# Project Erebus Environmental Statement Technical Appendix 22.1: Baseline Noise Survey

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|---|---|
| Client: | Blue Gem Wind Ltd |
| Project No: | 2923 |
| Version: | 1 |
| Date: | 2021-07-23 |

# Document Information

| | |
|---|---|
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| Reviewed: | Jonas Beaugas |
| Approved: | E Stella |
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## Revision History

| Version | Date | Authored | Reviewed | Approved | Notes |
|---|---|---|---|---|---|
| 1 | 2021-07-27 | Alasdair Baxter | Jonas Beaugas | E Stella | draft |
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# Technical Appendix 22.1 – Baseline Noise Survey

# 1. Introduction

In order to characterise the existing noise climate within the onshore development area, a baseline noise survey was undertaken. Sensitive receptor locations in the vicinity of the onshore development area were agreed with Pembrokeshire County Council (PCC). Figure 22.3 shows the onshore development area and the survey locations. Surveys were undertaken between 7th July and 21st July 2021.

A total of 5 sensitive receptor locations were agreed as part of consultation. This appendix to Chapter 22 Noise and Vibration details the baseline noise survey approach as well as quantifying the existing acoustic environment within the onshore development area.

Baseline survey measurements were conducted in accordance with current guidance, including British Standard (BS) 4142:2014+A1:2019 Method for Rating and Assessing Industrial and Commercial Sound and BS 7445:2003 Description and measurement of environmental noise and the methodology used was agreed with relevant stakeholders during consultation.

Sound level meters (SLM) were fully calibrated, traceable to UKAS standards and satisfied the requirements of BS EN 61672-1:2013 for a 'Class 1' Sound Level Meter (SLM). Calibration certificates are included in Section 3.

Measurements at landfall receptors were undertaken during favourable weather conditions, i.e. with windspeed <5m/s and no precipitation. Measurements at onshore substation receptors were undertaken over a two week period with concurrent weather measurements and the data filtered to remove adversely weather affected periods.

# 2. Survey Results

## 2.1 Landfall

The landfall study area encompasses the proposed landfall location, within an area at West Angle Beach.

Measurements were conducted at one receptor location, details of which are shown in Table A22.1 and on Figure 22.2. Short-term attended measurements were taken during the daytime (1 hour) and night time (30 minutes) reference periods.

*Table A22.1 – Baseline Noise Monitoring Location, Landfall Receptor*

| Receptor Identifier | Address (Nearest) | X | Y |
|---|---|---|---|
| **LFR1** | The Beach House, Angle | 185432 | 203182 |

Table A22.3.2 and Table A22.3.3 contains a summary of the measured baseline noise data at the sensitive receptor location within the landfall study area during both daytime and night time respectively.

*Table A22.2 – Baseline Noise Monitoring Location, Landfall Receptor*

| Receptor identifier | Period | Date | Start time | End Time | $L_{Aeq}$ | $L_{Amax}$ | $L_{A90}$ |
|---|---|---|---|---|---|---|---|
| **LFR1** | Daytime | 8th July 2021 | 10:17 | 11:17 | 43.5 | 68.2 | 36.8 |
| | Night-time | 8th July 2021 | 00:04 | 00:39 | 35.3 | 62.9 | 31.7 |

## 2.2 Cable Route Corridor

It was considered that classifying all cable route corridor receptors as falling under Category A of the ABC Method of BS5228:2009+A1:2014 represented the most conservative and precautionary approach to the construction noise assessment and that, therefore, conducting noise monitoring along the cable route corridor was not necessary. This approach was considered to be in accordance with the Proportionate Approach to Environmental Impact Assessment.

## 2.3 Onshore Substation Study Area

The onshore substation study area encompasses the proposed substation location, and the nearest sensitive receptors.

Measurements were conducted at four receptor locations, details of which are shown in Table A22.3 and on Figure 22.2. Short-term attended measurements were taken during the daytime (up to 60 minutes) and night time (up to 30 minutes) reference periods.

*Table A22.3 – Baseline Noise Monitoring Location, Substation Receptors*

| Receptor Identifier | Address (Nearest) | X | Y |
|---|---|---|---|
| **SSR1** | Lambeeth Farm, Pwllcrochan, | 193803 | 201663 |
| **SSR2** | Moreston Cottage, Goldborough Road, Hundleton, | 193607 | 200982 |
| **SSR3** | Goldborough Farm, Hundleton, | 193925 | 201030 |
| **SSR4** | Sunnyridge, Wallaston Five Cross, Hundleton, | 192369 | 201232 |

At the four substation receptor locations continuous logging equipment was installed for up to two weeks and unattended measurements were taken in fifteen minute reference interval periods. This approach ensured representative, repeatable background noise measurements were obtained of the existing soundscape and followed best practice in accordance with guidance contained within BS4142:2014+A1:2019.

Samples of $L_{A90}$ were cross referenced against weather data recorded on site (using a Lufft WS-600-UMB Compact Weather Station located at monitoring location SSR3) during the corresponding measurement period. All samples influenced by adverse weather conditions (representative environmental noise measurements should be undertaken during favourable weather conditions, i.e. with windspeed <5m/s and no precipitation) were considered unsuitable for noise monitoring due to noise interference and have been removed from the final results.

Statistical analysis (following guidance in BS4142:2014+A1:2019) methods have been applied to the resulting data sets in order to assess the background noise levels with a greater degree of scrutiny.

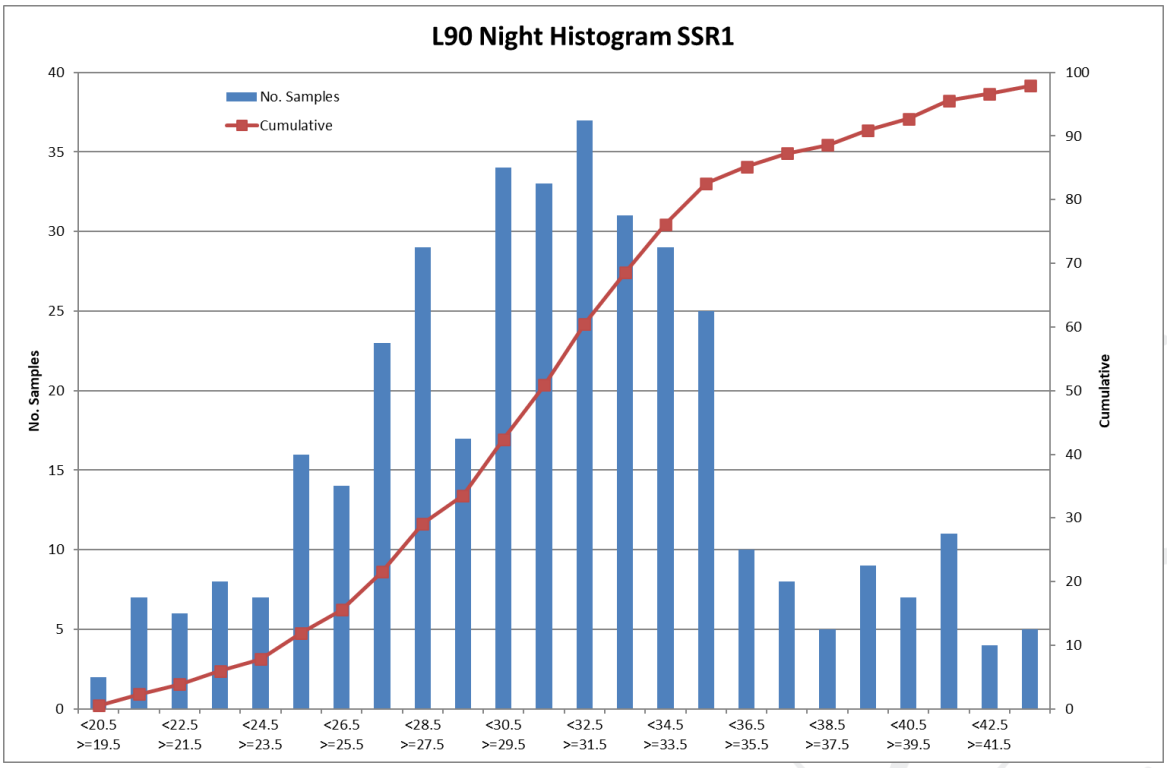
Tables A22.4 to A22.7 contain a summary of the long term measured baseline noise data within the onshore substation/national grid infrastructure study area at the four receptor locations during the night-time (night-time is considered to be the constraining period due to lower background noise levels than daytime).

Graphical outputs of the statistical analysis used for determining repeatable $L_{A90}$ (background) noise levels at each long term measurement location are included in Charts A22.1 to A22.4.

*Table A22.4 – Baseline Noise Data Analysis, SSR1*

| Period | Date | Average $L_{A90,15min}$ | Mode | Standard Deviation |
|---|---|---|---|---|
| Night-time | 8th to 21st July 2021 | 32 | 32 | 5.2 |

*Chart A22.1 – Baseline Noise Data Cumulative Distribution, SSR1*

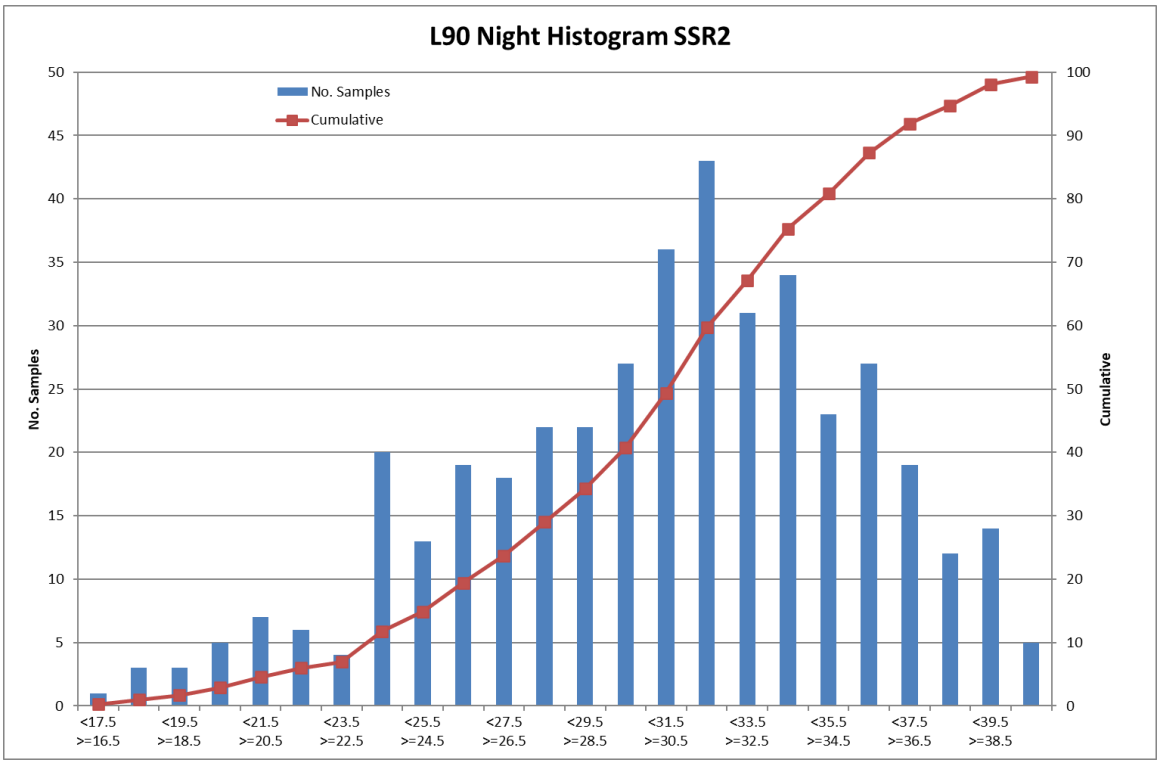


In the chart it can be seen that the data follows a reasonably standard normal distribution curve and that there is a clear modal value at 32 dB; this corresponds with the average (arithmetic mean) and this value was chosen as the representative $L_{A90}$.

*Table A22.5 – Baseline Noise Data Analysis, SSR2*

| Period | Date | Average $L_{A90,15min}$ | Mode | Standard Deviation |
|---|---|---|---|---|
| Night-time | 8th to 21st July 2021 | 31 | 32 | 4.9 |

*Chart A22.2 – Baseline Noise Data Cumulative Distribution, SSR2*

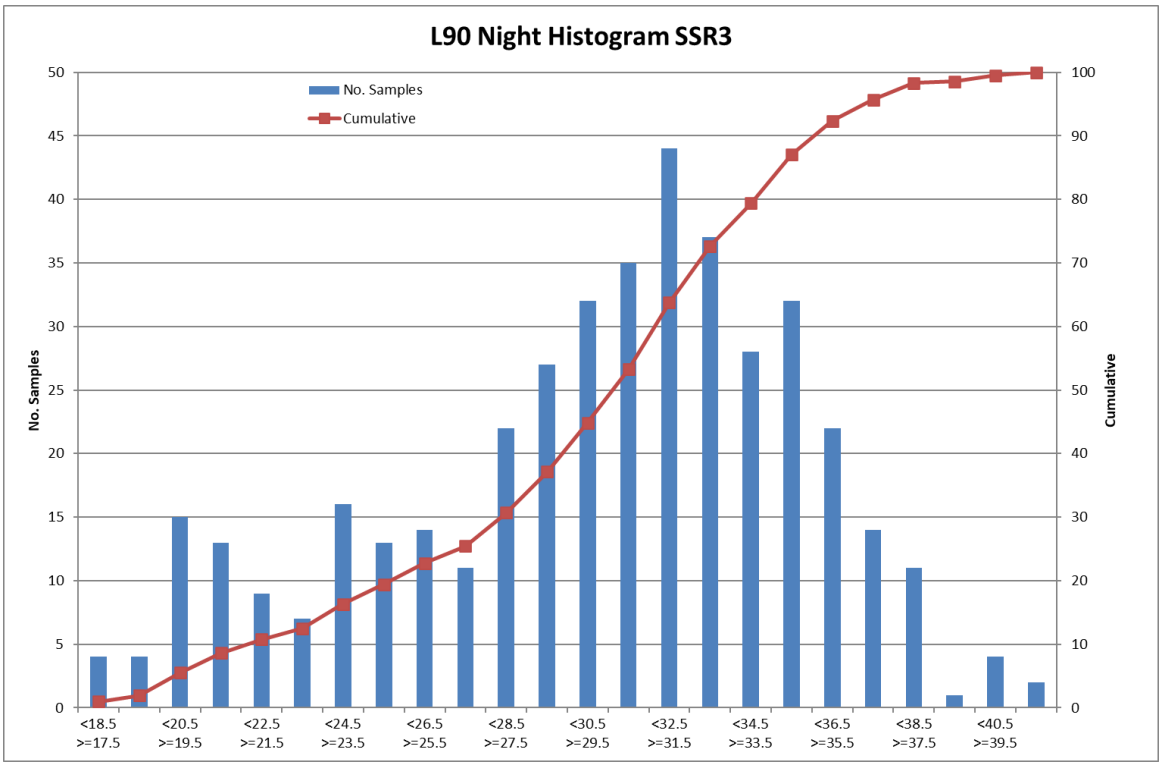



The chart shows a very clear modal peak at 32 dB and a relatively standard normal distribution. The modal value of 32 dB was therefore chosen as the representative $L_{A90}$.

*Table A22.6 – Baseline Noise Data Analysis, SSR1*

| Period | Date | Average $L_{A90,15min}$ | Mode | Standard Deviation |
|---|---|---|---|---|
| Night-time | 8th to 21st July 2021 | 30 | 32 | 7.0 |

*Chart A22.3 – Baseline Noise Data Cumulative Distribution, SSR1*

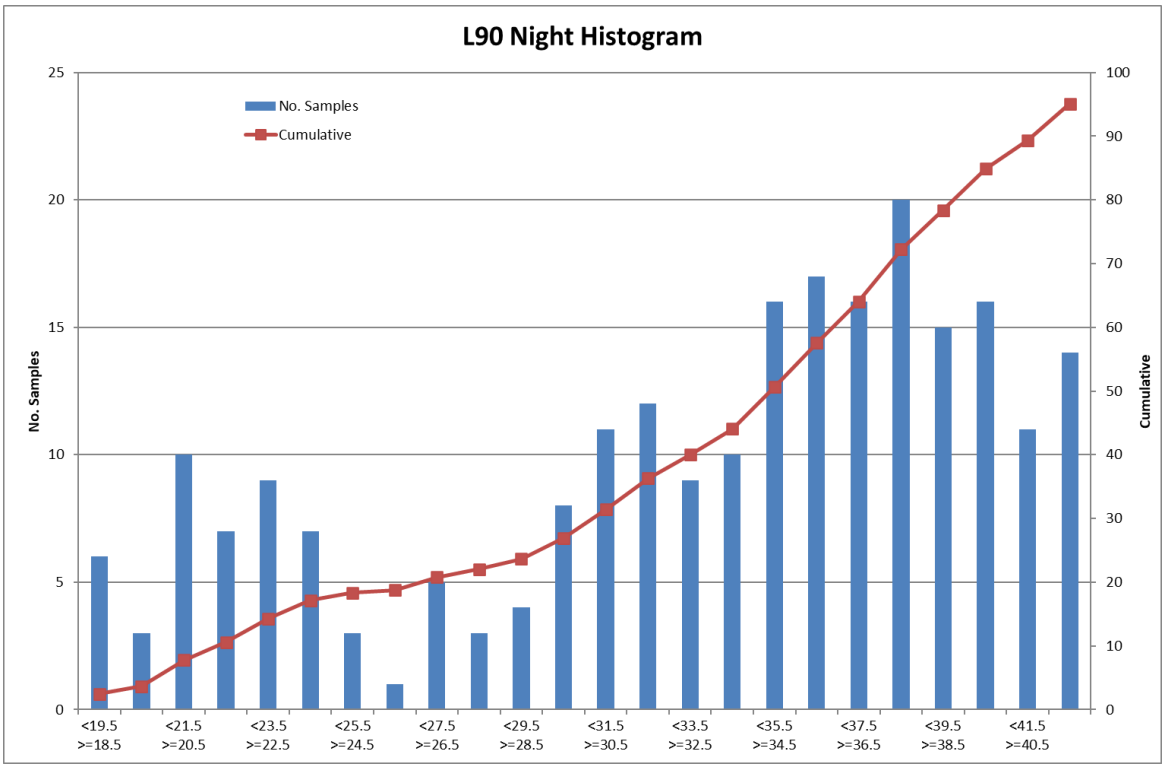



A very clear modal peak appears at 32 dB and has been chosen as the representative $L_{A90}$.

*Table A22.7 – Baseline Noise Data Analysis, SSR1*

| Period | Date | Average $L_{A90,15min}$ | Mode | Standard Deviation |
|---|---|---|---|---|
| Night-time | 8th to 21st July 2021 | 32 | 32 | 5.2 |

*Chart A22.4 – Baseline Noise Data Cumulative Distribution, SSR1*




Whilst the modal peak appears at 38 dB, the data does not display a standard normal distribution. The average (arithmetic mean) of 34 dB was therefore considered as the representative $L_{A90}$.

# 3. Calibration Certificates

# CERTIFICATE OF CALIBRATION

0653

**Date of Issue: 25 February 2021** **Certificate Number: UCRT21/1266**

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems



Approved Signatory

K. Mistry

| | |
|---|---|
| Customer | ANV Measurement Systems<br>Beaufort Court<br>17 Roebuck Way<br>Milton Keynes<br>MK5 8HL |
| Order No. | ANV MS HIRE |
| Description | Sound Level Meter / Pre-amp / Microphone / Associated Calibrator |

Identification

| *Manufacturer* | *Instrument* | *Type* | *Serial No. / Version* |
|---|---|---|---|
| Rion | Sound Level Meter | NL-52 | 00921176 |
| Rion | Firmware | | 2.0 |
| Rion | Pre Amplifier | NH-25 | 21218 |
| Rion | Microphone | UC-59 | 04208 |
| Rion | Calibrator | NC-74 | 34536109 |
| | Calibrator adaptor type if applicable | | NC-74-002 |

| | |
|---|---|
| Performance Class | 1 |
| Test Procedure | TP 2.SLM 61672-3 TPS-49 |

*Procedures from IEC 61672-3:2006 were used to perform the periodic tests.*

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

*If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003*

| | | | |
|---|---|---|---|
| Date Received | 24 February 2021 | ANV Job No. | UKAS21/02138 |
| Date Calibrated | 25 February 2021 | | |

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate

| *Dated* | *Certificate No.* | *Laboratory* |
|---|---|---|
| 24 March 2020 | UCRT20/1330 | 0653 |

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

# CERTIFICATE OF CALIBRATION

**Certificate Number**
**UCRT21/1266**

UKAS Accredited Calibration Laboratory No. 0653



Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

| | | | |
|---|---|---|---|
| SLM instruction manual title | Sound Level Meter | NL-42 / NL-52 | |
| SLM instruction manual ref / issue | | 11-03 | |
| SLM instruction manual source | | Manufacturer | |
| Internet download date if applicable | | N/A | |
| Case corrections available | | Yes | |
| Uncertainties of case corrections | | Yes | |
| Source of case data | | Manufacturer | |
| Wind screen corrections available | | Yes | |
| Uncertainties of wind screen corrections | | Yes | |
| Source of wind screen data | | Manufacturer | |
| Mic pressure to free field corrections | | Yes | |
| Uncertainties of Mic to F.F. corrections | | Yes | |
| Source of Mic to F.F. corrections | | Manufacturer | |
| Total expanded uncertainties within the requirements of IEC 61672-1:2002 | | Yes | |
| Specified or equivalent Calibrator | | Specified | |
| Customer or Lab Calibrator | | Lab Calibrator | |
| Calibrator adaptor type if applicable | | NC-74-002 | |
| Calibrator cal. date | | 11 February 2021 | |
| Calibrator cert. number | | UCRT21/1195 | |
| Calibrator cal cert issued by | | 0653 | |
| Calibrator SPL @ STP | 94.00 | dB | Calibration reference sound pressure level |
| Calibrator frequency | 1002.00 | Hz | Calibration check frequency |
| Reference level range | 25 - 130 | dB | |

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

| Environmental conditions during tests | Start | End | | | |
|---|---|---|---|---|---|
| Temperature | 23.48 | 23.37 | ± | 0.30 | °C |
| Humidity | 45.0 | 45.0 | ± | 3.00 | %RH |
| Ambient Pressure | 101.51 | 101.58 | ± | 0.03 | kPa |

Response to associated Calibrator at the environmental conditions above.

| | | | | | |
|---|---|---|---|---|---|
| Initial indicated level | 94.0 | dB | Adjusted indicated level | 94.0 | dB |
| The uncertainty of the associated calibrator supplied with the sound level meter ± | | | | 0.10 | dB |

Self Generated Noise — This test is currently not performed by this Lab.

| | | | |
|---|---|---|---|
| Microphone installed (if requested by customer) = Less Than | N/A | dB | A Weighting |
| Uncertainty of the microphone installed self generated noise ± | N/A | dB | |

Microphone replaced with electrical input device - UR = Under Range indicated

| Weighting | A | | | C | | | Z | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10.2 | dB | UR | 14.0 | dB | UR | 18.8 | dB | UR |
| Uncertainty of the electrical self generated noise ± | | | | | | 0.12 | | dB | |

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* =2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

…… END ……

Calibrated by: C. Hirlav R 3

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

# CERTIFICATE OF CALIBRATION

0653

**Date of Issue: 30 March 2021** **Certificate Number: UCRT21/1430**

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems



Approved Signatory

B. Giles

| | |
|---|---|
| Customer | ANV Measurement Systems<br>Beaufort Court<br>17 Roebuck Way<br>Milton Keynes<br>MK5 8HL |

| | | | | |
|---|---|---|---|---|
| Order No. | ANV MS HIRE | | | |
| Description | Sound Level Meter / Pre-amp / Microphone / Associated Calibrator | | | |
| Identification | *Manufacturer* | *Instrument* | *Type* | *Serial No. / Version* |
| | Rion | Sound Level Meter | NL-52 | 00732101 |
| | Rion | Firmware | | 2.0 |
| | Rion | Pre Amplifier | NH-25 | 32129 |
| | Rion | Microphone | UC-59 | 05286 |
| | Rion | Calibrator | NC-74 | 34536109 |
| | | Calibrator adaptor type if applicable | | NC-74-002 |

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

*Procedures from IEC 61672-3:2006 were used to perform the periodic tests.*

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

*If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003*

Date Received 29 March 2021 ANV Job No. UKAS21/03217

Date Calibrated 30 March 2021

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

| Previous Certificate | *Dated* | *Certificate No.* | *Laboratory* |
|---|---|---|---|
| | 24 June 2020 | UCRT20/1544 | 0653 |

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# CERTIFICATE OF CALIBRATION

| Certificate Number | |
|---|---|
| UCRT21/1430 | |
| UKAS Accredited Calibration Laboratory No. 0653 | Page 2 of 2 Pages |

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

| | | | |
|---|---|---|---|
| SLM instruction manual title | Sound Level Meter NL-42 / NL-52 | | |
| SLM instruction manual ref / issue | 11-03 | | |
| SLM instruction manual source | Manufacturer | | |
| Internet download date if applicable | N/A | | |
| Case corrections available | Yes | | |
| Uncertainties of case corrections | Yes | | |
| Source of case data | Manufacturer | | |
| Wind screen corrections available | Yes | | |
| Uncertainties of wind screen corrections | Yes | | |
| Source of wind screen data | Manufacturer | | |
| Mic pressure to free field corrections | Yes | | |
| Uncertainties of Mic to F.F. corrections | Yes | | |
| Source of Mic to F.F. corrections | Manufacturer | | |
| Total expanded uncertainties within the requirements of IEC 61672-1:2002 | Yes | | |
| Specified or equivalent Calibrator | Specified | | |
| Customer or Lab Calibrator | Lab Calibrator | | |
| Calibrator adaptor type if applicable | NC-74-002 | | |
| Calibrator cal. date | 18 March 2021 | | |
| Calibrator cert. number | UCRT21/1370 | | |
| Calibrator cal cert issued by | 0653 | | |
| Calibrator SPL @ STP | 94.01 | dB | Calibration reference sound pressure level |
| Calibrator frequency | 1001.96 | Hz | Calibration check frequency |
| Reference level range | 25 - 130 | dB | |

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

| Environmental conditions during tests | Start | End | | | |
|---|---|---|---|---|---|
| Temperature | 25.02 | 24.96 | ± | 0.30 | °C |
| Humidity | 42.4 | 42.6 | ± | 3.00 | %RH |
| Ambient Pressure | 101.69 | 101.65 | ± | 0.03 | kPa |

Response to associated Calibrator at the environmental conditions above.

| | | | | | |
|---|---|---|---|---|---|
| Initial indicated level | 94.0 | dB | Adjusted indicated level | 94.0 | dB |
| The uncertainty of the associated calibrator supplied with the sound level meter ± | | | | 0.10 | dB |

Self Generated Noise — This test is currently not performed by this Lab.

| | | | |
|---|---|---|---|
| Microphone installed (if requested by customer) = Less Than | N/A | dB | A Weighting |
| Uncertainty of the microphone installed self generated noise ± | N/A | dB | |

Microphone replaced with electrical input device - UR = Under Range indicated

| Weighting | A | | | C | | | Z | | |
|---|---|---|---|---|---|---|---|---|---|
| | 11.0 | dB | UR | 15.5 | dB | UR | 22.7 | dB | UR |
| Uncertainty of the electrical self generated noise ± | | | | | | 0.12 | | dB | |

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

……. END ……

Calibrated by: B. Bogdan R 2

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

# CERTIFICATE OF CALIBRATION

0653

**Date of Issue: 08 January 2021** **Certificate Number: UCRT21/1053**

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems



Approved Signatory

K. Mistry

| | |
|---|---|
| Customer | ANV Measurement Systems<br>Beaufort Court<br>17 Roebuck Way<br>Milton Keynes<br>MK5 8HL |
| Order No. | ANV MS HIRE |
| Description | Sound Level Meter / Pre-amp / Microphone / Associated Calibrator |

Identification

| *Manufacturer* | *Instrument* | *Type* | *Serial No. / Version* |
|---|---|---|---|
| Rion | Sound Level Meter | NL-52 | 00620864 |
| Rion | Firmware | | 2.0 |
| Rion | Pre Amplifier | NH-25 | 21000 |
| Rion | Microphone | UC-59 | 03877 |
| Rion | Calibrator | NC-74 | 34536109 |
| | Calibrator adaptor type if applicable | | NC-74-002 |

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

*Procedures from IEC 61672-3:2006 were used to perform the periodic tests.*

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

*If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003*

Date Received 06 January 2021 ANV Job No. UKAS21/01011

Date Calibrated 08 January 2021

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate

| *Dated* | *Certificate No.* | *Laboratory* |
|---|---|---|
| 29 January 2020 | UCRT20/1128 | 0653 |

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# CERTIFICATE OF CALIBRATION

| Certificate Number | |
|---|---|
| UCRT21/1053 | |
| UKAS Accredited Calibration Laboratory No. 0653 | Page 2 of 2 Pages |

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

| | | | |
|---|---|---|---|
| SLM instruction manual title | Sound Level Meter NL-42 / NL-52 | | |
| SLM instruction manual ref / issue | 11-03 | | |
| SLM instruction manual source | Manufacturer | | |
| Internet download date if applicable | N/A | | |
| Case corrections available | Yes | | |
| Uncertainties of case corrections | Yes | | |
| Source of case data | Manufacturer | | |
| Wind screen corrections available | Yes | | |
| Uncertainties of wind screen corrections | Yes | | |
| Source of wind screen data | Manufacturer | | |
| Mic pressure to free field corrections | Yes | | |
| Uncertainties of Mic to F.F. corrections | Yes | | |
| Source of Mic to F.F. corrections | Manufacturer | | |
| Total expanded uncertainties within the requirements of IEC 61672-1:2002 | Yes | | |
| Specified or equivalent Calibrator | Specified | | |
| Customer or Lab Calibrator | Lab Calibrator | | |
| Calibrator adaptor type if applicable | NC-74-002 | | |
| Calibrator cal. date | 07 January 2021 | | |
| Calibrator cert. number | UCRT21/1028 | | |
| Calibrator cal cert issued by | 0653 | | |
| Calibrator SPL @ STP | 94.00 | dB | Calibration reference sound pressure level |
| Calibrator frequency | 1002.02 | Hz | Calibration check frequency |
| Reference level range | 25 - 130 | dB | |

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

| Environmental conditions during tests | Start | End | | | |
|---|---|---|---|---|---|
| Temperature | 24.20 | 23.87 | ± | 0.30 | °C |
| Humidity | 35.1 | 31.8 | ± | 3.00 | %RH |
| Ambient Pressure | 100.81 | 100.88 | ± | 0.03 | kPa |

Response to associated Calibrator at the environmental conditions above.

| | | | | | | |
|---|---|---|---|---|---|---|
| Initial indicated level | 94.2 | dB | | Adjusted indicated level | 94.0 | dB |
| The uncertainty of the associated calibrator supplied with the sound level meter ± | | | | | 0.10 | dB |

Self Generated Noise — This test is currently not performed by this Lab.

| | | | |
|---|---|---|---|
| Microphone installed (if requested by customer) = Less Than | N/A | dB | A Weighting |
| Uncertainty of the microphone installed self generated noise ± | N/A | dB | |

Microphone replaced with electrical input device - UR = Under Range indicated

| Weighting | A | | | C | | | Z | | |
|---|---|---|---|---|---|---|---|---|---|
| | 11.3 | dB | UR | 15.4 | dB | UR | 20.8 | dB | UR |
| Uncertainty of the electrical self generated noise ± | | | | | | 0.12 | | dB | |

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k$=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

…… END ……

Calibrated by: C. Hirlav R 3

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

# CERTIFICATE OF CALIBRATION

0653

**Date of Issue: 12 January 2021** **Certificate Number: UCRT21/1069**

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems



Approved Signatory

K. Mistry

| | |
|---|---|
| Customer | ANV Measurement Systems<br>Beaufort Court<br>17 Roebuck Way<br>Milton Keynes<br>MK5 8HL |

| | | | | |
|---|---|---|---|---|
| Order No. | ANV MS HIRE | | | |
| Description | Sound Level Meter / Pre-amp / Microphone / Associated Calibrator | | | |
| Identification | *Manufacturer* | *Instrument* | *Type* | *Serial No. / Version* |
| | Rion | Sound Level Meter | NL-52 | 00610211 |
| | Rion | Firmware | | 2.0 |
| | Rion | Pre Amplifier | NH-25 | 10205 |
| | Rion | Microphone | UC-59 | 05742 |
| | Rion | Calibrator | NC-74 | 34536109 |
| | | Calibrator adaptor type if applicable | | NC-74-002 |

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

*Procedures from IEC 61672-3:2006 were used to perform the periodic tests.*

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

*If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003*

Date Received 06 January 2021 ANV Job No. UKAS21/01012

Date Calibrated 12 January 2021

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

| Previous Certificate | *Dated* | *Certificate No.* | *Laboratory* |
|---|---|---|---|
| | 09 January 2020 | UCRT20/1037 | 0653 |

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

# CERTIFICATE OF CALIBRATION

**Certificate Number**
**UCRT21/1069**

UKAS Accredited Calibration Laboratory No. 0653



Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

| | | | |
|---|---|---|---|
| SLM instruction manual title | Sound Level Meter | NL-42 / NL-52 | |
| SLM instruction manual ref / issue | | 11-03 | |
| SLM instruction manual source | | Manufacturer | |
| Internet download date if applicable | | N/A | |
| Case corrections available | | Yes | |
| Uncertainties of case corrections | | Yes | |
| Source of case data | | Manufacturer | |
| Wind screen corrections available | | Yes | |
| Uncertainties of wind screen corrections | | Yes | |
| Source of wind screen data | | Manufacturer | |
| Mic pressure to free field corrections | | Yes | |
| Uncertainties of Mic to F.F. corrections | | Yes | |
| Source of Mic to F.F. corrections | | Manufacturer | |
| Total expanded uncertainties within the requirements of IEC 61672-1:2002 | | Yes | |
| Specified or equivalent Calibrator | | Specified | |
| Customer or Lab Calibrator | | Lab Calibrator | |
| Calibrator adaptor type if applicable | | NC-74-002 | |
| Calibrator cal. date | | 07 January 2021 | |
| Calibrator cert. number | | UCRT21/1028 | |
| Calibrator cal cert issued by | | 0653 | |
| Calibrator SPL @ STP | 94.00 | dB | Calibration reference sound pressure level |
| Calibrator frequency | 1002.02 | Hz | Calibration check frequency |
| Reference level range | 25 - 130 | dB | |

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

| Environmental conditions during tests | Start | End | | | |
|---|---|---|---|---|---|
| Temperature | 25.09 | 25.10 | ± | 0.30 | °C |
| Humidity | 32.2 | 32.0 | ± | 3.00 | %RH |
| Ambient Pressure | 100.53 | 100.56 | ± | 0.03 | kPa |

Response to associated Calibrator at the environmental conditions above.

| | | | | | |
|---|---|---|---|---|---|
| Initial indicated level | 93.9 | dB | Adjusted indicated level | 94.0 | dB |
| The uncertainty of the associated calibrator supplied with the sound level meter ± | | | | 0.10 | dB |

Self Generated Noise — This test is currently not performed by this Lab.

| | | | |
|---|---|---|---|
| Microphone installed (if requested by customer) = Less Than | N/A | dB | A Weighting |
| Uncertainty of the microphone installed self generated noise ± | N/A | dB | |

Microphone replaced with electrical input device - UR = Under Range indicated

| Weighting | A | | | C | | | Z | | |
|---|---|---|---|---|---|---|---|---|---|
| | 11.2 | dB | UR | 15.3 | dB | UR | 21.9 | dB | UR |
| Uncertainty of the electrical self generated noise ± | | | | | | 0.12 | | dB | |

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* =2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

…… END ……

Calibrated by: B. Bogdan R 2

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

# CERTIFICATE OF CALIBRATION

0653

**Date of Issue: 14 October 2020** **Certificate Number: UCRT20/2000**

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems



Approved Signatory

K. Mistry

| | |
|---|---|
| Customer | ANV Measurement Systems<br>Beaufort Court<br>17 Roebuck Way<br>Milton Keynes<br>MK5 8HL |
| Order No. | ANV MS HIRE |
| Description | Sound Level Meter / Pre-amp / Microphone / Associated Calibrator |

Identification

| *Manufacturer* | *Instrument* | *Type* | *Serial No. / Version* |
|---|---|---|---|
| Rion | Sound Level Meter | NL-52 | 00231665 |
| Rion | Firmware | | 2.0 |
| Rion | Pre Amplifier | NH-25 | 21609 |
| Rion | Microphone | UC-59 | 13789 |
| Rion | Calibrator | NC-74 | 34536109 |
| | Calibrator adaptor type if applicable | | NC-74-002 |

| | |
|---|---|
| Performance Class | 1 |
| Test Procedure | TP 2.SLM 61672-3 TPS-49 |

*Procedures from IEC 61672-3:2006 were used to perform the periodic tests.*

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

*If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003*

| | | | |
|---|---|---|---|
| Date Received | 13 October 2020 | ANV Job No. | UKAS20/10569 |
| Date Calibrated | 14 October 2020 | | |

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate

| *Dated* | *Certificate No.* | *Laboratory* |
|---|---|---|
| 01 October 2019 | UCRT19/2094 | 0653 |

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# CERTIFICATE OF CALIBRATION

| Certificate Number | |
|---|---|
| UCRT20/2000 | |
| UKAS Accredited Calibration Laboratory No. 0653 | Page 2 of 2 Pages |

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

| | | | |
|---|---|---|---|
| SLM instruction manual title | Sound Level Meter NL-42 / NL-52 | | |
| SLM instruction manual ref / issue | 11-03 | | |
| SLM instruction manual source | Manufacturer | | |
| Internet download date if applicable | N/A | | |
| Case corrections available | Yes | | |
| Uncertainties of case corrections | Yes | | |
| Source of case data | Manufacturer | | |
| Wind screen corrections available | Yes | | |
| Uncertainties of wind screen corrections | Yes | | |
| Source of wind screen data | Manufacturer | | |
| Mic pressure to free field corrections | Yes | | |
| Uncertainties of Mic to F.F. corrections | Yes | | |
| Source of Mic to F.F. corrections | Manufacturer | | |
| Total expanded uncertainties within the requirements of IEC 61672-1:2002 | Yes | | |
| Specified or equivalent Calibrator | Specified | | |
| Customer or Lab Calibrator | Lab Calibrator | | |
| Calibrator adaptor type if applicable | NC-74-002 | | |
| Calibrator cal. date | 22 September 2020 | | |
| Calibrator cert. number | UCRT20/1900 | | |
| Calibrator cal cert issued by | 0653 | | |
| Calibrator SPL @ STP | 94.02 | dB | Calibration reference sound pressure level |
| Calibrator frequency | 1001.91 | Hz | Calibration check frequency |
| Reference level range | 25 - 130 | dB | |

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

| Environmental conditions during tests | Start | End | | | |
|---|---|---|---|---|---|
| Temperature | 23.60 | 24.20 | ± | 0.30 | °C |
| Humidity | 46.1 | 45.3 | ± | 3.00 | %RH |
| Ambient Pressure | 101.23 | 101.25 | ± | 0.03 | kPa |

Response to associated Calibrator at the environmental conditions above.

| | | | | | |
|---|---|---|---|---|---|
| Initial indicated level | 94.1 | dB | Adjusted indicated level | 94.0 | dB |
| The uncertainty of the associated calibrator supplied with the sound level meter ± | | | | 0.10 | dB |

Self Generated Noise — This test is currently not performed by this Lab.

| | | | |
|---|---|---|---|
| Microphone installed (if requested by customer) = Less Than | N/A | dB | A Weighting |
| Uncertainty of the microphone installed self generated noise ± | N/A | dB | |

Microphone replaced with electrical input device - UR = Under Range indicated

| Weighting | A | | | C | | | Z | | |
|---|---|---|---|---|---|---|---|---|---|
| | 11.0 | dB | UR | 14.8 | dB | UR | 19.9 | dB | UR |
| Uncertainty of the electrical self generated noise ± | | | | | | 0.12 | | dB | |

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k$=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

…… END ……

Calibrated by: B. Bogdan R 2

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

# CERTIFICATE OF CALIBRATION

0653

**Date of Issue: 02 March 2021** **Certificate Number: UCRT21/1280**

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems



Approved Signatory

B. Giles

| | | | | |
|---|---|---|---|---|
| Customer | ANV Measurement Systems<br>Beaufort Court<br>17 Roebuck Way<br>Milton Keynes<br>MK5 8HL | | | |
| Order No. | ANV MS HIRE | | | |
| Test Procedure | Procedure TP 1 Calibration of Sound Calibrators | | | |
| Description | Acoustic Calibrator | | | |
| Identification | *Manufacturer* | *Instrument* | *Model* | *Serial No.* |
| | Rion | Calibrator | NC-75 | 35292147 |

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) 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.

| | | |
|---|---|---|
| ANV Job No. | UKAS21/03147 | |
| Date Received | 01 March 2021 | |
| Date Calibrated | 02 March 2021 | |
| Previous Certificate | *Dated* | 07 May 2020 |
| | *Certificate No.* | UCRT20/1404 |
| | *Laboratory* | 0653 |

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Measurements

The sound pressure level generated by the calibrator in its WS2 configuration was measured five times by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below. It is corrected to the standard atmospheric pressure of 101.3 kPa (1013 mBar) using original manufacturers information.

| Test Microphone | *Manufacturer* | *Type* |
|---|---|---|
| | Brüel & Kjær | 4134 |

Results

The level of the calibrator output under the conditions outlined above was

94.03 ± 0.10 dB rel 20 µPa

Functional Tests and Observations

| | | | |
|---|---|---|---|
| The frequency of the sound produced was | 1000.00 Hz | ± | 0.13 Hz |
| The total distortion was | 0.10 % | ± | 17.3 % of Reading |

During the measurements environmental conditions were

| | | | | |
|---|---|---|---|---|
| Temperature | 23 | to | 24 | °C |
| Relative Humidity | 31 | to | 39 | % |
| Barometric Pressure | 102.0 | to | 102.1 | kPa |

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

…….. END ……

**Note:**

| | | |
|---|---|---|
| Calibrator adjusted prior to calibration? | NO | |
| Initial Level | N/A | dB |
| Initial Frequency | N/A | Hz |

Additional Comments The results on this certificate only relate to the items calibrated as identified above.

None

Calibrated by: B. Bogdan R 2

# G. LUFFT Mess- und Regeltechnik GmbH

CERTIFIED
DIN EN ISO 9001
NR 70100222
CERTIFICADO

Lufft

**zertifiziert nach DIN EN ISO 9001 / *certified in accordance with DIN EN ISO 9001***

## Kalibrierschein
## *Calibration Certificate*

| | |
|---|---|
| Zertifikatnummer / *no. of certificate* | 7730 |
| | LUFFT calibration |
| Kalibrierdatum / *calibration date* | 2021-03 |

| | |
|---|---|
| Gegenstand<br>*Object* | **compact weather station WS 600-UMB** |
| Hersteller<br>*Manufacturer* | **LUFFT Mess- und Regeltechnik GmbH** |
| Typ<br>*Type* | **8370.U02** |
| Fabrikat/Serien-Nr.<br>*Serial number* | **013.0615.0701.045** |
| Auftraggeber<br>*Customer* | **Equinox Instruments Limited<br>Beevor Street<br>LN5 5A LN6 7DJ Lincoln** |
| Auftragsnummer<br>*Order No.* | **2946** |
| Anzahl der Seiten des Kalibrierscheines<br>*Number of pages of the certificate* | **6** |
| Datum der Kalibrierung<br>*Date of calibration* | **12.03.2021 to 17.03.2021** |

Dieses Zertifikat dokumentiert die Kalibrierung des genannten Messgerätes unter Berücksichtigung der Zertifizierung nach DIN EN ISO 9001. Die verwendeten Referenzgeräte sind rückgeführt auf nationale Normale. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.

*This calibration certificate documents the calibration of the mentioned measuring instrument in consideration of the certification in accordance with DIN EN ISO 9001. The used reference standards are traceable to national standards. The user is obliged to have the object recalibrated at appropriate intervals. This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal are not valid.*

| Stempel<br>*Seal* | Datum<br>*Date* | Stellv. Leiter des Kalibrierlaboratoriums<br>*Deputy Head of the calibration laboratory* | Bearbeiter<br>*Person in charge* |
|---|---|---|---|
| G. LUFFT<br>Meß- u. Regeltechnik GmbH<br>Gutenbergstraße 20<br>70736 Fellbach<br>Postfach 4252<br>70719 Fellbach | 18.03.2021 | Sven Birnbaum | Francesco De Marco |

Dieser Kalibrierschein ist elektronisch signiert und liegt als Original als PDF-Datei vor.
*This calibration certificate is electronic signed and exists as original as PDF-file.*


G. LUFFT Mess- und Regeltechnik GmbH
Gutenbergstraße 20
DE-70736 Fellbach
Germany

Tel: ++49(0)711/51822-0
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www.Lufft.com

Geschäftsführer/Managing directors:
Tom Bolling
Stephan Gramlich
Randall Evers

Amtsgericht Stuttgart
HRB 721373
Ust.ID: DE 250580689
Steuernummer 90490/28336

## calibration item

The calibration object is a compact weather station with sensors for temperature, relative humidity, absolute pressure, wind speed, wind direction, precipitation.
Measurement data are available with a RS485 interface.
The calibration object is unscathed.

| | |
|---|---|
| **Temperature** | |
| measuring range | -50...+60°C |
| accuracy | 0,2°C (-20...50°C), other 0,5°C (>-30°C) |
| resolution | 0,01 K |
| measuring element | NTC |
| **Relative humidity** | |
| measuring range | 0...100 % |
| accuracy | 2,0 % |
| resolution | 0,01 % |
| measuring element | capacity |
| **Absolute pressure** | |
| measuring range | 300...1200 mbar |
| accuracy | 0,5 mbar (0°C...40°C) |
| resolution | 0,01 mbar |
| measuring element | capacity |
| **Wind speed** | |
| measuring range | 0...75 m/s |
| accuracy | 0,3m/s or 3% (0...35m/s), 5% (>35m/s) |
| resolution | 0,01 m/s |
| measuring element | ultrasonic |
| **Wind direction** | |
| measuring range | 0...359,9° |
| accuracy | 3° |
| resolution | 0,01° |
| measuring element | ultrasonic |

## reference standard

| | |
|---|---|
| **Temperature** | |
| reference standards | PT100 resistance thermometer |
| reference numbers | 006418, 006436, 006429, 006430, 006431, 006432 |
| calibration marks | 5550-, 5551-, 5552-, 5553-, 5554-, 5555-D-K-15202-01-00-2020-09 |
| uncertainty of measurement | 10 mK...15 mK |
| **Temperature** | |
| reference standard | precision temperature measuring instrument |
| reference number | 801116 |
| calibration mark | 01-0447-D-K-15186-01-00 2019-05 |
| uncertainty of measurement | 3,3 mK...8,3 mK |
| **Dew point temperature** | |
| reference standard | dew point mirror |
| reference number | 601007 |
| calibration mark | 7244MBW2019 |
| uncertainty of measurement | 30 mK...50 mK |

**Pressure**

| | |
|---|---|
| reference standard | precision pressure measuring system |
| reference number | 005003 |
| calibration mark | 04759809-D-K-15105-01-00-2020-04 |
| uncertainty of measurement | 0,011 mbar...0,033 mbar |

**Velocity measurement unit with different, integrated sensors**

**Differential pressure**

| | |
|---|---|
| reference standard | differential pressure sensors |
| reference number | 005122 |
| calibration mark | 7473-LUFFT-2020-09 |

**Temperature + humidity**

| | |
|---|---|
| reference standard | temperature+humidity-transmitter |
| reference number | 062022 |
| calibration mark | 5617-D-K-15202-01-00-2020-09 |

**Absolute pressure**

| | |
|---|---|
| reference standard | absolute pressure sensor |
| reference number | 005022 |
| calibration mark | 5618-D-K-15202-01-00-2020-09 |

**precipitation**
**doppler-simulator**

| | |
|---|---|
| reference standard | K-Band doppler-simulator |
| reference number | 801070 |

**frequency**

| | |
|---|---|
| reference standard | oscilloscope |
| reference number | 801069 |
| calibration mark | E-1908381 |

**calibration procedure**

*Temperature:*
The temperature calibration was accomplished after the calibration instruction "Calibration of temperature measuring instruments" N9003.
A direct comparison between the used reference standard and the calibration item was accomplished.
The temperature values ($t_{90}$) refer to the International Temperature Scale of 1990 (ITS-90).

*Humidity:*
The humidity calibration was accomplished after the calibration instruction "Calibration of humidity measuring instruments" N9004. A direct comparison between the used reference standard and the calibration item was accomplished.
The temperature values refer to the International Temperature Scale of 1990 (ITS-90).

*Pressure:*
The pressure calibration was accomplished after the calibration instruction "Calibration of pressure measuring instruments" N9103. A direct comparison between the used reference standard and the calibration item was accomplished.

*Air velocity:*
The airflow calibration was accomplished after the calibration instruction "Calibration of airflow measuring instruments" N9007. A direct comparison between the used reference standard and the calibration item was accomplished.

| Zertifikatnummer / *no. of certificate* | 7730 |
|---|---|
| Kalibrierdatum / *calibration date* | 2021-03 |

**measurement conditions**

*temperature / relative humidity:*
climate chamber, medium: air
The relative humidity has been calculated from measured air and dew point temperature.

*description:*
Adaptation time was at least 120 minutes for every calibration point.
The calibration unit was placed in the center of the climate chamber and was completely exposed to the climate conditions.
The measurement values of the calibration object ("indicated value") were recorded with a LUFFT-ISOCON and the recorder-function of the Software UMB-config-tool V2.7. The recording interval was 10 seconds. The power supply was 24 VDC.

*absolute pressure*

| | |
|---|---|
| pressure transmission medium: | dry air |
| reference layer calibration object: | top edge of the case |
| Position during calibration: | vertical |

*air velocity:*
wind tunnel, medium: air
diameter nozzle outlet: 255 mm

precipitation:
The calibration procedure for the radar precipitation sensor uses electronic simulation. A doppler simulator modifies the radar signal by modulating an additional frequency on it which corresponds to a given fall velocity of the drop. The drop diameter can then be determined from the correlation between the fall velocity and the size of the drop.

**ambient conditions**

| | | |
|---|---|---|
| temperature in °C: | 22,0 | 1 K |
| rel. humidity in %: | 28 | 10 % |
| air pressure in mbar: | 984 | 10 mbar |

**calibration results**

**Temperature calibration**

| Reference standard | Calibration unit | | |
|---|---|---|---|
| temperature $t_{90}$ in °C | indicated value $t_{90}$ in °C | measurement deviation $T_{90}$ in K | uncertainty of measurement $U$ in K |
| -0,01 | -0,07 | -0,06 | 0,15 |
| 19,75 | 19,70 | -0,05 | 0,15 |
| 39,96 | 39,77 | -0,19 | 0,15 |

**Humidity calibration**

| Reference standards | | Calibration unit | | |
|---|---|---|---|---|
| air-temperature $t_{90}$ in °C | relative humidity $U_w$ in % | indicated value $U$ in % | measurement deviation $U$ in % | uncertainty of measurement $U$ in % |
| 20 | 19,3 | 19,1 | -0,2 | 0,6 |
| 20 | 50,1 | 50,1 | 0,0 | 0,9 |
| 20 | 80,0 | 79,7 | -0,3 | 1,7 |

Zertifikatnummer / *no. of certificate* 7730

Kalibrierdatum / *calibration date* 2021-03

**Pressure calibration**

| reference standard | calibration item $p_{Anzeige}$ | |
|---|---|---|
| $p_{Normal}$ in mbar | M1 (up) in mbar | M2 (down) in mbar |
| 751,0 | 751,0 | 751,1 |
| 850,0 | 850,1 | 850,0 |
| 925,0 | 925,1 | 925,1 |
| 1000,0 | 1000,0 | 1000,0 |
| 1099,0 | 1098,9 | 1098,9 |

**Interpretation:**

| reference standard | calibration item | | | |
|---|---|---|---|---|
| absolute pressure $p_{Normal}$ in mbar | mean value $p_{Miw}$ in mbar | measurement deviation $p$ in mbar | hysteresis $h$ in mbar | uncertainty of measurement $U$ in mbar |
| 751,0 | 751,1 | +0,1 | 0,1 | 0,3 |
| 850,0 | 850,1 | +0,1 | 0,1 | 0,3 |
| 925,0 | 925,1 | +0,1 | 0,0 | 0,3 |
| 1000,0 | 1000,0 | 0,0 | 0,0 | 0,3 |
| 1099,0 | 1098,9 | -0,1 | 0,0 | 0,3 |

**air velocity calibration**

| | reference | calibration object | |
|---|---|---|---|
| Nr. | flow $u$ in m/s | indicated value with RMSE calculation at 32 directions $u$ in m/s | measurement deviation $u$ in m/s |
| 1 | 2,00 | 1,95 | -0,05 |
| 2 | 5,00 | 5,02 | +0,02 |
| 3 | 10,00 | 10,04 | +0,04 |
| 4 | 20,00 | 19,96 | -0,04 |
| 5 | 50,00 | 50,05 | +0,05 |

**direction calibration**

| | reference | calibration object |
|---|---|---|
| Nr. | flow $u$ in m/s | measurement deviation with RMS calculation of 32 directions in ° |
| 1 | 2,0 | 1,7 |
| 2 | 5,0 | 0,9 |
| 3 | 10,0 | 0,8 |
| 4 | 20,0 | 0,8 |
| 5 | 50,0 | 1,4 |

**precipitation drop size calibration**

| reference | calibration object | |
|---|---|---|
| drop size in mm | indicated value in mm | measurement deviation in mm |
| 0,115 | 0,116 | +0,001 |
| 0,670 | 0,670 | 0,000 |
| 2,730 | 2,733 | +0,003 |

**observations**

The uncertainty stated is the expanded uncertainty *U* obtained by multiplying the standard uncertainty by the coverage factor $k = 2$. It has been determined in accordance with EA-4/02 M. The value of the measurand lies with a normal distribution with a probability of approximately 95 % within the assigned range of values.

**The measuring instrument was adjusted. Calibration data before adjustment:**

**Humidity calibration**

| Reference standards | | Calibration unit | | |
|---|---|---|---|---|
| air-temperature $t_{90}$ in °C | relative humidity $U_w$ in % | indicated value *U* in % | measurement deviation *U* in % | uncertainty of measurement *U* in % |
| 20 | 19,5 | 22,1 | +2,6 | 0,6 |
| 20 | 50,0 | 52,2 | +2,2 | 0,9 |
| 20 | 80,1 | 82,2 | +2,1 | 1,5 |

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