

SOUND LEVEL ASSESSMENT

Oakdene
Windmill Lane
Burseldon
Hampshire
SO31 8BG



January 2024

Contents

	Apple Environmental company information	3
	Contact information	4
1	Introduction and assessment brief	5
2	Relevant guidance	6
3	Site description	11
4	Survey methodology	13
5	Monitoring results	17
6	Interpretation of monitoring results	20
7	Assessment evaluation	23
8	Summary and limitations	30
9	References	31
	Appendices	
	Sound level instrument calibration	33
	Noise profile summary sheets	38

Company information



Unit 3 Estevan Farm, Stoney Lane, Medstead, Alton, Hampshire GU34 5EL

Telephone: 01420 563377
e.mail: info@appleenvironmental.co.uk

www.appleenvironmental.co.uk

This report, and the information and advice which it contains, is provided by Apple Environmental Limited solely for internal use and reliance by its Client in performance of Apple Environmental Limited's duties and liabilities under its contract with the Client. Any advice, opinions, recommendations within this report should be read and relied upon only in the context of the report as a whole. The advice and opinions in this report are based upon the information made available to Apple Environmental Limited at the date of this report and on current UK standards, codes, technology and construction practices as at the date of this report. Following final delivery of this report to the Client, Apple Environmental Limited will have no further obligations or duty to advise the Client on any matters, including development affecting the information or advice provided in this report. This report has been prepared on behalf of Apple Environmental Limited in their capacity as environmental consultants. The contents of this report do not, in any way, purport to include any manner of legal advice or opinion. The report is prepared in accordance with the terms and conditions of Apple Environmental Limited's contract with the Client. Regard should be had to those terms and conditions when considering and/or placing any reliance upon this report. Should the Client wish to release this report to a Third Party for that party's reliance, Apple Environmental Limited may, at its discretion, agree to such release provided that:

- (a) Apple Environmental Limited's agreement is obtained prior to such release, and;
- (b) By release of this report to the Third Party, that Third Party does not acquire any rights, contractual or otherwise, whatsoever against Apple Environmental Limited and;
- (c) Apple Environmental Limited accordingly, assumes no duties, liabilities or obligations to that Third Party, and;
- (d) Apple Environmental Limited accepts no responsibility for any loss of damage incurred by the Client, or for any conflict of Apple Environmental Limited's interests arising out of the Clients release of this report to the Third Party.

Contact information

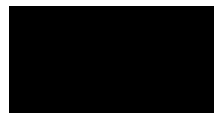
Site address

Oakdene	Contact:	Michael Knappett
Windmill Lane	Telephone:	01329 842668
Burseldon	E-mail:	michael@bjcplanning.co.uk
Hampshire		
SO31 8BG		

Report co-ordinator

Apple Environmental Limited	Contact:	Adrian Whittle
Unit 3 Estevan Farm	Telephone:	01420 563377
Stoney Lane	E-mail:	adrian@appleenvironmental.co.uk
Medstead		
Hampshire		
GU34 5EL		

Final check by: Laura Charman



1 Introduction and assessment brief

1.1 Introduction

Apple Environmental Limited has been commissioned to undertake a sound level assessment on land to the northeast of the existing dwelling at 3 Oakdene, Windmill Lane, Burseldon, in support of a proposed planning application for the construction of a new single-storey park home dwelling with an associated garden, along with the replacement of an amenity building on the site (the latter building does not form part of the assessment).

This work had been primarily requested due to the close proximity of M27 motorway, 20m to the northeast, the A3024 approximately 170m to the northwest of the site, and the A27 approximately 470m to the southwest of the site. Neither of these A-roads is expected to have a significant impact on the new dwelling.

The assessment has been performed by Dr. Adrian Whittle; Tech.IoA.

1.2 Aims and objectives

In order to address the above noise concerns an assessment has been carried out in accordance with the Department for Communities and Local Government National Planning Policy Framework 2023, and with reference to other guideline documents as detailed below in Section 2 and Section 6. In addition to this, reference has been made to the Eastleigh Borough Council District Local Plan (2016 - 2036).

The overall aim of this work therefore is to determine the extent to which the proposed development could be impacted by noise from nearby road traffic.

The principal objectives are as follows:

- to identify all dominating sound source(s) at the site;
- to make reference to continuous 24-hour monitoring for the determining of both day-time and night-time sound levels at the site;
- to make reference to a 1/3 octave analysis to ascertain the dominant sound frequencies and other characteristics such as impulse or tonality;
- to determine the impact from any identified sound sources on the proposed residential development; and
- to make recommendations accordingly.

2 Relevant guidance

2.1 Overview

Since the revocation of Planning Policy Guidance 24 (PPG24), the National Planning Policy Framework (NPPF) has been introduced - and subsequently revised, most recently in December 2023. This document provides some general guidance to local authorities on considering the impact of noise in planning and policy decisions. This includes guidance for local authorities, in which they should ‘...aim to avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development’. No specific guidance is provided in the NPPF on acoustic criteria, therefore the British Standard 7445-1:2003 ‘Description and measurement of environmental noise – Part 1: Guide to quantities and procedures’ has been consulted for guidance on the noise measurement parameters required to undertake a suitable assessment.

In addition to this, the British Standard 8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’ has been used to determine acceptable noise criteria within dwellings, and the Calculation of Road Traffic Noise 1988. The World Health Organisation Night Noise Guidelines for Europe, 2009, and Guidelines for Community Noise, 1999, have also been referred to. Where relevant, elements of each have been discussed below.

2.2 NPPF

Since the revocation of Planning Policy Guidance 24 (PPG24), the National Planning Policy Framework (NPPF) has been introduced, and subsequently revised; most recently in 2023. This document provides some general guidance to local authorities on considering the impact of noise in planning and policy decisions. There is no direct guidance provided on acoustic criteria in the NPPF, therefore other more prescriptive documents have been referred to, as detailed below. Reference is however made to the following sections of the NPPF:

- *Paragraph 180 Sub-section (e)* states that new development should not be put at unacceptable risk from, or adversely impacted by noise pollution; and
- *Paragraph 191 Sub-section (a)* states that planning decisions should ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health and living conditions. In doing so, they should mitigate and reduce to a minimum potential adverse impacts resulting from noise pollution from new development - and avoid noise giving rise to significant impacts of health and the quality of life.

2.3 British Standard 7445-1:2003

Part 1 of the British Standard 7445-1:2003 defines the basic quantities required for the description of noise in community environments and describes basic procedures for the determination of these quantities. It provides guidance on the positioning of instrumentation including the distance from the exposed building and the preferred height of the microphone as well as detailing measurements to be taken during preferable meteorological conditions.

2.4 British Standard 8233:2014

British Standard 8233:2014 has reviewed and amended the former 1999 standard. As before, it sets out guidance on desirable internal ambient noise levels for dwellings. Table 1 below summarises the recommended acoustic design criteria for a dwelling

Table 1 BS 8233:2014 desirable acoustic design criteria for good standard

Location	Internal noise level	
	Daytime	Night time
Living room	35dB $L_{Aeq, (16hr)}$	-
Dining room	40dB $L_{Aeq, (16hr)}$	-
Bedroom	35dB $L_{Aeq, (16hr)}$	30dB $L_{Aeq, (8hr)}$

It is therefore generally recommended that for a dwelling, acceptable internal noise levels during the daytime should not exceed 35dB $L_{Aeq, 16hr}$, and during the night time, noise levels of 30dB $L_{Aeq, 8hr}$.

In addition to the above, BS8233 also states that where development is considered desirable or necessary then despite external noise levels exceeding these guidelines, the internal target may be relaxed by up to 5dB and reasonable conditions can still be achieved.

The standard also reiterates the fact that it is desirable that noise levels in outdoor amenity areas such as gardens and balconies do not exceed 50dB $L_{Aeq,T}$ and that 55dB $L_{Aeq,T}$ should be regarded as the upper limit. However it also states that this may not be achievable in some areas, such as city centres, and that a compromise between noise and the convenience of living in these areas can be met.

2.5 WHO Night Noise Guidelines for Europe, 2018

The WHO Night Noise Guidelines for Europe have published guidelines for night time noise based upon exposure effects relationships which take into account the effects of noise on public health and wellbeing when sleeping. The night noise guideline values are recommended for the protection of public health from night noise and are shown below in Table 2.

Table 2 WHO recommended night noise guidelines for Europe

Guideline	Noise level
Night noise guideline (NNG)	$L_{night,outside}$ 40dB(A)
Interim Target (IT)	$L_{night,outside}$ 55dB(A)

For the primary prevention of subclinical adverse health effects related to night noise in the population, it is recommended that the population should not be exposed to night noise levels greater than 40dB(A) of $L_{night,outside}$ during the part of the night when most people are in bed.

The lowest observed adverse effect level (LOAEL) of night noise, 40dB(A) $L_{night,outside}$, can be considered a health based limit value of the night noise guidelines (NNG) necessary to protect the public, including most of the vulnerable groups such as children, the chronically ill and the elderly, from the adverse health effects of night noise.

An interim target (IT) of 55dB(A) $L_{\text{night, outside}}$ is recommended in the situations where the achievement of NNG is not feasible in the short term for various reasons. It should be noted that the interim target is not a health-based limit value by itself. Vulnerable groups cannot be protected at this level. Therefore, the interim target should be considered only as a feasibility-based intermediate target which can be temporarily considered by policy-makers for exceptional local situations.

2.6 WHO Guidelines for Community Noise, 1999

The WHO Guidelines for Community Noise also consider the impact of night-time exposure to noise and sleep disturbance, such that if negative effects on sleep are to be avoided, the equivalent sound pressure level ($L_{\text{Aeq, 8hr}}$) should not exceed 30dB indoors for continuous noise.

If the noise is not continuous, sleep disturbance correlates best with L_{Amax} and effects have been observed at 45dB or less. These guidelines state that this is particularly true if the background level is low. Noise events exceeding 45dB(A) should therefore be limited where possible. More specifically, the document states that 10 to 15 occurrences per night that exceed the limiting L_{Amax} external noise level of 45dB may be considered acceptable.

For sensitive groups, an even lower limit would be preferred but this value is not specified. It also declares that it should be possible to sleep with a bedroom window slightly open (resulting in a reduction of 15dB(A) from outside to inside). To prevent sleep disturbances, the equivalent sound pressure level and the number and level of sound events should be considered. Mitigation targeted to the first part of the night is believed to be effective for the ability to fall asleep.

The WHO Guidelines for Community Noise are considered to be complimentary to the WHO Night Noise Guidelines for Europe.

2.7 The Eastleigh Borough Council Local Plan (2016 - 2036) - April 2022

The Local Plan specifically addresses potential noise issues with regards to development proposals within Policy DM8 (para.1.c), as summarised below.

- *Development will not be permitted if it is likely to cause loss of amenity or impact on public health through noise or vibration.*

In accordance with this policy the Council require a noise assessment which would be expected to:

- identify all significant sources of noise;
- assess the likely short and long term impacts of noise generated or exposure to noise; and
- propose noise protection measures.

It is specifically noted that where acceptable internal noise levels cannot be met then alternative ventilation will be required.

2.8 The Calculation of Road Traffic Noise 1988 (CRTN)

CRTN provides general guidance on the direct measurement of road traffic noise in which L_{A10} (18hr) values are generally referred to. In situations where road traffic noise is clearly dominant and relatively consistent the guidance allows for a shortened assessment to be undertaken, in which arithmetic average values can be obtained over three consecutive 1 hour periods between 10.00H and 17.00H.

In doing so the L_{A10} (18hr) value can be supplemented for a L_{A10} (3hr) - 1dB. This in turn can be converted to a day-time L_{eq} by means of the following: L_{Aeq} (16hr) = L_{A10} (18hr) - 2dB.

For this purpose the corresponding sound level measurements need to be obtained at a position between 4 - 15m from the source traffic in open space.

2.9 Professional Practice Guidance on Planning and Noise 2017 (ProPG)

The Professional Practice Guidance: Planning & Noise (ProPG) was published in 2017 by the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH).

It aims to provide guidance on noise during the planning stage for new residential development and provides a standardised approach to assess the suitability. It is not the purpose of this guidance to replace that which is in the NPPF, although it does significantly expand on the noise policies within that framework.

The first step of a ProPG assessment is to measure noise levels around a receptor site in order to understand the noise climate. Once this is completed, it sets out various assessment risk-based routes which are dependent on those noise levels. It is important to note that ProPG is generally applicable to transport noise only, and should not be used to assess industrial noise.

3 Site description

The area where the new dwelling is to be located has a tarmacadam and scalping ground surface housing three shipping storage containers. It lies within a pre-established park home site at the northeastern-most end of Windmill Lane. The lane is a no-through road ending at the M27 motorway embankment.

The land here sits around 1m lower than the motorway, and the proposed dwelling is expected to be positioned around 20m from the motorway, and around 12m from the slip-road carriageway edge; both of which lie to the northeast.

The new dwelling would lie around 20m to the northeast of the nearest neighbouring dwelling beyond which there are a number of other similar park home dwellings along with amenity buildings and stabling.

Beyond the site, dwellings align both sides of Windmill Lane out to an approximate distance of 450m from the motorway. The subject site and its close proximity to the M27 are shown below in Figure 1 and Photographs 1 and 2.

Figure 1 Selected features of the immediate area



Copyright OS Maps reproduced under licence No. 100044753

Photograph 1 Showing the proposed development area



Photograph 2 Showing the amenity building and dwelling to the southeast



4 Survey methodology

4.1 Instrumentation

In performing this current assessment, A-weighted noise readings have been used from a previous assessment undertaken on this site in March 2018. The justification for doing so is that there appear to have been no significant changes in the layout of the neighbouring roads and no new features introduced likely to impact noise exposure. With regards to road-use, Department of Transport data suggests that overall motor vehicle traffic on UK roads remains lower than it was before the Covid-19 pandemic. As such, the use of 2018 data suggests consideration of a worst-case situation.

The sound level data used was obtained by means of a Cirrus Optimus CR171B Class I integrating sound pressure level meter. This was calibrated prior to use at 94dB and checked for drift following its use, by means of a CR151 Cirrus Acoustic Calibrator. The instrumentation details and serial numbers are as shown below in Table 3. The corresponding calibration documentation (for that date) has been appended to this report.

Table 3 Sound level instrumentation used

Equipment	Description	Serial No.
Cirrus Optimus CR:171B	Class 1 sound level meter with 1/3 octave frequency analyser	G068537
Cirrus Acoustic Calibrator CR:151	IEC 60942.2003 Class 1 calibrator	70846

4.2 NEC/BS8233 noise measurement

The assessment was performed over a continuous 46-hour period, from 16:00H on Tuesday 20th March 2018 through to 14:00H on Thursday 22nd March 2018. In doing so, L_{Aeq} , L_{Amax} , and a selection of percentile values were obtained from one-second readings. In doing so, $L_{(A)eq}$ values and the 10th highest $L_{(A)max}$ values have been obtained from one-second readings. Of these values, the latter allows reference to be made to the WHO Guidelines for Community Noise, 1999.

Through consideration of the road characteristics, such as this being a straight stretch of road continually past the site, with no pedestrian crossing points, it was deemed acceptable to select just one measurement location.

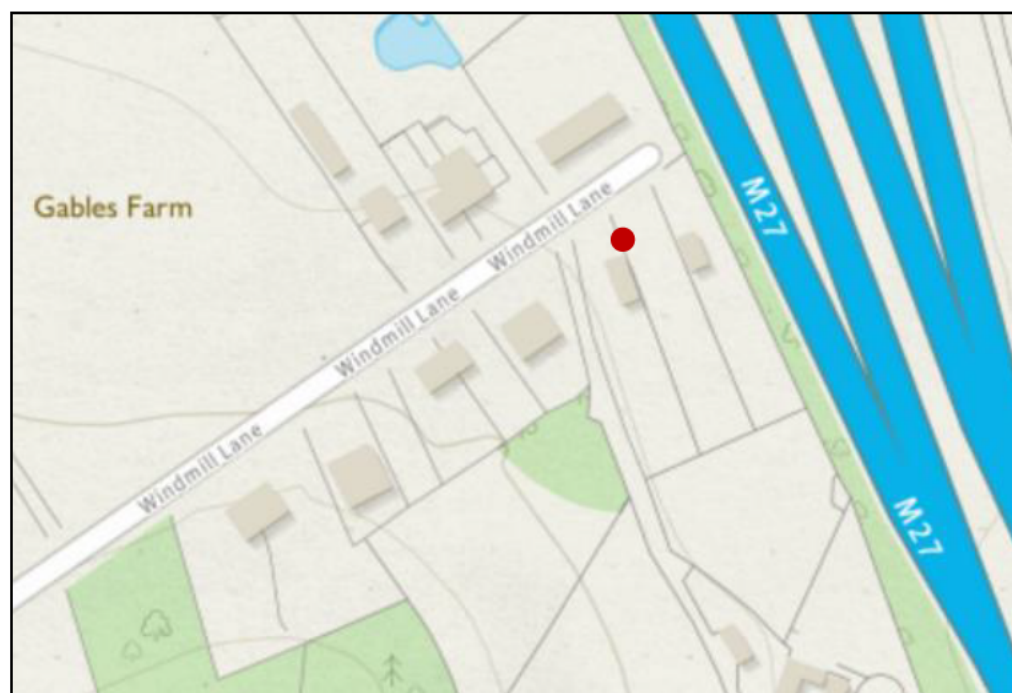
The road surface was dry throughout the exercise although it is possible for there to have been some over-night moisture which may have dampened the road during the early morning period.

The sound levels were measured at a distance of approximately 45m from the carriageway edge, and at a height of around 1.5m above ground level. The microphone diaphragm remained vertical throughout the measurement period.

More specifically the microphone was attached via an extension lead to the top of a hanging basket bracket, positioned approximately 500mm from the boundary fence within the front garden of Unit 2 Oakdene. There was a direct line of sight between the microphone and the motorway embankment. It is expected that the microphone would have picked up a reflective contribution from the fence behind; hence the findings have been adjusted accordingly (Section 5).

The approximate measurement location has been shown below on the proposed site plan, Figure 2, and in Photograph 3. The mean weather conditions throughout the monitoring period have also been recorded, and detailed below in Section 4.3.

Figure 2 The location of the sound level monitoring at the site



● Position of sound level instrument

Photograph 3 The location of the sound level instrument



The nature of the ground surface between the measurement position and the motorway was variable, consisting of scrubby vegetation in the vicinity of the embankment, beyond which there were tarmac surfaced areas.

4.3 Weather conditions

The weather conditions throughout each day of sound level monitoring have been detailed below in Table 4.

The winds were generally light at less than 3.5m/s, with the direction swinging round from north to south. As such, on some occasions this would have had the potential to take the road noise away from the receiver; however considering the close proximity of the motorway, it is doubtful that the wind direction was particularly significant in this instance.

Table 4 Weather conditions at the site during noise monitoring

Date	Time	Temp / °C	Rainfall	Wind speed / m/s	Wind direction
20/03/2018	12:00 - 18:00	11	0	3.5	NNW
	18:00 - 00:00	7	0	0.8	N
21/03/2018	00:00 - 06:00	6	0	3	SSE
	06:00 - 12:00	10	0	1.9	SSE
	12:00 - 18:00	11	0	7	SE
	18:00 - 00:00	10	0	5.8	ESE
22/03/2018	00:00 - 06:00	7	0	1.6	SSW
	06:00 - 12:00	10	0	1.8	WSW
	12:00 - 18:00	10	0	1.6	W

The temperature during the monitoring period ranged between 6 and 11 degrees Celsius, whilst the wind speed ranged from 0.8m/s to 5.7m/s. There was no rainfall during the monitoring period.

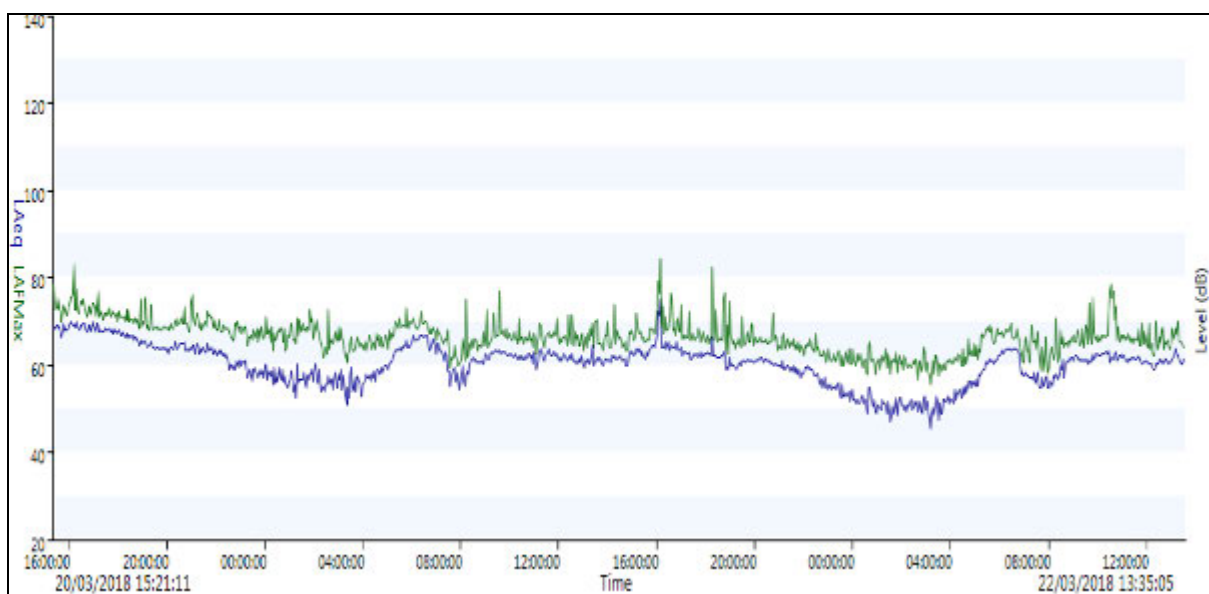
5 Monitoring results

The assessment has been conducted in accordance with the National Planning Policy Framework 2023 and Eastleigh Borough Council Local Plan, in conjunction with guidance from CRTN 1988 and BS8233:2014. It follows the procedure outlined in the Institute of Acoustics /CIEH document, ProPG: planning and noise, 2017.

The original noise measurements were undertaken over a continuous 46-hour period, running from 16:00H on Tuesday 20th March 2018 through to 14:00H on Thursday 22nd March 2018.

A plotted profile showing the L_{Aeq} trend over the continuous 46-hour measurement period has been reproduced below in Graph 1.

Graph 1 L_{Aeq} measurement profile over the 46-hour measurement period



The measurement parameters obtained have been reproduced below in Table 5.

Note that the day-time readings for the NEC/BS8233 assessment have been shown as the arithmetic average of the day-time sound levels on the 20th March from 16.00H through to 23.00H, from 07.00H to 23.00H on the 21st March and from 07:00H to 14:00H on the 23rd March 2018.

Similarly the night-time readings have been shown as the arithmetic average of the night-time sounds levels recorded over both nights during the two periods from 23:00H to 07:00H.

Note also that Table 5 also shows the 10th highest L_{AFMax} level, which allows the aforementioned WHO Guidelines to determine the theoretical degree of sleep disturbance.

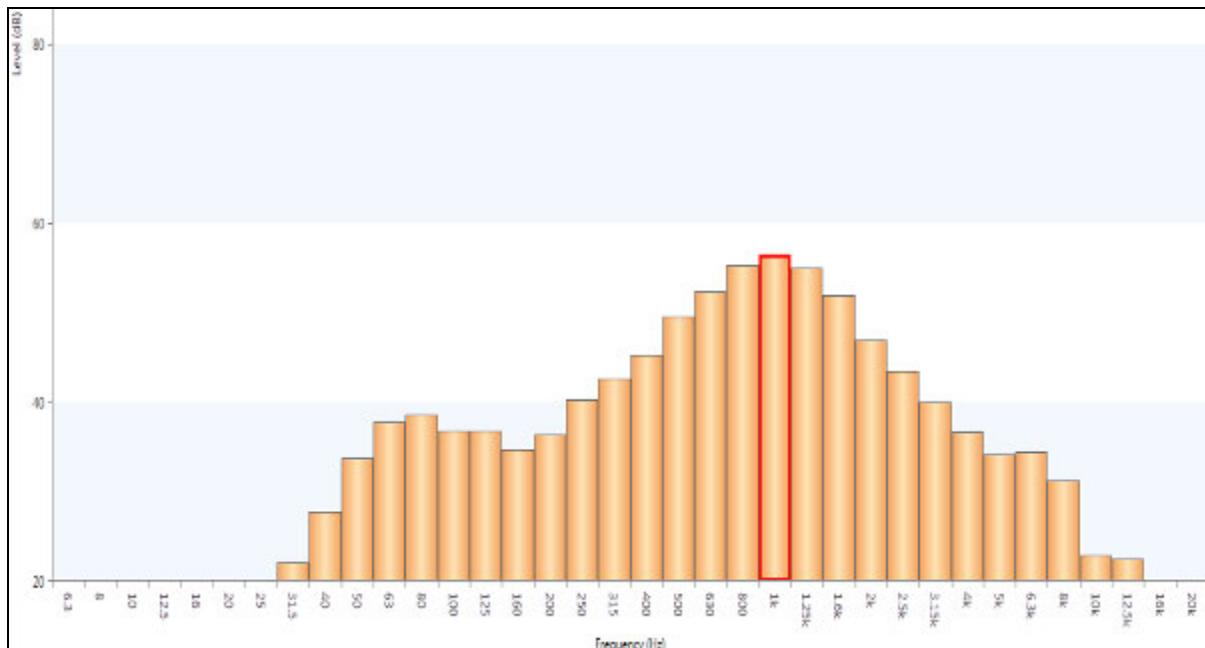
It is generally accepted that a reflective surface can accentuate the recorded sound levels by a factor of 3dB. In this specific instance, the microphone was positioned in front of a timber fence, which is believed to have exerted a reflective effect in at least one plane. Consequently the results discussed have been adjusted by means of subtracting 3dB.

Table 5 Sound level readings for the NEC/BS8233 assessment (adjusted)

Parameter	Day-time period 1	Day-time period 2	Day-time period 3	Day-time (averaged)
	16.00H - 23.00H / dB(A)	07.00H - 23.00H / dB(A)	07.00H - 14.00H / dB(A)	07:00H / 23:00H / dB(A)
	Positioned 25m from the dwelling façade at a height of 1.5m			
L _{Aeq}	63.0dB	59.2dB	57.7dB	60.0dB
10 th highest L _{Amax}	N/A	N/A	N/A	N/A
Parameter	Night-time 1	Night-time 2	Night-time (averaged)	
	16.00H - 23.00H / dB(A)	07.00H - 23.00H / dB(A)	23.00H - 07.00H / dB(A)	
	Positioned 25m from the dwelling façade at a height of 1.5m			
L _{Aeq}	57.7 dB	53.9 dB	56.0dB	
10 th highest L _{Amax}	64.0dB	62.0dB	63.0dB	

In addition to the above, a one-third octave band analysis was performed, the results from which - covering the entire monitoring period - have been reproduced below in Graph 2.

Graph 2 A-weighted 1/3 octave band profile for the complete measurement period



6 Interpretation of monitoring results

Through reference to Graph 1 above, it can be seen that the traffic noise in this location followed the expected diurnal variation, and was generally consistent, with the day-time L_{Aeq} only occasionally above 65dB and rarely falling below 52dB. This suggests that there is little else other than road traffic responsible for the noise in the area.

With regards to the night-time period, it can be seen that traffic movement continued throughout the night-time period, although noticeably tailing off between midnight and 5.00H, before continuing at a similar level to that reported on the previous morning.

Through reference to Graph 2 above showing the frequency profile at the measurement position, again this is typical of that associated with road traffic, i.e. a predominance of middle frequency noise, elevated low high frequency noise (presumably) from heavy vehicles passing by, and little evidence of tonality.

For the purposes of determining sound pressure levels for a uniform line source with distance from the source, the following equation has been used:

$$L_2 = L_1 - (10\log(r_2/r_1))\text{dB}$$

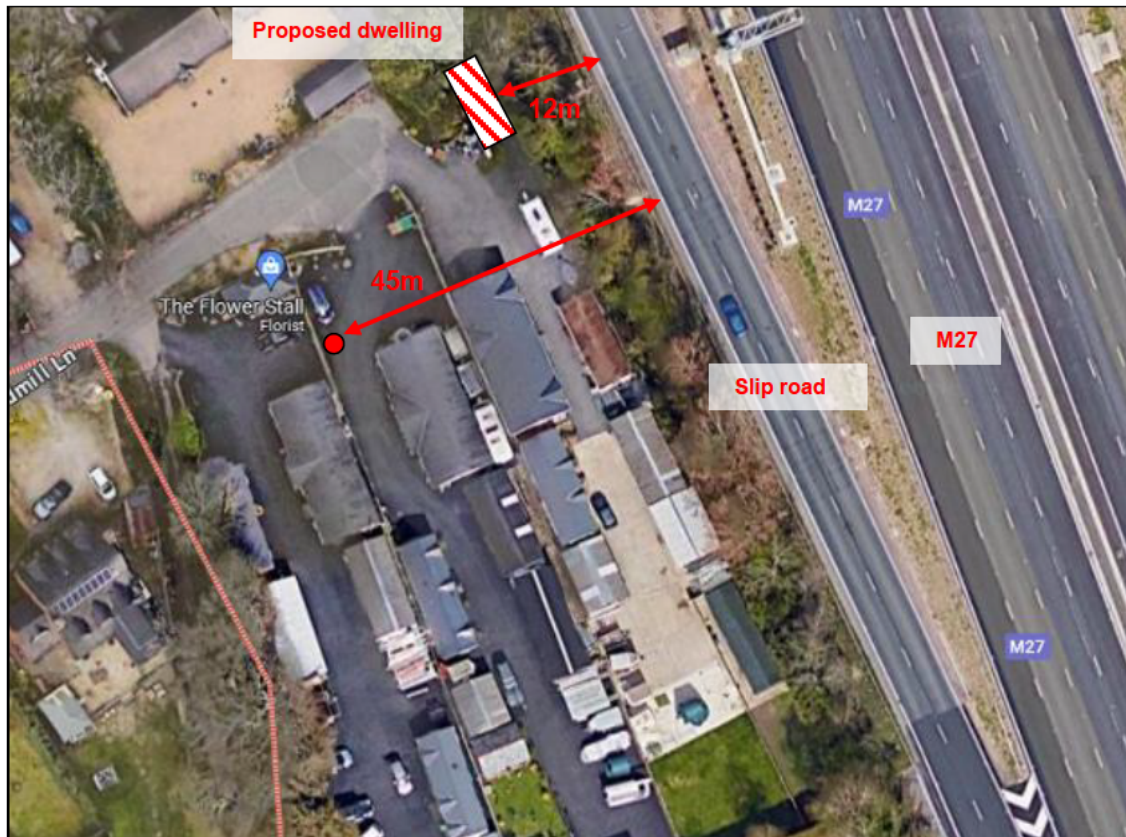
Where: L_1 is the measured $L_{Aeq(\text{day/night})}$ value, r_1 is the distance from the source to the measurement position, and r_2 is the distance from the source to the receptor.

With regards to the day-time and night-time sound levels, the potential impact at the proposed dwelling has been calculated and reproduced below in Table 6, using the sound level measurement obtained at a distance of 45m from the source in conjunction with the above equation.

This has been shown as the theoretical value at the closest façade to the nearest M27 carriageway edge, using the estimated distance shown below in Figure 3.

For the day-time period the L_{eq} of **60dB(A)** has been used, as the average of the three day-time period values of 63.0dB, 59dB and 58dB, whereas for the night-time calculation a **56dB(A)** averaged L_{eq} value has been used, from the two night-time period values of 58dB and 54.0dB.

Figure 3 The location of the proposed dwelling and the estimated distance from the closest façade to the M27 carriageway edge



Copyright OS Maps reproduced under licence No. 100044753

● Sound level measurement position

It is noted that both of the bedrooms and dining area will face northeast towards the M27, all of which will be around 12m back from the M27 carriageway edge at its closest.

With regards to all bedroom windows and the dining area facing onto the M27, the theoretical sound level at this façade (L_2) can be calculated from this measured value using the following equation:

$$L_2 = L_1 - (10\log(r_2/r_1))\text{dB}$$

Where: L_1 is the measured $L_{\text{Aeg(day/night)}}$ value, r_1 is the distance from the source to the measurement position (45m), and r_2 is the distance from the source to the receptor (12m).

Therefore, for the day-time: $L_2 = 60 - 10\log(12/45) = \underline{\underline{66\text{dB}}}$

For the night-time: $L_2 = 56 - 10\log(12/45) = \underline{\underline{62\text{dB}}}$

In calculating the above façade sound levels a number of presumptions have been made, namely:

- that the measured sound levels are typical of the sound levels at this location;
- that the propagation of sound will behave in an ideal manner that reflects the theory applied; and
- that there would be no interference with the propagating sound (i.e. no other adsorption, attenuation, deflection or reflection).

Through further reference to the WHO Guidelines for Community Noise this assessment also considers the fast-weighted $L_{A\text{max}}$ levels simultaneously measured during the night-time period. More specifically this assessment considers the 10th highest value for the night-time of **63dB(A)**.

Once again using the above equation the theoretical $L_{A\text{max}}$ can be calculated for the bedrooms and dining area.

$$L_{A\text{max}} = 63 - 10\log(12/45) = \underline{\underline{69\text{dB}}}$$

The calculated façade levels have been summarised in Table 6 below.

Table 6 Predicted impact of traffic noise at the window positions on the northeastern façade expressed as the $L_{A\text{eq}}$ and $L_{A\text{max}}$

Dwelling	Approximate expected distance from the M27 edge / metres	Predicted $L_{A\text{eq}}$ /dB	Predicted $L_{A\text{eq}}$ /dB	Predicted $L_{A\text{max}}$ /dB
		Day-time	Night-time	
Bedrooms 1 and 2	12	66	62	69
Dining and family room	12			

7 Assessment evaluation

7.1 Results summary

This report has taken the view that the dominant day and night-time noise source at the proposed development site is likely to be vehicles using the M27 to the immediate northeast of the site.

Using the previous measured sound level data obtained on the boundary fence between the existing Units 1 and 2, the day-time and night-time L_{Aeq} at the northeastern facade of the proposed unit has been predicted by means of theoretical calculation.

The corresponding theoretical day-time and night-time internal and external broadband sound pressure levels have been shown below in Table 7. In doing so, the following is noted:

- the internal sound levels have been shown on the presumption that each dwelling should be capable of attenuating road traffic noise by at least 25dB in a windows-closed situation; and
- a partially open window scenario is expected to be able to reduce the external façade sound level by up to 15dB internally (Ref. BS8233); and
- the external sound level for the dwelling relates to the proposed amenity space at the yard-facing front of the building.

Table 7 Theoretical broadband noise exposure levels expressed as the L_{eq} - dB(A)

Room / position	Day-time			Night-time		
	External recreation area	Internal with windows closed	Internal with window partially open	External recreation area	Internal with windows closed	Internal with window partially open
Bedrooms 1 and 2 (northeast-facing)	66	41	51	62	37	47
Sitting room (northeast-facing)	66	41	51			

7.2 Evaluation against guideline criteria

As shown above, the external (uninfluenced) day-time sound level at the dwelling facade expressed as the $L_{eq(16hr)}$ was reported to be 66dB(A), which is expected to result in a maximum internal exposure level of around 51dB(A) for a situation where a double-glazed window is partially open. Through reference to BS8233, the guideline level for residential planning purposes is an internal day-time level no greater than 35dB. It is apparent therefore that this is unlikely to be achieved in the absence of mitigation.

With regards to the night-time situation, the external (uninfluenced) night-time sound level at the dwelling facade expressed as the $L_{eq(8hr)}$ was 62dB(A), which is expected to result in a maximum internal exposure level of around 47dB(A) where a window may be partially open. The corresponding guideline level for planning purposes is an internal night-time level no greater than 30dB, which similarly is unlikely to be achieved in the absence of mitigation.

Reference is also made to the WHO Guidelines for Community Noise state that up to 10 occurrences per night exceeding a L_{Amax} external noise level of 45dB may be considered acceptable; hence by considering the 10th highest value it can be determined whether or not this 45dB limit can be theoretically met.

In doing so, it has been reported that the 10th highest L_{Amax} is 69dB, which would suggest the corresponding internal level through a partially open window should be in the region of 54dB(A). Again this exceeds the 45dB guideline value.

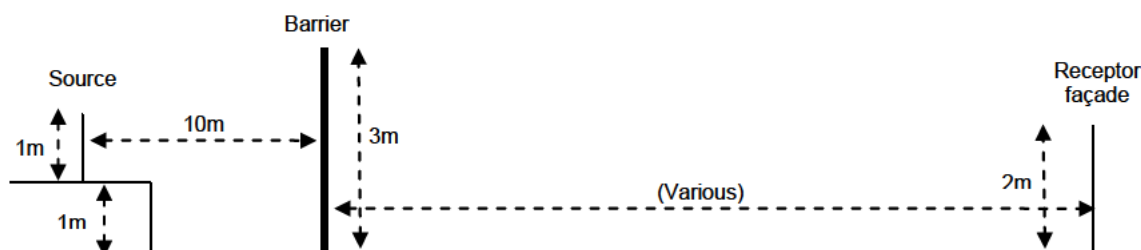
7.3 Perimeter barrier height calculation

It is apparent from the above data that the proposed site is likely to be impacted to varying degrees by noise coming from the adjacent motorway. In order to mitigate for this, it is understood that a 3m high close-boarded timber fence will be installed along the northeastern boundary. This section of the report calculates the beneficial effect that such may have on the sound pressure levels at the northeastern façade of the building. In doing so this has been performed for a ground floor external and internal receptor position as the proposed dwelling would be a single storey structure. The parameters used for the barrier height calculations are as follows:

- a source sound height of 1m (traffic) on a 1m embankment (total height 2m);
- a distance of 10m from the source to the barrier fence;
- a barrier fence height of 3m; and
- a receptor height of 2m*.

* Note that despite using a receptor window height of 2m above ground level, the fact that the road lies around 1m above the current site ground height, means that in actuality this window position is expected to be around 1m above the road surface level, as indicated in Figure 4 below.

Figure 4 Schematic representation of the barrier



The sound pressure level unweighted frequency breakdown has been shown below in Table 8. The values tabulated for the day-time represent the arithmetic average of the three day-time frequencies, whilst the night-time values represent the arithmetic average of the two night-time frequencies

Table 8 Measured SPLs for each frequency (day-time and night-time)

Frequency / Hz	Approximate distance from measurement position to source / metres	Sound pressure level /dB	Sound pressure level /dB
		Day-time	Night-time
63	45	66	62
125	45	56	51
250	45	51	47
500	45	55	52
1000	45	57	54
2000	45	49	47
4000	45	39	37

In order to perform this assessment it has been calculated that a 3m high barrier, 10m from the source should have an angle from the source to barrier top of 5.7° and an angle of source to receiver of less than 0.1° . The corresponding path difference at a distance of 45m has therefore been calculated as 0.412.

The effect that the barrier should have at this point has been shown below in Tables 9 and 10 for the day-time and night-time periods respectively. This is based upon a path difference of 0.4, which is deemed appropriate considering the fact that most of the proposed dwelling unit will be closer to the source than the measurement position.

Table 9 Calculating the day-time barrier effect at 45m from the source

Frequency	63	125	250	500	1000	2000	4000
Octave band level (dB)	66	56	51	55	57	49	39
A-weightings (dB)	-26	-16	-9	-3	0	+1	+1
A-weighted levels (dB)	40	40	42	52	57	50	40
A-weighted level at the measurement position without a barrier = 59dB							
Barrier attenuation (dB)	-8	-9	-10	-11	-14	-16	-19
A-weighted levels (dB)	32	31	32	41	43	34	21
A-weighted level at the measurement position with a barrier = 46dB							
Expected barrier reduction = 13dB							

Table 10 Calculating the night-time barrier effect at 45m from the source

Frequency	63	125	250	500	1000	2000	4000
Octave band level (dB)	62	51	47	52	54	47	37
A-weightings (dB)	-26	-16	-9	-3	0	+1	+1
A-weighted levels (dB)	36	35	38	49	54	48	38
A-weighted level at the measurement position without a barrier = 56dB							
Barrier attenuation (dB)	-8	-9	-10	-11	-14	-16	-19
A-weighted levels (dB)	28	26	28	38	40	32	19
A-weighted level at the measurement position with a barrier = 43dB							
Expected barrier reduction = 13dB							

Hence the expected barrier reduction at this point has been calculated to be 13dB.

Using the above sound level values, the sound reduction that a barrier of height 3m, positioned 10m from the motorway carriageway could have for the proposed unit can be calculated, again using the following equation:

$$L_2 = L_1 - (10\log(r_2/r_1))\text{dB}$$

Where: L_1 is the calculated sound level for either the day or night, r_1 is the distance from the source to the reference monitoring position (i.e. 45m from the carriageway), and r_2 is the distance from the source to the receptor.

In doing so, the following additional criteria have been used:

- an air temperature of 20°C for day-time readings and 10°C for night-time readings, a humidity level of 70% and no other influential weather factors;
- free-field conditions;
- sound propagation across a soft level surface; and
- no transmission of sound through the barrier, around the barrier, or no reflection of sound towards the receptor.

For the proposed dwelling

Estimated distance of the closest façade to the M27 carriageway edge = 12m

Day-time $L_2 = 46 - (10\log(12/45))\text{dB} = \underline{52\text{dB}}$

Night-time $L_2 = 43 - (10\log(12/45))\text{dB} = \underline{49\text{dB}}$

Through reference to the above calculations, the barrier should result in the theoretical day-time and night-time sound levels shown below in Table 11.

In doing so, the following should be noted:

- the external sound level relates to the façade facing the motorway, and therefore considers a potentially worst-case situation;
- the internal sound levels have been shown on the presumption that each dwelling unit should be capable of attenuating motorway noise by at least 25dB; and

- in considering a partially open window scenario this report has made the presumption that the external façade sound level could be reduced by up to 15dB internally.

Table 11 Theoretical broadband noise exposure levels expressed as the Leq - dB(A) with the use of a barrier fence

Day-time			Night-time		
External	Internal with windows closed	Internal with window partially open	External	Internal with windows closed	Internal with window partially open
52	<30	37	49	<30	34

7.4 Evaluation against guideline criteria

As shown above in Table 11, through the emplacement of a continuous close-boarded timber barrier along the northeastern boundary, it has been suggested that the external northeastern façade day-time sound level could be reduced to around 52dB(A).

The internal sound level during both the day-time and night-time with windows closed, is expected to be below 30dB(A), whereas with a partially open window the day-time sound level could be in the region of 37dB(A), and the night-time level in the region of 34dB(A).

Through reference to the noise exposure guidelines for dwellings as detailed within BS8233:2014, it is generally accepted that the external sound level should ideally not exceed 50dB in recreational areas during the day-time, whereas the internal day-time level should not exceed 35dB and the internal night-time level should not exceed 30dB.

It is apparent therefore that even with the recommended acoustic barrier in place the external sound level at the façade of the proposed dwelling nearest to the motorway will most likely exceed the 50dB(A) guideline level; however as this façade would be up close to the barrier fence, and therefore not considered a recreational area, the exceedence of this guideline value here should not be a concern.

It is more likely that the chosen recreational area would be the open space outside the southwestern façade, in which case there should be some degree of additional attenuation provided by the dwelling itself. It is expected therefore that the 50dB(A) external guideline value could easily be achievable here.

With regards to the internal sound exposure levels, the only potential concern arises with northeasterly-facing windows partially open. In considering this, it is similarly apparent that the day-time guideline level of 35dB and the night-time level of 30dB could be exceeded within the proposed dwelling. More specifically, the day-time guideline level could be exceeded by 2dB and the night-time level by 4dB.

Through further reference to BS8233, although it is desirable that the external noise should not prevent a 'good' standard of living to be attainable, it also states that in some circumstances the internal target may be relaxed by up to 5dB and still allow 'reasonable' conditions to be achieved. In doing so, the proposed dwelling could now be considered to offer 'reasonable' living conditions.

Reference has also been made to the WHO guidelines, whereby the internal night-time sound level should not exceed 45dB(A) on more than 10 occasions.

In doing so, the 10th highest $L_{(Amax)}$ was calculated to be in the region of 54dB; however, if the aforementioned acoustic barrier is expected to provide around 13dB of attenuation through adsorption and reflection, the corresponding sound level could actually be in the region of 41dB(A), which suggests compliance with these guidelines.

8 Summary and limitations

8.1 Summary

This assessment principally makes reference to the noise exposure guidelines for dwellings as detailed within BS8233:2014. As such it aims to determine whether the proposed dwelling unit could be exposed to noise emanating from the adjacent M27 motorway, resulting in an external day-time exposure level of 50dB or less, along with an internal day-time exposure level of 35dB or less and a night-time internal level of 30dB or less.

In making this assessment, the report has considered a situation where a continuous 3000mm high barrier fence is emplaced along the northeastern site boundary. The barrier should be robust, and typically have a mass density of at least 10kg/m² in order to achieve the required noise attenuation, through absorption and reflection.

In doing so, the findings of this report are basically that the above guideline levels would appear to be marginally exceeded for internal exposure with windows open.

In considering this however, BS8233:2014 suggests that a 'reasonable' standard of living could still be achievable within this dwelling, if this 'relaxation' were to be applied.

8.2 Limitations

The above concluded findings are reached on the basis that firstly, incoming roadside noise will be attenuated by a perimeter fence along the northeastern boundary to a height of 3000mm, and secondly on the basis that all windows will contain acoustic glazing allowing a sound reduction of at least 25dB (broadband) to be achieved when closed.

In addition to the above, it is recognised that some presumptions have been made regarding the manner in which the sound levels may be influenced or behave at this location, however it is believed that these have been made with regard to reasoned scientific understanding and professional judgement.

9 References

1. The Little Red Book of Acoustics: A Practical Guide, 2nd Ed., Watson, R. and Downey, O., Blue Tree Acoustics, 2008.
2. National Planning Policy Framework, Department for Communities and Local Government, December 2023.
3. Noise Policy Statement for England - DEFRA (March 2010)
4. The Eastleigh Borough Council Local Plan (2016 - 2036) - April 2022
5. Professional Practice Guidance on Planning and Noise; Association of Noise Consultants, the Institute of Acoustics and the Chartered Institute of Environmental Health - May 2017
6. British Standard 7445-1:2003 'Description and Measurement of Environmental Noise - Guide to quantities and procedures'.
7. British Standard 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings
8. World Health Organisation Night Noise Guidelines for Europe, WHO, 2018
9. World Health Organisation Guidelines for Community Noise, WHO, 1999
10. The Control of Road Traffic Noise (CRTN) 1988 (HMSO).

APPENDIX

Sound level instrument calibration

Noise profile summary sheets

Certificate of Calibration



Equipment Details

Instrument Manufacturer Cirrus Research plc
Instrument Type CR:171B
Description Sound Level Meter
Serial Number G068537

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	B&K 4192	Serial Number	1920791	Calibration Ref.	S6450
Pistonphone Type	B&K 4220	Serial Number	613843	Calibration Ref.	S6388

Calibrated by



Calibration Date

22 September 2017

Calibration Certificate Number

252698

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

Certificate of Calibration



Certificate Number: **114003**

Date of Issue: **22 September 2017**

Microphone Capsule

Manufacturer: **Cirrus Research plc**
Model Number: **MK:224**

Serial Number: **202161A**

Calibration Procedure

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 the National Physical Laboratory, Middlesex, UK.

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

Date of Calibration: **12 September 2017**

Open Circuit **55.6 mV/Pa**

Sensitivity at 1 kHz: **-25.1 dB rel 1 V/Pa**

Environmental Conditions

Pressure: **99.20 kPa**

Temperature: **23.0 °C**

Humidity: **43.0 %**

Calibration Laboratory

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

Test Engineer: Debra Swalwell



Cirrus Research plc, Acoustic House, Bridlington Road
Hunmanby, North Yorkshire, YO14 0PH, United Kingdom
Telephone: 0845 230 2434 **Int:** +44 1723 891655
Email: sales@cirrusresearch.co.uk
Web: www.cirrusresearch.co.uk
UK Registration No. 987160

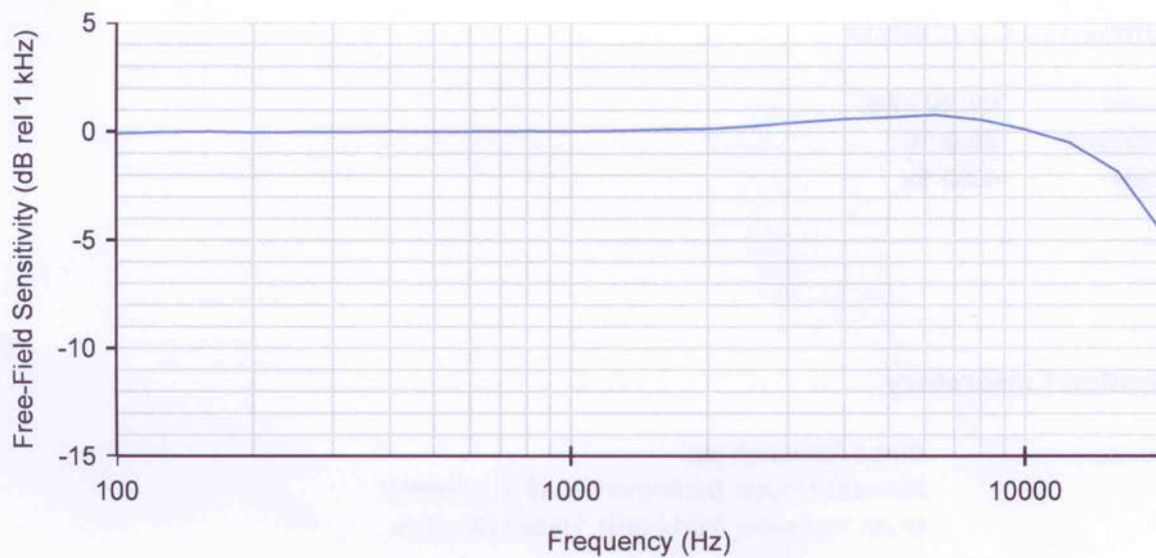


FM 531001

EMS 552104

Free-Field Frequency Response

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
100	-0.09	0.01
125	-0.02	0.06
160	0.00	0.10
200	-0.04	0.06
250	-0.03	0.08
315	-0.02	0.09
400	0.00	0.10
500	-0.01	0.10
630	-0.01	0.09
800	0.02	0.08
1 000	0.00	0.05
1 250	0.04	0.04
1 600	0.09	0.03
2 000	0.12	-0.03
2 500	0.23	-0.08
3 150	0.41	-0.21
4 000	0.57	-0.42
5 000	0.65	-0.81
6 300	0.77	-1.46
8 000	0.54	-2.72
10 000	0.09	-4.71
12 500	-0.50	-6.71
16 000	-1.85	-9.78
20 000	-4.61	-13.82



Certificate of Calibration

Certificate Number: **113987**

Date of Issue: **21 September 2017**



Instrument

Manufacturer: **Cirrus Research plc**

Serial Number: **70846**

Model Number: **CR:515**

Calibration Procedure

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 IEC 60942:2003 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.

Date of Calibration: **21 September 2017**

Initial Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	93.93	1000.3	0.26
2	93.92	1000.3	0.26
3	93.94	1000.3	0.26
Average	93.93	1000.3	0.26
Uncertainty	± 0.13	± 0.1	± 0.10

The reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level.

Adjusted Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	94.00	1000.3	0.27
2	93.99	1000.3	0.26
3	94.01	1000.3	0.26
Average	94.00	1000.3	0.26
Uncertainty	± 0.13	± 0.1	± 0.10

The reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level.



Environmental Conditions

Pressure: 101.10 kPa
Temperature: 23.6 °C
Humidity: 45.1 %

Evidence of Pattern Approval

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC 60942:2003 Annex A to Class 1. This has been confirmed with the Physikalisch Technische Bundesanstalt (PTB).

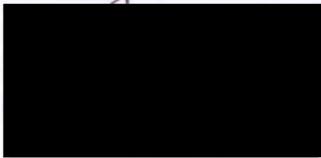
Statement of Calibration

As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the Class 1 requirements of IEC 60942:2003.

Calibration Laboratory

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

Test Engineer: Craig Scott



Measurement Summary Report

Name 1
Time 20/03/2018 15:21:11 **Place** **Project**
Duration 1.22:13:54 Oakdene
Instrument G068537, CR:171B

Calibration

Before 20/03/2018 15:20 **Offset** -0.06 dB **After** 22/03/2018 15:05 **Offset** -0.25 dB

Basic Values		Statistical Levels (Ln)	
L _{Aeq}	62.3 dB	LAF1	69.9 dB
L _{AE}	114.6 dB	LAF5	67.5 dB
L _{AFMax}	84.2 dB	LAF10	65.7 dB
		LAF50	60.6 dB
		LAF90	50.1 dB
		LAF95	45.5 dB
		LAF99	39.0 dB

