Te Rere Hau Windfarm
Annual Noise Monitoring Report

2021—2022

Adam Fuller

Engineer, TRH Services

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Contents

1.0 Purpose

This annual noise monitoring report for the year through March 2022 has been prepared by TRH Services on behalf of NZ Windfarms to fulfil our resource consent s128 review Condition 20, with contributions by Marshall Day Acoustics as noted.

As required by Condition 19.4, we provided a copy of the draft report to the Community Liaison Group prior to the group meeting held 26 May and we have not received any feedback outside of that meeting.

2.0 Compliance with Conditions 4, 5, and 5A—5C

To demonstrate compliance with these conditions, refer to report "Rp 009 R01 2011095W" prepared by Marshall Day Acoustics with TRH Services, and submitted to Council on 1 Feb 2019. Taken with the remainder of this report, which indicates no adverse alterations to wind turbines with respect to noise emissions during the preceding year, we submit that we remain in compliance with the conditions.

The Condition 5C noise curtailment regime active on turbines 88, 103, and 104 prevented approximately 569 turbine-hours of running. The curtailment parameters are unchanged from last year. A further 2,258 turbine-hours of low-wind start-ups and generation were voluntarily curtailed by noise curtailment across the fleet.

3.0 Wind turbine alterations

The year included the following significant repairs and machinery replacements

- Blade leading edge tape repairs to 55 of 65 PNCC turbines.
- Generator replacements (like-for-like, turbine 51)
- Gearbox replacement (like-for-like, turbines 31, 52, 53, 96)

Marshall Day Acoustics provided the following Acoustic Impact statement:

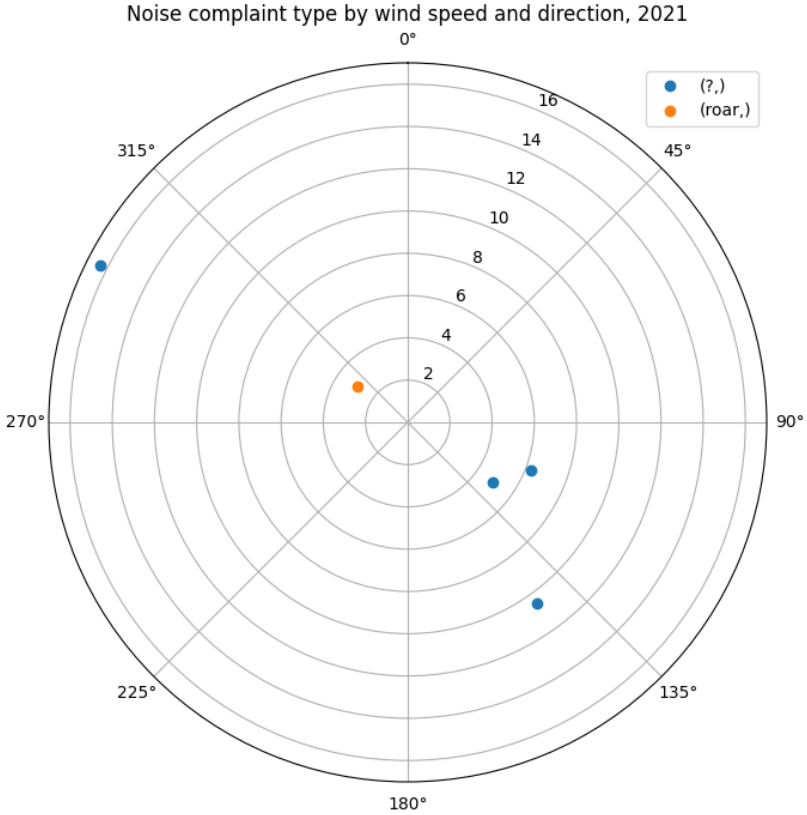
> Generator, blade and gearbox replacements where the replacement parts are the same as those removed will not have a significant effect on noise emissions.
>
> Blade leading edge tape repairs are an ongoing maintenance item which will generally reduce the high-frequency whistle of blade rotation, which would normally accumulate slowly as the leading edge tape wears or becomes damaged. We understand that priority of these repairs is given to turbines which contribute more significantly to noise received at residences. This work is expected to reduce noise levels.
>
> None of the repair or maintenance items carried out on the TRH wind farm over the 2021 – 2022 operating year will cause an increase in noise emissions. Leading edge tape repairs will have reduced noise emissions.

4.0 Complaints register

The following noise complaints were received since the beginning of 2021 (5 during 2021).

Name	Address	Date	Time	Complaint Description	Wind Speed [m/s]	Wind Direction [deg]
Sue Ellingham	47 Ridgeview Rd	25/05/2021	11:51	Sue has called this morning to complain about the noise coming from the wind turbines. She said it is an easterly wind and that is when they can hear it the most.	11	144
Sue Ellingham	47 Ridgeview Road	8/06/2021	9:09	Last night is was very bad and it is still bad now.	5	126
Sue Ellingham	47 Ridgeview Rd	22/10/2021	11:18	Strong easterly - wind farm noise complaint	6	111
Sue Ellingham	47 Ridgeview Rd	25/11/2021	11:33	Sue reports she could hear a loud roar from the windfarm happening for quite a while last night. 1st noticed at 2045.	3	306
Richard Day	1009 Makomako Rd	17/12/2021	10:33	Richard has complained about the noise from the widfarm - has been going all night and still going.	16	297
Sue Ellingham	47 Ridgeview Road	16/01/2022	9:18	Caller advises that there is a lot of noise coming from the windfarm. She advises that it has been an issue since yesterday.	9	104
Sue Ellingham	47 Ridgeview Road	17/01/2022	8:35	Caller advises the noise from the windfarm is howling through the house due to the easterly wind.	7	108
Richard Day	1009 Makomako Rd	26/01/2022	19:55	Caller states the noise from the windfarm is louder than usual tonight.	12	287
Sue Ellingham	47 Ridgeview Road	3/03/2022	9:52	Started last night and is still going this morning.	6	108
Murray Olsen	19 Ridgeview Rd	31/03/2022	20:34	8.30am droning was really terrible, this week both wind farms have been bad. NZ windfarms was better when they were doing testing but now it's a lot more regular. Really bad Thursday night 24/3/22 was particularly bad.	5	72

The figure below shows all complaints categorized based on the text of the complaint and plotted according to the wind speed and direction at the time of the of the complaint.



Generally, for the affected residents, “roar” noise is heard in easterly winds and “woosh” noise in westerly winds.

After the 25 Nov complaint blade repairs were carried out on T86 and T87 by 3 Dec which may well have solved the unusual noise for those on Ridgeview Road.

5.0 Community Liaison Group meeting minutes

5.1 26 May 2022

Aokautere School Hall, 26 May 2022

Present: Adam Radich (TRH), Adam Fuller (TRH, minutes), Brent Barrett (PNCC), Simon Mori (PNCC), Murray Olsen (murrayaok@outlook.com), Clel Wallace, Nikki Banks, Sue and Sam Ellingham, Joe Poff, Mark and Kelly Dawson, Dennis and Glenda Moore

Meeting opened 6:30pm by Adam R, welcome all to 4th annual TRH community meeting.

Repower question from Dennis Moore 319 Forrest Hill Road, can currently see 3 turbines how will their view change? Referred to upcoming 16 June repower presentation.

Adam R clarifies there will be a repower presentation 16 June at Globe Restaurant with our experts in RMA, noise, visual present to answer questions, invites are forthcoming.

Adam R presented annual noise Powerpoint.

Question: where is the noise monitoring terminal located? A: by Irvin's septic tank.

Question from Mr. Wallace: How was it decided the existing NMT should be located at 38 Ridgeview Road where it is known to be sheltered by trees, when louder/more open locations exist at 48, 47, or especially 21 Ridgeview Road? Trees are growing over time increasing this factor. A: this was determined by the s128 commissioners.

Adam R commented that Rangitane o Manawatu has indicated they will not require a cultural impact assessment for repower. Mark Dawson: "We'll see you on Te Karere mate, that's bullshit."

Mr. Olsen question: 31 March 2021, the combined noise with Turitea was a horrible droning. TRH: we will investigate the available noise data specifically and reply direct to Mr. Olsen.

Mr. Dawson and Adam R discussed who should be or have been notified for CLG meetings including this meeting and the 3x previous annual meetings. The consent determines in schedule 2 who must be invited, anyone with a metering point on their property, anyone within rural residential overlay, anyone who falls within 35DBA contour lines in certain noise conditions.

Question: Mr. Dawson asked about an unexplained $4.3 million for NZ Windfarms around the 2017/2018 timeframe.

Question from Mr. Wallace: what if any infrasound will repower turbines produce and how would this be perceived at his residence? Response from TRH: new turbines come with measured data on noise emissions including at low frequencies.

Mr. Dawson asked: How did Forest Hill Rd photo locations get selected in repower assessment? TRH: Steven Brown selected the locations and directed Virtual View to photograph from these locations for photo simulations of repower turbines.

Mr Dawson wants to know if there was ever a NMT on his property prior to him owning it and if so he believes he should have been notified when he purchased the property.

Comment by Mr. Wallace: at the previous repower community meeting, the presentation and printed visual aids were low quality. TRH: Acknowledged, we will upgrade the audio visual equipment for the upcoming meeting and will print any maps good quality A3.

Mark Dawson requested a copy of the repower visual impact assessment.

Question: when would repower start? Response: End of 2024 as a rough guideline.

Questions closed approximately 7:15pm. Tea and snacks until doors closed approximately 8:30pm.

5.2 18 May 2021

18:30 Aokautere school hall

Attendees;

NZWF, Warren Koia, Adam Radich, Peter Darke

Residents, Joseph Poff, Morris McDonald, Nikki Banks, Clel Wallace, Ash Kells, Stephen

PNCC, Head planner Simon Mori

Welcome and NZ renewable generation industry overview

Presentation given on annual noise report.

Joe Poff asked about potential for hydrogen uptake in NZ, Adam commented on unsolved storage issues and the necessity for the hydrogen to be made using renewable energy resources.

Ash Kells; Asked about battery technology and if it was possible, Adam comment around capacity and development of sizable batteries and also regarding battery technology under test in Australia.

Morris McDonald; Asked about turbine lifespan and options moving forward. Adam answered regarding 20 year life with some of fleet already being at 16yrs, we are strategically looking at best way forward whether that be a life extension or a repower is currently undecided.

Joe Poff; Asked about Mod 7 gears, Adam commented as third stages fail we are continuing to put in Mod 7 gear sets.

Clel Wallace; Asked about combined noise with Turitea, Adam commented Turitea consent requires them to look at the combined noise effects and this has no material impact on our farm operation.

Clel Wallace; Asked about consent for new turbines, Adam commented that we would be required to get a new consent for new turbines or at least a variation to our current consent as current consent is for W500 turbines specifically.

Nikki Banks; Asked what is our preferred way for residents to make complaints, Adam commented that via our system is best as saves council undertaking unnecessary admin.

Nikki Banks; Commented on behalf of herself and Sue Ellingham that they are truly grateful for the efforts of NZWF to provide noise relief as the curtailment has been truly beneficial.

6.0 Noise Monitoring Terminal

Noise monitoring at a permanent noise monitoring terminal (NMT) at the Irvin Property (Site 4, 38 Ridgeview Road) is required in Condition 13. This was completed in May 2018, with calibration completed by 10 June. The NMT gathers A-weighted noise statistics including L_{A90} as required by NZS6808:2010, and stores audio data to a hard disk, which is regularly exchanged and archived by NZWL.

The NMT is a Norsonic NOR140 sound level meter connected to a class 1 measurement microphone with an outdoor windscreen and protection kit, located at approximately the same location as used during the 2011 – 2013 monitoring exercise. This location complies with the requirements of clause 7.1.6 in New Zealand Standard NZS 6808:2010 “Acoustics – Wind farm noise”.

The measurement system is calibrated periodically by NZWL staff using a class 1 compliant field calibrator. Both the meter/microphone system and the field calibrator are subject to periodic laboratory calibration, which is undertaken at the prescribed intervals by NZWL. The latest calibration certificate for the field calibrator is included at the end of this report. The next calibration check for the calibrated source is booked for 16 May 2022. L_{A90} statistics are collected continuously in 10-minute intervals as required by NZS6808:2010 and stored on a web server.

The logger was installed and went live on 7 Jun 2018 at 13:30. In the year through 31 Mar 2022 it operated continuously except for the lost data below, for a total of 8668 hours.

	Minutes of missing noise data
2021-04	60
2021-05	0
2021-06	10
2021-07	0
2021-08	0
2021-09	250
2021-10	0
2021-11	40
2021-12	530
2022-01	0
2022-02	4520
2022-03	120

Outages can be caused by power failures, or power spikes which may cause a reset of the remote on site PC. Some are also caused by outages in the cellular system, which disrupt the data upload to the web site.

<<< Comment requested from Neil Jepsen on any work during past 12 months >>>

7.0 Analysis of operational data

This section has been provided by Marshall Day Acoustics.

We have compared the collected L_{A90}(10-min) sound level measurements with the wind speed measurements taken at the reference met mast, and applied the operational filters described in Condition 7 (ensuring most turbines are operating, including nearest turbines and T103-T104, excluding curtailed periods, assessing only night-time data, and restricting assessments to the operating wind speeds).

These data are presented as scatter plots and regression lines relating to the four critical wind sectors (WNW, NNW, SSE, ESE). These plots can be compared with the plots presented in the *Compliance Assessment Report Rp 009 R01 2011095W* relating to Site 4. Tables are provided to summarise the compliance status of these measurements, and additional graphs are provided to visually summarise the regression lines of background, limit, 2011-2013 measurements, the results from previous annual reports, and current year measurements.

The data collected during the 2011-2013 period excluded high background noise periods where possible to reflect the most exposed periods of turbine noise – during both "shutdown" and "operational" measurements. By contrast the current year measurements (and those of previous annual assessments) have not been so selected (aside from removing rainfall periods) and so include increased traffic periods and seasonal effects.

Therefore, when evaluating trends of operational noise, the values between annual reporting periods are most usefully compared.

7.1 WNW

Site 4, WNW

Wind Speed (m/s):	6	7	8	9	10	11	12	13	14	15
Background Noise Level (dB L_{A90}):	24	26	28	30	32	34	36	38	40	42
Operational Noise Level (dB L_{A90}):	27	29	31	32	34	36	38	40	42	44
Noise Limit (dB LA90):	35	40	40	40	40	40	41	43	45	47
Turbine Noise Level (dB L_{A90}):	22	25	27	29	31	33	35	37	39	41
Exceedance (dB):	0	0	0	0	0	0	0	0	0	0

7.2 NNW

Site 4, NNW

Wind Speed (m/s):	6	7	8	9	10	11	12	13	14	15
Background Noise Level (dB LA90):	25	26	28	30	32	34	36	38	40	42
Operational Noise Level (dB L_{A90}):	25	28	30	32	34	36	38	39	41	43
Noise Limit (dB LA90):	35	40	40	40	40	40	41	43	45	47
Turbine Noise Level (dB L_{A90}):	18	21	24	27	29	31	33	35	36	38
Exceedance (dB):	0	0	0	0	0	0	0	0	0	0

7.3 SSE

Site 4, SSE

Wind Speed (m/s):	6	7	8	9	10	11	12	13	14	15
Background Noise Level (dB LA90):	24	27	29	32	35	38	41	44	47	50
Operational Noise Level (dB L_{A90}):	31	34	36	38	41	42	44	46	47	48
Noise Limit (dB LA90):	35	40	40	40	40	43	46	49	52	55
Turbine Noise Level (dB L_{A90}):	30	33	35	37	39	41	41	41	--	--
Exceedance (dB):	0	0	0	0	0	0	0	0	--	--

7.4 ESE

Site 4, ESE

Wind Speed (m/s):	6	7	8	9	10	11	12	13	14	15
Background Noise Level (dB LA90):	25	31	35	38	41	43	44	45	46	48
Operational Noise Level (dB L_{A90}):	36	38	40	42	44	46	47	48	49	51
Noise Limit (dB LA90):	35	40	40	43	46	48	49	50	51	53
Turbine Noise Level (dB L_{A90}):	35	37	39	40	41	43	44	45	46	47
Exceedance (dB):	0	0	0	0	0	0	0	0	0	0

8.0 Comments

This section has been provided by Marshall Day Acoustics.

The regression lines plotted through the 2021-2022 data all show compliance with the high-amenity noise limit under all wind conditions. Where there are differences from previous measurements, it is generally because of the high background sound levels which make the determination of "turbine noise level" very sensitive to small changes in average measured operational noise level.

No curtailments are reflected in this data – periods where turbines have been shut down or have not started due to curtailment requirements have been excluded from this data. If these data points were included, this would further reduce the average sound levels during the relevant wind conditions.

No significant trend in noise level increasing or decreasing over time is evident by the comparison of the "annual report" data sets.

9.0 Complaints Assessment

This section has been provided by Marshall Day Acoustics.

NZWL has provided a register of complaints which included the current assessment period 1 Apr 2020 – 31 Mar 2021.

The register shows 10 complaints over this period. Seven were received from 47 Ridgeview Road which is directly opposite the permanent monitoring location. The noise level recorded by the NMT provides a relevant point of reference for these complaints. One complaint was received from 19 Ridgeview Road, which is approximately 440 metres south of the measurement location, and the remaining two complaints were received from 1009 Makomako Road which is 2.5 km south of the wind farm.

The complaints have been sorted by date received. The time and text of the complaint are included, and the noise level and wind farm state are described. We note that the time of the complaint may not correspond directly to the time that the problem noise occurred.

The "Full Operation" column describes whether enough turbines were enabled to comply with the requirements of Condition 7.4 for valid sound level reporting. The "Curtailed" column describes whether any turbines were shut down in response to either mandatory or voluntary curtailment programming.

Date	Time	Complaint Description	Wind Direction [deg]	Wind Speed [m/s]	Noise Level (dB LA90, Site 4)	Full Operation?	Curtailed?
25/05/2021	11:51	Called this morning to complain about the noise coming from the wind turbines. She said it is an easterly wind and that is when they can hear it the most.	144	11	41	Yes	No
8/06/2021	9:09	Last night is was very bad and it is still bad now.	126	5	35 - 41	Yes	No
22/10/2021	11:18	Strong easterly - wind farm noise complaint	111	6	41	No	No
25/11/2021	11:33	Reports could hear a loud roar from the windfarm happening for quite a while last night. 1st noticed at 2045.	306	5 - 12	34 - 42	Yes	No
17/12/2021	10:33	Complained about the noise from the windfarm - has been going all night and still going.	297	6 - 18	27 - 45	Yes	No
16/01/2022	9:18	Caller advises that there is a lot of noise coming from the windfarm. She advises that it has been an issue since yesterday.	104	6 - 12	35 - 43	No	Yes
17/01/2022	8:35	Caller advises the noise from the windfarm is howling through the house due to the easterly wind.	108	7	39	No	No
26/01/2022	19:55	Caller states the noise from the windfarm is louder than usual tonight.	287	8 - 13	40 - 43	Yes	No
3/03/2022	9:52	Started last night and is still going this morning.	108	4 - 7	35 - 50	Yes	No
31/03/2022	20:34	8.30am droning was really terrible, this week both wind farms have been bad. NZ windfarms was better when they were doing testing but now it's a lot more regular. Really bad Thursday night 24/3/22 was particularly bad.	72	5	40 - 44	Yes	No

9.1 Comments

Unlike previous years' complaints, all of these occur at times with elevated noise levels – at or above the average noise level.

Complaints in this period generally do not cite specific noise characteristics, and seem more oriented towards general noise level than to specific sounds under low background conditions. Coupled with the

lower number of complaints, this may be related to less gearbox noise from the nearest turbines which have been treated as part of the mitigations required under these consent conditions.

Calibration certificate for sound level meter

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Calibration, Sales & Service of Audiological and Acoustical Equipment

TEST REPORT FOR A SOUND LEVEL METER - PERIODIC TESTS: SO016643-1407102

TRH SERVICES LTD
C/O 138 Benmore Ave
Cloverlea
Palmerston North

Job Number: SO016643-1407102 **Date of report:** 12 May, 2022

Measurement Procedure: The above instrument was tested using Diatec procedure ECSP10 and to the requirements of IEC 61672-3:2006 Electroacoustics - Sound Level Meters - Part 3: Periodic Tests. The laboratory is accredited for compliance to ISO/IEC 17025. All tests and measurements reported here are traceable to New Zealand and Australian National Standards. Measurement results reported are traceable to SI units via recognised National Standards.

Item tested:

Sound Level Meter:	Norsonic	Nor140	**Serial No:**	1407102
Designation:	Class: 1			
Firmware version:	v4.0.1120			
Microphone:	Norsonic	1227	Serial No:	151749
Applied data:	Body - Norsonic, Nor140. Windscreen - Default, Flat			
Notes:	-			
Date of test:	12 May, 2022			
Tested by:	RJ			

Ambient conditions at the time of tests:

Temperature: 23.5 °C Humidity: 37.3 %RH Atmospheric pressure: 1024.5hPa

Tests Performed:	*Clause*	*Result*
Absolute Calibration	9	Pass
Acoustical Frequency Weighting	11	Pass
Self Generated Noise	10.1	Pass
Electrical Noise	10.2	Pass
Electrical Frequency Weightings	12	Pass
Frequency and Time Weightings	13	Pass
Reference Level Linearity	14	Pass
Toneburst	16	Pass
Peak C Sound Level	17	Pass
Overload Indicator	18	Pass

Result: Passed all tests.

Statement of Compliance: The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organisation responsible for approving the results of pattern evaluation tests performed in accordance with IES 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1:2002.

(.....) (.....)

Robert Jaques — Authorised IANZ Signatory

Alex Dalay — Report checked

Street Address: Millennium Centre, Level 2 Building A, 600 Great South Road, Ellerslie, Auckland 1051.
Postal address: PO Box 74103, Greenlane, Auckland 1546, New Zealand.
Phone: +64 9 279 8833 **Fax:** +64 9 279 8883 **Email:** info@diatec-diagnostics.co.nz **Web:** www.diatec-diagnostics.co.nz

All measurements reported herein have been performed in accordance with the laboratory's scope of accreditation

Calibration certificate for field calibrator

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Calibration, Sales & Service of Audiological and Acoustical Equipment

ACOUSTIC CALIBRATOR CALIBRATION CERTIFICATE

12 May 2022

TRH Services Ltd
C/O 138 Benmore Ave
Cloverlea
Palmerston North

IANZ Accredited Laboratory 537

Make: Norsonic	Type: Nor1256	Serial No: 125626090
Date Tested: 12 May 2022	By: RJ	Job No: SO016643-125626090

A measurement of the output sound pressure level of the calibrator was made by the insert voltage method, using a microphone of known sensitivity. Testing has been conducted in accordance with IEC60942 (2017) Annex B - Periodic Verification Tests. Tested using Diatec procedure; Proc_Sound_Calibrators.

Results
Measurement results reported are traceable to SI units via recognised National Standards.

Reference Microphone: Bruel & Kjaer 4134 **Serial No:** 1094890 fitted with protection grid.

Ambient Temperature: **23.5** °C ± 1°C **Ambient Pressure**:**1022.0** hPa

Calibrator frequency was **251.2** Hz on the 250Hz setting
Calibrator frequency was **1000.0** Hz on the 1kHz setting
Distortion was **0.25** % THD+N on the 250Hz setting @114dB
Distortion was **0.16** % THD+N on the 1kHz setting @114dB

The sound pressure level measured **94.10** dBSPL re 20 µPa on the 1 kHz @ 94dB setting.

The sound pressure level measured **114.08** dBSPL re 20 µPa on the 1 kHz @ 114dB setting.

The sound pressure level measured **94.04** dBSPL re 20 µPa on the 250 Hz @ 94dB setting.

The sound pressure level measured **114.01** dBSPL re 20 µPa on the 250 Hz @ 114dB setting.

The expanded uncertainty was calculated using a coverage factor of 2.04 and is estimated to be ±0.06 dB with a confidence level of 95%. The sound calibrator was tested with the ½ inch aperture.

The sound calibrator was tested against Class 1_ tolerance limits of the standard and has been shown to meet periodic verification criteria described in IEC60942:2017 for the sound pressure level(s), distortion and frequency(ies) stated, for the environmental conditions under which tests were performed.

Note: The manufacturer of this model of calibrator does not claim type approval conformance to IEC60942 (2017 edition) as it was manufactured before this standard was written.

(Robert Jaques)
Authorised IANZ signatory

(Alex Dalay)
Report Checked

Street Address: Millennium Centre, Level 2 Building A, 600 Great South Road, Ellerslie, Auckland 1051.
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All measurements reported herein have been performed in accordance with the laboratory's scope of accreditation

Calibration certificate for microphone

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Calibration, Sales & Service of Audiological and Acoustical Equipment

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MICROPHONE CALIBRATION CERTIFICATE

12 May 2022 **Job No**: SO016643-1407102

TRH Services Ltd
C/O 138 Benmore Ave
Cloverlea
Palmerston North

IANZ Accredited Laboratory 537

Measurement results reported are traceable to SI units via recognised National Standards.
Tested using Diatec procedure; Proc_Microphone_Calibration.

Test Date: 12 May 2022 **Type**: Norsonic 1227 **Serial No**: 151749

Ambient Temperature: 23.5°C ± 1°C **Ambient Pressure**: 1023.4 hPa

Visual Check: OK

Comments: -

Open Circuit Sensitivity by Insert Voltage Method: OK

Value: **-27.27** dB re 1 volt/Pa (**43.28** mV/Pa) at **1000.0** Hz

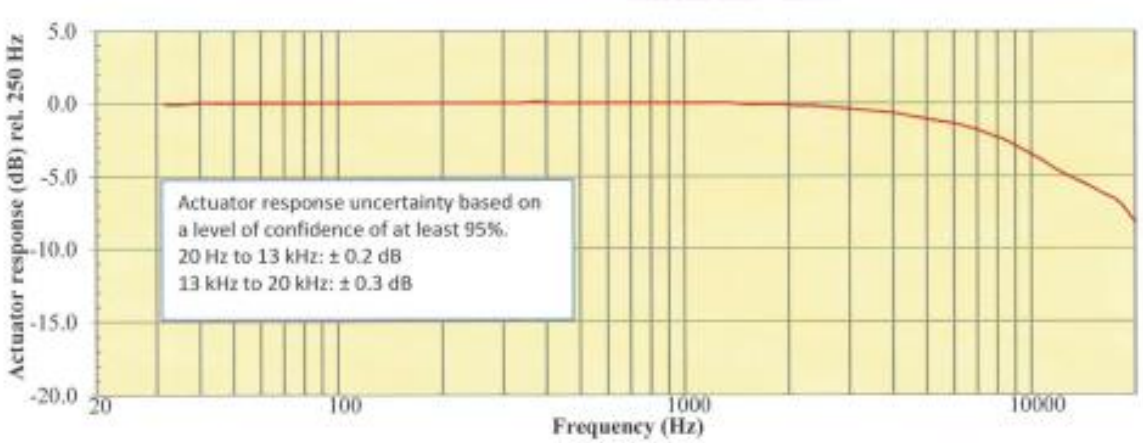
Reference Calibrator: Bruel and Kjaer Type 4226 **Serial No**: 2623634

Uncertainty in this result is estimated to be ±0.06 dB with a confidence level of 95% using a coverage factor of 2.02.

Relative Frequency Response (Electrostatic Actuator): OK

See attached plot of the pressure response of the microphone.

Test performed by: R Jaques (IANZ Signatory) Checked and approved: A Daisy



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All measurements reported herein have been performed in accordance with the laboratory's scope of accreditation