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Appendix 12.1

Noise Monitoring Locations and the Proposed Development

Keerglen Wind Farm

Mayo Planning Authority - Inspection Purposes Only



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Appendix 12.2

Wind Speed Calculations for Hub Height

Keerglen Wind Farm

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A GOOD PRACTICE GUIDE TO THE APPLICATION OF ETSU-R-97 FOR THE
ASSESSMENT AND RATING OF WIND TURBINE NOISE



4.5 Wind Shear Corrections

- 4.5.1 Basing the predictions on sound power data tested in accordance with the IEC 61400-11 standard (or equivalent) should mean that the wind reference used corresponds to hub height wind speeds, standardised to 10 m height using a fixed correction (see **Annex A**). These predictions can then be compared to background levels and/or associated noise limits derived using an equivalent wind speed reference, which will have wind shear taken into account directly.
- 4.5.2 When this is not the case, for example when considering background data measured against direct wind speed measurements at 10 m height, it is necessary to apply corrections to account for this. Any such corrections should be clearly outlined and detailed in any noise assessment so that they can be reviewed by any assessor. The assessment should be made using the most detailed information available.
- 4.5.3 Examples of methods which can be used to correct predictions to account for wind shear effects, when only using a 10 m mast, are included in **Supplementary Guidance Note 4** (wind shear). This note presents methods to calculate corrections on the basis of long-term data measured at different heights, but as such data may not be available for a specific site, typical shear values are also presented. Alternatively, similarly derived corrections representing typical (average) shear values can be applied to the wind speed reference used for the derived typical background noise levels.
- 4.5.4 The following simplified method is proposed for ease of use: applying a fixed correction by subtracting the following factors from the wind speed reference used in the turbine predictions: 1 m/s for turbine hub heights of up to 30 m, 2 m/s for hub heights of up to 60 m and 3 m/s for hub heights of more than 60 m. Such a generic approach would be suitable in the context of a study made using a 10 m mast to limit costs, in the absence of site-specific data.
- 4.5.5 If it can be demonstrated that the predicted levels are below the applicable lower fixed limits regardless of wind speed, it can be seen that wind shear would not have an effect on the assessment and this may form the basis of a suitable planning condition.

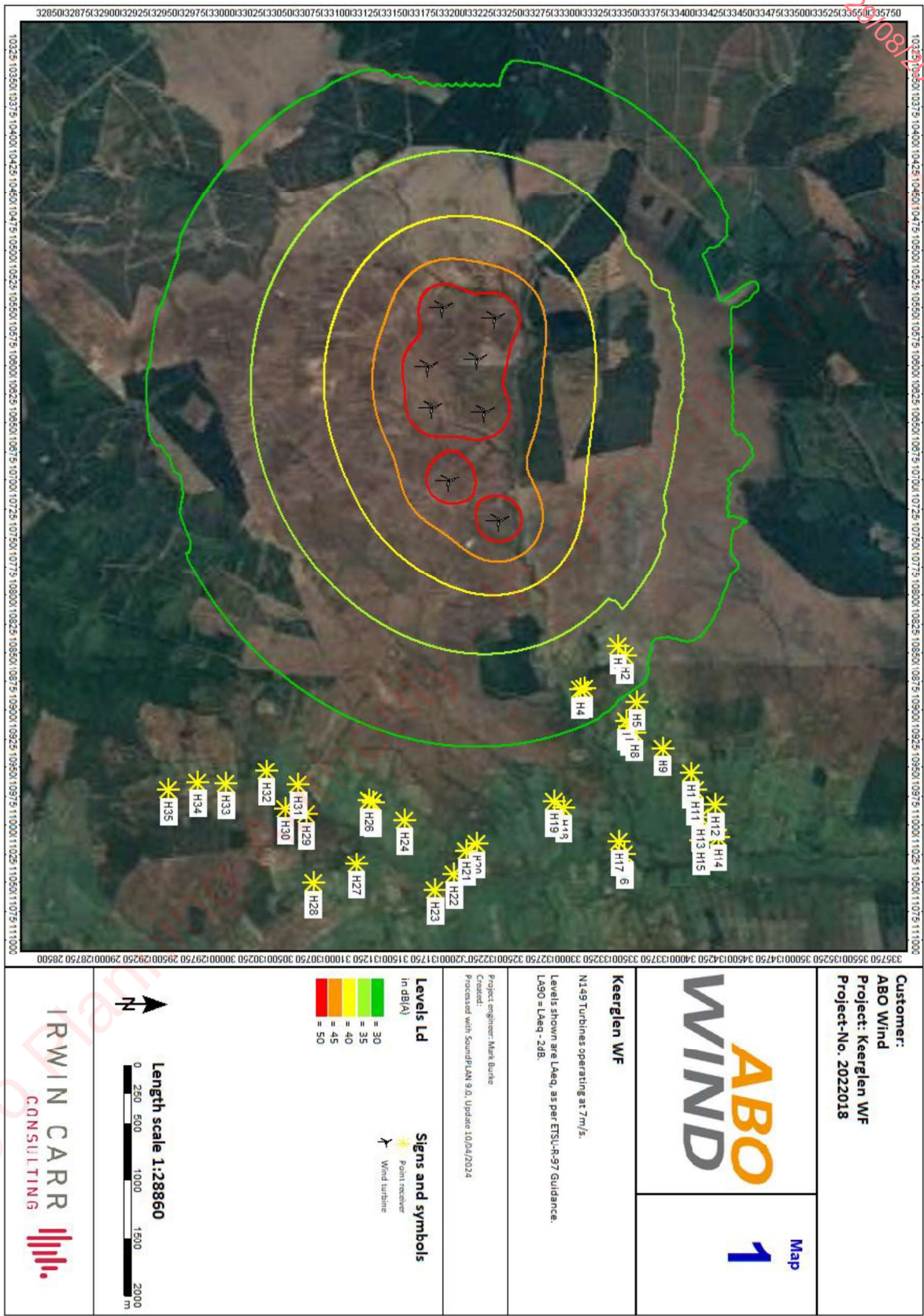
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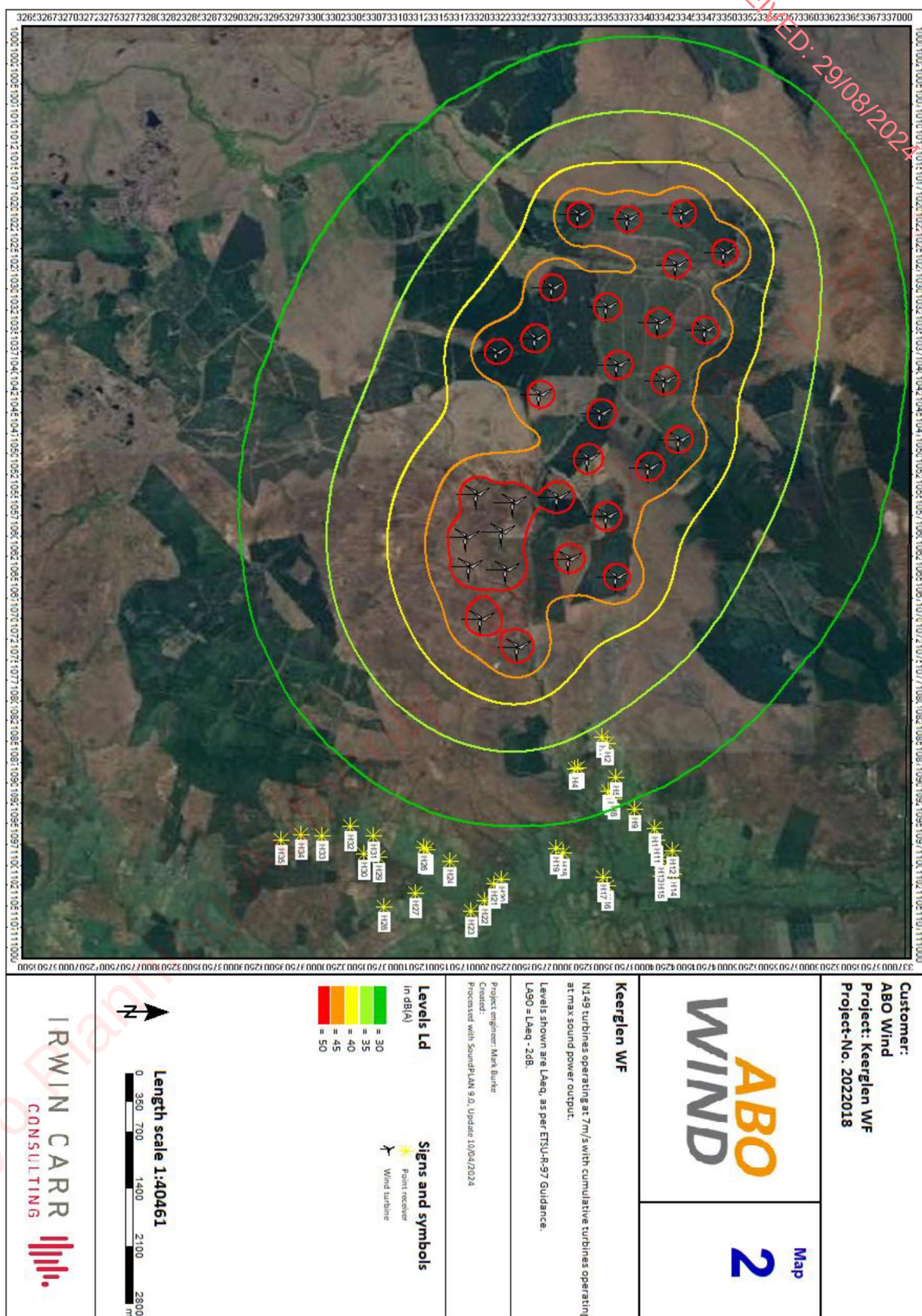
Appendix 12.3

SoundPlan Noise Outputs

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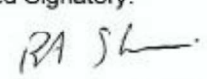
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Appendix 12.4

Calibration Certificates of Noise Instruments

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		MTS Calibration Ltd, The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG, England Telephone: 01642 876 410	
CERTIFICATE OF CALIBRATION		Page 1 of 11 pages	
Issued by: MTS Calibration Ltd		Approved Signatory:  Tony Sherris	
Date of Issue: 02 February 2022		Certificate Number: 36616	
Sound Level Meter			
Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1			
Client: Environmental Measurements Unit 12, Tallaght Business Centre Whitestown Business Park Co.Dublin 24, Ireland		Instrument Make: Larson Davis Instrument Model: LxT1L Serial Number: 0004726	
Associated Equipment		Make	
Pre-amplifier		Larson Davis	
Microphone		PCB	
Calibrator		Larson Davis	
Calibrator supplied by		MTS for this calibration	
Model		Serial number	
PRMLxT		055748	
377B02		314001	
CAL200		9175	
The measurements were performed at The Grange Business Centre, Belasis Avenue, TS23 1LG. The results only apply to the items tested.			
Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1			
Test results summary, detailed results are shown on subsequent pages.			
Tests performed	Section	Results of test	Page
Calibration Certificate	22		1
Additional information			2
Indication with Calibrator Supplied	10	No Limit	3
Self-Generated Noise	11	No Limit	3
Frequency and Time-weightings at 1kHz	14	Complies	3
Long term stability	15	Complies	3
High stability	21	Complies	3
Acoustic Tests	12	Complies	4
Frequency Weighting A	13	Complies	5
Frequency Weighting C	13	Complies	6
Frequency Weighting Z	13	Complies	7
Level Linearity	16	Complies	8
Level Linearity Range Control	17		n/a
Tone-burst Response	18	Complies	9
Peak C sound level	19	Complies	10
Overload indication	20	Complies	11
The instrument was within the above specification as received - no modifications were made			
The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013			
Additional tests performed		Reference	
Microphone full frequency response		36616	
Filter calibration, third octave or octave		36616F	
		See additional certificate	
		See additional certificate	
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.			

Calibration Certificate

Certificate Number 2022001439

Customer:

Noise & Vibration Consultants Ltd

Navan, County Meath Ireland

Model Number LxT SE

Serial Number 0006990

Test Results **Pass**

Initial Condition As Manufactured

Description Sound Expert LxT
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378

Technician Jacob Cannon

Calibration Date 3 Feb 2022

Calibration Due

Temperature 23.59 °C ± 0.25 °C

Humidity 51.3 %RH ± 2.0 %RH

Static Pressure 86.94 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1L S/N 077587 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, [770,01 Rev O Supporting Firmware Version 4,0,5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 84601, United States
716-684-0001



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A PCB DIVISION

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Page 1 of 8

D0001.8407 Rev F

Calibration Certificate

Certificate Number 2022001448

Customer:

Noise & Vibration Consultants Ltd
Navan, County Meath Ireland

Model Number LxT SE

Serial Number 0006991

Test Results Pass

Initial Condition As Manufactured

Description Sound Expert LxT
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378

Technician Jacob Cannon

Calibration Date 3 Feb 2022

Calibration Due

Temperature 23.63 °C ± 0.25 °C

Humidity 52.5 %RH ± 2.0 %RH

Static Pressure 86.96 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT 1L S/N 077588 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

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716-684-0001



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Page 1 of 8

D0001.8407 Rev F

Calibration Certificate

Certificate Number 2022001449

Customer:

Noise & Vibration Consultants Ltd
Navan, County Meath Ireland

Model Number LxT SE
Serial Number 0007005
Test Results Pass
Initial Condition As Manufactured
Description Sound Expert LxT
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378
Technician Jacob Cannon
Calibration Date 3 Feb 2022
Calibration Due
Temperature 23.61 °C ± 0.25 °C
Humidity 51.2 %RH ± 2.0 %RH
Static Pressure 86.96 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1L S/N 077589 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, [770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10]

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

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Appendix 12.5

Candidate Turbine Manufacturer's Noise Emission Data

Keerglen Wind Farm

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Classification: Internal Purpose



Third octave sound power levels with serrated trailing edge – Mode 0

Mode 0

hub height 105 m – 105.6 dB(A)

third octave sound power levels [dB(A)] at standardized wind speeds v_s										
Frequency	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
10 Hz	37.6	38.8	42.3	46.7	48.1	48.5	48.5	48.5	48.5	48.4
12.5 Hz	42.4	43.6	47.2	51.6	53.0	53.3	53.3	53.3	53.3	53.3
16 Hz	47.0	48.2	51.8	56.2	57.6	57.9	57.9	57.9	57.9	57.9
20 Hz	51.4	52.6	56.1	60.5	61.9	62.3	62.3	62.3	62.3	62.3
25 Hz	55.8	57.0	60.5	64.9	66.3	66.2	66.2	66.2	66.2	66.2
31.5 Hz	59.9	61.1	65.0	69.4	70.8	71.7	71.7	71.7	71.7	71.7
40 Hz	65.8	67.0	69.4	73.8	75.2	75.3	75.3	75.3	75.3	75.3
50 Hz	67.0	68.2	72.7	77.1	78.5	80.4	80.4	80.4	80.4	80.4
63 Hz	71.9	73.1	75.2	79.6	81.0	81.7	81.7	81.7	81.7	81.7
80 Hz	74.8	76.0	78.9	83.3	84.7	84.5	84.5	84.5	84.5	84.5
100 Hz	75.8	77.0	80.9	85.3	86.7	89.2	89.2	89.2	89.2	89.2
125 Hz	78.0	79.2	81.9	86.3	87.7	87.7	87.7	87.7	87.7	87.7
160 Hz	81.3	82.5	84.9	89.3	90.7	89.0	89.0	89.0	89.0	89.0
200 Hz	80.4	81.6	84.9	89.3	90.7	90.3	90.3	90.3	90.3	90.3
250 Hz	81.7	82.9	86.4	90.8	92.2	91.2	91.2	91.2	91.2	91.2
315 Hz	82.9	84.1	88.0	92.4	93.8	94.5	94.5	94.5	94.5	94.5
400 Hz	83.3	84.5	88.3	92.7	94.1	94.1	94.1	94.1	94.1	94.1
500 Hz	82.0	83.2	88.0	92.4	93.8	94.3	94.3	94.3	94.3	94.3
630 Hz	83.2	84.4	89.6	94.0	95.4	96.3	96.3	96.3	96.3	96.3
800 Hz	82.5	83.7	89.2	93.6	95.0	95.4	95.4	95.4	95.4	95.4
1000 Hz	83.8	85.0	90.6	95.0	96.4	96.2	96.2	96.2	96.2	96.2
1250 Hz	83.4	84.6	90.1	94.5	95.9	95.5	95.5	95.5	95.5	95.5
1600 Hz	82.9	84.1	89.8	94.2	95.6	94.5	94.5	94.5	94.5	94.5
2000 Hz	81.4	82.6	88.1	92.5	93.9	93.3	93.3	93.3	93.3	93.3
2500 Hz	79.1	80.3	85.7	90.1	91.5	91.3	91.3	91.3	91.3	91.3
3150 Hz	76.9	78.1	81.5	85.9	87.3	88.6	88.6	88.6	88.6	88.6
4000 Hz	76.8	78.0	76.7	81.1	82.5	84.6	84.6	84.6	84.6	84.6
5000 Hz	72.2	73.4	74.3	78.7	80.1	79.8	79.8	79.8	79.8	79.8
6300 Hz	68.5	69.7	72.7	77.1	78.5	79.6	79.6	79.6	79.6	79.6
8000 Hz	66.6	67.8	70.6	75.0	76.4	77.7	77.7	77.7	77.7	77.7
10000 Hz	62.7	63.9	66.7	71.1	72.5	73.5	73.5	73.5	73.5	73.5
Total sound power level	94.0	95.2	99.8	104.2	105.6	105.6	105.6	105.6	105.6	105.6