Appendix 10A: Calibration Certificates

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **19 August 2019** CERTIFICATE NUMBER **131752**

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Approved signatory
H.Sykes
Electronically signed:
H Sykes

Sound Calibrator : IEC 60942:2003

Instrument information

Manufacturer: Pulsar Instruments **Model:** Model 105

Serial number: 50719 **Class:** 1

Test summary

Date of calibration: 19 August 2019

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC 60942:2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC 60942:2003 Annex A to Class 1. This has been confirmed with the PhysikalischTechnische Bundesanstalt (PTB).

As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the Class 1 requirements of IEC 60942:2003.

CERTIFICATE OF CALIBRATION

Certificate Number: **131752**

Environmental conditions

The following conditions were recorded at the time of the test:

Pressure: 100.25 kPa
Temperature: 23.8 °C
Humidity: 48.7 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Acoustic Calibrator	Bruel and Kjaer	4231	2610257
Distortion Meter	Keithley	2015	1046217
Multimeter	Fluke	8845A	9708001

Initial Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Limits	Uncertainty
Level (dB)	94.00	93.91	93.88	93.87	**93.89**	-0.11	±0.40	0.11 dB
Distortion (%)	< 3.00	0.45	0.39	0.48	**0.44**	0.44	+3.00	1.00 %
Frequency (Hz)	1000.0	1000.1	1000.1	1000.1	**1000.1**	0.1	±10.0	0.1 Hz

The measured quantities or deviations (as applicable), extended by the expanded combined uncertainty of measurement, must not exceed the corresponding tolerance.

Adjusted Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Limits	Uncertainty
Level (dB)	94.00	94.00	94.02	94.02	**94.01**	0.01	±0.40	0.11 dB
Distortion (%)	< 3.00	0.42	0.49	0.48	**0.46**	0.46	+3.00	1.00 %
Frequency (Hz)	1000.0	1000.1	1000.1	1000.1	**1000.1**	0.1	±10.0	0.1 Hz

End of results

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **20 August 2019** CERTIFICATE NUMBER **131799**

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Approved signatory
S.Doveton
Electronically signed:

Sound Calibrator : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc **Model:** CR:515

Serial number: 60601 **Class:** 1

Test summary

Date of calibration: 20 August 2019

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC 60942:2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC 60942:2003 Annex A to Class 1. This has been confirmed with the PhysikalischTechnische Bundesanstalt (PTB).

As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the Class 1 requirements of IEC 60942:2003.

CERTIFICATE OF CALIBRATION

Certificate Number: **131799**

Environmental conditions

The following conditions were recorded at the time of the test:

Pressure: 101.15 kPa
Temperature: 23.6 °C
Humidity: 51.0 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Acoustic Calibrator	Bruel and Kjaer	4231	2610257
Distortion Meter	Keithley	2015	1046217
Multimeter	Fluke	8845A	9708001

Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Limits	Uncertainty
Level (dB)	94.00	93.86	93.86	93.87	**93.86**	-0.14	±0.40	0.11 dB
Distortion (%)	< 3.00	0.19	0.18	0.19	**0.19**	0.19	+3.00	1.00 %
Frequency (Hz)	1000.0	1000.3	1000.3	1000.3	**1000.3**	0.3	±10.0	0.1 Hz

The measured quantities or deviations (as applicable), extended by the expanded combined uncertainty of measurement, must not exceed the corresponding tolerance.

End of results

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research Plc
Instrument Type	CR:171C
Description	Sound Level Meter
Serial Number	G061732

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	GRAS 40AP	Serial Number	173198	Calibration Ref.	0170
Calibrator Type	B&K 4231	Serial Number	2564324	Calibration Ref.	A1914
Calibrator Type	B&K 4231	Serial Number	2564325	Calibration Ref.	A1915
Calibrator Type	B&K 4231	Serial Number	2594796	Calibration Ref.	A1916

Calibrated by

Calibration Date 20 August 2019
Calibration Certificate Number 273715

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
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Email: sales@cirrusresearch.co.uk

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **20/08/19** CERTIFICATE NUMBER **131797**

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Test engineer:
D.Swalwell
Electronically signed:

Microphone

Microphone capsule

Manufacturer: Cirrus Research plc

Model: MK:224

Serial Number: 211910D

Calibration procedure

Date of calibration: 19 August 2019

Open circuit: 53.9 mV/Pa

Sensitivity at 1 kHz: -25.4 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 100.00 kPa

Temperature: 22.0 °C

Humidity: 48.0 %

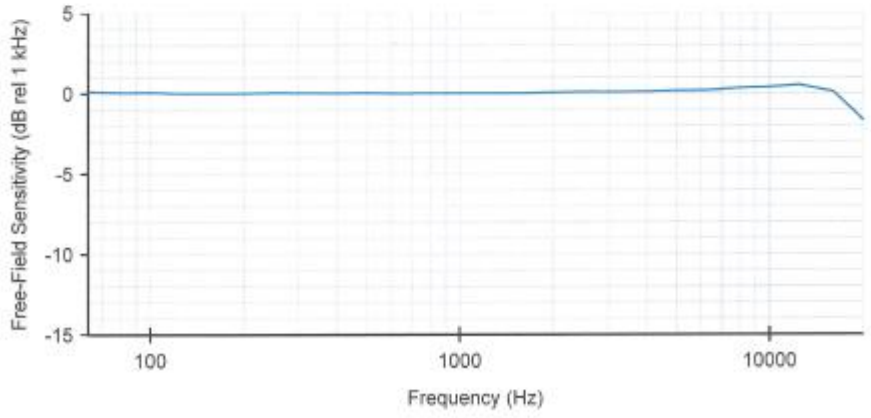
CERTIFICATE OF CALIBRATION

Certificate Number: 131797

Free-Field Frequency Response : Tabular

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
63	0.11	-0.06
80	0.03	-0.02
100	0.06	0.06
125	0.00	0.03
160	-0.01	0.05
200	-0.01	0.05
250	0.04	0.06
315	0.02	0.05
400	0.01	0.05
500	0.02	0.04
630	0.00	0.03
800	0.01	0.02
1 000	0.00	0.00
1 250	0.01	-0.02
1 600	0.01	-0.08
2 000	0.06	-0.14
2 500	0.08	-0.25
3 150	0.07	-0.46
4 000	0.09	-0.72
5 000	0.16	-1.15
6 300	0.17	-1.80
8 000	0.31	-2.79
10 000	0.38	-4.33
12 500	0.51	-6.05
16 000	0.08	-7.68
20 000	-1.70	-10.70

Free-Field Frequency Response : Graphical



Outdoor Kit Calibration Information

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Job Referance Number	51041
Instrument Manufacturer	Cirrus Research Plc
Instrument Type	CR:171C
Description	Sound Level Meter
Serial Number	G061732
Outdoor Microphone Type	MK:170
Outdoor Microphone/Preamplifier Serial Number	0281
Primary Calibration Certificate Number	273715
Date of calibration	20th August 2019
Engineer	Shane Doveton

This information is in addition to the primary calibration certificate for the sound level meter. The calibration certificate number is shown above and should be use in conjunction with this additional information.

The sound level meter detailed above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the standards to which the instrument has been designed.

All calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

The microphone capsule was calibrated using an electrostatic calibration system to produce the frequency response and a reference acoustic source for the final sensitivity testing.

In addition to the calibration of the complete sound level meter in its standard configuration, (instrument, MV:200 series preamplifier and microphone capsule), the sound level meter and microphone capsule were tested with the MK:170 preamplifier in place of the MV:200 series.

The same tests electrical and acoustic tests were carried out in accordance with the relevant standards to confirm that the sound level meter, when used with the Outdoor Microphone/Preamplifier Type MK:170, provided the same performance.

The sound level meter, G061732 , has been tested with Outdoor Microphone/Preamplifier Type MK:170 Serial Number 0281 and conforms to the requirements of the standards stated in the instrument user manual.

Date of calibration	20th August 2019
Engineer	

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research Plc
Instrument Type	CR:171C
Description	Sound Level Meter
Serial Number	G061733

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	GRAS 40AP	Serial Number	173198	Calibration Ref.	0170
Calibrator Type	B&K 4231	Serial Number	2564324	Calibration Ref.	A1914
Calibrator Type	B&K 4231	Serial Number	2564325	Calibration Ref.	A1915
Calibrator Type	B&K 4231	Serial Number	2594796	Calibration Ref.	A1916

Calibrated by H Sykes

Calibration Date 19 August 2019
Calibration Certificate Number 273685

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CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **19/08/19** CERTIFICATE NUMBER **131751**

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Test engineer:
D.Swalwell
Electronically signed:

Microphone

Microphone capsule

Manufacturer: Cirrus Research plc

Model: MK:224

Serial Number: 606473B

Calibration procedure

Date of calibration: 14 August 2019

Open circuit: 46.1 mV/Pa

Sensitivity at 1 kHz: -26.7 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 100.50 kPa

Temperature: 21.0 °C

Humidity: 44.0 %

CERTIFICATE OF CALIBRATION

Certificate Number: **131751**

Free-Field Frequency Response : Tabular

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
63	0.02	-0.13
80	0.03	-0.01
100	0.20	0.23
125	0.01	0.07
160	0.02	0.09
200	0.00	0.08
250	0.09	0.13
315	0.06	0.10
400	0.03	0.08
500	0.02	0.07
630	0.00	0.06
800	0.02	0.04
1 000	0.00	0.02
1 250	0.00	-0.01
1 600	0.02	-0.06
2 000	0.04	-0.14
2 500	0.05	-0.26
3 150	0.06	-0.44
4 000	-0.02	-0.80
5 000	-0.11	-1.40
6 300	-0.44	-2.39
8 000	-0.96	-4.04
10 000	-1.74	-6.43
12 500	-1.91	-8.45
16 000	-2.97	-10.71
20 000	-4.80	-13.77

Free-Field Frequency Response : Graphical