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FROST BOSS C39 FROST FAN

FIELD TEST - 2100 RPM

ASSESSMENT OF NOISE EFFECTS

Report No 16237 v2

Prepared for:

New Zealand Frost Fans Ltd
Hastings
November 2016

Prepared by: .....

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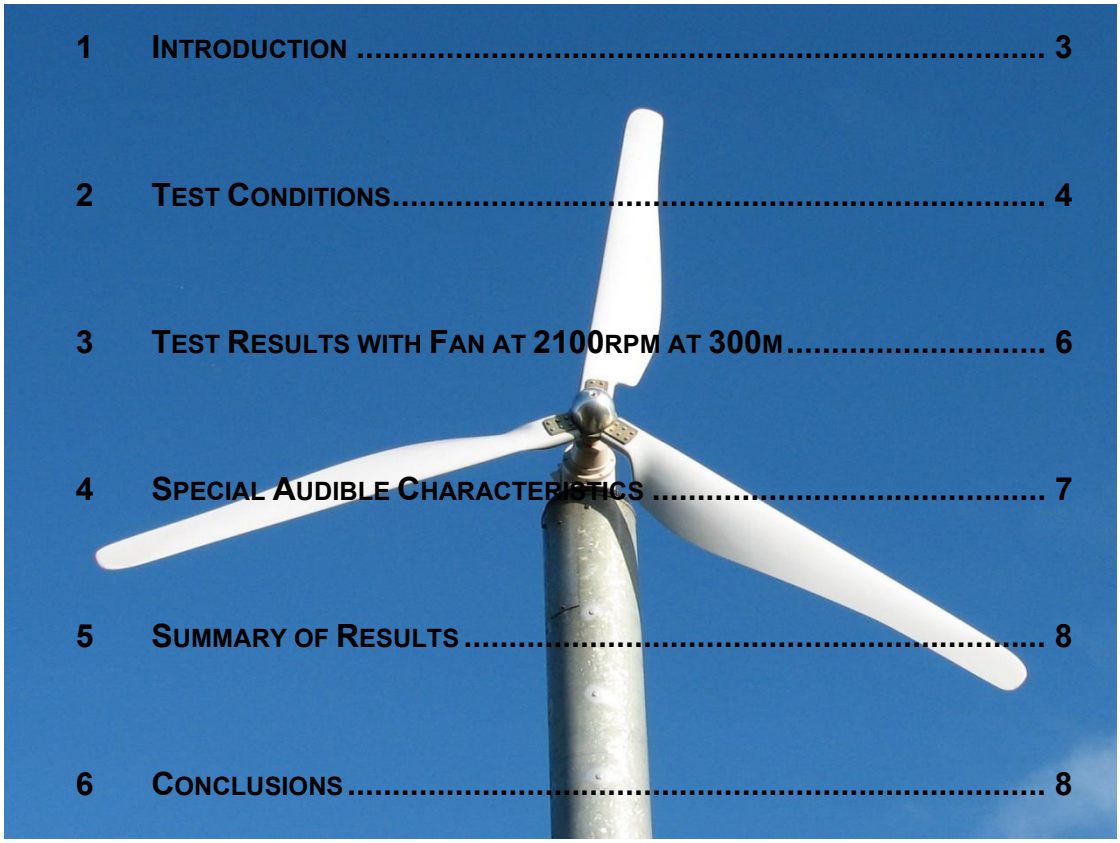
CONTENTS



1 INTRODUCTION

This report sets out the results of field measurements undertaken on the night of Monday 12 September 2016 of a Frost Boss C39 frost fan. Measurements were undertaken at 300m from the frost fan operating at an engine speed of 2100rpm and a fan speed of 488rpm at 1445 Omahu Road, Hastings, as shown on Figure 1.

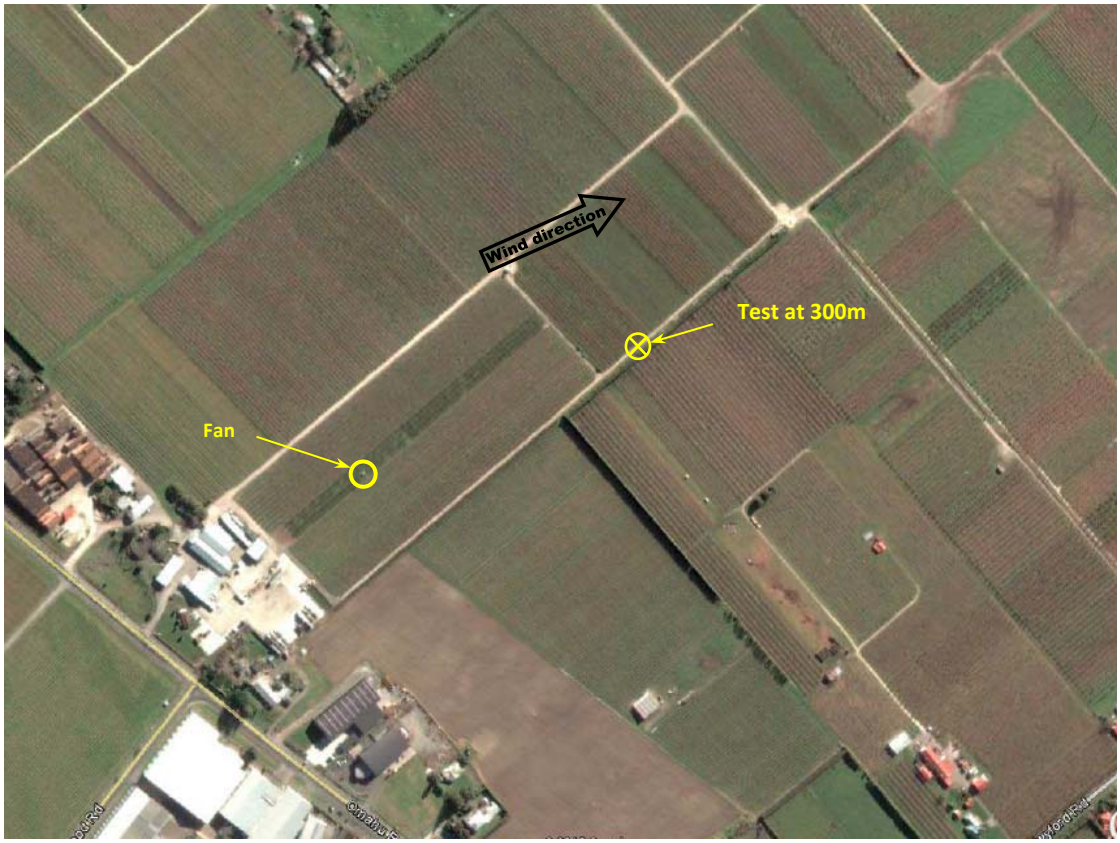


Figure 1. Test Location at 1445 Omahu Road

2 TEST CONDITIONS

The weather throughout the noise monitoring period was fine and the sky was clear. An ambient wind was variable throughout the testing and typically 2 – 3m/s from the frost fan towards the monitoring position (south westerly). The reported wind speed is a 1 minute average during the test period. The canopy temperature is measured 1m above the ground and the tower temperature is measured 10m above the ground at the top of the tower. Where the tower temperature is above the canopy temperature (which occurred throughout the monitoring period) this indicates a temperature inversion is present and the wind speed was measured 6.5m above the ground from a tower mounted spar.

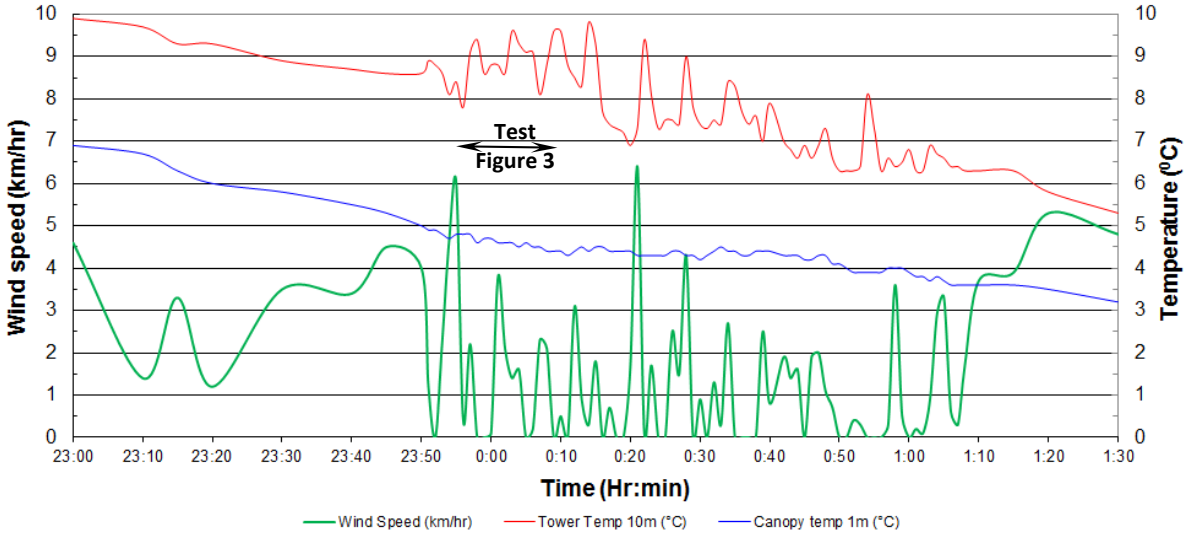


Figure 2. Wind Speed and Temperature during Testing

The meteorological conditions were compatible with those set out for Category 6 in Concawe[1], which gives enhanced meteorological conditions. When testing commenced the temperature was 5^0C and it dropped to 4^0C at the completion of the testing. The weather conditions were considered ideal for monitoring noise from the frost fan.

[1] The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities, Report No 4/81, May 1981 prepared by C J Manning, Acoustic Technology for Concawe's Special Task Force on Noise Propagation

The topography was flat and the apple trees in the orchard were in a dormant state with no leaves.

The technical information of the frost fan tested is:

The equipment used for the measurements was:

- Brüel & Kjær 2250 Hand-held Analyser platform with Sound Level Meter Software BZ 7222, Frequency Analysis Software and BZ 7225 Enhanced Logging Software. Re-calibration is next due in October 2017;
- Brüel & Kjær ½" type 4189 microphone, serial number 2650951. Re-calibration is next due in October 2017;
- Brüel & Kjær 4230 calibrator serial number 930422. Re-calibration is next due in October 2017;
- Brüel & Kjær type UA0237 90mm diameter windscreen;
- All measurements were undertaken in accordance with the requirements of *NZS 6801:2008 Acoustics - Measurement of Environmental Sound* and assessed in accordance with the requirements of *NZS 6802:2008 Acoustics – Environmental Noise*.

Engine	Cummins 6BT 5.9 Turbo Diesel
Engine Cabinet	Standard FrostBoss Alloy powder coated cabinet
Exhaust	Standard FrostBoss single chamber internal muffler
Blade type	Standard C9 series composite blades
Blade number	three
Fan Diameter	5.5m
Fan pitch	fixed
Tower height	10.5m
Upper gearbox	Deran ratio 1.68:1
Lower Gearbox	Deran ratio 2.563:1
Overall ratio	4.306
Fan Speed	488 rpm
Engine Speed	2100 rpm
Precession time	5min 43sec

3 TEST RESULTS WITH FAN AT 2100RPM AT 300M

Figure 3 shows the real time noise trace of the frost fan operating at 2100rpm as measured over a 15 minute period, which gave two full rotations of the frost fan.

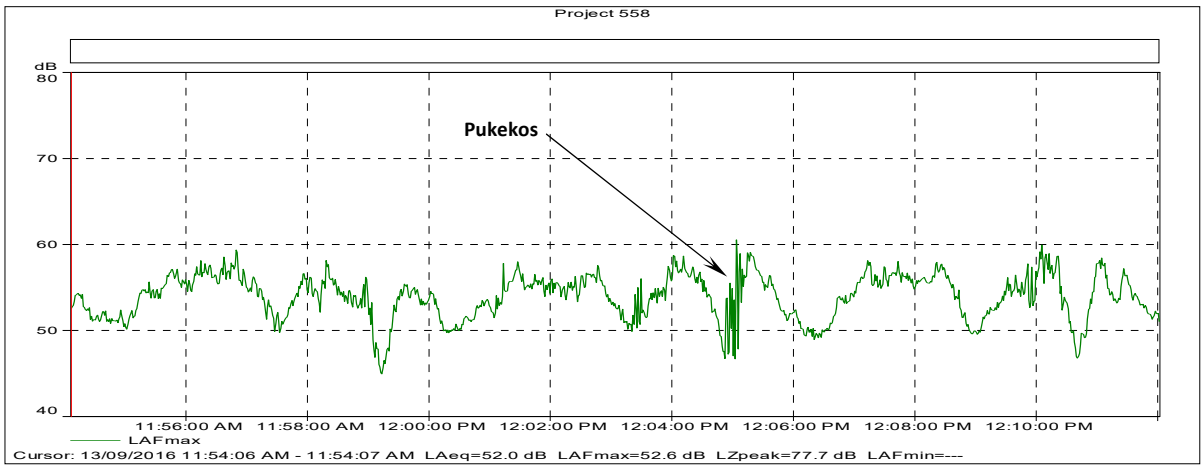


Figure 3. Real Time Noise Trace at 2100rpm

Figure 4 shows the sound spectrum in one third octave bands for the test undertaken at 2100rpmm.

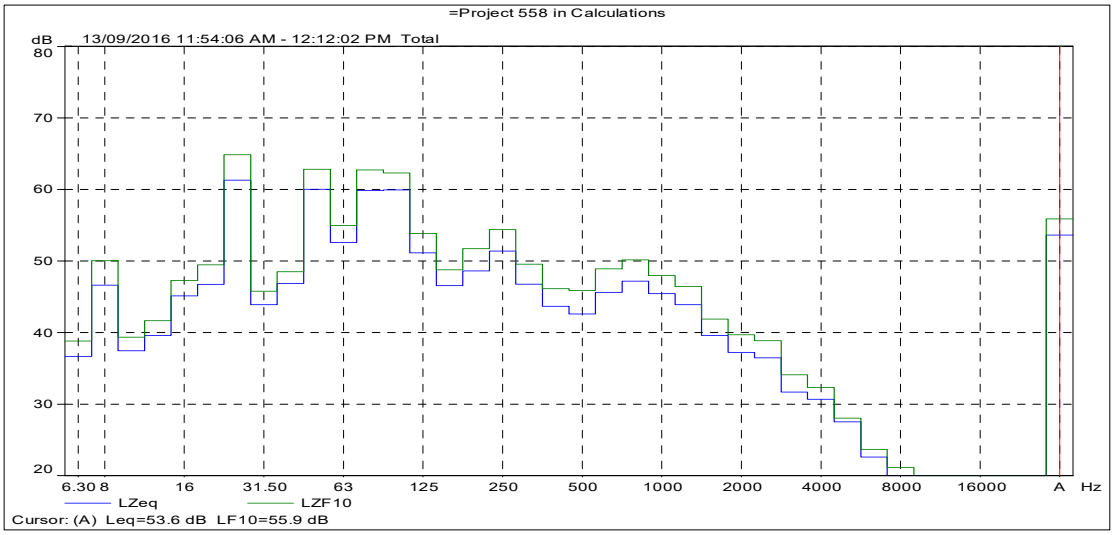


Figure 4. 1/3 Octave Spectrum at 2100rpm – Total Test Duration

Based on the measured level at 300m the noise over a 15 minute period for the Frost Boss C39 frost fan at 2100rpm is 54dB L_{Aeq}.

4 SPECIAL AUDIBLE CHARACTERISTICS

Appendix B4 of NZS 6802:2008 Acoustics – Environmental Noise sets the test to determine if there is a tone to the sound of interest. To determine if a tone is present the relevant section of the Standard states:

B4.2 Objective test methods

Where there is doubt about the presence of tonality, the following two methods provide an objective measure for tonality. The simplified test method may be carried out using one-third octave band measurement equipment. The reference test method requires the use of narrow band analysis. If the simplified method does not indicate tonality, it may still be necessary to use the reference method to confirm the presence or absence of tonality. In addition, the reference method can properly assess modulated tones or complex tones.

B4.3 Simplified test method for tonality

A test for the presence of a prominent discrete-frequency spectral component (tonality) can be made by comparing the levels of neighbouring one-third octave bands in the sound spectrum. An adjustment for tonality shall be applied if the LEQ in a one-third-octave band exceeds the arithmetic mean of the LEQ in both adjacent bands by more than the values given in table B2.

Table B2 - One-third octave band level differences

One-third octave band	Level difference
25 - 125 Hz	15dB
160 - 400 Hz	8dB
500 - 10000 Hz	5dB
NOTE - At frequencies below 500Hz the criterion could be too severe and tones might be identified where none is actually audible. For complex spectra the method is often inadequate and the reference method should be used.	

A check of the individual frequencies in the ⅓ octave bands, as set out on Figure 4, shows there are no tonal characteristics to the sound that would warrant an adjustment to the measurements due to the tonal component. In addition, there are no other characteristics, such as a whacking sound sometimes associated with frost fans, which were sufficient to attract a 5dB penalty due to a special audible characteristic to the sound. Thus, the measured level equates to the rating level for the C39 frost fan operating at 2100rpm.

5 SUMMARY OF RESULTS

A summary of the measured levels of the Frost Boss C39 Frost Fan is set out in Table 1.

Test Speed	Octave Level, Hz									
	31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**A**
2100rpm at 300m – L_{eq}	62	63	61	54	49	50	43	35	25	54

Based on 15 minute measurement

Table 1. Measured Noise Levels (dB L_{eq})

6 CONCLUSIONS

Based on the above the Frost Boss C39 Frost Fan does not generate any tonal or impulsive sound.

When measured in accordance with the requirements of NZS 6801:2008 *Acoustics - Measurement of Environmental Sound* and assessed in accordance with the requirements of NZS 6802:2008 *Acoustics – Environmental Noise* the noise from the Frost Boss C39 frost fan operating at 2100rpm is 54dB L_{Aeq} when measured at 300m from the frost fan with clear line of sight to the frost fan.

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