



Report for the BS4142:2014+A1:2019 Assessment for European Metal Recycling Ltd., Darlaston, Walsall.

Monitoring Date(s): 11th - 12th July 2022

Contract Reference: 17919

Client Name: European Metal Recycling Ltd.

Client Address: Bentley Road South,
Walsall,
Wednesbury
WS10 8LW

Monitoring Organisation: Synergy Environmental Solutions Limited
Silverdale Enterprise Centre
Kents Lane
Newcastle-under-Lyme
Staffordshire
ST5 6SR

Date of Report: 17 March 2023

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Executive Summary

Synergy Environmental Solutions Limited was appointed by Mr. Matthew Wright of European Metal Recycling Ltd. to undertake an environmental noise survey to BS4142:2014 *Methods for Rating and Assessing Industrial and Commercial Sound* at the company's Darlaston site.

The purpose of the survey was to predict and rate the noise produced by the new Refrigeration Recycling Warehouse and to ascertain whether this will have an adverse effect on nearby residents. The Refrigeration Recycling Warehouse will be a newly constructed unit and will replace one which is to the East of the site.

The site work was undertaken by Mr. Aidan Willis on 11th July - 12th July 2022.

The results of calculations show that the specific sound level of the plant is 11dB below the night-time background sound level, and 19dB below the daytime background sound level. As a result of these calculations, it is predicted that adverse impact is highly unlikely.

A list of results and details of calculations can be found in Section 8 of this report. The full results from the environmental noise surveys are shown as a time history of L_{Aeq} , L_{Amax} , L_{A10} and L_{A90} in Appendix 1.

The following general recommendations should be considered as best practise to minimise the potential for noise impact:

- To minimise the time in which accessways remain open, during which sound may propagate freely from inside the warehouse, install door closers on pedestrian doorways and timers on roller shutter doors.
- Continue to ensure that materials are transported and handled with care and keep the drop height at the steel outlet to a minimum so that impact noise is minimised.

1. Introduction

Synergy Environmental Solutions Limited was appointed by Mr. Matthew Wright of European Metal Recycling Ltd. to undertake an environmental noise survey to BS4142:2014 Methods for Rating and Assessing Industrial and Commercial Sound at the company's Darlaston site.

The purpose of the survey was to predict and rate the noise produced by the new Refrigeration Recycling Warehouse and to ascertain whether this will have an adverse effect on nearby residents. The Refrigeration Recycling Warehouse will be a newly constructed unit and will replace one which is to the East of the site.

This report presents the overall methodology, results and calculations from the survey and demonstrates whether the plants are likely to cause adverse impact at the closest noise-sensitive receiver. Where applicable the report outlines the mitigation measures required to meet the criteria.

The site work was undertaken by Mr. Aidan Willis on 11th July - 12th July 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:171B	G300995	5 th July 2021
Cirrus Research Acoustic Calibrator CR:515	57692	5 th July 2021

Table 2: Calibration offset during the survey

Time Period	Offset before measurement period	Offset after measurement period
Survey 1 (Day Survey)	0.51dB	1.08dB
Survey 2 (Night Survey)	0.94B	0.65dB

4. Details of Source

Main sound sources of the specific sound	<p>The warehouse is not yet in operation. It is said that sound generated within the newly constructed warehouse will not be impulsive but will be steady and unfluctuating when in operation. Details of plants to be installed within the warehouse can be found in section eight of this report.</p> <p>Some impulsive noise will be generated at the steel output, as extracted material will drop into a metal container. This sound, generated by the current installation, was not audible at any measurement location.</p> <p>Some impulsive noise may also be generated by FLT movement as refrigeration units are unloaded from HGVs.</p>
Hours of operation	Warehouse may be operational up to 24 hours a day, 5 days a week.
Statement of operational rates	The plants installed will be on / off and will have no half-power mode.
Description of premises	The warehouse will be a newly constructed unit on the site of the existing Refrigeration Recycling Warehouse. The external walls and roof will be clad with Kingspan QuadCore KS1000RW.

5. Subjective Impressions

Dominance or audibility of the specific sound	Sounds generated by the current Refrigeration Recycling Warehouse are not perceptible at either measurement positions.
Main sources contributing to the residual sound	Traffic noise from the A454, M6 and other local routes. It should be noted that sounds generated at Ecobat were also perceptible at the Bentley Road South property.

6. Noise Sensitive Receivers

6.1 Oberon Grove

Sensitivity of receptor	Residential Property.
Measurement Location	Sampling was undertaken at the nearest residential properties, 11 and 12 Oberon Grove, with the microphone positioned at a height of 1.4m, positioned at least 3.5m away from reflecting façades. The exact sampling position was based on accessibility, safety, and collecting representative noise data at the nearest noise sensitive receiver to the plant.
Topography of Intervening Ground	The ground to the north of the Transport Yard, backing on to the train line, is elevated. This will interfere with the direct sound propagation path and will provide some attenuation to the properties on Oberon Grove and other noise sensitive receivers beyond the raised ground. The Refrigeration Recycling Warehouse may be visible from the top floor of the properties on Oberon Grove as it is topographically higher than the Transport Yard.
Reason for choice of measurement location	This measurement position was chosen as it will reflect the acoustic environment at the closest noise sensitive receiver to the plant.

6.2 Property off Bentley Road South (No. 49)

Sensitivity of receptor	Residential Property.
Measurement Location	Sampling was undertaken at an additional nearby residential property off Bentley Road South, no. 49, with the microphone positioned at a height of 1.4m, positioned at least 3.5m away from reflecting façades. 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 properties off Bentley Road South are topographically lower than the EMR Darlaston site, and the line of sight to the site is completely blocked by the Oberon Grove properties and a bridge crossing the railway.
Reason for choice of measurement location	This measurement position was chosen as it will reflect the acoustic environment at an additional noise sensitive receiver.

7. Weather Conditions

The following weather conditions were recorded during the survey:

	Day Survey (10:10 – 13:34)		Night Survey (01:13 – 02:16)	
	Start	End	Start	End
Wind speed	< 1ms ⁻¹			
Temperature	23°C	32°C	26°C	27°C
Estimated cloud cover	1 Oktas	0 Oktas	8 Oktas	8 Oktas
Precipitation and ground condition	Dry with no precipitation			

8. Results and Calculations

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}
EMR Darlaston Site Boundary	59dB	83dB	46dB
Oberon Grove	47dB	74dB	43dB
Property off Bentley Road South	55dB	71dB	51dB

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}
EMR Darlaston Site Boundary	37dB	57dB	35dB
Oberon Grove	40dB	61dB	35dB
Property off Bentley Road South	45dB	57dB	37dB

Sound Emissions of Plants to be Installed in the Refrigeration Recycling Warehouse

Figures for noise emission of plants similar to those to be installed have been supplied by the manufacturer of the plants, URT. A summary of their sound pressure levels, taken at a distance of 1m from the source and 1.6m from the ground, is in the table below.

Plant	L _{Aeq}
Step 1 Feeding	76dB
Step 1 Treatment Device	75dB
Robot Detection	73dB
Filling Hopper / Feeding	81dB
Shredder	86dB
Separation Iron / Foam	85dB
Separation NF / NF-metals	74dB
Matrix Degassing	78dB
Chiller	67dB
Ventilator Dust Collection Filter	75dB
Discharge Iron	76dB
Discharge NF / Plastic	72dB
Heavy / Light Separation	85dB
RTO (Ventilator) Step 3	80dB

Logarithmically adding the sound pressure levels gives a total sound pressure level of 92dB.

BS 4142 Assessment

For the following calculations the results of monitoring at Oberon Grove have been used, as these will demonstrate the potential impact at the closest noise-sensitive receiver.

Residual Sound Level - L_r	Daytime: 47dB Night-time: 40dB
Background Sound Level - $L_{A90,T}$	Daytime: 43dB Night-time: 35dB
Total sound pressure level of plants in new Refrigeration Recycling Warehouse - L_a	92dB
Sound reduction index of Kingspan QuadCore KS1000RW (R_w)	25dB*1
Distance correction of 200m	43dB
Acoustic Feature Correction	0dB *2
Calculated Specific Sound Level of the new Refrigeration Recycling Warehouse - L_s	24dB
Excess of Rating Level over Background Sound Level	Daytime: -19dB Night-time: -11dB
Assessment result	The specific sound level is significantly below both the daytime and night-time background sound levels, indicating adverse impact is highly unlikely
Uncertainty of the assessment	See discussion

*1 Information supplied by manufacturer.

*2 It was reported by the site contact that sound generated by plants in the newly constructed Refrigeration Recycling Warehouse will not be impulsive but will be steady and unfluctuating when in operation. Subjective impressions of sounds generated by the current installation are that they are not distinct, tonally, impulsively or otherwise, from the acoustic environment.

9. Discussion

Description and Locations of Noise Sensitive Receivers



Map Point	Location
[1]	Site Boundary Measurement Location
[2]	EMR Darlaston Shear Area
[3]	EMR Darlaston Refrigeration Recycling Warehouse
[4]	Oberon Grove Measurement Location
[5]	Property off Bentley Road South Measurement Location
[6]	Ecobat Solutions

The residential properties at Oberon Grove and the private road off Bentley Road South are the nearest noise sensitive receivers to the EMR Darlaston Site. With the exception of an earth bund along the northern edge of EMR Darlaston's site, much of the intervening ground between the Refrigeration Recycling Warehouse and Oberon Grove is topographically lower. It is possible that the Refrigeration Recycling Warehouse is visible from the rear façades of the properties on Oberon Grove, meaning there may be a direct sound propagation path.

From the properties off Bentley Road South, the line of sight to EMR Darlaston is completely blocked both by the Oberon Grove properties and a bridge crossing the railway. Some noise from the direction of Ecobat Solutions, another nearby recycling centre, was noted during the day survey; these sounds are encompassed in the residual sound level.

Of the activities on site, sound generated in the Shear Area towards the north of the site will likely remain the predominant sound for those living at the properties on Oberon Grove. To a degree, these sounds will mask those generated in the new refrigeration recycling plant.

Conversely, the total sound reduction index of the façades of the building may in practise be lower than that of the figure used in the calculation, as there will be several doorways and roller shutter doors installed for access. Open elements of a façade will temporarily allow sound to be freely transmitted from inside the building. In order to mitigate against this, it will be beneficial to minimise the total time these sections may be open. This can be done by installing door closers on pedestrian doorways and timers on roller shutter doors.

Some impulsive noise will be generated at the steel output, as extracted material will drop into a metal container. This sound, as generated by the current installation, was not audible at any measurement location. To mitigate against this, the drop height of the steel into the container should be considered; keeping this distance as short as practically possible will minimise impact sound.

Uncertainty of the Assessment

As the specific sound level is significantly below both the daytime and night-time background sound levels, it is predicted that adverse impact is highly unlikely. There is minimal uncertainty regarding measurements reflecting the typical acoustic environment, as measurements were taken at the closest noise sensitive receivers under normal operating conditions.

10. Conclusion

The result of the assessment for the new Refrigeration Recycling Warehouse shows that the specific sound level falls significantly below both the daytime and night-time background sound levels. Sounds generated by the operations within this warehouse are predicted to cause no adverse impact on those at Oberon Grove.

11. Recommendations

The following general recommendations should be considered as best practise to minimise the potential for noise impact:

- To minimise the time in which accessways remain open, during which sound may propagate freely from inside the warehouse, install door closers on pedestrian doorways and timers on roller shutter doors.
- Continue to ensure that materials are transported and handled with care and keep the drop height at the steel outlet to a minimum so that impact noise is minimised.

Appendix 1 – Monitoring Results

01/08/2022



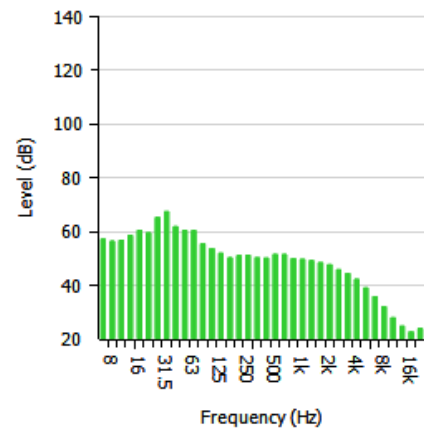
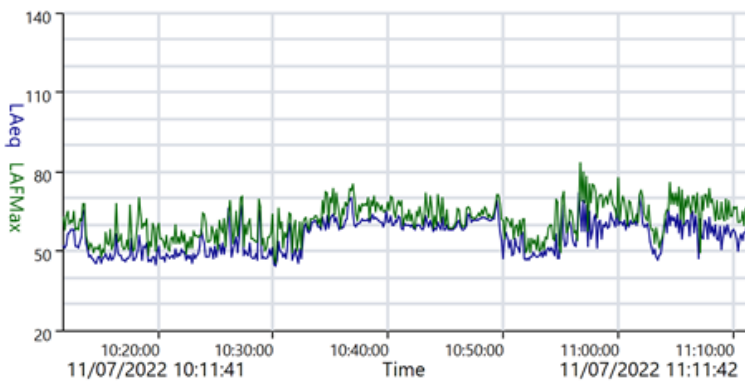
Measurement Summary Report

Name 1 - Day survey, site boundary
Time 11/07/2022 10:11:41 **Person** **Place** **Project**
Duration 01:00:00 European Metal 17148
Instrument G300995, CR:171B

Calibration

Before 11/07/2022 10:06 **Offset** 0.51 dB **After** 11/07/2022 13:48 **Offset** 1.08 dB

Basic Values		Statistical Levels (Ln)	
LAeq	59.4 dB	LAF1	69.8 dB
LAE	95.0 dB	LAF5	64.6 dB
LAFMax	83.3 dB	LAF10	62.1 dB
		LAF50	54.4 dB
		LAF90	45.7 dB
		LAF95	45.0 dB
		LAF99	44.0 dB



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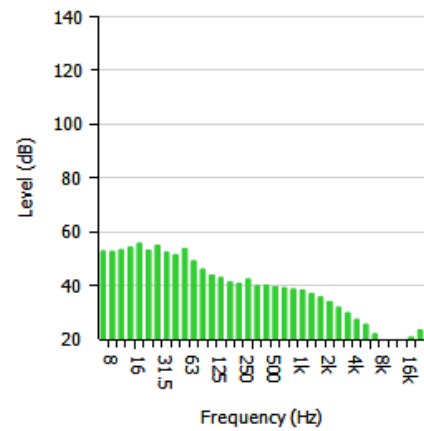
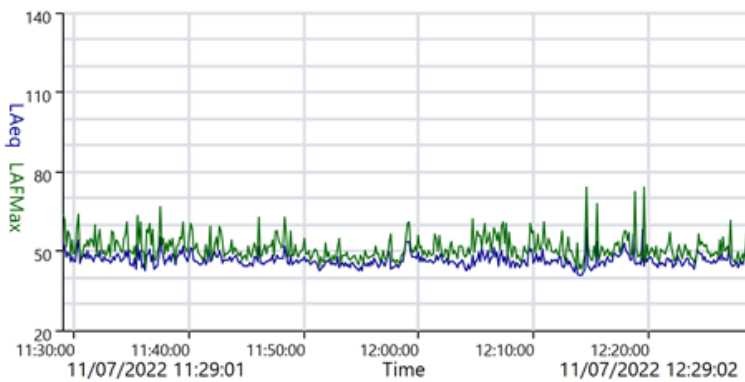
Measurement Summary Report

Name 2 - Day survey, Oberon Grove
Time 11/07/2022 11:29:01 **Person** **Place** **Project**
Duration 01:00:00 European Metal 17148
Instrument G300995, CR:171B

Calibration

Before 11/07/2022 10:06 **Offset** 0.51 dB **After** 11/07/2022 13:48 **Offset** 1.08 dB

Basic Values		Statistical Levels (Ln)	
LAeq	47.4 dB	LAF1	55.3 dB
LAE	83.0 dB	LAF5	50.6 dB
LAFMax	74.0 dB	LAF10	48.8 dB
		LAF50	45.5 dB
		LAF90	43.2 dB
		LAF95	42.5 dB
		LAF99	41.2 dB



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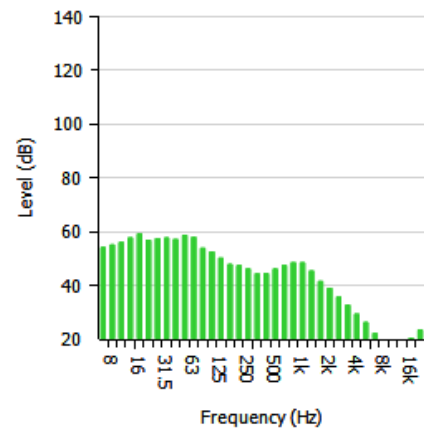
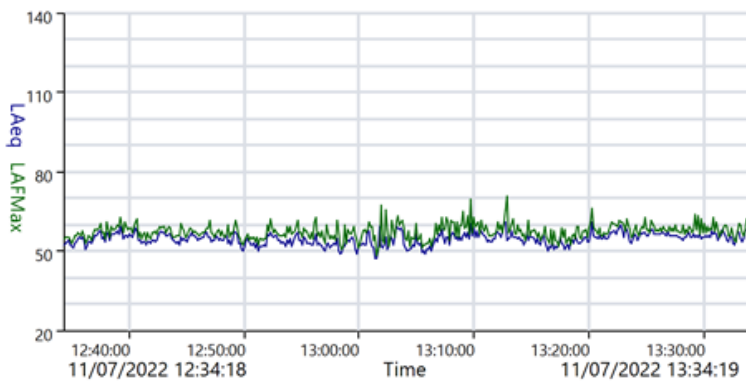
Measurement Summary Report

Name	3 - Day survey, Bentley Road South			
Time	11/07/2022 12:34:18	Person	Place	Project
Duration	01:00:00		European Metal	17148
Instrument	G300995, CR:171B			

Calibration

Before	11/07/2022 10:06	Offset	0.51 dB	After	11/07/2022 13:48	Offset	1.08 dB
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Basic Values		Statistical Levels (Ln)	
LAeq	55.0 dB	LAF1	60.4 dB
LAE	90.6 dB	LAF5	58.2 dB
LAFMax	70.7 dB	LAF10	57.2 dB
		LAF50	54.3 dB
		LAF90	51.0 dB
		LAF95	50.1 dB
		LAF99	48.4 dB



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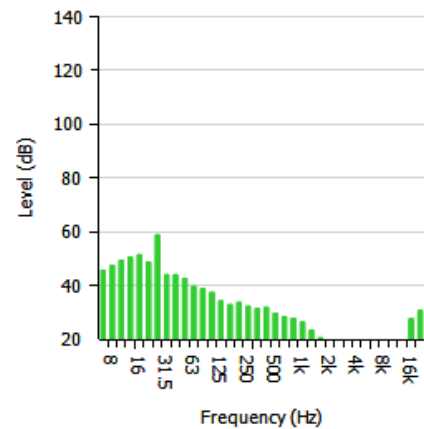
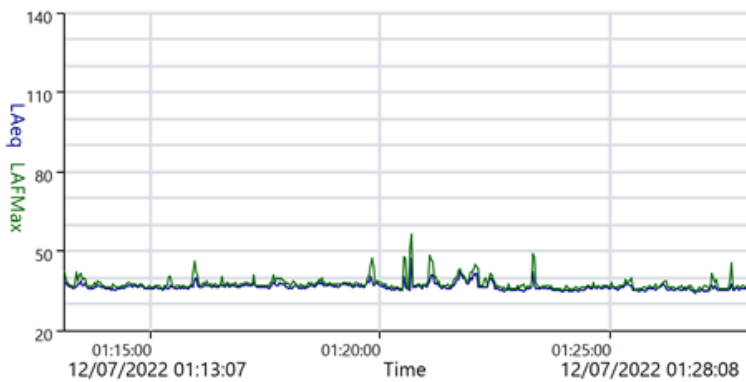
Measurement Summary Report

Name 4 - Night survey, site boundary
Time 12/07/2022 01:13:07 **Person** **Place** **Project**
Duration 00:15:00 **European Metal** **17148**
Instrument G300995, CR:171B

Calibration

Before 12/07/2022 01:03 **Offset** 0.94 dB **After** 12/07/2022 02:18 **Offset** 0.65 dB

Basic Values		Statistical Levels (Ln)	
LAeq	36.6 dB	LAF1	41.5 dB
LAE	66.1 dB	LAF5	38.5 dB
LAFMax	56.5 dB	LAF10	37.5 dB
		LAF50	36.0 dB
		LAF90	35.0 dB
		LAF95	34.8 dB
		LAF99	34.3 dB



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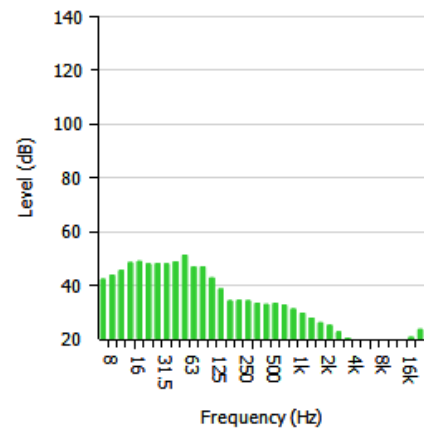
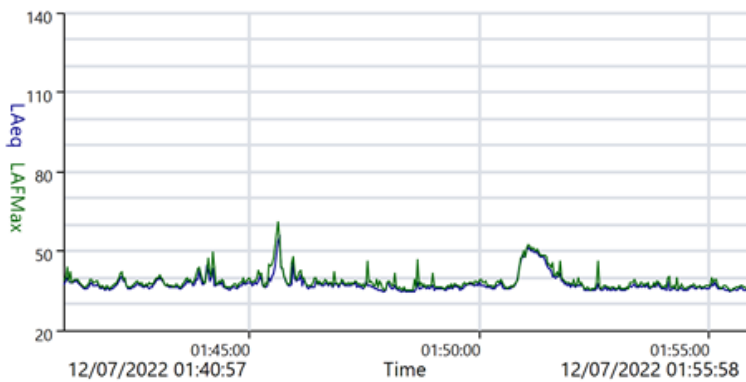
Measurement Summary Report

Name 5 - Night survey, Oberon Grove
Time 12/07/2022 01:40:57 **Person** **Place** **Project**
Duration 00:15:00 **Place** European Metal **Project** 17148
Instrument G300995, CR:171B

Calibration

Before 12/07/2022 01:03 **Offset** 0.94 dB **After** 12/07/2022 02:18 **Offset** 0.65 dB

Basic Values		Statistical Levels (Ln)	
LAeq	39.9 dB	LAF1	50.2 dB
LAE	69.4 dB	LAF5	44.4 dB
LAFMax	61.0 dB	LAF10	39.7 dB
		LAF50	36.5 dB
		LAF90	35.2 dB
		LAF95	34.9 dB
		LAF99	34.4 dB



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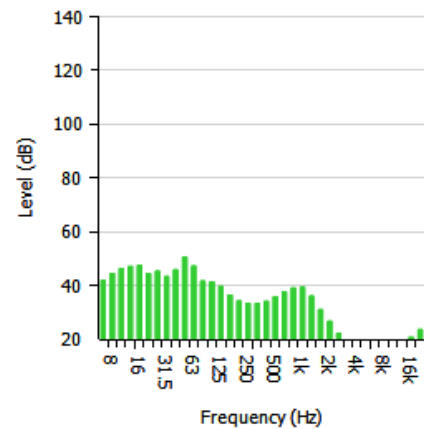
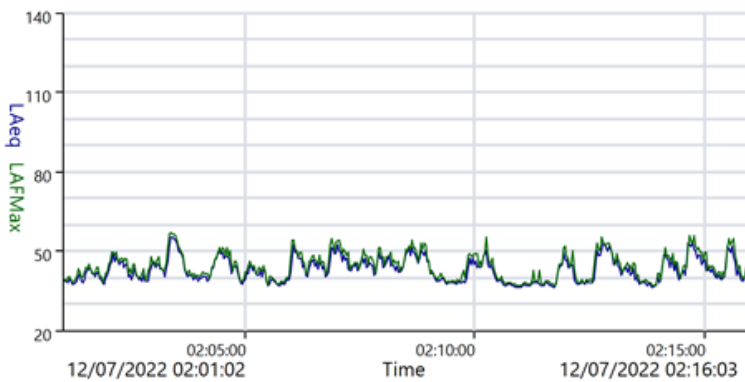
Measurement Summary Report

Name 6 - Night survey, Bentley Road South
Time 12/07/2022 02:01:02 **Person** **Place** **Project**
Duration 00:15:00 **Place** European Metal **Project** 17148
Instrument G300995, CR:171B

Calibration

Before 12/07/2022 01:03 **Offset** 0.94 dB **After** 12/07/2022 02:18 **Offset** 0.65 dB

Basic Values		Statistical Levels (Ln)	
LAeq	45.2 dB	LAF1	54.0 dB
LAE	74.7 dB	LAF5	50.6 dB
LAFMax	56.6 dB	LAF10	49.0 dB
		LAF50	42.0 dB
		LAF90	37.4 dB
		LAF95	36.8 dB
		LAF99	36.2 dB



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Appendix 2 – Calibration Certificates

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**


DATE OF ISSUE **05 July 2021** CERTIFICATE NUMBER **159477**



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

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Approved signatory
T. Goodrich
Electronically signed:



Sound Level Meter : IEC 61672-3:2013

Instrument information

Manufacturer:	Cirrus Research plc	Notes:
Model:	CR:171B	
Serial number:	G300995	
Class:	1	
Firmware version:	5.6.3177	

Test summary

Date of calibration: 05 July 2021

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: 159477
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Environmental conditions

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

Before	Pressure: 99.56 kPa	Temperature: 22.6 °C	Humidity: 51.7 %
After	Pressure: 99.56 kPa	Temperature: 22.3 °C	Humidity: 48.9 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	TTI	TG4001	395851
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: 9384F

Microphone

Model: MK:224
 Serial number: 214591E


Test results summary

Test	Result
Internal settings adjustment	Complies
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	05/07/21	CERTIFICATE NUMBER 159478



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: 214591E

Calibration procedure

Date of calibration: 05 July 2021

Open circuit: 42.3 mV/Pa

Sensitivity at 1 kHz: -27.5 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: 99.43 kPa

Temperature: 22.6 °C

Humidity: 57.8 %

CERTIFICATE OF CALIBRATION

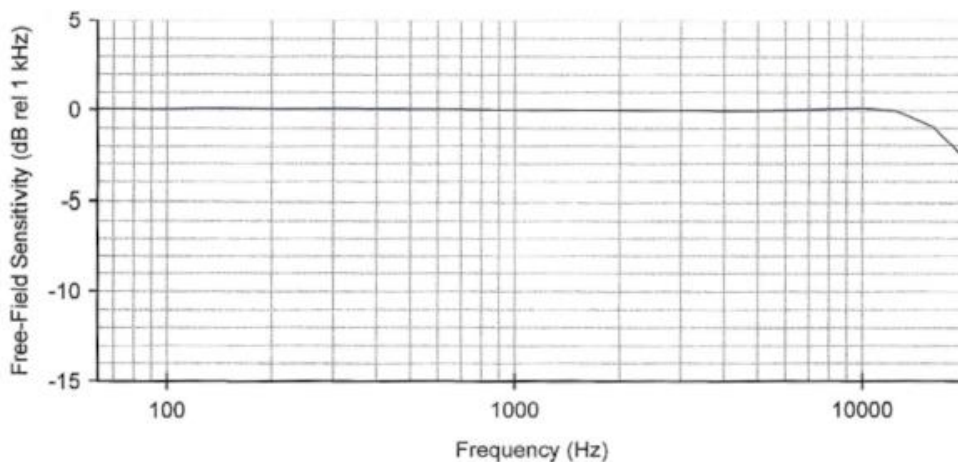
Certificate Number:
159478

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Free-Field Frequency Response : Tabular

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
63	0.03	-0.16
80	0.04	-0.04
100	0.01	-0.03
125	0.07	0.06
160	0.07	0.09
200	0.04	0.07
250	0.03	0.07
315	0.06	0.08
400	0.05	0.08
500	0.04	0.06
630	0.04	0.06
800	0.02	0.02
1 000	0.00	0.00
1 250	-0.01	-0.04
1 600	-0.01	-0.12
2 000	0.00	-0.21
2 500	-0.03	-0.35
3 150	-0.03	-0.59
4 000	-0.04	-0.91
5 000	-0.04	-1.37
6 300	0.01	-2.05
8 000	0.06	-3.08
10 000	0.11	-4.50
12 500	-0.04	-6.54
16 000	-0.95	-8.89
20 000	-2.86	-11.97

Free-Field Frequency Response : Graphical



CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**
DATE OF ISSUE **05 July 2021** CERTIFICATE NUMBER **159474**



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

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Approved signatory
T. Goodrich
Electronically signed:

Sound Calibrator : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc **Notes:**
Model: CR:515
Serial number: 57692
Class: 1

Test summary

Date of calibration: 05 July 2021

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 with the Physikalisch-Technische Bundesanstalt (PTB), Laboratoire National d'Essais (LNE) and APPLUS.

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: 159474
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Environmental conditions

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

Pressure: 99.43 kPa
 Temperature: 22.0 °C
 Humidity: 56.7 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Acoustic Calibrator	Bruel and Kjaer	4231	2229486
Distortion Meter	Keithley	2015	0761605
Multimeter	Fluke	8845A	1293007

Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	94.00	94.04	94.03	94.04	94.04	0.04	±0.40	0.11 dB
Distortion (%)	< 3.00	0.43	0.39	0.38	0.40	0.40	+3.00	0.13 %
Frequency (Hz)	1000.0	1000.3	1000.3	1000.3	1000.3	0.3	±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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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*

Chairman of the Examining Board

Institute Secretary

Date 1992

*Reference Number HC180
Centre University of Derby*



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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