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IMMISSION AUDIT REPORT – **Project: 13228.02**

South Kent Wind Project
R4368 – Turbine T002
Chatham-Kent, Ontario

Prepared for:

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February 28, 2020

Revision History

Version	Description	Author	Reviewed	Date
1	Initial Report	AED	MAD	February 28, 2020

Important Notice and Disclaimer

Executive Summary

Aercoustics Engineering Limited ("Aercoustics") was retained by South Kent Wind LP to complete the acoustic audit requirements outlined in the Renewable Energy Approval ("REA") for South Kent Wind Project ("SKWP"). SKWP operates under REA #2871-8UKGPC, issued on June 15, 2012.

In response to Section G of the REA, emission audit ("E-Audit") tests were conducted at six (6) SKWP turbines and test reports were submitted to the Ministry of the Environment, Conservation and Parks ("MECP"). Based on these reports, the MECP requested that additional supporting immission audit ("I-Audit") tests be conducted at receptor locations close to each test turbine in order to support the completion of the E-Audit requirement.

This report presents the results of the additional I-Audit assessment for receptor R4368 near turbine T002. The E-Audit results for T002 indicated that the measured sound power level of the test turbine exceeded the sound power level set out in the REA. As such, the audit at R4368 was conducted to assess compliance of the sound pressure level in the far field.

The monitoring near receptor R4368 was conducted over the following period:

Audit Receptor	Audit Start Date	Audit End Date	Monitoring Duration (weeks)
R4368	September 18, 2019	November 23, 2019	10

The audit has been completed as per the methodology outlined in Parts D and E5.5 RAM-I (Revised Assessment Methodology) of the "*MECP Compliance Protocol for Wind Turbine Noise*" (updated April 21, 2017).

Based on the results presented in this report, the assessment requirements outlined in the Compliance Protocol have been met and the cumulative sound impact calculated at R4368 complies with the MECP sound level limits at all wind bins with sufficient data for assessment.

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1 Introduction

Aercoustics Engineering Limited ("Aercoustics") was retained by South Kent Wind LP to complete the acoustic audit requirements outlined in the Renewable Energy Approval ("REA") for South Kent Wind Project ("SKWP"). SKWP operates under REA #2871-8UKGPC, issued on June 15, 2012.

In response to Section G of the REA, emission audit ("E-Audit") tests were conducted at six (6) SKWP turbines and test reports were submitted to the Ministry of the Environment, Conservation and Parks ("MECP"). Based on these reports, the MECP requested that additional supporting immission audit ("I-Audit") tests be conducted at receptor locations close to each test turbine in order to support the completion of the E-Audit requirement.

This report presents the results of the I-Audit assessment for receptor R4368 near turbine T002.

The audit was completed per the methodology outlined in Part D and Part E of the Compliance Protocol for Wind Turbine Noise ("Compliance Protocol" or "Protocol"), April 2017 revision. The Compliance Protocol is an Ontario MECP document used to evaluate noise from a wind turbine at nearby receptors.

2 Background

The most up-to-date E-Audit report submitted and reviewed by the MECP for turbine T002 is as follows:

> REPORT ID: 13228.00.T002.RP5, South Kent Wind Farm – Turbine T002 IEC 61400-11 Edition 3.0 Measurement Report dated 21 December 2018 – Revision 1.

The results of the E-Audit test are summarized in Table 1 below.

Table 1: E-Audit Results Summary

Sound Power			Maximum Tonal Audibility	
REA (dBA)	Audit (dBA)	Exceeds REA plus 0.5 dB* (Y/N)	Audit (dBA)	Exceeds 3 dB** (Y/N)
105	105.9	Y	0.9	N

* REA sound power levels plus 0.5 dB threshold specified in accordance with Section E3.1 of the Protocol.
** 3 dB threshold specified in accordance with Section D3.8.3 of the Protocol.

The E-Audit results indicated that the measured sound power level of the test turbine exceeded the sound power level set out in the REA.

In review of the report, the MECP requested that additional supporting measurements be conducted at the receptor location closest to the test turbine, in accordance with Section E.3.1.2 of the Protocol. This feedback was delivered in an email dated January 4, 2019 and further clarified in a call on January 14, 2019.

The turbine did not have a tonal audibility greater than 3 dB and therefore a tonal assessment in the far field is not required for this test turbine.

For reference, a detailed summary of the sound power and tonal audibility assessment results from the T002 E-Audit is provided in Appendix F.

3 Facility Description

South Kent Wind Project is a wind facility comprising 124 Siemens SWT-101 wind turbines with name plate capacities of 2.221 MW, 2.126 MW, 1.903 MW, and 1.824 MW. The total name plate capacity of the facility is 270 megawatts. Each turbine has a hub height of 99.5 metres. The facility is located in the Chatham-Kent Municipality.

The facility has two large substation transformers rated at 148 and 129 MVA. The facility is designed to operate 24 hours per day, 7 days per week.

4 Audit Location

The receptor selection process, measurement equipment, and details regarding the monitoring locations are provided in this section.

4.1 Receptor Selection

Measurement equipment was erected at receptor R4368 near the test turbine T002. The measurement location was selected as per Section E3.1.2 of the Compliance Protocol, wherein measurements are to be conducted at the point of reception with the greatest predicted noise impact from the specified test turbine (“worst-case receptor”). The frequent downwind conditions were also considered for receptors with similar predicted partial sound levels from the test turbine. The prevailing wind direction for the site is discussed in the following section. The receptor location was selected in consultation with the MECP and confirmed in a letter from the MECP dated March 29, 2019.

The receptor selection table for T002 is shown in Table 2 below. Predicted sound impacts at the receptor were obtained from the Noise Assessment Report for SKWP prepared by Hatch and dated May 7, 2013. A sound model using the original assessment report parameters was created by Aercoustics to calculate predicted sound levels at monitor locations.

Table 2: Receptor Selection Table

SPL Rank	Point of Reception ID	Nearest Turbine	Distance to Test Turbine (m)	Predicted Overall Sound Level (dBA)	Predicted Partial Sound Level from **test turbine** only* (dBA)	Wind Direction from Test Turbine	Notes
1	R4266	T002	742	38.9	34.5	Crosswind	Not downwind
2	**R4368**	**T002**	**755**	**39.4**	**34.3**	**Downwind**	**Measured location**

* These values are predicted based on the manufacturer specified sound power level for each turbine, not the measured sound power levels. They are included to be indicative of the relative contribution of the turbine of interest at each location.

4.1.1 Historical Wind Direction

Historical wind direction information was provided by SKWP and used to support selection of suitable audit receptors. This wind direction information is provided in Figure 1, and the prevailing downwind direction for the facility was determined to be 210°.

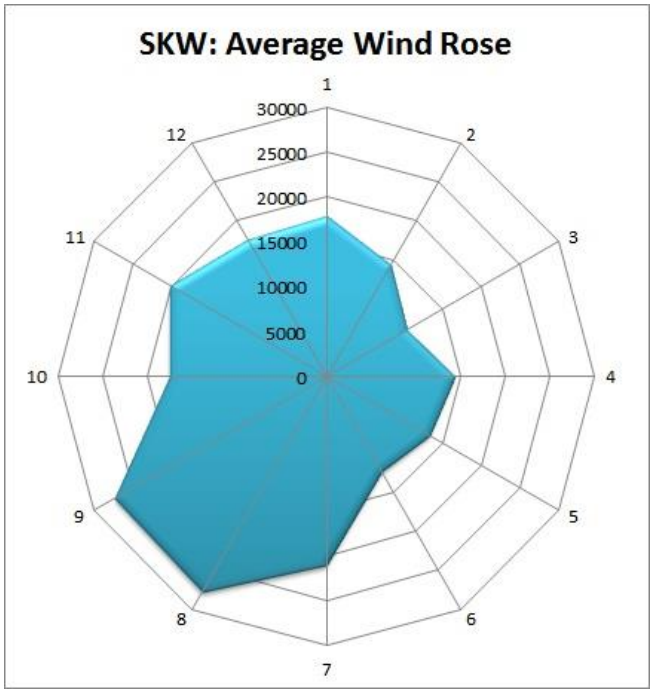


Figure 1: Historical Wind Rose used for Receptor Selection

4.2 Monitoring Location

The monitor was erected at approximately the same coordinates of R4368, 755 metres away from the test turbine (turbine T002). The monitor was erected at the receptor height

of 4.5 metres. The ground cover between the measurement location and the nearest turbines was open field, predominantly covered with short crops.

Table 3 provides a summary of the receptor and monitor locations. Site photographs and plans are provided in Appendix A.

Table 3: Coordinates and Turbines to Receptor and Measurement Locations

Audit Receptor	Measurement Duration	Location	Coordinates (UTM x, y, Zone 17T)	Distance to Test Turbine (m)	Predicted Overall Sound Level (dBA)
R4368	Sep 18, 2019 – Nov 23, 2019	Receptor	426448 mE / 4691566 mN	755	39.4
		Monitor	426458 mE / 4691559 mN	755	39.4

4.3 Existing Ambient Environment

The ambient acoustic environment for the SKWP site is comprised of a mixture of many different ambient sources. The contribution of noise from flora, fauna, traffic, and industry near the monitor location were considered throughout the measurement campaign.

Existing ambient noise sources were categorized as either extraneous – such as short-term events, or frequency-specific noise – or constant noise sources as part of the existing ambient sound environment. In the case of extraneous noise sources, filtering was employed to reduce or remove it, as further discussed in Section 5.3.2. For constant noise sources identified as being a part of the existing ambient sound environment, efforts were made to ensure that the noise was equally present in both *Total Noise* and *Background* periods, as further discussed in Section 5.3.3.

4.3.1 Flora Noise

Ambient noise from flora refers to the noise generated by wind blowing over vegetation and foliage and is typically proportional to wind speed, with higher wind speeds generating increased amounts of noise. Due to its ever-present and broadband nature, noise from flora is considered a constant noise source as part of the existing ambient environment.

The monitor was located in a field with short crop cover, which had negligible noise impact on the measurements. An area of approximately 40x40 ft was cleared around the monitor prior to installation. The monitor was also located approximately 20 metres from a line of shrubs to the north-west, with no trees in the vicinity.

4.3.2 Fauna Noise

Noise from fauna refers to noise typically arising from the activity of insects, birds, livestock, or dogs. Noise of this nature may be concentrated at high frequencies (such as crickets chirping) or limited to short-term events (such as dogs barking). Noise from fauna is considered extraneous noise.

Cricket noise was present at the monitor location and was especially prominent in the early fall months from September to November. There were no other significant sources of fauna noise identified at the monitor location.

4.3.3 Traffic Noise

Traffic noise may include short-term events such as individual car passbys (considered extraneous noise) or constant noise (i.e. “traffic hum”) from high-volume or frequently travelled roads and highways.

The monitor was located approximately 20 metres from Kent Bridge Road to the south-west. Due to the traffic volume and proximity to the nearest road, individual car passbys were frequent throughout the measurement campaign.

The monitor was not located near any major highways and therefore constant traffic noise was not a concern during the measurements.

4.3.4 Industry Noise

No significant sources of industry noise were identified in the vicinity of the monitor.

4.3.5 Self-Generated Noise

Self-generated noise is noise which results from wind blowing over the monitoring equipment and is a factor at high wind speeds at the measurement position. This noise was minimized by a secondary wind screen installed around the microphone in accordance with Section D2.1.4 of the Protocol. The insertion loss of the wind screen has been tested and was accounted for in the analysis.

4.3.6 Other Sources

No other notable ambient noise sources were identified in the vicinity of the monitor.

5 Audit Methodology

For the duration of the measurement campaign, acoustic and weather data were logged simultaneously in one-minute intervals at the measurement location. Analysis and filtering were conducted in accordance with Sections D5.2 and E5.5 of the Protocol, with additional filters applied as needed—following the guidance in the Protocol—to remove or reduce extraneous ambient noise (see Section 5.3.2 below) and ensure representative ambient conditions (see Section 5.3.3 below).

Intervals that passed the filtering criteria were sorted into integer wind bins[1] depending on the measured wind speed at 10 metres above ground level (“10m-AGL”) and classified as

[1] An integer wind bin spans 1 m/s, centred on each integer wind speed, open at the low end and closed at the high end.

either *Total Noise* or *Background* depending on the operation of the nearby SKWP turbines. The *Turbine-Only* sound level for each wind bin was determined by logarithmically subtracting the average *Background* levels from the *Total Noise* level in wind bins with sufficient data for assessment.

5.1 Measurement Equipment

The following acoustic and non-acoustic measurement equipment was installed at the monitor location:

- One (1) Type 1 sound level meter with microphone and pre-amplifier, installed at receptor height;
- One (1) primary and one (1) secondary[2] windscreen for the microphone; and
- One (1) anemometer, installed at 10m-AGL

The measurement equipment was configured to log one-minute equivalent sound levels (L_{eq}) in A-weighted broadband and 1/3rd octave band frequencies. The microphone was installed at least 5 metres away from any large reflecting surfaces, as far away as practically possible from trees and other foliage, and in direct line of sight to the nearest SKWP turbines.

Table 4 lists the specific make, model, and serial numbers for the measurement equipment.

Table 4: Equipment Details

Audit Receptor	Equipment	Make/Model	Serial Number	Date of Last Calibration
R4368	Data Acquisition Card	NI 9234	1A5E7FC	June 10, 2019
	Signal Conditioner	PCB 480E09	34423	May 17, 2019
	Microphone	PCB 377B02	158838	March 6, 2019
	Pre-Amplifier	PCB 426E01	41180	March 6, 2019
	Weather Anemometer	Vaisala WXT520	K0640011	July 25, 2019

The measurement chain was calibrated before, during, and after the measurement campaign using a type 4231 Brüel & Kjær acoustic calibrator. The measurement equipment was also verified by laboratory calibration per the requirements in Section D2.3 of the Protocol; calibration certificates are provided in Appendix D.

[2] The 1/3 octave band insertion loss of the secondary windscreen has been tested and has been accounted for in the data analysis.

5.2 Measurement Parameters

Measurement equipment was configured to run from approximately 9pm to 6am, local time. The measurement parameters acquired and used in the audit are listed in Table 5.

Table 5: Measurement Parameters Used in the Study

Parameter Group	Measurement Parameters	Notes
Acoustic (microphone height)	L_{Aeq}	dBA
	L_{90}	dBA
	1/3rd Octave Band	dBA (20 Hz – 10 kHz)
	Signal Recording	Uncompressed raw files
Weather (10-m height)	Wind Speed	m/s
	Wind Direction	0-360˚
	Temperature	˚C
	Humidity	0-100%
	Precipitation	mm
Turbine (hub height)	Wind Speed	Provided by operator
	Yaw Angle	Provided by operator
	Power Output	Provided by operator
	Rotational Speed	Provided by operator

SKWP wind turbine operational information was collected during the measurement campaign using the facility SCADA system and provided to Aercoustics by South Kent Wind LP.

5.3 Filtering Criteria

Intervals were included or excluded from analysis depending on several filtering criteria. Some of these criteria apply to all intervals and some apply only for *Total Noise* or *Background* intervals. Measurement intervals were first passed through the *All Intervals* filters, after which they were sorted into either *Total Noise* or *Background* categories based on the operation of the nearby turbines. Intervals were included in the assessment dataset if they met all the following criteria:

All Intervals

- Occurred between 10pm – 5am
- Had no precipitation within one hour before or after
- Had an ambient temperature above -20˚C
- Had minimal influence from extraneous ambient noise sources

Total Noise Intervals

- All nearby turbines were operating
- Test turbine was generating at least 85% of the maximum rated power output
- Monitor was located downwind of the test turbine

Background Intervals

- All nearby turbines were parked (i.e. not rotating)

5.3.1 Turbines in Study Area

As noted above, several filtering criteria were applied based on the operation of the nearest turbine and the turbines in the surrounding area. To verify the operation of these turbines, information from the facility SCADA was processed along with the acoustic and weather data.

The minimum number of turbines included in the study area for the receptor and verified for *Total Noise* measurements was selected based on the guidance of Section D3.8.1 of the Protocol:

> ***D3.8.1 Overall equivalent sound level – wind turbines operational***
>
> *"[…] At a minimum, all relevant turbines of the subject and adjacent wind facilities, typically within 3 km of the measurement location should be operational. In the event that an adjacent wind facility dominates the background sound levels, subsequent to approval by the Ministry, an alternative measurement location may be selected."*

The minimum number of turbines included in the study area of the receptor and verified for *Background* measurements was selected based on the guidance of Section D3.5.2 of the Protocol:

> ***D3.5.2 Acoustic measurements with wind turbines parked***
>
> *"Ambient noise measurements shall be carried out at a point of reception with all turbines in the vicinity of the point of reception parked. The prediction model will be used to determine the number of turbines that require parking in order for the predicted noise contribution of the wind facility to fall to 30 dBA or 10 dB less than the applicable criterion."*

The turbines in the study area of the receptor are listed in Table 6 below.

Table 6: Turbines Included in the Study Area

Audit Receptor	Turbines verified for *Total Noise* Measurements	Turbines verified for *Background* Measurements
R4368	T001, T002, T003, T004, T006, T007, T008, T093, T106, T107, T118, T138, T166, T167	T001, T002, T003, T004, T006, T106, T118, T138, T166

Parked turbines do not rotate or generate power. There is some idling of the blades (~2 RPM or less), but the acoustic impact of the turbines in this condition is negligible at the receptor. The turbines were confirmed to be running in their normal operating mode for the duration of the monitoring campaign. See Appendix B for a statement from the operator.

5.3.2 Removal of Extraneous Noise

'Extraneous noise' is defined as ambient sound sources unrelated to the operation of the wind facility. The removal or reduction of extraneous noise sources in the measurement data is important to ensure the assessment of turbine-only sound levels is as accurate and free of contamination as possible. The Protocol provides the following guidance regarding extraneous noise:

> ***C2.4.7 Extraneous noise sources[3]***
>
> *"Measurements are to be inhibited when the sound level is affected by noise from extraneous sources such as vehicle noise, dogs barking and wind gusts (i.e. other than wind turbine sound).*
>
> *"The same result can also be achieved by digitally recording the sound level time history and later editing out the extraneous events and recalculating the descriptors such as Leq. This should address measurement situations where extraneous sounds were not inhibited."*
>
> ***D3.5 Acoustic measurements***
>
> *"[…] In addition, if the background sound levels are greater than the applicable exclusion limits then the applicable limits are the background sound levels without extraneous noise sources."*
>
> ***D5.3 Effects of insects and fauna***
>
> *"The analysis shall identify the influence of any insects, fauna, or other extraneous but constant sources of noise and verify them through sound recordings. Noise from insects*

[3] It is acknowledged that the measurements in this report follow Part D and Part E of the Protocol and this guidance is from Part C. Nevertheless, the guidance regarding the removal of extraneous noise in Part C is applicable here as the requirement to remove contamination from the measurement dataset follows good engineering principles for noise measurements.

> *can be removed from the 1/3rd octave spectra of each measurement. It has to be shown, however, that the contribution of the wind turbine noise in those frequencies is minimal."*
>
> ***D6 Assessment of compliance***
>
> *"[…] However, if the background sound levels are greater than the applicable exclusion limits then the applicable limits are now the background sound levels without extraneous noise sources."*

Extraneous noise can be steady or transient. Steady noise can be removed via filtering or removal of specific 1/3rd octave bands affected by the contamination (as per Protocol section D5.3). Transient noise can be removed or reduced from the dataset by automatic and manual filtering techniques.

Steady noise from crickets, identified at a frequency of 3150 Hz and above and verified through listening tests, was removed from the 1/3rd octave spectra for all measurements. The contribution from the wind turbine noise in those frequencies was evaluated as further discussed in Section 6.4.2.

A combination of automatic filtering and manual removal of the data was used to exclude intervals that were contaminated with extraneous noise from car passbys and other short-term events.

5.3.3 Representative Ambient Conditions

The conditions present during the *Total Noise* and *Background* periods must be from similar weather and wind shear conditions, per Protocol section D3.8.2:

> ***D3.8.2 Overall equivalent sound level – wind turbines parked***
>
> *"Ambient noise measurements should be performed with the turbines parked and conducted within the same general measurement period and with the same weather and wind shear conditions. Measurements of ambient noise obtained during other periods are not recommended and should only be used with great caution to ensure that they represent the "current" ambient noise."*

Background measurements were collected periodically throughout the measurement campaign to ensure the *Background* and *Total Noise* measurements were collected during similar conditions in the same seasons.

5.3.4 Adjacent Wind Facilities

No additional wind facilities were present in the area adjacent the receptor location.

5.4 Compliance Criteria

The minimum criteria required for an assessment of compliance per the Compliance Protocol are detailed in this section.

5.4.1 Sample Size Requirements

Requirements per the RAM-I methodology of the Compliance Protocol (Section E5.5) are used for this audit. Per Section E5.5 of the Protocol, an assessment dataset is considered complete if at least three wind bins from 1 – 7 m/s (inclusive) or two wind bins from 1 – 4 m/s (inclusive) are complete. A wind bin is considered complete if there are at least 60 valid *Total Noise* and 30 valid *Background* intervals.

5.4.2 Sound Level Limits

Sound level limits vary with 10m-AGL wind speed and by class designation. The area surrounding the SKWP site has been previously designated as Class 3. Exclusion limits for a Class 3 area are summarized in Table 7 below.

Table 7: MECP Exclusion Limits (Class 3)

Wind speed at 10 m height, 10m-AGL (m/s)	Sound Level Exclusion Limit (dBA)
≤ 6	40
7	43

These sound level limits apply to points of reception. Given that the predicted impact at the monitoring location is greater than the predicted impact at the receptor (see Table 3, Section 4.2), results at the monitor are conservative and can be used to show compliance at the receptor.

5.5 Deviations

Any deviations from the methods prescribed in the Protocol are discussed in this section.

5.5.1 Measurement Bandwidth

As noted in Table 5, the measurement bandwidth used is 20 – 10,000 Hz. This is a deviation from the Protocol Section D2.1.1 requirement of a 20 – 20,000 Hz frequency response. Due to the high attenuation of noise levels at high frequencies, noise at the receptor from the wind facility above 10,000 Hz will be insignificant[4].

6 Audit Results

Sound levels and weather conditions measured throughout the course of the I-Audit campaign are summarized in the following sections.

6.1 Audit Duration

The length of the monitoring campaign is summarized in Table 8 below.

[4] From Table 2 of ISO 9613-2, acoustic frequencies above 8 kHz experience attenuation from atmospheric absorption alone of more than 80 dB/km.

Table 8: Length of Monitoring Campaign

Audit Receptor	Audit Start Date	Audit End Date	Monitoring Duration (weeks)
R4368	September 18, 2019	November 23, 2019	10

6.2 Weather Conditions

Throughout the measurement campaign, a variety of weather conditions were encountered. The range of weather conditions measured in the assessment dataset are summarized in Table 9. Note that the assessment dataset includes the *Total Noise* and *Background* data that remains after filtering.

Table 9: Range of Weather Conditions in Assessment Dataset

Audit Receptor	Atmospheric Pressure (hPa)	10m-AGL Wind Speed (m/s)	Relative Humidity (%)	Temperature (°C)	Hub-Height Wind Speed (m/s)
R4368	973 – 1006	0.12 – 9.7	44 – 86	-2 – 26	0 – 14.4

During the audit period, the predominant wind direction was measured to be from the south-west. A wind rose detailing the measured wind directions observed during the entire measurement campaign is provided in Figure 2. Note that wind directions shown on the wind rose indicate the direction the wind is coming from. The purple shaded region represents the downwind condition from the test turbine at the monitor location.

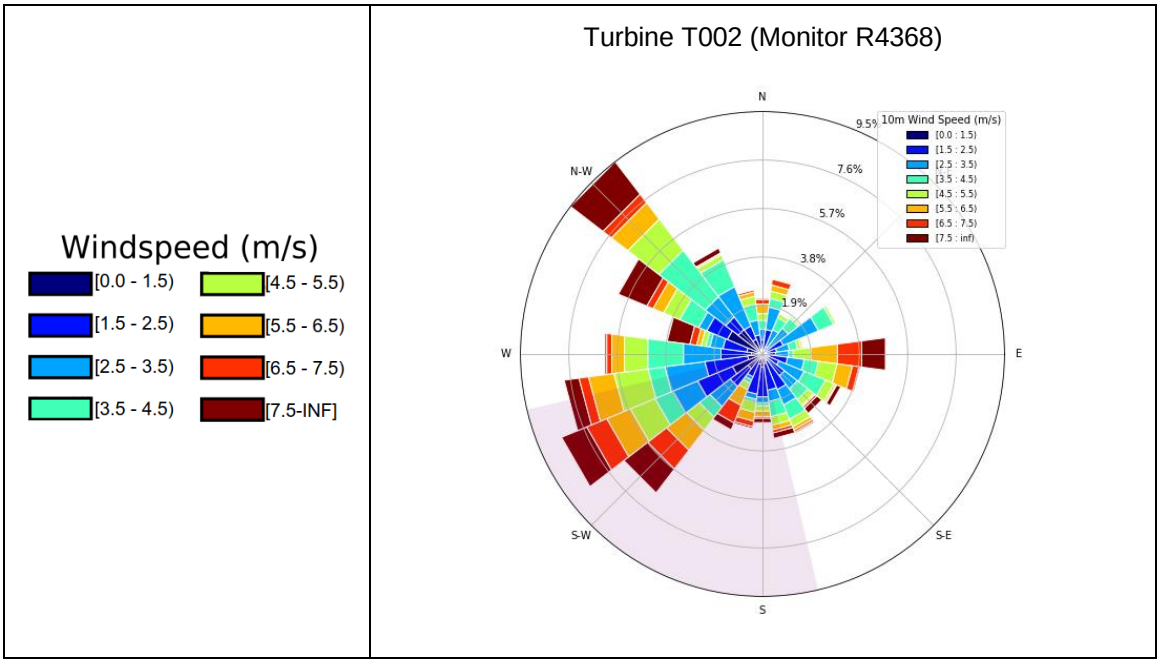


Figure 2: Wind Rose (All Measured Data)

From Figure 2, the distribution of wind directions observed during the measurement campaign is similar to those expected based on the historical wind rose provided in Section 4.1.1. Wind roses for the assessment dataset are included in Appendix C.

6.3 Data Excluded due to Filtering Criteria

A range of power output and wind conditions were measured over the course of the audit campaign. Table 10 provides the amount of time during the measurements (between 9pm and 6am) where the two main filtering conditions (high turbine power and downwind conditions) were met, i.e. the percentage of time during the measurement campaign that a receptor experienced the maximum noise impact from the South Kent Wind Project facility.

Table 10: Prevalence of Suitable Turbine Conditions During Measurements

Audit Receptor	Test Turbine	Prevalence of Downwind	Prevalence of High Output (>85% power)	Prevalence of Downwind and High Output
R4368	T002	31%	5%	2%

These conditions represent the minimum requirements for valid *Total Noise* intervals. The additional filters discussed in Section 5.3 further reduced the assessment dataset.

6.4 Measured Sound Levels

Average measured sound levels by wind bin for *Total Noise* and *Background* periods are presented in Table 11 below.

Table 11: Average Measured Sound Levels, RAM-I Analysis

Audit Receptor	Period	Measurement Parameter	Wind Bin (m/s)						
			1	2	3	4	5	6	7
R4368	Total Noise	Number of Samples	0	0	0	24	65	111	107
		Average L_{Aeq} (dBA)	-	-	-	-	41	42	44
		Standard Deviation (dB)	-	-	-	-	0.9	0.9	1.1
	Background	Number of Samples	131	170	5	24	37	53	31
		Average L_{Aeq} (dBA)	32	37	-	-	36	38	41
		Standard Deviation (dB)	6.8	8.3	-	-	1.4	1.6	1.2

- Sound level not reported in wind bin if minimum sample size not met for *Total Noise* (60) or *Background* (30).

It should be noted that the sound levels presented here are rounded to the nearest integer; all calculations and analysis are conducted using the un-rounded sound levels.

Measurement data points from Table 11 are also plotted in Figure 3 below.

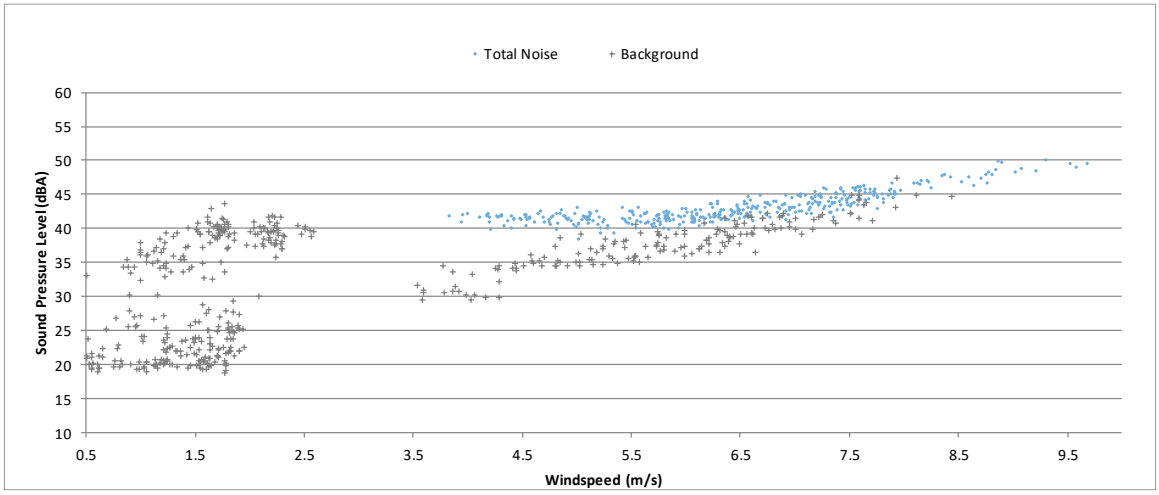


Figure 3: Average Measured Total Noise and Background Sound Levels
Monitor Near R4368

6.4.1 Tonal Adjustment

Based on the E-Audit test results, the maximum tonal audibility measured at the turbine location was 0.9 dB at 428 Hz. This is less than 3 dB and, and therefore no formal tonal assessment was conducted per Section D3.8.3 of the Compliance Protocol.

6.4.2 Other Adjustments

As noted in Section 5.3.2, the 1/3rd octave band frequencies at 3150 Hz and above were removed from the assessment dataset due to contamination from cricket noise. The contribution from the wind facility at these excluded frequencies was determined at the monitor location by calculating the partial noise impact from the facility in the excluded frequency range. The impact from the facility at 3150 Hz and above was determined to be 3.4 dBA at the monitor. Although the excluded impact is negligible, it has been added logarithmically to the final calculated Turbine-Only sound level at the monitor location shown in Table 13.

6.5 Turbine-Only Sound Levels

The average measured sound levels by wind bin for *Total Noise* and *Background* periods are presented in Table 12.

Table 12: Calculated Turbine-Only Sound Levels, RAM-I Analysis

Audit Receptor	Measurement Period	Wind Bin (m/s)						
		1	2	3	4	5	6	7
R4368	Total Noise (dBA)	-	-	-	-	41	42	44
	Background (dBA)	32	37	-	-	36	38	41
	Signal to Noise (dBA)	-	-	-	-	5.1	3.5	2.9
	Turbine-Only (dBA) [monitor location]	-	-	-	-	40	39	41*
	Tonal Adjustment	-						

\- Sound level not reported in wind bin if minimum sample size not met for *Total Noise* (60) or *Background* (30).

* Signal-to-noise level less than 3 dB. Increased uncertainty in determination of Turbine-Only Sound Impact.

7 Assessment of Compliance

This section provides the results of the measurements and calculations as they pertain to the determination of compliance of the facility in accordance with the criteria listed in Section 5.4 of this report.

7.1 Assessment Table

Table 13 compares the final Turbine-Only sound levels for each wind bin at the Receptor location to the applicable exclusion limits and background sound levels. Final Turbine-Only sound levels at the Point of Reception are calculated by taking the Turbine-Only sound level at the measurement location and applying any applicable adjustments as indicated in Table 12.

Table 13: Assessment Table

Audit Receptor	Wind speed at 10m-AGL (m/s)	1	2	3	4	5	6	7
R4368	Turbine-Only Sound Level (dBA)	-	-	-	-	40	39	41*
	Background Sound Level (dBA)	*32*	*37*	-	-	*36*	*38*	*41*
MECP Exclusion Limit (dBA)		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	-	Yes	Yes	Yes

- Sound level not reported in wind bin if minimum sample size not met for *Total Noise* (60) or *Background* (30).

* Signal-to-noise level less than 3 dB. Increased uncertainty in determination of Turbine-Only Sound Impact.

7.2 Statement of Compliance

Based on the Receptor Turbine-Only sound levels presented in Table 13, sound immission levels at the audited receptor are in compliance with the applicable sound level limits.

8 Conclusion

Aercoustics was retained by South Kent Wind LP to complete an additional supporting I-Audit at the worst-case receptor of turbine T002, in response to the E-Audit test submitted December 21, 2018 and reviewed by the MECP.

The additional I-Audit measurements were conducted in accordance with the MECP Compliance Protocol for Wind Turbine Noise from September 18, 2019 to November 23, 2019 at receptor R4368 near T002.

Based on the results presented in this report, the assessment requirements outlined in the Compliance Protocol have been met and the cumulative sound impact calculated at R4368 complies with the MECP sound level limits at all wind bins with sufficient data for assessment.

Appendix A
Site Details

Legend

- Ontario HWY 401
- Campaign Monitor
- Spring 2015 Campaign Monitor
- Receptor Locations
- South Kent Turbines

Third Party Turbines

- Talbot
- Chatam
- Front Line
- Port Alma
- Bisnett Line
- Raleigh
- Erieau Blenheim

N

Project ID:	13228.02
Drawn by:	AA
Reveiwed by:	AD
Date:	February 12, 2020
Revision:	1
Scale:	As Indicated

South Kent Wind Project
Immission Audit Report
R4368 - T002

Appendix A.1

Site Plan Overview

aercoustics

Legend

Campaign Receptor

- **Campaign Monitor**
- **Campaign Receptor**
- **South Kent Turbines**
- **Kent Bridge Road**

N

Project ID:	13228.02
Drawn by:	AA
Reveiwed by:	AD
Date:	February 10, 2019
Revision:	1
Scale:	As Indicated

South Kent Wind Project
Immission Audit Report
R4368 - T002

Appendix A.2

Monitor and Receptor Location

aercoustics

Project ID:	13228.02
Drawn by:	AA
Reveiwed by:	AD
Date:	February 11, 2020
Revision:	1
Scale:	As Indicated

South Kent Wind Project
Immission Audit Report
R4368 - T002

Appendix A.3

Monitor to T002

aercoustics

Appendix B
Statement from the Operator

SP South Kent Wind LP
2050 Derry Road West
2nd Floor
Mississauga, ON L5N 0B9
www.southkentwind.com

February 12, 2020

Director, Environmental Approvals Access and Service
Integration Branch Ministry of Environment
2 St. St Clair Avenue West, Floor 12A
Toronto ON M4V 1L5

Subject: South Kent Wind Project (REA #2871-8UKGPC) Receptor Imission Audit 2019-2020

Dear Director

Please accept this letter as confirmation that all turbines tested during the acoustics measurement campaign conducted by Aercoustics Engineering Limited from September 18, 2019 to January 22, 2020 were operating normally for the duration of the campaign, with the exception of specific time periods during which the turbines were placed in remote owner stop to facilitate ambient noise measurements.

The turbines placed in remote owner stop for ambient measurements were different depending on the receptor targeted, and were as follows:

- R4368: T001, T002, T003, T004, T006, T106, T118, T138, T166
- R3287: T031, T032, T033, T034, T035, T036, T039, T040, T041, T108, T135, T156
- R3344: T026, T028, T029, T030, T035, T036, T042, T108, T109, T120, T135
- R3167: T032, T033, T037, T038, T039, T040, T045, T046
- R2794: T055, T056, T057, T060, T100, T111, T164
- R4248: T001, T002, T003, T004, T006, T093, T102, T138, T152, T166, T167

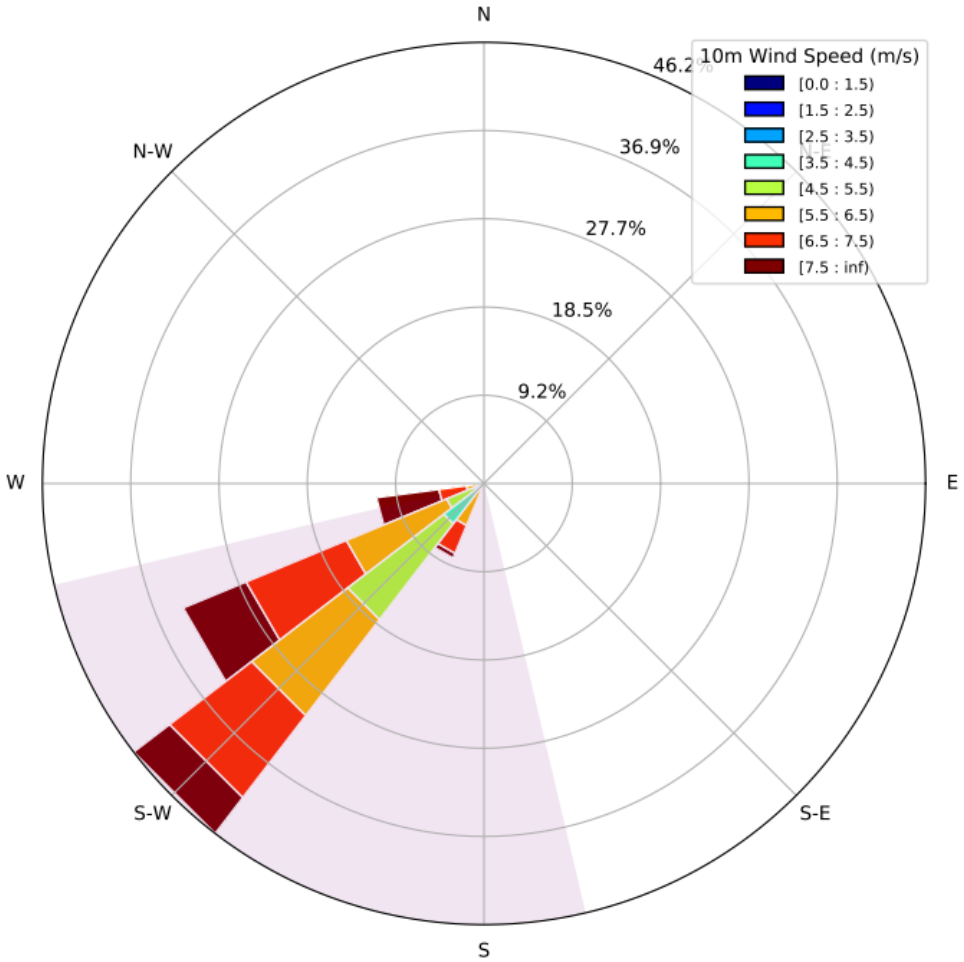
The turbines verified for operational measurements were different depending on the receptor targeted, and were as follows:

- R4368: T001, T002, T003, T004, T006, T007, T008, T093, T106, T107, T118, T138, T166, T167
- R3287: T024, T029, T030, T031, T032, T033, T034, T035, T036, T039, T040, T041, T042, T108, T120, T135, T155, T156
- R3344: T026, T028, T029, T030, T031, T034, T035, T036, T041, T042, T108, T109, T120, T135, T155
- R3167: T032, T033, T034, T037, T038, T039, T040, T041, T044, T045, T046
- R2794: T054, T055, T056, T057, T058, T060, T097, T100, T111, T163, T164
- R4248: T001, T002, T003, T004, T006, T093, T102, T138, T152, T166, T167

Sincerely,

Kevin Aikenhead
Facility Manager
South Kent Wind
C: 519-350-9373

Appendix C
Wind Roses



Legend

Turbine Downwind Direction

Project ID:	13228.02
Drawn by:	AA
Reveiwed by:	AD
Date:	February 14, 2020
Revision:	1
Scale:	As Indicated

South Kent Wind Project
Immission Audit Report
R4368 - T002

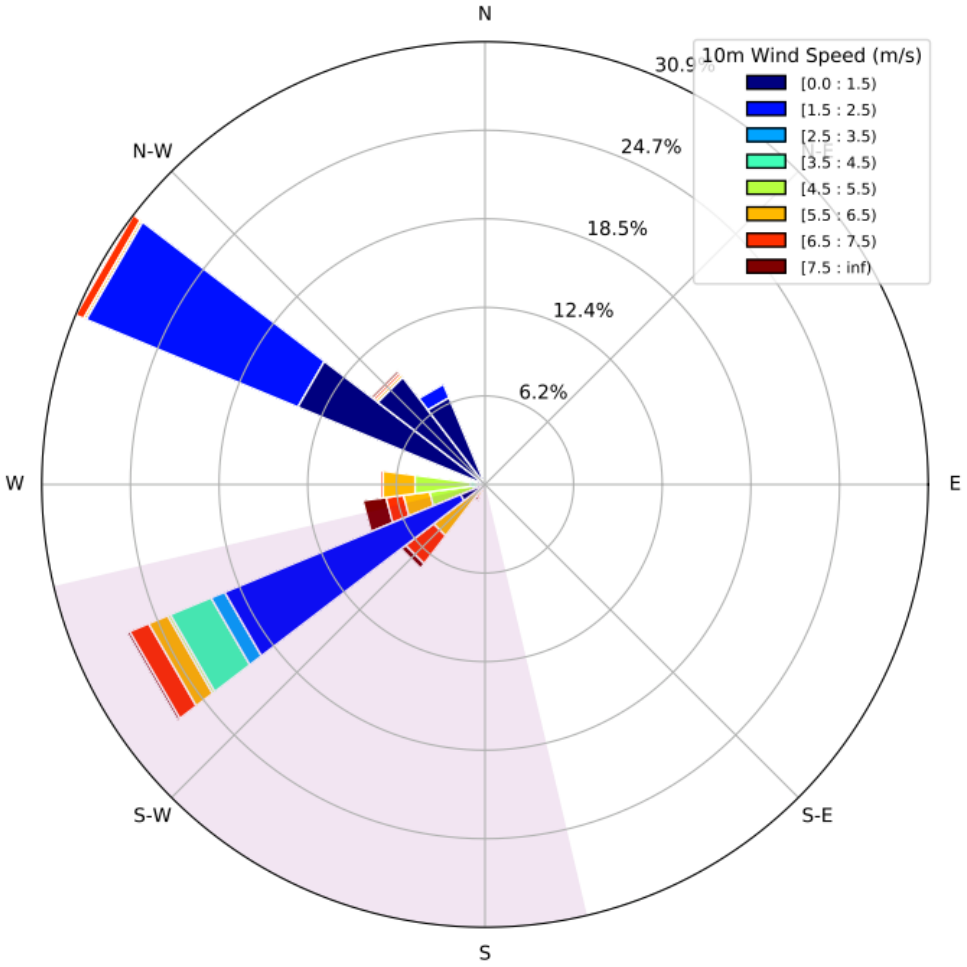
Appendix C.1

Supplementary Wind Rose based on Assessment Data Total Noise

aercoustics

Legend

Turbine Downwind Direction



Project ID:	13228.02
Drawn by:	AA
Reveiwed by:	AD
Date:	February 14, 2020
Revision:	1
Scale:	As Indicated

South Kent Wind Project
Immission Audit Report
R4368 - T002

Appendix C.2

Supplementary Wind Rose based on Assessment Data Background Noise

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Appendix D
Calibration Certificates

CALIBRATION CERTIFICATES

Details are disclosed in the table below regarding the calibration of the equipment used for the Immission Audit at monitor location R4368. The associated calibration certificates are provided in this appendix.

Audit Receptor	Equipment	Make/Model	Serial Number	Date of Last Calibration
R4368	Data Acquisition Card	NI 9234	1A5E7FC	June 10, 2019
	Signal Conditioner	PCB 480E09	34423	May 17, 2019
	Microphone	PCB 377B02	158838	March 6, 2019
	Pre-Amplifier	PCB 426E01	41180	March 6, 2019
	Weather Anemometer	Vaisala WXT520	K0640011	July 25, 2019

CERTIFICATE of CALIBRATION

Make : PCB Piezotronics

Reference # : 155801

Model : 378B02

Customer : Aercoustics Engineering Ltd
Mississauga, ON

Descr. : Microphone System 1/2" Free Field

Serial # : 123029

P. Order : 2019.03.04C

Asset # : 00813

Cal. status : Received in spec's, no adjustment made.

Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.

Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.

Our calibration system complies with the requirements of ISO-17025 standard, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.

Calibrated : Mar 06, 2019

By : Petro Onasko

Cal. Due : Mar 06, 2021

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-216 J-324 J-333 J-420 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7
Phone : 905 565 1584 Fax: 905 565 8325
http: // www.navair.com
e-Mail: service @ navair.com

NT NAVAIR TECHNOLOGIES

6375 Dixie Rd Unit# 7
Mississauga, ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: 378B02	Approved by: JR	Feb-16	Ver 1.0

Calibration Report for Certificate : 155801

Make			Model	Serial		Asset
PCB Piezotronics			378B02	123029		00813
PCB Piezotronics			377B02	158838		

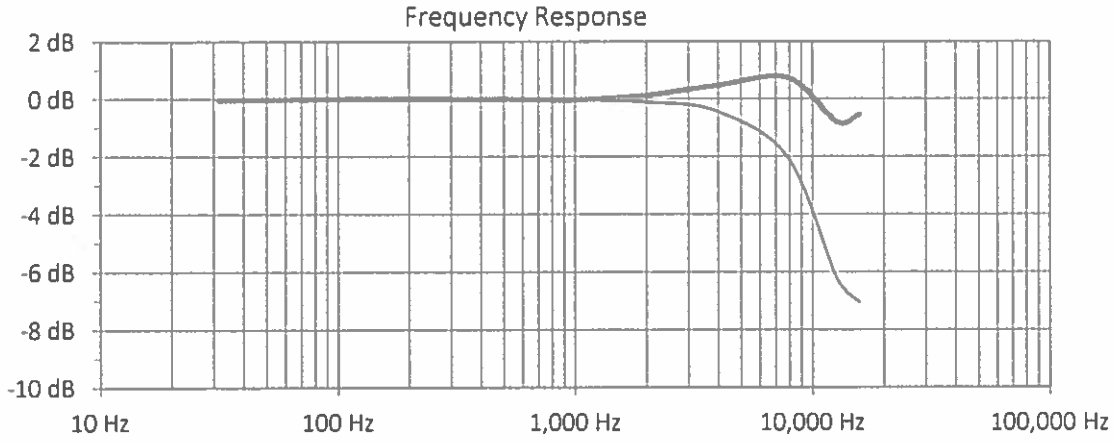
Sensitivity at 250 Hz

Specs Nom	Unit	Min	Reading	Max	In/Out
50	mV/Pa	39.72	52.91	62.94	In
-26.02	dB re 1V/Pa	-28.02	-25.53	-24.02	In
0	dB re 50mV/Pa	-2	0.49	2	In

Ambient Conditions: Static Pressure 100.0 kPa
Temperature 23.3°C
Rel.Humidity 30.4%

Frequency response

	Lower	Upper	
Freq	Pressure	Free Field	
Hz	dB	dB	
31.5	-0.04	-0.04	
63.1	-0.02	-0.01	
125.9	0.00	0.00	
251.3	0.00	0.00	ref
502.5	-0.01	-0.01	
1005.1	-0.05	-0.03	
1978.7	-0.11	0.12	
3957.5	-0.44	0.47	
7914.9	-2.07	0.72	
12663	-6.23	-0.80	
15830	-7.07	-0.54	



CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157210
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	34423	P. Order :	2019.05.16C
Asset # :	00980		

Cal. status : Received in spec's, no adjustment made.

Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.

Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.

Our Quality System system complies with the requirements of ISO-9001-2015 and is registered under certificate CA96/269, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.

Calibrated : May 17, 2019 By : Petro Onasko

Cal. Due : May 17, 2021

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-255 J-301 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

6375 Dixie Rd. Mississauga, ON, L5T 2E7
Phone : 800-668-7440 Fax: 905 565 8325
http: // www.navair.com
e-Mail: service @ navair.com

NT NAVAIR TECHNOLOGIES

6375 Dixie Rd Unit# 7
Mississauga, ON L5T 2E7
Tel: (905)565-1583
Fax: (905)565-8325

Form: 480E09	Approved by: J. Raposo	Jun-18	Ver 1.2

Calibration Report for Certificate : 157210

Make	Model	Serial №	Asset
PCB Piezotronics	480E09	00034423	00980

Test	Input		Min	Reading	Max		In/Out

Gain accuracy at 1 kHz

Gain Set

• 1	1.000 V		0.9800	1.0000 V	1.0200		In
• 10	0.100 V		0.9800	1.0003 V	1.0200		In
• 100	0.010 V		0.9800	0.9994 V	1.0200		In

Gain Flatness

Gain • 1

10 Hz	1.000 V		-5.0	0.2%	5.0		In
10 kHz	1.000 V		-5.0	0.0%	5.0		In
50 kHz	1.000 V		-5.0	0.0%	5.0		In
100 kHz	1.000 V		-5.0	0.0%	5.0		In

Gain • 10

10 Hz	0.100 V		-5.0	0.2%	5.0		In
10 kHz	0.100 V		-5.0	0.0%	5.0		In
50 kHz	0.100 V		-5.0	-0.1%	5.0		In
100 kHz	0.100 V		-5.0	-0.9%	5.0		In

Gain • 100

10 Hz	0.010 V		-5.0	-0.2%	5.0		In
10 kHz	0.010 V		-5.0	0.5%	5.0		In
50 kHz	0.010 V		-5.0	1.3%	5.0		In

Compliant Calibration Certificate

Template Revisio

NATIONAL INSTRUMENTS
CALIBRATED
S/N/ID 1A5E7FC
DATE: 10-JUN-2019
DUE: 10-JUN-2020
ni.com/calibration

Certificate Number:	6050807.1	**OE Number:**	21685752
Date Printed:	10-JUN-2019	**Page:**	1 of 14
Customer:	Aercoustics Engineering LTD (CA) 1004 Middlegate Rd No 1100 ONTARIO MISSISSAUGA, L4Y 1M4 CANADA		
Manufacturer:	National Instruments	**Model:**	NI 9234
Serial Number:	1A5E7FC		
Part Number:	195551B-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	10-JUN-2019	**Recommended Calibration Due:**	10-JUN-2020
Procedure Name:	NI 9234	**Verification Results:**	As Found: Passed As Left: Passed
Procedure Version:	3.6.1.0	**Calibration Executive Version:**	4.6.2.0
Lab Technician:	Rogelio Gaytan	**Driver Info:**	NI-DAQmx:17.6.0
Temperature:	23.0° C	**Humidity:**	43.7% RH

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments.

As Left The calibration data of the unit when returned from National Instruments.

The As Found and As Left readings are identical for units not adjusted or repaired.

This calibration conforms to ANSI/NCSL Z540.1-1994 (R2002) requirements.

The TUR (Test Uncertainty Ratio) of this calibration is maintained at a ratio of 4:1 or greater, unless otherwise indicated in the measurements. A TUR determination is not possible for singled sided specification limits and therefore the absence of a value should not be interpreted as a TUR of 4:1 or greater, but rather undetermined. When provided, the expanded measurement uncertainty is calculated according to the Guide to the Expression of Uncertainty in Measurement (GUM) for a confidence level of approximately 95%. The uncertainty is calculated at time of calibration and does not include the object long-term stability and different environmental and operational conditions.

Results are reviewed to establish where any measurement results exceeded the manufacturer's specifications. Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'.

The Calibration Certificate can be viewed or downloaded online at www.ni.com/calibration/. To request a hard copy, contact **NI Customer Service at Tel:(800) 531-5066 or E-mail customer.service@NI.com**

Ted Talley
Technical Manager

National Instruments Calibration Services Austin
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11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

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Calibration Notes

Type	Note
Asset	Verification and adjustment were performed.

Standards Used

Manufacturer	Model	Type	Tracking Number	Calibration Due	Notes
Fluke	5720A	Calibrator	9379	09-JUL-2019	
National Instruments	PXI-4461	Function generator	9520	20-AUG-2019	
National Instruments	PXI-4071	Digital multimeter	9840	17-MAY-2020	
National Instruments	PXI-4132	SMU	9170	06-MAY-2020	

The standards used in this calibration are traceable to NIST and/or other National Measurement Institutes (NMI's) that are signatories of the International Committee of Weights and Measures (CIPM) mutual recognition agreement (MRA).

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Calibration Results

As Found

Verify Accuracy

Lower Range	Upper Range	Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
-5 V	5 V	0	4.00000 V	3.99520 V	4.00000 V	4.00480 V	Passed	
-5 V	5 V	0	0.00000 V	-0.00120 V	0.00004 V	0.00120 V	Passed	
-5 V	5 V	0	-4.00000 V	-4.00480 V	-3.99991 V	-3.99520 V	Passed	
-5 V	5 V	1	4.00000 V	3.99520 V	3.99999 V	4.00480 V	Passed	
-5 V	5 V	1	0.00000 V	-0.00120 V	0.00003 V	0.00120 V	Passed	
-5 V	5 V	1	-4.00000 V	-4.00480 V	-3.99991 V	-3.99520 V	Passed	
-5 V	5 V	2	4.00000 V	3.99520 V	4.00009 V	4.00480 V	Passed	
-5 V	5 V	2	0.00000 V	-0.00120 V	0.00009 V	0.00120 V	Passed	
-5 V	5 V	2	-4.00000 V	-4.00480 V	-3.99990 V	-3.99520 V	Passed	
-5 V	5 V	3	4.00000 V	3.99520 V	4.00001 V	4.00480 V	Passed	
-5 V	5 V	3	0.00000 V	-0.00120 V	0.00003 V	0.00120 V	Passed	
-5 V	5 V	3	-4.00000 V	-4.00480 V	-3.99995 V	-3.99520 V	Passed	

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As Found

Verify Gain Matching

Max Gain Difference for Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	10240	10240	4 V	-0.040 dB	-0.000 dB	0.040 dB	Passed	
1	10240	10240	4 V	-0.040 dB	-0.000 dB	0.040 dB	Passed	
2	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	
3	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	

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As Found

Verify Phase Matching

Max Phase Difference for Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	16384	1000 Hz	-0.085 Degrees	-0.014 Degrees	0.085 Degrees	Passed	
1	51200	16384	1000 Hz	-0.085 Degrees	0.014 Degrees	0.085 Degrees	Passed	
2	51200	16384	1000 Hz	-0.085 Degrees	-0.010 Degrees	0.085 Degrees	Passed	
3	51200	16384	1000 Hz	-0.085 Degrees	0.010 Degrees	0.085 Degrees	Passed	
0	51200	16384	10000 Hz	-0.490 Degrees	-0.124 Degrees	0.490 Degrees	Passed	
1	51200	16384	10000 Hz	-0.490 Degrees	0.124 Degrees	0.490 Degrees	Passed	
2	51200	16384	10000 Hz	-0.490 Degrees	-0.106 Degrees	0.490 Degrees	Passed	
3	51200	16384	10000 Hz	-0.490 Degrees	0.088 Degrees	0.490 Degrees	Passed	

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As Found

Verify Common Mode Rejection Ratio

Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	16384	1000 Hz	40.000 dB	50.930 dB	100.000 dB	Passed	
1	51200	16384	1000 Hz	40.000 dB	49.963 dB	100.000 dB	Passed	
2	51200	16384	1000 Hz	40.000 dB	52.517 dB	100.000 dB	Passed	
3	51200	16384	1000 Hz	40.000 dB	48.592 dB	100.000 dB	Passed	

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As Found

Verify IEPE Current

Channel	Rate	DMM Range	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	0.01 A	2.000 mA	2.000 mA	2.074 mA	2.200 mA	Passed	
1	51200	0.01 A	2.000 mA	2.000 mA	2.066 mA	2.200 mA	Passed	
2	51200	0.01 A	2.000 mA	2.000 mA	2.055 mA	2.200 mA	Passed	
3	51200	0.01 A	2.000 mA	2.000 mA	2.074 mA	2.200 mA	Passed	

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Verify IEPE Compliance Voltage

Channel	Rate	SMU Voltage Limit	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	24 V	2 mA	19.000 V	20.916 V	24.000 V	Passed	
1	51200	24 V	2 mA	19.000 V	20.919 V	24.000 V	Passed	
2	51200	24 V	2 mA	19.000 V	20.921 V	24.000 V	Passed	
3	51200	24 V	2 mA	19.000 V	20.916 V	24.000 V	Passed	

As Left

Verify Accuracy

Lower Range	Upper Range	Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
-5 V	5 V	0	4.00000 V	3.99520 V	4.00002 V	4.00480 V	Passed	
-5 V	5 V	0	0.00000 V	-0.00120 V	0.00000 V	0.00120 V	Passed	
-5 V	5 V	0	-4.00000 V	-4.00480 V	-3.99999 V	-3.99520 V	Passed	
-5 V	5 V	1	4.00000 V	3.99520 V	3.99999 V	4.00480 V	Passed	
-5 V	5 V	1	0.00000 V	-0.00120 V	0.00000 V	0.00120 V	Passed	
-5 V	5 V	1	-4.00000 V	-4.00480 V	-3.99998 V	-3.99520 V	Passed	
-5 V	5 V	2	4.00000 V	3.99520 V	3.99996 V	4.00480 V	Passed	
-5 V	5 V	2	0.00000 V	-0.00120 V	-0.00001 V	0.00120 V	Passed	
-5 V	5 V	2	-4.00000 V	-4.00480 V	-3.99995 V	-3.99520 V	Passed	
-5 V	5 V	3	4.00000 V	3.99520 V	4.00000 V	4.00480 V	Passed	
-5 V	5 V	3	0.00000 V	-0.00120 V	0.00001 V	0.00120 V	Passed	
-5 V	5 V	3	-4.00000 V	-4.00480 V	-4.00000 V	-3.99520 V	Passed	

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Verify Gain Matching

Max Gain Difference for Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	
1	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	
2	10240	10240	4 V	-0.040 dB	-0.000 dB	0.040 dB	Passed	
3	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	

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As Left

Verify Phase Matching

Max Phase Difference for Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	16384	1000 Hz	-0.085 Degrees	-0.014 Degrees	0.085 Degrees	Passed	
1	51200	16384	1000 Hz	-0.085 Degrees	0.014 Degrees	0.085 Degrees	Passed	
2	51200	16384	1000 Hz	-0.085 Degrees	-0.010 Degrees	0.085 Degrees	Passed	
3	51200	16384	1000 Hz	-0.085 Degrees	0.010 Degrees	0.085 Degrees	Passed	
0	51200	16384	10000 Hz	-0.490 Degrees	-0.124 Degrees	0.490 Degrees	Passed	
1	51200	16384	10000 Hz	-0.490 Degrees	0.124 Degrees	0.490 Degrees	Passed	
2	51200	16384	10000 Hz	-0.490 Degrees	-0.106 Degrees	0.490 Degrees	Passed	
3	51200	16384	10000 Hz	-0.490 Degrees	0.088 Degrees	0.490 Degrees	Passed	

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Verify Common Mode Rejection Ratio

Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	16384	1000 Hz	40.000 dB	53.784 dB	100.000 dB	Passed	
1	51200	16384	1000 Hz	40.000 dB	51.790 dB	100.000 dB	Passed	
2	51200	16384	1000 Hz	40.000 dB	56.452 dB	100.000 dB	Passed	
3	51200	16384	1000 Hz	40.000 dB	52.447 dB	100.000 dB	Passed	

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As Left

Verify IEPE Current

Channel	Rate	DMM Range	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	0.01 A	2.000 mA	2.000 mA	2.074 mA	2.200 mA	Passed	
1	51200	0.01 A	2.000 mA	2.000 mA	2.066 mA	2.200 mA	Passed	
2	51200	0.01 A	2.000 mA	2.000 mA	2.055 mA	2.200 mA	Passed	
3	51200	0.01 A	2.000 mA	2.000 mA	2.074 mA	2.200 mA	Passed	

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Building A
11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

As Left

Verify IEPE Compliance Voltage

Channel	Rate	SMU Voltage Limit	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	24 V	2 mA	19.000 V	20.915 V	24.000 V	Passed	
1	51200	24 V	2 mA	19.000 V	20.919 V	24.000 V	Passed	
2	51200	24 V	2 mA	19.000 V	20.922 V	24.000 V	Passed	
3	51200	24 V	2 mA	19.000 V	20.915 V	24.000 V	Passed	

SOH Wind Engineering LLC
141 Leroy Road · Williston, VT 05495 · USA
Tel 802.316.4368 · Fax 802.735.9106 · www.sohwind.com

CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

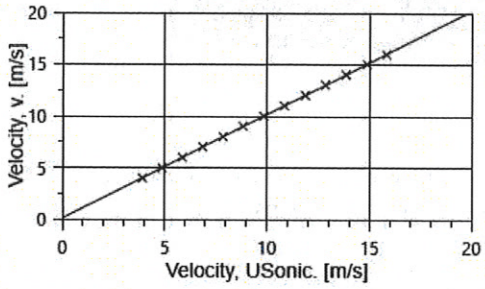
Certificate number: 19.US2.06531 **Date of issue:** July 25, 2019
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K0640011
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

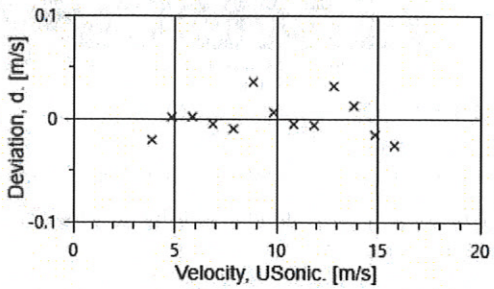
Anemometer received: July 24, 2019 **Anemometer calibrated:** July 25, 2019
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.00527 · U [m/s] + 0.11040

Standard uncertainty, slope: 0.00141 **Standard uncertainty, offset:** 0.13536
Covariance: -0.0000198 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999989
Absolute maximum deviation: 0.036 m/s at 9.039 m/s
Barometric pressure: 1005.8 hPa **Relative humidity:** 43.7%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, U. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.31	26.9	31.2	4.004	3.8933	-0.021	0.023
4	14.49	26.9	31.2	4.996	4.8586	0.001	0.026
6	20.97	26.9	31.2	6.010	5.8667	0.002	0.030
8	28.60	26.9	31.2	7.018	6.8767	-0.005	0.034
10	37.33	26.9	31.2	8.019	7.8767	-0.010	0.038
12	47.44	26.9	31.2	9.039	8.8467	0.036	0.043
13-last	58.34	26.9	31.2	10.024	9.8552	0.006	0.047
11	70.40	26.9	31.2	11.012	10.8500	-0.005	0.051
9	84.01	26.9	31.2	12.030	11.8633	-0.006	0.056
7	98.80	26.9	31.2	13.046	12.8367	0.032	0.060
5	114.34	26.9	31.2	14.036	13.8400	0.012	0.064
3	131.37	26.9	31.2	15.045	14.8717	-0.015	0.069
1-first	148.55	26.8	31.2	15.998	15.8300	-0.026	0.073





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord2	Wind tunnel, blockage factor = 1.0035
13924	Control cup anemometer
-	Mounting tube, D = 19 mm
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP008	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was calibrated at the 90° position.

Certificate number: 19.US2.06531

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CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

Certificate number: 19.US2.06528 **Date of issue:** July 25, 2019

Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K0640011

Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland

Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

Anemometer received: July 24, 2019 **Anemometer calibrated:** July 25, 2019

Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F

Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.99544 · U [m/s] + -0.06695

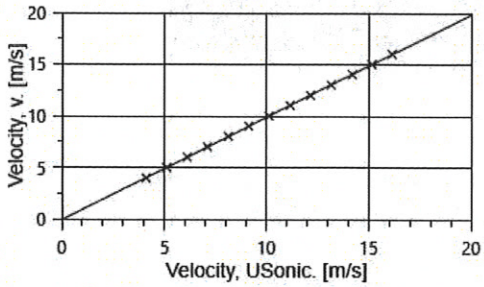
Standard uncertainty, slope: 0.00162 **Standard uncertainty, offset:** -0.26084

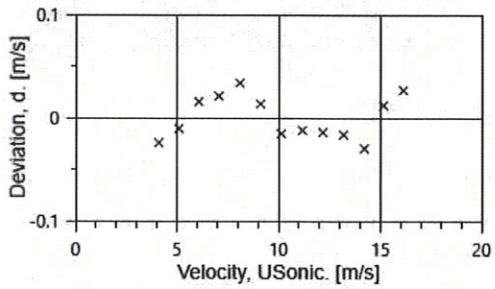
Covariance: -0.0000264 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999986

Absolute maximum deviation: 0.034 m/s at 8.043 m/s

Barometric pressure: 1005.6 hPa **Relative humidity:** 44.0%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, U. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.25	26.7	31.2	3.990	4.1000	-0.024	0.023
4	14.54	26.8	31.2	5.003	5.1034	-0.010	0.026
6	21.01	26.8	31.2	6.014	6.0933	0.016	0.030
8	28.58	26.8	31.2	7.015	7.0933	0.021	0.034
10	37.57	26.8	31.2	8.043	8.1133	0.034	0.039
12	47.40	26.8	31.2	9.035	9.1300	0.013	0.043
13-last	58.30	26.8	31.2	10.020	10.1483	-0.015	0.047
11	70.73	26.8	31.2	11.037	11.1667	-0.012	0.051
9	83.98	26.8	31.2	12.027	12.1633	-0.014	0.056
7	98.57	26.8	31.2	13.030	13.1733	-0.016	0.060
5	114.47	26.8	31.2	14.042	14.2033	-0.030	0.064
3	131.13	26.7	31.2	15.029	15.1533	0.012	0.069
1-first	148.98	26.7	31.2	16.020	16.1333	0.027	0.073





AC-1746

EQUIPMENT USED

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TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
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HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, barometer
PL3	Pitot tube
XB001	Computer Board. 16 bit A/D data acquisition board
Njord2-PC	PC dedicated to data acquisition

The accuracies of all measurements were traceable to the SI through NIST or CIPM recognized NMI's.

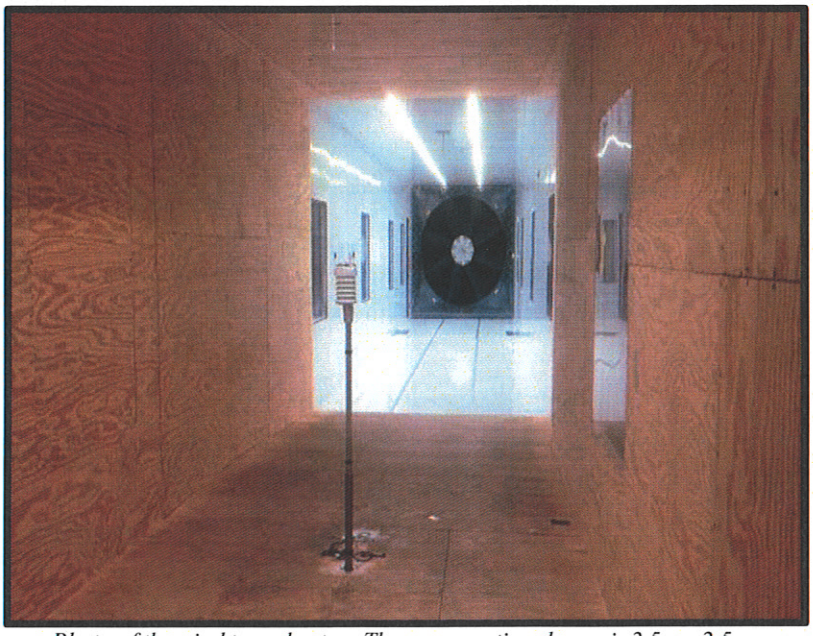

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was calibrated at the 0° position.

Certificate number: 19.US2.06528

Appendix E
MECP I-Audit Checklist

MECP I-Audit Checklist

Wind Energy Project – Screening Document – Acoustic Audit Report – Immission

Information Required in the Acoustic Audit Report – Immission

Item #	Description	Complete?	Comment
1	Did the Sound level Meter meet the Type 1 Sound level meter requirements according to the IEC standard 61672-1 Sound level Meters, Part 1: Specifications? Section D2.1.1	✓	
2	Was the complete sound measurement system, including any recording, data logging or computing systems calibrated immediately before and after the measurement session at one or more frequencies using an acoustic calibrator on the microphone (must not exceed ±0.5dB)? Section D2.1.3	✓	
3	Are valid calibration certificate(s) of the noise monitoring equipment and calibration traceable to a qualified laboratory? Is the validity duration of the calibration stated for each item of equipment? Section D2.3	✓	
4	Was the predictable worst case parameters such as high wind shear and wind direction toward the Receptor considered? Section D3.2	✓	
5	Is there a Wind Rose showing the wind directions at the site? Section D7 (1e)	✓	
6	Did the results cover a wind speed range of at least 4-7 m/s as outlined in section D 3.8.?	✓	
7	Was the weather report during the measurement campaign included in the report? Section D7 (1c)	✓	
8	Did the audit state there was compliance with the limits at each wind speed category? Section D6	✓	
9	Are pictures of the noise measurement setup near Point of reception provided? Section D3.3.2 & D3.4	✓	
10	Was there justification of the Receptor location choice(s) prior to commencement of the I-Audit? Section D4.1	✓	
11	Was there sufficient valid data for different wind speeds? Section D5.2 # 3	✓	
12	Was the turbine (operational) specific information during the measurement campaign in tabular form (i.e. wind speed at hub height, anemometer wind speed at 10 m height, air temperature and pressure and relative humidity) Section D3.7	✓	
13	Were all the calculated standard deviations at all relevant integer wind speeds provided? Section D7 (2d)	✓	
14	Compliance statement	✓	
15	All data included in an Excel spreadsheet	✓	
16	If deviations from standard; was justification of the deviations provided	✓	

Appendix F
E-Audit Report Summary

E-AUDIT REPORT SUMMARY

This section provides a summary of the results from the following E-Audit report:

> REPORT ID: 13228.00.T002.RP5, South Kent Wind Farm – Turbine T002 IEC 61400-11 Edition 3.0 Measurement Report dated 21 December 2018 – Revision 1.

Sound Power Level of Turbine

The calculated apparent sound power level at hub height is summarized in Table 1. Corresponding sound power levels for 10 m height wind speeds are provided in Table 2.

Table 1 – $L_{WA,\,K}$ at each integer wind speed

Wind Speed (m/s)	Apparent L_{WA}, (dBA)	Uncertainty (dB)
7.5	101.5	0.7
8	102.9	0.7
8.5	104.7	0.7
9	105.2	0.7
9.5	105.6	0.7
10	105.9	0.6
10.5	105.9	0.7
11	105.8	0.7
11.5	105.8	0.7
12	105.4	0.7
12.5	105.3	0.8

Table 2 – $L_{WA\ 10m,\,K}$ at each integer wind speed

Wind Speed (m/s)	Apparent L_{WA}, (dBA)	Uncertainty (dB)
5	100.6	0.7
6	104.3	0.7
7	105.9	0.7
8	105.7	0.6
9	105.1	0.9

Tonality Analysis

The tonality analysis for the turbine is summarized in Table 3. All ΔL_{tn} and ΔL_a values reported represent the energy average of all data points with an identified tone that fall within the same frequency of origin.

Table 3 – Tonality Assessment Summary

Wind Speed (m/s)	Frequency (Hz)	Tonality, ΔL_{tn} (dB)	Tonal audibility, ΔL_a (dB)	FFT's with tones	Total # of FFT's	Presence (%)
7.5	58	-4.3	-2.3	73	161	45%
7.5	418	-5.0	-2.8	120	161	75%
8	59	-4.5	-2.5	52	232	22%
8	428	-1.3	0.9	110	232	47%
8	472	-3.2	-0.9	107	232	46%
8.5	481	-1.5	0.8	134	140	96%
9	494	-3.8	-1.5	83	88	94%
9.5	496	-2.8	-0.5	44	45	98%
10	499	-2.8	-0.5	26	26	100%
10.5	123	-4.9	-2.8	48	49	98%
10.5	509	-3.2	-0.8	44	49	90%
11	512	-3.8	-1.5	42	45	93%
11.5	515	-3.1	-0.8	29	31	94%
12	125	-4.2	-2.2	10	10	100%
12	515	-2.0	0.3	10	10	100%
12.5	124	-4.7	-2.7	7	7	100%

Closure

Measurements and analyses per IEC 61400-11:2012 (Edition 3.0) were performed on turbine T002 of the South Kent Wind Farm, located in the municipality of Chatham-Kent. The test turbine was found to have a maximum apparent sound power level of 105.9 dBA and a maximum tonal audibility of 0.9 dB.

End of Report