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IMMISSION AUDIT REPORT – **Project: 13350.02**

South Branch Wind Farm

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South Dundas Township, United Counties of Stormont Dundas and Glengarry

Prepared for:

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1	Initial Report	DH	PA	March 12, 2020
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1 Introduction

Aercoustics Engineering Limited ("Aercoustics") has been retained by EDP Renewables Canada Ltd. ("EDPR") to complete an Immission Audit ("I-audit") of the South Branch Wind Farm ("South Branch"). South Branch operates under Renewable Energy Approval ("REA") #8279-974KHK.

The I-audit is being completed per the methodology outlined in Part D and Part E of the Compliance Protocol for Wind Turbine Noise ("Compliance Protocol" or the "Protocol"). The Compliance Protocol is an Ontario Ministry of the Environment, Conservation and Parks ("MECP") document used to evaluate noise from a wind turbine at nearby receptors.

2 Background

I-audit compliance testing for South Branch was originally conducted in 2014 and 2015 in two phases, per Condition E of the South Branch REA. The reports prepared from this testing were reviewed by the MECP, and a letter of review ("MECP Letter") was issued to South Branch in November 2018 recommending one (1) additional I-audit and one additional Emission Audit ("E-audit") be conducted. This report details the results of the I-audit testing; the results of the E-audit testing are provided in a separate test report.

I-audit testing was conducted at two (2) receptors in the Fall months. Two receptors were selected after testing conducted the Spring of 2019 at one location resulted in an incomplete data set. The MECP Letter indicated one (1) immission audit be completed, results from the two receptors are presented here as additional information for the MECP.

3 Facility Description

South Branch is a wind facility located in South Dundas and is made up of ten (10) wind turbine generators ("turbines"), having a total output of 30 megawatts. The facility has one (1) substation transformer, whose acoustic emission has been previously tested. South Branch operates 24 hours per day, 7 days per week. I-audit measurements occur nightly from 10pm to 5am.

It is noted that the turbine ID nomenclature used by the site has changed from the REA. Current IDs and their REA equivalents are provided below in Table 1. Turbines T01-T04 were permitted, but never installed. Nomenclature from the REA is used in this report.

Table 1: REA Permit ID compared to New Turbine IDs

REA Permit turbine #	New turbine #	REA Permit turbine #	New turbine #
T05	T109	T10	T103
T06	T110	T11	T104
T07	T107	T12	T105
T08	T108	T13	T106
T09	T102	T15	T101

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 locations were selected using the guidance provided in the South Branch REA, with priority given to locations having high predicted sound impacts and frequent downwind conditions from South Branch turbines. Selected measurement locations are summarized in Table 2 and Table 3.

4.1.1 Historical Wind Direction

Historical wind direction information was provided to Aercoustics by EDPR and used to support selection of suitable audit receptors. This wind direction information is provided in Figure 1, and the prevailing downwind direction for South Branch was determined to be 225°.

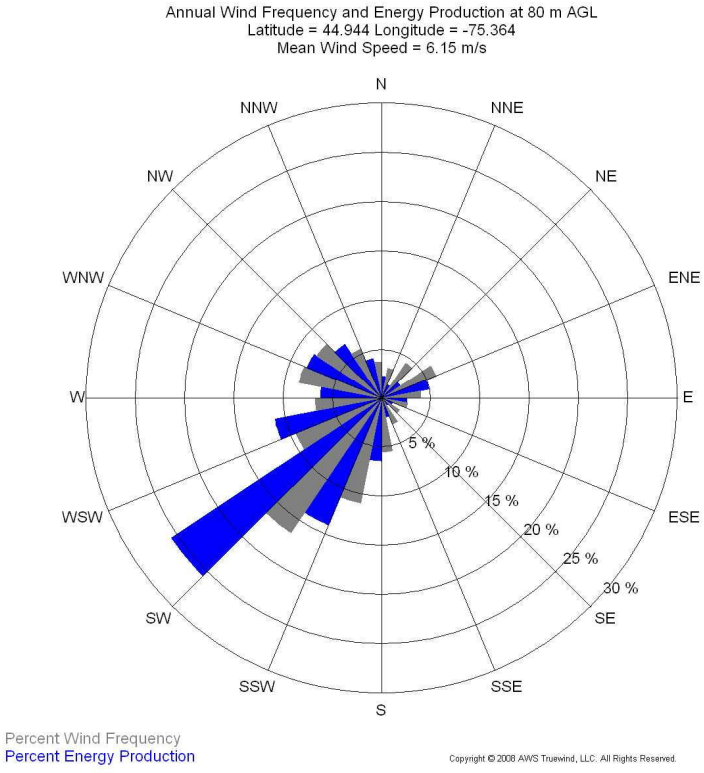

Figure 1: Historical Wind Rose used for Receptor Selection

As shown in Figure 1, the wind predominantly blows from the southwest, with some directions showing almost no periods of suitable winds (southeast and north, for example).

4.1.2 Receptor Selection Table

Monitoring location were selected based on the predicted sound impact, wind direction, and the availability of suitable area for monitoring. Existing receptors (i.e. existing dwellings) were also prioritized over vacant lot receptors. Receptors having no suitable area to place the monitoring equipment were also excluded. Potential monitoring locations were discussed in a conference call with the MECP prior to measurements starting. Selected measurement locations are summarized in Table 2.

Table 2: Receptor Selection Table. Locations selected for monitoring are identified in green

ID	Receptor Type	Distance to Nearest Turbine (m)	Nearest Turbine*	Predicted Impact (dBA)	Downwind Direction (°)	Wind Direction**	Rating	Notes
V_260	Vacant Lot	667	T05	38.8	173	CW	Low	1, 2
R_202	Receptor	694	T12	38.6	272	CW	High	selected
V_251	Vacant Lot	585	T05	38.6	100	CW	Low	1, 2
V_288	Vacant Lot	626	T15	38.4	214	DW	Med	1
V_298	Vacant Lot	714	T12	38.3	297	CW	Med	1
R_194	Receptor	814	T12	38.2	335	CW	Med	3
R_76	Receptor	679	T07	38.2	98	CW	Low	2
R_173	Receptor	808	T10	38.1	287	CW	High	selected
V_257	Vacant Lot	672	T05	38.1	14	UW	Low	1, 2
V_258	Vacant Lot	716	T05	38.1	170	CW	Low	1, 2
R_192	Receptor	614	T15	38	279	CW	High	
R_195	Receptor	711	T13	38	223	DW	High	

* Turbine IDs from REA.

** Direction from nearest turbine to monitor relative to prevailing wind direction, +/-45°

Notes:

1 Vacant Lot (less preferable)

2 Poor wind direction, infrequent downwind periods expected

3 Poor availability of monitoring area

Predicted sound impacts at the receptor were obtained from the Noise Assessment Report for South Branch prepared by GL Garrad Hassan and dated April 25, 2013. A sound model using the original assessment report parameters was created by Aercoustics to calculate predicted sound levels at monitor locations.

4.2 Monitoring Location

The location of the measurement equipment for each receptor is described in this section.

R173: The monitor was erected north of the receptor by approximately 40 metres, towards the closest turbine. The receptor itself is surrounded by trees, and the monitoring equipment was erected outside the trees and in the adjacent field. The ground cover between the measurement location and the nearest turbine was an open field with occasional shelter belts.

R202: The monitor was erected west of the receptor by approximately 60 metres, across the road towards the closest turbine. This location was chosen due to the available land access on the adjacent property. The ground cover between the measurement location and the nearest turbine was an open field with occasional shelter belts.

Receptor and monitor locations are summarized below in Table 3. Site photographs and plans are provided in Appendix A.

Table 3: Coordinates and Nearest Turbines to Receptor and Measurement Locations

Audit Receptor	Coordinates (UTM x,y, Zone 18T)		Distance to Closest Turbine	
	Receptor	*Monitor*	*Receptor*	*Monitor*
R173	472676 m E / 4977641 m N	472650 m E / 4977672 m N	808 m	774 m
R202	473489 m E / 4978989 m N	473428 m E / 4978991 m N	694 m	633 m

4.3 Ambient Environment

South Branch is located in a Class III (rural) area. Ambient noise in rural areas is typically driven by a mixture of flora, fauna, traffic, and industry. These sources may be extraneous – such as short-term events, or frequency-specific contamination – or they may be a constant presence that forms part of the existing ambient acoustic environment. If the noise is extraneous, filtering is employed to reduce or remove it (see Section 5.3.2).

Self-generated noise from the measurement equipment is also a factor at high wind speeds. This noise is minimized by the usage of a secondary wind screen installed around the microphone. The secondary wind screen meets the requirements of Section D2.1.4 of the Protocol. The insertion loss of the wind screen is tested and accounted for in the analysis.

4.3.1 Flora

Noise from flora was found to be the main driver of the ambient noise at this site. Small patches of trees are present near at both receptors. The monitoring period started in November, and therefore any leaves from deciduous trees or shrubs are expected to have fallen off prior to the start of monitoring.

4.3.2 Fauna

No significant contamination from fauna was found in the measurement dataset.

4.3.3 Traffic

Infrequent traffic was observed during the monitoring period along the closest roadway, Henderson Road. The occasional data point was excluded due to extraneous noise from traffic passing by the monitor. This impact was reduced at the monitor for R202 due to its increased distance from the roadway.

4.3.4 Industry

Near R202 was an agricultural barn having ventilation fans that were audible in some measurement intervals. The acoustic impact of these fans at the monitoring position is estimated to be approximately 34 dBA, based on the measured ambient sound level at low 10-m AGL wind bins. Conversations with the landowner indicated that the fans may cycle on and off at different speeds, depending on the ventilation requirements. A picture of these fans is shown in Appendix A.

No significant sources of industry are present around R173.

4.3.5 Other Sources

No significant contamination from other sources was found in the measurement dataset.

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 are conducted per Section D5.2 and E5.5 of the Protocol with additional filters applied as needed – following the guidance of the Protocol – to remove or reduce extraneous ambient noise (see Section 5.3.2) and ensure representative ambient conditions (see Section 5.3.4).

Intervals that pass the filtering criteria are sorted into integer wind bins[1] depending on the measured 10m-AGL[2] wind speed. Each interval is then classified as either *Total Noise* or *Background* depending on the operation of the nearby South Branch turbines. The *Turbine-Only* sound level at each wind bin is determined by logarithmically subtracting the average *Background* sound level from the *Total Noise* sound level in wind bins having sufficient data for assessment. Minimum thresholds for sufficient data are discussed in Section 5.4.1.

[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.
[2] Above ground level

5.1 Measurement Equipment

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

- One (1) Type 1 sound level meter with microphone and pre-amplifier, installed at 4.5 metre height.
- One (1) primary and one (1) secondary windscreen for the microphone.
- One (1) anemometer, installed 10 metres above ground level ("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 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 South Branch turbines.

Table 4 lists the specific make, model, and serial number for the measurement equipment used at each location.

Table 4: Equipment Details

Audit Receptor	Equipment	Make/Model	Serial Number	Date of Last Calibration
R173	Sound Level Meter	NI 9234	1ADD8EC	March 26, 2019
	Microphone & Pre-amplifier	PCB 378B02	124691	October 15, 2018*
	Signal Conditioner	PCB 480E09	00033658	March 5, 2019
	Weather Station	Vaisala WXT536	R1151162	March 15, 2019
R202	Sound Level Meter	NI 9234	1A6C102	October 10, 2019
	Microphone & Pre-amplifier	PCB 378B02	142561	July 29, 2019
	Signal Conditioner	PCB 480E09	00036691	April 30, 2019
	Weather Station	Vaisala WXT520	J4830029	July 27, 2018

* see Section 5.5.2 for more information

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

5.2 Measurement Parameters

Measurement equipment is configured to run nightly 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 (4.5m height)	L_{Aeq}	dBA
	L_{90}	dBA
	1/3rd Octave Band	dBA (20 Hz–10 kHz)
	Signal Recording	Uncompressed raw files
Weather (10m height)	Wind Speed	m/s
	Wind Direction	0-360˚
	Temperature	˚C
	Humidity	0-100%
	Atmospheric Pressure	hPa
	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

During the measurement campaign, turbine operational information was obtained from the facility SCADA system and provided to Aercoustics by EDPR.

5.3 Filtering Criteria

Intervals are 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 are first passed through the *All Intervals* filters, after which they are sorted into either *Total Noise* or *Background* categories based on the operation of the nearby turbines. Intervals that fail to meet the applicable filtering criteria are excluded from analysis.

All Intervals

- Have occurred between 10pm – 5am
- Have no precipitation within one hour before or after
- Have an ambient temperature above -20˚C
- Have minimal influence from extraneous ambient noise (see Section 5.3.3)

Total Noise Intervals

- Have all nearby turbines are operating (see Section 5.3.1)
- Have nearest turbine generating at least 85% of its maximum rated power output
    - Threshold reduced to 75% for some wind bins (see Section 5.3.2)
- Have downwind wind direction

Background Intervals

- Have all nearby turbines parked (i.e. not rotating)
- Have hub height wind speed greater than 5 m/s (Section 5.3.4)

Analysis and filtering are conducted per Section D5.2 and E5.5 of the Protocol with additional filters applied as needed, following the guidance the Protocol, to remove or reduce extraneous ambient noise (see Section 5.3.2) and ensure representative ambient conditions (see Section 5.3.4).

5.3.1 Turbines in Study Area

As noted above, several filtering criteria are 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 is processed along with the acoustic and weather data as part of the audit methodology.

The minimum number of turbines included in the study area for each receptor are 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 for each receptor are listed in Table 6. All South Branch turbines were confirmed to be parked and not generating for Background periods. All turbines within 1.5 km of the measurement location were verified to be operational during Total Noise periods. The cumulative impact of the remaining turbines was predicted to be less than 30 dBA.

Table 6: Turbines included in the study area for each receptor

Audit Receptor	Turbines in Study area (REA numbering in parentheses)
R173, R202	T10 T11 T12 T13

The turbines were confirmed to be running in their correct operating mode for the duration of the monitoring campaign, see Appendix C for a statement from the operator.

5.3.2 Turbine Power Threshold

The 85% minimum power threshold for Total Noise data points has been reduced to 75% some wind bins at both monitors. This was implemented after an extended monitoring campaign (13 weeks, see Table 8) failed to collect enough data points in some wind bins. A reduction to 75% power output maintains the 90% sound power output condition of the turbine, per the RAM-I audit conditions of the Compliance Protocol. Wind bins having a reduced power threshold applied are indicated in Table 12.

5.3.3 Removal of Extraneous Noise

'Extraneous noise' is noise unrelated to the operation of the wind facility that is not part of the typical ambient environment in the area. It is typically noise that is short-duration (transient) or limited to specific frequencies. It is considered acoustic contamination and should be removed wherever possible. Examples of extraneous noise include – but are not limited to – car passes, insects, dogs barking, and wind gusts. Extraneous noise is removed from the measurement data wherever 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 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."*

[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.

> ***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 extraneous noise may be removed via filtering of specific 1/3rd octave bands affected by the contamination (see Protocol section D5.3). Transient noise may be removed via a combination of automatic and manual filtering techniques. Automatic filtering of transient extraneous noise is achieved by removing points where the measured L_{Aeq} is significantly greater than the measured L_{90} for the same interval. Manual filtering of extraneous noise is conducted via listening tests to identify intervals having audible contamination.

Note: the identification and removal of extraneous noise in the measurement datasets presented in this report is achieved by listening tests, removing 1/3rd octave bands above 2500 Hz from the assessment, and an automatic filter that excludes any Total Noise or Background interval if (LAeq-L90)>10 dB.

5.3.4 Representative Ambient Conditions

The conditions present during the *Total Noise* and *Background* assessment 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."*

Note: turbines shutdowns were conducted periodically throughout the measurement campaign, to ensure similar weather conditions between Total Noise and Background periods. Further, Background intervals having hub-height wind speeds below 5 m/s were excluded to remove calm conditions from the Background periods. These conditions excluded from the dataset are not representative ambient conditions because they have wind speeds that are too low for the turbines to generate their maximum sound outputs.

5.3.5 Adjacent Wind Facilities

No additional wind facilities are present in the area surrounding the audit receptors.

5.4 Compliance Criteria

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

5.4.1 Sample Size Requirements

This audit follows the requirements of the RAM-I methodology. Sample size requirements for RAM-I are provided in Section E5.5(1) and E5.5(5) of the Compliance Protocol.

> *E5.5(1): "The objective of the RAM I-Audit is to assess the acoustic immission at the measurement location at wind speeds between 1 and 7 m/s (inclusive). At a minimum, data must be acquired to satisfy the requirements of at least one of the following:*
>
> > *three (3) of the wind speed bins between 1 and 7 m/s (inclusive), or*
> > *two (2) of the wind speed bins between 1 and 4 m/s (inclusive)."*
>
> *E5.5(5): "The Ministry may accept a reduced number of data points for each wind speed bin with appropriate justification (i.e. 60 data points in place of 120 for turbine operational measurements and 30 data points in place of 60 data points for ambient measurements). The acceptable number of data points will be influenced by the quality of the data (standard deviation)."*

In this study, 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

The area surrounding South Branch has been designated as Class III. Exclusion limits for a Class III area are summarized in Table 7 below.

Table 7: MECP Exclusion Limits (Class III)

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

These sound level limits apply to points of reception, and therefore an adjustment of the turbine-only sound levels calculated at the monitoring position may be required to determine the impact at the receptor. This adjustment is based on the modelled difference in sound level between monitor and receptor locations.

Section D3.5 and D6 of the Protocol also notes that where the measured *Background* sound level exceeds the exclusion limits, the sound level limit for that wind bin is the *Background* sound level without extraneous noise sources. Wind bins where the measured *Background* sound level exceed the exclusion limits are noted in Table 11.

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 bandwidth of the measurement equipment 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].

5.5.2 R173 Microphone – Date of Last Calibration

The microphone used for R173 had a date of last calibration of more than one year from the audit period. The effect on the data is expected to be negligible for two reasons. The first reason is that the measurement chain was regularly calibrated during the measurement campaign using a field calibrator having a laboratory calibration within one year. The second reason is that a two-year laboratory calibration interval is both a typical industry standard – as noted in the IEC 61400-11 standard for sound emission measurements of a wind turbine – and is also the calibration interval noted on the calibration certificate itself (see Appendix B).

Since the preparation of the original version of this report, this microphone was subjected to a laboratory calibration on May 5, 2020. This calibration confirmed the microphone to be operating within manufacturer's specification and the calibration certificate is included in Appendix B.

5.5.3 Reduced Power Threshold

Due to a lack of sufficient data for an assessment of compliance, the minimum power threshold was reduced from 85% to 75% for wind bins that do not have sufficient data with the 85% power threshold. This is discussed further in Section 6.4.1.

6 Audit Results

Sound levels and weather conditions measured throughout the course of the I-audit campaign are summarized in the following sections. Note that all sound levels presented are rounded to the nearest integer. All calculations and analyses, however, are conducted using the un-rounded sound levels.

6.1 Audit Duration

The length of monitoring time for each monitor location is summarized below in Table 8.

Table 8: Length of monitoring campaign for at each measurement location

Measurement Location	Audit Start Date	Audit End Date	Monitoring Duration (weeks)
R173	November 7, 2019	February 13, 2020	13

[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.

Measurement Location	Audit Start Date	Audit End Date	Monitoring Duration (weeks)
R202	November 7, 2019	February 13, 2020	13

6.2 Weather Conditions

Throughout the audit campaign, a variety of weather conditions were measured. The range of weather conditions measured in the assessment datasets are summarized in Table 9. Note that the assessment dataset is 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)
R173	973 – 1032	2.3 – 12.2	48 – 91	-20 – 1	5.6 – 13.2
R202	979 – 1023	0.6 – 10.7	47 – 87	-20 – 3	7.1 – 13.4

A wind rose detailing the measured wind directions observed during the measurement campaign is provided in Figure 2. Note that wind directions shown on the wind roses indicate the direction the wind is coming from.

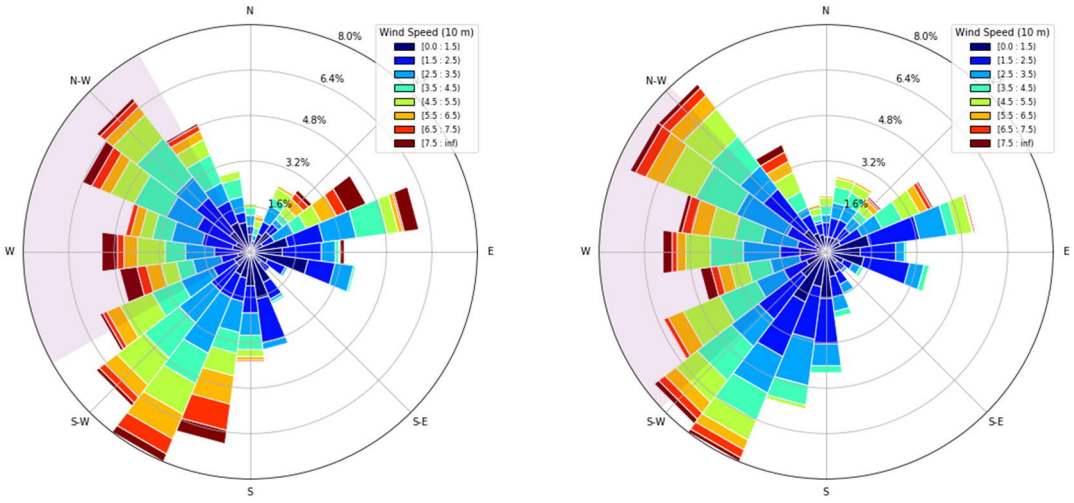

Figure 2: Wind Roses for monitors R173 (left) and R202 (right). Data presented includes all measured data. Downwind direction indicated by shaded red area. Wind direction taken from the yaw angle of the closest turbine and wind speed is taken from the 10m-AGL weather station.

6.3 Prevalence of Audit Conditions

A range of turbine power outputs and wind directions were measured over the course of the audit campaign. Table 10 provides the amount of time during the measurements where the two main filtering conditions (85% turbine power and downwind conditions) were met.

Table 10: Prevalence of audit conditions observed during the measurement campaign

Audit Receptor	Nearest Turbine	Prevalence of Downwind	Prevalence of High Output, >85% power	Prevalence of Downwind and High Output
R173	T10	40%	8% (11%)	2% (4%)
R202	T12	36%	7% (9%)	2% (3%)

Note: values in parentheses indicate prevalence after reduced (75%) power threshold applied.

These conditions represent the minimum requirements for valid *Total Noise* intervals. The additional filters applied to the dataset (discussed in Section 5.3) further reduced the data available for assessment. This data is an indicator of how often during the campaign the maximum noise impacting conditions occurred at the audit receptors.

6.4 Measured Sound Levels

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

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

Audit Receptor	Period	Measurement Parameter	Wind Bin (m/s)						
			1	2	3	4	5	6	7
R173	Total Noise	Number of Samples	0	0	0	0	13	68	136
		Average L_{Aeq} [dBA]	-	-	-	-	-	44	49
		Standard Deviation [dB]	-	-	-	-	-	1.7	1.6
	Background	Number of Samples	0	11	20	15	47	141	97
		Average L_{Aeq} [dBA]	-	-	29*	33*	38	43	47
		Standard Deviation [dB]	-	-	-	-	2.1	2.1	1.8
R202	Total Noise	Number of Samples	0	0	0	1	13	37	91
		Average L_{Aeq} [dBA]	-	-	-	-	-	44*	48
		Standard Deviation [dB]	-	-	-	-	-	0.7	1.4
	Background	Number of Samples	37	110	126	46	39	30	91
		Average L_{Aeq} [dBA]	34	35	36	37	39	42	45
		Standard Deviation [dB]	0.5	1.9	1.4	1.0	1.4	1.5	1.4

- Minimum sample size not met in this wind bin, sound levels not reported except as noted by (*).

* Below minimum sample size requirements, data presented for information only.

6.4.1 Measured Sound Levels – Reduced Power Threshold

As shown in Table 11, there are wind bins at both receptors that do not meet the minimum sample size requirements. In order to increase the available data for assessment in these

wind bins, the minimum turbine power threshold has been reduced to 75%. This reduction was confirmed to maintain the 90% sound power using the e-audit test results, conducted on SBW turbine T07 in November 2019.

Average measured sound levels by wind bin for *Total Noise* and *Background* periods with a 75% turbine power threshold applied are presented in Table 12. As noted in the table, the reduced power threshold is only applied to wind bins from Table 11 that did not have sufficient data.

Table 12: Average Measured Sound Levels at Measurement Locations, RAM-I Analysis – Reduced Power

Audit Receptor	Period	Measurement Parameter	Wind Bin (m/s)						
			1	2	3	4	5	6	7
R173	Total Noise	Number of Samples	0	0	0	11†	91†	68	136
		Average L_{Aeq} [dBA]	-	-	-	-	41	44	49
		Standard Deviation [dB]	-	-	-	-	0.9	1.7	1.6
	Background	Number of Samples	0	11	20	15	47	141	97
		Average L_{Aeq} [dBA]	-	-	29*	33*	38	43	47
		Standard Deviation [dB]	-	-	-	-	2.1	2.1	1.8
R202	Total Noise	Number of Samples	-	-	-	16†	60†	97†	91
		Average L_{Aeq} [dBA]	-	-	-	42*	43	45	48
		Standard Deviation [dB]	-	-	-	0.3	1.0	0.9	1.4
	Background	Number of Samples	37	110	126	46	39	30	91
		Average L_{Aeq} [dBA]	34	35	36	37	39	42	45
		Standard Deviation [dB]	0.5	1.9	1.4	1.0	1.4	1.5	1.4

- Minimum sample size not met in this wind bin, sound levels not reported except as noted by (*).
* Below minimum sample size requirements, data presented for information only.
† 75% power threshold applied.

Measurement data points from Table 12 are plotted below in Figure 3 and Figure 4. Intervals having a corresponding turbine power output below 85% are coloured in black.

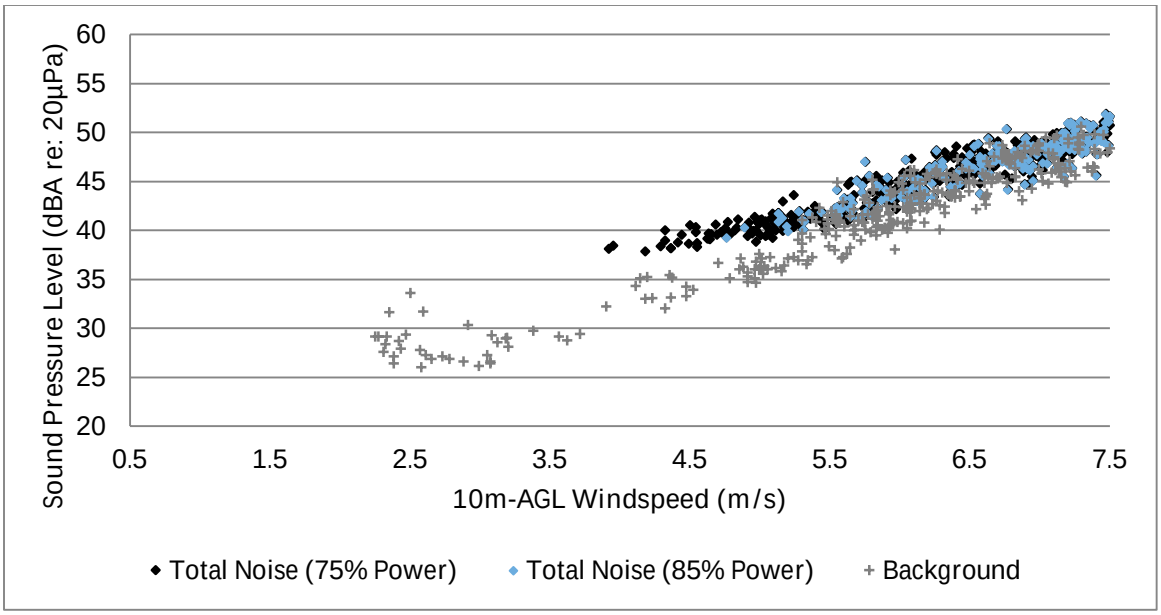

Figure 3: Monitor near R173, average measured Total Noise and Background sound levels. Data points introduced after the reduction of the minimum power threshold are indicated in black.

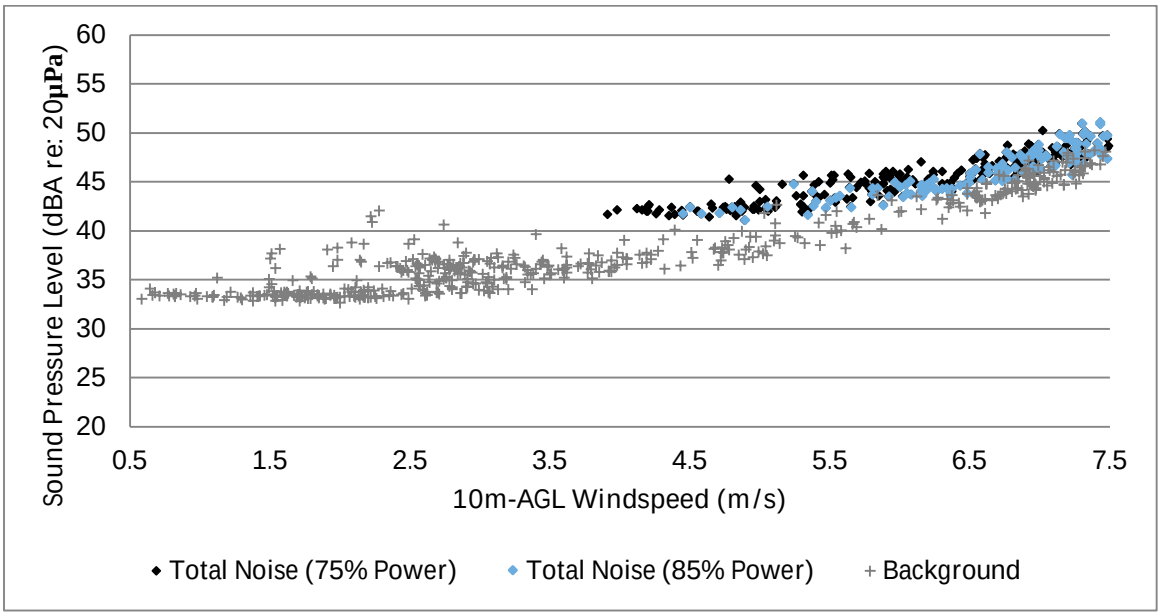

Figure 4: Monitor near R202, average measured Total Noise and Background sound levels. Data points introduced after the reduction of the minimum power threshold are indicated in black.

6.5 Sound Level Adjustments

Any adjustments applied to the measured sound levels are described in this section.

6.5.1 Distance Adjustment

The sound levels presented in Table 11 and Table 12 are the average measured levels at the measurement position. Compliance is determined at the receptor, and therefore an adjustment to the background-corrected (i.e. Turbine-Only) sound levels calculated at the monitoring position is required prior to comparison with the applicable limits. The difference in predicted sound level between the monitor and receptor position was taken as the applicable distance adjustment for each monitor. Distance adjustments are summarized in Table 13.

Table 13: Distance Adjustments

Receptor ID	Applicable Distance Adjustment (dB)
R173	-0.4
R202	-0.8

6.5.2 Tonal Adjustment

Prominent tones suspected to originate from the turbine were not observed during listening tests of the measurement data. Further, attended spot-check measurements near turbines T10 (T103), T12 (T105), and T13 (T106) found no audible tones (see Appendix D for details). Finally, per MECP request, a formal assessment of tonal audibility was conducted on the measurement data, the results of which are summarized below. Two frequencies of interest were chosen, based on previous e-tests as well as the tonal audibility spot check results.

Table 14: Tonal Audibility Assessment Summary Table (R173)

Frequency	Measurement Parameter	Wind Bin (m/s)						
		1	2	3	4	5	6	7
77 Hz	Total Number of Samples	0	0	0	11†	91†	68	136
	Number of Samples with Tone	0	0	0	0	1	1	3
	Tone Prevalence	-	-	-	0%	1%	1%	2%
	Tonal Audibility (dB)	-	-	-	-	-	-	-
	Tonal Penalty (dB)	0	0	0	0	0	0	0
285 Hz	Total Number of Samples	0	0	0	11†	91†	68	136
	Number of Samples with Tone	0	0	0	1	0	0	0
	Tone Prevalence	-	-	-	9%	0%	0%	0%
	Tonal Audibility (dB)	-	-	-	-	-	-	-
	Applicable Tonal Penalty (dB)	0	0	0	0	0	0	0

† 75% power threshold applied.

Table 15: Tonal Audibility Assessment Summary Table (R202)

Frequency	Measurement Parameter	Wind Bin (m/s)						
		1	2	3	4	5	6	7
77 Hz	Total Number of Samples	0	0	0	16†	60†	97†	91
	Number of Samples with Tone	0	0	0	0	0	0	0
	Tone Prevalence	-	-	-	0%	0%	0%	0%
	Tonal Audibility (dB)	-	-	-	-	-	-	-
	Tonal Penalty (dB)	0	0	0	0	0	0	0
285 Hz	Total Number of Samples	-	-	-	16†	60†	97†	91
	Number of Samples with Tone	-	-	-	0	0	0	0
	Tone Prevalence	-	-	-	0%	0%	0%	0%
	Tonal Audibility (dB)	-	-	-	-	-	-	-
	Applicable Tonal Penalty (dB)	0	0	0	0	0	0	0

† 75% power threshold applied.

Based on the results in Table 14 and Table 15, no tonal penalties are applicable for this dataset. This assessment was conducted per the IEC 61400-11:2012 (ed 3.0) standard. Per the standard, tones having a prevalence below 20% are not reported.

6.6 Turbine-Only Sound Levels

The average measured *Total Noise* and *Background* sound levels, as well as calculated Turbine-Only sound levels, are presented below in Table 16 and Table 17.

Table 16: R173 Calculated Turbine-Only Sound Levels, RAM-I Analysis

Audit Receptor	Measurement Period	Wind Bin (m/s)						
		1	2	3	4	5	6	7
R173	Total Noise (dBA)	-	-	-	-	41[1]	44	49
	Background (dBA)	-	29	29	33	38	43	47
	Signal to Noise (dBA)	-	-	-	-	2.5	1.3	1.3
	Turbine-Only (dBA) [monitor location]	-	-	-	-	37	39	43
	Tonal Adjustment	-	-	-	-	-	-	-
	Distance Adjustment	-0.4 dB						
	Other Adjustments	-						
	Turbine-Only (dBA) [receptor location]	-	-	-	-	37	38	42
MECP Exclusion Limit (dBA)		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	-	Y	Y	Y

\- Minimum sample size not met in this wind bin, sound levels not reported except as noted by (*).
* Sound level calculated from less than 60 Total Noise data points.
[1] Minimum 75% turbine power threshold applied.

Table 17: R202 Calculated Turbine-Only Sound Levels, RAM-I Analysis

Audit Receptor	Measurement Period	Wind Bin (m/s)						
		1	2	3	4	5	6	7
R202	Total Noise (dBA)	-	-	-	42[1]	43[1]	45[1]	48
	Background (dBA)	34	35	36	37	39	42	45
	Signal to Noise (dBA)				5.1	3.9	2.6	2.4
	Turbine-Only (dBA) [monitor location]	-	-	-	40	41	41	44
	Tonal Adjustment	-	-	-	-	-	-	-
	Distance Adjustment	-0.8 dB						
	Other Adjustments	-						
	Turbine-Only (dBA) [receptor location]	-	-	-	40*	40	40	43
MECP Exclusion Limit (dBA)		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	Y	Y	Y	Y

\- Minimum sample size not met in this wind bin, sound levels not reported except as noted by (*).
* Sound level calculated from less than 60 Total Noise data points.
[1] Minimum 75% turbine power threshold applied.

7 Discussion

Valid Total Noise data points were found to occur primarily at and above the 6 m/s wind bin (see Table 11). There were very few data points measured below 5 m/s 10m-AGL, which indicates that periods of high wind shear were infrequent during this measurement campaign. Given the length of the monitoring campaign, as well as the similar difficulties with data collection found during the Spring monitoring campaign (see Section 2), it is likely that infrequent periods of high wind shear found during high turbine output is not a seasonal variation, but rather the typical site conditions.

All Total Noise wind bins meet the MECP standard deviation targets of 2/2.5 dB (Section E5.5(8) of the Protocol). This implies that the variation in sound level for a given wind speed is low. However, several of the wind bins also have very low signal-to-noise levels (<3 dB), which implies that the Background sound environment is the primary driver of the sound levels in these wind bins. This is not unexpected, as the average Background sound levels exceed the MECP exclusion limits at a number of wind bins (see Table 18 and Table 19). The ambient in both locations was driven by a mixture of wind-induced noise and foliage noise from nearby trees.

At R202, there was also an impact of noise from a nearby ventilation fan that was audible at times in the measurement data, however this was audible only at low winds and is not driving the elevated ambient at high winds speeds. The signal-to-noise at the lowest wind speed with data is still reasonable (5.1 dB at 4 m/s, see Table 17), and therefore the noise from this fan is not considered to have a significant impact on the data quality.

As the ambient noise is primarily wind-induced, both receptors show the greatest signal-to-noise ratios at the lowest available wind bins (5 m/s). At these wind bins, where the data quality is highest, the Turbine-Only sound levels most closely align with the predicted sound impacts. This strongly suggests that the sound levels at all other receptors would also comply with the applicable sound level limits.

All wind bins having sufficient data show sound levels that are below both the MECP exclusion limits and the Background sound levels for the wind bin.

8 Assessment of Compliance

This section provides the results of the measurements and calculations as they pertain to the determination of compliance of the facility per the criteria outlined in the Protocol and summarized in Section 5.4 of this report.

8.1 Assessment Table

Table 18 compares the final receptor Turbine-Only sound levels for each wind bin to the applicable sound level limits. Final Turbine-Only sound levels at the receptor are calculated by taking the Turbine-Only sound level at the measurement location and applying any applicable adjustments discussed in Section 6.5.

Table 18: Assessment Table – R173

Audited Receptor	Wind Bin (10m-AGL) [m/s]	1	2	3	4	5	6	7
R173	Turbine-Only Sound Level (Receptor Location) [dBA]	-	-	-	-	37*	38*	42*
	Background Sound Level [dBA]	-	29	29	33	38	43	47
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	-	Y	Y	Y

\- Sound level not reported in wind bin if minimum sample size not met for Total Noise or Background except as noted by (**).

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

Table 19: Assessment Table – R202

Audited Receptor	Wind Bin (10m-AGL) [m/s]	1	2	3	4**	5	6	7
R202	Turbine-Only Sound Level (Receptor Location) [dBA]	-	-	-	40	40	40*	43*
	Background Sound Level [dBA]	34	35	36	37	39	42	45
MECP Exclusion Limit [dBA]		40	40	40	40	40	40	43
Compliance? (Y/N)		-	-	-	Y	Y	Y	Y

- Sound level not reported in wind bin if minimum sample size not met for Total Noise or Background except as noted by (**).
* Signal-to-noise level less than 3 dB. Increased uncertainty in determination of Turbine-Only Sound Impact.
** Turbine-Only sound level calculated from less than 60 Total Noise data points

8.2 Statement of Compliance

Based on the receptor Turbine-Only sound levels presented in Table 18 and Table 19, sound immission levels at South Branch receptors R173 and R202 are in compliance with the applicable sound level limits.

9 Conclusion

An acoustic immission audit per the requirements of the MECP Compliance Protocol for Wind Turbine Noise was conducted at South Branch receptors R173 and R202. Per the results presented in this report and summarized in Table 18 and Table 19, the noise impacts at both receptors were found to be in in compliance with the applicable sound level limits.

aercoustics

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1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 0G1

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Fax 416-249-3613
aercoustics.com

Appendix A
Location Details

Legend

- Receptor Locations
- Campaign Monitors

South Branch Wind Turbines

- Turbines Not Built
- Turbines Built

N

Project ID:	13350.02
Drawn by:	MWJ
Reveiwed by:	DH
Date:	March 10, 2020
Revision:	1
Scale:	As Indicated

South Branch Wind Project
R173 and R202 I-Audit Report

Appendix A.1

Site Plan Overview

aercoustics

Legend

- Selected Monitors
- Campaign Receptor
- Turbines Built
- Henderson Road

N

Project ID:	13350.02
Drawn by:	MWJ
Reveiwed by:	DH
Date:	March 10, 2020
Revision:	1
Scale:	As Indicated

South Branch Wind Project
R173 and R202 I-Audit Report

Appendix A.2a

Monitor and Receptor Location

aercoustics

Legend

- Selected Monitors
- Campaign Receptor
- Turbines Built
- Henderson Road

N

Project ID:	13350.02
Drawn by:	MWJ
Reveiwed by:	DH
Date:	March 10, 2020
Revision:	1
Scale:	As Indicated

South Branch Wind Project
R173 and R202 I-Audit Report

Appendix A.2b

Monitor and Receptor Location

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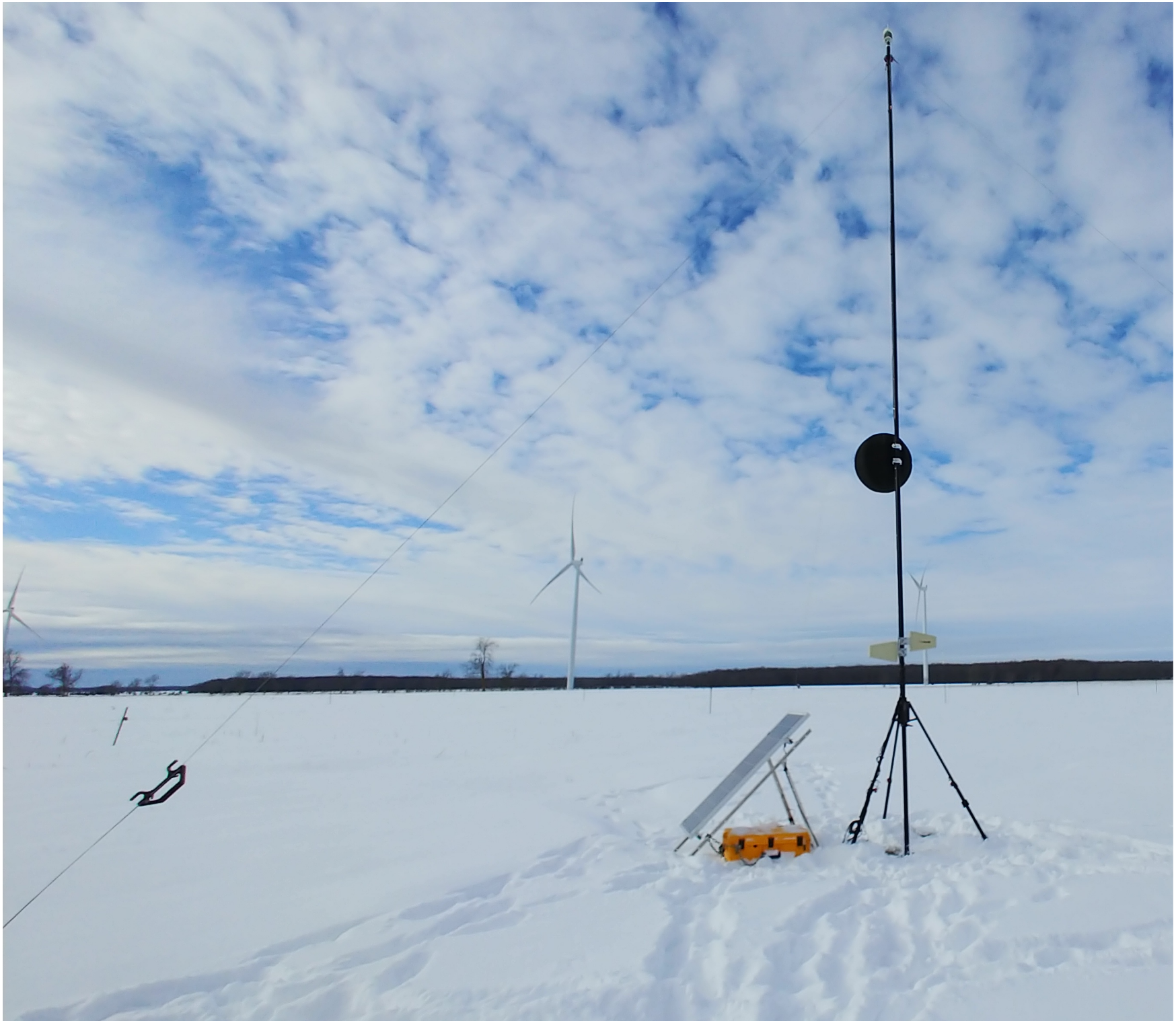
Project ID:	13350.02
Drawn by:	MWJ
Reveiwed by:	DH
Date:	March 10, 2020
Revision:	1
Scale:	As Indicated

South Branch Wind Project
R173 and R202 I-Audit Report

Appendix A.3a

Monitor R173 to T10

aercoustics



Project ID:	13350.02
Drawn by:	MWJ
Reveiwed by:	DH
Date:	March 10, 2020
Revision:	1
Scale:	As Indicated

South Branch Wind Project
R173 and R202 I-Audit Report

Appendix A.3b

Monitor R202 to T12

aercoustics

Project ID:	13350.02
Drawn by:	MWJ
Reveiwed by:	DH
Date:	March 10, 2020
Revision:	1
Scale:	As Indicated

South Branch Wind Project
R173 and R202 I-Audit Report

Appendix A.4a

Monitor R173 to Receptor

aercoustics

Project ID:	13350.02
Drawn by:	MWJ
Reveiwed by:	DH
Date:	March 10, 2020
Revision:	1
Scale:	As Indicated

South Branch Wind Project
R173 and R202 I-Audit Report

Appendix A.4b

Monitor R202 to Receptor

aercoustics

Project ID:	13350.02
Drawn by:	MWJ
Reveiwed by:	DH
Date:	March 10, 2020
Revision:	1
Scale:	As Indicated

South Branch Wind Project
R173 and R202 I-Audit Report

Appendix A.5

Monitor R202 - Nearby Ventilation Fans

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Mississauga, ON L4Y 0G1

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Fax 416-249-3613
aercoustics.com

Appendix B
Calibration Certificates

CERTIFICATE of CALIBRATION

Make : PCB Piezotronics

Reference # : 154351

Model : 378B02

Customer : Aercoustics Engineering Ltd
Mississauga, ON

Descr. : Microphone System 1/2" Free Field

Serial # : 124691

P. Order : 2018.10.02C

Asset # : 00780

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 : Oct 15, 2018

By : Petro Onasko

Cal. Due : Oct 15, 2020

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 : **154351**

Make			Model	Serial		Asset
PCB Piezotronics			378B02	124691		00780
PCB Piezotronics			377B02	164620		

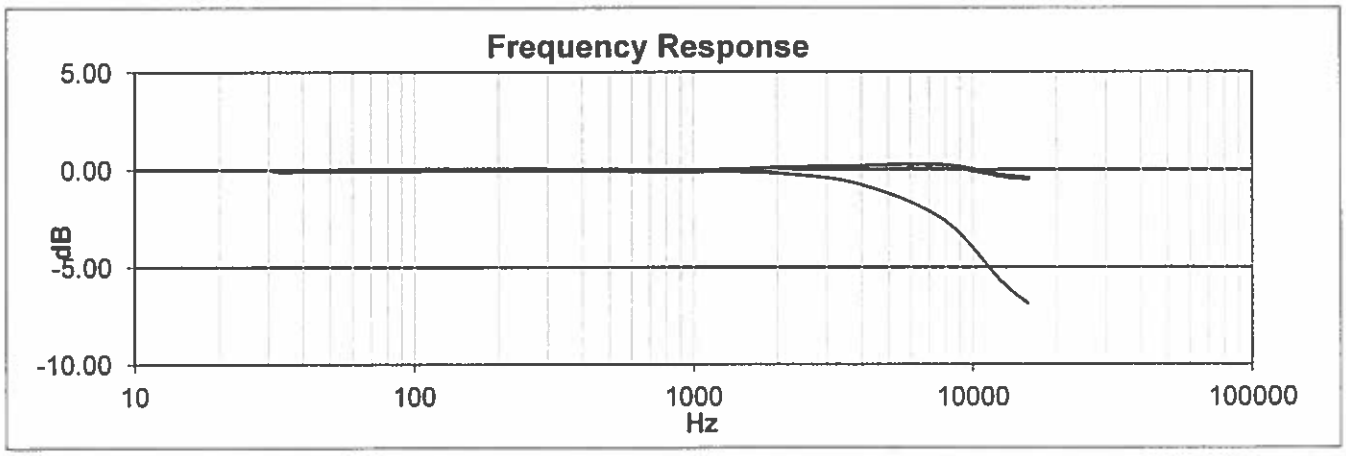
Sensitivity at 250Hz

Specs Nom	Unit	Min	Reading	Max	In/Out
50	mV/Pa	39.72	47.26	62.94	In
-26.02	dB re 1V/Pa	-28.02	-26.51	-24.02	In
0	dB re 50mV/Pa	-2	-0.49	2	In

Ambient Conditions:
Static Pressure 98.7 kPa
Temperature 22.1°C
Rel.Humidity 42.0%

Frequency response

	Lower	Upper	
Freq	Pressure	Free Field	
Hz	dB	dB	
31.5	-0.05	-0.04	
63.1	-0.01	-0.02	
125.9	0.00	0.00	
251.3	0.00	0.00	ref
502.5	-0.02	-0.01	
1005.1	-0.08	-0.05	
1978.7	-0.18	0.08	
3957.5	-0.75	0.16	
7914.9	-2.61	0.19	
12663	-5.73	-0.31	
15830	-6.89	-0.46	



CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	161545
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	124691	P. Order :	2020.05.04C
Asset # :	00780		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 164620

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 05, 2020 By : Petro Onasko

Cal. Due : May 05, 2022

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

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NT NAVAIR TECHNOLOGIES

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

Form: 378B02	Approved by: J.R.	Feb-16	Ver 1.0

Calibration Report for Certificate : 161545

Make			Model	Serial	Asset		
PCB Piezotronics			378B02	**124691**	00780		
PCB Piezotronics			426E01	**043048**	00780		
PCB Piezotronics			377B02	**164620**	00780		

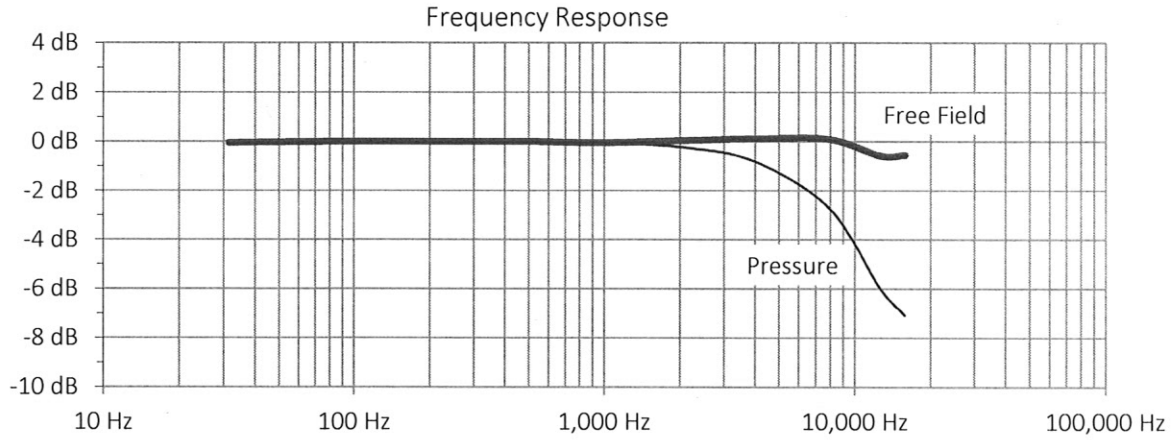
Sensitivity at 250 Hz

Specs Nom	Unit		Min	Reading	Max		In/Out
50.0 mV/Pa			39.72	**47.35**	62.94		In
−26.02 dB	re 1 V/Pa		-28.02	**-26.49**	-24.02		In
0 dB	re 50 mV/Pa		-2	**-0.47**	2		In

Ambient Conditions: Static Pressure 99.7 kPa
Temperature 23.0°C
Rel.Humidity 31.0%

Frequency response

	Lower	Upper	
Freq	Pressure	Free Field	
Hz	dB	dB	
31.5	−0.05	−0.05	
63.1	−0.02	−0.02	
125.9	−0.01	−0.00	
251.3	**0.00**	**0.00**	ref
502.5	−0.02	−0.01	
1005.1	−0.08	−0.06	
1978.7	−0.22	+0.03	
3957.5	−0.80	+0.11	
7914.9	−2.71	+0.09	
12663	−6.02	−0.59	
15830	−7.09	−0.55	



CERTIFICATE of CALIBRATION

Make : PCB Piezotronics

Model : 480E09

Descr. : Conditioning Amplifier

Serial # : 00033658

Asset # : P16

Reference # : 155800

Customer : Aercoustics Engineering Ltd
Mississauga, ON

P. Order : 2019.03.04C

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 05, 2019

By : Petro Onasko

Cal. Due : Mar 05, 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

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Tel: (905)565-1583
Fax: (905)565-8325

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

Calibration Report for Certificate : 155800

Make	Model	Serial №	Asset
PCB Piezotronics	480E09	00033658	P16

Test	Input		Min	Reading	Max		In/Out

Gain accuracy at 1 kHz

Gain Set V

• 1	1.000 V		0.9800	1.000	1.0200		In
• 10	0.100 V		0.9800	1.000	1.0200		In
• 100	0.010 V		0.9800	0.996	1.0200		In

Gain Flatness

Gain • 1

10 Hz	1.000 V		-5.0	0.0%	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	0.0%	5.0		In
10 kHz	0.100 V		-5.0	0.0%	5.0		In
50 kHz	0.100 V		-5.0	-0.3%	5.0		In
100 kHz	0.100 V		-5.0	-1.4%	5.0		In

Gain • 100

10 Hz	0.010 V		-5.0	-0.3%	5.0		In
10 kHz	0.010 V		-5.0	-0.7%	5.0		In
50 kHz	0.010 V		-5.0	-1.3%	5.0		In

VAISALA

Test report no. H31-19110191

TEST REPORT

Product family	WXT530 series
Product type	WXT536
Order code	6B1B2A4B1A1B
Serial number	R1151162
Manufacturer	Vaisala Oyj, Finland
Test date	15 March 2019

This test report certifies that the product was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Lower limit	Upper limit	Unit
Rain response	392	345	575	mV
Zero wind speed	0	0	0.4	m/s
Pressure difference	-0.11	-1	1	hPa
Temperature difference	0.37	-2	2	°C
Humidity difference	-0.7	-10	10	%RH
Heating current	0.74	0.6	0.8	A
Current (service port)	1.19	0.5	2	mA
Communication (service port)	pass	PASS	PASS	-
Current (main port)	0.85	0.5	2	mA
Communication (main port)	pass	PASS	PASS	-

Ambient conditions / Humidity 23.47 ±5 %RH, Temperature 23.16 ±1 °C, Pressure 991.07 ±1 hPa.

Signature

Technician

 DOC233154-A.doc

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Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Calibration sheet no. H31-19110192

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	R0620001
Manufacturer	Vaisala Oyj, Finland
Test date	11 February 2019

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Calibration results

Test phase of calibration process	Reference value	Observed value	Difference*	Uncertainty**
Pressure	1083.6	1083.6	0	± 0.4 hPa
Pressure	898.5	898.4	-0.1	± 0.4 hPa
Pressure	797.5	797.5	0	± 0.4 hPa
Pressure	598.8	598.8	0	± 0.4 hPa
Temperature	59.7	59.7	0	± 0.2 °C
Temperature	-6	-6	0	± 0.2 °C
Temperature	-32.8	-32.8	0	± 0.2 °C
Temperature	24.9	24.9	0	± 0.2 °C
Temperature	-52.2	-52.2	0	± 0.2 °C
Relative humidity	29.3	29.3	0	± 2 %RH
Relative humidity	58	58	0	± 2 %RH
Relative humidity	92.2	92.2	0	± 3 %RH

*The test points for error values are polynomial fitting curve fitting points.
**The calibration uncertainty given at 95 % confidence level, k = 2

Traceability
The working standards for pressure and temperature are calibrated at Vaisala Measurement Standards Laboratory (MSL) by using MSL working standards traceable to National Institute of Standards and Technology (NIST, USA). The relative humidity values are calculated from measured temperature and dew-point temperature values. The dew-point working standards are traceable to the Finnish National Humidity Laboratory (MIKES).

Signature

Technician

Doc218938-A

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227
Email firstname.lastname@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

Compliant Calibration Certificate

Template Revision: Feb2018

Certificate Number:	5977189.1	**OE Number:**	21632647
Date Printed:	26-MAR-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:	1ADD8EC		
Part Number:	195551B-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	26-MAR-2019	**Recommended Calibration Due:**	26-MAR-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:	Rachel McKinnon	**Driver Info:**	NI-DAQmx:17.6.0
Temperature:	23.1° C	**Humidity:**	42.7% RH

NATIONAL INSTRUMENTS
CALIBRATED
SN/ID 1ADD8EC
DATE 26-MAR-2019
DUE 26-MAR-2020
ni.com/calibration

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**

Victor Peña
Technical Manager

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

NATIONAL INSTRUMENTS

Calibration Notes

Type	Note
Asset	Verification and adjustment were performed.

Standards Used

Manufacturer	Model	Type	Tracking Number	Calibration Due	Notes
Fluke	5700A	Calibrator	2554	01-MAY-2019	
National Instruments	PXI-4461	Function generator	9520	20-AUG-2019	
National Instruments	PXI-4071	Digital multimeter	9840	15-MAY-2019	
National Instruments	PXI-4132	SMU	9170	03-MAY-2019	

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	3.99993 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	-3.99984 V	-3.99520 V	Passed	
-5 V	5 V	1	4.00000 V	3.99520 V	3.99990 V	4.00480 V	Passed	
-5 V	5 V	1	0.00000 V	-0.00120 V	0.00001 V	0.00120 V	Passed	
-5 V	5 V	1	-4.00000 V	-4.00480 V	-3.99986 V	-3.99520 V	Passed	
-5 V	5 V	2	4.00000 V	3.99520 V	3.99986 V	4.00480 V	Passed	
-5 V	5 V	2	0.00000 V	-0.00120 V	-0.00006 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	3.99990 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	-3.99987 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	-0.010 Degrees	0.085 Degrees	Passed	
1	51200	16384	1000 Hz	-0.085 Degrees	0.016 Degrees	0.085 Degrees	Passed	
2	51200	16384	1000 Hz	-0.085 Degrees	-0.016 Degrees	0.085 Degrees	Passed	
3	51200	16384	1000 Hz	-0.085 Degrees	0.008 Degrees	0.085 Degrees	Passed	
0	51200	16384	10000 Hz	-0.490 Degrees	-0.071 Degrees	0.490 Degrees	Passed	
1	51200	16384	10000 Hz	-0.490 Degrees	0.138 Degrees	0.490 Degrees	Passed	
2	51200	16384	10000 Hz	-0.490 Degrees	-0.138 Degrees	0.490 Degrees	Passed	
3	51200	16384	10000 Hz	-0.490 Degrees	0.083 Degrees	0.490 Degrees	Passed	

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NATIONAL INSTRUMENTS

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	52.360 dB	100.000 dB	Passed	
1	51200	16384	1000 Hz	40.000 dB	51.157 dB	100.000 dB	Passed	
2	51200	16384	1000 Hz	40.000 dB	51.200 dB	100.000 dB	Passed	
3	51200	16384	1000 Hz	40.000 dB	50.988 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	2.084 mA	2.200 mA	Passed	
1	51200	0.01 A	2.000 mA	2.000 mA	2.072 mA	2.200 mA	Passed	
2	51200	0.01 A	2.000 mA	2.000 mA	2.075 mA	2.200 mA	Passed	
3	51200	0.01 A	2.000 mA	2.000 mA	2.073 mA	2.200 mA	Passed	

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As Found

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	20.856 V	24.000 V	Passed	
1	51200	24 V	2 mA	19.000 V	20.860 V	24.000 V	Passed	
2	51200	24 V	2 mA	19.000 V	20.859 V	24.000 V	Passed	
3	51200	24 V	2 mA	19.000 V	20.861 V	24.000 V	Passed	

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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	4.00000 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	-4.00000 V	-3.99520 V	Passed	
-5 V	5 V	1	4.00000 V	3.99520 V	4.00000 V	4.00480 V	Passed	
-5 V	5 V	1	0.00000 V	-0.00120 V	-0.00001 V	0.00120 V	Passed	
-5 V	5 V	1	-4.00000 V	-4.00480 V	-4.00000 V	-3.99520 V	Passed	
-5 V	5 V	2	4.00000 V	3.99520 V	4.00000 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	-3.99999 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	0.00000 V	0.00120 V	Passed	
-5 V	5 V	3	-4.00000 V	-4.00480 V	-3.99998 V	-3.99520 V	Passed	

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As Left

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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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	-0.010 Degrees	0.085 Degrees	Passed	
1	51200	16384	1000 Hz	-0.085 Degrees	0.016 Degrees	0.085 Degrees	Passed	
2	51200	16384	1000 Hz	-0.085 Degrees	-0.016 Degrees	0.085 Degrees	Passed	
3	51200	16384	1000 Hz	-0.085 Degrees	0.009 Degrees	0.085 Degrees	Passed	
0	51200	16384	10000 Hz	-0.490 Degrees	-0.071 Degrees	0.490 Degrees	Passed	
1	51200	16384	10000 Hz	-0.490 Degrees	0.138 Degrees	0.490 Degrees	Passed	
2	51200	16384	10000 Hz	-0.490 Degrees	-0.138 Degrees	0.490 Degrees	Passed	
3	51200	16384	10000 Hz	-0.490 Degrees	0.083 Degrees	0.490 Degrees	Passed	

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As Left

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	51.647 dB	100.000 dB	Passed	
1	51200	16384	1000 Hz	40.000 dB	51.670 dB	100.000 dB	Passed	
2	51200	16384	1000 Hz	40.000 dB	52.850 dB	100.000 dB	Passed	
3	51200	16384	1000 Hz	40.000 dB	51.503 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	2.071 mA	2.200 mA	Passed	
1	51200	0.01 A	2.000 mA	2.000 mA	2.072 mA	2.200 mA	Passed	
2	51200	0.01 A	2.000 mA	2.000 mA	2.075 mA	2.200 mA	Passed	
3	51200	0.01 A	2.000 mA	2.000 mA	2.073 mA	2.200 mA	Passed	

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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	20.857 V	24.000 V	Passed	
1	51200	24 V	2 mA	19.000 V	20.861 V	24.000 V	Passed	
2	51200	24 V	2 mA	19.000 V	20.858 V	24.000 V	Passed	
3	51200	24 V	2 mA	19.000 V	20.860 V	24.000 V	Passed	

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NATIONAL INSTRUMENTS

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

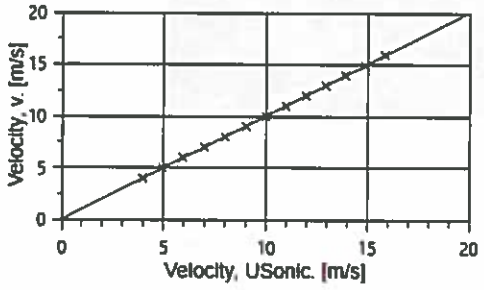
Certificate number: 18.US1.03709 **Date of issue:** July 27, 2018
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** J4830029
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

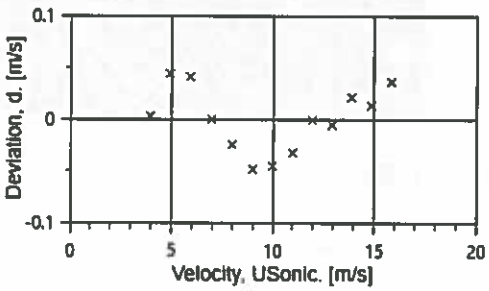
Anemometer received: July 27, 2018 **Anemometer calibrated:** July 27, 2018
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.00297 · f [m/s] + -0.00028

Standard uncertainty, slope: 0.00242 **Standard uncertainty, offset:** -93.60706
Covariance: -0.0000587 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999968
Absolute maximum deviation: -0.048 m/s at 8.988 m/s
Barometric pressure: 1000.8 hPa **Relative humidity:** 55.8%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, f. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.04	28.6	27.2	3.971	3.9567	0.003	0.021
4	14.26	28.7	27.2	4.989	4.9310	0.044	0.023
6	20.54	28.7	27.2	5.988	5.9300	0.041	0.026
8	27.96	28.7	27.3	6.987	6.9667	0.000	0.029
10	36.56	28.7	27.2	7.989	7.9900	-0.025	0.033
12	46.28	28.6	27.3	8.988	9.0100	-0.048	0.037
13-last	56.99	28.6	27.2	9.974	9.9897	-0.045	0.041
11	69.06	28.6	27.3	10.980	10.9800	-0.033	0.045
9	82.31	28.6	27.2	11.988	11.9533	-0.001	0.049
7	96.33	28.6	27.3	12.969	12.9367	-0.006	0.053
5	111.71	28.6	27.3	13.966	13.9033	0.021	0.057
3	127.70	28.6	27.2	14.930	14.8733	0.013	0.061
1-first	145.52	28.6	27.2	15.936	15.8533	0.036	0.065





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord1	Wind tunnel, blockage factor = 1.0035
2254	Control cup anemometer
-	Mounting tube, D = 19 mm
TT002	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP005	Setra Model 239, 0-1inWC, differential pressure transducer
HY003	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, barometer
PL8	Pitot tube
XB002	Computer Board. 16 bit A/D data acquisition board
9PRZRW1	PC dedicated to data acquisition

Traceable calibrations of the equipment are carried out by external accredited institutions: Atlantic Scale, Essco Calibration Labs & Furness Controls. A real-time analysis module within the data acquisition software detects pulse frequency.

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: 18.US1.03709

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

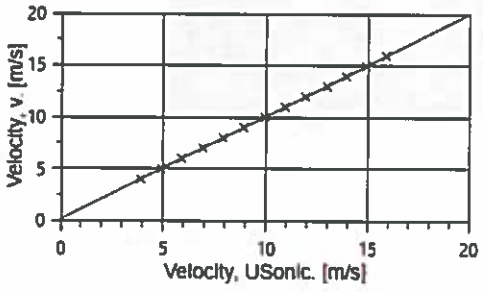
Certificate number: 18.US1.03711 **Date of issue:** July 27, 2018
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** J4830029
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

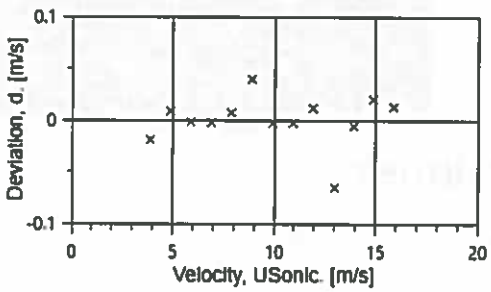
Anemometer received: July 27, 2018 **Anemometer calibrated:** July 27, 2018
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 0.99376 · f [m/s] + 0.11963

Standard uncertainty, slope: 0.00188 **Standard uncertainty, offset:** 0.16585
Covariance: -0.0000347 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999981
Absolute maximum deviation: -0.065 m/s at 12.970 m/s
Barometric pressure: 1001.0 hPa **Relative humidity:** 55.9%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, f. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.05	28.5	27.2	3.973	3.8967	-0.019	0.021
4	14.26	28.6	27.2	4.988	4.8897	0.009	0.023
6	20.51	28.6	27.2	5.981	5.9000	-0.002	0.026
8	28.04	28.6	27.2	6.994	6.9200	-0.002	0.029
10	36.51	28.6	27.2	7.981	7.9033	0.007	0.033
12	46.49	28.6	27.2	9.005	8.9017	0.039	0.037
13-last	57.20	28.5	27.2	9.989	9.9345	-0.003	0.041
11	69.13	28.6	27.2	10.982	10.9333	-0.003	0.045
9	82.21	28.6	27.2	11.977	11.9200	0.012	0.049
7	96.40	28.6	27.2	12.970	12.9967	-0.065	0.053
5	111.62	28.6	27.2	13.957	13.9300	-0.006	0.057
3	128.07	28.5	27.2	14.950	14.9033	0.020	0.061
1-first	145.43	28.5	27.2	15.930	15.8967	0.013	0.065





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord1	Wind tunnel, blockage factor = 1.0035
2254	Control cup anemometer
-	Mounting tube, D = 19 mm
TT002	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP005	Setra Model 239, 0-1inWC, differential pressure transducer
HY003	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, barometer
PL8	Pitot tube
XB002	Computer Board. 16 bit A/D data acquisition board
9PRZRW1	PC dedicated to data acquisition

Traceable calibrations of the equipment are carried out by external accredited institutions: Atlantic Scale, Essco Calibration Labs & Furness Controls. A real-time analysis module within the data acquisition software detects pulse frequency.

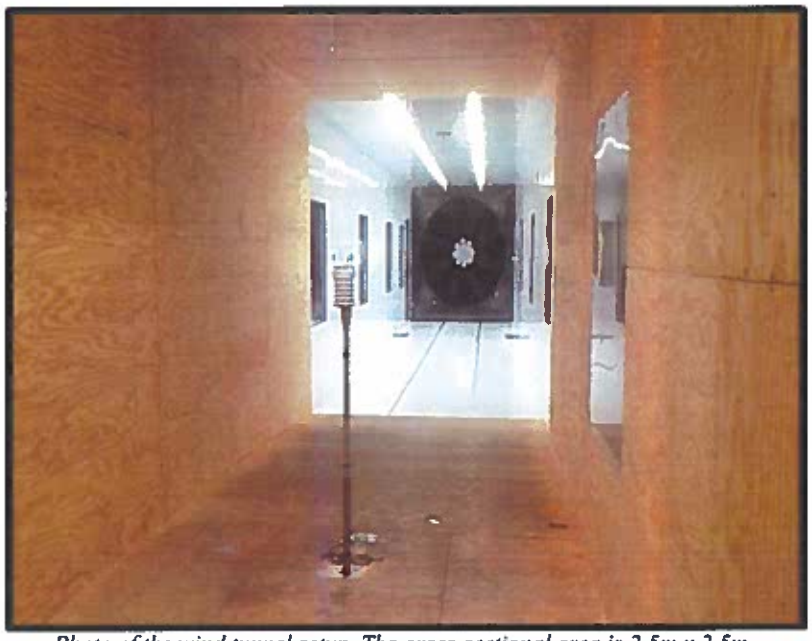


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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: 18.US1.03711

~ *Calibration Certificate* ~

Model Number: 480E09

Serial Number: 36691

Description: Signal Conditioner

Manufacturer: PCB

Customer:

P.O.:

Method : Comparison Method (AT103-3)

Calibration Data

Temperature: 74 °F (24 °C)

Humidity: 46%

Channel	Volts	Current (mA)	Gain X1	Gain X10	Gain X100
1	26.9	2.97	1.002	10.019	100.126

Condition of Unit

As Found: n/a

As Left: New unit, in tolerance

Notes

1. Calibration is N.I.S.T. traceable through PCB control number QC-726.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. Measurement uncertainty (95% confidence level with a coverage factor of 2) for the sensitivity reading is +/- 0.2 %
5. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.

Technician: Darius Story DS

Date: 04/30/19

Due Date:

ilac-MRA A2LA ACCREDITED

CALIBRATION CERT #1862.02

PCB PIEZOTRONICS INC.

Headquarters: 3425 Walden Avenue, Depew, NY 14043

Calibration Performed at: 10869 Highway 903, Halifax, NC 27839

TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ELE98-3639518357

#1421

~ Certificate of Calibration and Compliance ~

Model: 378B02	Serial Number: 142561	
Microphone Model: 377B02	Serial Number: 313871	Manufacturer: PCB
Preamplifier Model: 426E01	Serial Number: 064212	Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
Newport	BTH-W/N	8410668	CA1187	7/17/19	7/17/20
0	0	0	0	not required	not required
PCB Piezotronics	443B102	715	CA2133	8/1/18	8/1/19
PCB Piezotronics	480E09	31291	CA2037	7/5/19	7/3/20
Larson Davis	PRA951-4	243	CA1457	1/24/19	1/24/20
0	0	0	0	not required	not required
Larson Davis	ADP005	0	0	not required	not required
Larson Davis	PRM915	124	CA1024	1/11/19	1/10/20
Larson Davis	GPRM902	3999	CA1090	9/19/18	9/19/19
Larson Davis	LF-Amplifier	104	CA1435	3/20/19	3/20/20
Larson Davis	PRM915	123	CA866	11/8/18	11/8/19
Larson Davis	PRM916	144	CA2001	10/24/18	10/24/19
Larson Davis	CAL250	5019	CA1496	11/6/18	11/6/19
Larson Davis	2201	140	CA890	6/3/19	6/3/20
Larson Davis	PRM902	4701	CA1450	8/31/18	8/30/19

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. System Sensitivity is measured following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-63.

Technician: William M. Urbanek WMU Date: July 29, 2019

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CALIBRATION CERT #1862.01

PCB PIEZOTRONICS
VIBRATION DIVISION
3425 Walden Avenue, Depew, New York, 14043
TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL93-3647256850.216+0

~ Calibration Report ~

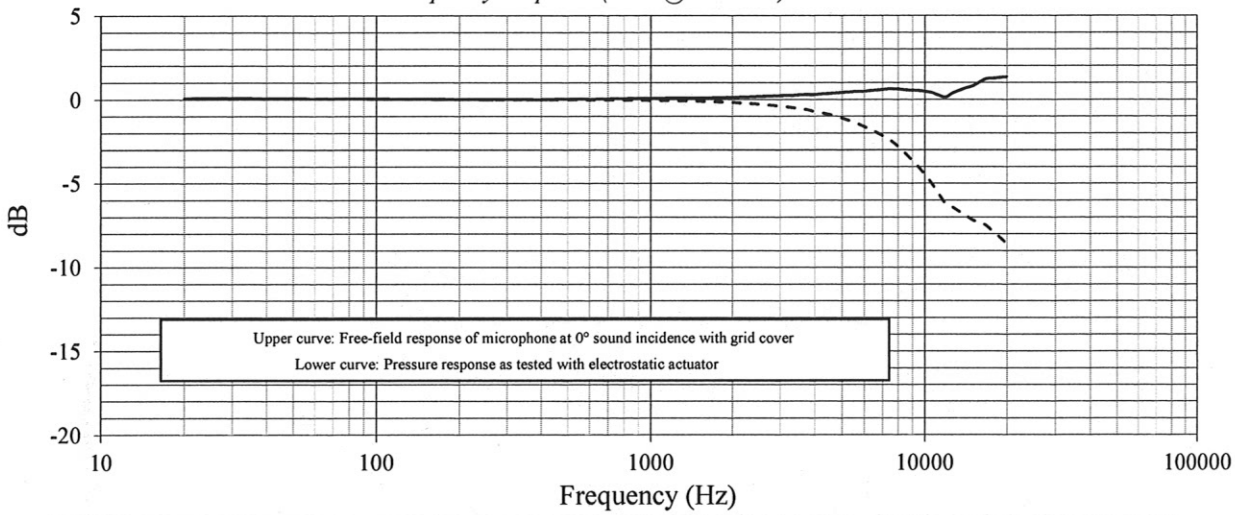
Model: 378B02 Serial Number: 142561
Microphone Model: 377B02 Serial Number: 313871 Description: 1/2" Free-Field Microphone
Preamplifier Model: 426E01 Serial Number: 064212 and Preamplifier

Calibration Data

System Sensitivity @ 251.2 Hz: 56.61 mV/Pa Polarization Voltage, External: 0 V
-24.94 dB re 1V/Pa

Temperature: 74 °F (23°C) Ambient Pressure: 989 mbar Relative Humidity: 45 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	0.07	0.07	1679	-0.14	0.09	7499	-2.45	0.62	-	-	-
25.1	0.09	0.09	1778	-0.15	0.10	7943	-2.77	0.62	-	-	-
31.6	0.08	0.08	1884	-0.17	0.11	8414	-3.17	0.56	-	-	-
39.8	0.08	0.08	1995	-0.18	0.13	8913	-3.57	0.54	-	-	-
50.1	0.06	0.06	2114	-0.21	0.13	9441	-3.99	0.53	-	-	-
63.1	0.05	0.05	2239	-0.23	0.14	10000	-4.47	0.48	-	-	-
79.4	0.04	0.04	2371	-0.25	0.16	10593	-4.99	0.41	-	-	-
100.0	0.04	0.04	2512	-0.28	0.18	11220	-5.61	0.25	-	-	-
125.9	0.04	0.04	2661	-0.32	0.19	11885	-6.18	0.14	-	-	-
158.5	0.02	0.02	2818	-0.35	0.21	12589	-6.41	0.36	-	-	-
199.5	0.02	0.02	2985	-0.40	0.22	13335	-6.66	0.53	-	-	-
251.2	0.00	0.00	3162	-0.44	0.24	14125	-6.91	0.68	-	-	-
316.2	0.00	0.01	3350	-0.49	0.25	14962	-7.17	0.80	-	-	-
398.1	0.00	0.00	3548	-0.54	0.28	15849	-7.33	1.02	-	-	-
501.2	-0.01	0.03	3758	-0.61	0.29	16788	-7.50	1.22	-	-	-
631.0	-0.02	0.02	3981	-0.71	0.29	17783	-7.86	1.25	-	-	-
794.3	-0.04	0.06	4217	-0.79	0.32	18837	-8.21	1.30	-	-	-
1000.0	-0.05	0.07	4467	-0.88	0.35	19953	-8.59	1.34	-	-	-
1059.3	-0.06	0.07	4732	-0.99	0.38	-	-	-	-	-	-
1122.0	-0.07	0.07	5012	-1.12	0.41	-	-	-	-	-	-
1188.5	-0.07	0.08	5309	-1.26	0.44	-	-	-	-	-	-
1258.9	-0.08	0.08	5623	-1.41	0.47	-	-	-	-	-	-
1333.5	-0.09	0.09	5957	-1.59	0.48	-	-	-	-	-	-
1412.5	-0.09	0.10	6310	-1.77	0.52	-	-	-	-	-	-
1496.2	-0.11	0.10	6683	-1.97	0.55	-	-	-	-	-	-
1584.9	-0.12	0.09	7080	-2.19	0.59	-	-	-	-	-	-

Technician: William M. Urbanek WMU Date: July 29, 2019

ilac-MRA A2LA ACCREDITED
CALIBRATION CERT #1862.01

PCB PIEZOTRONICS VIBRATION DIVISION
3425 Walden Avenue, Depew, New York, 14043
TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL93-3647256850.216+0

Compliant Calibration Certificate

NATIONAL INSTRUMENTS
CALIBRATED
SN/ID: 1A6C102
DATE: 10-OCT-2019
DUE: 10-OCT-2020

Certificate Number:	6183126.1	**OE Number:**	21778082
Date Printed:	10-OCT-2019	**Page:**	1 of 14
Customer:	Aercoustics Engineering LTD (CA) 1004 Middlegate Road Suite 1100 ONTARIO MISSISSAUGA, L4Y 0G1 CANADA		
Manufacturer:	National Instruments	**Model:**	NI 9234
Serial Number:	1A6C102		
Part Number:	195551B-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	10-OCT-2019	**Issued Date:**	10-OCT-2019
Procedure Name:	NI 9234	**Recommended Calibration Due:**	10-OCT-2020
Procedure Version:	3.6.1.0	**Verification Results:**	As Found: Passed As Left: Passed
Lab Technician:	Yik Khai Hong	**Calibration Executive Version:**	5.0.0.0
		Driver Info:	NI-DAQmx:17.6.0
Temperature:	23.3° C	**Humidity:**	46.6% RH

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments, if the unit is functional.

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 requirement.

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%.

Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'. NI Service Labs do not consider uncertainties when making statements of compliance to a specification.

This certificate applies exclusively to the item identified above and shall not be reproduced except in full, without National Instruments written authorization. Calibration certificates without signatures are not valid.

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 Email orders@ni.com.

Ming Hui

Ming Hui Tan
Technical Manager

NI Malaysia Sdn. Bhd.
8 Lebuh Batu Maung 1
Bayan Lepas, Penang
Malaysia
Tel: 604 377 6000

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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	3138	05-SEP-2020	
Agilent	33250A	Function generator	8459	22-MAR-2020	
National Instruments	PXI-4071	Digital multimeter	16772	27-DEC-2019	
National Instruments	PXI-4132	SMU	27088	31-JUL-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	4.00005 V	4.00480 V	Passed	
-5 V	5 V	0	0.00000 V	-0.00120 V	0.00019 V	0.00120 V	Passed	
-5 V	5 V	0	-4.00000 V	-4.00480 V	-3.99972 V	-3.99520 V	Passed	
-5 V	5 V	1	4.00000 V	3.99520 V	4.00002 V	4.00480 V	Passed	
-5 V	5 V	1	0.00000 V	-0.00120 V	0.00023 V	0.00120 V	Passed	
-5 V	5 V	1	-4.00000 V	-4.00480 V	-3.99958 V	-3.99520 V	Passed	
-5 V	5 V	2	4.00000 V	3.99520 V	3.99995 V	4.00480 V	Passed	
-5 V	5 V	2	0.00000 V	-0.00120 V	0.00011 V	0.00120 V	Passed	
-5 V	5 V	2	-4.00000 V	-4.00480 V	-3.99979 V	-3.99520 V	Passed	
-5 V	5 V	3	4.00000 V	3.99520 V	3.99993 V	4.00480 V	Passed	
-5 V	5 V	3	0.00000 V	-0.00120 V	0.00009 V	0.00120 V	Passed	
-5 V	5 V	3	-4.00000 V	-4.00480 V	-3.99974 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	-0.013 Degrees	0.085 Degrees	Passed	
1	51200	16384	1000 Hz	-0.085 Degrees	0.013 Degrees	0.085 Degrees	Passed	
2	51200	16384	1000 Hz	-0.085 Degrees	0.007 Degrees	0.085 Degrees	Passed	
3	51200	16384	1000 Hz	-0.085 Degrees	0.007 Degrees	0.085 Degrees	Passed	
0	51200	16384	10000 Hz	-0.490 Degrees	-0.133 Degrees	0.490 Degrees	Passed	
1	51200	16384	10000 Hz	-0.490 Degrees	0.133 Degrees	0.490 Degrees	Passed	
2	51200	16384	10000 Hz	-0.490 Degrees	0.073 Degrees	0.490 Degrees	Passed	
3	51200	16384	10000 Hz	-0.490 Degrees	0.073 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	68.056 dB	100.000 dB	Passed	
1	51200	16384	1000 Hz	40.000 dB	69.003 dB	100.000 dB	Passed	
2	51200	16384	1000 Hz	40.000 dB	67.153 dB	100.000 dB	Passed	
3	51200	16384	1000 Hz	40.000 dB	70.744 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	2.084 mA	2.200 mA	Passed	
1	51200	0.01 A	2.000 mA	2.000 mA	2.087 mA	2.200 mA	Passed	
2	51200	0.01 A	2.000 mA	2.000 mA	2.076 mA	2.200 mA	Passed	
3	51200	0.01 A	2.000 mA	2.000 mA	2.081 mA	2.200 mA	Passed	

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As Found

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	20.937 V	24.000 V	Passed	
1	51200	24 V	2 mA	19.000 V	20.940 V	24.000 V	Passed	
2	51200	24 V	2 mA	19.000 V	20.949 V	24.000 V	Passed	
3	51200	24 V	2 mA	19.000 V	20.942 V	24.000 V	Passed	

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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	3.99997 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	-4.00001 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	-4.00000 V	-3.99520 V	Passed	
-5 V	5 V	2	4.00000 V	3.99520 V	3.99998 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	-3.99999 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	0.00000 V	0.00120 V	Passed	
-5 V	5 V	3	-4.00000 V	-4.00480 V	-4.00001 V	-3.99520 V	Passed	

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As Left

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	-0.013 Degrees	0.085 Degrees	Passed	
1	51200	16384	1000 Hz	-0.085 Degrees	0.013 Degrees	0.085 Degrees	Passed	
2	51200	16384	1000 Hz	-0.085 Degrees	0.007 Degrees	0.085 Degrees	Passed	
3	51200	16384	1000 Hz	-0.085 Degrees	0.008 Degrees	0.085 Degrees	Passed	
0	51200	16384	10000 Hz	-0.490 Degrees	-0.133 Degrees	0.490 Degrees	Passed	
1	51200	16384	10000 Hz	-0.490 Degrees	0.133 Degrees	0.490 Degrees	Passed	
2	51200	16384	10000 Hz	-0.490 Degrees	0.075 Degrees	0.490 Degrees	Passed	
3	51200	16384	10000 Hz	-0.490 Degrees	0.075 Degrees	0.490 Degrees	Passed	

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As Left

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	69.400 dB	100.000 dB	Passed	
1	51200	16384	1000 Hz	40.000 dB	68.357 dB	100.000 dB	Passed	
2	51200	16384	1000 Hz	40.000 dB	65.560 dB	100.000 dB	Passed	
3	51200	16384	1000 Hz	40.000 dB	71.613 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	2.084 mA	2.200 mA	Passed	
1	51200	0.01 A	2.000 mA	2.000 mA	2.087 mA	2.200 mA	Passed	
2	51200	0.01 A	2.000 mA	2.000 mA	2.076 mA	2.200 mA	Passed	
3	51200	0.01 A	2.000 mA	2.000 mA	2.081 mA	2.200 mA	Passed	

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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	20.938 V	24.000 V	Passed	
1	51200	24 V	2 mA	19.000 V	20.940 V	24.000 V	Passed	
2	51200	24 V	2 mA	19.000 V	20.948 V	24.000 V	Passed	
3	51200	24 V	2 mA	19.000 V	20.943 V	24.000 V	Passed	

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Malaysia
Tel: 604 377 6000

NATIONAL INSTRUMENTS™

aercoustics

Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 0G1

Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

Appendix C
Turbine Operational Statement from the Operator

SOUTH BRANCH WIND FARM

March 11, 2020

Aercoustics Engineering Limited
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 0G1
Email: duncanh@aercoustics.com

Re: **Wind Turbine Operating Conditions**: Services Agreement dated March 21, 2019 by and between South Dundas Windfarm Limited Partnership ("Owner") and Aercoustics Engineering Limited ("Contractor")

To Whom It May Concern:

Please accept this letter as confirmation that to the best of Owner's knowledge all turbines tested during the Winter 2019-2020 acoustic measurement campaign conducted by Aercoustics Engineering Ltd. from November 7, 2019 through February 13, 2020 were operating as normal for the duration of the campaign. Please note, wind turbine 102, which was not part of the acoustic measurement campaign was offline prior to the beginning of the campaign and returned to service on February 5, 2020.

For any questions, please contact Doug Ziegler at 713-356-2418.

Sincerely,

South Dundas Windfarm Limited Partnership by its General Partner, SBWF GP, Inc

DS

DocuSigned by:
1AA6B44331BC410...

Brian Hayes
Executive Vice President, Asset Operations

aercoustics

Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 0G1

Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

Appendix D
Tonality Spot Measurements Summary

aercoustics

Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
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Subject: South Branch Wind Farm Spot Check Measurements
Aercoustics Project #: 13350.02

Date: June 25, 2019

The following memorandum details the short-term spot check measurements that were conducted to determine the presence and strength of any tones from South Brach Wind Farm ("South Branch") turbines nearby the selected immission receptor location.

Background

Aercoustics has been retained by EDP Renewables to conduct wind turbine emission and immission measurements for the South Branch facility per the requirements stipulated by the Ministry of the Environment, Conservation and Parks ("MECP"). In tandem with the Immission and Emission testing, an assessment of the risk of high tonal audibility was conducted through spot check measurements of the nearby South Branch turbines.

Calculated tonal audibility is a measure of the perceived strength and audibility of a tone at a given frequency. Per MECP protocols, sound levels having high measured tonal audibilities are assessed a penalty, depending on the strength of the detected tone. Tonal audibility typically decreases with distance from the tonal source, although the strength of a tone is heavily dependant on masking noise level and the amount of decrease from a wind turbine to nearby receptor is not always predictable. High calculated tonal audibility near the turbine presents a risk of high tones at the receptor location (and vice-versa).

Site Visit Conditions

The spot check measurements were conducted on April 18, 2019. Weather conditions were cloudy with a temperature of 10°C and winds from the South-east between 8 - 13 m/s at hub-height.

Methodology & Equipment

Turbines T103 – 106, nearest the immission measurement location at R173, were chosen for spot check measurements to assess the presence and audibility of any tones. Throughout the site visit, Turbine T104 was curtailed/paused and was not operating therefore measurements could not be carried out on this turbine.

Measurements were taken with a Bruel & Kjaer 2250 Sound Level Meter, with the microphone and secondary windscreen positioned on a reflective board at ground level, 156 m directly downwind of the turbine. This test setup is based on the IEC 61400-11 standard for wind turbine noise testing. The equipment was calibrated using a hand-held calibrator before and after the measurements. Equipment information and calibration dates are shown in Table 1. Three measurements were conducted per turbine, each measurement lasting approximately one minute.

Table 1 T103 Tonality Assessment Summary

Equipment	Serial Number	Date of Last Calibration (dd-mmm-yy)
Bruel & Kjaer 2250 Class 1 integrating Sound Level Meter	3006579	24-Sep-18
Bruel & Kjaer Type 4231 Class 1 Sound Calibrator	3012378	29-Jan-19

Tonality Assessment Summary

Results of the calculated tonal audibility for each turbine are presented the tables below. Prevalence is determined based on the proportion of total measurement time a tone was detected at each turbine.

Tonal audibility calculation is based on the IEC 61400-11 methodology. Per the IEC 61400-11 standard, a tonal audibility value greater that 0 dB indicate a tone is “audible”, and a tonal audibility value less than -3 dB would not typically be reported.

Table 2 T103 Tonality Assessment Summary

HH Wind Speed (m/s)	Power (kW)	Frequency (Hz)	Prevalence	Tonal audibility, ΔL_a (dB)
8.4	1917	285	78%	-9.5 to -8.0
		107	3%	-8.2
		58	3%	-9.9

Table 3 T105 Tonality Assessment Summary

HH Wind Speed (m/s)	Power (kW)	Frequency (Hz)	Prevalence	Tonal audibility, ΔL_a (dB)
10.6-12.2	2733-2948	76	14%	-9.4 to -5.0
		77	32%	-7.7 to -3.8
		78	10%	-7.5 to -5.7
		79	21%	-10.0 to -5.6

Table 4 T106 Tonality Assessment Summary

HH Wind Speed (m/s)	Power (kW)	Frequency (Hz)	Prevalence	Tonal audibility, ΔL_a (dB)
13.2	2936	90	4%	-3.4
		78	7%	-8.5 to -1.3
		77	15%	-7.5
		71	4%	-9.9

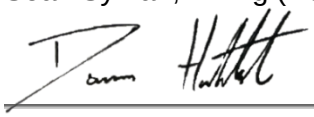
As shown in the above tables, the tonal audibility values of turbines T103, T105 and T106 have been measured to have low frequency tones detectable at low tonal audibilities (below 0 dB). The measured tones are similar in frequency and lower in magnitude to those measured during the emission tests at South Branch T107 and T108, conducted in 2015.

These results indicate that the low frequency tone detected in the 2015 e-tests on turbines T107 and T108 are also detectable in the turbines tested here. The tonal audibility is low, and therefore presents a low risk of tonal issues being present during receptor testing.

Sincerely,

AERCOUSTICS ENGINEERING LIMITED

Sean Syman, B.Eng (Hons).



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Appendix E
I-Audit Checklist

Appendix E: 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.?	✓	RAM-I assessment conducted
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	✓	RAM-I assessment conducted
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	✓	See Section 5.5 of report

End of Report