1	1.1	-0.03	0.30	
30 dB	30.00	29.97	-1.1	1.1	-0.03	0.30	

4.15. Toneburst response, Time-weighting Fast

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (section 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
Continuous, Ref.	133.00	133.00	-0.8	0.8	0.00	0.11	
200 ms Burst	132.00	132.01	-0.8	0.8	0.01	0.11	
2 ms Burst	115.00	114.96	-1.8	1.3	-0.04	0.11	
0.25 ms Burst	106.00	105.89	-3.3	1.3	-0.11	0.11	

4.16. Toneburst response, Time-weighting Slow

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (section 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
Continuous, Ref.	133.00	133.00	-0.8	0.8	0.00	0.11	
200 ms Burst	125.60	125.58	-0.8	0.8	-0.02	0.11	
2 ms Burst	106.00	105.97	-3.3	1.3	-0.03	0.11	

4.17. Toneburst response, Leq

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (section 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
Continuous, Ref.	133.00	133.00	-0.8	0.8	0.00	0.11	
200 ms Burst	116.00	116.01	-0.8	0.8	0.01	0.11	
2 ms Burst	96.00	95.98	-1.8	1.3	-0.02	0.11	
0.25 ms Burst	87.00	86.88	-3.3	1.3	-0.12	0.11	

4.18. Peak C sound level, 8 kHz

Peak-response to a 8 kHz single- cycle sine measured in least-sensitive range, relative to continuous signal. (section 17)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
Continuous, Ref.	130.00	130.00	-0.4	0.4	0.00	0.11	
Single Sine	133.40	134.47	-2.4	2.4	1.07	0.40	

4.19. Peak C sound level, 500 Hz

Peak-response to a 500 Hz half-cycle sine measured in least-sensitive range, relative to continuous signal. (section 17)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	
Continuous, Ref.	130.00	130.00	-0.4	0.4	0.00	0.11	
Half-sine, Positive	132.40	131.93	-1.4	1.4	-0.47	0.40	
Half-sine, Negative	132.40	131.93	-1.4	1.4	-0.47	0.40	

4.20. Overload indication

Overload indication in the least sensitive range determined with a 4 kHz positive/negative half-cycle signal. (section 18)

	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dB]	[dB]	[dB]	[dB]	[dB]	
Continuous	135.00	-0.4	0.4	0.00	0.20	
Half-sine, Positive	138.40	-10.0	10.0	3.40	0.20	
Half-sine, Negative	138.40	-10.0	10.0	3.40	0.20	
Difference	138.40	-1.8	1.8	0.00	0.30	

4.21. Environmental conditions, Following calibration

Actual environmental conditions following calibration. (section 7)

	Measured	
	[Deg C/ kPa / %RH]	
Air temperature	23.00	
Air pressure	98.40	
Relative humidity	47.00	

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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.