hepworth acoustics

THE OLIVE SCHOOL, MANCHESTER
NOISE IMPACT ASSESSMENT

On behalf of:

Conlon Constuction

Report No: P22-461-R01v2
January 2023

THE OLIVE SCHOOL, MANCHESTER
NOISE IMPACT ASSESSMENT

Report prepared by:
Hepworth Acoustics Ltd
21 Little Peter Street
Manchester
M15 4PS

On behalf of:
Conlon Constuction

Report prepared by: James Shaw BSc MIOA – Senior Consultant 

Report checked by: Graham Bowland BSc MIOA – Technical Director 

CONTENTS

1.0	INTRODUCTION	1
2.0	NOISE SURVEY	3
3.0	PLANT NOISE LIMITS	4
4.0	EXTERNAL NOISE BREAK-IN	5
5.0	PLAYGROUND NOISE	8
6.0	OUTDOOR SPORTING PROVISION	10
7.0	SUMMARY & CONCLUSION	15

FIGURE 1 – PROPOSED SITE LAYOUT 16

APPENDIX I: NOISE UNITS & INDICES 17

1.0 INTRODUCTION

1.1 Hepworth Acoustics Ltd was commissioned by Conlon Construction to carry out a noise impact assessment in connection with a planning application for the construction of the Olive Manchester Primary School in Cheetham Hill, Manchester. The proposed layout and location of the site is shown in Figure 1.

1.2 It is proposed that the school will offer teaching accommodation for a 2 Form Entry (2FE) sized school for pupils aged 4 -11. The site is approximately 2.5 kilometres north of Manchester City Centre and is currently a public park (Bignor Street Park) with some areas of hardstanding used as a basketball court and multi use games area (MUGA).

1.3 The site is located in a residential area of northern Manchester and is bounded to the north by Brentfield Avenue, with Bellot Street Park on the other side of the road. Bordering the site to the south and west of the site is Tamerton Drive with Hillcity Day Nursey and residential properties on the road. The New Testament Church of God Faith Tabernacle is located to the south of the site. To the east, the site is bound by Heywood Street and residential properties on the opposite side of the road.

1.4 The proposals are for construction of the new building towards the north east corner of the site. Vehicular access will be from the north close to the junction with Brentfield Avenue and Heywood Road.

1.5 The newly constructed school will be two storey and will consist of Foundation Stage and Key Stage 1 provision on the ground floor and Key Stage 2 provision on the first floor. Ancillary spaces such as the kitchen and offices as well as one larger and one smaller double height halls will be located on the ground floor, predominantly along the northern elevation. All building services equipment will be on the northern elevation.

1.6 The noise assessment has included:

- An inspection of the site and surrounding area;
- Review of noise levels measured by others during the feasibility study and used to establish the noise climate at the site;
- Advice on the control of break-in of external noise to teaching areas in line with Building Bulletin 93, ‘Acoustic Design of Schools’ (BB93:2015).

- Assessment of noise from proposed external fixed plant and recommendation of any necessary outline mitigation measures.
- Assessment of noise from proposed MUGA and Cricket Batting Nets and recommendation of any necessary outline mitigation measures.

1.7 All recommendations are given for acoustic reasons only and compliance with other requirements (e.g. fire/structural) should be checked by others.

1.8 The various noise units and indices referred to in this report are described in Appendix II. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

2.0 NOISE SURVEY

2.1 Two environmental noise surveys were carried out on the site in November 2020 and March 2022 by others as part of the feasibility study for the school.

2.2 The results of the daytime noise surveys are summarised in Table 1 below. Full details of the noise survey are detailed in Report 'FS0766-AEC-XX-XX-T-J-0001-001Acoustic_Survey-S5-P01' which is appended to this report.

2.3 During each survey measurements were taken at three locations:

- A – 40m west from the edge of Heywood Road.
- B – 12m west from the edge of Heywood Road.
- C – 20m north from the edge of Tamerton Drive.

2.4 The surveys were carried out from 16:00 to 17:00 on Thursday 27th November 2020 and from 10:00 and 12:30 on Monday 14th March 2022 in terms of $L_{Aeq,T}$, $L_{A1,T}$ and $L_{A90,T}$ in 15-minute periods.

2.5 The measured daytime 15-minute values are considered to be representative of the corresponding 1-hour values in line with BS 4142 and the corresponding 30-minute values in line with BB93.

Table 1: Summary of measured noise levels (dB)

Location	15:00-17:00 27th November 2020			10:00-12:30 14th March 2022		
	$L_{Aeq,15mins}$	$L_{A90,15mins}$	$L_{Amax15mins}$	$L_{Aeq,15mins}$	$L_{A90,15mins}$	$L_{Amax15mins}$
A: Heywood Road/Brentfield Avenue	-	-	-	50	46	66-69
B: Heywood Road	54	43	65-68	54	47	69-70
C: Tamerton Drive	48	43	57-66	49	46	64-65

2.6 Following the restrictions following the COVID 19 pandemic the background (L_{A90}) measurements from the 2022 survey have been adopted for the purpose of this assessment as it was concluded that the results of 2022 survey are more representative than those measured during the associated lockdown in November 2020.

2.7 The results of the noise surveys have been considered in our recommendations set out in Section 3.0

3.0 PLANT NOISE LIMITS

3.1 British Standard 4142:2014+A1:2019, '*Methods for rating and assessing industrial and commercial sound*' is appropriate guidance for assessing the potential noise impact from plant noise sources.

3.2 An initial estimate of the potential noise impact from the operating noise source is determined by comparing the difference between the background sound level and the plant rating level at the nearest dwelling. The rating level is calculated from the L_{Aeq} at the nearest dwelling with the addition of appropriate character corrections to account for impulsivity, tonality, intermittency etc.

3.3 Regarding the outcome of the initial estimate, BS 4142 states that:

- Typically, the greater this difference, the greater the magnitude of impact;
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and,
- The lower the rating level is relative to the measured background level, the less likely it is that the operation will have an adverse impact or a significant adverse impact. Where the rating level is does not exceed the background sound level, this is an indication of the specific sound source having low impact, depending on the context.

3.4 Therefore, appropriate criteria for plant noise at this development would be to control the rating level from any externally mounted plant associated with the new buildings to within the existing representative background noise levels (L_{A90}) at the nearest dwellings.

3.5 As such, at this stage it is appropriate to use the methodology set out in BS 4142 to determine appropriate noise limits for any new plant/equipment to be installed. We recommend that the rating level of noise from any new fixed plant/equipment is controlled to be no higher than representative daytime background noise level as follows:

Table 2: Plant Noise Limits at Dwellings (dB)

School Day (08:00-17:00) $L_{Ar,Tr}$	Evening (19:00-07:00) $L_{Ar,Tr}$
46	43

4.0 EXTERNAL NOISE BREAK-IN

4.1 BB93:2015 *'Acoustic Design of Schools: Performance Standards'*, applies to new schools and provides useful guidance on acoustic design of education buildings.

BB93:2015

4.2 The acoustic performance standards of BB93:2015 provide acoustic performance criteria for each room type and are determined by the room usage as defined in Table 1 of BB93:2015.

4.3 The Indoor Ambient Noise Level (IANL) is determined by combining the noise levels from all relevant sources including external noise sources such road traffic and aircraft as well as noise from mechanical ventilation, heating systems, lighting and other classroom building services. The internal ambient noise level within a room with partially open windows will be between 10-15 dB below the external noise level. Therefore, for naturally ventilated areas, where the external noise level exceeds the IANL criterion (with + 5 dB tolerance for natural ventilation) by more than 10 dB, then it is likely that some alternative means of ventilation will be necessary. This means that where external noise levels exceed 50–55 dB L_{Aeq} outside new build teaching areas, an alternative (acoustically treated) means of ventilation is likely to be required.

4.4 There is no statutory requirement to achieve the IANL or RT criteria in administration and ancillary spaces. As teaching spaces are to be ventilated by mechanical means, no relaxation of the IANL criteria is applicable.

4.5 The corresponding IANL tolerances are shown in Table 3 below.

Table 3: Summary of IANL Tolerance/Limits for Mechanical/Natural Ventilation System

Condition	Ventilation System	IANL Limit $L_{Aeq,30mins}$
Normal – Ventilation for normal teaching and learning activities	Mechanical Natural / Hybrid	Table 1 values Table 1 values + 5 dB
Summertime – ventilation under local control of teacher to prevent overheating allowable during the hottest 200 hrs of the year	Mechanical Natural / Hybrid	Table 1 values + 5 dB ≤55 dB
Intermittent Boost - ventilation under local control of teacher to provide dilution of fumes	Mechanical Natural	Table 1 value +5 dB ≤55 dB

4.12 The normal condition for a ventilation system with mechanical air supply is defined as when the system is operating to limit the daily average carbon dioxide concentration to no more than 1,000ppm with the maximum concentration not exceeding 1,500ppm for more than 20 consecutive minutes on any day during normal school operating hours. This would normally equate to a minimum ventilation rate of approximately 8l/s per person. Mechanical ventilation in this context refers to systems (or parts of systems) that use mechanical fans to mix or drive the air including those in mechanical, hybrid, mixed mode and natural ventilation systems. The upper limits for IANL under normal conditions for relevant spaces with natural ventilation are shown in Table 4 below including relevant relaxation of the IANL criteria where appropriate.

Table 4: IANL from Table 1 of BB93 for New Builds

Type of Room	Upper Limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB
Primary school: classroom, class base, general teaching area, small group room, music room	35 natural ventilation (+5 if mechanically ventilated)
Open plan Teaching area Resource/breakout area	40 natural ventilation (+5 if mechanically ventilated)
Study room (individual study, withdrawal, remedial work, teacher preparation)	
Atrium, circulation space not intended for teaching and learning	
Meeting room, Interviewing/counselling room, video conference room	40 natural ventilation (+5 if mechanically ventilated)
Dining room	45
Administration and ancillary spaces: Kitchen Office, medical room, staff room Corridor, stairwell, coats and locker area Changing area	 50 40 45 50 50

(The +5 dB does not apply to teaching and learning spaces where the IANL is greater than or equal to 45 dB)

External Noise Ingress

4.13 The logarithmic mean of the ambient noise levels measured during the daytime at Location 1 is 50 dB $L_{Aeq,T}$ and 54 dB $L_{Aeq,T}$. at Location 2. For Location 3 the measured noise level was 49 dB $L_{Aeq,T}$

4.14 It is considered that Location 1 and 2 is representative of the proposed elevations (north and east) potentially most exposed to noise. The southern and western elevations will be partially shieled or fully shielded from noise from Heywood Road and Brentfield Avenue.

4.15 We understand that proposals for the ventilation strategy for the development are based on a natural ventilation for ancillary spaces with MVHR's proposed for classrooms. It is therefore assumed that for all outward facing classrooms, windows will remain closed. The exact specification of proposed mechanical ventilation has yet to be determined and will be reviewed at a later stage.

4.16 Standard well-sealed thermal double glazing (4mm glass - 4mm glass) has a typical sound reduction performance of 25 dB $R_w + C_{tr}$.

4.17 As such, resulting internal noise levels in classrooms and other spaces with the windows closed should be no more than 29 dB $L_{Aeq,T}$, which is below the lowest relevant internal ambient noise limit from BB93 for any room type. Therefore, standard double glazing will be suitable for this development.

4.18 In order to maintain the sound insulation of the building envelope, we recommend that any non-glazed elements should be designed such that they provide a minimum sound insulation of at least 40 dB R_w. This will be straight-forward to achieve with standard building materials.

5.0 PLAYGROUND NOISE

5.1 Figure 1 shows the position of two proposed playgrounds as part of the development. The KS1 playground is located to the south eastern corner of the site. The KS2 playground is located on the western elevation of the building.

5.2 There is no government recommended objective method of assessing noise levels from external playground areas. The approach adopted assesses predicted noise levels outside the nearest residences to determine any influence from the proposed playground areas and to assess the impact of any change in existing noise levels.

5.3 We have predicted noise levels from the proposed playground areas outside the nearest existing residences. The assessment has been undertaken using reference noise levels measured by Hepworth Acoustics at a similar school playground at a 1FE school and whilst KS2 children were playing, as shown in Table 5 below.

Table 5: Summary of Measured Play Area Noise Levels (dB)

Date	Description	Noise level
January 2022	1FE KS2 Playground @ 10m	59 dB L_{Aeq}

5.4 There is likely to be a staggered lunch/playtime schedule at the school. We have therefore based our assessment on the predicted noise level at the nearest residential windows assuming 100 children in each playground at any one time as shown in Tables 6 & 7.

Table 6: Predicted Worst-Case Noise Levels from Proposed KS1 Playground Area (dB)

Parameter	Predicted noise level, dB L_{Aeq}
1FE KS2 Playground @ 10m	59
Distance attenuation of 41 metres from a central playground location to nearest window on Heywood Road	-12
Noise level at receiver	**47**

5.5 The calculated worst-case noise from children in the KS1 playground will be 47 dB L_{Aeq} which is below the existing measured prevailing noise levels of 54 dB L_{Aeq}.

Table 7: Predicted Worst-Case Noise Levels from Proposed KS2 Playground Area (dB)

Parameter	Predicted noise level, dB L_{Aeq}
1FE KS2 Playground @ 10m	59
Distance attenuation of 100 metres from a central playground location to nearest window on Tamerton Drive	-20
Noise level at receiver	**39**

5.6 The calculated worst-case noise from children in the KS2 playground will be 39 dB L_{Aeq} which is below the existing measured prevailing noise levels at Tamerton Drive of 49 dB L_{Aeq}.

5.7 It is also important to note the following:

- The playground noise occurs on weekdays only - there being no noise from the school on Saturdays or Sundays;
- The noise occurs in the daytime only and not in the evenings or at night - therefore for this daytime noise it is considered that only ground floor habitable rooms and gardens need to be considered; and
- The noise occurs for only parts of the school day, particularly during lunchtime use of the school playground.

5.8 We therefore conclude that the new playground will not result in any unacceptable noise impact.

6.0 OUTDOOR SPORTING PROVISION

6.1 The proposals are to construct a multi-use games area (MUGA) to the eastern side of the site and two cricket practise nets to the south west corner as part of the school development.

6.2 We understand that the MUGA will be used during school hours only weekdays and the cricket batting during the evenings and weekends only. There are no floodlights proposed for either area therefore use will be limited to daylight hours only. The MUGA will not be hired to third parties for use outside school hours except for after school club usage.

Multi-use Games Area (MUGA)

6.3 The nearest residences are the houses on Tamerton Drive. houses are around 85 metres from the proposed MUGA.

6.4 There are currently no specific noise criteria for outdoor sports grounds. The 2021 *National Planning Policy Framework* (NPPF) provides some general guidance to local authorities on taking noise into account in planning policies and decisions. This includes guidance that local authorities should '*ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life*'.

6.5 However, there is as yet no specific guidance on numerical acoustic assessment/design criteria for proposed new developments provided in the NPPF, accompanying Technical Guidance document, National Planning Practice Guidance 'Noise', nor the *Noise Policy Statement for England* (NPSE) 2010.

6.6 British Standard 4142: 2014 '*Methods for rating and assessing industrial and commercial sound'* describes methods for rating and assessing sound of an industrial and/or commercial nature. This standard explicitly excludes recreational noise, so it is not applicable to outdoor sports areas such as this.

World Health Organisation Guidelines for Community Noise (1999)

6.7 Guidance that has been used for similar developments includes the World Health Organisation Guidelines for Community Noise (1999). This states the following for outdoor living areas:

> *Annoyance to community noise varies with the type of activity producing the noise. Speech communication, relaxation, listening to the radio and TV are all examples of noise-producing activities. During the daytime, few people are seriously annoyed by activities with L_{Aeq} level below 55 dB; or moderately annoyed with L_{Aeq} levels below 50 dB.*

6.8 The WHO criteria were reviewed in a report by the National Physical Laboratory (reference CMAM16) which states:

> *Exceedance of the WHO guideline values does not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher levels of noise exposure are reached.*

6.9 Therefore, it is not necessarily the case that where these levels are exceeded, the noise will adversely affect nearby residential properties.

Sport England Design Guidance Note 'Artificial Grass Pitch (AGP) Acoustics – Planning Implications'

6.10 The 2015 Sport England Design Guidance Note provides guidance on the acoustics related planning implications of AGPs (also known AWPs). The aims of the Note are as follows:

- Increase awareness of good design in sports facilities;
- Help key building professions, clients, user representatives and other stakeholders to follow best practice;
- Encourage well designed sports facilities that meet the needs of sports and are a pleasure to use.

6.11 The Sport England Design Guidance Note states that *"The determining noise criteria for AGPs proximity to residential properties, to avoid moderate annoyance in the daytime and evenings, as set by The World Health Organisation's 'Guidelines for Community Noise' 50 dB $L_{Aeq,1hr}$ upper noise limit external to residential properties and within external living areas"*

6.12 Page 7 of the document has the following guidance on typical noise levels:

Noise level measurements were taken at a distance of 10 metres behind the mid-way points along goal lines and sidelines. They were found to be highest behind the sideline halfway line. The most significant noise levels were found to be generally derived from the voices of players, with the exception of hockey where impact noises of balls hitting perimeter strike boards and goal back boards were more noticeable. Such impact noises can be mitigated by incorporating shock absorbing noise reduction measures. Assuming such mitigation measures, the most significant noise source from typical AGP sports sessions is therefore voice and as such, a typical noise level can be determined.

From the measurement data, a typical free-field noise level of 58 dB $L_{Aeq(1\ hour)}$ at a distance of 10 metres from the sideline halfway marking has been determined as representative for noise from an AGP.

6.13 We note that this noise level is based on a receiver height above ground of 1.5 metres.

6.14 Therefore, for assessment purposes, we have used as a source noise level the value of 58 dB $L_{Aeq,1hour}$ taken from the Sport England Design Guidance for artificial grass pitches. This value was measured at 10 metres laterally from the halfway line. For this assessment, we will use this value at 10 metres from the goal-line nearest to the adjacent residences, to follow a cautious approach and also to consider the geometry of the proposed MUGA.

6.15 For the purposes of determining the resulting noise levels outside the nearest dwellings, we have assumed that for average noise levels (i.e. L_{Aeq} values), the pitch acts as an area sound source. Since the pitch is 15 metres wide, the nearest dwellings are within the near-field (i.e. at a distance from the noise source that is less than three times the largest dimension). This means that distance attenuation is equivalent to 3 dB per doubling of distance, which is the same as would be the case for a line source.

Table 8: Prediction of Noise Impact from MUGA Usage

Description	dB(A)
Typical pitch noise levels @ 10 metres, dB L_{Aeq}	59
Distance attenuation, 85 metres hemispherical propagation	19
Resultant noise level at nearest residence on Tamerton Drive, dB L_{Aeq}	40

6.16 As can be seen from Table 8, the predicted L_{Aeq} levels are below the WHO recommended daytime limit of 50 dB.

6.17 The predicted pitch noise levels are also 9 dB below the existing L_{Aeq} ambient noise levels of 49 dB L_{Aeq} measured on site during the school day close to Tamerton Drive.

6.18 Based on this, no specific noise mitigation measures are required, however the general good practice recommendations given below should be observed.

6.19 Sport England's *Artificial Grass Pitch (AGP) Acoustics – Planning Implications (2015)* has the following general recommendations for outdoor pitches, which we endorse:

6.20 Weldmesh fencing is commonly used to enclose the MUGA and the panels should be securely clamped with resilient fixings to avoid vibrations. Sheet metal signs or hoardings can make a clattering noise when hit by a ball and these should be avoided in proximity to the playing surface or replaced by soft vinyl signs.

6.21 People tend to congregate around the entrance to the AGP and as such, it is advisable that the entrance and access route should be located away from housing where possible.

6.22 By following the recommendations in this report, we predict that the noise impact due to the proposed MUGA will be within reasonable limits.

Outdoor Batting area

6.23 We understand that the batting nets will be constructed from a fully enclosed tunnel fabric netting system, this construction ensures there will be no impact noise from balls hitting the fencing and the fabric absorbs the impact. It is also understood that he nets will predominantly be used by junior groups in these cases it is standard practise that lightweight tennis or plastic balls are typically used instead of traditional cricket balls, this results in a much softer impact from the bat striking the ball.

6.24 Therefore, our assessment focuses on the impact of noise from players and coaches using the area. The calculations are based upon source noise measurements gathered by Hepworth Acoustics during a coaching/practise session at a local sports club. A noise level of 59 dB $L_{Aeq(5\ mins)}$ was measured at a distance of 3 metres away from the side of the pitch. The measured noise level includes direction by coaches and children playing sports (laughing and shouting).

6.25 We have calculated the resulting noise levels outside the nearest dwellings in each direction taking into account distance attenuation only. The calculated L_{Aeq} noise levels without any specific noise

mitigation measures have been calculated at 1.5m above ground level outside the dwellings at the junction of Tamerton Drive and Heywood Street. The results are shown in Table 9 below.

Table 9: Prediction of Noise Impact from Batting Enclosure Usage

Description	dB(A)
Typical coaching noise level @ 3 metres, dB L_{Aeq}	59
Distance attenuation, 20 metres hemispherical propagation	16
Resultant noise level at nearest residence on junction of Tamerton Drive and Heywood Street , dB L_{Aeq}	43

6.26 The predicted noise levels are 6 dB below the existing L_{Aeq} ambient noise levels of 49 dB L_{Aeq} measured on site during the school day close to Tamerton Drive, and 5 dB below the measured ambient noise level of 49 dB L_{Aeq} during the after-school period (15:00-17:00).

6.27 Therefore, we consider the construction of the batting enclosures is not anticipated to result in any demonstrable harm to the amenity of neighbouring residents by reason of noise.

7.0 SUMMARY & CONCLUSION

7.1 Hepworth Acoustics was commissioned by Conlon Construction to carry out a noise assessment in connection with a proposed planning application for a new school building at land in Cheetham Hill, Manchester.

7.2 Appropriate plant noise limits have been determined based on the results of the noise survey in line with the requirements of BS 4142:2014+A1:2019 guidance.

7.3 Potential noise ingress to the new buildings has been assessed against the prevailing ambient noise levels in the area in the context of achieving the BB93 criteria for internal ambient noise levels.

7.4 Noise from use of the proposed playgrounds and outdoor sporting provision has also been evaluated and we have concluded that there will be no unacceptable impact.

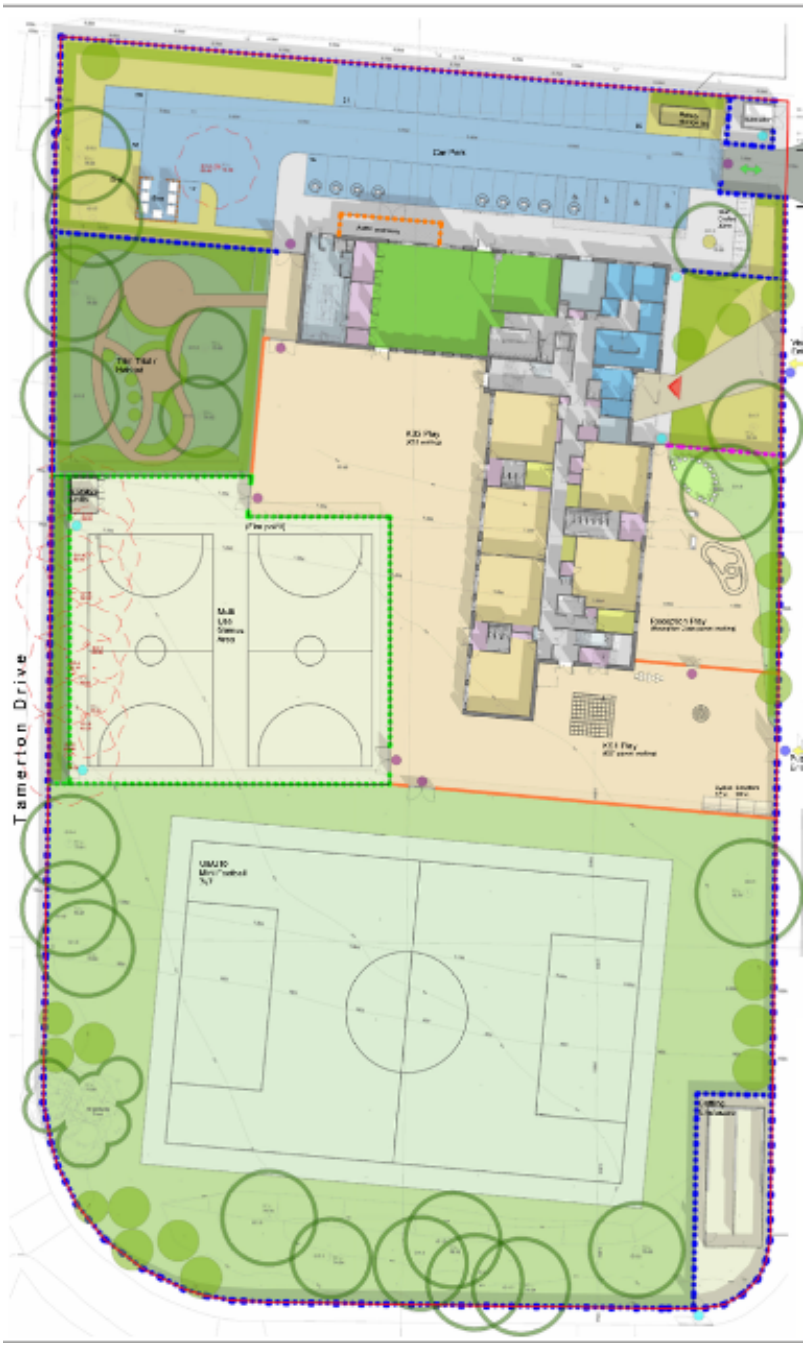
Key:
Not to scale

North

hepworthacoustics

Title: Figure 1: Proposed Site Layout

Project: P22-461



Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3 dB(A) higher than each of the individual noise levels e.g. 60 dB(A) plus 60 dB(A) = 63 dB(A). In terms of perceived 'loudness', a 3 dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

$L_{Aeq,T}$ This is the A–weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period. In other words, $L_{Aeq,T}$ is the level of a continuous noise which has the same total (A–weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.

L_{AFmax} This is the maximum A–weighted noise level that was recorded during the measurement period in terms of 'Fast' time weighting.

$L_{A1,T}$ This is the A–weighted noise level exceeded for 1% of the time period. $L_{A1,T}$ is usually used as a measure of peak noise in the assessment of noise break-in in BB93.

$L_{A90,T}$ This is the A–weighted noise level exceeded for 90% of the time period. $L_{A90,T}$ is used as a measure of background noise.

Acoustic & Engineering Consultants Limited
Suite 316, 3rd Floor, Broadstone Mill, Broadstone Road, Stockport, SK5 7DL
Telephone 0161 449 5900 mail@aecltd.co.uk www.aecltd.co.uk

Ref: FS0766-AEC-XX-XX-T-J-0001-001Acoustic_Survey-S5-P01 21 March 2022

To:	Oguzhan Topac	of:	Mott MacDonald
Cc:	Louise French	of:	Mott MacDonald

STAR Academies Trust, Olive School, Cheetham Hill, Manchester

Noise Survey & Interpretive Report

1.0 PURPOSE OF REPORT

1.1 The purpose of this short technical report is to present the findings of a baseline noise measurement survey undertaken on the proposed development site, and to give an initial overview of the potential implications for the proposed location and design of a primary school. A full acoustic design report will need to be prepared once the location and layout of the school has been set.

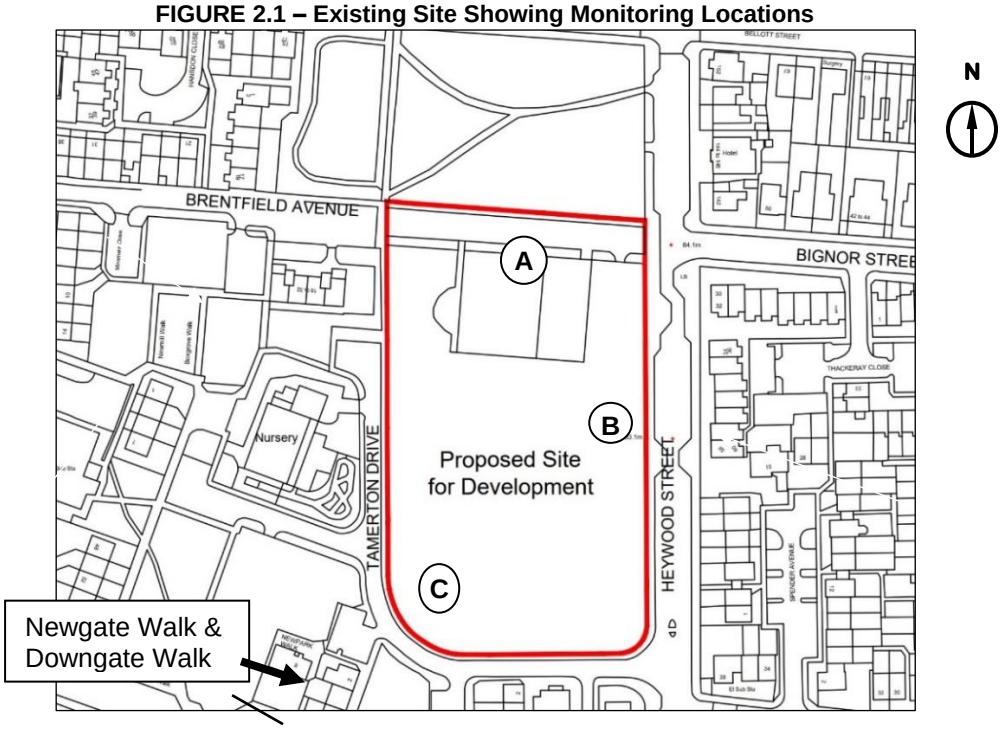
1.2 Appendix A provides a brief summary of acoustic terms used in this report.

2.0 SITE DESCRIPTION & MEASUREMENT LOCATIONS

2.1 The proposed development site is located on land off Bignor Street, Cheetham Hill, Manchester. The site is currently public open space surrounded by residential properties on Heywood Street and Bignor Street to the east, Tamerton Drive, Newgate Walk and Downgate Walk to the southwest, and Brentfield Avenue and Waterloo Road to the west. There is also a day nursery located to the west of the site off Tamerton Drive.

2.2 The final location of the proposed school building on the site is still being developed although two massing options have been reviewed. The noise measurement locations, indicated on Figure 2.1 below, were selected to represent the potential school building location(s) and the existing nearby residential properties.

FIGURE 2.1 – Existing Site Showing Monitoring Locations



Constructionline
Part of Capita plc
ANC ACOUSTICS & NOISE CONSULTANTS
CITATION APPROVED HEALTH & SAFETY SYSTEMS

3.0 CRITERIA

3.1 Building Bulletin 93 "*Acoustic design of schools*" (BB93) provides indoor ambient noise level (IANL) limits to be achieved in the various spaces. Where ventilation is provided by natural or hybrid (natural and mechanical) means, there is a permitted +5dB relaxation to the IANL limits due to external noise ingress, except where the IANL is greater than or equal to 45dBA.

3.2 BB93 states that the IANL limits for natural ventilation can usually be achieved where external ambient free-field noise levels at the façades do not exceed the IANL by more than the following:

- 16dB for single side ventilated spaces, and
- 20dB for cross/stack ventilated spaces.

3.3 Based on the above, the maximum acceptable external free-field ambient noise levels to achieve the required IANL limits for different natural ventilation methods are presented in Table 3.1, below.

Table 3.1 – Maximum Acceptable External Noise Levels to Allow for Natural Ventilation Provision

Example Space	IANL (+allowance for natural ventilation), $dBL_{Aeq,30min}$	Indicative External Free-field Limit, $dBL_{Aeq,30min}$	
		Single Side Ventilated Space	Cross or Roof Ventilated Space
SEN Teaching Space	30*	46*	50*
Standard Classrooms	35 (+5)	51	55
Multi-Purpose Hall			
Learning Resource	40 (+5)	56	60
Office and staff room			
Sports Hall			
Dining room	45	56	60
Kitchen	50	61	65

***These are specialist areas, and any alternative performance standard should be agreed by an acoustician and the school client body.**

3.4 In addition to the above, BB93 states that in order "*to protect students from regular discrete noise events, e.g. aircraft or trains, indoor ambient noise levels should not exceed 60dB$L_{A1,30min}$. This is achieved by default for spaces with IANLs up to 40dB$L_{Aeq,30min}$, but requires assessment in spaces with higher IANL limits, eg, 45 and 50dB*."

3.5 In relation to noise from any external building services plant serving the school, it is recommended that the total free-field 'rating'[1] noise level from all plant operating simultaneously is controlled to not exceed the existing background noise levels at the nearest noise sensitive receptors during either the school day or evening periods.

[1] The 'rating' level is defined in BS4142. It is the specific noise level ($dBL_{Aeq,T}$) plus a correction for acoustic character, if required.

4.0 EXTERNAL NOISE CLIMATE

4.1 An initial noise survey was undertaken in November 2020 while the Greater Manchester area was under a lockdown due to Covid-19 and and supplementary noise measurements were undertaken in March 2022 to confirm the initial levels. These measurements are discussed below.

4.2 It was agreed with Oguzhan Topac of Mott MacDonald that, because the site was not secure, only attended measurements would be undertaken on the proposed development site. Noise measurements were undertaken at three locations, identified as A to C on Figure 1 above and described in Appendix B.

4.3 The measurement locations are all considered representative of the noise levels on the proposed development site, and representative of the noise levels at the nearby residential properties surrounding the site.

4.4 All measurements were undertaken under free-field conditions, in general accordance with BS7445-1: 2003 '*Description and measurement of environmental noise. Guide to quantities and procedures*', over 15-minute durations.

4.5 Full details of the 2020 and 2022 noise surveys are presented in Appendix B with measurement equipment calibration certificates provided in Appendix C.

2020 Survey

4.6 AEC attended site during various time periods between 0600h in the early morning and 2100h in the evening, on Thursday 26 November 2020 and measured noise levels at the locations identified on Figure 1.

4.7 After each 15-minute period the ambient noise level was very stable, therefore, all measurements are considered representative of a 30-minute period, as required by BB93.

4.8 The noise climate at all measurement positions is dominated by road traffic noise. Bignor Street and Heywood Street are the dominant noise sources. However, distant road traffic noise from Waterloo Road and other roads, also contributed to the measured noise levels. Measured ambient noise levels throughout the survey ranged between 44 to 56dB$L_{Aeq,15mins}$. Noise from children playing in the day nursery, located to the west, was audible at Location C and noise levels were typically <50dB$L_{Aeq,15mins}$ on the site.

4.9 AEC understands that the typical operating hours for the school will be day (0800 to 1700h) and evening (1700-2100h). The background noise levels measured at locations representative of the properties on Heywood Street (Location B), Brentfield Avenue (Location A) and Newpark Walk & Downgate Walk (Location C) for these periods, are presented in Table 4.2, below.

Table 4.2 – Free-Field Background Noise Levels at Nearest Noise Sensitive Receptors

Receptor	Background Noise Level, dB$L_{A90,T}$	
	School Day (0800 to 1700h)	Evening (1900-2100h)
Heywood Street & Brentfield Avenue	43	41
Newpark Walk & Downgate Walk	43	40

2022 Survey

4.10 AEC attended site between 1000 and 1230h on Monday 14 March 2022 and between 2000 and 2100h in the evening of Thursday 17 March 2022 and measured noise levels at the locations identified on Figure 1.

4.11 After each 15-minute period the ambient noise level was very stable, therefore, all measurements are considered representative of a 30-minute period, as required by BB93.

4.12 The noise climate at all measurement positions is dominated by road traffic noise. Bignor Street and Heywood Street are the dominant noise sources. However, distant road traffic noise from Waterloo Road and other roads, also contributed to the measured noise levels. Measured ambient noise levels throughout the survey ranged between 48 to 54dB$L_{Aeq,15mins}$. Noise from children playing in the day nursery, located to the west, was audible at Location C and noise levels were typically <50dB$L_{Aeq,15mins}$ on the site.

4.13 AEC understands that the typical operating hours for the school will be day (0800 to 1700h) and evening (1700-2100h). The background noise levels measured at locations representative of the properties on Heywood Street (Location B), Brentfield Avenue (Location A) and Newpark Walk & Downgate Walk (Location C) for these periods, are presented in Table 4.2, below.

Table 4.2 – Free-Field Background Noise Levels at Nearest Noise Sensitive Receptors

Receptor	Background Noise Level, dB$L_{A90,T}$	
	School Day (0800 to 1700h)	Evening (1900-2100h)
Heywood Street & Brentfield Avenue	46	46
Newpark Walk & Downgate Walk	45	44

4.14 Background noise levels were dominated by distant road traffic.

5.0 Assessment of Proposed School Location

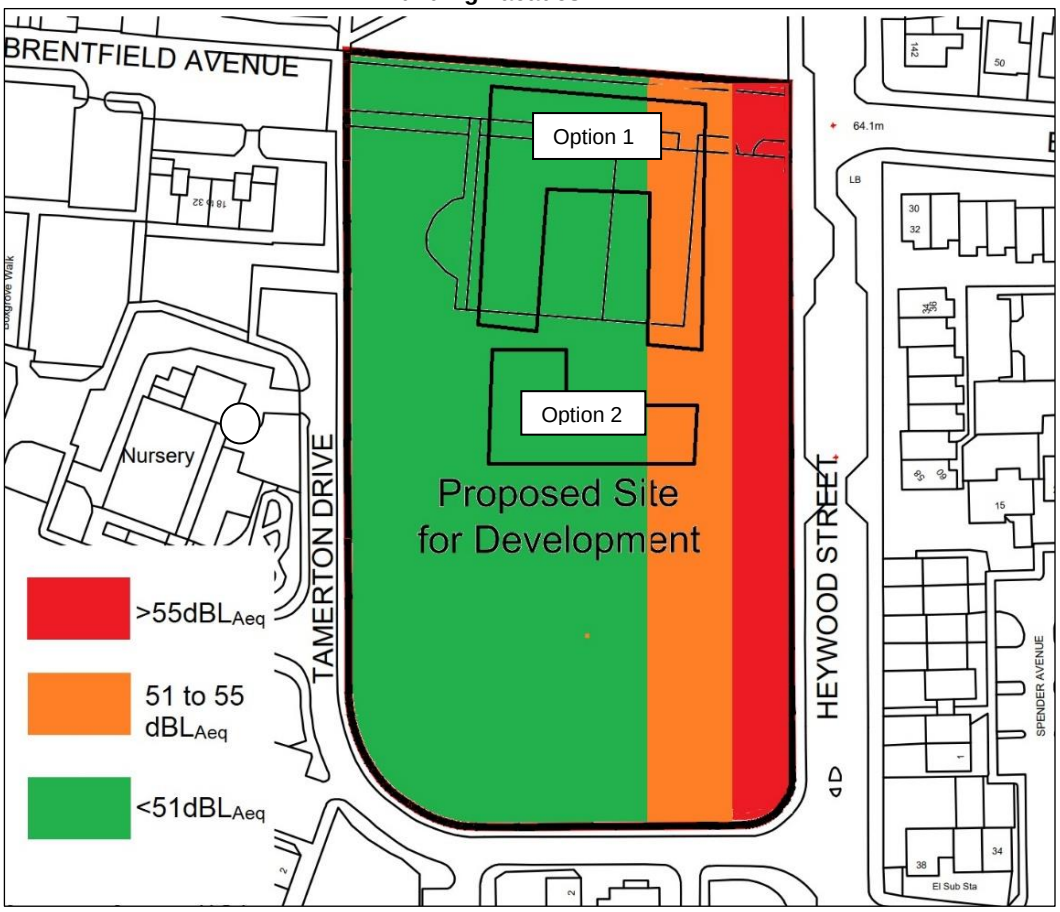
Assessment of External Noise Levels

5.1 The final layout and location of the proposed school is not yet set; however, two possible options for the proposed building location are sketched in Figure 5.1, below.

5.2 Based on the daytime measured ambient noise levels presented in Tables B1 and B2 in Appendix B, the anticipated free-field daytime ambient noise levels external to the proposed school building elevations are indicated on Figure 5.1, below. These are indicative and based on the highest noise levels measured on-site.

5.3 The screening effects of the new school buildings have not been considered on the indicative noise levels presented on Figure 5.1.

FIGURE 5.1 – Indicative Day-time Free-Field Ambient Noise Levels ($dBL_{Aeq,30min}$) Affecting Potential Building Facades



5.4 The typical maximum noise levels (dBL_{A01}) were below $61dBL_{A01,15min}$ at all locations.

5.5 The ambient noise levels are approximately $>55dBL_{Aeq,15mins}$ within 12 meters of the edge of Heywood Street. The noise levels attenuate as distance from Heywood Street is increased, and beyond 30m the majority of the site is exposed to noise levels below $51dBL_{Aeq,T}$ (green area).

5.6 Based on a comparison of the limits in Table 3.1 and the free-field ambient noise levels presented on Figure 5.1, the following observations can be made:

- Any specialist space for children with special hearing or communication needs, should be located in the quieter area of the site (to the west), with no line of sight from the windows to Heywood Street. Single sided ventilation would not be suitable to these spaces, however, cross or stack ventilation may be possible with specialist design input from an acoustician.

- Classrooms located on the eastern façade(s), with line of sight to Heywood Street, cannot have single sided ventilation with a large open area on the façade. However, a cross or stack ventilation system could be possible with a more restricted open area on the façade (subject to detailed design review from acoustician).

- All other classrooms and spaces that have windows located away from Heywood Street can be naturally ventilated, if desirable, although openings on the facades should be limited to a minimum where possible (subject to detailed design review from acoustician).

5.7 Based on the measured external maximum noise levels ($dBL_{A1,30min}$), the indoor levels would not typically exceed 60$dBL_{A1,30min}$, in any space, as required by BB93. Even if the space is naturally ventilated on a single side.

Plant Noise Levels

5.8 In order to achieve AEC's proposed plant noise level limit, the free-field 'rating' noise level with all new plant operating simultaneously should be controlled to not exceed the levels presented in Table 5.1, below, external to nearest noise sensitive receptors residential receptors.

5.9 The background noise levels were higher in the 2022 survey than the 2020 measurements and this is due to the increased road traffic in the area following the removal of restrictions due to the Covid pandemic. It is AEC's opinion that the 2022 survey is more representative of the typical noise climate in the area and the background noise level limits to be achieved at the nearest noise sensitive receptors have been set accordingly.

Table 5.1 – Free-field Rating Noise Level Limit at Nearest Noise Sensitive Receptors

Receptor	Background Noise Level, $dBL_{A90,T}$	
	School Day (0800 to 1700h)	Evening (1900-2100h)
Heywood Street & Brentfield Avenue	46	46
Newpark Walk & Downgate Walk	45	44

5.10 The proposed noise level limits are readily achievable with suitably located and specified plant and standard mitigation measures such as atmosphere side acoustic attenuators, where required.

I trust the above is clear and of assistance.

Yours sincerely,

Paul Knowles BSc (Hons) MIOA(D)

Checked by: DMT
David Terry BSc(Hons) MIOA

APPENDIX A – Acoustic Terminology in Brief

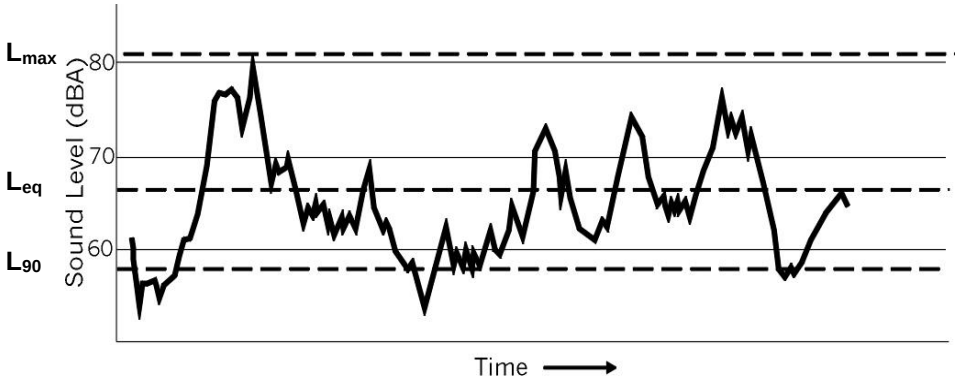
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air. The rate at which the pressure fluctuations occur determines the pitch or *frequency* of the sound. The frequency is expressed in Hertz *(Hz)*, that is, cycles per second. The human ear is sensitive to sounds from about 20 Hertz to 20,000 Hertz. Although sound can be of one discreet frequency - a 'pure tone' - most sound is made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same subjective way. This is the basis of the A-weighted sound pressure level *dBA,* normally used to assess the effect of noise on people. The dBA weighting emphasises or reduces the importance of certain frequencies within the audible range.

Sound Units

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as fifteen minutes or one hour, the statistically determined results being used to quantify various aspects of the sound.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of sound can be described by several different levels. The most common of these are described below. It should be noted that in many instances in the main body of text, the unit will be proceeded by a dB descriptor in the report e.g. $L_{Aeq,T}$ could be written $dBL_{Aeq,T}$



Example of Sound Level Varying with Time

$L_{Aeq,T}$ The equivalent continuous (A-weighted) sound level. It may be thought of as the "average" sound level over a given time, T. It is used for assessing noise from various sources: industrial and commercial premises, construction sites, railways and other intermittent noises and can be considered as the "ambient" noise level.

$L_{A1,T}$ The (A-weighted) sound level exceeded for 1% of a measurement period. It is the value generally used to indicate a 'typical' maximum noise level.

$L_{A90,T}$ The (A-weighted) sound level exceeded for 90% of a measurement period. It is the value often used to describe background noise.

Free-field Level This refers to the sound level measured outside, away from reflecting surfaces.

Façade Level This refers to the sound level measured outside, at 1m from a hard reflecting surface, typically 3dB greater than the free-field level.

APPENDIX B – Noise Survey Details

<table>
<tr><td>Date & Time of Survey:</td><td colspan="6">2020
Thursday 27 November 2020: 0600 to 0700h, 1000 to 1100h, 1500 to 1600h, 1700 to 1800h & 2000 to 2100h.
2022
Monday 14 March 2022: 1000 to 1230h.
Thursday 17 March 2022: 2000 and 2100h.</td></tr>
<tr><td>Personnel:</td><td colspan="6">2020
Michael Ridley & David Terry (AEC).
2022
Paul Knowles & Ross Chamberlain (AEC)</td></tr>
<tr><td>Equipment Used:</td><td colspan="6">2020
Cirrus CR:171B Real Time Analyser (AEC Kit 3).
B&K 2250 lite Real Time Analyser (AEC Kit 4).
2022
B&K 2250 Real Time Analyser (AEC Kit 1).</td></tr>
<tr><td>Calibration:</td><td colspan="6">The sound level analysers, which conform to BS EN 61672-1: 2003 ‘Electro acoustics – sound level meters - Part 1 Specifications’ for Class 1 Type Z meters, were in calibration and check calibrated before and after the measurement periods using a Brüel & Kjær type 4231 (94dB) calibrator. There was no significant drift of calibration. Calibration certificates are available on request.</td></tr>
<tr><td rowspan="5">Weather Conditions:</td><td>Date</td><td>Period</td><td>Wet/Dry</td><td>Temp°C</td><td>Wind Speed & Direction</td><td>Cloud Cover</td></tr>
<tr><td rowspan="2">27.11.2020</td><td>Day</td><td>Dry</td><td>7°C</td><td>Negligible</td><td>80%</td></tr>
<tr><td>Evening</td><td>Dry</td><td>3°C</td><td>Negligible</td><td>40%</td></tr>
<tr><td>14.03.2022</td><td>Day</td><td>Dry</td><td>12°C</td><td>3m/s, westerly</td><td>40%</td></tr>
<tr><td>17.03.2022</td><td>Evening</td><td>Dry</td><td>10°C</td><td>3m/s, northerly</td><td>40%</td></tr>
<tr><td>Measurement Locations:</td><td colspan="6">Measurements were undertaken at three locations around the development site. Identified as A to C on Figure 1 and described below.

A – 40m west from the edge of Heywood Road.
B – 12m west from the edge of Heywood Road.
C – 20m north from the edge of Tamerton Drive.</td></tr>
<tr><td>Measurement Details:</td><td colspan="6">Measurements were undertaken over various periods in terms of L_{eq}, L_{01}, L_{90}, and L_{max}.</td></tr>
<tr><td rowspan="2">Façade / Free-Field:</td><td colspan="6">A, B & C - free-field.</td></tr>
<tr><td colspan="6">Full results for the attended measurements are given in Tables B1 and B2.</td></tr>
<tr><td>Measured Data:</td><td colspan="6">Full octave band centre frequency data was obtained for all measurements and is available on request.</td></tr>
</table>

TABLE B1 – Measured Noise Levels

Location	Period, h	Noise Level, dB				Comments
		L_{Aeq}	L_{A01}	L_{A90}	$L_{Amax, F}$	
A	0605 – 0620	45.8	56.3	42.0	61.8	The main noise source was road traffic noise from Heywood Street. Background noise was made up of road traffic noise from surrounding roads.
	1002 – 1017	48.7	51.6	43.9	60.0	
	1507 – 1522	53.0	53.6	45.2	74.2	Voices and dog barking nearby affecting dBL_{Aeq} and dBL_{Amax}.
	2031 – 2046	46.3	54.1	40.7	65.2	Road traffic noise.
B	0623 – 0638	45.7	57.0	42.7	61.5	The main noise source was road traffic noise from Heywood Street. Background noise was made up of road traffic noise from surrounding roads.
	1020 – 1035	51.7	55.8	43.5	67.1	
	1524 – 1539	55.8	59.8	42.8	68.2	
	1724 – 1739	52.3	60.6	44.0	65.0	
	1958 – 2013	49.2	57.0	41.0	63.3	
C	0640 – 0655	44.2	48.1	43.0	53.7	The main noise source was road traffic noise from Heywood Street. Background noise was made up of road traffic noise from surrounding roads.
	1036 – 1051	46.7	49.0	43.1	64.0	
	1540 – 1555	49.7	52.6	43.0	66.2	
	1740 – 1755	45.4	51.2	41.2	56.6	
	2014 – 2029	43.7	49.2	40.2	55.6	

TABLE B2 – Measured Noise Levels

Location	Period, h	Noise Level, dB				Comments
		L_{Aeq}	L_{A01}	L_{A90}	$L_{Amax, F}$	
A	Daytime – 14 March 2022					
	1025-1040	49.6	56.5	45.9	66.3	The main noise source was road traffic on Heywood Street. Background noise was made up of road traffic noise from surrounding roads.
	1123-1138	50.6	57.5	47.0	68.7	
	1216-1227	48.9	54.3	46.4	65.4	
	Evening – 17 March 2022					
	2000-2010	51.1	57.8	46.7	62.0	The main noise source was road traffic on Heywood Street. Background noise was made up of road traffic noise from surrounding roads.
B	Daytime – 14 March 2022					
	0948-1013	54.1	63.2	45.5	68.1	The main noise source was road traffic on Heywood Street. Background noise was made up of road traffic noise from surrounding roads.
	1043-1058	53.9	63.8	46.5	68.8	
	1139-1154	54.2	64.2	46.7	69.8	
	Evening – 17 March 2022					
	2010-2020	58.9	69.2	48.5	76.6	The main noise source was road traffic on Heywood Street. Background noise was made up of road traffic noise from surrounding roads.
	2045-2055	62.1	75.7	46.2	82.4	
C	Daytime – 14 March 2022					
	1005-1020	48.1	54.0	45.3	64.8	The main noise source was road traffic on Heywood Street. Background noise was made up of road traffic noise from surrounding roads. Noise from nursery was audible but did not affect the ambient noise level. Children not outside during measurement period 1157 to 1212h.
	1104-1119	49.2	56.2	45.8	63.6	
	1157-1212	49.1	56.4	46.1	65.0	
	Evening – 17 March 2022					
	2021-2031	53.3	64.5	44.4	71.4	The main noise source was road traffic noise from Heywood Street. Background noise was made up of road traffic noise from surrounding roads.
	2032-2042	50.2	60.2	43.6	66.8	

APPENDIX C – Calibration Records

Certificate of Calibration

Issued by University of Salford (Acoustics Calibration Laboratory)
UKAS ACCREDITED CALIBRATION LABORATORY NO. 0801

Page 1 of 3

APPROVED SIGNATORIES
Claire Lomax [x] Andy Moorhouse [ ]
Gary Phillips [ ] Danny McCaul [ ]

acoustic calibration laboratory
The University of Salford, Salford, Greater Manchester, M5 4WT, UK
http://www.acoustics.salford.ac.uk
t 0161 295 3030/0161 295 3319 f 0161 295 4456 e c.lomax1@salford.ac.uk

UKAS CALIBRATION 0801

University of Salford MANCHESTER

Certificate Number: 04127/2 Date of Issue: 31 January 2019

PERIODIC TEST OF A SOUND LEVEL METER to IEC 61672-3:2006

FOR:	AEC Lockside 1 Stockport Road Marple Stockport Cheshire, SK6 6BD
FOR THE ATTENTION OF:	Ross Chamberlain
PERIODIC TEST DATE:	31/01/2019
TEST PROCEDURE:	CTP12 (Laboratory Manual)

Sound Level Meter Details

Manufacturer	Bruel & Kjaer	
Model	2250 Light	
Serial number	2580167	
Class	1	
Hardware version	4.0	Sound Level Meter Software BZ7222 Version 4.7.4

Associated Items	Microphone	Preamplifier	Calibrator
Manu	Bruel & Kjaer	Bruel & Kjaer	Bruel & Kjaer
Model	4950	ZC 0032	4231
Serial Number	2585983	26746	2588816
Calibrator Adaptor	-	-	UC0210

Test Engineer (initial): GP Name: Gary Phillips

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to the units of measurement realized at the National Physical Laboratory or other recognized national metrology institutes. This certificate may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

Certificate Number: 04127/2 Date of Issue: 31 January 2019

Procedures from IEC 61672-3: 2006 and TPS 49 Edition 2 June 2009 were used to perform the periodic tests. The manufacturer's instruction manual was marked as follows: B&K 2250-L with mic 4950 BE 1774-11 June 2007 From hardware version 2.0. Adjustment data used to adjust the sound levels indicated in response to the application of a multi-frequency sound calibrator to sound levels equivalent to those that would be indicated in response to plane, progressive sound waves were obtained from the manufacturer's instruction manual referred to in this certificate. The sound level meter calibration check frequency is 1000 Hz, the reference sound pressure level is 94 dB. As this instrument only has a single range, this range is the reference level range.

The environmental conditions in the laboratory at the start of the test were:
Static pressure 98.510 kPa ± 0.015 kPa; air temperature 22.7 °C ± 0.4 °C; relative humidity 43.0 % ± 2.4 %.

The initial response of the instrument to application of the associated sound calibrator was 94.0 dB (C). The instrument was then adjusted to indicate 93.9 dB (C). This indication was obtained from the calibration certificate of the calibrator, 04127/1 and information in the manufacturer's instruction manual specified in this certificate, when the instrument is configured as follows; Transducer: 4950 (2585983), Sound Field Correction: Free-field, Windscreen Correction: None. The instrument was calibrated without a windscreen. Consult manufacturer's instructions if using a windscreen.

With the microphone installed the level of self-generated noise was:

A: 17.7 dB*†

* Under-range indicated on instrument display.

†Indicates that the measured level exceeds the highest anticipated level of self-generated noise stated in the manufacturer's instruction manual.

With the microphone replaced by an electrical input device with a similar capacitance to the supplied microphone, the levels of self-generated noise were:

A: 14.6 dB*†
B: 14.0 dB*†
C: 15.3 dB*†
Z: 20.3 dB*

* Under-range indicated on instrument display.

†Indicates that the measured level exceeds the highest anticipated level of self-generated noise stated in the manufacturer's instruction manual.

The environmental conditions in the laboratory at the end of the test were:
Static pressure 98.470 kPa ± 0.015 kPa; air temperature 23.1 °C ± 0.4 °C; relative humidity 41.4 % ± 2.4 %.

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to the units of measurement realized at the National Physical Laboratory or other recognized national metrology institutes. This certificate may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

Certificate of Calibration

Issued by University of Salford (Acoustics Calibration Laboratory)
UKAS ACCREDITED CALIBRATION LABORATORY NO. 0801

Certificate Number: 04127/2 Date of Issue: 31 January 2019

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

The microphone corrections applied as specified in 12.6 of IEC 61672-3:2006 were obtained from a frequency response measured by this Laboratory using the electrostatic actuator method. This response in isolation is not covered by our UKAS accreditation.

Instruments used in the verification procedure were traceable to *National Standards*. The multi-frequency calibrator method was employed in the acoustical tests of a frequency weighting.

The uncertainty evaluation has been carried out in accordance with UKAS requirements. All measurement results are retained at the acoustic calibration laboratory for at least four years.

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to the units of measurement realized 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.

CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research plc**

DATE OF ISSUE **30 October 2019** CERTIFICATE NUMBER **133684**

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

Approved signatory
J.Johnston
Electronically signed:

Sound Calibrator : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc

Model: CR:515

Serial number: 89379

Class: 1

Notes:

Test summary

Date of calibration: 11 October 2019

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.

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 PhysikalischTechnische Bundesanstalt (PTB).

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.

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: **133684**

Environmental conditions

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

Pressure: 99.50 kPa
Temperature: 23.4 °C
Humidity: 55.3 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Acoustic Calibrator	Bruel and Kjaer	4231	1795641
Distortion Meter	Keithley	2015	1175401
Multimeter	Fluke	8845A	9440017

Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Limits	Uncertainty
Level (dB)	94.00	94.00	94.00	94.00	**94.00**	0.00	±0.40	0
Distortion (%)	< 3.00	1.18	1.18	1.21	**1.19**	1.19	+3.00	0
Frequency (Hz)	1000.0	1000.0	1000.0	1000.0	**1000.0**	0.0	±10.0	0

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

End of results

Certificate of Calibration

Issued by University of Salford (Acoustic Calibration Laboratory)

University of Salford MANCHESTER

Page 1 of 2

APPROVED SIGNATORIES

Claire Lomax [x] Andy Moorhouse [ ]

Gary Phillips [ ] Danny McCaul [ ]

acoustic calibration laboratory

The University of Salford, Salford, Greater Manchester, M5 4WT, UK

http://www.acoustics.salford.ac.uk

t 0161 295 3030/0161 295 3319 f 0161 295 4456 e c.lomax1@salford.ac.uk

Certificate Number: 05541/1 Date of Issue: 24 November 2021

CALIBRATION OF A SOUND CALIBRATOR

FOR:	Acoustic & Engineering Consultants ltd Suite 316, 3rd Floor Broadstone Mill Broadstone Road Stockport Cheshire SK5 7DL
FOR THE ATTENTION OF:	Ross Chamberlain
DESCRIPTION:	Sound calibrator with housing for one-inch microphones with adaptor UC 0210 for half-inch microphones.
MANUFACTURER:	B&K
TYPE:	4231
SERIAL NUMBER:	3018624
DATE RECEIVED:	9 November 2021
DATE OF CALIBRATION:	15 November 2021
LOCATION OF CALIBRATION:	Acoustic Calibration Laboratory, Newton G31, University of Salford.
TEST PROCEDURE:	CTP06 (Laboratory Manual)

Test Engineer (initial):	GP	Name:	Gary Phillips

Results in this certificate relate only to instruments tested.

This certificate provides traceability of measurement to the SI system of units and/or to the 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.

Certificate of Calibration

Issued by University of Salford (Acoustic Calibration Laboratory)

Certificate Number: 05541/1 Date of Issue: 24 November 2021

MEASUREMENTS

The sound pressure level generated by the calibrator was measured using a calibrated, WS2P condenser microphone as specified in this certificate. The calibration was carried out with the calibrator in the half-inch configuration.

Five determinations of the sound pressure level, frequency and total distortion were made.

The results have been corrected to the reference pressure of 101.325 kPa using manufacturer's data.

RESULTS

Coupler configuration:	Half-inch
Microphone type:	GRAS 40AG
Output level (dB re 20μPa):	94.06 dB ± 0.09 dB
Frequency (Hz):	999.98 Hz ± 0.12 Hz
Total Distortion (%):	0.09 % ± 0.23 % *

*Negative values of distortion are not realistic and are not included in the confidence interval.

Average environmental conditions at the time of measurement were:

Pressure:	102.204 kPa ± 0.015 kPa
Temperature:	22.8 °C ± 0.4 °C
Relative humidity:	43.6 % ± 2.1 %

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

All measurement results are retained at the acoustic calibration laboratory for at least four years.

-----END OF CERTIFICATE-----

This certificate provides traceability of measurement to the SI system of units and/or to the 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.

Certificate of Calibration

Issued by University of Salford (Acoustics Calibration Laboratory)

University of Salford MANCHESTER

Page 1 of 3

APPROVED SIGNATORIES

Claire Lomax [x] Andy Moorhouse [ ]

Gary Phillips [ ] Danny McCaul [ ]

acoustic calibration laboratory

The University of Salford, Salford, Greater Manchester, M5 4WT, UK

http://www.acoustics.salford.ac.uk

t 0161 295 3030/0161 295 3319 f 0161 295 4456 e c.lomax1@salford.ac.uk

Certificate Number: 05541/2 Date of Issue: 22 November 2021

PERIODIC TEST OF A SOUND LEVEL METER to IEC 61672-3:2006

FOR:	Acoustic & Engineering Consultants ltd Suite 316, 3rd Floor Broadstone Mill Broadstone Road, Stockport Cheshire, SK5 7DL
FOR THE ATTENTION OF:	Ross Chamberlain
DATE RECEIVED:	9th November 2021
PERIODIC TEST DATE:	15th and 16th November 2021
LOCATION OF CALIBRATION:	Acoustic Calibration Laboratory, Newton G31, University of Salford
TEST PROCEDURE:	CTP12 (Laboratory Manual)

Sound Level Meter Details-

Manufacturer	B&K
Model	2250
Serial number	2456390
Class	1
Hardware version	4.0
Software version	BZ7222 Version 4.7.5

Associated Items:-

Type	Manufacturer	Model	Serial Number	Adaptor
Microphone	B&K	4189	2876807	
Preamplifier	B&K	ZC 0032	25899	
Calibrator	B&K	4231	3018624	UC0210

Test Engineer (initial):	GP	Name:	Gary Phillips

Results in this certificate relate only to instruments tested.

This certificate provides traceability of measurement to the SI system of units and/or to the 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.

Certificate Number: 05541/2 Date of Issue: 22 November 2021

Procedures from IEC 61672-3: 2006 and TPS 49 Edition 2 June 2009 were used to perform the periodic tests. The manufacturer's instruction manual was marked as follows: B&K 2250 BE 1712-15 April 2007 from hardware version 1.1. Adjustment data used to adjust the sound levels indicated in response to the application of an electrostatic actuator to sound levels equivalent to those that would be indicated in response to plane, progressive sound waves were obtained from the manufacturer's instruction manual referred to in this certificate. The sound level meter calibration check frequency is 1000 Hz, the reference sound pressure level is 94 dB. As this instrument only has a single range, this range is the reference level range.

The environmental conditions in the laboratory at the start of the test were:
Static pressure 102.110 kPa ± 0.013 kPa; air temperature 23.2 °C ± 0.4 °C; relative humidity 47.6 % ± 2.1 %.

The initial response of the instrument to application of the associated sound calibrator was 94.0 dB (C). No adjustment of the instrument was required. This indication was obtained from the calibration certificate of the calibrator 05541/1 and information in the manufacturer's instruction manual specified in this certificate, when the instrument is configured as follows; Input: Top socket, Transducer: 4189 (2876807), Sound Field Correction: Free-field, Windscreen Auto Detect: Off, Windscreen Correction: None. The instrument was calibrated without a windshield. Consult manufacturer's instructions if using a windshield.

With the microphone installed the level of self-generated noise was:

A: 17.2 dB*

***** Under-range indicated on instrument display.

With the microphone replaced by the electrical input device specified in the manufacturer's instruction manual, the levels of self-generated noise were:

A: 13.2 dB*
B: 12.3 dB*
C: 13.4 dB*
$Z_{LF\ normal}$: 18.4 dB*
$Z_{LF\ extended}$: 22.8 dB*

* Under-range indicated on instrument display.

The environmental conditions in the laboratory at the end of the test were:
Static pressure 101.518 kPa ± 0.013 kPa; air temperature 22.4°C ± 0.4 °C; relative humidity 49.2 % ± 2.1 %.

This certificate provides traceability of measurement to the SI system of units and/or to the 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.

Certificate of Calibration

Issued by University of Salford (Acoustics Calibration Laboratory)

Certificate Number: 05541/2 Date of Issue: 22 November 2021

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

The microphone corrections applied as specified in 12.6 of IEC 61672-3:2006 were obtained from a frequency response measured by this Laboratory using the electrostatic actuator method. This response in isolation is not covered by our UKAS accreditation.

Instruments used in the verification procedure were traceable to *National Standards*. The electrostatic actuator method was employed in the acoustical tests of a frequency weighting.

All measurement results are retained at the acoustic calibration laboratory for at least four years.

-----END OF CERTIFICATE-----

This certificate provides traceability of measurement to the SI system of units and/or to the 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.