SHARPS REDMORE

ACOUSTIC CONSULTANTS • Established 1990

Report

Tesco Yeading Extra,
Glencoe Road, Hayes,
UB4 9SQ

Environmental Noise Assessment of a proposal to allow Sunday delivery hours

Prepared by
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Project No 2322121

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Contents

Appendices

1.0 Introduction

1.1 SR has been instructed to consider the noise implications of a proposal to seek a relaxation of the current Sunday delivery restrictions, to allow a single delivery to be made to the front door of the Tesco store at Glencoe Road, Yeading between 0900 and 1000 hours on Sundays.

1.2 This assessment is prepared to determine whether noise associated with a single delivery to the front door of the Tesco store between 0900 and 1000 hours would avoid giving rise to significant adverse impact, which is the test under the NPPF.

1.3 Planning permission (ref. 36999E/89/1214) was granted in 1990 for the erection of a District Shopping Centre incorporating a retail store, 12 small shops (with residential accommodation above), surgery, public house/restaurant, public conveniences, petrol filling station, community facilities and associated car parking and landscaping. In March 1994, London Borough of Hillingdon refused an application (ref 36999T/93/878) to vary condition 12 of the consent to allow trading on Sundays between 10 a.m. and 6 p.m. The decision was appealed (ref T/APP/R5510/A/94/236865/P2) and upheld subject to the imposition of various conditions including the prevention of service deliveries on Sundays.

1.4 Tesco is continuing to experience significant logistical issues relating to the availability of fresh produce on Sundays, and hence seeks a single front door delivery between 0900 and 1000 hours to alleviate this situation.

1.5 The closest residential properties to a delivery at the front door of the Tesco store would be those located approximately 60 metres to the north (flats above the shops) at Jollys Lane, approximately 95 metres to the west in Clayton Terrace, and 120 metres to the south in Sharpness Close, as indicated at Appendix A.

1.6 Appropriate assessment criteria are presented in Section 2 whilst details of a noise survey undertaken at the site are displayed in Section 3.

1.7 An assessment of noise from deliveries is presented in section 4; delivery activity noise reduction measures are outlined in section 5.

2.0 Assessment methodology and criteria

National policy

2.1 The National Planning Policy Framework (NPPF), September 2023, sets out the Government's planning policies for England and "these policies articulate the Government's vision of sustainable development." In respect of noise, Paragraph 185 of the NPPF states the following:

"Planning policies and decisions should also 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:

a) 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;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation".

2.2 Guidance on the interpretation of the policy aims contained within the NPPF is contained within National Planning Policy Guidance (NPPG). The NPPG introduces the concept of a noise exposure hierarchy based on likely average response. The guidance contained in the NPPG is summarised in the table below:

TABLE 1: Noise Exposure Hierarchy

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not noticeable	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.3 The NPPF and NPPG reinforce the March 2010 DEFRA publication, "Noise Policy Statement for England" (NPSE), which states three policy aims, as follows:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

2.4 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"… all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

2.5 Taking an overview of national policy aims and guidance it is clear that when considering the impact of noise that the fact can be heard and causes impact, is not reason to refusal an application as consideration should also be given to the significance of the impact and the mitigation measures available.

2.6 It is possible to apply objective standards to the assessment of noise and the effect produced by the introduction of a certain noise source may be determined by several methods, as follows:

i) The effect may be determined by reference to guideline noise values, such as those contained in the World Health Organisation (WHO) "*Guidelines for Community Noise"*.

ii) Alternatively, the impact may be determined by considering the change in noise level that would result from the proposal, in an appropriate noise index for the characteristic of the noise in question. There are various criteria linking change in noise level to effect. This is the method that is suited to, for example, the assessment of noise from road traffic because it is capable of displaying impact to all properties adjacent to a road link irrespective of their distance from the road.

iii) Another method is described within BS 4142:2014 to determine the significance of sound impact from sources of industrial and/or commercial nature. The sources that the newly revised standard is intended to assess are sound from industrial and manufacturing processes, sound from fixed plant installations, sound from loading and unloading of goods at industrial

and/or commercial premises and the sound from mobile plant and vehicles, such as forklift, train or ship movements.

Guidelines for Community Noise

2.7 The WHO "Community Noise Guidelines" (CNG) values are appropriate to what are termed "critical health effects". This means that the limits are at the lowest noise level that would result in any psychological or physiological effect. They are, as defined by NPSE, set at the Lowest Observed Adverse Effect Level (LOAEL), but do not define the level above which effects are significant (the SOAEL). Compliance with the LOAEL should, therefore, be seen as a robust aim.

2.8 The relevant World Health Organisation (CNG) noise values are summarised in the following table:

TABLE 2: WHO CNG values

Document	Level	Guidance
World Health Organisation "Community Noise 2000"	L_{AeqT} = 55 dB	Serious annoyance, daytime and evening. (Continuous noise, outdoor living areas)
	L_{AeqT} = 50 dB	Moderate annoyance, daytime and evening. (Continuous noise, outdoor living areas).
	L_{AeqT} = 35 dB	Moderate annoyance, daytime and evening. (Continuous noise, dwellings, indoors)
	L_{AeqT} = 30 dB	Sleep disturbance, night-time (indoors)
	L_{Amax} = 60 dB	Sleep disturbance, windows open at night. (Noise peaks outside bedrooms, external level).
	L_{Amax} = 45 dB	Sleep disturbance at night (Noise peaks inside bedrooms, internal level)

2.9 For L_{AeqT} criteria the time base (T) given in the documents is 16 hours for daytime limits and 8 hours for night time limits. When assessing impact, this has the tendency to smooth out the hourly variations in noise level. As such, our calculations are carried out to a 1 hour time base, which is a more stringent assessment than is given in WHO Guidelines for Community Noise.

2.10 The internal CNG values can be converted to an external value by the addition of the attenuation provided by a partially open window of 15 dB.

Changes in noise level

2.11 Changes in noise levels of less than 3 dBA are not perceptible under normal conditions and changes of 10 dBA are equivalent to a doubling of loudness. This guidance has been accepted by inspectors, at inquiry, to encompass changes in noise levels in the index L_{AeqT}.

2.12 Table 3 shows the response to changes in noise (known as a semantic scale); this table has been developed from general consensus opinion of acousticians.

TABLE 3: Change in noise level

Change in noise level L_{AeqT} dB	Response	Impact
<3	Imperceptible	None
3 – 5	Perceptible	Slight/moderate
6 – 10	Up to a doubling	Moderate/significant
11 – 15	More than a doubling	Substantial
>15	-	Severe

2.13 Where the existing ambient noise level is already above the criteria developed from the various guidance documents, it may be considered unreasonable to adopt such criteria. It would be reasonable, however, given the above statement, to consider criteria which do not exceed the existing noise climate, thus giving rise to an overall 3 dB increase i.e. the minimum perceptible. If it is less than the minimum perceptible it cannot be described as disturbing or to affect the amenity of residents.

Assessment using BS 4142:2014+A1:2019

2.14 As outlined, this British Standard enables the significance of sound impact to be determined in relation to industrial and commercial sources. The assessment method is a two-step process; firstly, an initial estimate of the noise impact is determined according to the following summary process:

i) Determine the background sound levels, in terms of the index L_{A90}, at the receptor locations of interest.

ii) Determine the specific sound level of the source being assessed, in terms of its L_{AeqT} level (T = 1 hour for day or 15 minutes for night), at the receptor location of interest.

iii) Apply a rating level acoustic feature correction if the source sound has tonal, impulsive, intermittent, or other characteristics which attract attention.

iv) Compare the rating sound level with the background sound level; the greater the difference between the two, the higher the likelihood of adverse impact.

v) A difference (rating – background) of around +10 dB is an indication of significant adverse impact, depending on the context; a difference of +5 dB is an indication of an adverse impact, depending on the context. Where

the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending upon context.

vi) The intent of the planning system is to ensure that a development does not result in "significant adverse impacts on health and quality of life." BS 4142:2014 considers that the threshold of significant adverse impact is "a difference around +10 dB or more … depending upon the context". However, the NPPF and NPPG state that where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement *"…all reasonable steps should be taken to mitigate and minimise adverse effects in health and quality of life while together taking into account the guiding principles of sustainable development. This does not mean that adverse effects cannot occur but that effort should be focused on minimising such effects"*.

2.15 BS 4142:2014+A1:2019 uses the concept of '*context*' in the process of identifying noise impact; this is the second part of the BS 4142 assessment process to determine the overall noise impact. It is important to appreciate that a BS 4142 assessment which does not consider both the initial estimate/numerical level difference and the context upon which the sound occurs is incomplete, and not in accordance with the requirements of the British Standard.

2.16 Section 11 of BS 4142:2014 explains "*The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs* (our emphasis). A*n effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context"* (our emphasis).

2.17 There are many *context* points to consider when undertaking an assessment of sound impact including:

- The absolute level of sound;
- The character and level of the specific sound in the context of the existing noise climate; for example is the sound to occur in a location already characterised by similar activities as those proposed?
- The sensitivity of the receptors;
- The time and duration that the specific sound is to occur;
- The conclusions of assessments undertaken using alternative assessment methods, for example WHO guidelines noise values or change in noise level;

2.18 It is therefore entirely possible that whilst the numerical outcome of a BS 4142:2014+A1:2019 assessment is indicative of adverse or significant adverse

impact, when the proposal is considered in *context* the significance of the impact is reduced to an acceptable level.

Local policy

2.19 The London Boroughs of Hillingdon, Hounslow and Richmond upon Thames have a joint Supplementary Planning Document (SPD) relating to noise, entitled "Development Control for Noise Generating and Noise Sensitive Development".

2.20 In relation to the assessment of noise from industrial and commercial development the SPD identifies that the most relevant Standard is BS 4142:2014 (now BS 4142:2014+A1:2019). The SPD states:

As a general rule, the Boroughs will seek to achieve the external noise standards detailed in **Table 2** below (all terms are as defined in BS4142).

Table 2: New Industrial and Commercial Development - External Noise Standards

Noise Impact From Relevant Proposed Industrial Or Commercial Premises Or Plant	Development Outcome
Rating Level (LAr,Tr) is at least 5 dB(A) below the Background Level LA90	Normally acceptable
Rating level (LAr,Tr) is no more than 5 dB(A) above the Background Level LA90	Acceptable only if there are overriding economic or social reasons for development to proceed
Rating level (LAr,Tr) is more than 5 dB(A) above the Background Level LA90	Normally unacceptable

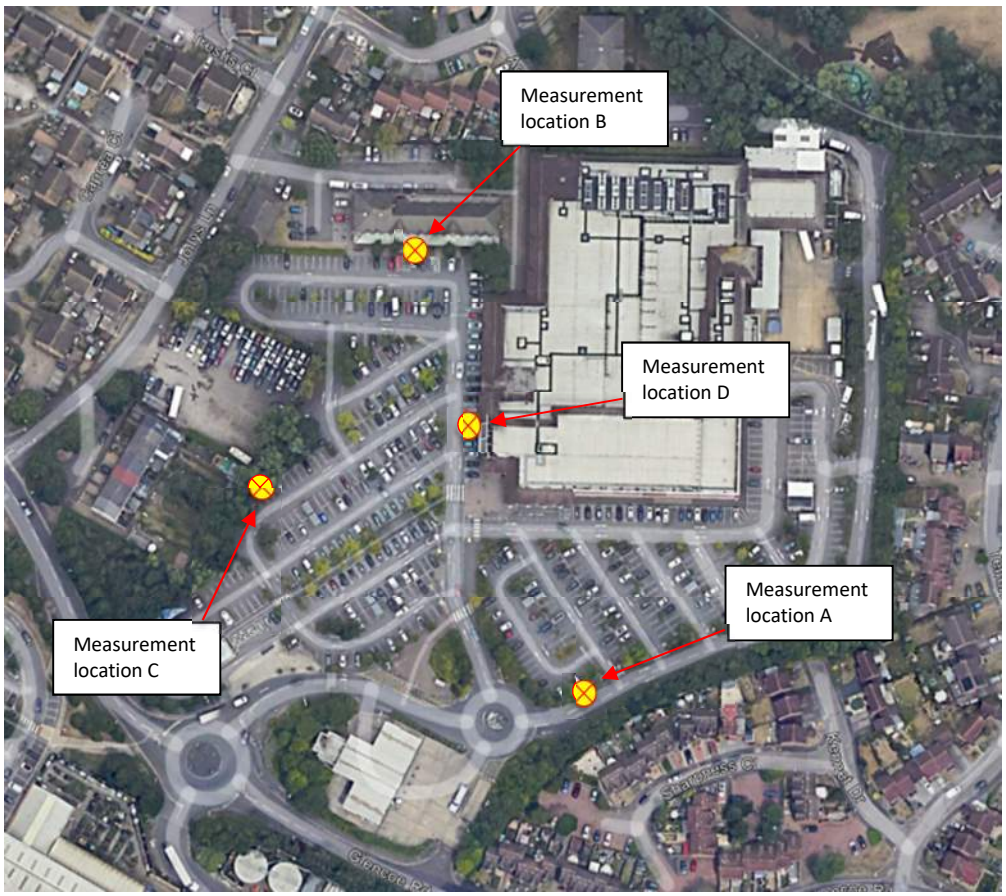
Note: All terms as defined in BS4142

3.0 Noise survey details

3.1 A noise survey has been undertaken to obtain baseline measurements of the existing noise climate in the vicinity of the Tesco store at the time a delivery is sought, and to directly measure the noise of a delivery occurring to the front door e store. service series of noise measurements were taken from 0800 hours on the morning of Sunday 5th November 2023, to establish the existing background and ambient noise climate, and to directly measure the noise from a single delivery to the front door of the store.

3.2 The survey approach was to measure at four locations; three at positions representative of the closed residential properties to the north, west and south, and the other approximately 5 metres from the delivery unloading activity. The noise measurement locations are indicated in the figure below.

FIGURE 1: Noise measurement locations



3.3 The noise measurements were carried out using three Norsonic 118 sound level meters and associated environmental microphone kits, and a Norsonic 140 sound level meter and associated environmental microphone kit. The sound level meters were all calibrated at the start and end of the survey and no drift in level was observed. Details of the noise survey personnel and sound level meter calibration certificates are presented at Appendix B.

3.4 At measurement locations A and B the microphones were set at a height of approximately 3 m above local ground level, whilst locations C and D were at a height of 1.6 metres. Baseline noise measurements were taken over 15 minute samples before and after the delivery occurred, in free field conditions. The weather conditions locally were observed to be dry, cloudy with a light breeze from the north west (<5m/s). Weather conditions are not considered to have affected the measured noise levels during the survey.

3.5 The noise levels from measurement locations A to C are summarised in Figures 2 to 4 below, and presented in full in Appendix C.

FIGURE 2: Measured Sunday noise levels Sharpness Close (location A)

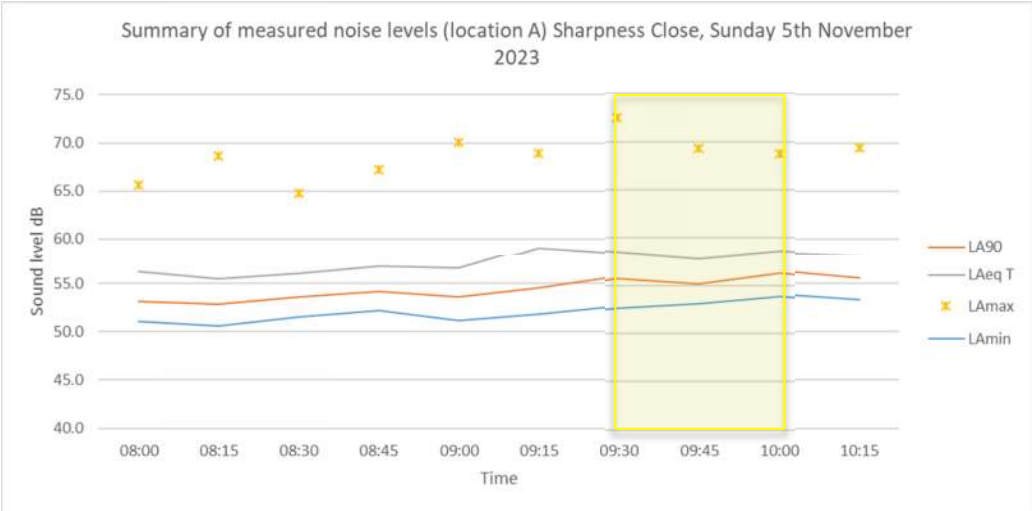


FIGURE 3: Measured Sunday noise levels Jolly's Lane (location B)

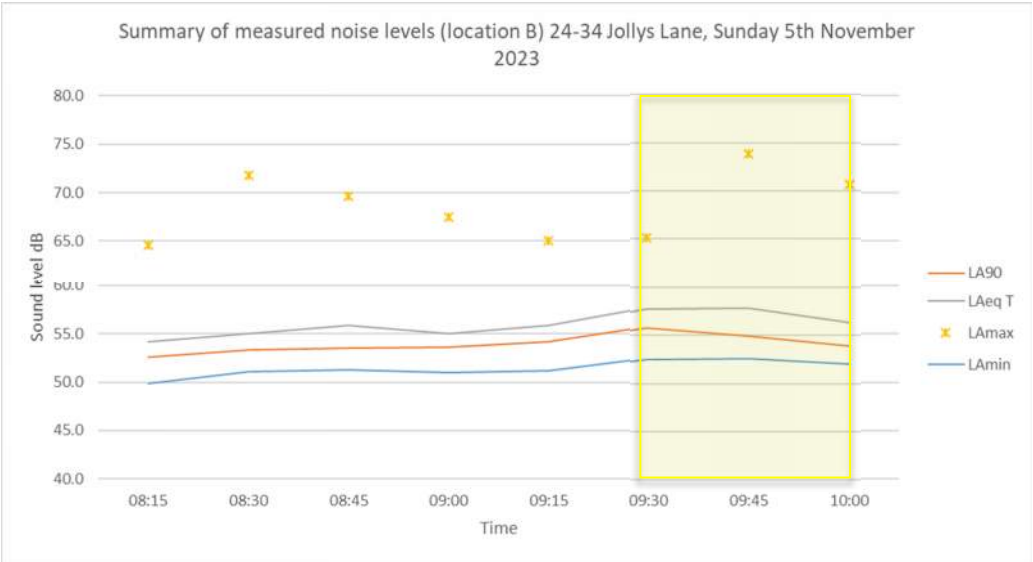
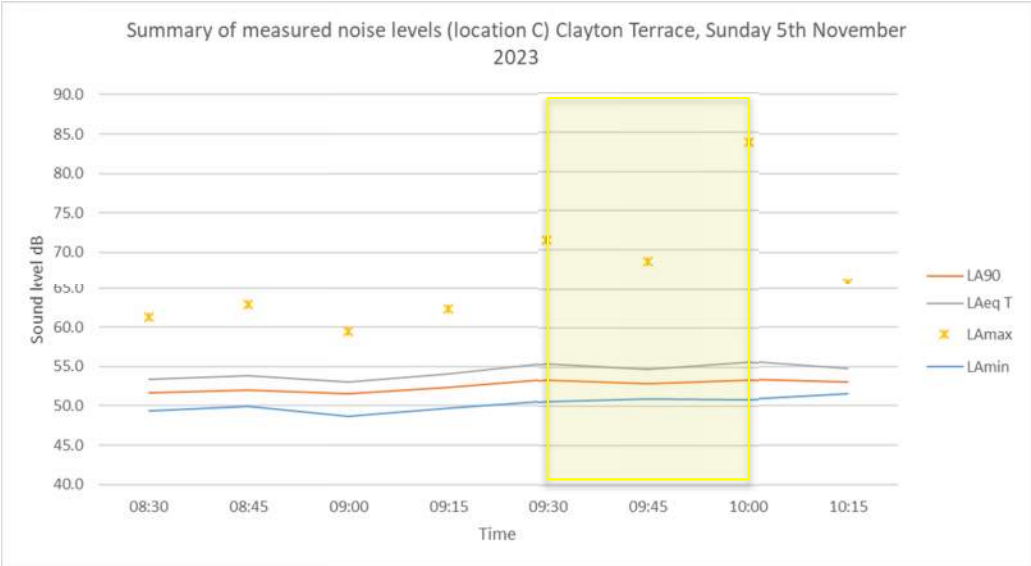


FIGURE 4: Measured Sunday noise levels Clayton Terrace (location C)



3.6 The noise measurements at location D established a period source noise level at 5 metres from delivery unloading activity. A delivery event source noise level of 66 dB $L_{Aeq\ 30\ minutes}$ was measured. The measured noise levels include all activity associated with the removal of roll cages from the wagon, including the use of the tailgate lift, movement of cages, removal of secure straps, and the roller shutter door. The measured delivery activity noise level of 66 dB $L_{Aeq\ T}$ (at 5m) compares well with the SR database of source noise levels associated with deliveries made via tailgate lift.

3.7 From site observations, the existing noise climate was contributed to by existing local road traffic sources and vehicles entering the Tesco car park for browsing, prior to the store opening at 1000 hours. Subjectively at all three measurement locations A to C, whilst delivery activity noise was perceptible, it was not the dominant source present. This is indicated at Figures 2 to 4 insofar that there is very little material change in noise level compared to the periods prior to and after the delivery event.

4.0 Noise from delivery activity

4.1 The closest residential properties to a delivery at the front door of the Tesco store would be those located approximately 60 metres to the north (flats above the shops) at Jollys Lane, approximately 95 metres to the west in Clayton Terrace, and 120 metres to the south in Sharpness Close, as indicated at Appendix A.

4.2 The following source noise levels were direct measured at the Glencoe Road, Tesco store in relation to the arrival, unloading and departure of the delivery vehicle, and are normalised to a 10 metre reference distance below:

TABLE 4: Delivery activity source noise levels (free field)

Measured delivery event source noise level (at 10 metres)					
Arrival		Unloading		Departure	
Duration (mins)	$L_{Aeq\ T}$ (dB)	Duration (mins)	$L_{Aeq\ T}$ (dB)	Duration (mins)	$L_{Aeq\ T}$ (dB)
1	69	30	60	1	72

4.3 The source noise levels in Table 4 include all delivery activity at the front door, including manoeuvring, roller shutter noise, secure strap removal, tailgate lift and movement of roll cages.

4.4 Table 5 below shows the predicted ambient ($L_{Aeq\ T}$) delivery activity noise levels at the closest residential properties to the front door delivery (full delivery event activity noise predictions are included at Appendix D1).

TABLE 5: Predicted delivery activity noise levels

Receptor	Predicted noise level dB $L_{Aeq\ 1\text{-}hour}$
17 Sharpness Close	38
Jollys Lane	44
Clayton Terrace	40

4.5 An assessment of delivery activity noise levels using the methodology in BS 4142:2014 is presented in Appendix E. The table below summarises the comparison of the predicted delivery rating level and background noise climate, during the addition period that Sunday front door deliveries are sought (between 0900 and 1000 hours).

TABLE 6: Summary of BS 4142:2014 assessment of delivery activity noise

Receptor	Excess of rating level over background level dB	Initial estimate from BS 4142 assessment	Compliance with SPD L_{A90} v rating level criteria (L_{A90} - 5 dB)
17 Sharpness Close	-11	Low impact* for front door deliveries between 0900 and 1000 hours Sunday morning	Yes
Jollys Lane	-5		Yes
Clayton Terrace	7		Yes

*Depending on the context

4.6 Table 6 indicates that noise associated with a single Sunday morning front door delivery is indicative of low noise impact (in accordance with BS 4142) and complies with the requirements of the SPD insofar that noise would be "normally acceptable".

4.7 Section 11 of BS 4142:2014+A1:2019 explains "*The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs* (my emphasis). *An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context"* (my emphasis).

4.8 The BS 4142 assessment at Appendices E1 to E3 summarise the key contextual considerations in this instance. The first is how the predicted delivery activity noise levels compare to the WHO CNG values; the table below shows this comparison.

TABLE 7: Comparison of predicted delivery event noise levels with the WHO CNG values

	Noise level dB $L_{Aeq\ 1\ hour}$		
Receptor	17 Shaprness Close	Jollys Lane	Clayton Terrace
Predicted delivery event noise level	38	44	40
WHO guideline daytime noise value [1]	55	55	55
Comply with WHO daytime guidelines	YES	YES	YES

Notes

[1] Where $L_{Aeq\ T}$ = 16 hour night time.

4.9 The comparison in Table 7 indicates that predicted delivery event noise levels are significantly below the WHO guideline values. The comparison with the existing noise climate (Figures 2 to 4) is that delivery activity noise is well below the existing ambient noise climate during the hour period (0900 and 1000 hours) on a Sunday morning that front door deliveries are sought.

4.10 With regard to noise impact and reference to Table 1 'Noise Exposure Hierarchy', it is considered that the outcome of the above comparison falls below the Lowest Observed Adverse Effect Level (LOAEL).

4.11 Overall this assessment shows that noise associated with a single front door delivery to the Tesco store at Glencoe Road on Sunday mornings between 0900 and 1000 hours would be indicative of low noise impact. Hence in accordance with both national and local planning policy noise should not be a reason to refuse a planning application.

5.0 Delivery activity noise reduction measures

5.1 It is recommended that the following noise minimisation measures shall be implemented to reduce noise levels from front door delivery activity:

- There will be adequate signage and instruction to ensure that all drivers and staff follow the noise management measures;
- All engines to be switched off as soon as vehicles are parked in the unloading position;
- All delivery vehicles to be driven in as quiet a manner as possible, avoiding unnecessary engine revving;
- No radios or stereos to be left on in vehicles during deliveries or at other times;
- Staff to be instructed to work quietly when unloading roll cages from the wagon;
- Tailgate flaps to be lowered to gently to avoid excessive impact with the ground;
- All components of the delivery system to be maintained in good working order.

6.0 Assessment conclusions

6.1 Sharps Redmore (SR) has undertaken an environmental noise assessment to consider whether the Tesco store at Glencoe Road, Yeading could receive a single delivery to the front door of the store between 0900 and 1000 hours on a Sunday morning without associated noise giving rise to significant adverse impact.

6.2 This assessment objectively demonstrates that noise associated with delivery activity to the front door of the Tesco store at Glencoe Road, Yeading, between 0900 and 1000 hours on Sundays, would not give rise to significant adverse impact and hence would comply with the requirements of the NPPF, and local planning policy by complying with the requirements of the local authority's Supplementary Planning Document.

APPENDIX A

SITE LOCATION PLAN

Appendix A: Tesco Extra Yeading site location plan

APPENDIX B

NOISE SURVEY STAFF/EQUIPMENT DETAILS

Noise survey personal:

Sharps Redmore technician - Andrew Collins TechIOA. Joined SR 2014, Andrew has nearly ten years' experience in environmental noise measurement and has undertaken a considerable number of noise surveys in relation to retail activity.

Andrew has successfully completed the IOA course 'Certificate of Compentence Environmental Noise Measurement '

Date: Sunday 5th November 2023

Location: Tesco Glencoe Road, Hayes, Yeading

Calibration certificates

Calibration certificates for the noise monitoring equipment used are displayed below.

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration

Certificate number: **42270**

Test Object:	**Sound Level Meter, BS EN IEC 61672-1:2003 Class 1** **Associated Frequency Analyser to BS EN IEC 61260:1996 Class 1**
Producer:	**Norsonic AS.**
Type:	**118**
Serial number:	**31342**
Customer:	**Sharps Redmore**
Address:	**The White House, London Road,** **Copdock, Ipswich, Suffolk. IP8 3JH.**
Contact Person:	**Emily Sharpe**
Order No:	**ESS 22 0060**

Introduction:
Calibration has been performed as set out in CA Technical Procedures which are based on the procedures for periodic verification of sound level meters as per the **Test Object** listed above. Results and conformance statement are overleaf and detailed results, where appropriate, are provided in the attached Measurement Report.

Tested:	*Producer*	*Type*	*Serial No*	*Certificate No*
Microphone	GRAS	40AF	73283	42269
Calibrator*	Norsonic	1251	30868	42268
Preamplifier	Norsonic	1206	30370	Included

* The calibrator was complete with any required coupler for the microphone specified.

Additional items that have also been submitted for verification:

Wind shield	Norsonic	Nor1451 (ø 60mm)
Attenuator	N/A	
Extension cable	N/A	

These items have been taken into account wherever appropriate.

Instruction Manual: Nor118 User Guide- November 2002 Edition Firmware Version: v3.4.6238 The test object is a single channel instrument.

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.90 ±0.04	22.23 ±0.35	50.45 ±1.1

Calibration Dates:

Received date:	17/10/2022	Reviewed date:	31/10/2022
Calibration date:	28/10/2022	Issued date:	31/10/2022

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan B.Eng (Hons), M.Sc*

Reviewed by: *Jenny Crawford*

Certificate of Calibration

Continuation of Certificate number: 42270

The statements of conformance and observation notes detailed in this certificate are made with reference to the following standards in respect of the calibration of the test object.

Manufactured:	**BS EN IEC 61672-1:2003**
Periodic Tests:	**BS EN IEC 61672-3:2006**
Pattern Evaluation:	**Not Applicable**
Filter Evaluation:	**BS EN IEC 61260:1996 Class 1**

Conformance:

From markings on the sound level meter or by reference to the manufacturer's published literature it has been determined that the instrument submitted for verification was originally manufactured to the listed standard and similarly that the associated sound calibrator conforms to the BS EN IEC 60942 standard.

Measurement Summary:

Indication at the calibration check frequency - IEC61672-3 Ed.1 #9	Passed
Self-generated noise - IEC 61672-3 Ed.1 #10.2	Passed
Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.1 #11	Passed
Electrical signal tests of frequency weightings - IEC 61672-3 Ed.1 #12	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.1 #13	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.1 #14	Passed
Toneburst response - IEC 61672-3 Ed.1 #16	Passed
Peak C sound level - IEC 61672-3 Ed.1 #17	Passed
Overload indication - IEC 61672-3 Ed.1 #18	Passed
1/1octave: Relative attenuation - IEC 61260, #4.4 & #5.3	Passed
1/3octave: Relative attenuation - IEC 61260, #4.4 & #5.3	Passed

Comments

Correct level with associated calibrator is 113.9dB(A). This was determined with the meter CAL sensitivity set to -25.7dB and G preamplifier correction only enabled and set to 0.1dB.

Statement of Conformance

The sound level meter submitted for testing has successfully completed the periodic tests for the environmental conditions under which the tests were performed. However, no general statement of conclusion can be made about conformance of the sound level meter to the full requirements of the manufactured standard because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in the manufacturer's standard and because the periodic tests completed cover only a limited subset of the specifications in the relevant standard

Filter Calibration

The filter functions have been found to conform, by electrical testing, to the relative attenuation requirement of the standard noted over the range of frequencies shown in the attached test report.

Observations

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a coverage probability of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA publication EA-4/02. Details of the uncertainty for each measurement are available from the Calibration Laboratory upon request. Details of the sources of corrections and their associated uncertainties that relate to this verification are contained within the test report accompanying this certificate.

This certificate relates only to the items tested above.

** End of Certificate **

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration

Certificate number: **42269**

Test Object: **Measurement Microphone**

Producer: **GRAS**
Type: **40AF**
Serial number: **73283**
Customer: **Sharps Redmore**
Address: **The White House, London Road, Copdock, Ipswich, Suffolk. IP8 3JH.**
Contact Person: **Emily Sharpe**
Order No: **ESS 22 0060**

Measurement Results	Sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)	Capacitance (pF)
Measurement 1	*-25.70*	*51.89*	*22.57*
Measurement 2	*-25.70*	*51.87*	*22.62*
Measurement 3	*-25.70*	*51.89*	*22.64*
Result (Average):	***-25.70***	***51.88***	***22.61***
Expanded Uncertainty:	0.10		1.00
Degree of Freedom:	>100		>100
Coverage Factor:	2		2

The stated sensitivity is the pressure sensitivity at 250Hz, S_{250}, and is valid at reference conditions. The following correction factors have been applied during the measurement:
Pressure:-0.011 dB/kPa Temperature:-0.01 dB/°C Humidity:-0.001 dB/%RH

Conditions	*Pressure kPa*	*Temperature °C*	*Humidty %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.86 ± 0.040	22.4 ± 0.1	51.2 ± 0.7

The calibration test report shown on the next page gives details of the response at other frequencies relative to this 250 Hz reference sensitivity. Results ≥100 Hz are obtained using an electrostatic actuator as described in BS EN 61094-6 and those below 100 Hz are obtained in a reference pressure chamber. Detailed results are available from the calibration laboratory upon request.

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a coverage probability of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level.

Calibration Dates:

Received date:	17/10/2022	Reviewed date:	31/10/2022
Calibration date:	28/10/2022	Issued date:	31/10/2022

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan B.Eng (Hons), M.Sc*
Reviewed by: *Jenny Crawford*

Certificate of Calibration

Continuation of Certificate number: 42269

Reference Calibrator: WSC2 - GRAS42AA-18277
Measurement Record: K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\GRAS40AF_73283_M1.nmf

Preconditioning
The equipment was preconditioned for more than 12 hours at the specified calibration temperature and humidity.

Instruments and Program
A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Traceability
The measured values for sound pressure, frequency, voltage, capacitance, temperature, humidity and ambient pressure are traceable to an accredited national physical laboratory.

Observations
The differences between the two results at 100 Hz are within normal limits bearing in mind the different test methods and are taken into account in arriving at the uncertainties of measurement.

Method of Calibration
The open circuit sensitivity of the microphone has been determined at 250 Hz against a reference laboratory standard measurement microphone by insert voltage techniques using a laboratory standard sound calibrator as a transfer standard. The electrostatic actuator frequency response was then obtained for frequencies above 100 Hz as described in BS EN IEC 61094-6. In addition, where requested the optional free field frequency response over the range 2 – 100 Hz has been obtained using a pressure chamber; in this case the reference frequency is 100 Hz. All of these results and their associated uncertainties are detailed in the table on page 3 of this certificate. See the observations field below for details of any discrepancies between the 100 Hz results obtained via the electrostatic actuator and pressure chamber.

The overall uncertainty at any frequency σCombined,Fn may be obtained by combining the uncertainty of the open circuit sensitivity σS250 with the uncertainty of the actuator / or LF pressure response at any other frequency σAct,Fn where Fn is the uncertainty at the frequency of interest using the relationship:

$$\sigma Combined,Fn = 2\sqrt{(\sigma 2S250 + \sigma 2ActFn)}$$

Appendix to this certificate
Where data is available from the microphone manufacturer to correct the actuator / pressure frequency response to obtain the random incidence and / or free field response it is shown in the appendix to this certificate. The uncertainty information relating to these corrections is the responsibility of the microphone manufacturer and when it is available the total uncertainty for the corrected frequency response at each point may then be obtained by including the correction uncertainty in the root-sum-square formula given above. These responses are outside the UKAS accredited scope, but are provided for information.

Observations

Continuation of Certificate number: **42269**

Numerical Results for Relative Frequency Response

Actuator Results					
Freq	Actuator	Uncert.	Freq	Actuator	Uncert.
Hz	dB re 250 Hz	dB	Hz	dB re 250 Hz	dB
100.0	0.01	0.21	5,010.70	-2.48	0.24
112.2	0.01	0.21	5,622.00	-2.89	0.24
125.9	0.01	0.21	6,307.90	-3.29	0.24
141.3	0.01	0.21	7,077.50	-3.78	0.24
158.5	0.01	0.21	7,940.90	-4.32	0.24
177.9	0.01	0.21	8,909.70	-4.90	0.48
199.6	0.01	0.21	9,996.70	-5.46	0.48
223.9	0.01	0.21	11,216	-6.37	0.48
251.2	Ref	0.21	12,585	-6.83	0.48
281.9	0.00	0.21	14,120	-7.30	0.48
316.3	0.00	0.21	15,843	-7.65	0.48
354.9	-0.01	0.21	17,775	-8.44	0.70
398.2	-0.01	0.21	19,944	-9.88	0.70
446.7	-0.02	0.21	22377		0.90
501.2	-0.03	0.21	25107		0.90
562.4	-0.04	0.21	28170		0.90
631.0	-0.05	0.21	31607		0.90
708.0	-0.06	0.21	35463		0.90
794.4	-0.08	0.21	39790		0.90
891.3	-0.11	0.21	44644		0.90
1000.0	-0.14	0.21	50091		0.90
1122.0	-0.17	0.21	56202		1.20
1258.9	-0.22	0.21	63058		1.20
1412.5	-0.28	0.21	70752		1.20
1584.8	-0.35	0.21	79383		1.20
1778.1	-0.44	0.21	89068		1.20
1995.1	-0.54	0.21	99934		1.20
2238.5	-0.67	0.21	112126		-
2511.6	-0.83	0.21	125806		-
2818.0	-1.01	0.21	141154		-
3161.8	-1.22	0.21	158375		-
3547.5	-1.49	0.21	177696		-
3980.3	-1.78	0.21	199375		-
4465.9	-2.12	0.24	-		-

Low Frequency		
Freq	dB re 100 Hz	Uncert.
Hz		dB
2.0		0.7
2.2		0.7
2.5		0.7
2.8		0.7
3.2		0.7
3.6		0.7
4.0		0.7
4.5		0.7
5.0		0.7
5.6		0.7
6.3		0.7
7.1		0.7
8.0		0.7
8.9		0.7
10.0		0.7
11.2		0.7
12.6		0.7
14.1		0.7
15.9		0.7
17.8		0.7
20.0		0.7
22.4		0.7
25.1		0.7
28.2		0.7
31.6		0.7
35.5		0.7
39.8		0.7
44.7		0.7
50.1		0.7
56.3		0.7
63.1		0.7
70.8		0.7
79.5		0.7
89.2		0.7
100.0	Ref	0.7

Continuation of Certificate number: 42269

Appendix to certificate (not accredited). Random and Free Field Corrected Data

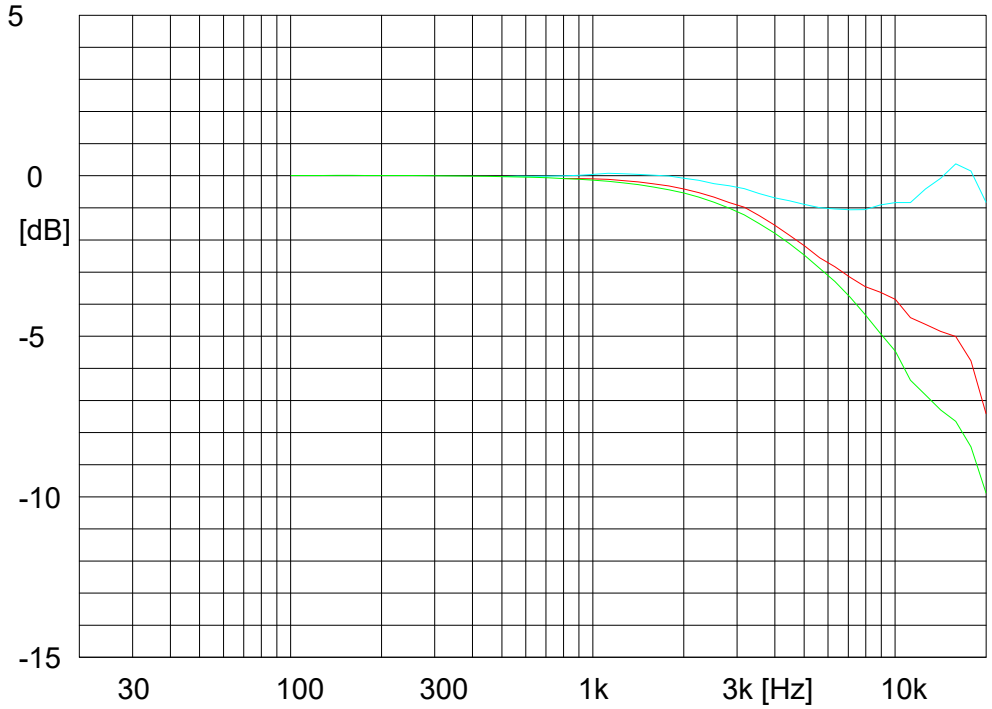
Corrected results, dB re 250 Hz					
Freq Hz	Random incidence corrected	Free field corrected	Freq Hz	Random incidence corrected	Free field corrected
100	0.01	0.01	5,010.70	-2.19	-0.90
112.2	0.01	0.01	5,622.00	-2.56	-1.00
125.9	0.01	0.01	6,307.90	-2.83	-1.03
141.3	0.01	0.01	7,077.50	-3.16	-1.06
158.5	0.01	0.01	7,940.90	-3.45	-1.05
177.9	0.01	0.01	8,909.70	-3.62	-0.91
199.6	0.01	0.01	9,996.70	-3.85	-0.83
223.9	0.01	0.01	11,216	-4.42	-0.84
251.2	0.01	0.01	12,585	-4.63	-0.41
281.9	0.00	0.00	14,120	-4.85	-0.08
316.3	0.00	0.00	15,843	-5.01	0.37
354.9	-0.01	-0.01	17,775	-5.76	0.15
398.2	-0.01	-0.01	19,944	-7.41	-0.83
446.7	-0.02	-0.02	22,377		
501.2	-0.03	-0.03	25,107		
562.4	-0.04	-0.02	28,170		
631	-0.05	-0.02	31,607		
708	-0.06	-0.01	35,463		
794.4	-0.08	0.00	39,790		
891.3	-0.09	0.01	44,644		
1,000.00	-0.10	0.04	50,091		
1,122.00	-0.11	0.08	56,202		
1,258.90	-0.15	0.06	63,058		
1,412.50	-0.20	0.05	70,752		
1,584.80	-0.25	0.02	79,383		
1,778.10	-0.32	-0.01	89,068		
1,995.10	-0.41	-0.08	99,934		
2,238.50	-0.53	-0.15	112,126		
2,511.60	-0.67	-0.25	125,806		
2,818.00	-0.84	-0.31	141,154		
3,161.80	-0.98	-0.40	158,375		
3,547.50	-1.24	-0.55	177,696		
3,980.30	-1.53	-0.68	199,375		
4,465.90	-1.86	-0.78	-		

The corrections used to produce these random and free field responses are published by the manufacturer and they are responsible for the accuracy of the data and for the associated uncertainties to be applied. Campbell Associates Limited use their best endeavours to ensure the accuracy of this data but are not responsible for any errors, omissions or for ensuring that the data is of the current issue.

If the actuator response was not measured for any frequency, then the corresponding cell in the above table will be blank; similarly, if correction data is not available from the manufacturer the cell will also be blank.
Correction data for frequencies below 100 Hz are not required

** End of Table Section **

Microphone Calibration Certificate



GRAS
Type: 40AF

Serial no: 73283

Sensitivity: 51.88 mV/Pa
-25.70 ±0.10 dB re. 1 V/Pa
Capacitance: 22.6 ±1.0 pF
Date: 28/10/2022

Signature:

Measurement conditions:

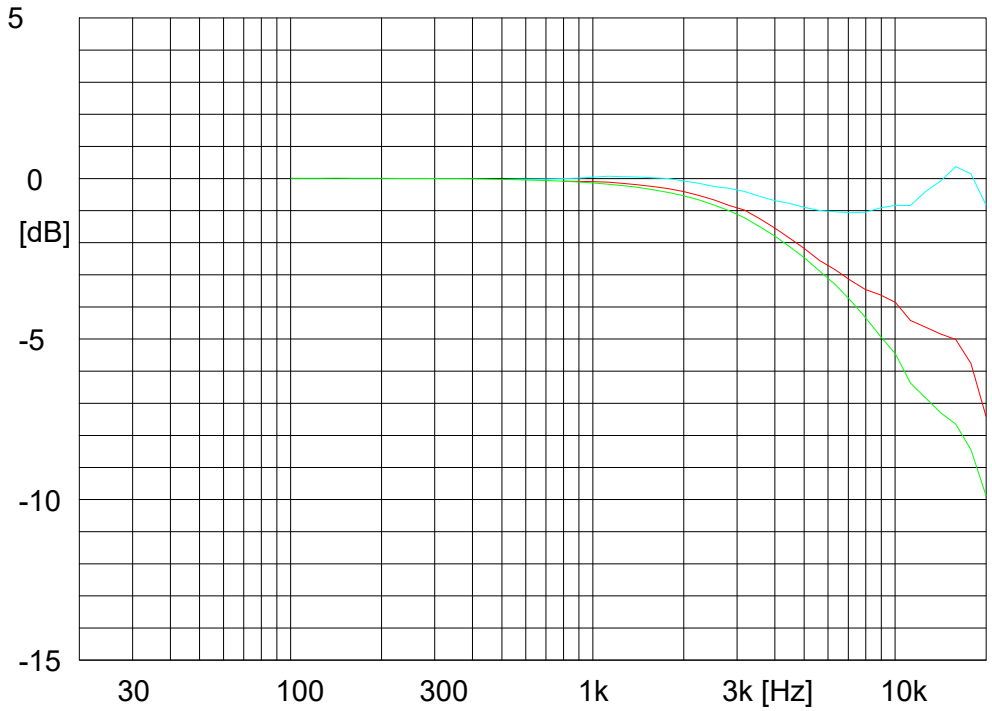
Polarisation voltage:	200.0 V
Pressure:	100.86 ±0.04 kPa
Temperature:	22.4 ±0.1 °C
Relative humidity:	51.2 ±0.7 %RH

Results are normalized to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Microphone Calibration Certificate



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Type: 40AF

Serial no: 73283

Sensitivity: 51.88 mV/Pa
-25.70 ±0.10 dB re. 1 V/Pa
Capacitance: 22.6 ±1.0 pF
Date: 28/10/2022

Signature:

Measurement conditions:

Polarisation voltage:	200.0 V
Pressure:	100.86 ±0.04 kPa
Temperature:	22.4 ±0.1 °C
Relative humidity:	51.2 ±0.7 %RH

Results are normalized to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Comment:

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration and Conformance

Certificate number: **42268**

Test Object: **Sound Calibrator**

Producer: **Norsonic AS.**
Type: **1251**
Serial number: **30868**
Customer: **Sharps Redmore**
Address: **The White House, London Road, Copdock, Ipswich, Suffolk. IP8 3JH.**
Contact Person: **Emily Sharpe**
Order No: **ESS 22 0060**

Measurement Results	Level dB	Level Stability dB	Frequency Hz	Distortion %
Measurement 1	114.06	0.06	1000.58	0.40
Measurement 2	114.06	0.04	1000.58	0.40
Measurement 3	114.06	0.06	1000.58	0.40
Result (Average):	**114.06**	**0.05**	**1000.58**	**0.40**
Expanded Uncertainty:	0.1	0.03	1	0.25
Degree of Freedom:	>100	21	>100	>100
Coverage Factor:	2	2.13	2	2

The stated level is relative to 20µPa. The level is traceable to National Standards. The stated level is valid at reference conditions. The following correction factors have been applied during the measurement
Pres:0.0005 dB/kPa Temp:0.003 dB/°C Humi:0 dB/%RH Load volume: 0.0003 dB/mm3

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.87 ±0.040	22.4 ±0.1	51.1 ±0.7

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.

Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2022\NOR1251_30868_M1.nmf

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Calibration Dates:

Received date:	17/10/2022	Reviewed date:	31/10/2022
Calibration date:	28/10/2022	Issued date:	31/10/2022

Technicians: (Electronic certificate)
Calibrated by: *Palaniwel Marappan B.Eng(Hons), M.Sc*
Reviewed by: *Jenny Crawford*

Certificate of Calibration and Conformance

Continuation of Certificate number: 42268

Reference Microphone: WSM5 - B&K4192-2496459

Measurements

The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Instruments and Program

A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Comments

Statement of Conformance and 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 BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

*This evidence is held on file at the calibration laboratory.

Notes:

The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in BOLD are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Observations:

This certificate relates only to the items tested above.

** End of Certificate **

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration

Certificate number: **41505**

Test Object:	**Sound Level Meter, BS EN IEC 61672-1:2003 Class 1** **Associated Frequency Analyser to BS EN IEC 61260:1996 Class 1**
Producer:	**Norsonic AS.**
Type:	**118**
Serial number:	**31797**
Customer:	**Sharps Redmore**
Address:	**The White House, London Road,** **Copdock, Ipswich, Suffolk. IP8 3JH.**
Contact Person:	**Emily Sharpe**
Order No:	**ESS 220045**

Introduction:
Calibration has been performed as set out in CA Technical Procedures which are based on the procedures for periodic verification of sound level meters as per the **Test Object** listed above. Results and conformance statement are overleaf and detailed results, where appropriate, are provided in the attached Measurement Report.

Tested:	*Producer*	*Type*	*Serial No*	*Certificate No*
Microphone	GRAS	40AF	102509	41504
Calibrator*	Norsonic	1251	31426	41503
Preamplifier	Norsonic	1206	27596	Included

* The calibrator was complete with any required coupler for the microphone specified.

Additional items that have also been submitted for verification:

Wind shield	Norsonic	Nor1451 (ø 60mm)
Attenuator	N/A	
Extension cable	N/A	

These items have been taken into account wherever appropriate.

Instruction Manual: Nor118 User Guide- November 2002 Edition Firmware Version: v2.0.752 The test object is a single channel instrument.

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	101.63 ±0.02	23.03 ±0.25	44.43 ±1.15

Calibration Dates:

Received date:	08/07/2022	Reviewed date:	18/07/2022
Calibration date:	15/07/2022	Issued date:	18/07/2022

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan B.Eng (Hons), M.Sc*

Reviewed by: *Jenny Crawford*

Certificate of Calibration

Continuation of Certificate number: **41505**

The statements of conformance and observation notes detailed in this certificate are made with reference to the following standards in respect of the calibration of the test object.

Manufactured:	**BS EN IEC 61672-1:2003**
Periodic Tests:	**BS EN IEC 61672-3:2006**
Pattern Evaluation:	**Not Applicable**
Filter Evaluation:	**BS EN IEC 61260:1996 Class 1**

Conformance:

From markings on the sound level meter or by reference to the manufacturer's published literature it has been determined that the instrument submitted for verification was originally manufactured to the listed standard and similarly that the associated sound calibrator conforms to the BS EN IEC 60942 standard.

Measurement Summary:

Indication at the calibration check frequency - IEC61672-3 Ed.1 #9	Passed
Self-generated noise - IEC 61672-3 Ed.1 #10.2	Passed
Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.1 #11	Passed
Electrical signal tests of frequency weightings - IEC 61672-3 Ed.1 #12	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.1 #13	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.1 #14	Passed
Toneburst response - IEC 61672-3 Ed.1 #16	Passed
Peak C sound level - IEC 61672-3 Ed.1 #17	Passed
Overload indication - IEC 61672-3 Ed.1 #18	Passed
1/1octave: Relative attenuation - IEC 61260, #4.4 & #5.3	Passed
1/3octave: Relative attenuation - IEC 61260, #4.4 & #5.3	Passed

Comments

Correct level with associated calibrator is 113.8dB(A). This was determined with the meter CAL sensitivity set to -25.8dB and G preamplifier correction only enabled and set to 0.1dB.

Statement of Conformance

The sound level meter submitted for testing has successfully completed the periodic tests for the environmental conditions under which the tests were performed. However, no general statement of conclusion can be made about conformance of the sound level meter to the full requirements of the manufactured standard because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in the manufacturer's standard and because the periodic tests completed cover only a limited subset of the specifications in the relevant standard

Filter Calibration

The filter functions have been found to conform, by electrical testing, to the relative attenuation requirement of the standard noted over the range of frequencies shown in the attached test report.

Observations

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a coverage probability of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA publication EA-4/02. Details of the uncertainty for each measurement are available from the Calibration Laboratory upon request. Details of the sources of corrections and their associated uncertainties that relate to this verification are contained within the test report accompanying this certificate.

This certificate relates only to the items tested above.

** End of Certificate **

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration

Certificate number: **41504**

Test Object: **Measurement Microphone**

Producer: **GRAS**
Type: **40AF**
Serial number: **102509**
Customer: **Sharps Redmore**
Address: **The White House, London Road, Copdock, Ipswich, Suffolk. IP8 3JH.**
Contact Person: **Emily Sharpe**
Order No: **ESS 220045**

Measurement Results	Sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)	Capacitance (pF)
Measurement 1	*-25.81*	*51.22*	*22.08*
Measurement 2	*-25.81*	*51.21*	*22.14*
Measurement 3	*-25.81*	*51.22*	*22.13*
Result (Average):	***-25.81***	***51.22***	***22.12***
Expanded Uncertainty:	0.10		1.00
Degree of Freedom:	>100		>100
Coverage Factor:	2		2

The stated sensitivity is the pressure sensitivity at 250Hz, S_{250}, and is valid at reference conditions. The following correction factors have been applied during the measurement:
Pressure:-0.011 dB/kPa Temperature:-0.01 dB/°C Humidity:-0.001 dB/%RH

Conditions	*Pressure kPa*	*Temperature °C*	*Humidty %RH*
Reference conditions	101.325	23	50
Measurement conditions	101.63 ± 0.041	23.1 ± 0.2	43.6 ± 1.1

The calibration test report shown on the next page gives details of the response at other frequencies relative to this 250 Hz reference sensitivity. Results ≥100 Hz are obtained using an electrostatic actuator as described in BS EN 61094-6 and those below 100 Hz are obtained in a reference pressure chamber. Detailed results are available from the calibration laboratory upon request.

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a coverage probability of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level.

Calibration Dates:

Received date:	08/07/2022	Reviewed date:	18/07/2022
Calibration date:	15/07/2022	Issued date:	18/07/2022

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan BEng(Hons), MSc*
Reviewed by: *Jenny Crawford*

Certificate of Calibration

Continuation of Certificate number: 41504

Reference Calibrator: WSC2 - GRAS42AA-18277
Measurement Record: K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\GRAS40AF_102509_M1.nmf

Preconditioning
The equipment was preconditioned for more than 12 hours at the specified calibration temperature and humidity.

Instruments and Program
A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Traceability
The measured values for sound pressure, frequency, voltage, capacitance, temperature, humidity and ambient pressure are traceable to an accredited national physical laboratory.

Observations
The differences between the two results at 100 Hz are within normal limits bearing in mind the different test methods and are taken into account in arriving at the uncertainties of measurement.

Method of Calibration
The open circuit sensitivity of the microphone has been determined at 250 Hz against a reference laboratory standard measurement microphone by insert voltage techniques using a laboratory standard sound calibrator as a transfer standard. The electrostatic actuator frequency response was then obtained for frequencies above 100 Hz as described in BS EN IEC 61094-6. In addition, where requested the optional free field frequency response over the range 2 – 100 Hz has been obtained using a pressure chamber; in this case the reference frequency is 100 Hz. All of these results and their associated uncertainties are detailed in the table on page 3 of this certificate. See the observations field below for details of any discrepancies between the 100 Hz results obtained via the electrostatic actuator and pressure chamber.

The overall uncertainty at any frequency σCombined,Fn may be obtained by combining the uncertainty of the open circuit sensitivity σS250 with the uncertainty of the actuator / or LF pressure response at any other frequency σAct,Fn where Fn is the uncertainty at the frequency of interest using the relationship:

$$\sigma_{Combined,Fn} = 2\sqrt{(\sigma^2_{S250} + \sigma^2_{ActFn})}$$

Appendix to this certificate
Where data is available from the microphone manufacturer to correct the actuator / pressure frequency response to obtain the random incidence and / or free field response it is shown in the appendix to this certificate. The uncertainty information relating to these corrections is the responsibility of the microphone manufacturer and when it is available the total uncertainty for the corrected frequency response at each point may then be obtained by including the correction uncertainty in the root-sum-square formula given above. These responses are outside the UKAS accredited scope, but are provided for information.

Observations

Continuation of Certificate number: **41504**

Numerical Results for Relative Frequency Response

Actuator Results					
Freq	Actuator	Uncert.	Freq	Actuator	Uncert.
Hz	dB re 250 Hz	dB	Hz	dB re 250 Hz	dB
100.0	0.01	0.21	5,010.70	-1.69	0.24
112.2	0.01	0.21	5,622.00	-2.03	0.24
125.9	0.01	0.21	6,307.90	-2.36	0.24
141.3	0.01	0.21	7,077.50	-2.81	0.24
158.5	0.01	0.21	7,940.90	-3.26	0.24
177.9	0.01	0.21	8,909.70	-3.94	0.48
199.6	0.01	0.21	9,996.70	-4.63	0.48
223.9	0.00	0.21	11,216	-5.60	0.48
251.2	Ref	0.21	12,585	-6.20	0.48
281.9	0.00	0.21	14,120	-6.79	0.48
316.3	0.00	0.21	15,843	-7.32	0.48
354.9	-0.01	0.21	17,775	-8.19	0.70
398.2	-0.01	0.21	19,944	-9.65	0.70
446.7	-0.01	0.21	22377		0.90
501.2	-0.02	0.21	25107		0.90
562.4	-0.03	0.21	28170		0.90
631.0	-0.03	0.21	31607		0.90
708.0	-0.04	0.21	35463		0.90
794.4	-0.05	0.21	39790		0.90
891.3	-0.07	0.21	44644		0.90
1000.0	-0.09	0.21	50091		0.90
1122.0	-0.11	0.21	56202		1.20
1258.9	-0.14	0.21	63058		1.20
1412.5	-0.17	0.21	70752		1.20
1584.8	-0.21	0.21	79383		1.20
1778.1	-0.27	0.21	89068		1.20
1995.1	-0.32	0.21	99934		1.20
2238.5	-0.41	0.21	112126		-
2511.6	-0.51	0.21	125806		-
2818.0	-0.63	0.21	141154		-
3161.8	-0.77	0.21	158375		-
3547.5	-0.94	0.21	177696		-
3980.3	-1.15	0.21	199375		-
4465.9	-1.38	0.24	-		-

Low Frequency		
Freq	dB re 100 Hz	Uncert.
Hz		dB
2.0		0.7
2.2		0.7
2.5		0.7
2.8		0.7
3.2		0.7
3.6		0.7
4.0		0.7
4.5		0.7
5.0		0.7
5.6		0.7
6.3		0.7
7.1		0.7
8.0		0.7
8.9		0.7
10.0		0.7
11.2		0.7
12.6		0.7
14.1		0.7
15.9		0.7
17.8		0.7
20.0		0.7
22.4		0.7
25.1		0.7
28.2		0.7
31.6		0.7
35.5		0.7
39.8		0.7
44.7		0.7
50.1		0.7
56.3		0.7
63.1		0.7
70.8		0.7
79.5		0.7
89.2		0.7
100.0	Ref	0.7

Continuation of Certificate number: 41504

Appendix to certificate (not accredited). Random and Free Field Corrected Data

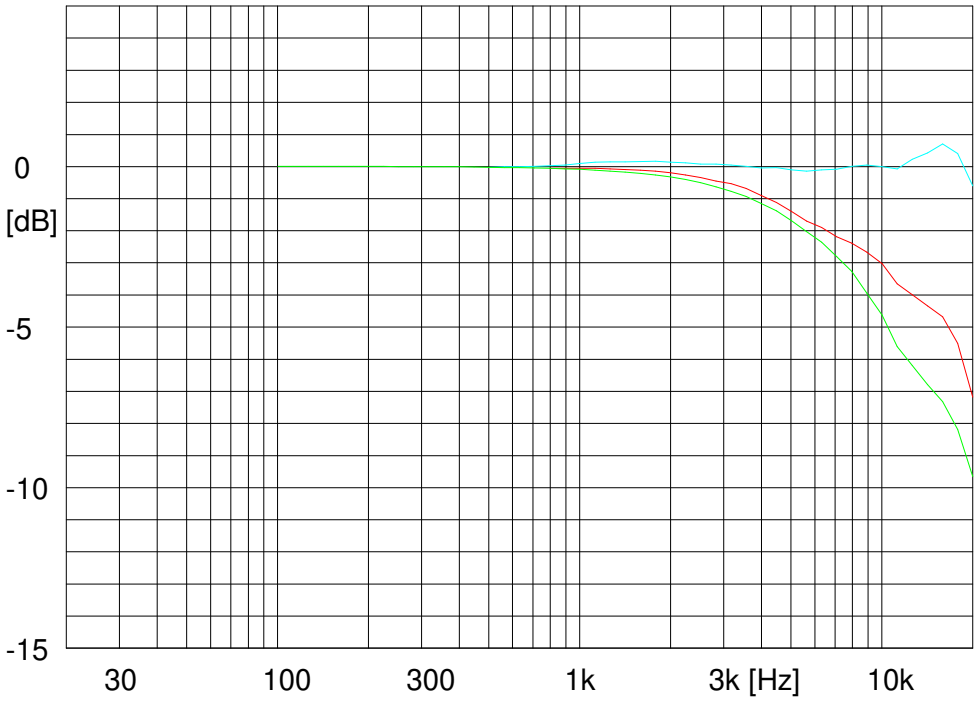
Corrected results, dB re 250 Hz					
Freq Hz	Random incidence corrected	Free field corrected	Freq Hz	Random incidence corrected	Free field corrected
100	0.01	0.01	5,010.70	-1.40	-0.11
112.2	0.01	0.01	5,622.00	-1.70	-0.14
125.9	0.01	0.01	6,307.90	-1.90	-0.10
141.3	0.01	0.01	7,077.50	-2.19	-0.09
158.5	0.01	0.01	7,940.90	-2.39	0.01
177.9	0.01	0.01	8,909.70	-2.66	0.05
199.6	0.01	0.01	9,996.70	-3.02	0.00
223.9	0.00	0.00	11,216	-3.65	-0.07
251.2	0.00	0.00	12,585	-4.00	0.22
281.9	0.00	0.00	14,120	-4.34	0.43
316.3	0.00	0.00	15,843	-4.68	0.70
354.9	-0.01	-0.01	17,775	-5.51	0.40
398.2	-0.01	-0.01	19,944	-7.18	-0.60
446.7	-0.01	-0.01	22,377		
501.2	-0.02	-0.02	25,107		
562.4	-0.03	-0.01	28,170		
631	-0.03	0.00	31,607		
708	-0.04	0.01	35,463		
794.4	-0.05	0.03	39,790		
891.3	-0.05	0.05	44,644		
1,000.00	-0.05	0.09	50,091		
1,122.00	-0.05	0.14	56,202		
1,258.90	-0.07	0.14	63,058		
1,412.50	-0.09	0.15	70,752		
1,584.80	-0.11	0.16	79,383		
1,778.10	-0.15	0.16	89,068		
1,995.10	-0.19	0.14	99,934		
2,238.50	-0.27	0.11	112,126		
2,511.60	-0.35	0.07	125,806		
2,818.00	-0.46	0.08	141,154		
3,161.80	-0.53	0.05	158,375		
3,547.50	-0.69	0.00	177,696		
3,980.30	-0.90	-0.05	199,375		
4,465.90	-1.12	-0.04	-		

The corrections used to produce these random and free field responses are published by the manufacturer and they are responsible for the accuracy of the data and for the associated uncertainties to be applied. Campbell Associates Limited use their best endeavours to ensure the accuracy of this data but are not responsible for any errors, omissions or for ensuring that the data is of the current issue.

If the actuator response was not measured for any frequency, then the corresponding cell in the above table will be blank; similarly, if correction data is not available from the manufacturer the cell will also be blank.
Correction data for frequencies below 100 Hz are not required

** End of Table Section **

Microphone Calibration Certificate



GRAS
Type: 40AF

Serial no: 102509

Sensitivity: 51.22 mV/Pa
-25.81 ±0.10 dB re. 1 V/Pa
Capacitance: 22.1 ±1.0 pF
Date: 15/07/2022

Signature:

Measurement conditions:

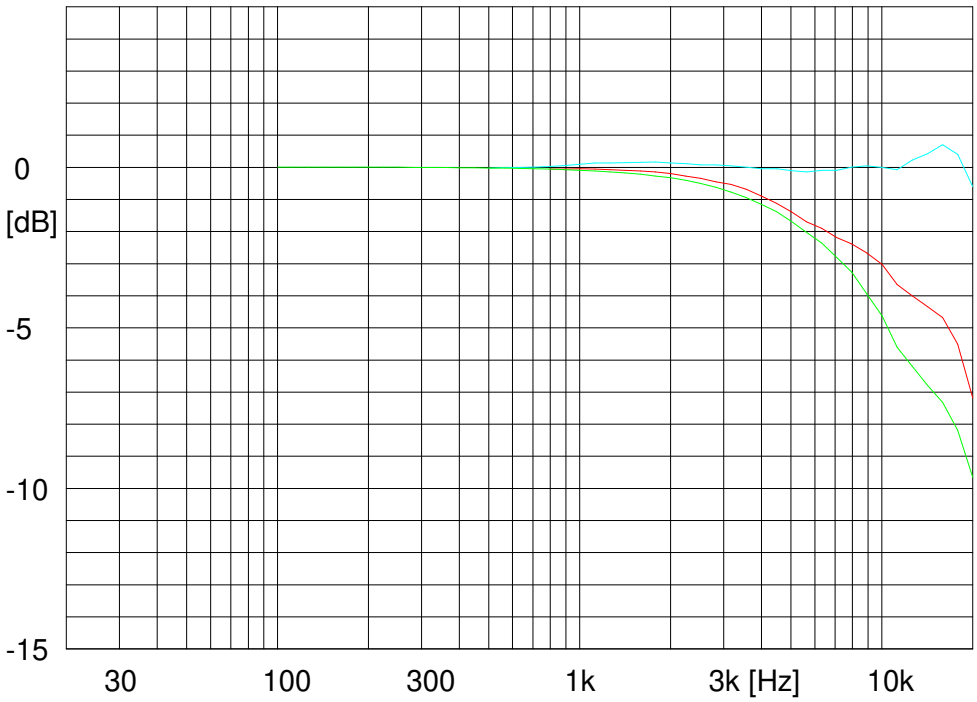
Polarisation voltage:	200.0 V
Pressure:	101.63 ±0.04 kPa
Temperature:	23.1 ±0.2 °C
Relative humidity:	43.6 ±1.1 %RH

Results are normalized to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Microphone Calibration Certificate



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Relative humidity:	43.6 ±1.1 %RH

Results are normalized to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Comment:

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration and Conformance

Certificate number: **45256**

Test Object: **Sound Calibrator**

Producer: **Norsonic AS.**
Type: **1251**
Serial number: **31426**
Customer: **Sharps Redmore**
Address: **The White House, London Road, Copdock, Ipswich. IP8 3JH.**
Contact Person: **Emily Sharpe**
Order No: **ES230038**

Measurement Results	Level	Level Stability	Frequency	Distortion
	dB	dB	Hz	%
Measurement 1	113.93	0.06	999.45	0.35
Measurement 2	113.92	0.04	999.45	0.35
Measurement 3	113.93	0.04	999.45	0.35
Result (Average):	**113.93**	**0.05**	**999.45**	**0.35**
Expanded Uncertainty:	0.1	0.03	1	0.1
Degree of Freedom:	>100	21	>100	>100
Coverage Factor:	2	2.13	2	2

The stated level is relative to 20µPa. The level is traceable to National Standards. The stated level is valid at reference conditions. The following correction factors have been applied during the measurement

Pres:0.0005 dB/kPa Temp:0.003 dB/°C Humi:0 dB/%RH Load volume: 0.0003 dB/mm3

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.438 ±0.041	22.7 ±0.1	42.4 ±0.9

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.

Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\Current Year\NOR1251_31426_M1.nmf

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Calibration Dates:

Received date:	18/08/2023	Reviewed date:	01/09/2023
Calibration date:	01/09/2023	Issued date:	01/09/2023

Technicians: (Electronic certificate)

Calibrated by: *Palanivel Marappan B.Eng(Hons), M.Sc*
Reviewed by: *Darren Batten*

Certificate of Calibration and Conformance

Continuation of Certificate number: 45256

Reference Microphone: WSM8 (A) - GRAS-40AG.147852

Measurements

The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Instruments and Program

A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Comments

Statement of Conformance and 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 BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

*This evidence is held on file at the calibration laboratory.

Notes:

The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in BOLD are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Observations:

This certificate relates only to the items tested above.

** End of Certificate **

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration

Certificate number: **44551**

Test Object:	**Sound Level Meter, BS EN IEC 61672-1:2003 Class 1** **Associated Frequency Analyser to BS EN IEC 61260:1996 Class 1**
Producer:	**Norsonic AS.**
Type:	**118**
Serial number:	**28204**
Customer:	**Sharps Redmore**
Address:	**The White House, London Road,** **Copdock, Ipswich. IP8 3JH.**
Contact Person:	**Emily Sharpe**
Order No:	**ESS 230030**

Introduction:
Calibration has been performed as set out in CA Technical Procedures which are based on the procedures for periodic verification of sound level meters as per the **Test Object** listed above. Results and conformance statement are overleaf and detailed results, where appropriate, are provided in the attached Measurement Report.

Tested:	*Producer*	*Type*	*Serial No*	*Certificate No*
Microphone	Norsonic	1225	227035	44550
Calibrator*	Norsonic	1251	30865	44549
Preamplifier	Norsonic	1206	30826	Included

* The calibrator was complete with any required coupler for the microphone specified.

Additional items that have also been submitted for verification:

Wind shield	Norsonic	Nor1451 (ø 60mm)
Attenuator	N/A	
Extension cable	N/A	

These items have been taken into account wherever appropriate.

Instruction Manual: Nor118 User Guide- November 2002 Edition Firmware Version: v2.0.752 The test object is a single channel instrument.

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.46 ±0	22.05 ±0.2	59.55 ±1.6

Calibration Dates:

Received date:	07/06/2023	Reviewed date:	20/06/2023
Calibration date:	19/06/2023	Issued date:	20/06/2023

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan B.Eng (Hons), M.Sc*

Reviewed by: *Jenny Crawford*

Certificate of Calibration

Continuation of Certificate number: **44551**

The statements of conformance and observation notes detailed in this certificate are made with reference to the following standards in respect of the calibration of the test object.

Manufactured:	**BS EN IEC 61672-1:2003**
Periodic Tests:	**BS EN IEC 61672-3:2006**
Pattern Evaluation:	**Not Applicable**
Filter Evaluation:	**BS EN IEC 61260:1996 Class 1**

Conformance:

From markings on the sound level meter or by reference to the manufacturer's published literature it has been determined that the instrument submitted for verification was originally manufactured to the listed standard and similarly that the associated sound calibrator conforms to the BS EN IEC 60942 standard.

Measurement Summary:

Indication at the calibration check frequency - IEC61672-3 Ed.1 #9	Passed
Self-generated noise - IEC 61672-3 Ed.1 #10.2	Passed
Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.1 #11	Passed
Electrical signal tests of frequency weightings - IEC 61672-3 Ed.1 #12	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.1 #13	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.1 #14	Passed
Toneburst response - IEC 61672-3 Ed.1 #16	Passed
Peak C sound level - IEC 61672-3 Ed.1 #17	Passed
Overload indication - IEC 61672-3 Ed.1 #18	Passed
1/1octave: Relative attenuation - IEC 61260, #4.4 & #5.3	Passed
1/3octave: Relative attenuation - IEC 61260, #4.4 & #5.3	Passed

Comments

Correct level with associated calibrator is 113.9dB(A). This was determined with the meter CAL sensitivity set to -25.1dB and G preamplifier correction only enabled and set to 0.1dB.

Statement of Conformance

The sound level meter submitted for testing has successfully completed the periodic tests for the environmental conditions under which the tests were performed. However, no general statement of conclusion can be made about conformance of the sound level meter to the full requirements of the manufactured standard because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in the manufacturer's standard and because the periodic tests completed cover only a limited subset of the specifications in the relevant standard

Filter Calibration

The filter functions have been found to conform, by electrical testing, to the relative attenuation requirement of the standard noted over the range of frequencies shown in the attached test report.

Observations

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a coverage probability of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA publication EA-4/02. Details of the uncertainty for each measurement are available from the Calibration Laboratory upon request. Details of the sources of corrections and their associated uncertainties that relate to this verification are contained within the test report accompanying this certificate.

This certificate relates only to the items tested above.

** End of Certificate **

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration

Certificate number: **44550**

Test Object: **Measurement Microphone**

Producer: **Norsonic AS.**
Type: **1225**
Serial number: **227035**
Customer: **Sharps Redmore**
Address: **The White House, London Road, Copdock, Ipswich. IP8 3JH.**
Contact Person: **Emily Sharpe**
Order No: **ESS 230030**

Measurement Results	Sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)	Capacitance (pF)
Measurement 1	*-25.15*	*55.27*	*25.79*
Measurement 2	*-25.15*	*55.27*	*26.06*
Measurement 3	*-25.15*	*55.24*	*26.08*
Result (Average):	***-25.15***	***55.26***	***25.98***
Expanded Uncertainty:	0.10		2.03
Degree of Freedom:	>100		>100
Coverage Factor:	2		2

The stated sensitivity is the pressure sensitivity at 250Hz, S_{250}, and is valid at reference conditions. The following correction factors have been applied during the measurement:
Pressure:uncertainty dB/kPa Temperature:-0.005 dB/°C Humidity:0 dB/%RH

Conditions	*Pressure kPa*	*Temperature °C*	*Humidty %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.47 ± 0.040	21.5 ± 0.1	59.8 ± 2.0

The calibration test report shown on the next page gives details of the response at other frequencies relative to this 250 Hz reference sensitivity. Results ≥100 Hz are obtained using an electrostatic actuator as described in BS EN 61094-6 and those below 100 Hz are obtained in a reference pressure chamber. Detailed results are available from the calibration laboratory upon request.

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a coverage probability of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level.

Calibration Dates:

Received date:	07/06/2023	Reviewed date:	20/06/2023
Calibration date:	19/06/2023	Issued date:	20/06/2023

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan B.Eng (Hons), M.Sc*
Reviewed by: *Jenny Crawford*

Certificate of Calibration

Continuation of Certificate number: 44550

Reference Calibrator: WSC1 (A) - Nor1253-24269
Measurement Record: K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\NOR1225_227035_M1.nmf

Preconditioning
The equipment was preconditioned for more than 12 hours at the specified calibration temperature and humidity.

Instruments and Program
A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Traceability
The measured values for sound pressure, frequency, voltage, capacitance, temperature, humidity and ambient pressure are traceable to an accredited national physical laboratory.

Observations
The differences between the two results at 100 Hz are within normal limits bearing in mind the different test methods and are taken into account in arriving at the uncertainties of measurement.

Method of Calibration
The open circuit sensitivity of the microphone has been determined at 250 Hz against a reference laboratory standard measurement microphone by insert voltage techniques using a laboratory standard sound calibrator as a transfer standard. The electrostatic actuator frequency response was then obtained for frequencies above 100 Hz as described in BS EN IEC 61094-6. In addition, where requested the optional free field frequency response over the range 2 – 100 Hz has been obtained using a pressure chamber; in this case the reference frequency is 100 Hz. All of these results and their associated uncertainties are detailed in the table on page 3 of this certificate. See the observations field below for details of any discrepancies between the 100 Hz results obtained via the electrostatic actuator and pressure chamber.

The overall uncertainty at any frequency σCombined,Fn may be obtained by combining the uncertainty of the open circuit sensitivity σS250 with the uncertainty of the actuator / or LF pressure response at any other frequency σAct,Fn where Fn is the uncertainty at the frequency of interest using the relationship:

$$\sigma Combined,Fn = 2\sqrt{(\sigma 2S250 + \sigma 2ActFn)}$$

Appendix to this certificate
Where data is available from the microphone manufacturer to correct the actuator / pressure frequency response to obtain the random incidence and / or free field response it is shown in the appendix to this certificate. The uncertainty information relating to these corrections is the responsibility of the microphone manufacturer and when it is available the total uncertainty for the corrected frequency response at each point may then be obtained by including the correction uncertainty in the root-sum-square formula given above. These responses are outside the UKAS accredited scope, but are provided for information.

Observations

Continuation of Certificate number: **44550**

Numerical Results for Relative Frequency Response

Actuator Results					
Freq	Actuator	Uncert.	Freq	Actuator	Uncert.
Hz	dB re 250 Hz	dB	Hz	dB re 250 Hz	dB
100.0	0.01	0.21	5,010.70	-2.14	0.24
112.2	0.02	0.21	5,622.00	-2.49	0.24
125.9	0.01	0.21	6,307.90	-2.87	0.24
141.3	0.02	0.21	7,077.50	-3.24	0.24
158.5	0.02	0.21	7,940.90	-3.63	0.24
177.9	0.02	0.21	8,909.70	-4.17	0.48
199.6	0.02	0.21	9,996.70	-4.86	0.48
223.9	0.01	0.21	11,216	-5.76	0.48
251.2	Ref	0.21	12,585	-6.17	0.48
281.9	0.01	0.21	14,120	-6.59	0.48
316.3	0.01	0.21	15,843	-7.20	0.48
354.9	0.00	0.21	17,775	-8.12	0.70
398.2	-0.01	0.21	19,944	-9.56	0.70
446.7	-0.01	0.21	22377		0.90
501.2	-0.02	0.21	25107		0.90
562.4	-0.03	0.21	28170		0.90
631.0	-0.04	0.21	31607		0.90
708.0	-0.05	0.21	35463		0.90
794.4	-0.07	0.21	39790		0.90
891.3	-0.09	0.21	44644		0.90
1000.0	-0.11	0.21	50091		0.90
1122.0	-0.15	0.21	56202		1.20
1258.9	-0.19	0.21	63058		1.20
1412.5	-0.23	0.21	70752		1.20
1584.8	-0.29	0.21	79383		1.20
1778.1	-0.36	0.21	89068		1.20
1995.1	-0.46	0.21	99934		1.20
2238.5	-0.57	0.21	112126		-
2511.6	-0.70	0.21	125806		-
2818.0	-0.85	0.21	141154		-
3161.8	-1.03	0.21	158375		-
3547.5	-1.28	0.21	177696		-
3980.3	-1.55	0.21	199375		-
4465.9	-1.84	0.24	-		-

Low Frequency		
Freq	dB re 100 Hz	Uncert.
Hz		dB
2.0		0.7
2.2		0.7
2.5		0.7
2.8		0.7
3.2		0.7
3.6		0.7
4.0		0.7
4.5		0.7
5.0		0.7
5.6		0.7
6.3		0.7
7.1		0.7
8.0		0.7
8.9		0.7
10.0		0.7
11.2		0.7
12.6		0.7
14.1		0.7
15.9		0.7
17.8		0.7
20.0		0.7
22.4		0.7
25.1		0.7
28.2		0.7
31.6		0.7
35.5		0.7
39.8		0.7
44.7		0.7
50.1		0.7
56.3		0.7
63.1		0.7
70.8		0.7
79.5		0.7
89.2		0.7
100.0	Ref	0.7

Continuation of Certificate number: 44550

Appendix to certificate (not accredited). Random and Free Field Corrected Data

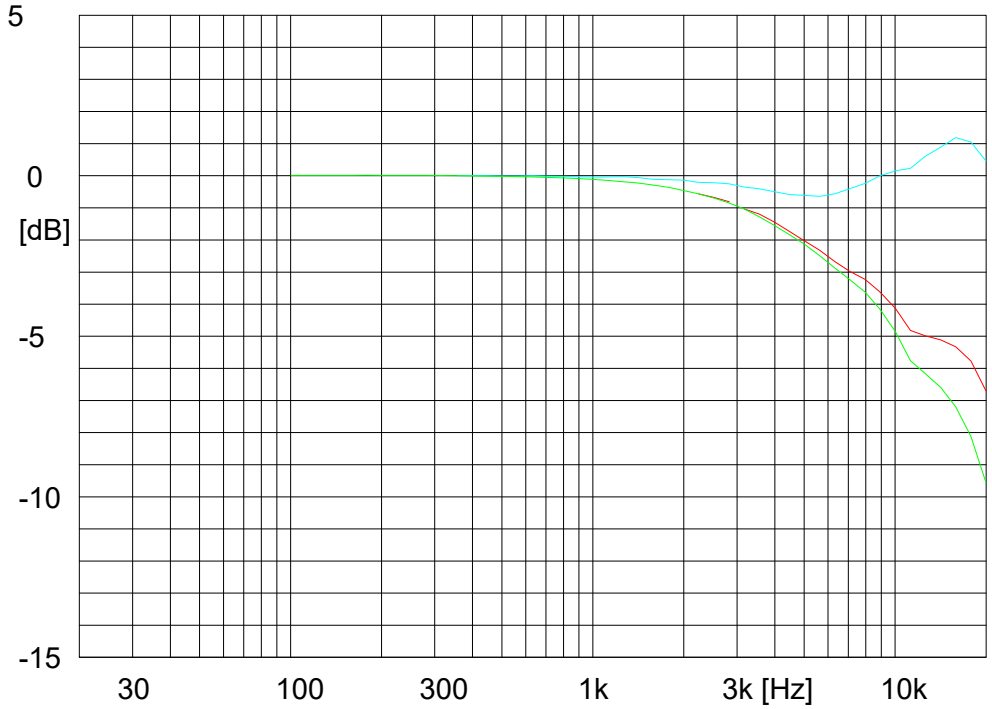
Corrected results, dB re 250 Hz					
Freq Hz	Random incidence corrected	Free field corrected	Freq Hz	Random incidence corrected	Free field corrected
100	0.01	0.01	5,010.70	-2.03	-0.61
112.2	0.02	0.02	5,622.00	-2.32	-0.64
125.9	0.01	0.01	6,307.90	-2.67	-0.56
141.3	0.02	0.02	7,077.50	-2.98	-0.40
158.5	0.02	0.02	7,940.90	-3.23	-0.24
177.9	0.02	0.02	8,909.70	-3.63	0.00
199.6	0.02	0.02	9,996.70	-4.13	0.15
223.9	0.01	0.01	11,216	-4.82	0.23
251.2	0.01	0.01	12,585	-4.99	0.61
281.9	0.01	0.01	14,120	-5.11	0.89
316.3	0.01	0.01	15,843	-5.33	1.19
354.9	0.00	0.00	17,775	-5.77	1.05
398.2	-0.01	0.01	19,944	-6.71	0.46
446.7	-0.01	0.00	22,377		
501.2	-0.02	-0.01	25,107		
562.4	-0.03	-0.01	28,170		
631	-0.04	0.00	31,607		
708	-0.05	-0.01	35,463		
794.4	-0.07	-0.02	39,790		
891.3	-0.09	-0.03	44,644		
1,000.00	-0.11	-0.04	50,091		
1,122.00	-0.15	-0.04	56,202		
1,258.90	-0.19	-0.03	63,058		
1,412.50	-0.23	-0.06	70,752		
1,584.80	-0.29	-0.11	79,383		
1,778.10	-0.36	-0.12	89,068		
1,995.10	-0.46	-0.14	99,934		
2,238.50	-0.57	-0.21	112,126		
2,511.60	-0.68	-0.22	125,806		
2,818.00	-0.81	-0.25	141,154		
3,161.80	-1.03	-0.35	158,375		
3,547.50	-1.20	-0.41	177,696		
3,980.30	-1.45	-0.50	199,375		
4,465.90	-1.74	-0.59	-		

The corrections used to produce these random and free field responses are published by the manufacturer and they are responsible for the accuracy of the data and for the associated uncertainties to be applied. Campbell Associates Limited use their best endeavours to ensure the accuracy of this data but are not responsible for any errors, omissions or for ensuring that the data is of the current issue.

If the actuator response was not measured for any frequency, then the corresponding cell in the above table will be blank; similarly, if correction data is not available from the manufacturer the cell will also be blank.
Correction data for frequencies below 100 Hz are not required

** End of Table Section **

Microphone Calibration Certificate



Norsonic
Type: 1225

Serial no: 227035

Sensitivity: 55.26 mV/Pa
-25.15 ±0.10 dB re. 1 V/Pa
Capacitance: 26.0 ±2.0 pF
Date: 19/06/2023

Signature:

Measurement conditions:

Polarisation voltage:	200.0 V
Pressure:	100.47 ±0.04 kPa
Temperature:	21.5 ±0.1 °C
Relative humidity:	59.8 ±2.0 %RH

Results are normalized to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Campbell Associates
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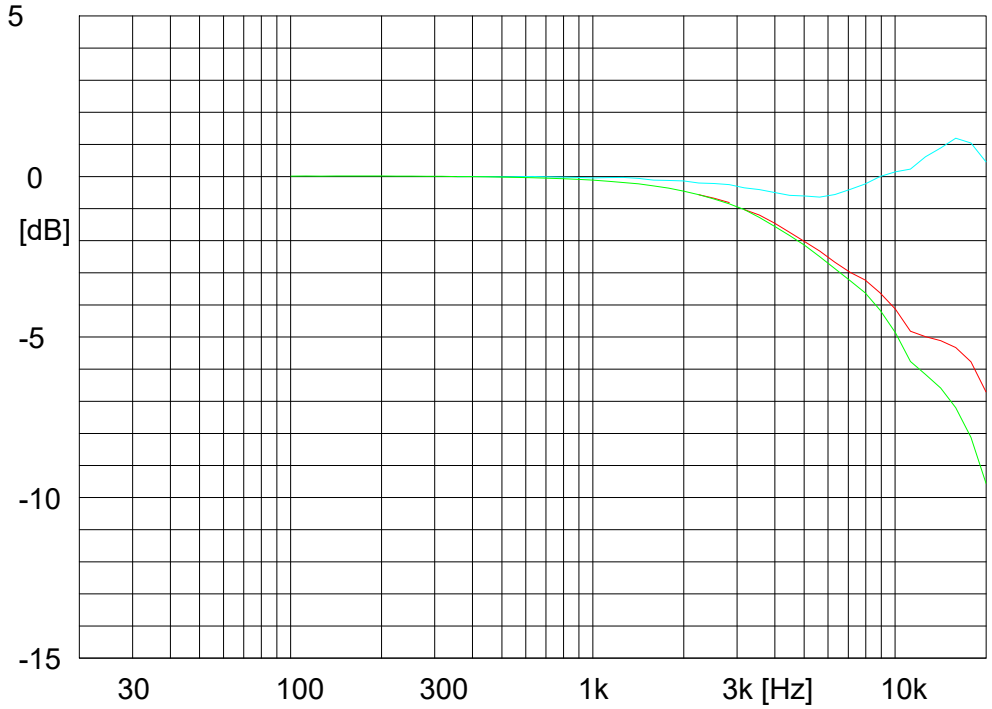
Microphone Calibration Certificate



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Results are normalized to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Comment:

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration and Conformance

Certificate number: **44549**

Test Object: **Sound Calibrator**

Producer: **Norsonic AS.**
Type: **1251**
Serial number: **30865**
Customer: **Sharps Redmore**
Address: **The White House, London Road, Copdock, Ipswich. IP8 3JH.**
Contact Person: **Emily Sharpe**
Order No: **ESS 230030**

Measurement Results	Level dB	Level Stability dB	Frequency Hz	Distortion %
Measurement 1	114.05	0.06	1000.81	0.80
Measurement 2	114.06	0.06	1000.82	0.80
Measurement 3	114.05	0.06	1000.82	0.81
Result (Average):	**114.05**	**0.06**	**1000.81**	**0.80**
Expanded Uncertainty:	0.1	0.02	1	0.1
Degree of Freedom:	>100	>100	>100	>100
Coverage Factor:	2	2	2	2

The stated level is relative to 20µPa. The level is traceable to National Standards. The stated level is valid at reference conditions. The following correction factors have been applied during the measurement
Pres:0.0005 dB/kPa Temp:0.003 dB/°C Humi:0 dB/%RH Load volume: 0.0003 dB/mm3

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.52 ±0.040	21.5 ±0.1	58.2 ±0.7

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.

Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\Current Year\NOR1251_30865_M1.nmf

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Calibration Dates:

Received date:	07/06/2023	Reviewed date:	20/06/2023
Calibration date:	19/06/2023	Issued date:	20/06/2023

Technicians: (Electronic certificate)
Calibrated by: *Palaniwel Marappan B.Eng(Hons), M.Sc*
Reviewed by: *Jenny Crawford*

Certificate of Calibration and Conformance

Continuation of Certificate number: 44549

Reference Microphone: WSM8 (A) - GRAS-40AG.147852

Measurements

The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Instruments and Program

A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Comments

Statement of Conformance and 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 BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

*This evidence is held on file at the calibration laboratory.

Notes:

The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in BOLD are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Observations:

This certificate relates only to the items tested above.

** End of Certificate **

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration

Certificate number: **41508**

Test Object: **Sound Level Meter, BS EN IEC 61672-1:2003 Class 1**

Producer:	**Norsonic AS.**
Type:	**140**
Serial number:	**1403669**
Customer:	**Sharps Redmore**
Address:	**The White House, London Road, Copdock, Ipswich, Suffolk. IP8 3JH.**
Contact Person:	**Emily Sharpe**
Order No:	**ESS 220045**

Introduction:
Calibration has been performed as set out in CA Technical Procedures which are based on the procedures for periodic verification of sound level meters as per the **Test Object** listed above. Results and conformance statement are overleaf and detailed results, where appropriate, are provided in the attached Measurement Report.

Tested:	*Producer*	*Type*	*Serial No*	*Certificate No*
Microphone	Norsonic	1225	332080	41507
Calibrator*	Norsonic	1251	31679	41506
Preamplifier	Norsonic	1206	30968	Included

* The calibrator was complete with any required coupler for the microphone specified.

Additional items that have also been submitted for verification:

Wind shield	Norsonic	Nor1451 (ø 60mm)
Attenuator	N/A	
Extension cable	Norsonic	Nor1408A/5M

These items have been taken into account wherever appropriate.

Instruction Manual: Im140_1Ed8R0En Firmware Version: v2.1.670 The test object is a single channel instrument.

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	101.50 ±0.09	22.35 ±0.9	44.85 ±2

Calibration Dates:

Received date:	08/07/2022	Reviewed date:	18/07/2022
Calibration date:	18/07/2022	Issued date:	18/07/2022

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan B.Eng (Hons), M.Sc*

Reviewed by: *Jenny Crawford*

Certificate of Calibration

Continuation of Certificate number: **41508**

The statements of conformance and observation notes detailed in this certificate are made with reference to the following standards in respect of the calibration of the test object.

Manufactured:	**BS EN IEC 61672-1:2003**
Periodic Tests:	**BS EN IEC 61672-3:2006**
Pattern Evaluation:	**Not Applicable**

Conformance:
From markings on the sound level meter or by reference to the manufacturer's published literature it has been determined that the instrument submitted for verification was originally manufactured to the listed standard and similarly that the associated sound calibrator conforms to the BS EN IEC 60942 standard.

Measurement Summary:

Indication at the calibration check frequency - IEC61672-3 Ed.1 #9	Passed
Self-generated noise - IEC 61672-3 Ed.1 #10.2	Passed
Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.1 #11	Passed
Electrical signal tests of frequency weightings - IEC 61672-3 Ed.1 #12	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.1 #13	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.1 #14	Passed
Toneburst response - IEC 61672-3 Ed.1 #16	Passed
Peak C sound level - IEC 61672-3 Ed.1 #17	Passed
Overload indication - IEC 61672-3 Ed.1 #18	Passed
1/1octave: Relative attenuation - IEC 61260, #4.4 & #5.3	Passed
1/3octave: Relative attenuation - IEC 61260, #4.4 & #5.3	Passed

Comments
Correct level with associated calibrator is 113.8 dB(A). This was determined with the meter CAL sensitivity set to -25.7dB and G preamplifier correction only enabled and set to 0.1dB. Case reflections have been excluded as tests were made

Statement of Conformance
The sound level meter submitted for testing has successfully completed the periodic tests for the environmental conditions under which the tests were performed. However, no general statement of conclusion can be made about conformance of the sound level meter to the full requirements of the manufactured standard because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in the manufacturer's standard and because the periodic tests completed cover only a limited subset of the specifications in the relevant standard

Observations
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a coverage probability of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA publication EA-4/02. Details of the uncertainty for each measurement are available from the Calibration Laboratory upon request. Details of the sources of corrections and their associated uncertainties that relate to this verification are contained within the test report accompanying this certificate.

This certificate relates only to the items tested above.

** End of Certificate **

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration

Certificate number: **41507**

Test Object: **Measurement Microphone**

Producer: **Norsonic AS.**
Type: **1225**
Serial number: **332080**
Customer: **Sharps Redmore**
Address: **The White House, London Road, Copdock, Ipswich, Suffolk. IP8 3JH.**
Contact Person: **Emily Sharpe**
Order No: **ESS 220045**

Measurement Results	Sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)	Capacitance (pF)
Measurement 1	*-25.73*	*51.69*	*23.11*
Measurement 2	*-25.74*	*51.65*	*23.08*
Measurement 3	*-25.74*	*51.64*	*23.05*
Result (Average):	***-25.74***	***51.66***	***23.08***
Expanded Uncertainty:	0.10		1.00
Degree of Freedom:	>100		>100
Coverage Factor:	2		2

The stated sensitivity is the pressure sensitivity at 250Hz, S_{250}, and is valid at reference conditions. The following correction factors have been applied during the measurement:
Pressure:uncertainty dB/kPa Temperature:-0.005 dB/°C Humidity:0 dB/%RH

Conditions	*Pressure kPa*	*Temperature °C*	*Humidty %RH*
Reference conditions	101.325	23	50
Measurement conditions	101.609 ± 0.043	22.9 ± 0.2	45.0 ± 1.3

The calibration test report shown on the next page gives details of the response at other frequencies relative to this 250 Hz reference sensitivity. Results ≥100 Hz are obtained using an electrostatic actuator as described in BS EN 61094-6 and those below 100 Hz are obtained in a reference pressure chamber. Detailed results are available from the calibration laboratory upon request.

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a coverage probability of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level.

Calibration Dates:

Received date:	08/07/2022	Reviewed date:	18/07/2022
Calibration date:	15/07/2022	Issued date:	18/07/2022

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan BEng(Hons), MSc*
Reviewed by: *Jenny Crawford*

Certificate of Calibration

Continuation of Certificate number: 41507

Reference Calibrator: WSC2 - GRAS42AA-18277
Measurement Record: K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\NOR1225_332080_M1.nmf

Preconditioning
The equipment was preconditioned for more than 12 hours at the specified calibration temperature and humidity.

Instruments and Program
A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Traceability
The measured values for sound pressure, frequency, voltage, capacitance, temperature, humidity and ambient pressure are traceable to an accredited national physical laboratory.

Observations
The differences between the two results at 100 Hz are within normal limits bearing in mind the different test methods and are taken into account in arriving at the uncertainties of measurement.

Method of Calibration
The open circuit sensitivity of the microphone has been determined at 250 Hz against a reference laboratory standard measurement microphone by insert voltage techniques using a laboratory standard sound calibrator as a transfer standard. The electrostatic actuator frequency response was then obtained for frequencies above 100 Hz as described in BS EN IEC 61094-6. In addition, where requested the optional free field frequency response over the range 2 – 100 Hz has been obtained using a pressure chamber; in this case the reference frequency is 100 Hz. All of these results and their associated uncertainties are detailed in the table on page 3 of this certificate. See the observations field below for details of any discrepancies between the 100 Hz results obtained via the electrostatic actuator and pressure chamber.

The overall uncertainty at any frequency σCombined,Fn may be obtained by combining the uncertainty of the open circuit sensitivity σS250 with the uncertainty of the actuator / or LF pressure response at any other frequency σAct,Fn where Fn is the uncertainty at the frequency of interest using the relationship:

$$\sigma Combined,Fn = 2\sqrt{(\sigma 2S250 + \sigma 2ActFn)}$$

Appendix to this certificate
Where data is available from the microphone manufacturer to correct the actuator / pressure frequency response to obtain the random incidence and / or free field response it is shown in the appendix to this certificate. The uncertainty information relating to these corrections is the responsibility of the microphone manufacturer and when it is available the total uncertainty for the corrected frequency response at each point may then be obtained by including the correction uncertainty in the root-sum-square formula given above. These responses are outside the UKAS accredited scope, but are provided for information.

Observations

Continuation of Certificate number: **41507**

Numerical Results for Relative Frequency Response

Actuator Results					
Freq	Actuator	Uncert.	Freq	Actuator	Uncert.
Hz	dB re 250 Hz	dB	Hz	dB re 250 Hz	dB
100.0	0.02	0.21	5,010.70	-1.57	0.24
112.2	0.02	0.21	5,622.00	-1.84	0.24
125.9	0.02	0.21	6,307.90	-2.12	0.24
141.3	0.01	0.21	7,077.50	-2.53	0.24
158.5	0.01	0.21	7,940.90	-2.93	0.24
177.9	0.01	0.21	8,909.70	-3.62	0.48
199.6	0.01	0.21	9,996.70	-4.27	0.48
223.9	0.01	0.21	11,216	-5.27	0.48
251.2	Ref	0.21	12,585	-5.87	0.48
281.9	0.00	0.21	14,120	-6.44	0.48
316.3	0.00	0.21	15,843	-7.19	0.48
354.9	-0.01	0.21	17,775	-8.33	0.70
398.2	-0.01	0.21	19,944	-10.13	0.70
446.7	-0.01	0.21	22377		0.90
501.2	-0.02	0.21	25107		0.90
562.4	-0.03	0.21	28170		0.90
631.0	-0.03	0.21	31607		0.90
708.0	-0.04	0.21	35463		0.90
794.4	-0.05	0.21	39790		0.90
891.3	-0.06	0.21	44644		0.90
1000.0	-0.08	0.21	50091		0.90
1122.0	-0.09	0.21	56202		1.20
1258.9	-0.12	0.21	63058		1.20
1412.5	-0.14	0.21	70752		1.20
1584.8	-0.15	0.21	79383		1.20
1778.1	-0.28	0.21	89068		1.20
1995.1	-0.32	0.21	99934		1.20
2238.5	-0.37	0.21	112126		-
2511.6	-0.45	0.21	125806		-
2818.0	-0.54	0.21	141154		-
3161.8	-0.62	0.21	158375		-
3547.5	-0.81	0.21	177696		-
3980.3	-0.93	0.21	199375		-
4465.9	-1.34	0.24	-		-

Low Frequency		
Freq	dB re 100 Hz	Uncert.
Hz		dB
2.0		0.7
2.2		0.7
2.5		0.7
2.8		0.7
3.2		0.7
3.6		0.7
4.0		0.7
4.5		0.7
5.0		0.7
5.6		0.7
6.3		0.7
7.1		0.7
8.0		0.7
8.9		0.7
10.0		0.7
11.2		0.7
12.6		0.7
14.1		0.7
15.9		0.7
17.8		0.7
20.0		0.7
22.4		0.7
25.1		0.7
28.2		0.7
31.6		0.7
35.5		0.7
39.8		0.7
44.7		0.7
50.1		0.7
56.3		0.7
63.1		0.7
70.8		0.7
79.5		0.7
89.2		0.7
100.0	Ref	0.7

Continuation of Certificate number: 41507

Appendix to certificate (not accredited). Random and Free Field Corrected Data

Corrected results, dB re 250 Hz					
Freq Hz	Random incidence corrected	Free field corrected	Freq Hz	Random incidence corrected	Free field corrected
100	0.02	0.02	5,010.70	-1.46	-0.04
112.2	0.02	0.02	5,622.00	-1.67	0.01
125.9	0.02	0.02	6,307.90	-1.92	0.19
141.3	0.01	0.01	7,077.50	-2.27	0.32
158.5	0.01	0.01	7,940.90	-2.53	0.46
177.9	0.01	0.01	8,909.70	-3.08	0.56
199.6	0.01	0.01	9,996.70	-3.54	0.74
223.9	0.01	0.01	11,216	-4.33	0.72
251.2	0.00	0.00	12,585	-4.69	0.92
281.9	0.00	0.00	14,120	-4.96	1.04
316.3	0.00	0.00	15,843	-5.32	1.20
354.9	-0.01	-0.01	17,775	-5.98	0.84
398.2	-0.01	0.00	19,944	-7.28	-0.12
446.7	-0.01	0.00	22,377		
501.2	-0.02	-0.01	25,107		
562.4	-0.03	-0.01	28,170		
631	-0.03	0.01	31,607		
708	-0.04	0.00	35,463		
794.4	-0.05	0.00	39,790		
891.3	-0.06	0.00	44,644		
1,000.00	-0.08	-0.01	50,091		
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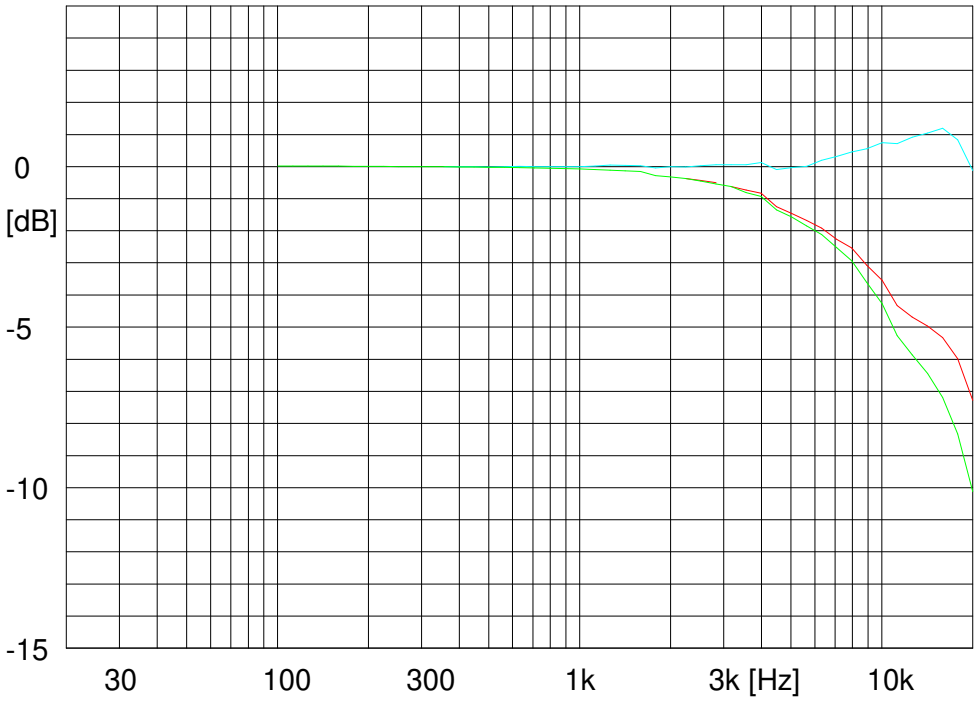
1,258.90	-0.12	0.04	63,058		
1,412.50	-0.14	0.03	70,752		
1,584.80	-0.15	0.03	79,383		
1,778.10	-0.28	-0.04	89,068		
1,995.10	-0.32	0.00	99,934		
2,238.50	-0.37	-0.01	112,126		
2,511.60	-0.43	0.03	125,806		
2,818.00	-0.50	0.06	141,154		
3,161.80	-0.62	0.06	158,375		
3,547.50	-0.73	0.06	177,696		
3,980.30	-0.83	0.13	199,375		
4,465.90	-1.24	-0.09	-		

The corrections used to produce these random and free field responses are published by the manufacturer and they are responsible for the accuracy of the data and for the associated uncertainties to be applied. Campbell Associates Limited use their best endeavours to ensure the accuracy of this data but are not responsible for any errors, omissions or for ensuring that the data is of the current issue.

If the actuator response was not measured for any frequency, then the corresponding cell in the above table will be blank; similarly, if correction data is not available from the manufacturer the cell will also be blank.
Correction data for frequencies below 100 Hz are not required

** End of Table Section **

Microphone Calibration Certificate



Norsonic
Type: 1225

Serial no: 332080

Sensitivity: 51.66 mV/Pa
-25.74 ±0.10 dB re. 1 V/Pa
Capacitance: 23.1 ±1.0 pF
Date: 15/07/2022

Signature:

Measurement conditions:

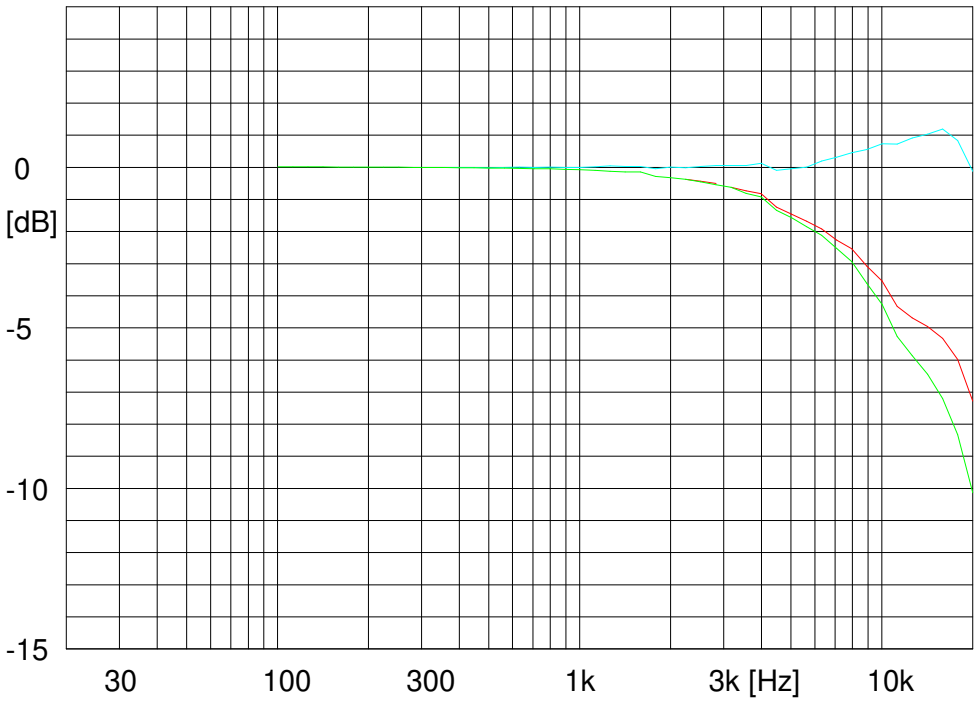
Polarisation voltage:	200.0 V
Pressure:	101.61 ±0.04 kPa
Temperature:	22.9 ±0.2 °C
Relative humidity:	45.0 ±1.3 %RH

Results are normalized to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Microphone Calibration Certificate



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Sensitivity: 51.66 mV/Pa
-25.74 ±0.10 dB re. 1 V/Pa
Capacitance: 23.1 ±1.0 pF
Date: 15/07/2022

Signature:

Measurement conditions:

Polarisation voltage:	200.0 V
Pressure:	101.61 ±0.04 kPa
Temperature:	22.9 ±0.2 °C
Relative humidity:	45.0 ±1.3 %RH

Results are normalized to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Comment:

Laboratory Location
Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

Certificate of Calibration and Conformance

Certificate number: **45381**

Test Object: **Sound Calibrator**

Producer: **Norsonic AS.**
Type: **1251**
Serial number: **31679**
Customer: **Sharps Redmore**
Address: **The White House, London Road, Copdock, Ipswich. IP8 3JH.**
Contact Person: **Emily Sharpe**
Order No: **ESS 230040**

Measurement Results	Level	Level Stability	Frequency	Distortion
	dB	dB	Hz	%
Measurement 1	113.89	0.06	1000.18	0.44
Measurement 2	113.90	0.06	1000.17	0.41
Measurement 3	113.90	0.06	1000.16	0.40
Result (Average):	**113.90**	**0.06**	**1000.17**	**0.42**
Expanded Uncertainty:	0.1	0.02	1	0.1
Degree of Freedom:	>100	>100	>100	>100
Coverage Factor:	2	2	2	2

The stated level is relative to 20µPa. The level is traceable to National Standards. The stated level is valid at reference conditions. The following correction factors have been applied during the measurement

Pres:0.0005 dB/kPa Temp:0.003 dB/°C Humi:0 dB/%RH Load volume: 0.0003 dB/mm3

Conditions	*Pressure kPa*	*Temperature °C*	*Humidity %RH*
Reference conditions	101.325	23	50
Measurement conditions	101.025 ±0.045	21.1 ±0.3	56.2 ±1.9

The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.

Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\Current Year\NOR1251_31679_M1.nmf

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Calibration Dates:

Received date:	07/09/2023	Reviewed date:	15/09/2023
Calibration date:	15/09/2023	Issued date:	15/09/2023

Technicians: (Electronic certificate)

Calibrated by: *Palaniwel Marappan B.Eng(Hons), M.Sc*
Reviewed by: *Darren Batten*

Certificate of Calibration and Conformance

Continuation of Certificate number: 45381

Reference Microphone: WSM11 (C) - GRAS40AG-291442

Measurements

The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Instruments and Program

A complete list of instruments, hardware and software that have been used for this calibration is available from the calibration laboratory

Comments

Statement of Conformance and 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 BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

*This evidence is held on file at the calibration laboratory.

Notes:

The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in BOLD are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Observations:

This certificate relates only to the items tested above.

** End of Certificate **

APPENDIX C

NOISE SURVEY RESULTS

Appendix C	Title: Noise survey results

Measurement location A - Sharpness Close

Date	Sample start time	Noise Parameter - dB				
		L_{A10}	L_{A90}	L_{Aeq}	L_{AMAX}	L_{AMIN}
5.11.23	08:00	58.1	53.2	56.2	65.6	51.1
	08:15	57.2	52.8	55.5	68.6	50.6
	08:30	57.7	53.6	56.0	64.8	51.5
	08:45	58.7	54.2	56.8	67.2	52.2
	09:00	58.5	53.6	56.6	70.1	51.2
	09:15	59.9	54.5	59.1	68.9	51.8
	09:30	60.4	55.7	58.5	72.5	52.7
	09:45	59.6	55.2	57.8	69.3	53.1
	10:00	60.2	56.4	58.6	68.7	53.9
	10:15	59.9	55.6	58.2	69.5	53.3

Measurement location B - Jollys Lane

Date	Sample start time	Noise Parameter - dB				
		L_{A10}	L_{A90}	L_{Aeq}	L_{AMAX}	L_{AMIN}
5.11.23	08:15	55.4	52.5	54.2	64.6	49.9
	08:30	56.2	53.4	55.0	71.8	51.1
	08:45	57.1	53.5	55.9	69.6	51.3
	09:00	56.0	53.0	54.8	67.5	50.9
	09:15	57.0	54.2	55.9	65.0	51.2
	09:30	58.6	55.7	57.7	65.1	52.5
	09:45	58.4	54.9	57.8	73.8	52.6
	10:00	57.4	53.9	56.3	70.7	52.0

Measurement location C - Clayton Terrace

Date	Sample start time	Noise Parameter - dB				
		L_{A10}	L_{A90}	L_{Aeq}	L_{AMAX}	L_{AMIN}
5.11.23	08:30	54.6	51.7	53.4	61.3	49.3
	08:45	55.2	52.0	53.8	62.9	49.9
	09:00	54.2	51.5	53.0	59.4	48.7
	09:15	55.1	52.3	54.0	62.3	49.7
	09:30	56.6	53.4	55.4	71.3	50.6
	09:45	55.6	52.9	54.7	68.5	51.0
	10:00	56.1	53.4	55.7	83.8	50.9
	10:15	56.1	53.1	54.7	66.1	51.5

Shaded cells indicate measurements taken during a delivery event to the front door of the Tesco store

APPENDIX D

PREDICTED DELIVERY EVENT NOISE LEVELS

APPENDIX D1.1

Assessment project: Tesco Yeading	Delivery component		
	Arrival	**Unloading**	**Departure**
Delivery noise activity - predicted ambient noise levels ($L_{Aeq\ T}$) *			
Closest residential property address:	**17 Sharpness Close**		
Measured source noise level normalised to 10 metres $L_{Aeq\ T}$	69	60	72
Time - minutes	1	30	1
Distance between noise source and residential property in metres	120	120	120
Screening attenuation dB	0	0	0
Convert to 1 hour - dB	-17.8	-3.0	-17.8
Distance attenuation correction - dB	-21.6	-21.6	-21.6
Activity $L_{Aeq\ 1\ hr}$	29.6 dB	35.4 dB	32.6 dB
Rating level correction	4 dB	6 dB	0 dB
Resultant daytime rating level $L_{Ar,\ Tr}$	33.6 dB	41.4 dB	32.6 dB
Overall delivery activity noise (arrival, unloading, departure) $L_{Aeq\ 1\ hr}$	**38 dB**		
Rating level dB $L_{Aeq\ 1\ hr}$	**43 dB**		

APPENDIX D1.2

Assessment project: Tesco Yeading	Delivery component		
	Arrival	**Unloading**	**Departure**
Delivery noise activity - predicted ambient noise levels ($L_{Aeq\ T}$) *			
Closest residential property address:	**Jollys Lane (flats above shops)**		
Measured source noise level normalised to 10 metres $L_{Aeq\ T}$	69	60	72
Time - minutes	1	30	1
Distance between noise source and residential property in metres	60	60	60
Screening attenuation dB	0	0	0
Convert to 1 hour - dB	-17.8	-3.0	-17.8
Distance attenuation correction - dB	-15.6	-15.6	-15.6
Activity $L_{Aeq\ 1\ hr}$	35.7 dB	41.4 dB	38.7 dB
Rating level correction	4 dB	6 dB	0 dB
Resultant daytime rating level $L_{Ar,\ Tr}$	39.7 dB	47.4 dB	38.7 dB
Overall delivery activity noise (arrival, unloading, departure) $L_{Aeq\ 1\ hr}$	**44 dB**		
Rating level dB $L_{Aeq\ 1\ hr}$	**49 dB**		

APPENDIX D1.3

Assessment project: Tesco Yeading	Delivery component		
	Arrival	**Unloading**	**Departure**
Delivery noise activity - predicted ambient noise levels ($L_{Aeq\ T}$) *			
Closest residential property address:	**Clayton Terrace**		
Measured source noise level normalised to 10 metres $L_{Aeq\ T}$	69	60	72
Time - minutes	1	30	1
Distance between noise source and residential property in metres	95	95	95
Screening attenuation dB	0	0	0
Convert to 1 hour - dB	-17.8	-3.0	-17.8
Distance attenuation correction - dB	-19.6	-19.6	-19.6
Activity $L_{Aeq\ 1\ hr}$	31.7 dB	37.4 dB	34.7 dB
Rating level correction	4 dB	6 dB	0 dB
Resultant daytime rating level $L_{Ar,\ Tr}$	35.7 dB	43.4 dB	34.7 dB
Overall delivery activity noise (arrival, unloading, departure) $L_{Aeq\ 1\ hr}$	**40 dB**		
Rating level dB $L_{Aeq\ 1\ hr}$	**45 dB**		

APPENDIX E

DELIVERY NOISE BS 4142 ASSESSMENT

APPENDIX E1

Results	**Time period**		**Relevant clause**	**Commentary**
	Sunday 5.11.23			
	08:00	09:00		
Receptor	**17 Sharpness Close**			
Background sound level dB (L_{A90})	53 dB	54 dB	**8.1, 8.1.3**	For night time the $L_{A90\ 5\ minute}$ value is the lowest measured value in that hour period
Specific sound level - predicted delivery event noise level	38 dB	38 dB		Predicted delivery activity noise level is $L_{Aeq\ 15\ minute}$ for nighttime and $L_{Aeq\ 1\ hour}$ for daytime
Acoustic feature correction (applied in delivery calc sheet)	6dB rating level correction applied to unloading component; 4 dB rating level correction applied to arrival component		**9.2**	6 dB acoustic characteristic correction applied to unloading component for clearly perceptible impulsivity; 4 dB correction applied for use of reversing alarms on arrival for clearly perceptible tonality.
Rating level	43 dB	43 dB	**9.2**	
Background sound level	53 dB	54 dB	**8.1**	
Excess of rating level over background level	-10	-11	**11**	
Assessment is indicative of 'low' impact depending upon context	**Relevant clause 11** 1. Predicted delivery event noise levels ($L_{Aeq\ 1\ hour}$) are well below the WHO Community Noise daytime guideline values 2. The predicted delivery event noise levels are well below the existing ambient noise climate from 0900 hours			
Uncertainty of the assessment	**Relevant clause 10**			
	Weather conditions during the survey were good with light winds observed and no rain			
	The excess of the rating level over the background sound level is between -11 dB and -10 dB in this instance the uncertainty of the measurement is unlikey to have any significance to the outcome of the assessment.			
	Delivery activity noise predictions are based upon noise source levels measured during a trial delivery to the front door of the store. The measured source noise levels correlate well with the extensive SR library of delivery activty noise levels and are therefore considered representative and robust.			

APPENDIX E2

Results	**Time period**		**Relevant clause**	**Commentary**
	Sunday 5.11.23			
	08:00	09:00		
Receptor	**Jollys Lane (flats above shops)**			
Background sound level dB (L_{A90})	54 dB	54 dB	**8.1, 8.1.3**	For night time the $L_{A90\ 5\ minute}$ value is the lowest measured value in that hour period
Specific sound level - predicted delivery event noise level	44 dB	44 dB		Predicted delivery activity noise level is $L_{Aeq\ 15\ minute}$ for nighttime and $L_{Aeq\ 1\ hour}$ for daytime
Acoustic feature correction (applied in delivery calc sheet)	6dB rating level correction applied to unloading component; 4 dB rating level correction applied to arrival component		**9.2**	6 dB acoustic characteristic correction applied to unloading component for clearly perceptible impulsivity; 4 dB correction applied for use of reversing alarms on arrival for clearly perceptible tonality.
Rating level	49 dB	49 dB	**9.2**	
Background sound level	54 dB	54 dB	**8.1**	
Excess of rating level over background level	-5	-5	**11**	
Assessment is indicative of 'low' impact depending upon context	**Relevant clause 11** 1. Predicted delivery event noise levels ($L_{Aeq\ 1\ hour}$) are well below the WHO Community Noise daytime guideline values 2. The predicted delivery event noise levels are well below the existing ambient noise climate from 0900 hours			
Uncertainty of the assessment	**Relevant clause 10**			
	Weather conditions during the survey were good with light winds observed and no rain			
	The excess of the rating level over the background sound level is -4 dB in this instance the uncertainty of the measurement is unlikey to have any significance to the outcome of the assessment.			
	Delivery activity noise predictions are based upon noise source levels measured during a trial delivery to the front door of the store. The measured source noise levels correlate well with the extensive SR library of delivery activty noise levels and are therefore considered representative and robust.			

APPENDIX E3

Results	Time period		Relevant clause	Commentary
	Sunday 5.11.23			
	08:00	09:00		
Receptor	**Clayton Terrace**			
Background sound level dB (L_{A90})	52 dB	52 dB	**8.1, 8.1.3**	For night time the $L_{A90\ 5\ minute}$ value is the lowest measured value in that hour period
Specific sound level - predicted delivery event noise level	40 dB	40 dB		Predicted delivery activity noise level is $L_{Aeq\ 15\ minute}$ for nighttime and $L_{Aeq\ 1\ hour}$ for daytime
Acoustic feature correction (applied in delivery calc sheet)	6dB rating level correction applied to unloading component; 4 dB rating level correction applied to arrival component		**9.2**	6 dB acoustic characteristic correction applied to unloading component for clearly perceptible impulsivity; 4 dB correction applied for use of reversing alarms on arrival for clearly perceptible tonality.
Rating level	45 dB	45 dB	**9.2**	
Background sound level	52 dB	52 dB	**8.1**	
Excess of rating level over background level	-7	-7	**11**	
Assessment is indicative of 'low' impact depending upon context	**Relevant clause 11** 1. Predicted delivery event noise levels ($L_{Aeq\ 1\ hour}$) are well below the WHO Community Noise daytime guideline values 2. The predicted delivery event noise levels are well below the existing ambient noise climate from 0900 hours			
Uncertainty of the assessment	**Relevant clause 10**			
	Weather conditions during the survey were good with light winds observed and no rain			
	The excess of the rating level over the background sound level is -7 dB in this instance the uncertainty of the measurement is unlikey to have any significance to the outcome of the assessment.			
	Delivery activity noise predictions are based upon noise source levels measured during a trial delivery to the front door of the store. The measured source noise levels correlate well with the extensive SR library of delivery activty noise levels and are therefore considered representative and robust.			

APPENDIX F

ACOUSTIC TERMINOLOGY

Acoustic Terminology

F1 Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sounds is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase in level of 3 dB, i.e. 50 dB + 50 dB = 53 dB. Increases in continuous sound are perceived in the following manner:

1 dB increase - barely perceptible.

3 dB increase - just noticeable.

10 dB increase - perceived as twice as loud.

F2 Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz (Hz) = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 18000Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium frequency than high or low frequencies.

F3 To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability automatically to weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).

F4 The second important characteristic of sound is amplitude or level. Two units are used to express level, a) sound power level - L_w and b) sound pressure level - L_p. Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity, etc. The sound level that is measured on a meter is the sound pressure level, L_p.

F5 External sound levels are rarely steady but rise or fall in response to the activity in the area - cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on the type and temporal distribution of a particular type of noise. A set of statistical indices have been developed for the subjective response to these different noise sources.

F6 The main noise indices in use in the UK are:

L_{A90}: The sound level (in dBA) exceeded for 90% of the time. This level gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background sound level" of an area.

L_{Aeq}: The equivalent continuous sound level in dBA. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the intermittent noise". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as aircraft and trains.

L_{A10}: The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given

sample. It has been used over many years to measure and assess road traffic noise.

L_{AMAX}: The maximum level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles, etc.

F7 The sound energy of a transient event may be described by a term SEL - Sound Exposure Level. This is the L_{Aeq} level normalised to one second. That is the constant level in dBA which lasting for one second has the same amount of acoustic energy as a given A weighted noise event lasting for a period of time. The use of this unit allows the prediction of the L_{Aeq} level over any period and for any number of events using the equation;

$$L_{AeqT} = SEL + 10 \log n - 10 \log T \text{ dB}.$$

Where

n = Number of events in time period T.

T = Total sample period in seconds.

F8 In the open, known as free field, sound attenuates at a rate of 6 dB per each doubling of distance. This is known as geometric spreading or sometimes referred to as the Inverse Square Law. As noise is measured on a Logarithmic scale, this attenuation in distance = 20 Log (ratio of distances), e.g. for a noise level of 60 dB at ten metres, the corresponding level at 160 metres is:

$$60 - 20 \text{ Log } {}^{160}/_{10} = 60 - 24 = 36 \text{ dB}.$$