



Report for the BS4142:2014+A1:2019 Assessment for ITM Power Limited, Shepcote Lane, Sheffield.

Monitoring Date(s): 28th - 29th June 2023

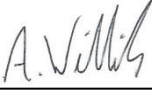
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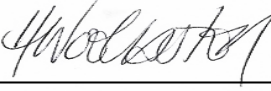
Client Name: ITM Power Limited

Client Address: 2 Bessemer Park
Shepcote Lane
Sheffield
S9 1DZ

Monitoring Organisation: Synergy Environmental Solutions Limited
Silverdale Enterprise Centre
Kents Lane
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Date of Report: 18 July 2023

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Executive Summary

Synergy Environmental Solutions Limited was appointed by Mr. Luke Shaw of ITM Power Limited to undertake an environmental noise survey at the company's Shepcote Lane site, Sheffield. The results of this survey were compared to Synergy Environmental Solutions previous survey (ref. 17220), which were used to conduct a BS 4142:2014+A1:2019 *Methods for Rating and Assessing Industrial and Commercial Sound* assessment.

The purpose of the survey is to assess and rate the noise produced from the site and to determine the likely effects of the noise on people who might be inside or outside a residential dwelling in the vicinity of the plant.

This report presents the overall methodology, results and calculations from the survey and demonstrates whether the plant is likely to cause adverse impact at the closest noise-sensitive receiver.

The site work was undertaken by Mr. Aidan Willis on the 28th and 29th June 2023, with the site work to determine background sound levels being taken on the 2nd and 3rd August 2022.

Results of BS 4142 Night-Time Assessment

The specific sound level determined by the BS 4142 assessment exceeds the background sound level by 6dB, indicating that adverse impact is likely. Observations made during the survey contradict this result, as no sounds were perceptible from the direction of ITM Power. In addition, no purging processes were noted at any point during this survey. This result may be attributed to external factors, such as an increase in vehicle movements on the M1 or other local routes.

Additionally, the results night-time of monitoring at Ingfield Avenue shows a decrease in L_{Aeq} levels between the two surveys (55dB in the previous survey, 52dB in this survey). These results indicate that sources other than ITM Power have a greater influence on the acoustic environment than activities undertaken at ITM Power.

Results of BS 4142 Daytime Assessment

The L_{Aeq} recorded during the daytime monitoring at Greasbro Avenue during this survey is below that of the previous survey.

As with the night survey, the results daytime of monitoring at Ingfield Avenue shows a decrease in L_{Aeq} levels between the two surveys (61dB in the previous survey, 57dB in this survey). These results again indicate that sources other than ITM Power have a greater influence on the acoustic environment than activities undertaken at ITM Power.

Based on the conditions observed during this survey, it can be concluded that sound produced by ITM Power has no adverse impact on nearby residential properties.

1. Introduction

Synergy Environmental Solutions Limited was appointed by Mr. Luke Shaw of ITM Power Limited to undertake an environmental noise survey at the company's Shepcote Lane site, Sheffield. The results of this survey were compared to Synergy Environmental Solutions previous survey (ref. 17220), which were used to conduct a BS 4142:2014+A1:2019 *Methods for Rating and Assessing Industrial and Commercial Sound* assessment.

The purpose of the survey is to assess and rate the noise produced from the site and to determine the likely effects of the noise on people who might be inside or outside a residential dwelling in the vicinity of the plant.

This report presents the overall methodology, results and calculations from the survey and demonstrates whether the plant is likely to cause adverse impact at the closest noise-sensitive receiver.

The site work was undertaken by Mr. Aidan Willis on the 28th and 29th June 2023, with the site work to determine background sound levels being taken on the 2nd and 3rd August 2022.

2. Relevant Legislation and Guidance

2.1 BS 4142:2014+A1:2019

BS 4142:2014+A1:2019 *Methods for Rating and Assessing Industrial and Commercial Sound* (hereafter referred to as BS 4142) is intended to be used to assess the impact of sound emanating from existing, proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature, and can be used to indicate the likelihood of adverse impact on those at nearby noise sensitive receivers.

BS 4142 defines terms such as Acoustic Environment, Ambient Sound Level, Background Sound Level, Measurement Time Interval, Rating Level, Reference Time Interval, Residual Sound Level and Specific Sound Level. These definitions are given in the Glossary of Terms within this report.

BS 4142 notes that where it is not possible to determine the Specific Sound Level directly by measurement, it may be appropriate to determine the Specific Sound Level by measurement and/or calculation. The recommended method of doing so is to obtain a measurement of the specific sound from an identical or similar plant at another location, and then use a method of calculation to estimate the Specific Sound Level at the assessment location(s).

By calculating the Specific Sound Level and adding an appropriate Acoustic Feature Correction, a Rating Level is given; this is then compared to the Background Sound Level. BS 4142 states that a Rating Level that is in excess of the Background Sound Level by 10dB or more is likely to be an indicator significant adverse impact, and an excess of 5dB is likely to be an indicator of adverse impact.

2.2 BS 8233:2014

BS 8233:2014 *Guidance on Sound Insulation and Noise Reduction for Buildings* (hereafter referred to as BS 8233) suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new or refurbished buildings undergoing a change of use rather than to assess the effect of changes in the external noise climate.

BS 8233 suggests suitable internal noise levels within different types of buildings, including residential dwellings. It suggests that within bedrooms, an internal noise level of 30dB $L_{Aeq,T}$ is a good standard and 35dB $L_{Aeq,T}$ is a reasonable standard. For living areas in the daytime, BS 8233 suggests that 30dB $L_{Aeq,T}$ is a good standard and 40dB $L_{Aeq,T}$ is a reasonable standard. BS 8233 also states that individual noise events should not exceed 45dB L_{Amax} in bedrooms at night.

2.3 WHO Guidelines for Community Noise

The World Health Organisation document *Guidelines for Community Noise* outlines some of the health effects which may be caused by noise related stress, and provides guidance values at which annoyance and sleep disturbance may be observed. The document suggests that an internal bedroom level of 30dB $L_{Aeq,8hour}$ will cause sleep disturbance, with a corresponding external level of 45dB $L_{Aeq,8hour}$ with the windows open. Levels for moderate and serious annoyance in outdoor living areas during the daytime and evening periods are given as 50dB $L_{Aeq,8hour}$ and 55dB $L_{Aeq,8hour}$, respectively.

2.4 Professional Practice Guidance on Planning & Noise

This Professional Practice Guidance on Planning and Noise (ProPG) was produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England. The recommended approach detailed in this guidance includes a framework to enable situations where noise is not an issue to be clearly determined, and to help identify the extent of risk at noisier sites. The document rates existing acoustic environments, using daytime noise levels of between 50dB and 70dB $L_{Aeq,16hour}$ and night-time noise levels of between 40dB and 60dB $L_{Aeq,8hour}$, to predict the degree of adverse impact the environment may have on residents of new properties.

3. Sound Measurement Equipment

The measurement equipment listed in Table 1 below was used during the survey. The sound level meter and acoustic calibrator conform to BS EN 61672-1:2013 and BS EN 60942:2018 respectively. The equipment calibration was verified before and after the survey, as shown in Table 2.

Table 1: Equipment used during the survey

Equipment	Serial Number	Last Calibration
Cirrus Research CR:171C	G300843	26 th July 2022
Cirrus Research Acoustic Calibrator CR:515	51090	26 th July 2022

Table 2: Calibration offset during the survey

Time Period	Offset before measurement period	Offset after measurement period
Greasbro Road, Day Survey (09:17 – 10:17)	-0.05dB	0.14dB
Ingfield Avenue, Day Survey (10:40 – 11:35)	0.14dB	0.17dB
Oxted Road / Jenkin Road, Day Survey (12:14 – 13:14)	0.17dB	0.09dB
Greasbro Road, Night Survey (03:00 – 03:15)	-0.02dB	0.1dB
Ingfield Avenue, Night Survey (03:18 – 03:33)	-0.02dB	0.1dB
Oxted Road / Jenkin Road, Night Survey (03:43 – 03:58)	-0.02dB	0.1dB

4. Details of Source

Main sound sources of the specific sound	It was reported by staff on site that, subjectively, the loudest sound source was from air releases generated by the purging process.
Hours of operation	Up to 24/7.
Statement of operational rates	The purging process will operate for thirty to sixty seconds before a test is conducted. Sounds of the purging process will emit from the outlets, which are located in the car park.
Description of premises	ITM Power's Shepcote site is a large unit located just off junction 34 of the M1. The site is surrounded by a mix of residential, industrial and commercial premises.

5. Subjective Impressions

Dominance or audibility of the specific sound	Sounds produced by ITM Power were not audible during this survey at any measurement location.
Main sources contributing to the residual sound	Road traffic noise from the M1 and local routes.

6. Noise Sensitive Receivers

6.1 Greasbro Road

Sensitivity of receptor	Residential Property
Measurement Location	Sampling was undertaken at the nearest residential property, 52 Greasbro Road, with the microphone positioned at a height of 1.4m, positioned at least 3.5m away from reflecting facades. The exact sampling position was based on accessibility and safety and collecting representative noise data at the nearest noise sensitive receiver to the plant.
Topography of Intervening Ground	The intervening ground consists of ITM's car park and another industrial unit. This area is topographically flat.
Reason for choice of measurement location	Ambient measurements were taken at the nearest sensitive receptor. This was 52 Greasbro Road. This location was chosen over 4 Greasbro road as the acoustic panelling at the rear of the properties differed in height, and as such it is predicted that 4 Greasbro Road would be less impacted by sounds generated at ITM Power.

6.2 Ingfield Avenue

Sensitivity of receptor	Residential Properties
Measurement Location	Sampling was undertaken in an additional residential area, with the microphone positioned at a height of 1.4m, positioned at least 3.5m away from reflecting facades. The exact sampling position was based on accessibility and safety and collecting representative noise data at the nearest noise sensitive receiver to the plant.
Topography of Intervening Ground	The entry and exit slip roads of junction 34 of the M1 separate ITM Power from the properties at Infield Avenue. The M1 is topographically higher than these two points and breaks the direct sound propagation path.
Reason for choice of measurement location	Ambient measurements were taken at an additional noise sensitive receptor.

6.3 Jenkin Hill (Oxted Road / Jenkin Road)

Sensitivity of receptor	Residential Properties
Measurement Location	Sampling was undertaken in an additional residential area, with the microphone positioned at a height of 1.4m, positioned at least 3.5m away from reflecting facades. The exact sampling position was based on accessibility and safety and collecting representative noise data at the nearest noise sensitive receiver to the plant.
Topography of Intervening Ground	The intervening ground lowers before raising back up, effectively creating an acoustic shadow zone where the Meadowhall Shopping Centre is. Sounds produced at ITM power will have a direct sound propagation path to properties on Jenkin Hill.
Reason for choice of measurement location	Ambient measurements were taken at an additional noise sensitive receptor.

7. Weather Conditions

The following weather conditions were recorded during the survey:

	Greasbro Road (09:17 – 10:17)		Ingfield Avenue (10:40 – 11:35)		Oxted Road / Jenkin Road (12:14 – 13:14)	
	Start	End	Start	End	Start	End
Wind speed	<1ms ⁻¹	<1ms ⁻¹	<1ms ⁻¹	<1ms ⁻¹	<1ms ⁻¹	<1ms ⁻¹
Temperature	21°C	21°C	28°C	27°C	31°C	29°C
Estimated cloud cover	8 Oktas	8 Oktas	8 Oktas	8 Oktas	8 Oktas	8 Oktas
Precipitation and ground condition	Dry with no precipitation					

	Greasbro Road (03:00 – 03:15)		Ingfield Avenue (03:18 – 03:33)		Oxted Road / Jenkin Road (03:43 – 03:58)	
	Start	End	Start	End	Start	End
Wind speed	<1ms ⁻¹	<1ms ⁻¹	<1ms ⁻¹	<1ms ⁻¹	<1ms ⁻¹	<1ms ⁻¹
Temperature	21°C	21°C	20°C	20°C	20°C	21°C
Estimated cloud cover	6 Oktas	5 Oktas	6 Oktas	6 Oktas	4 Oktas	4 Oktas
Precipitation and ground condition	Dry with no precipitation					

8. Results

The full results from the assessment are shown as a time history of L_{Aeq} , L_{Amax} , L_{A10} and L_{A90} in Appendix 1.

Day Survey

The time interval for the day survey was chosen to be 1 hour, as required by BS4142.

Location	L_{Aeq}	L_{Amax}	L_{A90}
Greasbro Road	61dB	78dB	58dB
Ingfield Avenue*1	57dB	68dB	55dB
Oxted Road / Jenkin Road	65db	82dB	50dB

*1 The results shown for this location differ to those shown in the measurement summary in Appendix 1. This is as an ambulance sounded its siren nearby; as a result of this new figures for L_{Aeq} , L_{Amax} and L_{A90} have been calculated from the first fifty-five minutes of the measurement.

Night Survey

The time interval for the night survey was chosen to be 15 minutes, as required by BS4142.

Location	L_{Aeq}	L_{Amax}	L_{A90}
Greasbro Road	57dB	67dB	52dB
Ingfield Avenue	52dB	63dB	48dB
Oxted Road / Jenkin Road	53dB	73dB	39dB

BS 4142 Daytime Assessment

The results of monitoring at Greasbro Avenue have been used, as this is the nearest noise sensitive receptor.

Measured Ambient Sound Level - L_a	61dB
Residual Sound Level - L_r	63dB
Background Sound Level - $L_{A90,T}$	58dB
Specific Sound Level - L_s	See assessment result
Acoustic Feature Correction ^{*1}	0dB
Rating Level	0dB
Excess of Rating Level over Background Sound Level	0dB
Assessment Result	The measured ambient sound level is below that of the residual sound level, demonstrating that sounds produced by ITM power had no impact on the nearest noise sensitive receiver during the survey.

*1 Acoustic feature corrections used in this assessment are based on the subjective method outlined in section 9.2 of BS 4142. Penalties of up to 6dB can be added if the sound is tonal, up to 9dB if impulsive and up to 3dB if distinctively intermittent or otherwise distinctive against the residual acoustic environment. In this case, no acoustic feature corrections have been added.

BS 4142 Night-Time Assessment

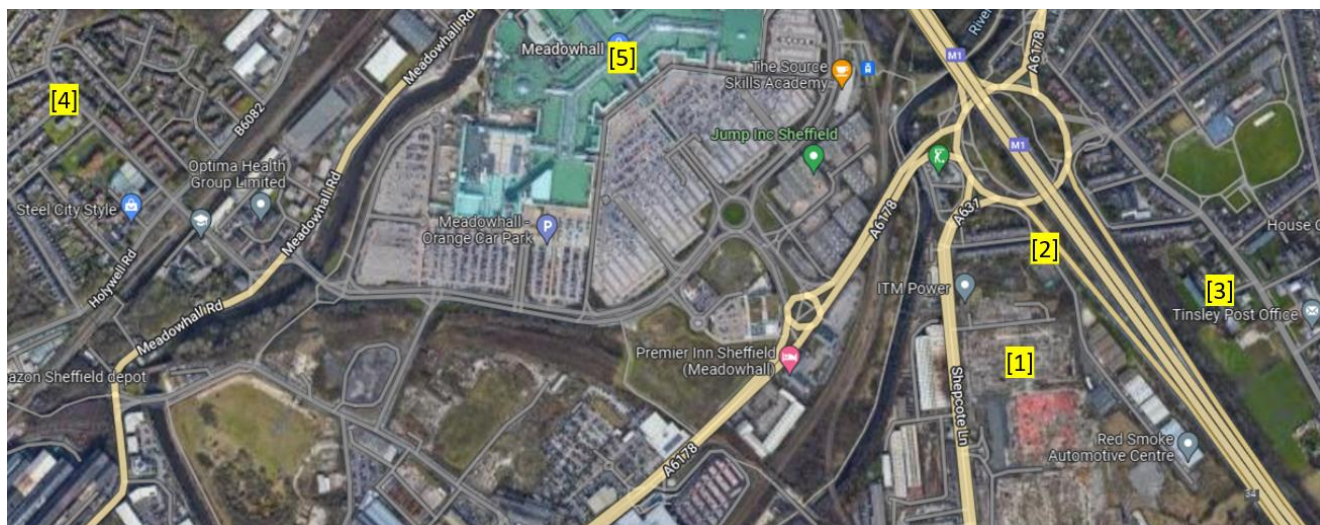
The results of monitoring at Greasbro Avenue have been used, as this is the nearest noise sensitive receptor.

Measured Ambient Sound Level - L_a	57dB
Residual Sound Level - L_r	54dB
Background Sound Level - $L_{A90,T}$	48dB
Specific Sound Level - L_s	54dB
Acoustic Feature Correction ^{*1}	0dB
Rating Level	54dB
Excess of Rating Level over Background Sound Level	6dB
Assessment Result	An excess of 6dB over the background sound level indicates that adverse impact is likely.

*1 Acoustic feature corrections used in this assessment are based on the subjective method outlined in section 9.2 of BS 4142. Penalties of up to 6dB can be added if the sound is tonal, up to 9dB if impulsive and up to 3dB if distinctively intermittent or otherwise distinctive against the residual acoustic environment. In this case, no acoustic feature corrections have been added.

9. Discussion

Description and Locations of Noise Sensitive Receptors



Map Point	Location
[1]	ITM Power
[2]	Greasbro Road Measurement Position
[3]	Ingfield Avenue Measurement Position
[4]	Oxted Road / Jenkin Road Measurement Position
[5]	Meadowhall Shopping Center

The site observations and sound propagation paths remain the same as Synergy Environmental Solutions previous report (ref. 17220). These are given below for context.

The residential properties at Greasbro Road are the closest noise sensitive receptor to ITM Power. The nearest noise source to these properties is the outlet of the purging process, which is located in the car park of ITM Power. Whilst a purge is being undertaken, air will be forced from these outlets; this process will only run for approximately 30 to 60 seconds, after which the remainder of the testing cycle will begin.

Sound from operations at ITM Power will, to a lesser degree, impact on properties at Ingfield Avenue and Jenkin Hill. The impact of sound on these properties will be lesser as these areas are a greater distance away from ITM Power; in addition to this, the M1 blocks the direct sound propagation path between ITM Power and Ingfield Avenue.

The intervening ground between ITM Power and Jenkin Hill, containing the Meadowhall Shopping Centre, is topographically lower than ITM Power and Jenkin Hill, meaning that sounds produced at ITM have a direct propagation path to residential properties on Jenkin Hill. The topography of the area also places Meadowhall in an acoustic shadow zone.

Results of BS 4142 Night-Time Assessment

The specific sound level determined by the BS 4142 assessment exceeds the background sound level by 6dB, indicating that adverse impact is likely. Observations made during the survey contradict this result, as no sounds were perceptible from the direction of ITM Power. In addition, no purging processes were noted at any point during this survey. This result may be attributed to external factors, such as an increase in vehicle movements on the M1 or other local routes.

Additionally, the results night-time of monitoring at Ingfield Avenue shows a decrease in L_{Aeq} levels between the two surveys (55dB in the previous survey, 52dB in this survey). These results indicate that sources other than ITM Power have a greater influence on the acoustic environment than activities undertaken at ITM Power.

Results of BS 4142 Daytime Assessment

The L_{Aeq} recorded during the daytime monitoring at Greasbro Avenue during this survey is below that of the previous survey.

As with the night survey, the results daytime of monitoring at Ingfield Avenue shows a decrease in L_{Aeq} levels between the two surveys (61dB in the previous survey, 57dB in this survey). These results again indicate that sources other than ITM Power have a greater influence on the acoustic environment than activities undertaken at ITM Power.

10. Conclusion

The results of night-time monitoring at Greasbro Avenue indicate the potential for adverse impact on those at the nearest noise sensitive receiver, however, the results of night-time monitoring at Ingfield Avenue, and the results of daytime monitoring at both locations, indicate that other nearby sound sources may have a greater impact on the acoustic environment.

Therefore, based on the conditions observed during this survey, it can be concluded that sound produced by ITM Power has no adverse impact on nearby residential properties.

Appendix 1 – Monitoring Results

29/06/2023



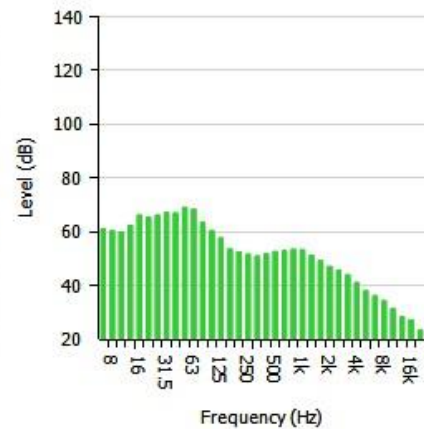
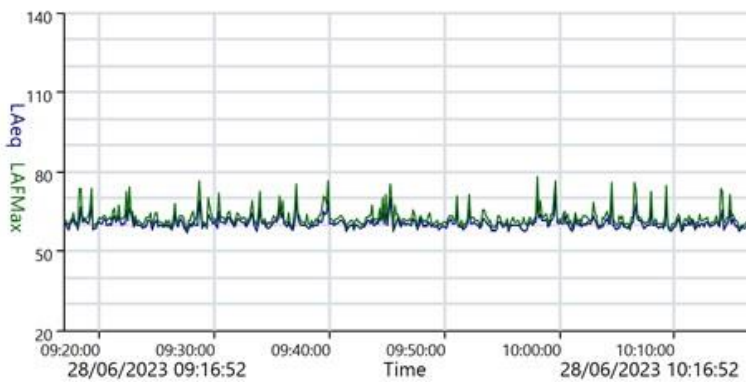
Measurement Summary Report

Name 1 - Greasbro Road, Day Survey
Time 28/06/2023 09:16:52 **Person** **Place** **Project**
Duration 01:00:00 ITM Power 18293
Instrument G300843, CR:171C

Calibration

Before 28/06/2023 09:16 **Offset** -0.05 dB **After** 28/06/2023 10:39 **Offset** 0.14 dB

Basic Values		Statistical Levels (Ln)	
LAeq	61.2 dB	LAF1	69.7 dB
LAE	96.8 dB	LAF5	63.4 dB
LAFMax	78.0 dB	LAF10	62.1 dB
		LAF50	59.9 dB
		LAF90	58.1 dB
		LAF95	57.6 dB
		LAF99	56.9 dB



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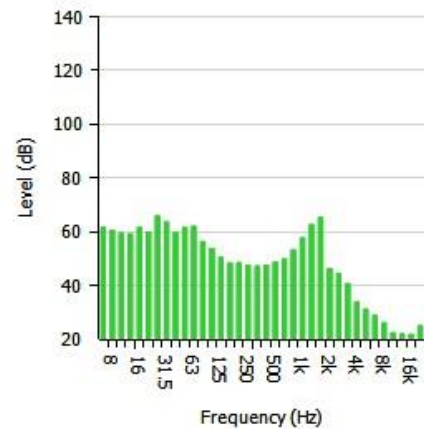
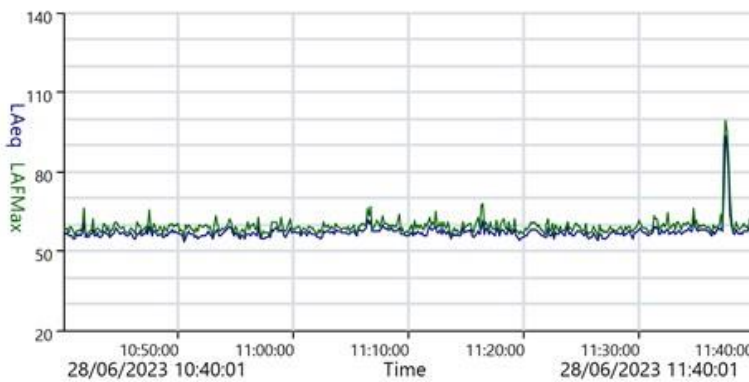
Measurement Summary Report

Name 2 - Ingfield Avenue, Day Survey
Time 28/06/2023 10:40:01 **Person** **Place** **Project**
Duration 01:00:00 ITM Power 18293
Instrument G300843, CR:171C

Calibration

Before 28/06/2023 10:39 **Offset** 0.14 dB **After** 28/06/2023 12:13 **Offset** 0.17 dB

Basic Values		Statistical Levels (Ln)	
LAeq	68.9 dB	LAF1	64.7 dB
LAE	104.5 dB	LAF5	59.2 dB
LAFMax	99.0 dB	LAF10	58.4 dB
		LAF50	56.5 dB
		LAF90	54.8 dB
		LAF95	54.4 dB
		LAF99	53.6 dB



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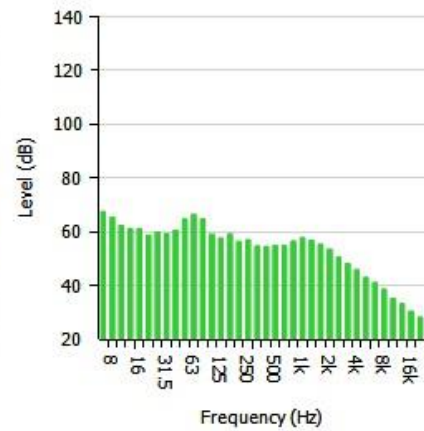
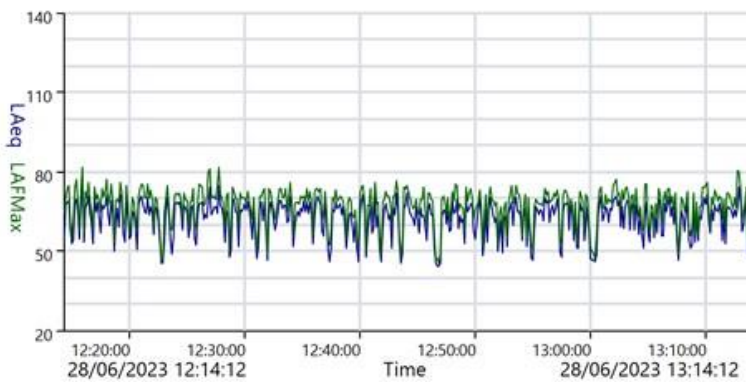
Measurement Summary Report

Name 3 - Oxted / Jenkin Road, Day Survey
Time 28/06/2023 12:14:12 **Person** **Place** **Project**
Duration 01:00:00 ITM Power 18293
Instrument G300843, CR:171C

Calibration

Before 28/06/2023 12:13 **Offset** 0.17 dB **After** 28/06/2023 13:16 **Offset** 0.09 dB

Basic Values		Statistical Levels (Ln)	
LAeq	65.3 dB	LAF1	73.5 dB
LAE	100.9 dB	LAF5	70.8 dB
LAFMax	81.6 dB	LAF10	69.3 dB
		LAF50	61.6 dB
		LAF90	49.5 dB
		LAF95	46.8 dB
		LAF99	44.8 dB



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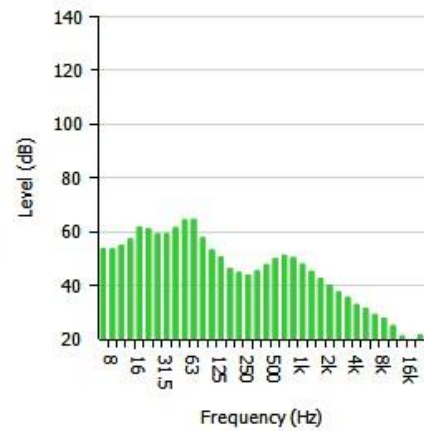
Measurement Summary Report

Name	4 - Greasebro Road, Night Survey			
Time	29/06/2023 02:57:12	Person	Place	Project
Duration	00:15:00		ITM Power	18293
Instrument	G300843, CR:171C			

Calibration

Before	29/06/2023 02:54	Offset	-0.02 dB	After	29/06/2023 03:58	Offset	0.10 dB
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Basic Values		Statistical Levels (Ln)	
LAeq	56.6 dB	LAF1	62.3 dB
LAE	86.1 dB	LAF5	60.1 dB
LAFMax	67.3 dB	LAF10	59.1 dB
		LAF50	55.7 dB
		LAF90	52.0 dB
		LAF95	51.1 dB
		LAF99	49.9 dB



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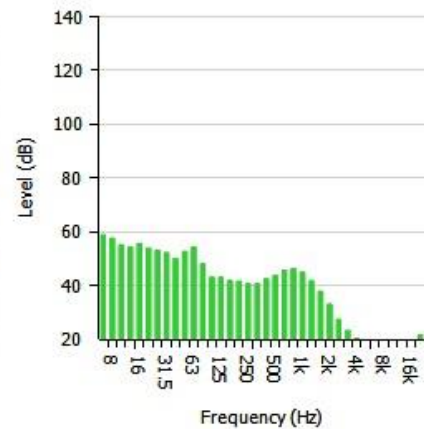
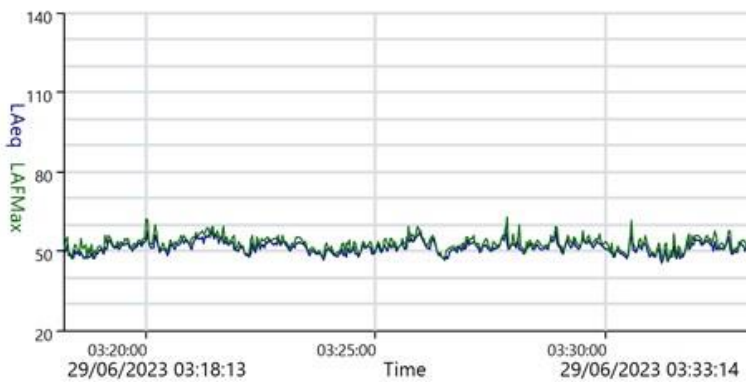
Measurement Summary Report

Name 5 - Ingfield Avenue, Night Survey
Time 29/06/2023 03:18:13 **Person** **Place** **Project**
Duration 00:15:00 ITM Power 18293
Instrument G300843, CR:171C

Calibration

Before 29/06/2023 02:54 **Offset** -0.02 dB **After** 29/06/2023 03:58 **Offset** 0.10 dB

Basic Values		Statistical Levels (Ln)	
LAeq	51.8 dB	LAF1	57.2 dB
LAE	81.3 dB	LAF5	55.0 dB
LAFMax	62.5 dB	LAF10	54.0 dB
		LAF50	51.1 dB
		LAF90	48.0 dB
		LAF95	47.3 dB
		LAF99	46.3 dB



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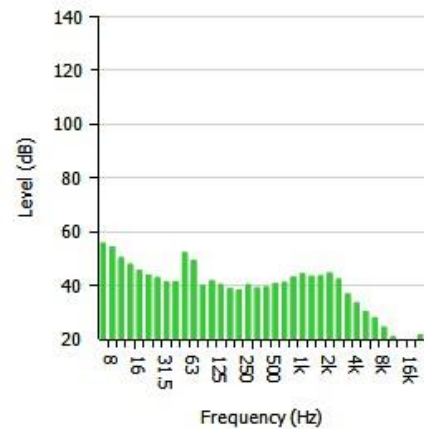
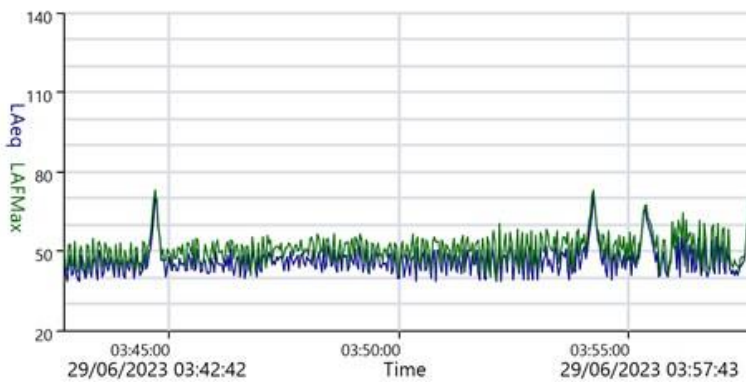
Measurement Summary Report

Name 6 - Oxted / Jenkin Road, Night Survey
Time 29/06/2023 03:42:42 **Person** **Place** ITM Power **Project** 18293
Duration 00:15:00
Instrument G300843, CR:171C

Calibration

Before 29/06/2023 02:54 **Offset** -0.02 dB **After** 29/06/2023 03:58 **Offset** 0.10 dB

Basic Values		Statistical Levels (Ln)	
LAeq	53.0 dB	LAF1	66.6 dB
LAE	82.5 dB	LAF5	56.1 dB
LAFMax	73.1 dB	LAF10	52.4 dB
		LAF50	44.1 dB
		LAF90	39.3 dB
		LAF95	38.4 dB
		LAF99	37.4 dB



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Appendix 2 – Calibration Certificates

CERTIFICATE OF CALIBRATION


ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **26 July 2022** CERTIFICATE NUMBER **177754**



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

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Approved signatory
R.Thomas
Electronically signed:


Sound Level Meter : IEC 61672-3:2013

Instrument information

Manufacturer: Cirrus Research plc Notes:
Model: CR:171C
Serial number: G300843
Class: 1
Firmware version: 5.7.3228

Test summary

Date of calibration: 26 July 2022
The calibration was performed respecting the requirements of ISO/IEC 17025:2017.
Periodic tests were performed in accordance with procedures from IEC 61672-3:2013.

The sound level meter submitted for testing successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to determine that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

Certificate Number: 177754
Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Before	Pressure: 101.44 kPa	Temperature: 21.7 °C	Humidity: 41.2 %
After	Pressure: 101.45 kPa	Temperature: 21.6 °C	Humidity: 40.7 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	KEYSIGHT	33511B	MY58001681
Attenuator	Cirrus Research	ZE:952	52200
Environmental Monitor	Comet	T7510	16966334

Additional instrument information

Instruction manual:

Reference level range: Single range

Pattern approval: No

Source of pattern approval: -

Preamplifier

Model: MV:200F

Serial number: 9250F

Microphone

Model: MK:224

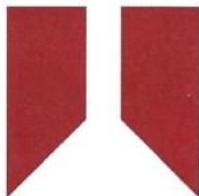
Serial number: 211798D

Test results summary

Test	Result
Toneburst response	Complies
Electrical noise-floor	Complies
Linearity	Complies
Electrical Frequency weightings	Complies
Frequency and time weightings at 1 kHz	Complies
C-weighted peak	Complies
Overload indication	Complies
High level stability	Complies
Long-term stability	Complies
Acoustic Frequency weightings	Complies

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**
DATE OF ISSUE **26 July 2022** CERTIFICATE NUMBER **177755**



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Test engineer:
D.Swalwell
Electronically signed:

Microphone

Microphone capsule

Manufacturer: Cirrus Research plc

Model: MK:224

Serial Number: 211798D

Calibration procedure

Date of calibration: 26 July 2022

Open circuit: 44.3 mV/Pa

Sensitivity at 1 kHz: -27.1 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 101.10 kPa

Temperature: 21.0 °C

Humidity: 52.0 %

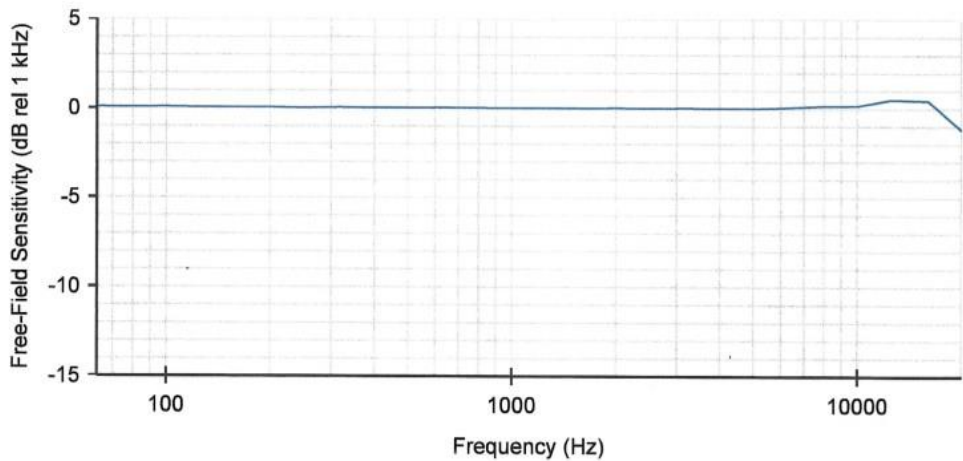
CERTIFICATE OF CALIBRATION

Certificate Number: 177755
Page 2 of 2

Free-Field Frequency Response : Tabular

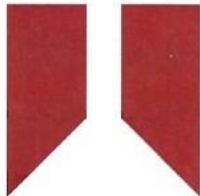
Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
63	0.08	-0.13
80	0.07	-0.03
100	0.07	0.01
125	0.05	0.02
160	0.05	0.05
200	0.05	0.07
250	0.01	0.03
315	0.05	0.04
400	0.03	0.04
500	0.03	0.03
630	0.03	0.03
800	0.02	0.00
1 000	0.00	-0.02
1 250	0.00	-0.06
1 600	0.01	-0.12
2 000	0.01	-0.21
2 500	0.00	-0.34
3 150	0.02	-0.56
4 000	0.01	-0.89
5 000	0.01	-1.35
6 300	0.06	-2.01
8 000	0.15	-3.01
10 000	0.16	-4.47
12 500	0.52	-6.01
16 000	0.45	-7.51
20 000	-1.19	-10.31

Free-Field Frequency Response : Graphical



CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**
DATE OF ISSUE **26 July 2022** CERTIFICATE NUMBER **177756**



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Approved signatory
R.Thomas
Electronically signed:

Sound Calibrator : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc **Notes:**
Model: CR:515
Serial number: 51090
Class: 1

Test summary

Date of calibration: 26 July 2022

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC60942_2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC60942_2003 Annex A to Class 1. This has been confirmed by Physikalisch-Technische Bundesanstalt (PTB), APPLUS (APPLUS) and Laboratoire National d'Essais (LNE).

Notes:

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

Certificate Number: 177756
Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Pressure: 101.29 kPa
 Temperature: 23.2 °C
 Humidity: 48.9 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Multimeter	Fluke	8845A	9705013
Distortion Meter	Keithley	2015	1046217
Acoustic Calibrator	Bruel and Kjaer	4231	2229486

Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	94.00	94.02	94.00	94.02	94.01	0.01	±0.40	0.11 dB
Distortion (%)	< 3.00	0.26	0.36	0.21	0.28	0.28	+3.00	0.13 %
Frequency (Hz)	1000.0	1000.1	1000.1	1000.1	1000.1	0.1	±10.0	0.1 Hz

The measured quantities or deviations (as applicable), extended by the expanded combined uncertainty of measurement, must not exceed the corresponding tolerance.

End of results

Appendix 3 – Certificates of Competency



Diploma in Acoustics and Noise Control

This is to certify that

Mr Aidan Willis

has satisfied the Examining Board in the following modules

General Principles of Acoustics

Project

Laboratory and Experimental Methods

Building Acoustics

Environmental Noise: Prediction, Measurement and Control

A handwritten signature in black ink, appearing to read "Stuart JC Dyne".

*Stuart JC Dyne
Chief Examiner*

A handwritten signature in black ink, appearing to read "John Pritchard".

*Dr John Pritchard
Education Committee Chairman*

Examination Date: 9-10 June 2022

Candidate Number: DY026

Centre: University of Derby



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T: +44 (0)330 999 9365 E: ioa@ioa.org.uk W: ioa.org.uk

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Diploma in Acoustics and Noise Control

This is to certify that

Helen Woollaston

*has satisfied the Examining Board in
the General Principles of Acoustics Module,
Laboratory, Project and Specialist Modules in*

*Noise Control Engineering
Transportation Noise*

A handwritten signature in black ink, appearing to read "S. Khan".

Chairman of the Examining Board

A handwritten signature in black ink, appearing to read "A. Hughes".

Institute Secretary

Date 1992

*Reference Number HC150
Centre University of Derby*



The Institute of Acoustics Limited, 77A St Peter's Street, St Albans, Herts. AL1 3BN
Tel: +44 (0)1727 848195 Fax: +44 (0)1727 850553 email: ioa@ioa.org.uk website: ioa.org.uk
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Certificate of Membership

This is to certify that

Miss Helen Woollaston

has been elected as a

Member

of the
Institute of Acoustics

*Given under the seal of the Institute
in accordance with the
Articles of Association and By-Laws*

President

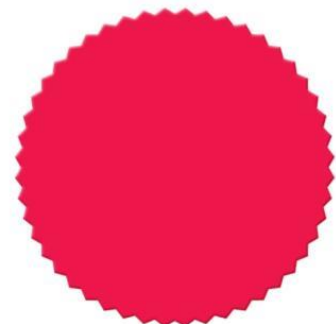
Institute Secretary

Valid Until

29-02-2024

Membership Number

41111



The certificate remains the property of the Institute and shall be returned to the Institute on demand.
Membership of the Institute is subject to annual renewal

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Glossary of Terms

A-weighting

The sound pressure level determined when using the frequency-weighting network A. The A-weighting network modifies the electrical response of a sound level meter so that the sensitivity of meter varies with frequency in approximately the same way that the sensitivity of the human hearing system.

Acoustic Environment

Sound from all sound sources as modified by the environment.

Ambient Sound Level $L_a = L_{aeq,T}$

Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T .

Note: The ambient sound level is a measure of the residual sound and the specific sound when present.

Background Sound Level $L_{A90,T}$

A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T , measured using time weighting, F , and quoted to the nearest whole number of decibels

Decibel dB

1. Unit level which denotes the ratio between two quantities that are proportional to power. The number of decibels corresponding to the ratio of two amounts of power is 10 times the logarithm to the base 10 of this ratio.
2. A linear numbering scale used to define a logarithmic amplitude scale, thereby compressing a wide range of amplitude values to a small set of numbers.
3. A unit that indicates that a quantity has a certain level above some pre-defined reference value.
4. The unit of measurement used for sound pressure levels. The scale is logarithmic rather than linear. The threshold of hearing is 0dB and the threshold of pain is 120dB. In practical terms these limits are seldom experienced and typical levels lie within the range 30dB (a quiet night-time level in a bedroom) to 90dB (at the kerbside of a busy city street).

Equivalent Continuous A-Weighted Sound Pressure Level L_{Aeq}

Value of the A-weighted sound pressure level of a continuous steady sound that within a specified time interval, T (starting at t_1 and ending at t_2) and measured in decibels has the same mean square sound pressure as the sound under consideration whose level varies with time.

Measurement Time Interval T_m

Total time over which measurements are taken.

Note: This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.

Pascals, Pa

A unit of pressure equal to one Newton per square metre.

In the measurement of sound we are concerned with the amplitude of the acoustic pressure measured in Pa.

Rating Level $L_{Ar,Tr}$

Specific sound level plus any adjustment for the characteristic features of the sound.

Reference Time Interval T_r

Specified interval over which the specific sound level is determined.

Note: This is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h.

Residual Sound Level $L_r = L_{Aeq,T}$

Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T .

Specific Sound Level $L_s = L_{Aeq,Tr}$

Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .

Standardised Weighted Level Difference ($DnTw$)

The standardised weighted level difference rating describes the acoustic performance of a completed part of a building. The method for calculating weighted values is defined in BS EN ISO 717-1:1997.

End of Report