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MCDONALDS MD HAVERHILL

Acoustic Assessment

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Acoustic Assessment of Proposed Restaurant and Drive-thru

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Acoustic Assessment

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Registration of Amendments

Revision and Date	Amendment Details	Revision Prepared By	Revision Approved By

1.0 INTRODUCTION

1.1 Create Consulting Engineers Ltd have been appointed by McDonald's Restaurants Ltd to undertake a noise impact assessment for a new McDonald's Restaurant in Haverhill.

1.2 This report assesses the proposals for the McDonalds restaurant, including all plant, deliveries and drive-thru activity.

1.3 The development comprises of a type NG140 building with associated drive-thru.

1.4 This report contains:

- a description of the existing site and the proposed development;
- a summary of the relevant global and local policy and standards; and
- the results of measurements undertaken on site.

1.5 Recommendations given in this report are for acoustic purposes only. It is the Client's responsibility to ensure that any work carried out complies with other regulations.

1.6 A glossary of acoustic terms used in this report is provided in Appendix A.

2.0 EXISTING ENVIRONMENT AND SITE PROPOSALS

2.1 The application site is located on the Haverhill Business Park, bounded by Bumpstead Road (B1057) to the East and Phoenix Road to the South.

2.2 Haverhill Business Park is located to the west of the site, which comprises of several commercial and industrial businesses. Those situated closest to the site boundary include B & C Glass Ltd., Buildbase, and Terence Barker.

2.3 The proposed site location and surrounding area is shown below.

Figure 2.1: Site location and surrounding area

2.4 The current site layout shows a type NG140 McDonald's restaurant, in the area shown above. The drive-thru route is situated along the east and southern boundary of the site. Access to the site is proposed along Bumsptead Road.

2.5 The restaurant will have several items of plant associated with it. A summary of the plant to be installed as part of the McDonalds development and the associated noise levels are discussed in Section 6.0.

2.6 We understand that the McDonalds restaurant will provide up to a 24-hour service.

2.7 The closest noise sensitive receptor to the development is the Travelodge situated approximately 50 m to the south. There are also residential dwellings approximately 145 m to the north-east of the site.

2.8 The noise sensitive receptors surrounding the site are shown in Figure 2.2.

Figure 2.2: Noise Sensitive Receptors

3.0 POLICY, STANDARDS AND CRITERIA

National Policy

3.1 A summary of the National Planning Policy Framework, National Planning Practice Guidance and the Noise Policy Statement for England is provided in Appendix B of this report.

3.2 We have been asked not to contact the Local authority whilst undertaking this assessment.

3.3 We have therefore referred to local policy and nationally accepted guidance in forming this assessment, as follows:

Local Policy

3.4 The Braintree District Council Local Plan – Section 1 (Adopted 2021) contains the following policy that is applicable in this instance.

Policy SP7 – Place Shaping Principles

> 'All new developments must meet high standards of urban and architectural design. Development frameworks, masterplans, design codes, and other design guidance documents will be prepared in consultation with stakeholders where they are needed to support this objective.
>
> All new development should reflect the following place shaping principles, where applicable:
>
> *[…]*
>
> - *Protect the amenity of existing and future residents and users with regard to noise, vibration, smell, loss of light, overbearing and overlooking.'*

3.5 The Braintree District Council Local Development Framework contains the following policy that is applicable in this instance.

Policy CS8 – Natural Environment and Biodiversity

> 'All development proposals will take account of the potential impacts of climate change and ensure the protection and enhancement of the natural environment, habitats and biodiversity and geo-diversity of the District. This will include where appropriate protection from:
>
> - *Air, noise, light and other types of pollution'*

Standards and Guidance

ProPG: Planning & Noise – New Residential Development (2017)

3.6 The Professional Practice Guidance on Planning and Noise (ProPG) has been developed by a working group consisting of representatives of the Association of Noise Consultants (ANC), Institute of Acoustics (IOA) and Chartered Institute of Environmental (CIEH).

3.7 The approach detailed in this guidance includes a framework to clearly determine situations where noise is not an issue, and to help identify the extent of risk at noisier sites.

3.8 This ProPG advocates a systematic, proportionate, risk based, 2-stage approach to assessing the risk of noise to future development, as follows:

- Stage 1 – an initial noise risk assessment of the proposed development site, considered to support wider Government planning and noise policy; and
- Stage 2 – a systematic consideration of four key elements:
  - Element 1 – demonstrating a "Good Acoustic Design Process";
  - Element 2 – observing internal "Noise Level Guidelines";
  - Element 3 – undertaking an "External Amenity Area Noise Assessment"; and
  - Element 4 – consideration of "Other Relevant Issues

3.9 The document advocates an assessment in a graduating manner from Negligible to High Risk as shown in the following figure:

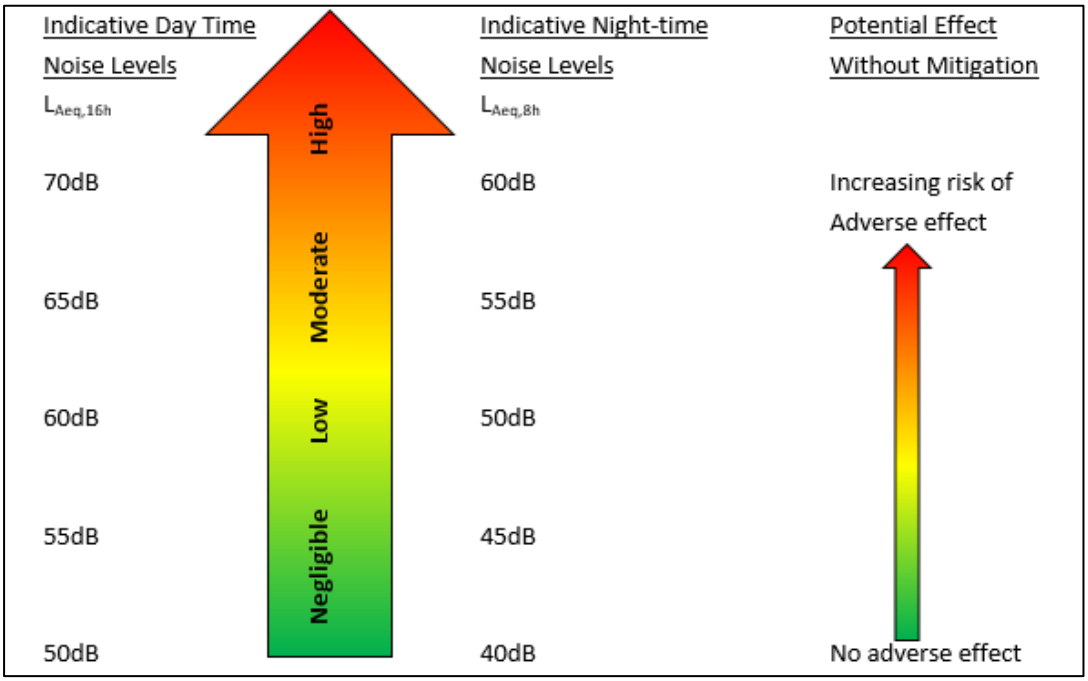


Figure 3.1: Initial Site Risk Assessment Using Fig. 1 of ProPG

3.10 This document states that "an indication that there might be more than 10 noise events at night (2300 – 0700) with L_{AFmax} > 60 dB means the site should not be regarded as negligible risk."

3.11 The approach outlined above, is underpinned by the preparation of an Acoustic Design Statement (ADS). This ADS should be more detailed for a site assessed as being 'high-risk', and less detailed for a site assessed as being 'low-risk'. This approach will result in one of four recommendations for the site; "grant without conditions", "grant with conditions", "avoid" or "prevent".

WHO: Guidelines on Community Noise (1999)

3.12 The WHO Guidelines for Community Noise state the following guideline values for noise in specific environments, as can be seen in Table 3.1.

Specific Environment	Critical Health Effects	$L_{Aeq,T}$ (dB)	$L_{AMAX,fast}$ (dB)
Dwelling, indoors	Speech intelligibility and moderate annoyance	35	-
Inside bedrooms	Sleep disturbance, night-time	30	45
Outdoor living area	Serious annoyance, daytime and evening	55	-
	Moderate annoyance, daytime and evening	50	-

Table 3.1: WHO Guideline Values for Community Noise

3.13 The document also states:

> *'For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{AMAX} more than 10-15 times per night (Vallet & Varnet, 1991).'*

3.14 These levels are reflected in the guidance provided in BS 8233 (2014).

BS 8233 (2014) Guidance on Sound Insulation and Noise Reduction for Buildings

3.15 British Standard 8233 (2014) 'Guidance on sound insulation and noise reduction for dwellings' provides contains guidance on limits for internal noise in common types of domestic and non-domestic buildings. The guidance is primarily intended for steady, continuous sources (such as noise from road traffic) but are also commonly used to provide a reasonable basis for assessing the suitability of noise levels within a dwelling. Careful interpretation and application of the guideline noise levels is often necessary.

3.16 The standard suggests the following internal ambient noise levels for dwellings:

Activity	Location	Day-Time Period 07:00 – 23:00	Night-Time Period 23:00 – 07:00
Resting	Living Room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$
NOTE 7 – Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved			

Table 3.2: BS 8223 (2014) Indoor Ambient Noise Levels

3.17 Note 4 of Section 7.7.2 of BS 8233 states:

> "Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{AMax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values."

3.18 Note 5 of BS 8233 states:

> "If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

3.19 Section 7.7.3.2 recommends that noise levels in external amenity areas should ideally not exceed 50 dB $L_{Aeq,T}$ and that 55 dB $L_{Aeq,T}$ should be considered as an upper limit. BS 8233 does, however, note that these values are guidelines and may not be achievable in all circumstances where development might be desirable.

BS 4142 (2014) +A1 (2019) Methods for Rating and Assessing Industrial and Commercial Sound

3.20 The British Standard 4142 (2014) describes methods for rating sound of an industrial and/or commercial nature to assess its likely effects on people who might be inside or outside a dwelling or premises used for residential purposes upon which the sound is incident.

3.21 BS 4142 specifies that an initial estimate of the impact of the specific sound can be obtained by subtracting the measured background sound level from the rating level and then considering the following:

- *Typically, the greater this difference, the greater the magnitude of the impact;*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and*
- *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. 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 on the context.*

3.22 The rating level is defined in BS 4142 as the sound level of the source plus any penalties for the characteristic features of the sound, such as tonality and impulsivity among others. Acoustical characteristics and associated penalties are shown in Table 3.3:

Acoustic Character	Subjective Level	Correction
Tonality	Just perceptible	+2 dB
	Clearly perceptible	+4 dB
	Highly Perceptible	+6 dB
Impulsivity	Just perceptible	+3 dB
	Clearly perceptible	+6 dB
	Highly Perceptible	+9 dB
Intermittency	Readily distinctive	+3 dB
Other sound characteristics	Readily distinctive	+3 dB

Table 3.3: Acoustical Characteristics for Determining the Rated Sound Level

3.23 The above correction values are based on the subjective nature of the sound, however BS 4142 also provides detailed guidance on objectively calculating the correction factors, which are included within Annexes C, D and E of the British Standard.

3.24 This latest version of the British Standard states that the most relevant background sound level should be applied for the most relevant time period and should reflect the period

which is being assessed. This could include the use of statistical analysis or averaging to calculate the most applicable background sound level.

3.25 It should be noted that BS 4142 does not always give an accurate rating of impact, particularly when the background noise levels are otherwise very low. It may therefore be appropriate to assess noise in absolute levels in otherwise very quiet environments.

3.26 Even in these cases it is useful to refer to this guidance as an initial assessment.

Criteria

3.27 The following summaries the criteria we have applied for this project.

3.28 Plant and activity noise associated with the business has been assessed in accordance with BS 4142 and the context of the site has been considered.

3.29 Guidance from BS 8233 and the WHO Guidelines has been referred to, to inform our assessment, particularly when discussing the context of the noise form the development.

4.0 MEASUREMENT SURVEY

4.1 We attended site on 1st April 2022 and again on 5th April 2022 to undertake a site survey. During the visit on 1st April 2022, a logging sound level meter was installed at the Travelodge, and another at the boundary of the site closest to the houses identified in chapter 2.

4.2 These locations were selected in order to provide representative sound levels at the closest noise sensitive receptors.

4.3 On the 1st April 2022 we conducted a walk over of the proposed site to better understand the pre-existing, residual noise sources at the site, and their potential for adverse impact upon proposed McDonald's site.

4.4 During the site visit, we identified that the dominant noise source at the closest receptors were traffic movements along Phoenix Road and Bumpstead Road. The traffic movements along Helions Bumpstead road were infrequent, however the observed vehicles were predominantly HGVs.

4.5 Across the proposed McDonalds site, the dominant noise source was from traffic movements on the roads surrounding the site. Infrequent occurrences of noise from the businesses to the west were audible, however these were noted as being mostly vehicle movements.

4.6 The only externally mounted plant that was identified was a high-level extract duct on the north-facing façade of the Travelodge. This was observed to be running continuously during the site walkover.

4.7 The measurement locations used for our survey are shown in the figure below:

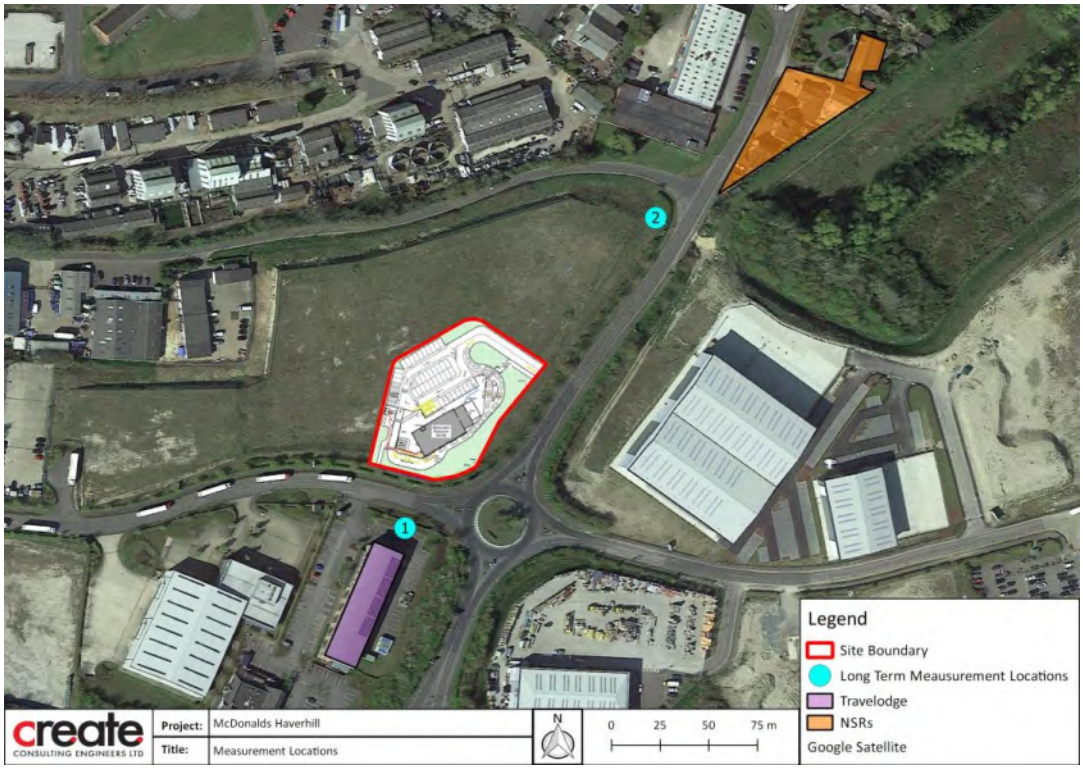


Figure 4.1: Measurement locations

4.8 All measurements were taken at a height of 1.5 m, in free-field conditions. The results of our survey are summarised in Section 5.0.

4.9 The equipment was calibrated to the manufacturers stated levels before and after the survey, and no significant drift in calibration was noted. A summary of equipment used, and calibration information is contained in Appendix C of this report.

4.10 During the survey period, a weather monitoring station was left to gather meteorological data at the site. Throughout this period wind speeds up to 6.5 m/s were recorded, and temperatures ranged between -4˚C and 13˚C. Any periods of inclement weather, where wind speeds exceed 5 m/s and rainfall occurred, have been excluded from any subsequent calculations in our assessment in line with BS 7445.

Drive-thru Survey

4.11 Between the 28th March 2022 and 29th March 2022, measurements were undertaken at 5 metres from the edge of an operating McDonalds drive-thru on Broadland Business Park. These measurements have been used to inform a noise model of the proposed site which is discussed in Section 7.0.

4.12 The survey location is shown in Figure 4.2, although due to the recent development of the restaurant, the building is not yet shown on the satellite imagery.

Figure 4.2: Measurement location at existing McDonald's building

4.13 When we attended site, we noticed that the noises from the surrounding roads was not particularly audible over the noise from the cars using the McDonalds drive thru. Although, occasional noise from vehicles passing on Poppy Way was noted.

4.14 When we returned to site, we noted that the morning traffic was noticeably more audible and was the dominant noise source. It is expected, that due to the early morning temperatures and the clear skies during the late evening, that a temperature inversion may have been causing noise from the surrounding roads to 'travel further' than in otherwise typical conditions.

4.15 It is for this reason, we did not use the full measurement data to inform our recommendations, and instead reviewed the log files of a 1-hour period during the start of the survey when the surrounding roads were not significantly impacting the drive-thru measurements.

4.16 We returned to site a third time at 03:30 on 12th April 2022 to measure noise from a delivery. Our measurements included:

- an articulated McDonalds lorry entering the site,
- the lorry idling for approximately 5 minutes following its arrival,
- the unloading of fifteen cages and two racks of crates,
- the manoeuvring of the delivery,
- the collection of used racks and crates,
- the lorry leaving the site

4.17 The crates were all on casters and unloaded using an integrated lift to the rear of the vehicle.

4.18 We were advised that this type of delivery is considered to be a typical delivery for McDonald's and therefore has been considered standard practice.

4.19 During our unattended survey at the noise sensitive receptor, wind speeds were below 1.5 m/s and temperatures ranged between 1˚C and 20˚C during the daytime and between 1˚C and 7˚C during the night-time.

4.20 Our equipment notes a short period or rain during the start of our survey, but this is inconsistent with our experience of the local weather, and we have therefore not excluded data during this period.

4.21 During our visit to the McDonalds at Broadland Business Park, the weather was as follows:

Date	Rain	Wind speed	Temperature
28th March 2022 to 29th March 2022	None	≤4.8 m/s	5˚C – 15˚C
12th April 2022	None	≤2.7 m/s	9 ˚C

Table 4.1: Weather Data for Broadlands Business Park Site Visit

5.0 RESULTS

Statistical Analysis of Background Sound Levels

5.1 Histograms of the daytime and night-time measurement results at MP1 and MP2 are shown in the following figures:

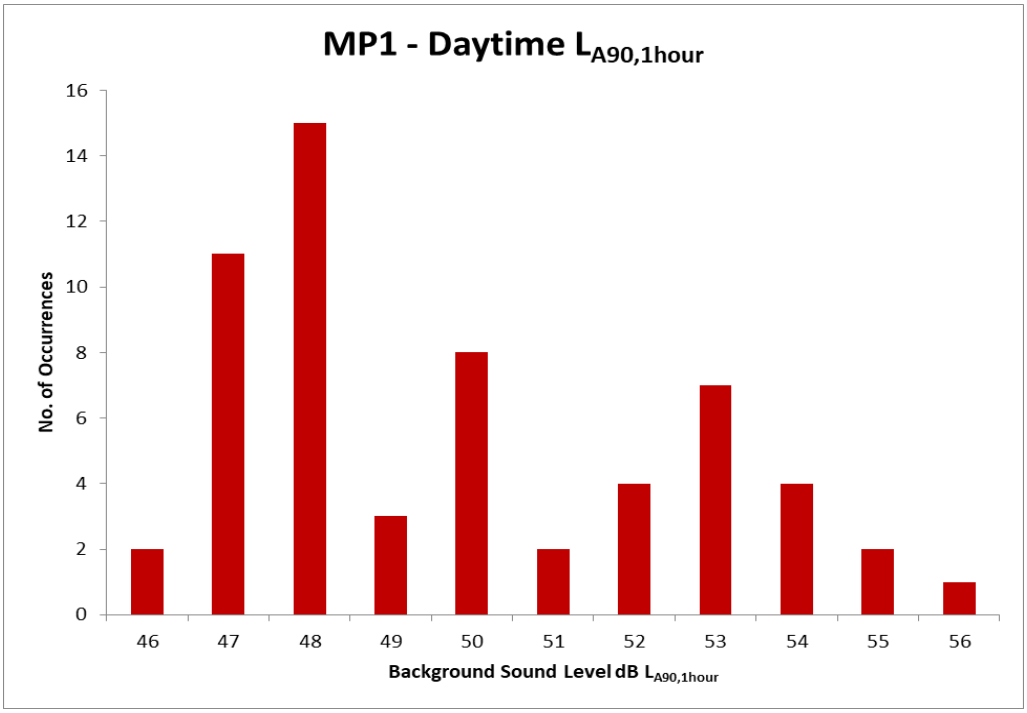


Figure 5.1: Daytime background noise levels MP1

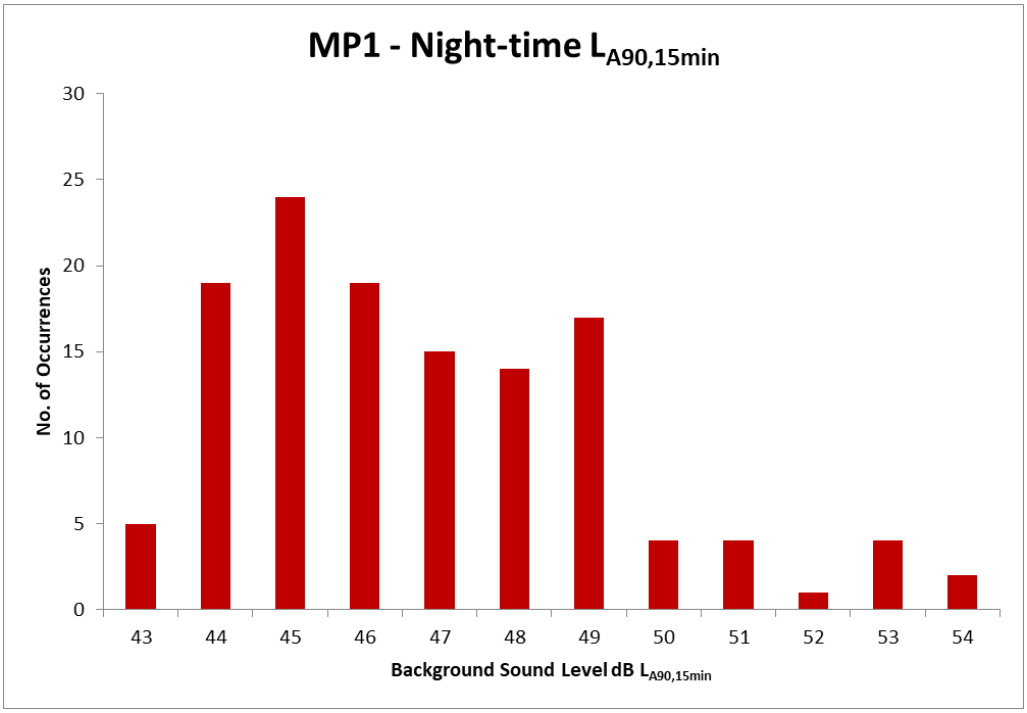


Figure 5.2: Night-time background noise levels MP1

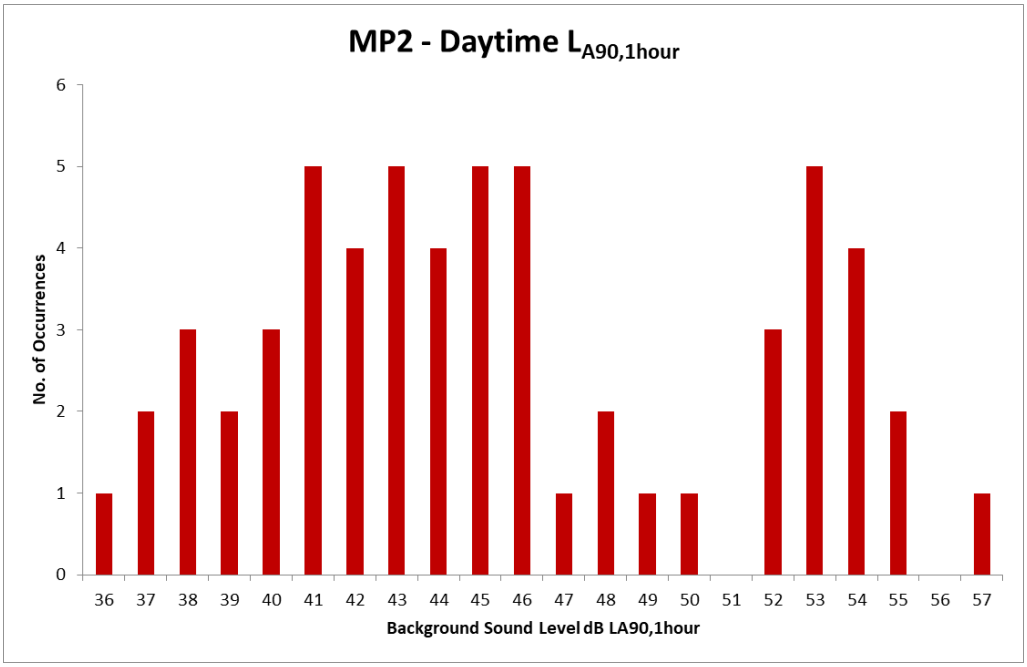


Figure 5.3: Daytime background noise levels MP2

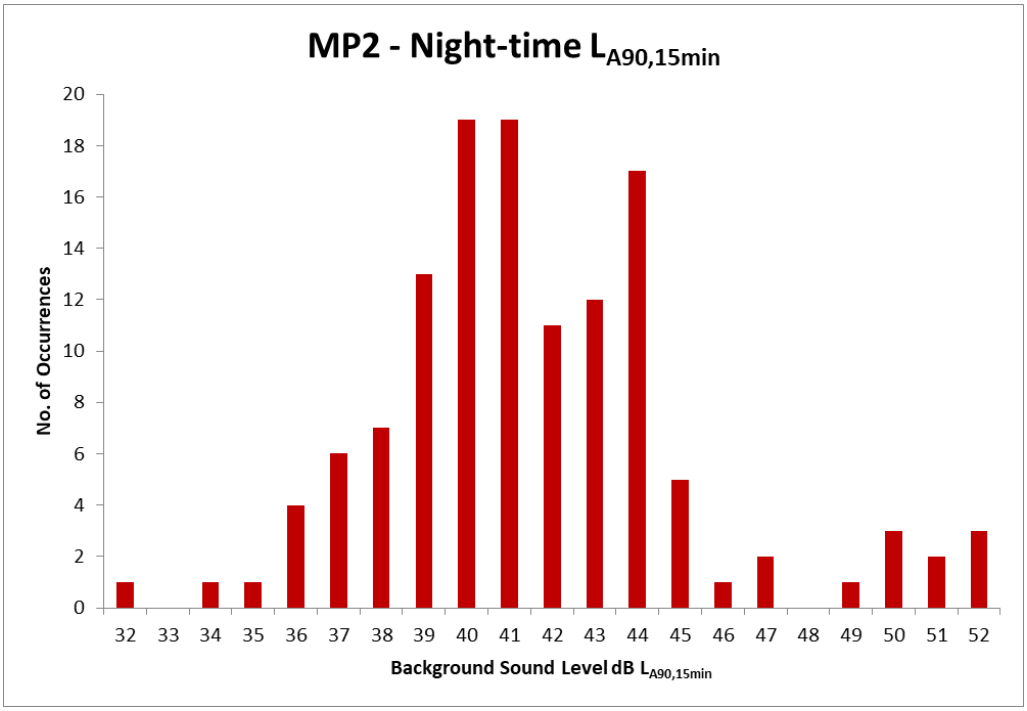


Figure 5.4: Night-time background noise levels MP2

5.2 For instances where there is equal distribution of the most commonly occurring L_{A90}, professional judgement has been used to determine the most appropriate level for assessment. For the purposes of this assessment, we have chosen the lowest values in an aim to reduce the likelihood of adverse impact on nearby NSRs.

5.3 A summary of the levels chosen from statistical analysis of the measured data can be seen in the following table:

Measurement Location	$L_{A90,1h}$ - Daytime	$L_{A90,15min}$ – Night-time
MP1	48	45
MP2	41	40

Table 5.1: Assessment Levels from Statistical Analysis

Noise levels from the drive-thru

5.4 Individual traffic movements were measured to range between 56 dB $L_{Aeq,T}$ and 69 dB $L_{Aeq,T}$ during the period of the survey which was not adversely impacted by other noise sources.

5.5 The higher noise level events were mainly influenced by brake squeal from vehicles.

5.6 The logarithmically averaged noise levels from vehicles using the drive-thru was 61 dB L_{Aeq} and each vehicle movement dominated the measurement, on average, for approximately 11 seconds.

5.7 For our assessment we have considered an average vehicle single event level (SEL) of 71 dB(A).

Noise levels from deliveries

5.8 During our survey, we measured a combined noise level of 58 dB $L_{Aeq,T}$ at 10 meters from the rear of the lorry cab as mobility, loading and unloading activities occurred.

5.9 The residual noise level when no activities were occurring was measured at 51 dB $L_{Aeq,T.}$

5.10 Noise levels during the delivery have subsequently been calculated to be 57 dB $L_{Aeq,T.}$

5.11 The delivery took approximately one hour and we understand these occur three times a week.

6.0 PLANT NOISE DATA

6.1 The following table summarises the plant that is to be installed as part of this project and the noise levels we have used for our assessment.

Unit name	Octave band A - sound pressure at 1m, dB B – sound power, dB								LAeq	Reference distance (m)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		
Danfoss OP-MPUM034 (v9000)									37 dB [A]	10 m
Danfoss OP-LPHM136 (v9000)									42 dB [A]	10 m
Scotsman ECC Series Remote Condensing Unit (ABS) (v9001)									70 dB [A]	1 m [1]
Manitowoc CVDT1200A Condensing Unit (ABS) (v9002)									62 dB [A]	1 m [2]
Adveco FPi Air Source Heat Pumps (v9005)									59 dB [A]	1 m [2]
Systemair Circular Duct Fan K 315M EC (v3030)									50 dB [A]	3m
TX9 wall fan (v3032)									43 dB [A]	3 m

Unit name	Octave band A - sound pressure at 1m, dB B – sound power, dB								LAeq	Reference distance (m)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		
Mitsubishi PKA-ZM35VKA (v2004)									62 dB [A]	1 m
Mr Slim HP1000 DXE PUHZ-ZRP71VHA 2 (v2005)									73 dB [A]	1 m
Nuair Extract Dave Size 6DE6-ES Induct outlet (v3031)	92 dB [B]	88 dB [B]	76 dB [B]	69 dB [B]	68 dB [B]	63 dB [B]	58 dB [B]	51 dB [B]	-	-
Nuair Extract Dave Size 6DE6-ES casing break out (v3031)	76 dB [B]	68 dB [B]	67 dB [B]	54 dB [B]	55 dB [B]	44 dB [B]	39 dB [B]	32 dB [B]	40 dB [A]	3 m
Mitsubishi PUHZ-RP250VKA (v2001a)	64 dB [A]	64 dB [A]	59 dB [A]	57 dB [A]	53 dB [A]	49 dB [A]	44 dB [A]	36 dB [A]	-	1 m
BW10500_ Breakout (v3002)	60 dB [A]	55 dB [A]	61 dB [A]	50 dB [A]	42 dB [A]	36 dB [A]	38 dB [A]	34 dB [A]	-	1 m
S1200L - Supply Fan Outlet - In Duct (v1050)	78 dB [B]	85 dB [B]	85 dB [B]	84 dB [B]	81 dB [B]	75 dB [B]	74 dB [B]	71 dB [B]	-	-
S2150IL - Supply Fan Outlet - In Duct (v1051)	75 dB [B]	85 dB [B]	81 dB [B]	80 dB [B]	77 dB [B]	73 dB [B]	70 dB [B]	65 dB [B]	-	-

Unit name	Octave band A - sound pressure at 1m, dB B – sound power, dB								LAeq	Reference distance (m)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		
S2120IL - Supply Fan Outlet - In Duct (v1052)	77 dB [B]	83 dB [B]	77 dB [B]	76 dB [B]	74 dB [B]	72 dB [B]	67 dB [B]	60 dB [B]	-	-
Mitsubishi PUZ-ZM35VKA (v2004)	58 dB [A]	51 dB [A]	45 dB [A]	44 dB [A]	40 dB [A]	36 dB [A]	32 dB [A]	31 dB [A]	57 dB [A]	1 m
Mitsubishi PUZ-ZM200YKA (v2001)	67 dB [A]	62 dB [A]	61 dB [A]	62 dB [A]	56 dB [A]	53 dB [A]	49 dB [A]	43 dB [A]	74 dB [A]	1 m
Mitsubishi PUZ-ZM250YKA (v2001)	71 dB [A]	61 dB [A]	61 dB [A]	61 dB [A]	56 dB [A]	53 dB [A]	49 dB [A]	43 dB [A]	73 dB [A]	1 m
Customer Order Point Speakers[1]									79 dB	0.5 m

Table 6.1: Plant noise data used for our assessment

1 – Manufactures data is not available, but we understand that this unit has been measured at this level as part of previous McDonald's developments.

2 – The manufacturers data does not provide a measurement distance for their reported level. We have assumed this distance as it is in line with similar equipment to the proposed in this project.

[A] – Denotes the Sound Pressure Level at a distance of 1m (unless otherwise specified)

[B] – Denotes the use of Sound Power levels

7.0 COMPUTER MODEL

7.1 We have constructed a 3D computer mode of the proposed site and the surrounding area using CadnaA version 4.6.

7.2 This Model allows us to consider the contribution of individual noise sources and investigate the impact of mitigation measures in an efficient way.

7.3 The model geometry for this project is shown below:

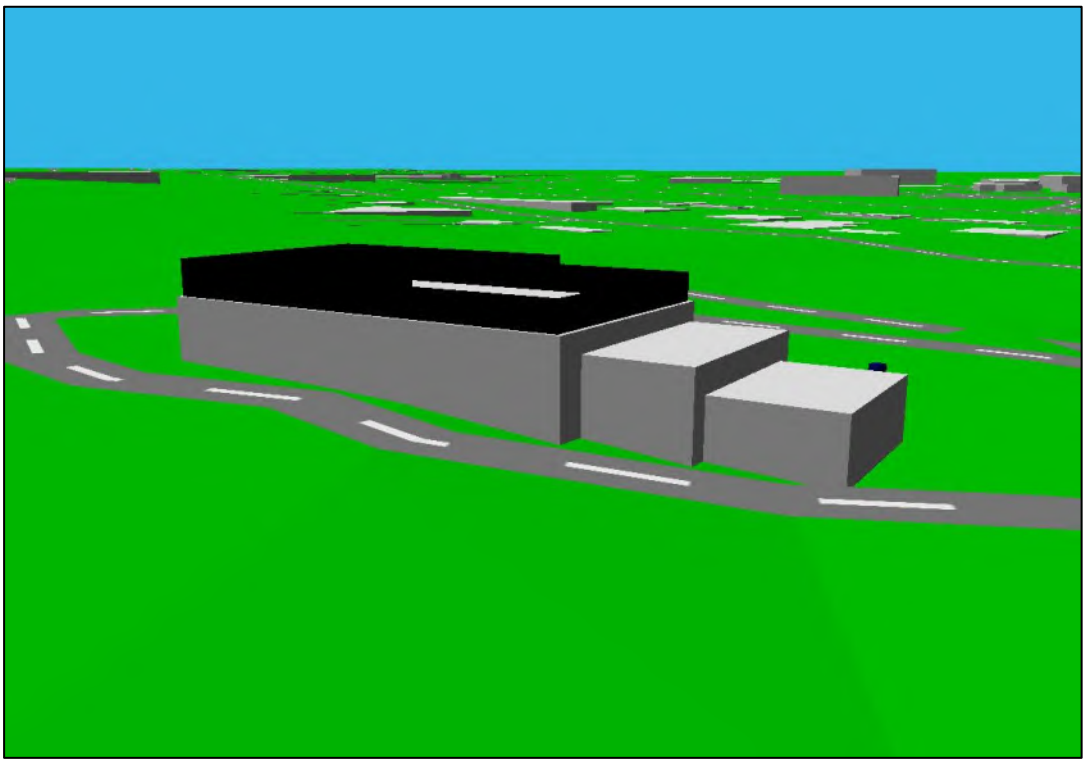


Figure 7.1: Model Geometry

7.4 For plant noise we have calculated the resultant level from the combined plant to the closest receptors, using the information on plant locations and equipment type as provided to us by McDonalds.

7.5 For delivery noise we have positioned a point source at the location shown in the transport assessment and calibrated it to the levels we have measured during our survey.

7.6 For drive though noise we have assumed that approximately 75 % of vehicles entering the site will use the drive through.

8.0 ASSESSMENT

8.1 We would not expect well maintained and serviced plant to exhibit tonal or other characteristics that may warrant a penalty in accordance with BS 4142.

8.2 There may, however, be times where plant turns on and off in the assessment period (1-hour during the daytime and 15-minutes during the night-time).

8.3 We have considered a + 3 dB correction for any potential intermittency from plant equipment. We have also considered that for deliveries, there could be the potential for sporadic, individual noise events that may be just perceptible at the Houses to the North-East and Travelodge. We have applied a +3 dB penalty to account for these activities.

8.4 This assessment has considered the potential impact of the Customer Order Point Speakers (COPS). This assessment is based on two order points operating simultaneously. A + 3 dB correction for intermittency has also been applied.

8.5 The following table summarises the initial BS 4142 assessment:

Assessment location	Noise source	Specific level, L_{Aeq}	Penalties	Rating Level, $L_{Ar,Tr}$	Background level $L_{AF90,T}$ (T= 1 hour during the daytime and 15 min during the night time)	Rating over background
Houses to the North-East	Plant	29 dB	+3 dB	32 dB	45 dB $L_{Aeq,1h}$ 41 dB $L_{Aeq,15min}$	Day: - 13 dB Night: - 9 dB
	Deliveries	30 dB	+3 dB	33 dB	45 dB $L_{Aeq,1h}$ 41 dB $L_{Aeq,15min}$	Day: - 12 dB Night: - 8 dB
	Drive thru	21 dB	0 dB	21 dB	45 dB $L_{Aeq,1h}$ 41 dB $L_{Aeq,15min}$	Day: -24 dB Night: -20 dB
	COPS	26 dB	+ 3 dB	29 dB	45 dB $L_{Aeq,1h}$ 41 dB $L_{Aeq,15min}$	Day: -16 dB Night: -12 dB
	Combined	-	-	***37 dB***	***45 dB $L_{Aeq,1h}$*** ***41 dB $L_{Aeq,15min}$***	***Day: -8 dB*** ***Night: -4 dB***
Travelodge (Second Floor Level)	Plant	35 dB	+3 dB	38 dB	48 dB $L_{Aeq,1h}$ 45 dB $L_{Aeq,15min}$	Day: - 10 dB Night: - 7 dB
	Deliveries	23 dB	+3 dB	26 dB	48 dB $L_{Aeq,1h}$ 45 dB $L_{Aeq,15min}$	Day: - 22 dB Night: - 19 dB
	Drive thru	31 dB	0 dB	31 dB	48 dB $L_{Aeq,1h}$ 45 dB $L_{Aeq,15min}$	Day: -17 dB Night: -14 dB
	COPS	33 dB	+ 3 dB	36 dB	48 dB $L_{Aeq,1h}$ 45 dB $L_{Aeq,15min}$	Day: -12 dB Night: -9 dB
	Combined	-	-	***41 dB***	***48 dB $L_{Aeq,1h}$*** ***45 dB $L_{Aeq,15min}$***	***Day: -7 dB*** ***Night: -4 dB***

Table 8.1: Summary of BS 4142 Assessment

8.6 The initial BS 4142 assessment indicates that there is a low/negligible potential for any adverse impact on the existing noise sensitive receptors.

8.7 For each noise-generating scenario, the levels predicted at the identified receptors have been calculated to not exceed the existing measured background noise levels.

8.8 Most of the individual rated noise levels are below 35 dB $L_{Ar,Tr}$ and should therefore be considered as very low, as defined in a previous revision of BS 4142 (1997).

8.9 Given the above considerations, we would not expect an adverse impact to be experienced following the development.

Road Traffic Noise

8.10 The proposed plans incorporate new road links, parking and drive thru facilities. The provision of this indicates that the road traffic in the area will increase due to an increase in vehicle trips to and from the site.

8.11 The following table summarises the predicted increase in traffic on each link road as identified in the accompanying transport statement (Doc Ref AF_VL_P22-2590_03), resultant of the McDonalds proposal:

Link	Road name	2024 (without scheme)	2024 (with Scheme)	% Increase
A	B1057 (North of Proposed Access)	5700	5946	4.3
B	B1057 (South of Proposed Access)	5700	6449	13.1
C	B1057 (South of Phoenix Road/Iceni W	5896	6644	12.7
D	B1057 (South of A1017 Rbt)	3964	4080	2.9
E	A1017 (East of B1057 Rbt)	5656	5657	0.0
F	A1017 (West of B1057 Rbt)	9072	9267	2.1

Table 8.2: Summary of Traffic Increase on surrounding roads

8.12 The transport statement indicates that the percentage of HGV's that make up the road traffic are not going to increase due to the development.

8.13 The increase in road traffic movements on the surrounding roads are negligible and would not be expected to lead to a significant increase in noise, i.e., less than or equal to 0.5 dB.

9.0 UNCERTAINTY

9.1 With all assessments there is a degree of uncertainty that must be considered.

9.2 Calculations were carried out using CadnaA. This software uses the method defined in ISO 9613-2 to calculated distance propagation assuming down wind conditions. This tends to result in a worst-case assessment although the standard does state that a +/- 3 dB uncertainty in the calculation method may be present. This is normally the case for complex models that include many reflections and objects, but in this project the model geometry is considered to be more simplified.

9.3 For our 3D model, we have used data from an attended measurement of a delivery at another McDonalds site. This measurement provides a sample of the noise associated with a delivery to these sites. It is important to consider that these deliveries may be subject to variations, such as materials being unloaded, delivery duration, vehicle specification, and time of delivery. However, the measurement data does provide what we consider to be representative of a typical delivery.

9.4 Our assessment of vehicle noise from the drive through uses the AADT data provided by the transport assessment. We have assumed an even amount of vehicle movements from one hour to the next. In practice, there will be some times that are busier than others and there could therefore be times where noise levels are above the levels predicted in our assessment.

9.5 In practice, even the highest noise levels from vehicle movements are 14 dB below the background noise during the night-time and given the existing road traffic on the site we would not expect the uncertainty associated with our calculations to change the outcome of our assessment.

10.0 CONCLUSIONS

10.1 Create Consulting Engineers have undertaken a noise assessment for the proposed McDonalds site in Haverhill.

10.2 An assessment of the operational plant, delivery and drive-thru noise has been undertaken with 3D noise modelling software.

10.3 The proposed plant, delivery and drive-thru operations have been assessed to the methodology outlined within BS 4142.

10.4 Increases in noise due to the increase in road traffic are not expected to be significant.

10.5 Our assessment concludes that there is no indication of any adverse impact on the noise sensitive receptors identified.

11.0 DISCLAIMER

11.1 Create Consulting Engineers Ltd disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report.

11.2 The copyright of this report is vested in Create Consulting Engineers Ltd and McDonald's Restaurants Ltd. The Client, or their appointed representatives, may copy the report for purposes in connection with the development described herein. It shall not be copied by any other party or used for any other purposes without the written consent of Create Consulting Engineers Ltd or McDonald's Restaurants Ltd.

11.3 Create Consulting Engineers Ltd accepts no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties rely upon the report at their own risk.

APPENDICES

APPENDIX A

Glossary of Acoustic Terms

dB(A)

The human ear is less sensitive to low (below 125Hz) and high (above 16kHz) frequency sounds. A sound level meter can be used to duplicate the ear's variable sensitivity to sound across a spectrum of frequencies. This is achieved by building a filter into the instrument with a similar frequency response to that of the average ear. This is called an "A-weighting filter". Measurements of sound made with this filter are called A-weighted sound level measurements and the unit is dB(A).

$L_{eq,T}$

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq}. The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period (T).

$L_{10,T}$

This is the minimum level exceeded for not more than 10% of the time period (T). This parameter is often used as a "not to exceed" criterion for noise.

$L_{90,T}$

This is the minimum level exceeded for not more than 90% of the time period (T). This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{fmax}

This is the maximum sound pressure level that has been measured over a period using a fast time constant.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 10 such octave bands whose centre frequencies are defined in accordance with international standards.

Addition of noise from several sources

Noise from different sound sources combine, on a logarithmic scale, to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than one alone and 3 identical sources produce a 5dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g., stream of cars) drops off by 3dB for each doubling of distance.

Sound Exposure Level (SEL)

This is the level at the reception point which, if maintained constant for a period of 1 second, would cause the same A weighted sound energy to be received as is actually received from a given noise event. The SEL is used to categorise and quantify the noise generated by individual railway vehicles and individual trains. As such, it serves as a "building block" to determine the L_{Aeq} for the total flow of trains over a given time period.

Subjective impression of noise

Sound intensity is not perceived directly at the ear; rather it is transferred by the complex hearing mechanism to the brain where acoustic sensations can be interpreted as loudness. This makes hearing perception highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a reasonable guide to help explain increases or decreases in sound levels for many acoustic scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud
20	About 4 times as loud

Barriers

Outdoor barriers can be used to reduce environmental noises, such as traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and its construction.

Reverberation control

When sound falls on the surfaces of a room, part of its energy is absorbed, and part is reflected back into the room. The amount of reflected sound defines the reverberation of a room, a characteristic that is critical for spaces of different uses as it can affect the quality of audio signals such as speech or music. Excess reverberation in a room can be controlled by the effective use of sound-absorbing treatment on the surfaces, such as fibrous ceiling boards, curtains and carpets.

APPENDIX B

National Planning Policy

National Planning Policy Framework (July 2021)

The National Planning Policy Framework (NPPF) replaces the previous version of the NPPF and the Planning Policy Statements (PPS) and Planning Policy Guidance (PPG), including the Department of the Environment's Planning Policy Guidance Note 24: 'Planning and Noise' (PPG 24), which was published in 1994. The main reference to noise within the latest version of the NPPF is at Paragraphs 174 (e) and 185:

> *'Para.174 (e). "Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> > *(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability."*
>
> *'Para.185. 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[65];*
> > *(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.'*

The reference number 65 cross references the National Policy Statement for England (2010) Explanatory Note.

Although some qualitative guidance on noise has been provided in the web-based Planning Practice Guidance document, there has been no alternative quantitative guidance proposed by the Government as a direct replacement for PPG24. This was due to the recognition that every site is different and that there is no single acceptable noise level, suitable for all applications.

National Planning Policy Guidance (2019)

On 6th March 2014, the Department for Communities and Local Government (DCLG) launched the National Planning Practice Guidance (NPPG) web-based resource to supersede previous planning guidance documents including PPG24 and provide clarification over all disciplinary sectors in the delivery of the design quality aspirations of the NPPF. This has been updated in July 2019.

The NPPG-Noise provides guidance on the assessment of noise, the needs to be considered when new developments may create additional noise and when developments would be sensitive to the prevailing acoustic environment.

The acoustic environment should be taken into account in the planning of new development and decision making should take the following into consideration:

- *'whether or not significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.'*

It then cross-references the Noise Policy Statement for England (2010) for further clarification on how to assess the overall effect of noise exposure.

<u>The Noise Policy Statement for England (2010)</u>

The Noise Policy Statement for England (NPSE) was published in March 2010 and is the overarching statement of noise policy for England and applies to all forms of noise other than occupational noise, setting out the long-term vision of Government noise policy which is to:

> *'Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.'*

The vision is supported by the following aims which are reflected in paragraph 1.7 of the Noise Policy Statement for England:

> *'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.'*

The Explanatory Note to the NPSE introduces three concepts to the assessment of the potential effects of noise:

- '***NOEL*** *– No Observed Effect Level: This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*
- ***LOAEL*** *– Lowest Observed Adverse Effect Level: This is the level above which adverse effects on health and quality of life can be detected.*
- ***SOAEL*** *– Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur.'*

Unlike the now redundant PPG24, the three levels are not defined numerically in the NPSE, and for the SOAEL the NPSE makes it clear that the noise level is likely to vary depending upon the noise source, the receptor and the time of day/day of the week, etc. The need for more research to investigate what may represent a SOAEL for noise is acknowledged and the NPSE asserts that not stating specific SOAEL levels provides policy flexibility in the period until there is further evidence and guidance.

APPENDIX C

Instrument Calibration Information

CAMPBELL ASSOCIATES
SOUND, VIBRATION & AIR SOLUTIONS

Sonitus House
5B Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, CM6 1HD
Telephone: 01371 871030
EORI: GB 720348755000

Delivery Note

Create Consulting Engineers Ltd
15 Princes Street
Norwich
NR3 1AF

Your Order Number: 4221
Order Placed by: Sam Ward
Date: 05/07/2021
Account No: CRE170
Our Order Number: 26267

Notes
Issue 2
Box - 2112
TL - 22713

Qty	Product Code	Product Description (Commodity code: 9027 80 00 00)
1	CALT-SLM	Traceable cal of Nor-140.1406932
1	CALT-SLM	Traceable cal of Nor-140.1406933
1	CALT-CAL	Traceable calibration ofNor-1251.34963

Delivery address (if not as above)

TBA

Quality Control Check

Goods checked by: [signature]
Goods counter-checked by: TA
Date: 6/7/21

CAMPBELL ASSOCIATES
SOUND, VIBRATION & AIR SOLUTIONS

Sonitus House, 5b Chelmsford Road Industrial Estate
Great Dunmow, Essex, CM6 1HD

Sales Tel: 01371 871033 Hire Tel: 01371 871037
Admin Tel: 01371 871030 Fax Tel: 01371 879106
E-Mail: info@campbell-associates.co.uk
Website: www.campbell-associates.co.uk

Technical Report

Customer: Create Consulting Engineers Ltd
Contact: Sam Ward
Order No: 4221

Technical log No: 22713
Report Date: 05 July 2021
Internal ref: 26267/CRE170B
Service Req'd: Calibration

Comments: Please calibrate to Traceable standard

Equipment ID:- NOR-140.1406932
Service Request:- Please calibrate to Traceable standard
Report: Traceable Calibration completed using Nor-1209.21140, Nor-1225.285513 & Nor-1251.34963 as the associated calibrator.
Certificate number: 38327

Equipment ID:- NOR-1209.21140
Service Request:-
Report: Used for calibration of Nor-140.1406932.
Certificate number: 38327

Equipment ID:- NOR-1225.285513
Service Request:- Diaphragm ok
Report: Traceable calibration completed - Sensitivity: -26.163dB, Capacitance: 22.073pF
Certificate number: 38326

Equipment ID:- NOR-140.1406933
Service Request:- Please calibrate to Traceable standard
Report: Traceable Calibration completed using Nor-1209.21141, Nor-1225.285519 & Nor-1251.34963 as the associated calibrator.
Certificate number: 38329

Equipment ID:- NOR-1209.21141
Service Request:-
Report: Used for calibration of Nor-140.1406933.
Certificate number: 38329

Equipment ID:- NOR-1225.285519
Service Request:- Diaphragm ok.

Technician:

CAMPBELL ASSOCIATES
SOUND, VIBRATION & AIR SOLUTIONS

Sonitus House, 5b Chelmsford Road Industrial Estate
Great Dunmow, Essex, CM6 1HD

Sales Tel: 01371 871033 Hire Tel: 01371 871037
Admin Tel: 01371 871030 Fax Tel: 01371 879106
E-Mail: info@campbell-associates.co.uk
Website: www.campbell-associates.co.uk

Technical Report

Customer: Create Consulting Engineers Ltd

Contact: Sam Ward

Order No: 4221

Technical log No: 22713

Report Date: 05 July 2021

Internal ref: 26267/CRE170B

Service Req'd: Calibration

Comments: Please calibrate to Traceable standard

Report: Traceable calibration completed - Sensitivity: -25.875dB, Capacitance: 22.93pF

Certificate number: 38328

Equipment ID:- NOR-1251.34963

Service Request:- Please calibrate to Traceable standard

Report: Traceable calibration completed - Level: 114.05dB, Frequency: 1000.6Hz, Distortion: 0.35%

Certificate number: 38325

Accessories supplied: C/w 2x soft carry case, 1x CA-1008L, 2X batteries, 1x windshield, instruction manual and various paperwork.

Important

Please note, our calibration and/or repair process may involve changing several parameters in your equipment. We endeavour to restore the original setting wherever possible, however, we cannot guarantee the equipment has been returned with your original settings. On receipt, please ensure that the settings meet your requirements prior to use.

PP

Technician:

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

CALIBRATION

Certificate of Calibration

Certificate number: **38327**

Test Object: **Sound Level Meter, BS EN IEC 61672-1:2013 Class 1**

Producer:	**Norsonic**
Type:	**140**
Serial number:	**1406932**
Customer:	**Create Consulting Engineers Ltd**
Address:	**BIC108 - ARISE Chelmsford, Alan Cherry Drive, Chelmsford,**
Contact Person:	**Jody Blacklock**
Order No:	**4221**

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	285513	38326
Calibrator*	Norsonic	1251	34963	38325
Preamplifier	Norsonic	1209	21140	included

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

Additional items that have also been submitted for verification:

Wind shield	-	-
Attenuator	N/A	
Extension cable		

These items have been taken into account whereever appropriate.

Instruction manual: Im140_1Ed8R0En Firmware version: v4.0.1282. The test object is a single channel instrument.

Conditions	*Pressure kPa*	*Temperature °C*	*Humidty %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.93 +/-0.01	23.23 +/-0.5	42.55 +/-0.35

Calibration Dates:

Received date:	24/06/2021	Reviewed date:	02/07/2021
Calibration date:	02/07/2021	Issued date:	02/07/2021

Technicians: (Electronic certificate)

Calibrated by: *Palanivel Marappan BEng (Hons), MSc*

Reviewed by: *Darren Batten*

Certificate of Calibration

Continuation of Certificate number: **38327**

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 61672-1:2013**
Periodics Tests:	**BS EN IEC 61672-3:2013**
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 Summery:

Indication at the calibration check frequency - IEC61672-3 Ed.2 #10	Passed
Self-generated noise - IEC 61672-3 Ed.2.0 #11.2	Passed
Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.2.0 #12	Passed
Electrical signal tests of frequency weightings - IEC 61672-3 Ed.2.0 #13	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.2.0 #13.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.2.0 #13.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.2.0 #13.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.2.0 #14	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.2.0 #16	Passed
Toneburst response - IEC 61672-3 Ed.2.0 #18	Passed
Peak C sound level - IEC 61672-3 Ed.2.0 #19	Passed
Overload indication - IEC 61672-3 Ed.2.0 #20	Passed
High level stability test - IEC 61672-3 Ed.2.0 #21	Passed
Long term stability test - IEC 61672-3 Ed.2.0 #15	Passed

Comments
Correct level with associated calibrator is 113.9dB(A).

Statement of Comformance
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 manufactored standard and because the periodic tests completed cover only a limited subset of the specifications in the relavant standard

Observations

This certificate relates only to the items tested above.

** End of Certificate **

Measurement Results:

Indication at the calibration check frequency - IEC61672-3 Ed.2 Clause 10

```
Reference level: 114.0 dB
Reference Range: 130 dB FS
Reference Frequency: 1000 Hz
Reference Calibrator: WSC5 - Nor1251-31824
Reference calibrator level: 114.02
Before calibration:
Environmental corrections: 0.00
Other corrections: -0.15
Notional level: 113.87
Calibrator level before adjustment: 113.9
After calibration:
Environmental corrections: 0.00
Other corrections: -0.15
Notional level: 113.87
Reference calibrator level after calibration: 113.9
Associated Calibrator: Norsonic - 1251 - 34963
Associated calibrator level: 114.05
Initial level check:
Environmental corrections: 0.00
Other corrections: -0.15
Notional level: 113.90
Indicated level: 113.9
Final level statement:
Environmental corrections after calibration: 0.00
Other corrections: -0.15
Notional level: 113.90
Calibrator level after adjustment: 113.9
This value shall be used for adjusting the sound level meter in the future.
Test Passed
```

Self-generated noise - IEC 61672-3 Ed.2.0 Clause 11.2

Network	Level (dB)	Comment
A	15.9	Microphone installed
A	9.8	Equivalent capacity
C	11.4	Equivalent capacity
Z	18.4	Equivalent capacity

Test Passed

Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.2.0 Clause 12

C-Weighted results

Frequency	SLM Meas (dB)	SLM U (dB)	Microphone Corr (dB)	Microphone U (dB)	Case Refl. Corr (dB)	Case Refl. U (dB)	Wind Screen Corr (dB)	Wind Screen U (dB)	Uncert (dB)	Lim (dB)	Result (dB)	
125 Hz	0.1	0.2	0.0	0.1	0.0	0.1			0.2	+-1.0	0.1	P
1 kHz	0.0	0.2	0.1	0.1	-0.1	0.1			0.3	+-0.7	0.0	P
4 kHz	-1.3	0.2	1.1	0.2	0.0	0.2			0.3	+-1.0	-0.2	P
8 kHz	-3.4	0.2	3.4	0.2	0.0	0.2			0.4	+1.5/-2.5	0.0	P

The level obtained at 1 kHz was used as reference for the calculations.
This level was: 91.80 dB.
The overall frequency response of the sound level meter, nominal case reflections and microphone response has shown to conform with the requirements in IEC 61672-3 for a class 1 sound level meter.
Frequency response test using electrostatic actuator.
Sources for correction data:
Microphone field corrections and uncertainty: Norsonic AS
Case reflections and uncertainty: Norsonic Cert. CAL022-2011-2849
Wind screen corrections and uncertainty:
Test Passed

Electrical signal tests of frequency weightings - IEC 61672-3 Ed.2.0 Clause 13

A-Weighted results:

Frequency	SLM Meas (dB)	SLM U (dB)	Microphone Corr (dB)	Microphone U (dB)	Case Refl. Corr (dB)	Case Refl. U (dB)	Wind Screen Corr (dB)	Wind Screen U (dB)	Uncert (dB)	Lim (dB)	Result (dB)	
63 Hz	0.0	0.1	0.0	0.1	0.0	0.1			0.19	+-1.0	0.0	P
125 Hz	-0.1	0.1	0.0	0.1	0.0	0.1			0.19	+-1.0	-0.1	P
250 Hz	-0.1	0.1	0.0	0.1	0.0	0.1			0.19	+-1.0	-0.1	P
500 Hz	0.0	0.1	0.0	0.1	0.1	0.1			0.19	+-1.0	0.1	P
1 kHz	0.0	0.1	0.0	0.1	-0.1	0.1			0.19	+-0.7	-0.1	P
2 kHz	-0.1	0.1	-0.1	0.1	0.1	0.1			0.19	+-1.0	-0.1	P
4 kHz	-0.2	0.1	-0.2	0.2	0.0	0.2			0.31	+-1.0	-0.4	P
8 kHz	-0.1	0.1	-0.1	0.2	0.0	0.2			0.31	1.5/2.5	-0.2	P
16 kHz	-0.1	0.1	0.8	0.3	-0.1	0.3			0.44	2.5/16	0.6	P

C-Weighted results:

Frequency	SLM Meas (dB)	SLM U (dB)	Microphone Corr (dB)	Microphone U (dB)	Case Refl. Corr (dB)	Case Refl. U (dB)	Wind Screen Corr (dB)	Wind Screen U (dB)	Uncert (dB)	Lim (dB)	Result (dB)	
63 Hz	-0.1	0.1	0.0	0.1	0.0	0.1			0.19	+-1.0	-0.1	P
125 Hz	0.0	0.1	0.0	0.1	0.0	0.1			0.19	+-1.0	0.0	P
250 Hz	-0.1	0.1	0.0	0.1	0.0	0.1			0.19	+-1.0	-0.1	P
500 Hz	0.0	0.1	0.0	0.1	0.1	0.1			0.19	+-1.0	0.1	P
1 kHz	0.0	0.1	0.0	0.1	-0.1	0.1			0.19	+-0.7	-0.1	P
2 kHz	-0.1	0.1	-0.1	0.1	0.1	0.1			0.19	+-1.0	-0.1	P
4 kHz	-0.1	0.1	-0.2	0.2	0.0	0.2			0.31	+-1.0	-0.3	P
8 kHz	-0.1	0.1	-0.1	0.2	0.0	0.2			0.31	1.5/2.5	-0.2	P
16 kHz	-0.1	0.1	0.8	0.3	-0.1	0.3			0.44	2.5/16	0.6	P

Z-Weighted results:

Frequency	SLM Meas (dB)	SLM U (dB)	Microphone Corr (dB)	Microphone U (dB)	Case Refl. Corr (dB)	Case Refl. U (dB)	Wind Screen Corr (dB)	Wind Screen U (dB)	Uncert (dB)	Lim (dB)	Result (dB)

Electrical signal tests of frequency weightings - IEC 61672-3 Ed.2.0 Clause 13

63 Hz	0.0	0.1	0.0	0.1	0.0	0.1	0.19	+-1.0	0.0	P
125 Hz	0.0	0.1	0.0	0.1	0.0	0.1	0.19	+-1.0	0.0	P
250 Hz	-0.1	0.1	0.0	0.1	0.0	0.1	0.19	+-1.0	-0.1	P
500 Hz	0.0	0.1	0.0	0.1	0.1	0.1	0.19	+-1.0	0.1	P
1 kHz	0.0	0.1	0.0	0.1	-0.1	0.1	0.19	+-0.7	-0.1	P
2 kHz	-0.1	0.1	-0.1	0.1	0.1	0.1	0.19	+-1.0	-0.1	P
4 kHz	-0.1	0.1	-0.2	0.2	0.0	0.2	0.31	+-1.0	-0.3	P
8 kHz	-0.1	0.1	-0.1	0.2	0.0	0.2	0.31	1.5/2.5	-0.2	P
16 kHz	-0.1	0.1	0.8	0.3	-0.1	0.3	0.44	2.5/16	0.6	P

The actual frequency response of Norsonic / 1225 285513 has been used for the calculations.
The overall frequency response of the sound level meter, nominal case reflections and microphone response has shown to conform with the requirements in IEC 61672-3 for a class 1 sound level meter.
The calculated uncertainties are checked against the requirements in the standard.
Sources for correction data:

Microphone response and uncertainty:	Measured response / Settings file
Case reflections and uncertainty:	Norsonic Cert. CAL022-2011-2849

Test Passed

Frequency weightings: A Network - IEC 61672-3 Ed.2.0 Clause 13.3

Frequency (Hz)	Ref. (dB)	Meas. (dB)	Uncert. (dB)	Dev. (dB)
63.1	92.0	92.0	0.12	0.0
125.9	92.0	91.9	0.12	-0.1
251.2	92.0	91.9	0.12	-0.1
501.2	92.0	92.0	0.12	0.0
1000.0	92.0	92.0	0.12	0.0
1995.3	92.0	91.9	0.12	-0.1
3981.1	92.0	91.8	0.12	-0.2
7943.3	92.0	91.9	0.12	-0.1
15848.9	92.0	91.9	0.12	-0.1

Test Passed

Frequency weightings: C Network - IEC 61672-3 Ed.2.0 Clause 13.3

Frequency (Hz)	Ref. (dB)	Meas. (dB)	Uncert. (dB)	Dev. (dB)
63.1	92.0	91.9	0.12	-0.1
125.9	92.0	92.0	0.12	0.0
251.2	92.0	91.9	0.12	-0.1
501.2	92.0	92.0	0.12	0.0
1000.0	92.0	92.0	0.12	0.0
1995.3	92.0	91.9	0.12	-0.1
3981.1	92.0	91.9	0.12	-0.1
7943.3	92.0	91.9	0.12	-0.1
15848.9	92.0	91.9	0.12	-0.1

Test Passed

Frequency weightings: Z Network - IEC 61672-3 Ed.2.0 Clause 13.3

Frequency (Hz)	Ref. (dB)	Meas. (dB)	Uncert. (dB)	Dev. (dB)
63.1	92.0	92.0	0.12	0.0
125.9	92.0	92.0	0.12	0.0
251.2	92.0	91.9	0.12	-0.1
501.2	92.0	92.0	0.12	0.0
1000.0	92.0	92.0	0.12	0.0
1995.3	92.0	91.9	0.12	-0.1
3981.1	92.0	91.9	0.12	-0.1
7943.3	92.0	91.9	0.12	-0.1
15848.9	92.0	91.9	0.12	-0.1

Test Passed

Frequency and time weightings at 1 kHz IEC 61672-3 Ed.2.0 Clause 14

Weightings		Ref.	Measured	Lim.		Uncert.	Dev.	Result
Time	Netw	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	
Fast	A	114.0	114.0	0.2	-0.2	0.12	0.0	P
Fast	C	114.0	114.0	0.2	-0.2	0.12	0.0	P
Fast	Z	114.0	114.0	0.2	-0.2	0.12	0.0	P
Slow	A	114.0	113.9	0.1	-0.1	0.12	-0.1	P
Leq	A	114.0	114.0	0.1	-0.1	0.12	0.0	P
SEL	A	124.0	124.0	0.1	-0.1	0.12	0.0	P

Test Passed

Level linearity on the reference level range - IEC 61672-3 Ed.2.0 Clause 16

Ref. (dB)	Measured (dB)	Lim. (dB)	(dB)	Uncert. (dB)	Dev. (dB)	Result
Measured at 8 kHz						
114.0	114.0	0.8	-0.8	0.12	0.0	P
119.0	119.0	0.8	-0.8	0.12	0.0	P
124.0	124.0	0.8	-0.8	0.12	0.0	P
129.0	129.0	0.8	-0.8	0.12	0.0	P
131.0	131.0	0.8	-0.8	0.12	0.0	P
132.0	132.0	0.8	-0.8	0.12	0.0	P
133.0	133.0	0.8	-0.8	0.12	0.0	P
134.0	134.1	0.8	-0.8	0.12	0.1	P
135.0	135.1	0.8	-0.8	0.12	0.1	P
136.0	136.1	0.8	-0.8	0.12	0.1	P
114.0	114.0	0.8	-0.8	0.12	0.0	P
109.0	109.0	0.8	-0.8	0.12	0.0	P
104.0	104.0	0.8	-0.8	0.12	0.0	P
99.0	99.0	0.8	-0.8	0.12	0.0	P
94.0	94.0	0.8	-0.8	0.12	0.0	P
89.0	89.0	0.8	-0.8	0.12	0.0	P
84.0	84.0	0.8	-0.8	0.12	0.0	P
79.0	79.0	0.8	-0.8	0.12	0.0	P
74.0	74.0	0.8	-0.8	0.12	0.0	P
69.0	69.0	0.8	-0.8	0.12	0.0	P
64.0	64.0	0.8	-0.8	0.12	0.0	P

Level linearity on the reference level range - IEC 61672-3 Ed.2.0 Clause 16

Ref. (dB)	Measured (dB)	Lim. (dB)	Lim. (dB)	Uncert. (dB)	Dev. (dB)	Result
59.0	59.0	0.8	-0.8	0.12	0.0	P
54.0	54.0	0.8	-0.8	0.12	0.0	P
49.0	49.0	0.8	-0.8	0.12	0.0	P
44.0	44.0	0.8	-0.8	0.12	0.0	P
39.0	39.0	0.8	-0.8	0.12	0.0	P
34.0	34.0	0.8	-0.8	0.12	0.0	P
30.0	30.0	0.8	-0.8	0.12	0.0	P
29.0	29.0	0.8	-0.8	0.12	0.0	P
28.0	28.0	0.8	-0.8	0.12	0.0	P
27.0	27.0	0.8	-0.8	0.12	0.0	P
26.0	26.0	0.8	-0.8	0.12	0.0	P
25.0	25.0	0.8	-0.8	0.12	0.0	P
24.0	24.1	0.8	-0.8	0.12	0.1	P

Test Passed

Toneburst response - IEC 61672-3 Ed.2.0 Clause 18

Burst type	Ref. (dB)	Measured (dB)	Lim. (dB)	Lim. (dB)	Uncert. (dB)	Dev. (dB)	Result
Fast 200 mSec	134.0	133.9	0.5	-0.5	0.16	-0.1	P
Fast 2.0 mSec	117.0	116.8	1.0	-1.5	0.16	-0.2	P
Fast 0.25 mSec	108.0	107.6	1.0	-3.0	0.16	-0.4	P
Slow 200 mSec	127.6	127.5	0.5	-0.5	0.16	-0.1	P
Slow 2.0 mSec	108.0	107.9	1.0	-3.0	0.16	-0.1	P
SEL 200 mSec	128.0	128.0	0.5	-0.5	0.16	0.0	P
SEL 2.0 mSec	108.0	107.9	1.0	-1.5	0.16	-0.1	P
SEL 0.25 mSec	99.0	98.6	1.0	-3.0	0.16	-0.4	P

Test Passed

Peak C sound level - IEC 61672-3 Ed.2.0 Clause 19

Pulse Type	Pulse Freq. (Hz)	Ref. RMS (dB)	Ref. Peak (dB)	Measured Value (dB)	Lim. (+/-dB)	Uncert. (dB)	Dev. (dB)	Result
1 cycle	8k	126.0	129.4	129.2	2.0	0.2	-0.2	P
Pos 1/2 cycle	500	129.0	131.4	131.3	1.0	0.2	-0.1	P
Neg 1/2 cycle	500	129.0	131.4	131.3	1.0	0.2	-0.1	P

Test Passed

Overload indication - IEC 61672-3 Ed.2.0 Clause 20

	Measured (dB)	Lim. (+/-dB)	Uncert. (dB)	Result
Level difference of positive and negative pulses:	0.0	1.5	0.16	P
Positive 1/2 cycle 4 kHz. Overload occurred at:	138.5			
Negative 1/2 cycle 4 kHz. Overload occurred at:	138.5			

Test Passed

High level stability test - IEC 61672-3 Ed.2.0 Clause 21

Test signal: Sine wave at 1 kHz

Initial level (dB)	Final level (dB)	Diff. (dB)	Lim. value (±dB)	Uncert. (dB)	Result
136.0	136.0	0.0	0.1	0.06	P

Test Passed

Long term stability test - IEC 61672-3 Ed.2.0 Clause 15

Test signal: Sine wave at 1 kHz

Time inteval (mm:SS)	StartLevel (dB)	StopLevel (dB)	Difference (dB)	Tolerence (±dB)	Uncert. (dB)	Result
25:09	114.0	114.0	0.0	0.1	0.06	P

Test Passed

*** End of results ***

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

CALIBRATION

Certificate of Calibration

Certificate number: **38326**

Test Object: **Measurement Microphone**

Producer:	**Norsonic**
Type:	**1225**
Serial number:	**285513**
Customer:	**Create Consulting Engineers Ltd**
Address:	**BIC108 - ARISE Chelmsford,** **Alan Cherry Drive, Chelmsford, Essex. CM1 1SQ.**
Contact Person:	**Jody Blacklock**
Order No:	**4221**

Measurement Results	Sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)	Capacitance (pF)
Measurement 1	*-26.16*	*49.21*	*22.03*
Measurement 2	*-26.16*	*49.19*	*22.11*
Measurement 3	*-26.17*	*49.15*	*22.08*
Result (Average):	***-26.16***	***49.19***	***22.07***
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	100.949 ± 0.042	23.8 ± 0.1	45.9 ± 0.9

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:	24/06/2021	Reviewed date:	02/07/2021
Calibration date:	02/07/2021	Issued date:	02/07/2021

Technicians: (Electronic certificate)

Calibrated by: *Palanivel Marappan BEng(Hons), MSc*

Reviewed by: *Darren Batten*

Certificate of Calibration

Continuation of Certificate number: **38326**

Reference Calibrator: WSC1 - Nor1253-24269
Measurement Record: K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\NOR1225_285513_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

Certificate of Calibration

Continuation of Certificate number: **38326**

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	0.00	0.21	5,010.70	-1.81	0.24
112.2	0.01	0.21	5,622.00	-2.15	0.24
125.9	0.01	0.21	6,307.90	-2.51	0.24
141.3	0.00	0.21	7,077.50	-2.99	0.24
158.5	0.00	0.21	7,940.90	-3.52	0.24
177.9	0.00	0.21	8,909.70	-4.10	0.48
199.6	0.00	0.21	9,996.70	-4.65	0.48
223.9	0.00	0.21	11,216	-5.31	0.48
251.2	Ref	0.21	12,585	-5.93	0.48
281.9	-0.01	0.21	14,120	-6.70	0.48
316.3	-0.01	0.21	15,843	-7.58	0.48
354.9	-0.01	0.21	17,775	-8.59	0.70
398.2	-0.02	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	-0.03	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	-0.08	0.21	44644		0.90
1000.0	-0.10	0.21	50091		0.90
1122.0	-0.12	0.21	56202		1.20
1258.9	-0.16	0.21	63058		1.20
1412.5	-0.19	0.21	70752		1.20
1584.8	-0.24	0.21	79383		1.20
1778.1	-0.30	0.21	89068		1.20
1995.1	-0.37	0.21	99934		1.20
2238.5	-0.46	0.21	112126		-
2511.6	-0.56	0.21	125806		-
2818.0	-0.69	0.21	141154		-
3161.8	-0.85	0.21	158375		-
3547.5	-1.03	0.21	177696		-
3980.3	-1.27	0.21	199375		-
4465.9	-1.52	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

Certificate of Calibration

Continuation of Certificate number: **38326**

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

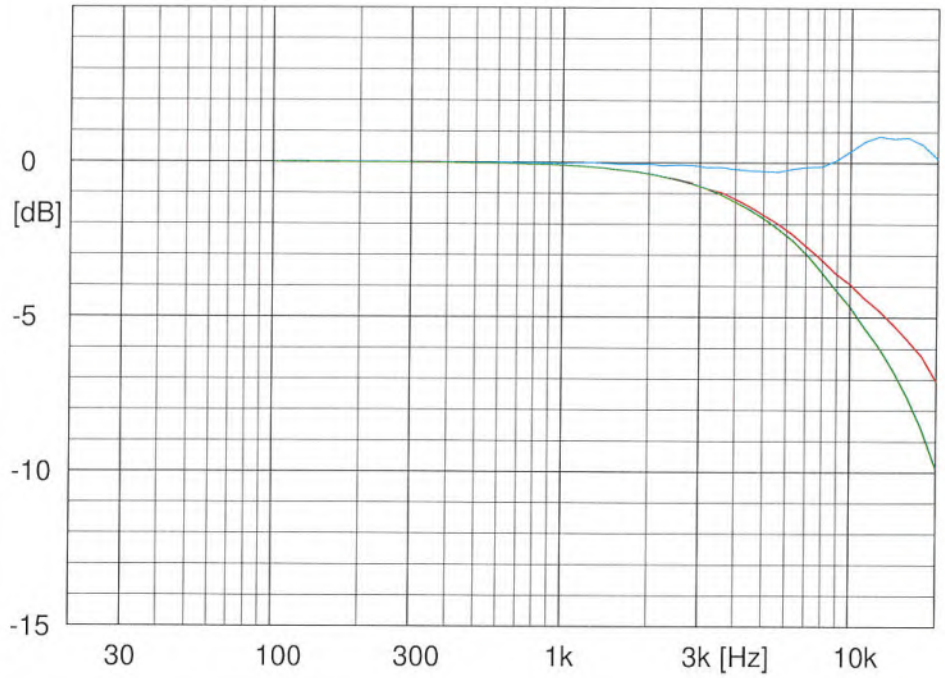
Corrected results, dB re 250 Hz					
Freq Hz	Random incidence corrected	Free field corrected	Freq Hz	Random incidence corrected	Free field corrected
100	0.00	0.00	5,010.70	-1.70	-0.28
112.2	0.01	0.01	5,622.00	-1.98	-0.30
125.9	0.01	0.01	6,307.90	-2.31	-0.20
141.3	0.00	0.00	7,077.50	-2.73	-0.15
158.5	0.00	0.00	7,940.90	-3.12	-0.13
177.9	0.00	0.00	8,909.70	-3.56	0.07
199.6	0.00	0.00	9,996.70	-3.92	0.36
223.9	0.00	0.00	11,216	-4.37	0.68
251.2	-0.01	-0.01	12,585	-4.75	0.85
281.9	-0.01	-0.01	14,120	-5.22	0.78
316.3	-0.01	-0.01	15,843	-5.71	0.81
354.9	-0.01	-0.01	17,775	-6.24	0.58
398.2	-0.02	-0.01	19,944	-7.03	0.13
446.7	-0.02	-0.01	22,377		
501.2	-0.03	-0.02	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	-0.08	-0.02	44,644		
1,000.00	-0.10	-0.03	50,091		
1,122.00	-0.12	-0.01	56,202		
1,258.90	-0.16	0.00	63,058		
1,412.50	-0.19	-0.02	70,752		
1,584.80	-0.24	-0.06	79,383		
1,778.10	-0.30	-0.06	89,068		
1,995.10	-0.37	-0.05	99,934		
2,238.50	-0.46	-0.10	112,126		
2,511.60	-0.54	-0.08	125,806		
2,818.00	-0.65	-0.09	141,154		
3,161.80	-0.85	-0.17	158,375		
3,547.50	-0.95	-0.16	177,696		
3,980.30	-1.17	-0.22	199,375		
4,465.90	-1.42	-0.27	-		

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: 285513

Sensitivity: 49.19 mV/Pa
-26.16 ±0.10 dB re. 1 V/Pa
Capacitance: 22.1 ±1.0 pF
Date: 02/07/2021

Signature:

Measurement conditions:

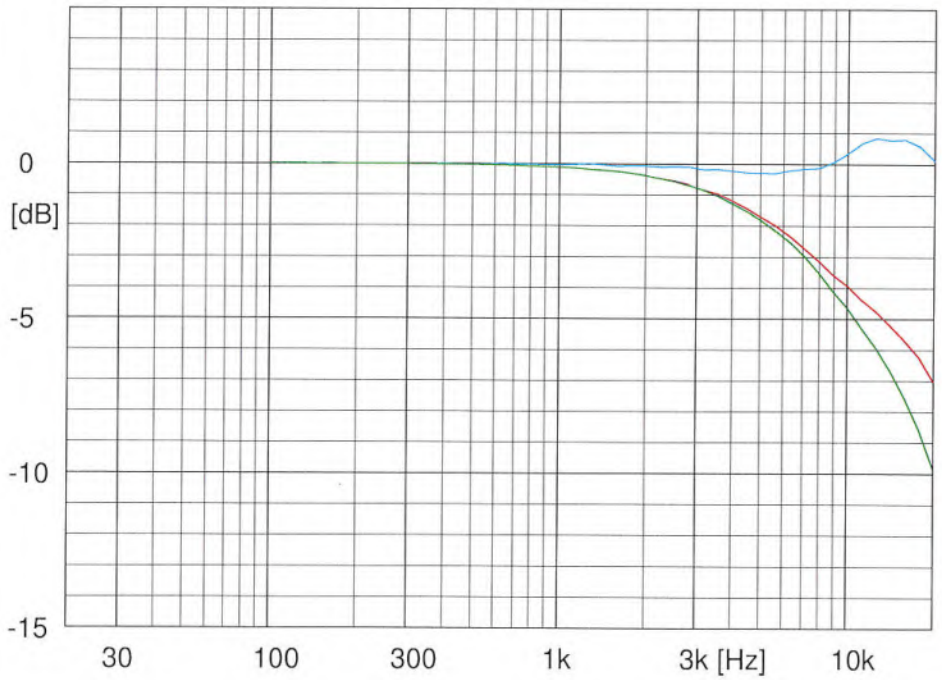
Polarisation voltage:	200.0 V
Pressure:	100.95 ±0.04 kPa
Temperature:	23.8 ±0.1 °C
Relative humidity:	45.9 ±0.9 %RH

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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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

CALIBRATION

Certificate of Calibration

Certificate number: **38329**

Test Object: **Sound Level Meter, BS EN IEC 61672-1:2013 Class 1**

Producer:	**Norsonic**
Type:	**140**
Serial number:	**1406933**
Customer:	**Create Consulting Engineers Ltd**
Address:	**BIC108 - ARISE Chelmsford, Alan Cherry Drive, Chelmsford,**
Contact Person:	**Jody Blacklock**
Order No:	**4221**

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	285519	38328
Calibrator*	Norsonic	1251	34963	38325
Preamplifier	Norsonic	1209	21141	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		

These items have been taken into account whereever appropriate.

lm140_1Ed8R0En

Conditions	*Pressure kPa*	*Temperature °C*	*Humidty %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.01 +/-0.01	23.55 +/-1.05	44.25 +/-3.55

Calibration Dates:

Received date:	24/06/2021	Reviewed date:	05/07/2021
Calibration date:	07/05/2021	Issued date:	05/07/2021

Technicians: (Electronic certificate)

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

Reviewed by: *Michael Tickner*

Certificate of Calibration

Continuation of Certificate number: **38329**

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 61672-1:2013**
Periodics Tests:	**BS EN IEC 61672-3:2013**
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 Summery:

Indication at the calibration check frequency - IEC61672-3 Ed.2 #10	Passed
Self-generated noise - IEC 61672-3 Ed.2.0 #11.2	Passed
Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.2.0 #12	Passed
Electrical signal tests of frequency weightings - IEC 61672-3 Ed.2.0 #13	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.2.0 #13.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.2.0 #13.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.2.0 #13.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.2.0 #14	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.2.0 #16	Passed
Toneburst response - IEC 61672-3 Ed.2.0 #18	Passed
Peak C sound level - IEC 61672-3 Ed.2.0 #19	Passed
Overload indication - IEC 61672-3 Ed.2.0 #20	Passed
High level stability test - IEC 61672-3 Ed.2.0 #21	Passed
Long term stability test - IEC 61672-3 Ed.2.0 #15	Passed

Comments
Correct level with associated calibrator is 113.9dB(A).

Statement of Comformance
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 manufactored standard and because the periodic tests completed cover only a limited subset of the specifications in the relavant standard

Observations

This certificate relates only to the items tested above.

** End of Certificate **

Measurement Results:

Indication at the calibration check frequency - IEC61672-3 Ed.2 Clause 10

```
Reference level: 114.0 dB
Reference Range: 130 dB FS
Reference Frequency: 1000 Hz
Reference Calibrator: WSC5 - Nor1251-31824
Reference calibrator level: 114.02
Before calibration:
Environmental corrections: 0.00
Other corrections: -0.15
Notional level: 113.87
Calibrator level before adjustment: 113.9
After calibration:
Environmental corrections: 0.00
Other corrections: -0.15
Notional level: 113.87
Reference calibrator level after calibration: 113.9
Associated Calibrator: Norsonic - 1251 - 34963
Associated calibrator level: 114.05
Initial level check:
Environmental corrections: 0.00
Other corrections: -0.15
Notional level: 113.90
Indicated level: 113.9
Final level statement:
Environmental corrections after calibration: 0.00
Other corrections: -0.15
Notional level: 113.90
Calibrator level after adjustment: 113.9
This value shall be used for adjusting the sound level meter in the future.
Test Passed
```

Self-generated noise - IEC 61672-3 Ed.2.0 Clause 11.2

Network	Level (dB)	Comment
A	16.1	Microphone installed
A	9.9	Equivalent capacity
C	11.6	Equivalent capacity
Z	18.0	Equivalent capacity

Test Passed

Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.2.0 Clause 12

C-Weighted results

Frequency	SLM Meas (dB)	SLM U (dB)	Microphone Corr (dB)	Microphone U (dB)	Case Refl. Corr (dB)	Case Refl. U (dB)	Wind Screen Corr (dB)	Wind Screen U (dB)	Uncert U (dB)	Lim (dB)	Result (dB)	
125 Hz	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.1	0.3	+-1.0	0.0	P
1 kHz	0.0	0.2	0.1	0.1	-0.1	0.1	0.1	0.1	0.3	+-0.7	0.0	P
4 kHz	-1.6	0.2	1.1	0.2	0.0	0.2	0.7	0.1	0.4	+-1.0	0.1	P
8 kHz	-3.8	0.3	3.4	0.2	0.0	0.2	0.1	0.2	0.4	+1.5/-2.5	-0.4	P

The level obtained at 1 kHz was used as reference for the calculations.
This level was: 91.30 dB.
The overall frequency response of the sound level meter, nominal case reflections, typical wind screen response and microphone response has shown to conform with the requirements in IEC 61672-3 for a class 1 sound level meter.
Frequency response test using electrostatic actuator.
Sources for correction data:

Microphone field corrections and uncertainty:	Norsonic AS
Case reflections and uncertainty:	Norsonic Cert. CAL022-2011-2849
Wind screen corrections and uncertainty:	Norsonic NTQ-L-T-007 04/01/2010

Test Passed

Electrical signal tests of frequency weightings - IEC 61672-3 Ed.2.0 Clause 13

A-Weighted results:

Frequency	SLM Meas (dB)	SLM U (dB)	Microphone Corr (dB)	Microphone U (dB)	Case Refl. Corr (dB)	Case Refl. U (dB)	Wind Screen Corr (dB)	Wind Screen U (dB)	Uncert U (dB)	Lim (dB)	Result (dB)	
63 Hz	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	0.0	P
125 Hz	-0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	-0.1	P
250 Hz	-0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	-0.1	P
500 Hz	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.21	+-1.0	0.1	P
1 kHz	0.0	0.1	0.0	0.1	-0.1	0.1	0.1	0.1	0.21	+-0.7	0.0	P
2 kHz	-0.1	0.1	-0.1	0.1	0.1	0.1	0.4	0.1	0.21	+-1.0	0.3	P
4 kHz	-0.2	0.1	-0.5	0.2	0.0	0.2	0.7	0.1	0.32	+-1.0	0.0	P
8 kHz	-0.1	0.1	-0.4	0.2	0.0	0.2	0.1	0.2	0.37	1.5/2.5	-0.5	P
16 kHz	-0.1	0.1	1.0	0.3	-0.1	0.3	-0.5	0.3	0.53	2.5/16	0.3	P

C-Weighted results:

Frequency	SLM Meas (dB)	SLM U (dB)	Microphone Corr (dB)	Microphone U (dB)	Case Refl. Corr (dB)	Case Refl. U (dB)	Wind Screen Corr (dB)	Wind Screen U (dB)	Uncert U (dB)	Lim (dB)	Result (dB)	
63 Hz	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	0.0	P
125 Hz	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	0.0	P
250 Hz	-0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	-0.1	P
500 Hz	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.21	+-1.0	0.1	P
1 kHz	0.0	0.1	0.0	0.1	-0.1	0.1	0.1	0.1	0.21	+-0.7	0.0	P
2 kHz	-0.1	0.1	-0.1	0.1	0.1	0.1	0.4	0.1	0.21	+-1.0	0.3	P
4 kHz	-0.1	0.1	-0.5	0.2	0.0	0.2	0.7	0.1	0.32	+-1.0	0.1	P
8 kHz	-0.1	0.1	-0.4	0.2	0.0	0.2	0.1	0.2	0.37	1.5/2.5	-0.5	P
16 kHz	-0.1	0.1	1.0	0.3	-0.1	0.3	-0.5	0.3	0.53	2.5/16	0.3	P

Z-Weighted results:

Frequency	SLM Meas	SLM U	Microphone Corr	Microphone U	Case Refl. Corr	Case Refl. U	Wind Screen Corr	Wind Screen U	Uncert	Lim	Result

Electrical signal tests of frequency weightings - IEC 61672-3 Ed.2.0 Clause 13

	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	
63 Hz	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	0.0	P
125 Hz	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	0.0	P
250 Hz	-0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.21	+-1.0	-0.1	P
500 Hz	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.21	+-1.0	0.1	P
1 kHz	0.0	0.1	0.0	0.1	-0.1	0.1	0.1	0.1	0.21	+-0.7	0.0	P
2 kHz	-0.1	0.1	-0.1	0.1	0.1	0.1	0.4	0.1	0.21	+-1.0	0.3	P
4 kHz	-0.1	0.1	-0.5	0.2	0.0	0.2	0.7	0.1	0.32	+-1.0	0.1	P
8 kHz	-0.1	0.1	-0.4	0.2	0.0	0.2	0.1	0.2	0.37	1.5/2.5	-0.5	P
16 kHz	-0.1	0.1	1.0	0.3	-0.1	0.3	-0.5	0.3	0.53	2.5/16	0.3	P

The actual frequency response of Norsonic / 1225 285519 has been used for the calculations.
The overall frequency response of the sound level meter, nominal case reflections, typical wind screen response and microphone response has shown to conform with the requirements in IEC 61672-3 for a class 1 sound level meter.
The calculated uncertainties are checked against the requirements in the standard.
Sources for correction data:

Microphone response and uncertainty:	Measured response / Settings file
Case reflections and uncertainty:	Norsonic Cert. CAL022-2011-2849
Wind screen corrections and uncertainty:	Norsonic NTQ-L-T-007 04/01/2010

Test Passed

Frequency weightings: A Network - IEC 61672-3 Ed.2.0 Clause 13.3

Frequency (Hz)	Ref. (dB)	Meas. (dB)	Uncert. (dB)	Dev. (dB)
63.1	92.0	92.0	0.12	0.0
125.9	92.0	91.9	0.12	-0.1
251.2	92.0	91.9	0.12	-0.1
501.2	92.0	92.0	0.12	0.0
1000.0	92.0	92.0	0.12	0.0
1995.3	92.0	91.9	0.12	-0.1
3981.1	92.0	91.8	0.12	-0.2
7943.3	92.0	91.9	0.12	-0.1
15848.9	92.0	91.9	0.12	-0.1

Test Passed

Frequency weightings: C Network - IEC 61672-3 Ed.2.0 Clause 13.3

Frequency (Hz)	Ref. (dB)	Meas. (dB)	Uncert. (dB)	Dev. (dB)
63.1	92.0	92.0	0.12	0.0
125.9	92.0	92.0	0.12	0.0
251.2	92.0	91.9	0.12	-0.1
501.2	92.0	92.0	0.12	0.0
1000.0	92.0	92.0	0.12	0.0
1995.3	92.0	91.9	0.12	-0.1
3981.1	92.0	91.9	0.12	-0.1
7943.3	92.0	91.9	0.12	-0.1
15848.9	92.0	91.9	0.12	-0.1

Test Passed

Frequency weightings: Z Network - IEC 61672-3 Ed.2.0 Clause 13.3

Frequency (Hz)	Ref. (dB)	Meas. (dB)	Uncert. (dB)	Dev. (dB)
63.1	92.0	92.0	0.12	0.0
125.9	92.0	92.0	0.12	0.0
251.2	92.0	91.9	0.12	-0.1
501.2	92.0	92.0	0.12	0.0
1000.0	92.0	92.0	0.12	0.0
1995.3	92.0	91.9	0.12	-0.1
3981.1	92.0	91.9	0.12	-0.1
7943.3	92.0	91.9	0.12	-0.1
15848.9	92.0	91.9	0.12	-0.1

Test Passed

Frequency and time weightings at 1 kHz IEC 61672-3 Ed.2.0 Clause 14

Weightings		Ref.	Measured	Lim.		Uncert.	Dev.	Result
Time	Netw	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	
Fast	A	114.0	114.0	0.2	-0.2	0.12	0.0	P
Fast	C	114.0	114.0	0.2	-0.2	0.12	0.0	P
Fast	Z	114.0	114.0	0.2	-0.2	0.12	0.0	P
Slow	A	114.0	113.9	0.1	-0.1	0.12	-0.1	P
Leq	A	114.0	114.0	0.1	-0.1	0.12	0.0	P
SEL	A	124.0	124.0	0.1	-0.1	0.12	0.0	P

Test Passed

Level linearity on the reference level range - IEC 61672-3 Ed.2.0 Clause 16

Ref. (dB)	Measured (dB)	Lim. (dB)	(dB)	Uncert. (dB)	Dev. (dB)	Result
Measured at 8 kHz						
114.0	114.0	0.8	-0.8	0.12	0.0	P
119.0	119.0	0.8	-0.8	0.12	0.0	P
124.0	124.0	0.8	-0.8	0.12	0.0	P
129.0	129.0	0.8	-0.8	0.12	0.0	P
131.0	131.0	0.8	-0.8	0.12	0.0	P
132.0	132.1	0.8	-0.8	0.12	0.1	P
133.0	133.1	0.8	-0.8	0.12	0.1	P
134.0	134.1	0.8	-0.8	0.12	0.1	P
135.0	135.1	0.8	-0.8	0.12	0.1	P
136.0	136.1	0.8	-0.8	0.12	0.1	P
114.0	114.0	0.8	-0.8	0.12	0.0	P
109.0	109.0	0.8	-0.8	0.12	0.0	P
104.0	104.0	0.8	-0.8	0.12	0.0	P
99.0	99.0	0.8	-0.8	0.12	0.0	P
94.0	94.0	0.8	-0.8	0.12	0.0	P
89.0	89.0	0.8	-0.8	0.12	0.0	P
84.0	84.0	0.8	-0.8	0.12	0.0	P
79.0	79.0	0.8	-0.8	0.12	0.0	P
74.0	74.0	0.8	-0.8	0.12	0.0	P
69.0	69.0	0.8	-0.8	0.12	0.0	P
64.0	64.0	0.8	-0.8	0.12	0.0	P

Level linearity on the reference level range - IEC 61672-3 Ed.2.0 Clause 16

Ref. (dB)	Measured (dB)	Lim. (dB)	Lim. (dB)	Uncert. (dB)	Dev. (dB)	Result
59.0	59.0	0.8	-0.8	0.12	0.0	P
54.0	54.0	0.8	-0.8	0.12	0.0	P
49.0	49.0	0.8	-0.8	0.12	0.0	P
44.0	44.0	0.8	-0.8	0.12	0.0	P
39.0	39.0	0.8	-0.8	0.12	0.0	P
34.0	33.9	0.8	-0.8	0.12	-0.1	P
30.0	29.9	0.8	-0.8	0.12	-0.1	P
29.0	29.0	0.8	-0.8	0.12	0.0	P
28.0	28.0	0.8	-0.8	0.12	0.0	P
27.0	26.9	0.8	-0.8	0.12	-0.1	P
26.0	25.9	0.8	-0.8	0.12	-0.1	P
25.0	25.0	0.8	-0.8	0.12	0.0	P
24.0	24.0	0.8	-0.8	0.12	0.0	P

Test Passed

Toneburst response - IEC 61672-3 Ed.2.0 Clause 18

Burst type	Ref. (dB)	Measured (dB)	Lim. (dB)	Lim. (dB)	Uncert. (dB)	Dev. (dB)	Result
Fast 200 mSec	134.0	133.9	0.5	-0.5	0.16	-0.1	P
Fast 2.0 mSec	117.0	116.8	1.0	-1.5	0.16	-0.2	P
Fast 0.25 mSec	108.0	107.4	1.0	-3.0	0.16	-0.6	P
Slow 200 mSec	127.6	127.5	0.5	-0.5	0.16	-0.1	P
Slow 2.0 mSec	108.0	107.9	1.0	-3.0	0.16	-0.1	P
SEL 200 mSec	128.0	128.0	0.5	-0.5	0.16	0.0	P
SEL 2.0 mSec	108.0	107.9	1.0	-1.5	0.16	-0.1	P
SEL 0.25 mSec	99.0	98.6	1.0	-3.0	0.16	-0.4	P

Test Passed

Peak C sound level - IEC 61672-3 Ed.2.0 Clause 19

Pulse Type	Pulse Freq. (Hz)	Ref. RMS (dB)	Ref. Peak (dB)	Measured Value (dB)	Lim. (+/-dB)	Uncert. (dB)	Dev. (dB)	Result
1 cycle	8k	126.0	129.4	129.1	2.0	0.2	-0.3	P
Pos 1/2 cycle	500	129.0	131.4	131.3	1.0	0.2	-0.1	P
Neg 1/2 cycle	500	129.0	131.4	131.3	1.0	0.2	-0.1	P

Test Passed

Overload indication - IEC 61672-3 Ed.2.0 Clause 20

	Measured (dB)	Lim. (+/-dB)	Uncert. (dB)	Result
Level difference of positive and negative pulses:	0.1	1.5	0.16	P
Positive 1/2 cycle 4 kHz. Overload occurred at:	138.7			
Negative 1/2 cycle 4 kHz. Overload occurred at:	138.6			

Test Passed

High level stability test - IEC 61672-3 Ed.2.0 Clause 21

Test signal: Sine wave at 1 kHz

Initial level (dB)	Final level (dB)	Diff. (dB)	Lim. value (±dB)	Uncert. (dB)	Result
136.0	136.0	0.0	0.1	0.06	P

Test Passed

Long term stability test - IEC 61672-3 Ed.2.0 Clause 15

Test signal: Sine wave at 1 kHz

Time inteval (mm:SS)	StartLevel (dB)	StopLevel (dB)	Difference (dB)	Tolerence (±dB)	Uncert. (dB)	Result
29:32	114.0	114.0	0.0	0.1	0.06	P

Test Passed

*** End of results ***

Laboratory Location

Campbell Associates Ltd

5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
Phone 01371 871030

CALIBRATION

Certificate of Calibration

Certificate number: **38328**

Test Object: **Measurement Microphone**

Producer:	**Norsonic**
Type:	**1225**
Serial number:	**285519**
Customer:	**Create Consulting Engineers Ltd**
Address:	**BIC108 - ARISE Chelmsford,** **Alan Cherry Drive, Chelmsford, Essex. CM1 1SQ.**
Contact Person:	**Jody Blacklock**
Order No:	**4221**

Measurement Results	Sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)	Capacitance (pF)
Measurement 1	*-25.88*	*50.83*	*22.98*
Measurement 2	*-25.87*	*50.85*	*22.92*
Measurement 3	*-25.87*	*50.85*	*22.89*
Result (Average):	***-25.88***	***50.85***	***22.93***
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	100.947 ± 0.042	24.0 ± 0.1	47.5 ± 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:	24/06/2021	Reviewed date:	02/07/2021
Calibration date:	02/07/2021	Issued date:	02/07/2021

Technicians: (Electronic certificate)

Calibrated by: *Palanivel Marappan BEng(Hons), MSc*

Reviewed by: *Darren Batten*

Certificate of Calibration

Continuation of Certificate number: **38328**

Reference Calibrator: WSC1 - Nor1253-24269
Measurement Record: K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\NOR1225_285519_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

Certificate of Calibration

Continuation of Certificate number: **38328**

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	-2.14	0.24
112.2	0.01	0.21	5,622.00	-2.52	0.24
125.9	0.01	0.21	6,307.90	-2.86	0.24
141.3	0.01	0.21	7,077.50	-3.31	0.24
158.5	0.01	0.21	7,940.90	-3.82	0.24
177.9	0.01	0.21	8,909.70	-4.36	0.48
199.6	0.01	0.21	9,996.70	-4.82	0.48
223.9	0.00	0.21	11,216	-5.40	0.48
251.2	Ref	0.21	12,585	-5.89	0.48
281.9	0.00	0.21	14,120	-6.60	0.48
316.3	0.00	0.21	15,843	-7.43	0.48
354.9	-0.01	0.21	17,775	-8.38	0.70
398.2	-0.01	0.21	19,944	-9.70	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	-0.07	0.21	39790		0.90
891.3	-0.09	0.21	44644		0.90
1000.0	-0.12	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	-0.24	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	-0.56	0.21	112126		-
2511.6	-0.69	0.21	125806		-
2818.0	-0.84	0.21	141154		-
3161.8	-1.03	0.21	158375		-
3547.5	-1.26	0.21	177696		-
3980.3	-1.52	0.21	199375		-
4465.9	-1.80	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

Certificate of Calibration

Continuation of Certificate number: **38328**

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

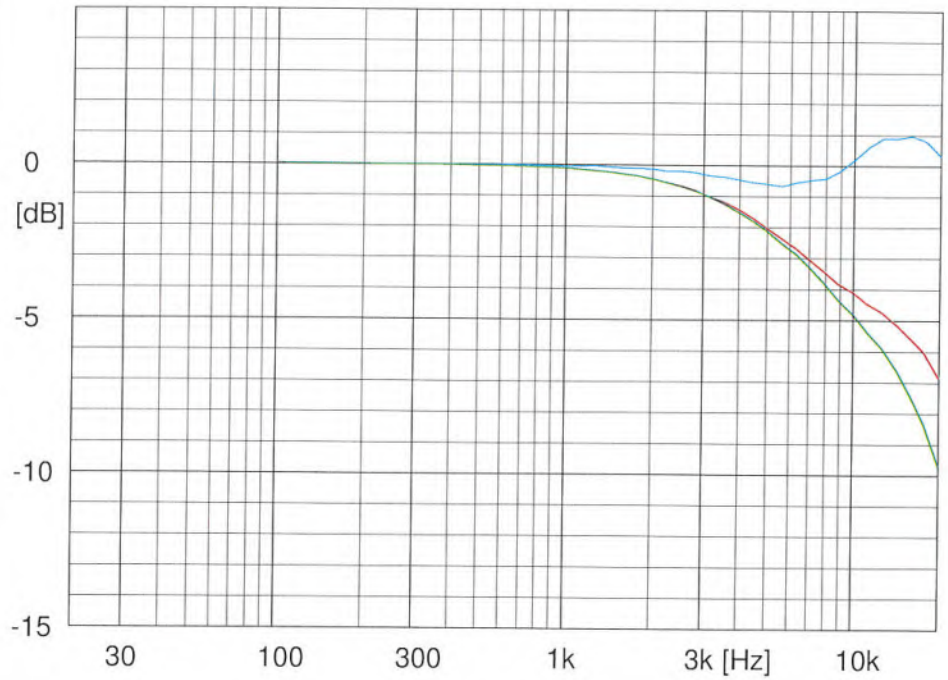
Corrected results, dB re 250 Hz					
Freq Hz	Random incidence corrected	Free field corrected	Freq Hz	Random incidence corrected	Free field corrected
100	0.02	0.02	5,010.70	-2.03	-0.61
112.2	0.01	0.01	5,622.00	-2.35	-0.67
125.9	0.01	0.01	6,307.90	-2.66	-0.55
141.3	0.01	0.01	7,077.50	-3.05	-0.47
158.5	0.01	0.01	7,940.90	-3.42	-0.43
177.9	0.01	0.01	8,909.70	-3.82	-0.19
199.6	0.01	0.01	9,996.70	-4.09	0.19
223.9	0.00	0.00	11,216	-4.46	0.59
251.2	0.00	0.00	12,585	-4.71	0.89
281.9	0.00	0.00	14,120	-5.12	0.89
316.3	0.00	0.00	15,843	-5.56	0.96
354.9	-0.01	-0.01	17,775	-6.03	0.79
398.2	-0.01	0.00	19,944	-6.85	0.31
446.7	-0.02	-0.01	22,377		
501.2	-0.03	-0.02	25,107		
562.4	-0.04	-0.02	28,170		
631	-0.05	-0.01	31,607		
708	-0.06	-0.02	35,463		
794.4	-0.07	-0.02	39,790		
891.3	-0.09	-0.03	44,644		
1,000.00	-0.12	-0.05	50,091		
1,122.00	-0.15	-0.04	56,202		
1,258.90	-0.19	-0.03	63,058		
1,412.50	-0.24	-0.07	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	-0.56	-0.20	112,126		
2,511.60	-0.67	-0.21	125,806		
2,818.00	-0.80	-0.24	141,154		
3,161.80	-1.03	-0.35	158,375		
3,547.50	-1.18	-0.39	177,696		
3,980.30	-1.42	-0.47	199,375		
4,465.90	-1.70	-0.55	-		

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: 285519

Sensitivity: 50.85 mV/Pa
-25.88 ±0.10 dB re. 1 V/Pa
Capacitance: 22.9 ±1.0 pF
Date: 02/07/2021

Signature:

Measurement conditions:

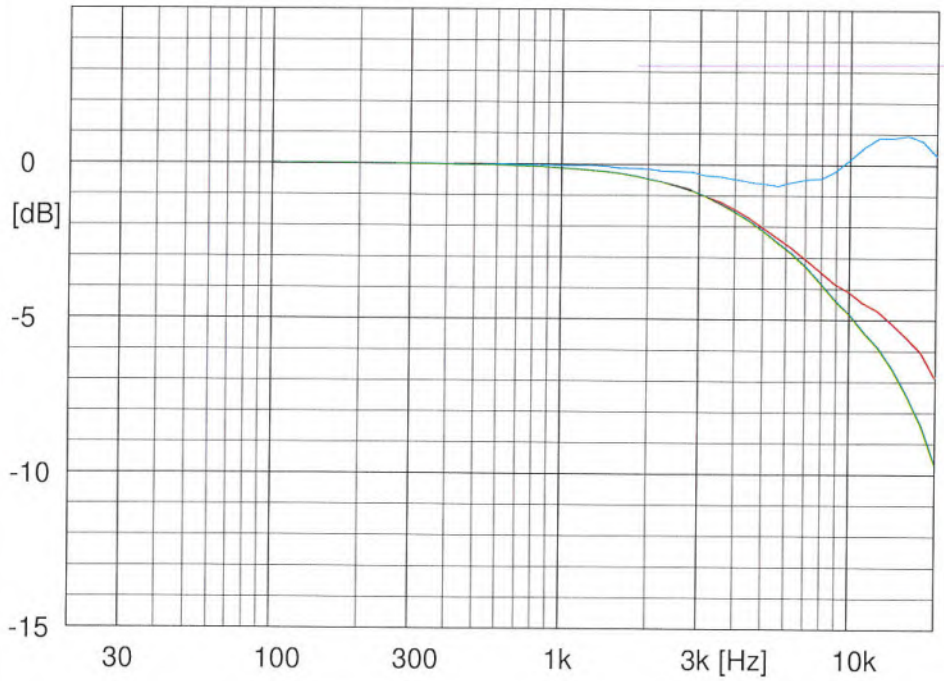
Polarisation voltage:	200.0 V
Pressure:	100.95 ±0.04 kPa
Temperature:	24.0 ±0.1 °C
Relative humidity:	47.5 ±1.0 %RH

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



Norsonic
Type: 1225

Serial no: 285519

Sensitivity: 50.85 mV/Pa
-25.88 ±0.10 dB re. 1 V/Pa
Capacitance: 22.9 ±1.0 pF
Date: 02/07/2021

Signature:

Measurement conditions:

Polarisation voltage:	200.0 V
Pressure:	100.95 ±0.04 kPa
Temperature:	24.0 ±0.1 °C
Relative humidity:	47.5 ±1.0 %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

CALIBRATION

Certificate of Calibration and Conformance

Certificate number: **38325**

Test Object: **Sound Calibrator**

Producer:	**Norsonic**
Type:	**1251**
Serial number:	**34963**
Customer:	**Create Consulting Engineers Ltd**
Address:	**BIC108 - ARISE Chelmsford,**
	Alan Cherry Drive, Chelmsford, Essex. CM1 1SQ.
Contact Person:	**Jody Blacklock**
Order No:	**4221**

Measurement Results	Level dB	Level Stability dB	Frequency Hz	Distortion %
Measurement 1	114.05	0.05	1000.60	0.35
Measurement 2	114.05	0.06	1000.60	0.35
Measurement 3	114.06	0.06	1000.61	0.35
Result (Average):	**114.05**	**0.06**	**1000.60**	**0.35**
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
Pressure:0.0005 dB/kPa Temperature:0.003 dB/°C Humidity:0 dB/%RH Load volume: 0.0003 dB/mm3

Conditions	*Pressure kPa*	*Temperature °C*	*Humidty %RH*
Reference conditions	101.325	23	50
Measurement conditions	100.942 ±0.042	23.5 ±0.1	44.9 ±0.8

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.

Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2021\NOR1251_34963_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:	24/06/2021	Reviewed date:	02/07/2021
Calibration date:	02/07/2021	Issued date:	02/07/2021

Technicians: (Electronic certificate)

Calibrated by: *Palanivel Marappan BEng(Hons), MSc*
Reviewed by: *Darren Batten*

Certificate of Calibration and Conformance

Continuation of Certificate number: **38325**

Reference Microphone: WSM8 - 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

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.

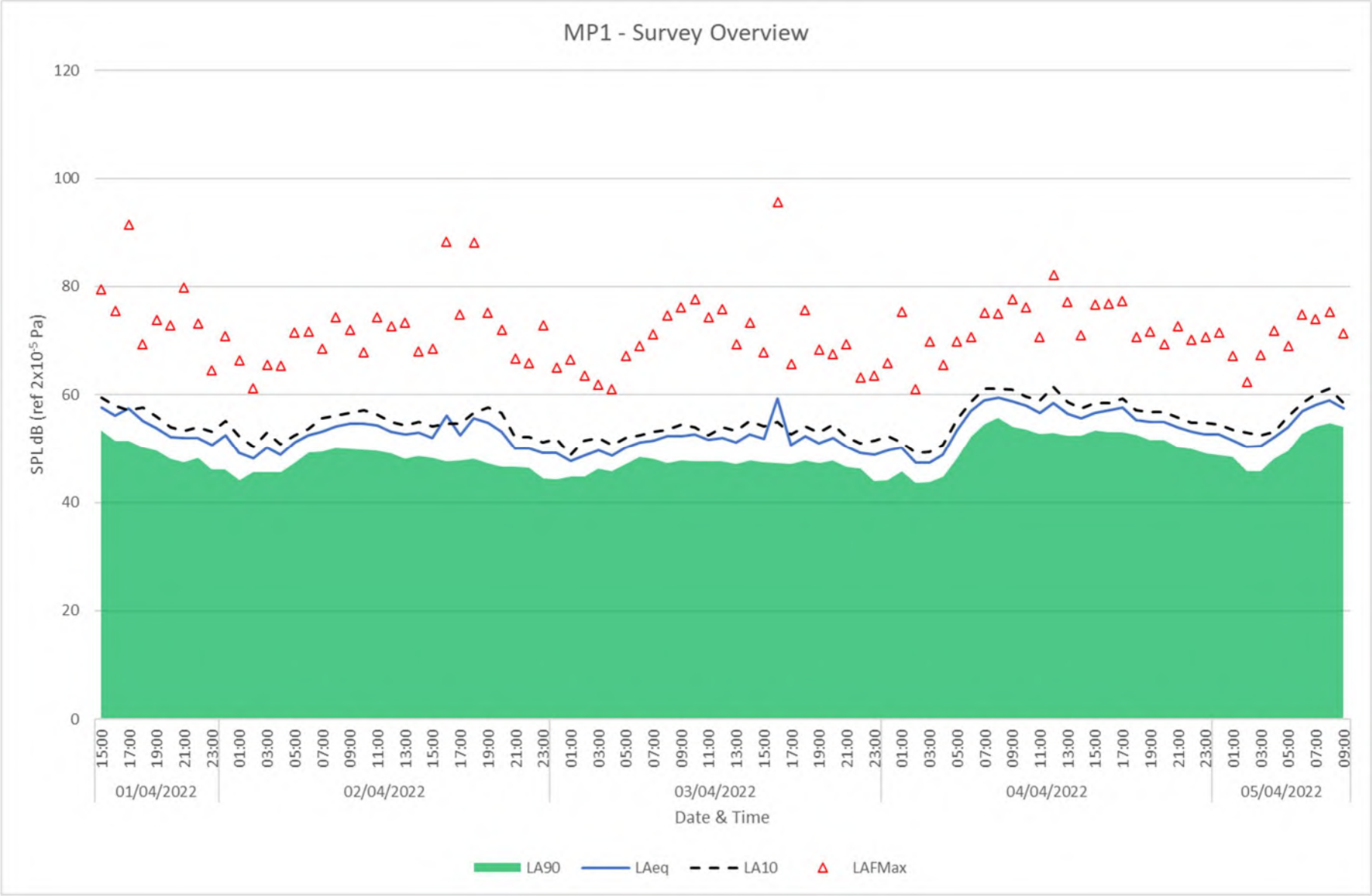
Observations:

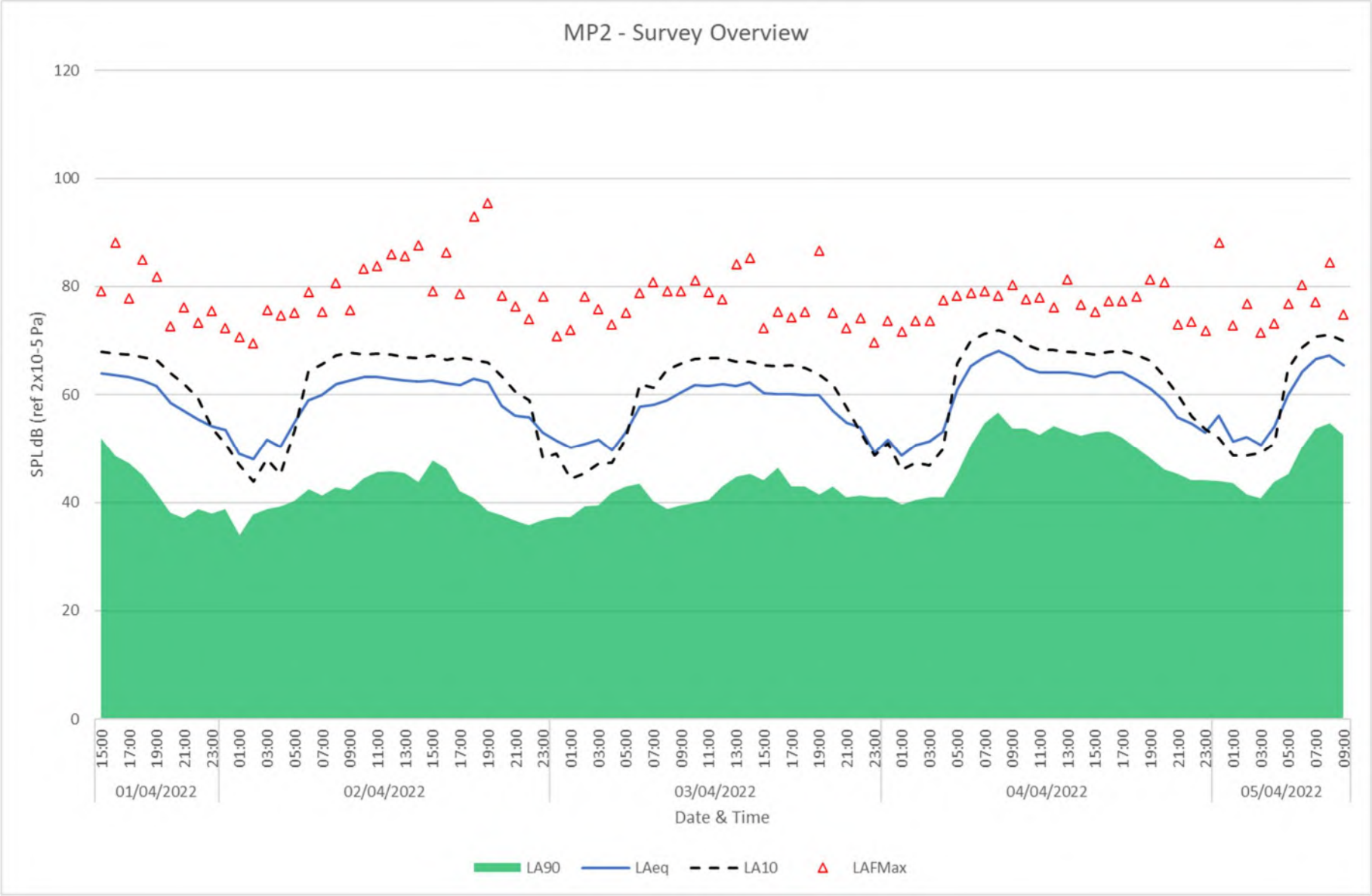
This certificate relates only to the items tested above.

** End of Certificate **

APPENDIX D

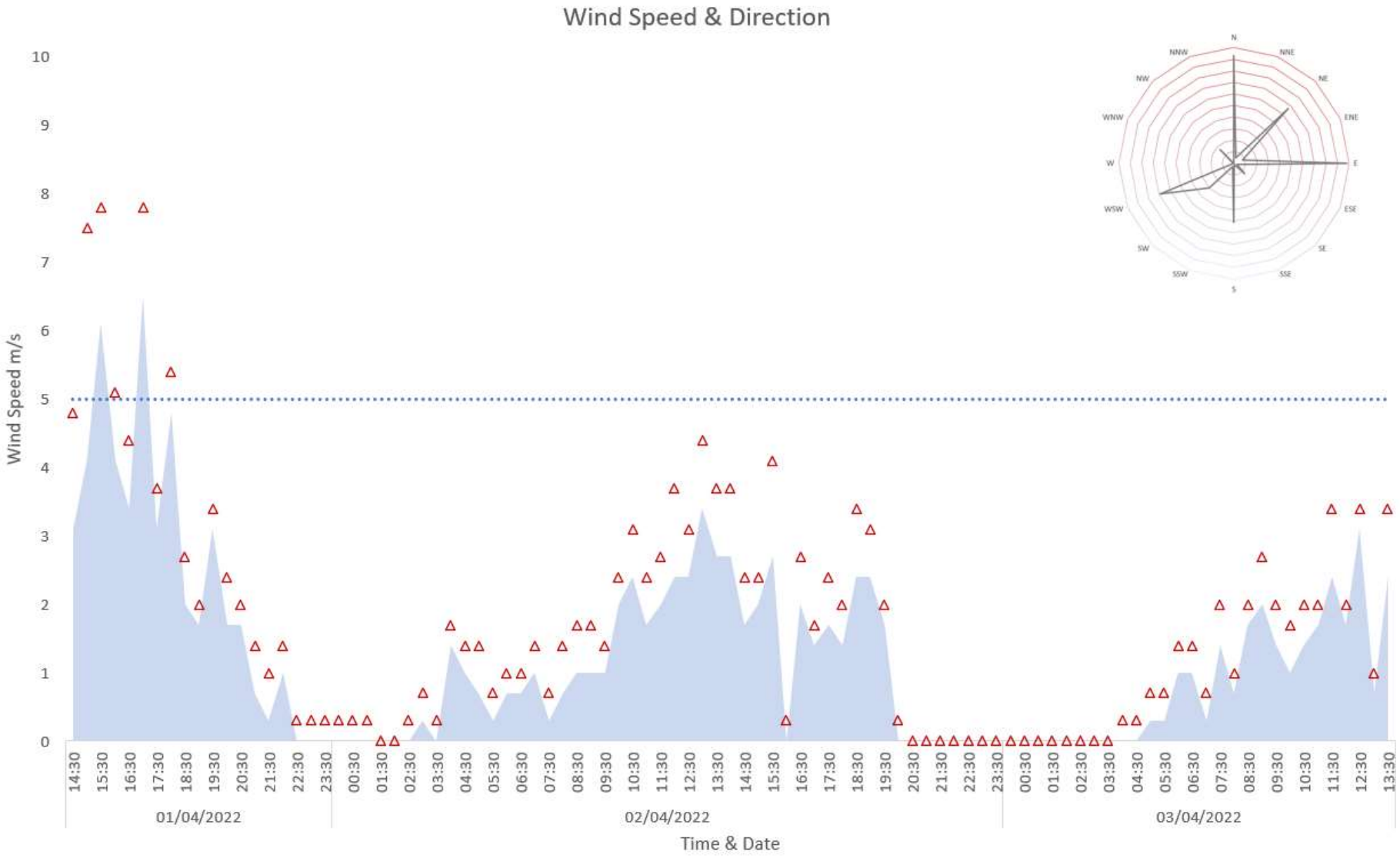
Full Survey Results

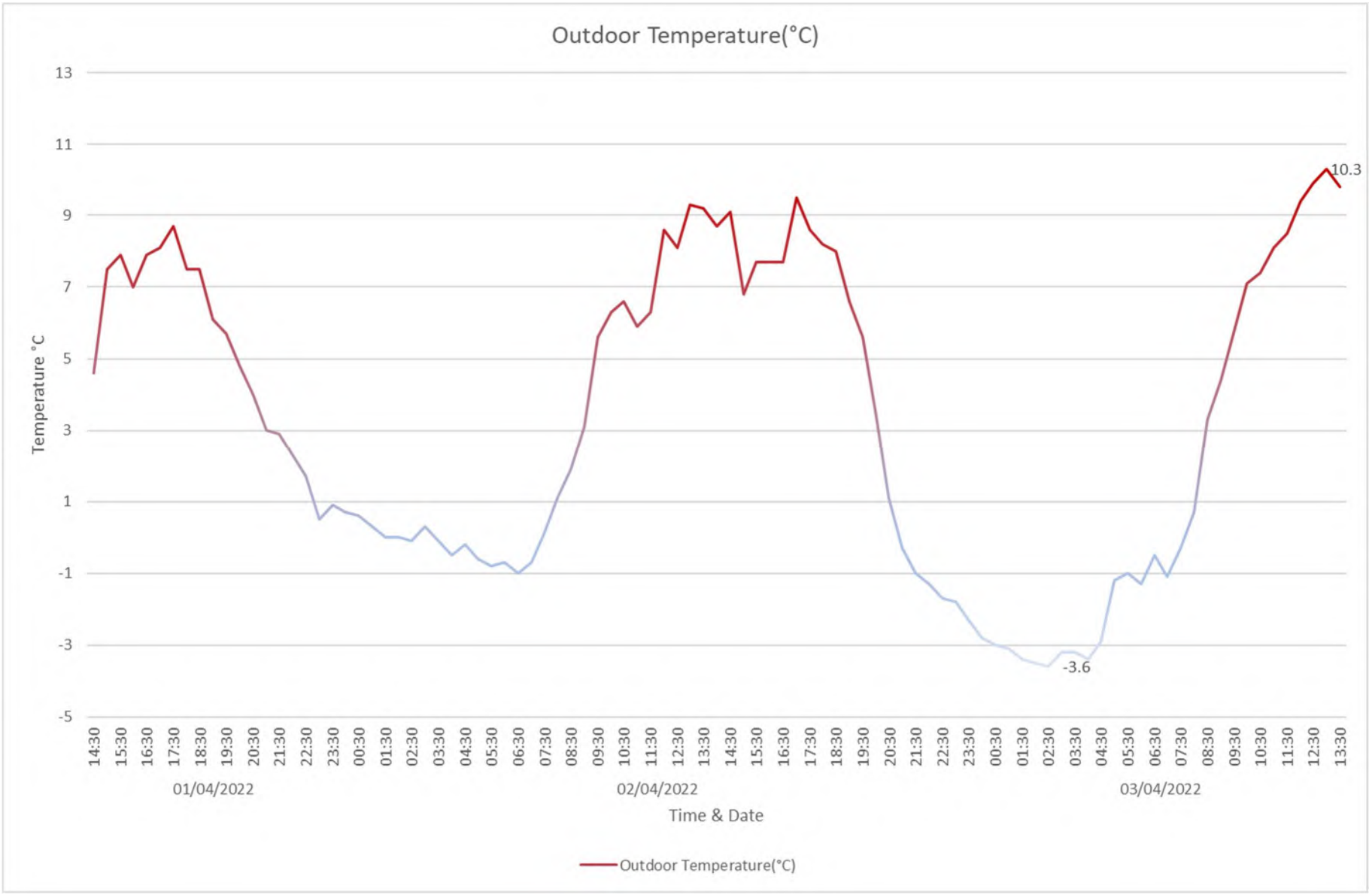

MP1 - Survey Overview
120
100
80
60
40
20
0
SPL dB (ref 2x10-5 Pa)
15:00
17:00
19:00
21:00
23:00
01:00
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
01:00
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
01:00
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
01:00
03:00
05:00
07:00
09:00
01/04/2022
02/04/2022
03/04/2022
04/04/2022
05/04/2022
Date & Time
LA90
LAeq
LA10
LAFMax

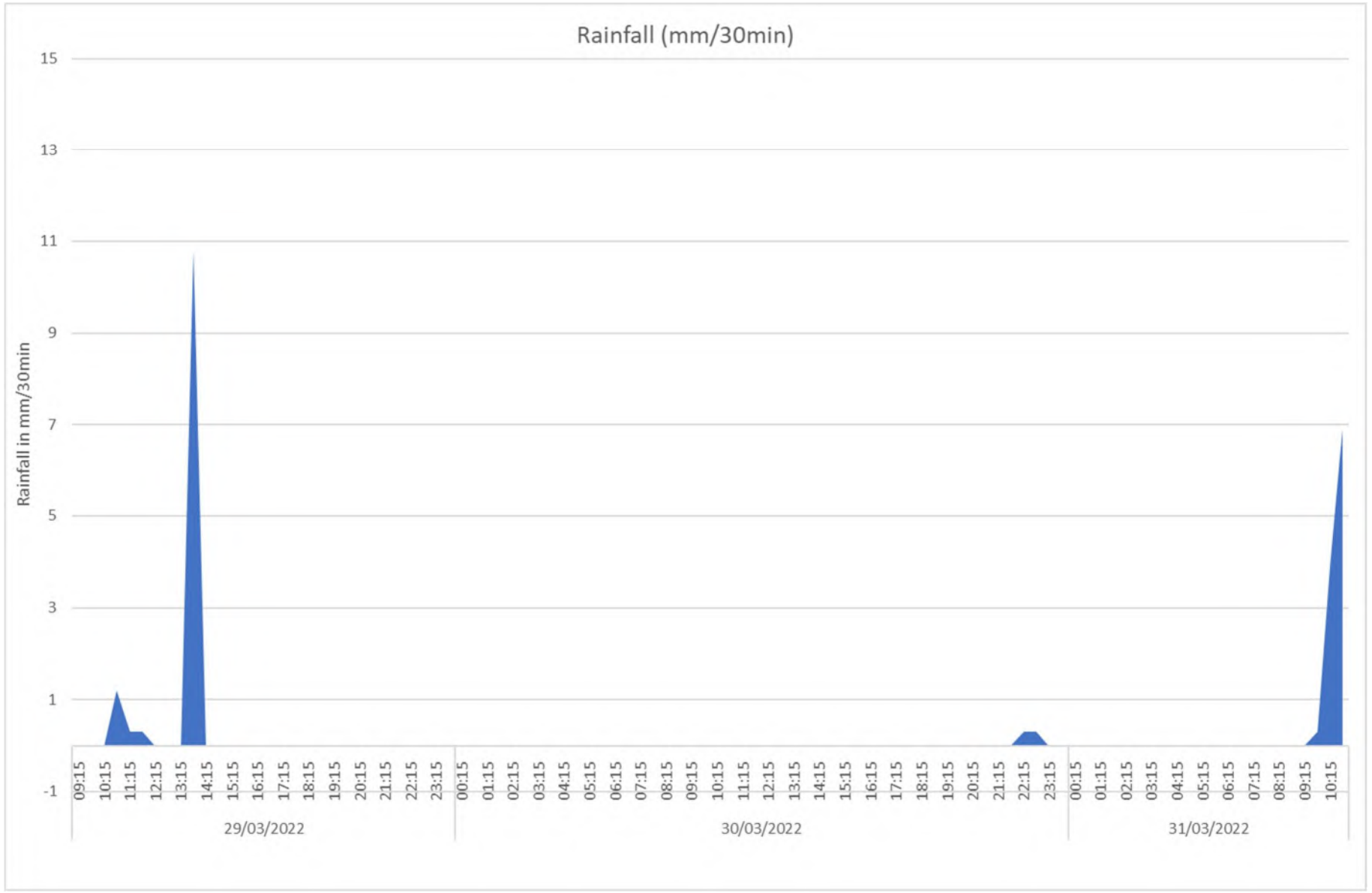

MP2 - Survey Overview
120
100
80
60
40
20
0
SPL dB (ref 2x10-5 Pa)
15:00
17:00
19:00
21:00
23:00
01:00
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
01:00
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
01:00
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
23:00
01:00
03:00
05:00
07:00
09:00
01/04/2022
02/04/2022
03/04/2022
04/04/2022
05/04/2022
Date & Time
LA90
LAeq
LA10
LAFMax

APPENDIX E

Weather Data


Wind Speed & Direction
Wind Speed m/s
0
1
2
3
4
5
6
7
8
9
10
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
14:30
15:30
16:30
17:30
18:30
19:30
20:30
21:30
22:30
23:30
00:30
01:30
02:30
03:30
04:30
05:30
06:30
07:30
08:30
09:30
10:30
11:30
12:30
13:30
14:30
15:30
16:30
17:30
18:30
19:30
20:30
21:30
22:30
23:30
00:30
01:30
02:30
03:30
04:30
05:30
06:30
07:30
08:30
09:30
10:30
11:30
12:30
13:30
01/04/2022
02/04/2022
03/04/2022
Time & Date


Outdoor Temperature(°C)
13
11
9
7
5
3
1
-1
-3
-5
Temperature °C
10.3
-3.6
14:30
15:30
16:30
17:30
18:30
19:30
20:30
21:30
22:30
23:30
00:30
01:30
02:30
03:30
04:30
05:30
06:30
07:30
08:30
09:30
10:30
11:30
12:30
13:30
14:30
15:30
16:30
17:30
18:30
19:30
20:30
21:30
22:30
23:30
00:30
01:30
02:30
03:30
04:30
05:30
06:30
07:30
08:30
09:30
10:30
11:30
12:30
13:30
01/04/2022
02/04/2022
03/04/2022
Time & Date
Outdoor Temperature(°C)


Rainfall (mm/30min)
Rainfall in mm/30min
15
13
11
9
7
5
3
1
-1
09:15
10:15
11:15
12:15
13:15
14:15
15:15
16:15
17:15
18:15
19:15
20:15
21:15
22:15
23:15
29/03/2022
00:15
01:15
02:15
03:15
04:15
05:15
06:15
07:15
08:15
09:15
10:15
11:15
12:15
13:15
14:15
15:15
16:15
17:15
18:15
19:15
20:15
21:15
22:15
23:15
30/03/2022
00:15
01:15
02:15
03:15
04:15
05:15
06:15
07:15
08:15
09:15
10:15
31/03/2022