

FINAL REPORT

Report:	A Review of the Engine Testing Management Software (ETMS)
Client:	Christchurch International Airport Ltd
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Definitions and Acronyms

CIAL	Christchurch International Airport Ltd
CDP	Christchurch District Plan
dB, dBA	Decibel is the unit measure for Sound Pressure Level (L) on a logarithmic scale. The A indicates A-weighting, an adjust made to the noise spectrum to approximate the response of the human ear to different frequencies of sound.
ET	On-Aircraft Engine Test
ETCMP	Engine Testing Compliance Monitoring Position
ETMS	Engine Test Management Software
GRUP	Ground Run Up Pad
L	Sound Pressure Level
LAm _{ax}	The maximum, A-weighted sound pressure level that occurs during an assessment period.
L _{dn} 7day	The Day-Night sound pressure level is the energy-equivalent, noise level, averaged over a 7-day period, with night time noise occurring between 2200 and 0700h penalised or weighted by 10 decibels, to account for the greater impact of night time noise.
Leq	The energy-equivalent sound pressure level over a specified period (e.g., 5 minutes or 1 hour).
MDA	Marshall Day Acoustics

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Executive Summary

This report summarises the review and its findings regarding the management of on-aircraft engine testing noise at Christchurch International Airport, in particular the Engine Testing Management Software system (**ETMS**), the on-line platform for monitoring and maintaining compliance with the rules in the Christchurch District Plan (**CDP**).

The key findings of the review include the following:

- The ETMS has been set up according to the methodology and noise database developed by the acoustic consultant, Marshall Day Acoustics.
- A series of Spot Check calculations of the predominant test configurations was conducted to confirm consistency between the ETMS calculations, the Noise Database of engine tests and noise-limit calculations.
- The results indicate the good working of the system, so that if users comply with engine testing (**ET**) run times as pre-approved by the ETMS, this should maintain compliance with the CDP ET noise limits.
- The ETMS user interface has many features to facilitate the input and management of data for Scheduling, Amending, Completing and Cancelling engine tests, to minimise data input errors, scheduling tests that would not comply with the current 7-day noise limit.
- Some recommendations have been compiled from user and management feedback to improve the system, mainly to streamline data input and enhance its usability.

1.0 Introduction

As an airport noise consultant specialist operating as a Sole Trader, the author of this report, Xavier Oh, has been engaged by Christchurch Airport Ltd (**CIAL**) to conduct a review of the airport's on-aircraft engine testing (**ET**) noise management for compliance with the Christchurch District Plan (**CDP**). Extracts from the CDP rules relevant to this report are included in Appendix 1.

This report is specifically aimed at fulfilling the requirements of CDP Appendix 6.11.14 a.ii.D, relating to the ET noise management system:

the Airport Noise Management Plan ... provide the details of a noise monitoring programme to maintain compliance with ... 6.1.6.2.6 a.v.-vii. and, in particular, ... (D) the review of the software used for ... predicting engine testing noise, at least once every five years to determine whether the models and/or software require updating.

The Engine Testing Management Software (**ETMS**) was established in 2017 and this is its first 5-year review. The next review will be due in 2028.

The key aims of this report are to provide confirmation and assurance that the systems in place effectively monitor and manage compliance with the CDP ET noise limits and to provide recommendations that might enhance the performance and reliability of the system.

A second aim of the report is to provide recommendations on any updates that could be made to improve the usability of the models and software.

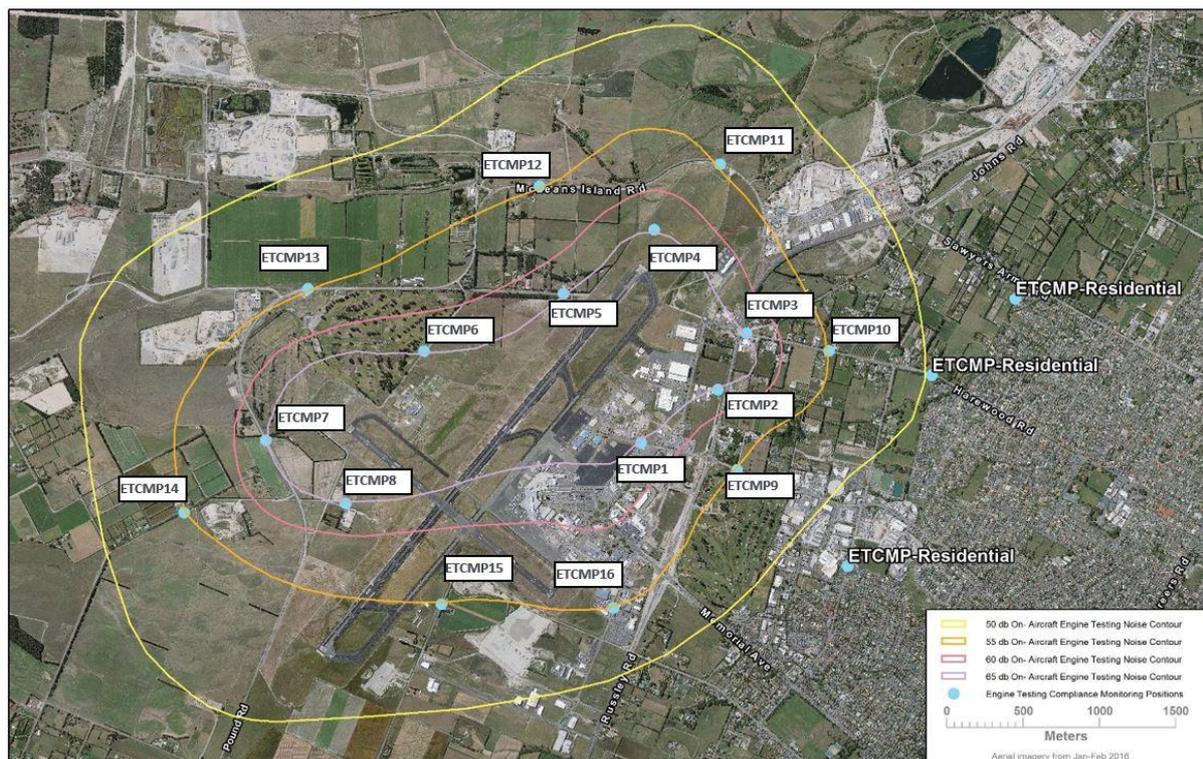
This review was undertaken as a remote, desktop exercise with all communications by telephone, on-line video and email.

2.0 Relevant Regulations

Rule 6.1.6.2.6 of the Christchurch District Plan (CDP) provides noise limits for on-aircraft engine testing at Christchurch Airport. The noise limits apply at locations called Engine Testing Compliance Monitoring Positions (ETCMP). See the full text and CDP Figure 2 in Appendix 1.

For both noise management and developing the ETMS, the ETCMP have been labelled as shown below in Figure 2.1

Figure 2.1 – ETCMP with labels:



ET Noise Limits

At the eight points closest to the airport operational centres (ETCMP 1 to 8), the ET noise limit is 65 dB Ldn 7 day. Ldn 7 day is the average noise level over any 7-day period incorporating a 10-decibel penalty added to any night time noise (2200-0700).

At the next eight points further from the airport (ETCMP 9 to 16), the ET noise limit is 55 dB Ldn 7 day. (In this report, it is understood that the use the dB unit is taken as synonymous with dBA, as the use of A-weighting is standard use in for these ET noise limits.)

A further noise limit of 75 dB L_{Amax} applies during the night time period of 22:00 to 07:00 at the three ETCMP Residential locations. L_{Amax} is the maximum, A-weighted noise level that occurs during an assessment period.

Other ET Restrictions

The CDP defines an “Unplanned Engine Test” as the on-aircraft, high-power testing of a jet engine that occurs at night between the hours of 22:00 and 07:00h. As well as the above noise limits, there is an additional restriction that limits these tests to a maximum of 5 unplanned engine testing events within any three month period, and maximum of 12 unplanned engine testing events per annum.

Testing of turbo prop engines on an aircraft between the hours of 22:00 and 07:00h, when the total duration of testing at high power is five minutes or more per aircraft, must be conducted in the vicinity of the threshold of Runway 11 (i.e., the north-western end of the cross-runway), except when Runway 11/29 is in use.

Exclusions

The above limits and restrictions do not apply to the following:

- The testing of engines on an aircraft used for Antarctic operations, and
- The testing of engines on any aircraft, where such work is necessary to satisfy an airworthiness directive or other like safety requirement issued by the Minister of Transport, the Director of Civil Aviation, or the Civil Aviation Authority, as is any other unplanned engine testing arising from an aircraft operator’s identification of a safety issue relating to an aircraft fleet or required as a result of a natural disaster including volcanic eruption.

3.0 Existing Noise Management System

The management of On-Aircraft Engine Testing (ET) noise at Christchurch Airport is centred around the web-based software package, the Engine Testing Management Software (ETMS). This is consistent with CDP rule 6.1.6.2.6 a. v.A. which stipulates that calculations of noise emissions for the engine testing events and configurations are permitted to demonstrate compliance or otherwise with the noise limits and that the noise level (Ldn 7 day) shall be calculated as a 7-day rolling average.

Before conducting an ET, registered operators or agencies (Users), including airlines and engine maintenance contractors, must register a Scheduled ET using the ETMS on-line software tool. The required information included the proposed aircraft, ET location, date, time and the duration and power level of each engine run. The ETMS calculates whether the ET can proceed without causing a breach of the Ldn 7 day noise limits at the 16 Engine Testing Compliance Monitoring Positions (ETCMP), taking into account recently Completed ET and other Scheduled ET.

If the proposed ET can be conducted within the noise limits for the current 7-day period, the ETMS home screen will indicate that the requested ET can proceed and add the test to the schedule. If the proposed ET is calculated to cause breach of the noise limits, the ETMS will not give permission for the test to proceed. The user would then need to make changes to this test or other planned, but not completed, ETs. After a test has been conducted, the user must update the status of the test in the ETMS to “Completed” and confirm the engine run times that occurred.

In this manner the ETMS monitors proposed and completed ET and provides mechanisms to predict and prevent breaches of the CDP ET noise limits by informing Users and withholding permission for non-complying tests.

The ETMS does allow some flexibility for the users. When an ET is finished and the user updates its status from Scheduled to Completed, the duration of each engine run and power setting must be confirmed. If the ET run differed from that originally scheduled and approved by the system, then the correct data must be entered. This means that a noise breach could occur if a Completed test was run longer or with higher power than anticipated when the ET was scheduled and pre-approved.

To help prevent this occurring, the ETMS home page displays the test schedule for the current 7-day period with Completed and Scheduled tests. The percentage of the noise budget that is currently accounted for is also displayed. This will give the user an indication of how close the current ET activity is to using up the noise budget.

Similarly, if an ET ran longer or with higher power than had been pre-approved, there could also be a knock-on effect on other ET that are already Scheduled in the ETMS. When originally requested and approved these other tests would have been complying. Now, after a Completed test has run longer or with a higher power than anticipated, the existing schedule might threaten to breach the noise limit, so the permitted status of these other Scheduled tests could change. In the event of a breach or when a breach is forecast to

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occur of the noise limits, a series of emails is automatically sent to alert concerned parties including the users, agency supervisor and CIAL.

The ETMS also implements the other rules in the CDP.

- Unplanned ET (high-power on-aircraft jet engine test in the night time period) are limited to 5 in any 3-month period and 12 in any year;
- High-power turboprop ET in the night time period must take place at the threshold of Runway 11, unless Runway 11/29 is in use; and
- ET that are excluded from the noise limits still need to be entered into the ETMS but do no impact the noise budget allocation.

The ETMS generates daily, quarterly and annual summary data of the ET and noise levels and these are published on the CIAL website. This data is also incorporated into an annual airport noise monitoring report by the consultant, Marshall Day Acoustics (**MDA**).

As required by CDP Rule 6.1.6.2.6 a. v. B., ET verification noise measurements were conducted by MDA in 2019 and 2021. The results were included in the airport noise monitoring reports.

4.0 Review Process Overview

This review process took the following steps:

1. The following documents were reviewed:
 - *Christchurch International Airport Engine Testing Procedures (Managing noise at Christchurch Airport October 2018)* which includes the *ETMS User Manual* issued to operators and contractor agencies who conduct ET.
 - *Christchurch Airport Noise Monitoring Reports* for 2019, 2021 and 2022, prepared by Marshall Day Acoustics. These annual reports cover both operational and ET noise. The 2022 is the most recent report on a full year of ET and the 2019 and 2021 reports include the results of noise measurements of aircraft engine tests, used to verify the ETMS and completed every two years. These reports are available on the CIAL website.
2. The ETMS User group including airlines and engine maintenance contractors were surveyed regarding their views of the ETMS and any recommended improvements.
3. Discussions were held with:
 - a. MDA, the acoustic consultant who developed the ET monitoring methodology to calculate the ET noise levels at the assessment locations.
 - b. Daylight Creative, the software company who developed the ETMS platform, based on the MDA methodology.
4. A series of Spot Check calculations were conducted for this review. This involved entering simulated test data into an off-line version of the ETMS to observe the usability and functioning of the software and the calculation outputs, including the predicted noise budgets used by the simulated ET cases.
5. Sections of the MDA Noise Database were examined in detail. The database contains the noise level at each of the 16 ETCMP receiver locations for the main ET configurations, including different aircraft type, test location, power setting and wind heading options.
6. Detailed Spot Check calculations using the MDA Noise Database were conducted to confirm that the ETMS accurately calculated the time-averaged noise levels at the ETCMP.

The outcomes of each of these steps are discussed in more detail below.

5.0 Review Outcomes

5.1 Documents

The *ET Procedures* document provides an overview of ET management at Christchurch International Airport, including considerations of safety, noise compliance and minimisation, roles, procedures, ET locations, restrictions, exemptions and dispensations.

The *ETMS User Manual* is an appendix of the *ET Procedures* document and provides detailed instructional training on the use of the ETMS for users who conduct ET at the airport. The dashboard page of the software displays the current test schedule and the calculated percentage of the permitted noise budget that has been allocated to the Scheduled and Completed ET in the system. Warning messages are provided when: the activity is nearing the noise limit for the current rolling 7-day period and a new test will not be accepted into the system as it would cause a breach of the noise limit.

Each year since 2017, MDA compiled a report on the ET noise levels using Activity Reports from the ETMS including the calculated noise levels at the 16 ETCMP. The information is published in the Airport's annual noise monitoring report.

In 2019 and 2021, MDA also conducted verification measurements using noise monitoring equipment placed on site at a few different ETCMP for several weeks. The measurements targeted the most important types of engine testing – the larger and most-commonly tested aircraft which dominate the noise budget. In 2019, measurements were obtained for the A320 at idle and the ATR600 at full power at ETCMP 6 and 11. In 2021, the ATR600 (full power), the A320 (high power) and the A320NEO (medium power) were measured at ETCMP 5 and 11. (These 2021 data points are used in the Spot Check calculations discussed in Section 5.5 below.)

The 2021 MDA verification measurements report concluded *“that there is good agreement between the ETMS and the noise measurements on site and that the ETMS is still an appropriate tool to use for engine testing noise compliance analysis at Christchurch Airport.”*

5.2 User Group Survey

The users of the ETMS were consulted via email correspondence for their feedback on the ETMS and its usability, and a request was made for any suggestions for improvements to the system.

Some common trends of the feedback concerned the Training Manual, the repetitiveness of entering data for scheduling a new test and the requirement to enter all test runs even those with only a low or idle power settings.

Their feedback, along with some suggestions from CIAL, these have been compiled into a potential implementation for discussions and to assess which are appropriate and feasible to implement. A summary of the collected comments and recommendations for improvements to the system is contained in Appendix A4.

5.3 Noise Calculation Methodology by MDA

The acoustical consulting firm, MDA, were engaged to provide measurements and calculations used to develop the CDP ET rules and the Ldn 7day noise limits.

MDA developed the calculation method to determine the noise level at any assessment location which became an early version of the ETMS. As well as the calculation itself, a key input developed by MDA is the Noise Database. This contains the instantaneous noise level at each ETCMP for the main aircraft and each combination of power setting, ET location and wind heading. The ETMS uses this data along with the run duration, the date, and the time of day of each Completed or Proposed engine test to calculate the Ldn 7 day and assess compliance against the rules in the CDP.

The Noise Database was compiled by MDA based on several resources and methodologies, including noise measurements on some of the aircraft conducted over recent years, manufacturer's data (where available), and comparative estimates based on the aircraft operational noise data. The directionality of noise emission from on-wing aircraft engines, atmospheric effects, and the propagation of noise over the local terrain were also taken into account.

The database includes noise data for the ATR, A320, A321NEO, B738 and C130, for each wind heading, ET location and power setting, assessed at the 16 ETCMP. These aircraft cover the majority of engine tests at Christchurch airport. For other aircraft requiring ET, MDA developed families of aircraft with relative adjustments to the noise levels. For example, the A320NEO is based on the A321NEO, the larger Airbus models (e.g. A330, A350 and A380) were based on the A320 and, similarly, the Boeing B787, B777 etc. were based on the B738 data.

While it is not within the scope of this review of the ETMS to review this input database by MDA, the focus became to confirm that the MDA methodology is accurately implemented by the ETMS. As mentioned, MDA provides an annual report on ET noise compliance based on data output from the ETMS and biennial verification measurements of ET, and effectively has a watching brief to keep the ET noise database up to date.

5.4 On-Line ETMS Development

The software company, Translate Digital, took the MDA ET calculation methodology and the MDA Noise Database and developed the current, web-based ETMS with its user interface for scheduling ET, instant assessment of potential breaches of the noise limits, email notification system and activity report generation. The ETMS was brought on-line in 2017.

Translate Digital later merged with Daylight Creative and Daylight Creative continues to host and maintain the platform. In 2021, MDA updated the Noise Database and Daylight Creative undertook the task of incorporating the new data into the ETMS.

The ETMS incorporates features that provide a user interface for scheduling ET, real-time permissions for scheduled ET, warning flags that indicate potential breaches of the noise limits and data summaries for regular reporting of completed tests and noise levels.

During this present review of the ETMS, it was not entirely clear how the calculations within the ETMS were verified as accurately reproducing the MDA calculation method at the time when the software was commissioned. It was decided to take the opportunity of this present review to conduct some verification calculations on the ETMS. This review takes into account both the MDA verification noise measurements of 2019 and 2021 and the current MDA Noise Database.

5.5 Spot Check ETMS calculations

The ETMS calculations involve the MDA Noise Database and the current Scheduled and Completed engine tests entered by the Users.

When a User proposes a new ET in the ETMS, the ETMS provides feedback on whether the test would be permitted in the current 7-day period. The dashboard page of the ETMS displays the percentage of the noise budget has already been used by Completed tests and allocated to Scheduled tests within the current 7-day period. This gives the User a general indication as to how the budget is tracking and therefore what new tests can be proposed. If a noise breach is predicted, the newly proposed or other Scheduled tests may need to be amended to accommodate the new test. Completed tests cannot be changed. The displayed budget status means that ETMS does not need to display the calculated noise level nor the ETCMP location for which the percentage of budget is indicated.

A Spot Check in this review involves inputting a single hypothetical (night time) test run into ETMS, which then calculates the percentage of the noise budget that the test would use. From this we calculate the noise budget for that aircraft configuration, in terms of the maximum number of night time minutes in a 7-day period that could be run without exceeding the noise limit of 55 or 65 Ldn 7-day depending on the ETCMP (assuming no other ET is run in the same 7-day period).

Note that some test runs are limited by noise levels at the innermost ETCMP (1 to 8) where the limit is 65 dBA Ldn 7-day. Others are limited by noise levels approaching 55 dBA at the more distant ETCMP (9 to 16).

The MDA verification measurements report (2021) provides the measured noise levels at the ETCMP receiver locations for the ET configurations in the report. This allows the calculation of the actual noise budget for comparison with the noise budget figure calculated from the ETMS output.

Table 5 summarises the three Spot Checks based on the MDA 2021 verification measurements at ETCMP 5 and 11. More details of these calculations are provided in Appendix 1.

Table 5 – Spot Checks (See Appendix 1 for more detail.)					
Spot Check	Aircraft	Power	Budget = Permitted night test minutes per 7-day period		Controlling noise limit
			ETMS output	Calculated from MDA Verification Measurement	
1	ATR600	Full	55 min	207 min	65 Ldn 7d at ETCMP 5
2	A320	High	23 min	69 min	55 Ldn 7d at ETCMP 11
3	A320 NEO	Medium	233 min	518 min	65 Ldn 7d at ETCMP 5

Taking the example of Spot Check 1 in Table 5, the ETMS will permit up to 55 minutes of night time ATR Full Power testing at the Ground Runup Pad in a 7-day period (assuming no other ET). The MDA measured noise level would allow 207 minutes of testing. The ETMS permits less testing (55 minutes) than the actual, measured noise level would allow (207 minutes). The same applies to Spot Checks 2 and 3.

The conclusion that can be drawn from Table 5 is that if operators comply with the ETMS time limit for any of these ET, then this would ensure compliance with the noise limits at the indicated ETCMP.

From these Spot Checks, it would appear that there is a large design or safety factor built into the ETMS, but this needs to be scrutinised more closely using the detailed Noise Data discussed in the next section.

5.6 Detailed Noise Database and Spot Checks

The 2021 MDA report on the verification measurements provides noise data at just the three locations where noise monitoring was conducted. In contrast, the MDA Noise Database provides noise level information at all 16 of the ETCMP, allowing the most crucial ETCMP and Wind Heading to be determined for each ET configuration. This is the data used in the internal calculations of the ETMS.

For both ATR600 and A320 engine runs at the Ground Run Up Pad/A11 in Spot Checks 1 and 2 above, an examination of the Noise Database showed that the most crucial compliance location is ETCMP 9 where the noise limit is 55dBA Ldn 7day.

Appendix 3 provides detail on the noise levels and the calculated noise budgets for these two Spot Checks, and these and other results are summarised in Table 6 below.

Table 6 – Database Spot Checks (See Appendix for more detail.)					
Spot Check	Aircraft	Power	Budget = Permitted night test minutes per 7-day period		Controlling noise limit
			ETMS output	Calculated for ETCMP 9	
1	ATR600	Full	55 min	65 min	55 Ldn 7d at ETCMP 9
2	A320	High	23 min	25 min	55 Ldn 7d at ETCMP 9
3	A320 NEO	Medium	233 min	250 min	55 Ldn 7d at ETCMP 9
4	A330	High	438 sec	480 sec	55 Ldn 7d at ETCMP 9
5	A350	High	18 min	20 min	55 Ldn 7d at ETCMP 9
6	A380	High	438 sec	480 sec	55 Ldn 7d at ETCMP 9

Notes:
 Checks 1 and 2 use noise levels from the Noise Database for the worst-case Wind Heading
 Check 3 uses the A321NEO data with zero correction and Checks 4, 5 and 6 use the A320
 noise profile with decibel corrections of 5, 1 and 5, respectively.

As in Table 5 (Spot Checks 1 and 2), the ETMS noise budgets are 55 and 23 minutes for these tests, respectively. Table 6 shows that the worst-case calculated noise budgets for these two ET configurations are 65 and 25 minutes, respectively.

In both cases the ETMS permits shorter ET runs than the actual noise levels would. This means that if ET operations remain within the limits set by the ETMS, this would safeguard compliance with the noise limits at all ETCMP.

These calculations, now based on the more comprehensive information contained in the Noise Database, represent the most crucial “pinch points” of all the ETCMP. This would be the first point where the budget would be used up by the ET configuration. This provides a stronger reassurance that the ETMS is correctly calculating the ET noise levels, enforcing the noise budgets and maintaining compliance with the CDP ET noise limits.

6.0 Discussion

In this case, assessing on-going compliance becomes a matter of reviewing each component or step in the noise management system for technical accuracy and implementation robustness, and thus building confidence in the overall system. The steps are listed here, and each is discussed further below.

- (1) The Noise Database,
- (2) The calculations within the ETMS,
- (3) The accurate input of Scheduled and Complete Engine Test data, and
- (4) The adherence to the limits imposed by the ETMS by the users.

(1) The Noise Database was developed and is maintained by MDA. If new aircraft come into operation at Christchurch or new engine testing noise data is obtained, the Database can be updated. While it is not within the remit of this review to test the accuracy of this noise data, the CDP requirement for 2-yearly verification measurements and the MDA reports of these from 2019 and 2021 provide supporting evidence that the Noise Database is fit for purpose.

(2) The initial Spot Checks (based on the 2021 verification measurements) and then the more detailed calculations based on the full Noise Database provide a level of reassurance that the ETMS is accurately calculating the on-going noise budget and thus restricting ET activity to avoid breaches of the CDP ET noise limits.

While it is not practicable to Spot Check every combination of ET configuration, the Spot Checks were selected (like the MDA verifications measurements) to cover the most frequently tested and impactful aircraft tests and provide assurance in the overall system.

(3) The on-line ETMS relies on the diligent use and accurate input of data by the Users and therefore could be subject to human error. The software and user interface have been designed to maximise usability and help minimise error, using pull-down menus for variable selection, pop-up error messages, prompts for missing or inconsistent data, and a detailed training manual.

Feedback from the user group was almost entirely positive with recommendations of only a few minor suggestions on improving usability and streamlining the input.

(4) Like any airside operation, especially where safety and environmental management are concerned, the enforcement of procedures and rules is the responsibility of everyone involved. Overall responsibility would lie with CIAL, the airport operator, with the assistance of Air Traffic Control (ATC) who are informed of the movement of aircraft to and from the run-up locations for the ET.

Of course, any regime to control noise could fail to guarantee compliance if operators either accidentally or deliberately exceed testing levels permitted by the ETMS. This could include test runs that had not been properly pre-registered in the system or tests that run longer than had been pre-approved. CIAL provides support to the Users on using and complying with the ETMS. Ultimately, the airport operator would have the usual contractual and legal

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mechanisms for ensuring that tenants and operators at the airport comply with all operational and environmental regulations.

7.0 Conclusion

In the Christchurch District Plan rules the Christchurch City Council has recognised the practicality of managing aircraft engine testing (ET) noise using a software-based “count and calculate” method such as the ETMS. While the overarching noise limits are designed to protect the amenity of residents, the ET rules allow for sufficient engine ground runs, necessary for the safe operation of the air transport services.

To provide reassurance of on-going compliance with the CDP ET noise limits and the robustness of the noise tracking, the system includes many features to manage ET activity and avoid excessive noise levels.

- All relevant engine tests require on-line pre-registration and pre-approval on the ETMS.
- The ETMS user interface is designed to minimise data error and provide instant feedback on available noise budget.
- This review has demonstrated an appropriate level of consistency between the outputs of the ETMS and equivalent manual calculations.
- Daily, quarterly, and annual reports of the ETMS calculated noise levels are available on the CIAL noise website.
- The system sends out automated email notifications when a breach has occurred or is forecast to occur.
- The 2-yearly verification noise measurements are conducted to check the ETMS calculations.
- This 5-yearly review has been conducted “*to determine whether the models and/or software require updating.*”

A.1 Appendix 1 – Christchurch District Plan Rules

Rule 6.1.6.2.6 of the CDP provides noise limits for on-aircraft engine testing at Christchurch Airport as quoted below.

6.1.6.2.6 On-aircraft engine testing at Christchurch International Airport

- a. The testing of engines on aircraft at Christchurch International Airport shall meet the following activity standards:
 - i. Noise from the testing of engines on aircraft shall not exceed the noise limits shown in Table 5 below at the engine testing compliance monitoring positions (ETCMPs) shown in Figure 2.

Table 5: On-aircraft engine testing noise limits

Noise Limit	Engine testing compliance monitoring positions (ETCMP) - refer Figure 2
65 dB L_{dn} , 7 day	8 points
55 dB L_{dn} , 7 day	8 points
75 dB L_{Amax} 22:00 to 07:00 only	Edge of residential zone – 3 points

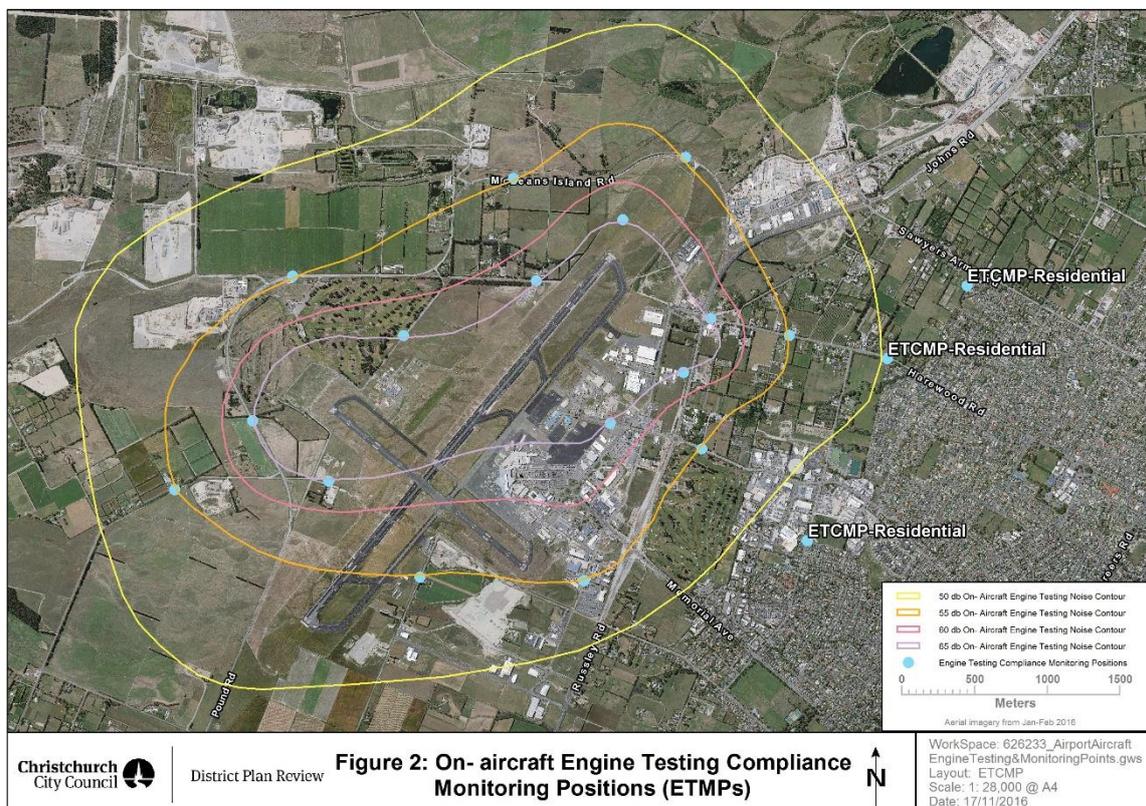


Figure 2: On-aircraft engine testing compliance monitoring positions (ETCMPs)

- ii. *All high power testing of jet engines on an aircraft shall occur between the hours of 07:00h and 22:00h, except that a maximum of 5 unplanned engine testing events within any three month period, up to a maximum of 12 unplanned engine testing events per annum, may occur between the hours of 22:00h and 07:00h.*
- iii. *Testing of turbo prop engines on an aircraft between the hours of 22:00h and 07:00h, when the total duration of testing at high power is five minutes or more per aircraft, shall be conducted in the vicinity of the threshold of Runway 11 (ie. the north-western end of the cross-runway).*
- iv. *The following exclusions apply:*
 - A. *The testing of engines on an aircraft used for Antarctic operations, is excluded from activity standards i.-iii.*
 - B. *The testing of engines on any aircraft is excluded from activity standards i.–iii., where such work is necessary to satisfy an airworthiness directive or other like safety requirement issued by the Minister of Transport, the Director of Civil Aviation or the Civil Aviation Authority, as is any other unplanned engine testing arising from an aircraft operator’s identification of a safety issue relating to an aircraft fleet, or required as a result of a natural disaster including volcanic eruption.*
 - C. *The testing of turbo prop engines on an aircraft is exempted from activity standard iii. when Runway 11/29 is in use.*
- v. *Monitoring and determining compliance with activity standard a.i. above shall be as follows:*
 - A. *Compliance or otherwise with activity standard a.i. shall be demonstrated by calculations of on-aircraft engine testing noise emissions based on the actual on-aircraft engine testing events and calculations of noise emissions for the engine testing events and configurations in question. The noise level ($L_{dn, 7day}$) shall be calculated as a 7 day rolling average.*
 - B. *The calculations in activity standard a.v.A. shall be verified by measurements undertaken with reference to at least four ETCMPs for a sample of at least two different on-aircraft engine test configurations. Verification measurements shall be carried out for an initial period of 6 months from 6 March 2017 and subsequently be undertaken at least once every two years.*
- vi. *An On-aircraft Engine Testing Report shall be provided quarterly by the airport operator to the Council, with the first covering the period ending the 30 June 2017 and provided to the Council by the 15 July 2017. The report shall include:*
 - A. *a summary of all on-aircraft engine testing activities undertaken in the quarter; and*
 - B. *identification of all tests undertaken both in accordance with activity standard a.i. and those excluded by activity standard a.iv., including reasons for the tests excluded and any measures taken to manage noise effects during those excluded tests.*
- vii. *An On-aircraft Engine Testing Noise Monitoring Report shall be provided annually by the airport operator to the Council by 6 March 2018, and annually thereafter. The report shall include:*
 - A. *the results of verification measurements in accordance with activity standard v.B.; and*

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- B. analysis of compliance with reference to Rule 6.1.6.2.6 a.i.; and*
- C. a summary of complaints received over the previous year in relation to noise from on-aircraft engine testing, and any actions taken in response.*
- viii. The additional activity standards in Rule 6.1.6.2.7 for on-aircraft engine testing at Christchurch International Airport shall be met.*

Note that the next section of the CDP, Rule 6.1.6.2.7, provides “Additional activity standards for aircraft operations and on-aircraft engine testing at Christchurch International Airport.” There are 3 sub-rules, listed below but not quoted in full, that are not directly relevant to this report.

- 6.1.6.2.7.1 Airport Noise Management Plan
- 6.1.6.2.7.2 Acoustic treatment and advice
- 6.1.6.2.7.3 Airport Noise Liaison Committee

A.2 Appendix 2 – Spot Check Calculations

The following Spot Checks are based on the data points from the Verification Measurements presented in the MDA Annual Noise Report for 2021.

Spot Check 1

Aircraft – ATR 600 at Full Power
ET Location - #1 Hangar Ground Run up pad
Night Time – nominal 40-minute duration.

ETMS – Output = 72.2% of budget (worst Heading of 150 degrees)
Therefore, the permissible operation is 55 minutes per week (of this test alone).

MDA measured Leq(5min) of 67.9 and 57.4 dBA at ETCMP 5 and 11, respectively, for a 2-minute test duration. This gave the following:

Noise level at ETCMP #5 = 71.9 dBA. Calculated budget = 207 min/week for 65Ldn 7d.
Noise level at ETCMP #11 = 61.4 dBA. Calculated budget = 232 min/week for 55Ldn 7d.

Conclusion: ETMS is consistent with (i.e. more stringent than) the MDA data points.

Spot Check 2

Aircraft – A320 at High Power
ET Location - #1 Hangar Taxiway 11
Night Time – nominal 10-minute duration

ETMS – Output = 43.3% of budget (worst Heading of 330 degrees)
Therefore permissible operation is 23 minutes per week (of this test alone).

MDA measured Leq(5min) of 64.4 dBA at ETCMP 11, for a 3-minute test duration. This gave the following:

Noise level at ETCMP #11 = 66.6 dBA. Calculated budget = 69 min/week for 55Ldn 7d.

Conclusion: ETMS is consistent with (i.e. more stringent than) the MDA data point.

Spot Check 3

Aircraft – A320 NEO at Medium Power
ET Location - #1 Hangar Taxiway 11
Night Time – nominal 10-minute duration

ETMS – Output = 17.2% of budget
Therefore permissible operation is 233 minutes per week (of this test alone).

MDA measured Leq(5min) of 60.9 dBA at ETCMP 5, for a 1-minute test duration. This gave the following:

Noise level at ETCMP #5 = 67.9 dBA. Calculated budget = 518 min/week for 65Ldn 7d.

Conclusion: ETMS is consistent with (i.e. more stringent than) the MDA data point.

A.3 Appendix 3 – Noise Database Check Calculations

Presented here are the data for more detailed and accurate Spot Checks than those presented in Appendix 1. The calculations are based on the noise levels in the MDA Noise Database used by the ETMS.

Table A3 contains data extracts from the database showing the instantaneous noise levels for ATR and A320 (Full Power) for the full range of Wind Headings. The highest noise level from the ATR is 66.9 dBA and, from the A320, 71.0 dBA.

In both cases, ETCMP 9, where the noise limit is 55dBA Ldn 7d, is the crucial receiver location. For these aircraft on the Ground Run Up Pad, ETCMP would be the first location to breach its noise limit. Below Table A2 are the Spot Check results and conclusions.

Table A3 – Extract from MDA Noise Database												
Heading	30	60	90	120	150	180	210	240	270	300	330	360
Instantaneous Noise Levels (dBA) at ETCMP 9 for ET at Ground Run Up Pad/ Taxiway A11 for each Wind Heading (Full Power)												
ATR	61.4	63.4	65.7	66.9	66	64	61.7	62.4	62.4	61.2	62.2	
A320	69.2	67	66.8	67	66.5	66.8	67	68.2	71	65	64	69.5

Spot Check 1

Aircraft – ATR 600 at Full Power

Controlling point (Highest instantaneous noise level in database) – ETCMP #9

ETMS – permissible operation is 55 minutes per week (of this test alone).

From the MDA Noise Database

Noise level at ETCMP #9 = 66.9 dBA. Calculated budget = 65 min/week for 55Ldn 7d.

Conclusion: ETMS is consistent with (i.e., more stringent than) the MDA data set.

Spot Check 2

Aircraft – A320 at High Power

Controlling point (Highest instantaneous noise level in database) – ETCMP #9

ETMS – permissible operation is 23 minutes per week (of this test alone).

From the MDA Noise Database

Noise level at ETCMP #9 = 71.0 dBA. Calculated budget = 25 min/week for 55Ldn 7d.

Conclusion: ETMS is consistent with (i.e. more stringent than) the MDA data set.

A.4 Appendix 4 – Compiled Recommendations

Feedback/Issues	Solutions
ETMS Input Function	
Entering multiple tests with similar configurations is time consuming and repetitive.	Create pre-populated templates for common test configurations (or allow Users to create their own). This will reduce repetition and potential errors. The User would still need to do a review to include the specific details of the current ET proposal.
For some aircraft types or locations there are limited permitted options for headings options (see the CIAL ET Procedures Oct 2018) but all headings are displayed A380 tests are usually conducted at Stand 20 with Heading, but this option is not available.	Add pull down menus that only display the relevant headings to avoid user error.
Graphics could assist with correct selection of Heading.	Include a picture or diagram of the Heading options.
Currently, for certain areas of the airport, the user is only able to select Domestic, International or Antarctic Aprons. These are not specific.	For selection of Testing Location, add gate locations to the pull-down menus.
Resolve the issue around entering the details for engine tests duration and power for each engine. Currently users have to enter the time at each power for each engine and then total this time up in a separate drop down.	Many of the fields could pre- or auto-populated based on the initial numbers entered and how sets of engines are tested at the same power and length of time (as anything else would unbalance the aircraft). When selecting the aircraft type, the ETMS should automatically prepopulate the number of engines on that type of aircraft
Tests cannot be created if the planned event is more than 24hrs in advance.	Allow Scheduled tests to be created more than 24 hours in advance.
It is not clear what weather information is required. Can this be automated?	Weather input to automatically generate from the airport's system forecast
"We did (A380) engine run recently. Wanted to do multiple starts (3 starts) for the trouble shooting. Each engine run would be 2 min. there is no option to select multiple starts within 15 min and duration of each start for 2 min. Had to select 15min	System to allow for multiple tests conducted on one aircraft in one session to be logged e.g. 3 x 2 minute runs in a 15 minute period.

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engine run. So the data you are looking for would not be accurate.”	
A users suggested not having to enter times (test durations) until after the test.	The expected run time is needed to predict potential noise breaches. Perhaps a maximum permissible time could be displayed.
ET Completion	
Sometimes a user forgets to update a Scheduled test to Completed, Amended or Cancelled.	Send an automatic email reminder if, after a certain period, a Scheduled Test has not been Completed, Amended (to a future time) or Cancelled in the system.
Sometimes a user forgets to or has a technical difficulty with entering a test in advance.	Allow engine tests to be entered post run for the rare instances where due to error or technology difficulties a user has not entered a scheduled test ahead of time.
General	
Some users would prefer additional access to the ETMS from phone or tablet.	Develop an ETMS app to allow users to enter tests via phone or tablet
If a user is deleted, the system will not accept the same user and email address to be reinstated.	Improve the new User/removing User function.