

CERTIFICATE OF CALIBRATION

No: C1009512

Page 1 of 10

CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	LAN-XI	No: 3050-100751
Microphone:	Brüel & Kjær	4189	No: 2621142
Preamplifier:	Brüel & Kjær	2669	No: 2679073
Supplied Calibrator:	Brüel & Kjær	None	No: None
Software version:	LabShop 15.1.0.15	Instruction manual:	BE-1631
Date of receipt:	2010-11-11	Identification:	
Pattern Approval:	PENDING		

CUSTOMER:

Brüel & Kjær Denmark Sound & Vibration 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 has been calibrated in accordance with the requirements as specified in IEC61672-3:2006 class 1. Procedures from IEC 61672-3:2006 were used to perform the periodic tests.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 (version 4.3 - DB: 4.33) and test collection LAN-XI 4189

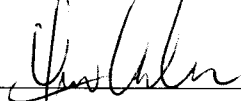
RESULTS:

	Initial calibration		Calibration prior to repair/adjustment
X	Calibration without repair/adjustment		Calibration after repair/adjustment

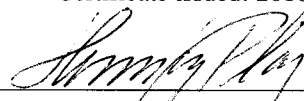
The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method,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

Date of Calibration: 2010-11-11

Certificate issued: 2010-11-11



Steen Andersen
 Calibration Technician



Henning Ploug
 Approved signatory

Summary

Preliminary inspection	Passed
Environmental conditions, Prior to calibration	Passed
Channel information	Passed
Reference information	Passed
Indication at the calibration check frequency	Passed
Self-generated noise, Microphone installed	Passed
Acoustical signal tests of a frequency weighting, C weighting	Passed
Self-generated noise, Electrical	Passed
Electrical signal tests of frequency weightings, A weighting	Passed
Electrical signal tests of frequency weightings, C weighting	Passed
Electrical signal tests of frequency weightings, Z weighting	Passed
Frequency and time weightings at 1 kHz	Passed
Level linearity on the reference level range, Upper	Passed
Level linearity on the reference level range, Lower	Passed
Toneburst response, Time-weighting Fast	Passed
Toneburst response, Time-weighting Slow	Passed
Toneburst response, Leq	Passed
Peak C sound level, 8 kHz	Passed
Peak C sound level, 500 Hz	Passed
Overload indication	Passed
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 for 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.

Instruments

<u>Category:</u>	<u>Type:</u>	<u>Manufacturer:</u>	<u>Serial No.:</u>
Generator	Pulse Generator	Brüel & Kjær	2415705
Voltmeter	DMM34970A	Agilent	MY41020547
Amplifier/Divider	3111 Output Module	Brüel & Kjær	2399410
Calibrator	4226	Brüel & Kjær	2305104
Adaptor	WA0302B, 15 pF	Brüel & Kjær	2456481

Preliminary inspection

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

Environmental conditions, Prior to calibration

Actual environmental conditions prior to calibration. (section 7)

	Measured
	[Deg C/ kPa / %RH]
Air temperature	22.30
Air pressure	99.40
Relative humidity	51.00

Channel information

Number of channel being calibrated.

Signal number	1
Channel information	0

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

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)	93.42	0.20
Calibration check frequency (in-house calibrator)	1000.00	1.00
Adjusted indication (in-house calibrator)	94.15	0.20

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 [dB]	Measured [dB]	Deviation [dB]	Uncertainty [dB]
A weighted	17.20	16.39	-0.81	0.30
Monitor Level	20.20	12.70	-7.50	0.30

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 [dB]	Mic. Correction C4226 [dB]	Body Influence [dB]	Expected [dB]	Measured [dB]	Corr. Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref. (1st)	94.23	0.10	0.00	94.13	94.18	94.18	-1.1	1.1	0.05	0.20
1000Hz, Ref. (2nd)	94.23	0.10	0.00	94.13	94.16	94.16	-1.1	1.1	0.03	0.20
1000Hz, Ref. (Average)	94.23	0.10	0.00	94.13	94.17	94.17	-1.1	1.1	0.04	0.20
125.89Hz (1st)	94.26	0.00	0.00	94.10	94.14	94.14	-1.5	1.5	0.04	0.20
125.89Hz (2nd)	94.26	0.00	0.00	94.10	94.14	94.14	-1.5	1.5	0.04	0.20
125.89Hz (Average)	94.26	0.00	0.00	94.10	94.14	94.14	-1.5	1.5	0.04	0.20
3981.1Hz (1st)	94.17	0.90	0.00	92.51	92.41	92.41	-1.6	1.6	-0.10	0.30
3981.1Hz (2nd)	94.17	0.90	0.00	92.51	92.41	92.41	-1.6	1.6	-0.10	0.30
3981.1Hz (Average)	94.17	0.90	0.00	92.51	92.41	92.41	-1.6	1.6	-0.10	0.30
7943.3Hz (1st)	93.96	2.80	0.00	88.20	87.64	87.64	-3.1	2.1	-0.56	0.40
7943.3Hz (2nd)	93.96	2.80	0.00	88.20	87.64	87.64	-3.1	2.1	-0.56	0.40
7943.3Hz (Average)	93.96	2.80	0.00	88.20	87.64	87.64	-3.1	2.1	-0.56	0.40

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 applicatis. (section 10.2)

	Max [dB]	Measured [dB]	Uncertainty [dB]
A weighted	13.20	9.88	0.30
C weighted	20.60	11.98	0.30
Z weighted	20.60	15.56	0.30

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 [dBV]	Expected [dB]	Measured [dB]	Acoustical Resp. [dB]	Body Influence [dB]	Corr. Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref.	-30.20	90.00	90.00	0.00	0.00	90.00	-1.1	1.1	0.00	0.12
63.096Hz	-4.00	90.00	90.04	0.00	0.00	90.04	-1.5	1.5	0.04	0.12
125.89Hz	-14.10	90.00	90.00	0.00	0.00	90.00	-1.5	1.5	0.00	0.12
251.19Hz	-21.60	90.00	89.97	0.00	0.00	89.97	-1.4	1.4	-0.03	0.12
501.19Hz	-27.00	90.00	89.96	0.00	0.00	89.96	-1.4	1.4	-0.04	0.12
1995.3Hz	-31.40	90.00	90.00	0.00	0.00	90.00	-1.6	1.6	0.00	0.12
3981.1Hz	-31.20	90.00	89.95	0.00	0.00	89.95	-1.6	1.6	-0.05	0.12
7943.3Hz	-29.10	90.00	89.96	0.00	0.00	89.96	-3.1	2.1	-0.04	0.12
15849Hz	-23.60	90.00	89.98	0.00	0.00	89.98	-17.0	3.5	-0.02	0.12

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 [dBV]	Expected [dB]	Measured [dB]	Acoustical Resp. [dB]	Body Influence [dB]	Corr. Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
1000Hz, Ref.	-30.20	90.00	90.00	0.00	0.00	90.00	-1.1	1.1	0.00	0.12
63.096Hz	-29.40	90.00	90.00	0.00	0.00	90.00	-1.5	1.5	0.00	0.12
125.89Hz	-30.00	90.00	90.03	0.00	0.00	90.03	-1.5	1.5	0.03	0.12
251.19Hz	-30.20	90.00	90.00	0.00	0.00	90.00	-1.4	1.4	0.00	0.12
501.19Hz	-30.20	90.00	90.03	0.00	0.00	90.03	-1.4	1.4	0.03	0.12
1995.3Hz	-30.00	90.00	90.03	0.00	0.00	90.03	-1.6	1.6	0.03	0.12
3981.1Hz	-29.40	90.00	89.96	0.00	0.00	89.96	-1.6	1.6	-0.04	0.12
7943.3Hz	-27.20	90.00	89.96	0.00	0.00	89.96	-3.1	2.1	-0.04	0.12
15849Hz	-21.70	90.00	89.94	0.00	0.00	89.94	-17.0	3.5	-0.06	0.12

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.	-30.20	90.00	90.00	0.00	0.00	90.00	-1.1	1.1	0.00	0.12
63.096Hz	-30.20	90.00	89.99	0.00	0.00	89.99	-1.5	1.5	-0.01	0.12
125.89Hz	-30.20	90.00	89.99	0.00	0.00	89.99	-1.5	1.5	-0.01	0.12
251.19Hz	-30.20	90.00	89.99	0.00	0.00	89.99	-1.4	1.4	-0.01	0.12
501.19Hz	-30.20	90.00	90.00	0.00	0.00	90.00	-1.4	1.4	0.00	0.12
1995.3Hz	-30.20	90.00	90.00	0.00	0.00	90.00	-1.6	1.6	0.00	0.12
3981.1Hz	-30.20	90.00	89.98	0.00	0.00	89.98	-1.6	1.6	-0.02	0.12
7943.3Hz	-30.20	90.00	89.97	0.00	0.00	89.97	-3.1	2.1	-0.03	0.12
15849Hz	-30.20	90.00	89.98	0.00	0.00	89.98	-17.0	3.5	-0.02	0.12

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	94.00	-0.4	0.4	0.00	0.12
LZF	94.00	94.00	-0.4	0.4	0.00	0.12
LAS	94.00	94.00	-0.4	0.4	0.00	0.12
LAeq	94.00	94.00	-0.4	0.4	0.00	0.12

Level linearity on the reference level range, Upper

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

	Expected [dB]	Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [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	114.02	-1.1	1.1	0.02	0.12
119 dB	119.00	119.02	-1.1	1.1	0.02	0.12
124 dB	124.00	124.02	-1.1	1.1	0.02	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	136.02	-1.1	1.1	0.02	0.12

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 [dB]	Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [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	83.99	-1.1	1.1	-0.01	0.12
79 dB	79.00	78.95	-1.1	1.1	-0.05	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	58.95	-1.1	1.1	-0.05	0.12
54 dB	54.00	53.95	-1.1	1.1	-0.05	0.12
49 dB	49.00	48.95	-1.1	1.1	-0.05	0.12
44 dB	44.00	43.93	-1.1	1.1	-0.07	0.12
39 dB	39.00	38.94	-1.1	1.1	-0.06	0.30
35 dB	35.00	34.95	-1.1	1.1	-0.05	0.30
34 dB	34.00	33.96	-1.1	1.1	-0.04	0.30
33 dB	33.00	32.95	-1.1	1.1	-0.05	0.30
32 dB	32.00	31.98	-1.1	1.1	-0.02	0.30
31 dB	31.00	30.98	-1.1	1.1	-0.02	0.30
30 dB	30.00	30.00	-1.1	1.1	0.00	0.30

Toneburst response, Time-weighting Fast

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

	Expected [dB]	Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [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	105.86	-3.3	1.3	-0.14	0.11

Toneburst response, Time-weighting Slow

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

	Expected [dB]	Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [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

Toneburst response, Leq

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

	Expected [dB]	Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [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

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 [dB]	Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [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

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 [dB]	Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [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

Overload indication

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

	Measured [dB]	Accept - Limit [dB]	Accept + Limit [dB]	Deviation [dB]	Uncertainty [dB]
Continuous	135.00	-0.4	0.4	0.00	0.20
Half-sine, Positive	138.50	-10.0	10.0	3.50	0.20
Half-sine, Negative	138.50	-10.0	10.0	3.50	0.20
Difference	138.50	-1.8	1.8	0.00	0.30

Environmental conditions, Following calibration

Actual environmental conditions following calibration. (section 7)

	Measured [Deg C/ kPa / %RH]
Air temperature	22.10
Air pressure	99.30
Relative humidity	51.00

DANAK (Danish Accreditation)

DANAK was established in 1991 in pursuance of the Danish Act No. 394 of 13 June 1990 on the promotion of Trade and Industry.

The requirements to be met by accredited laboratories are laid down in the "Danish Agency for Trade and Industry's" ("Erhvervsfremme Styrelsen's") Statutory Order on accreditation of laboratories to perform testing etc., and GLP-inspection. The statutory order refers to other documents where the criteria for accreditation are specified further.

The standards DS/EN ISO/IEC 17025 "General requirements for the competence of testing and calibration laboratories" and DS/EN 45002 "General criteria for the assessment of testing laboratories" describes fundamental criteria for accreditation. 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, DANAK draws up Technical Regulations 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 not subject to any commercial, financial or other pressures, which might influence their technical judgment,
- that the laboratory operates a documented quality system,
- 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 management and personnel have technical competence and practical experience in performing the service that they are accredited to perform,
- that the laboratory has procedures for traceability and uncertainty calculations,
- that accredited testing or calibration is performed in accordance with fully validated and documented methods,
- that the laboratory keeps records which contain sufficient information to permit repetition of the accredited test or calibration,
- that the laboratory is subject to surveillance by DANAK on a regular basis,
- that the laboratory shall take out an insurance, which covers liability in connection with the performance of accredited services.

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