



Acoustic Survey and Assessment for Proposed residential development at, Yew Tree Farm South Stott Lane, Middleton, Manchester, M24 6XJ

Prepared for:

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1. Introduction

- 1.1. Martin Environmental Solutions has been commissioned to undertake a noise survey and an acoustic assessment to support a discharge of condition to planning permission 16/00347/FUL granted by Rochdale Council for the conversion of existing barns to residential at Yew Tree Farm South, Stott Lane, Middleton, Manchester, M24 6XJ.

Site Location and Context

- 1.2. The site forms part of an existing farm and lies to the northeast of the main farm buildings. It is located to the south Oaken Bank Road with agricultural fields surrounding it. to the immediate northeast is another residential farm house. To the northwest are some stables and further along the road towards the main road are located further dwellings.
- 1.3. The main road is the A6049 Middleton Road which is a busy road leading from junction 19 of the M62 which lies approx. 440m to the west of the site.
- 1.4. As part of the planning permission the following condition was attached. This report aims to satisfy that condition.

“No above ground works shall take place until a scheme to protect the proposed dwellings from noise generated by the surrounding agricultural uses has first been submitted to and approved in writing by the Local Planning Authority. The scheme shall ensure noise levels of no more than:

- 35 dB(A) Leq (1 hour) in all habitable rooms with windows shut and other means of ventilation provided between 7am and 11pm*
- 30 dB(A) Leq 5 mins in the bedrooms with windows shut and other means of ventilation provided between 11pm and 7am*

The scheme shall thereafter be implemented in accordance with the duly approved details and a verification report submitted to and approved in writing by the Local Planning Authority to demonstrate that the required noise levels have been achieved for each plot before the dwelling on that plot is first occupied.

Reason: In order to ensure a satisfactory standard of amenity for future residents in accordance with policy EM/2 of the Council's Unitary Development Plan and the National Planning Policy Framework.”



2. Policy and Guidance

- 2.1. The impact of noise can be a material consideration in the determination of planning applications. The planning system has the task of guiding development to the most appropriate locations. It is recognised that on occasions it will be difficult to reconcile some land uses, such as housing, hospitals or schools, with other activities that generate high levels of noise. However, the planning system is tasked to ensure that, wherever practicable, noise-sensitive developments are separated from major sources of noise (such as road, rail and air transport and certain types of industrial development).
- 2.2. The Government's publication of the National Planning Policy Framework (NPPF), which seeks to prevent new and existing development from contributing to or being put at unacceptable risk from noise pollution, has replaced previous Planning Policy Statements and Planning Policy Guidance Notes.
- 2.3. The Government have also issued the Noise Policy Statement for England (NPSE). The NPSE clarifies the Government's underlying principles and aims in relation to noise and sets a vision to promote good health and a good quality of life through the effective management of noise while having regard to the Government's sustainable development strategy. The NPSE aims to mitigate and minimise adverse impacts on health and quality of life through the effective management and control of noise.
- 2.4. The NPSE introduces the following terms although no sound levels are given to represent these many authorities including those within Lancashire have identified the sound level criteria in line with the World Health Organisation, BS8233:2014 and BS4142: 2014 levels. The terms introduced by the NPSE are:
- NOEL – No Observed Effect Level (<30dB(A) inside <50dB(A) outside, 10dB below background)
- LOAEL – Lowest Observed Adverse Effect Level (30-35dB(A) inside 50-55dB(A) outside, background to +5dB)
- SOAEL – Significant Observed Adverse Effect Level (>35dB(A) inside, >55dB(A) outside, >+10dB above background)
- 2.5. The sound levels within the brackets of the previous paragraph are those determined by Lancashire authorities as appropriate levels to indicate the relevant effect levels represented by the NPSE. These levels are detailed within the Lancashire Planning



Guidance document on noise which is in the process of being finalised and is currently used by a number of Lancashire authorities.

- 2.6. Other commonly used examples of standards utilised by Local Planning authorities for the consideration of noise impacts include comparison of the likely noise levels to be experienced at a development, with levels that have been recommended by the World Health Organisation (WHO) as Guidelines for the prevention of Community Noise Annoyance and within BS8233: 2014.
- 2.7. The WHO recommended noise levels for outdoor amenity areas (gardens) that should not be exceeded are 55dB(A) $L_{Aeq,16hr}$ in order to avoid 'Serious Community Annoyance' or 50dB(A) $L_{Aeq,16hr}$ to avoid 'Moderate Community Annoyance' during the day. For indoor levels WHO set 35dB(A) $L_{Aeq,16hr}$ during the day to prevent Moderate Annoyance and 30 dB(A) $L_{Aeq,8hr}$ at night to prevent sleep disturbance.
- 2.8. The WHO guidance also recommends that maximum sound levels at night should not regularly exceed 45dB(A) within bedrooms to prevent sleep disturbance. Regularly is considered to be more than 10 times during any 8-hour night time period.
- 2.9. BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings' also specifies desirable noise levels to be achieved inside dwellings.
- 2.10. BS 8233:2014 'Sound insulation and noise reduction for buildings – Code of Practice' also specifies desirable noise levels to be achieved inside dwellings. BS 8233 presents two levels, the first between the hours of 07:00 – 23:00 and the second between 23:00 -07:00.
- 2.11. The daytime period suggests internal noise levels of 35dB $L_{Aeq,16hr}$, for resting in living rooms and bedrooms while for night time a level of 30dB $L_{Aeq,8hr}$ is recommended. Criteria for external areas mirrors that within the WHO guidance.
- 2.12. In addition, the recently published 'ProPG Planning & Noise, Professional Practice Guidance on Planning & Noise, New Residential Development' provides a 4-staged approach to undertaking a risk assessment in relation to anticipated sound levels at new residential development and the provision of mitigation measures. The guidance

is principally aimed at sites exposed predominantly to noise from transportation sources.

- 2.13. The first stage consists of an initial noise risk assessment, based on indicative day and night-time noise levels. Simple put the higher the ambient noise in an area the greater the impact. The levels given are shown below although it should be noted that these are in excess of both the Lancashire guidance, WHO and BS 8233: 2014.

Noise Risk Category*	Potential Effect if Unmitigated	Pre-Planning Application Guidance
0 – Negligible $L_{Aeq,16hr} < 50dB$ $L_{Aeq,8hr} < 40dB$	May be noticeable but no adverse effect on health and quality of life	In this category the development is likely to be acceptable from a noise perspective, nevertheless a good acoustic design process is encouraged to improve the existing environment and/or safeguard against possible future deterioration and to protect any designated tranquil areas. A noise assessment may be requested to demonstrate no adverse impact from noise. Application need not normally be delayed on noise grounds.
1 – Low $L_{Aeq,16hr} 50-63dB$ $L_{Aeq,8hr} 40-55dB$	Adverse effect on health and quality of life	In this category the development may be refused unless a good acoustic design process is followed and is demonstrated via a Level 1 Acoustic Design Statement which confirms how the adverse impacts of noise on the new development will be mitigated and minimised and that a significant adverse impact will not arise in the finished development. Planning conditions and other measures to control noise may be required.
2 – Medium $L_{Aeq,16hr} 63-69dB$ $L_{Aeq,8hr} 55-60dB$ $L_{AFmax} > 80dB^{**}$	Significant adverse effect on health and quality of life	In this category the development is likely to be refused unless good acoustic design process is followed and is demonstrated via a Level 2 Acoustic Design Statement which confirms how the adverse impacts of noise on the new development will be mitigated and minimised, and clearly demonstrates that a significant adverse noise impact will not arise in the finished development. Planning conditions and other measures to control noise will normally be required.
3 – High $L_{Aeq,16hr} > 69dB$ $L_{Aeq,8hr} > 60dB$ $L_{AFmax} > 80dB^{**}$	Unacceptable adverse effect of health and quality of life	In this category the development is very likely to be refused on noise grounds, even if a good acoustic design process is followed and is demonstrated via a Level 2 Acoustic Design Statement. Applicants are advised to seek expert advice on possible mitigation measures. Advice on the circumstances when the refusal of a new housing on noise grounds should normally be anticipated is included in the ProPG.

- 2.14. Stage 2, consists of a full assessment of the prevailing ambient noise and is required considered 4 elements to be considered:

- I. Element 1 – Good Acoustic Design
- II. Element 2 – Internal Noise Level Guidelines



- III. Element 3 – External Amenity Area Noise Assessment
- IV. Element 4 – Assessment of Other Relevant Issues

2.15. A good acoustic design is implicit in meeting the requirements of the NPPF and can help to resolve many potential acoustic issues.

2.16. Details of the criteria considered suitable are provided above for both internal and external sound levels. Element 4 includes such issues as local and national policy, likely occupants, wider planning objectives.

2.17. The above guidelines are likely to be the basis of the condition attached to the planning permission.



3. The Assessment

- 3.1 Background sound monitoring was undertaken on site over the 4th to 6th June 2018. The sound level meter was located in the farm yard between the proposed housing and the existing farm house and the meter was placed at a height of 1.5m.
- 3.2 All measurements were taken using a Cirrus, Optimus Green CR-171C, Type 1 sound level meters. The meters were calibrated before and after use and no significant deviation was identified. The calibration certificates are shown in Appendix B. Weather during the monitoring period was very warm, dry with clear skies and wind below 5m/s.
- 3.3 The full results are provided within Appendix A, with a summary of the day and night time sound levels shown below

Start Time	End Time	Duration	L _{Aeq}	L _{A90}	L _{AMax}
04/06/2018 18:13	04/06/2018 23:00	04:46:10	62.2	39.8	106.3
04/06/2018 23:00	05/06/2018 07:00	08:00:00	51.1	32.9	86.6
05/06/2018 07:00	05/06/2018 23:00	16:00:00	55.2	42.6	89.9
05/06/2018 23:00	06/06/2018 07:00	08:00:00	55.9	35.9	86.1
06/06/2018 07:00	06/06/2018 13:06	06:06:55	51.2	44.1	82.3

- 3.4 A review of the monitoring results identified that the background sound level was dominated by distance traffic, however substantial fluctuations in the sound level were present during the day and early morning periods from birdsong. Many of which are nesting within the building. Also, periods of dog barking were recorded during both the day and night-time periods. These dogs are currently housed within the barn to be converted and would be moved away from the site once the development has commenced.
- 3.5 An open window provides 15dB attenuation¹ and therefore the resulting sound level within the proposed properties will be 40.2dB(A) during the day and 40.9dB(A) during the night. Above both the recommended guideline levels detailed above and the requirements under the planning condition. As such additional mitigation measures are required to ensure a suitable internal sound level in all habitable rooms to the property.

¹ BS8233: 2014; Guidance on sound insulation and noise reduction for buildings



- 3.6 In addition to the above, Appendix A contains the daytime hourly and night-time 5-minute L_{Aeq} results. The median values of these were 51.55dB(A) and 45.1dB(A) respectfully. Through a partially open window this would result in internal levels of 36.55dB(A) and 30.1dB(A). Just above the recommended guideline figure sand those detailed within the planning condition.
- 3.7 A standard 6/12/6 double glazing unit will provide a sound reduction, $R_w(C;C_{tr})$, of 33(-1;-3). This would be adequate to the protect the properties during the day and night from the average sound levels and ensure that the levels stated within the planning permission are achieved.
- 3.8 In order to be able to keep windows closed additional ventilation provision must be made for the property. As such it is recommended that a ventilation system is used incorporating acoustic trickle ventilators for all windows to habitable rooms to the proposed property. The ventilators must achieve a similar of better performance to the windows when open and a number of suitable models are available from suppliers including the Greenwood DN Vent providing 34dB (C_{tr}) attenuation or the Titon, Trimvent Select S13 Ventilator providing 33dB (C_{tr}) attenuation. Other models and manufacturers area available.



4 Conclusions and Recommendations

- 4.1 Monitoring undertaken onsite has shown that the current sound levels will result in a very slight exceedance of the recommended guideline levels detailed in section 2 of the report and those stipulated by the planning authority within the planning consent. As such mitigation measures have been identified in the form of standard glazing units with trickle ventilation to allow windows to remain closed.
- 4.2 The above mitigation measures will ensure acceptable sound levels are achieved in line with BS8233:2014, the World Health Organisation guidelines and the Lancashire Planning and Noise Guidance document.
- 4.3 In conclusion the provision of the identified mitigation measures will ensure no adverse impact is experienced by the proposed dwellings and as such the proposal meets the requirements of the National Planning Policy Framework with respect to the sound levels to be experienced.

Figure 1 – Aerial Photograph



★ Monitoring location



Appendix A – Monitoring Results

Full Results

Time	L _{Aeq} (dB)	L _{AMax} (dB)	L _{A90} (dB)
04/06/2018 18:13	56.5	78.4	47.7
04/06/2018 19:00	59.2	83.0	48.4
04/06/2018 20:00	68.2	106.3	44.3
04/06/2018 21:00	51.1	76.9	41.0
04/06/2018 22:00	48.4	76.3	36.4
04/06/2018 23:00	44.3	72.8	33.6
05/06/2018 00:00	56.7	85.1	31.8
05/06/2018 01:00	37.8	51.9	30.8
05/06/2018 02:00	38.5	53.4	31.8
05/06/2018 03:00	42.4	63.4	32.6
05/06/2018 04:00	52.5	68.4	40.3
05/06/2018 05:00	50.8	75.3	43.5
05/06/2018 06:00	53.4	86.6	46.8
05/06/2018 07:00	59.2	89.9	48.9
05/06/2018 08:00	52.6	87.7	47.3
05/06/2018 09:00	56.8	79.4	49.1
05/06/2018 10:00	57.1	81.6	45.4
05/06/2018 11:00	56.6	81.9	43.4
05/06/2018 12:00	49.9	72.5	43.7
05/06/2018 13:00	51.8	78.7	40.6
05/06/2018 14:00	47.3	64.3	42.0
05/06/2018 15:00	47.5	71.1	42.1
05/06/2018 16:00	50.0	78.3	42.8
05/06/2018 17:00	56.0	79.6	43.9
05/06/2018 18:00	57.4	83.3	44.1
05/06/2018 19:00	59.9	85.5	41.4
05/06/2018 20:00	56.3	85.3	43.7
05/06/2018 21:00	48.8	78.0	40.3
05/06/2018 22:00	43.7	55.4	39.8
05/06/2018 23:00	56.1	84.0	39.0
06/06/2018 00:00	57.2	82.7	35.7
06/06/2018 01:00	38.8	52.3	32.7
06/06/2018 02:00	59.9	86.1	34.9
06/06/2018 03:00	57.8	84.7	34.3
06/06/2018 04:00	52.4	75.2	41.5
06/06/2018 05:00	52.5	78.9	47.9
06/06/2018 06:00	53.5	80.6	48.4
06/06/2018 07:00	49.3	64.4	44.9
06/06/2018 08:00	48.1	66.3	44.0
06/06/2018 09:00	54.9	82.3	43.0



06/06/2018 10:00	51.3	80.1	42.2
06/06/2018 11:00	50.4	77.4	46.0
06/06/2018 12:00	49.3	70.2	42.6
06/06/2018 13:00	50.3	79.2	44.5

Day-time 1-hour results

Start Time	End Time	Duration	LAeq
04/06/2018 19:00	04/06/2018 20:00	01:00:00	59.2
04/06/2018 20:00	04/06/2018 21:00	01:00:00	68.2
04/06/2018 21:00	04/06/2018 22:00	01:00:00	51.1
04/06/2018 22:00	04/06/2018 23:00	01:00:00	48.4
05/06/2018 07:00	05/06/2018 08:00	00:59:59	59.2
05/06/2018 08:00	05/06/2018 09:00	01:00:00	52.6
05/06/2018 09:00	05/06/2018 10:00	01:00:00	56.8
05/06/2018 10:00	05/06/2018 11:00	01:00:00	57.1
05/06/2018 11:00	05/06/2018 12:00	01:00:00	56.6
05/06/2018 12:00	05/06/2018 13:00	01:00:00	49.9
05/06/2018 13:00	05/06/2018 14:00	01:00:00	51.8
05/06/2018 14:00	05/06/2018 15:00	01:00:00	47.3
05/06/2018 15:00	05/06/2018 16:00	01:00:00	47.5
05/06/2018 16:00	05/06/2018 17:00	01:00:00	50.0
05/06/2018 17:00	05/06/2018 18:00	01:00:00	56.0
05/06/2018 18:00	05/06/2018 19:00	01:00:00	57.4
05/06/2018 19:00	05/06/2018 20:00	01:00:00	59.9
05/06/2018 20:00	05/06/2018 21:00	01:00:00	56.3
05/06/2018 21:00	05/06/2018 22:00	01:00:00	48.8
05/06/2018 22:00	05/06/2018 23:00	01:00:00	43.7
06/06/2018 07:00	06/06/2018 08:00	00:59:59	49.3
06/06/2018 08:00	06/06/2018 09:00	01:00:00	48.1
06/06/2018 09:00	06/06/2018 10:00	01:00:00	54.9
06/06/2018 10:00	06/06/2018 11:00	01:00:00	51.3
06/06/2018 11:00	06/06/2018 12:00	01:00:00	50.4
06/06/2018 12:00	06/06/2018 13:00	01:00:00	49.3
MEDIAN			51.55



Night-time 5 min results

Start Time	End Time	Duration	LAeq
04/06/2018 23:00	04/06/2018 23:05	00:04:59	39.5
04/06/2018 23:05	04/06/2018 23:10	00:05:00	39.1
04/06/2018 23:10	04/06/2018 23:15	00:05:00	39.2
04/06/2018 23:15	04/06/2018 23:20	00:05:00	36.0
04/06/2018 23:20	04/06/2018 23:25	00:05:00	38.5
04/06/2018 23:25	04/06/2018 23:30	00:05:00	38.9
04/06/2018 23:30	04/06/2018 23:35	00:05:00	53.9
04/06/2018 23:35	04/06/2018 23:40	00:05:00	39.4
04/06/2018 23:40	04/06/2018 23:45	00:05:00	36.9
04/06/2018 23:45	04/06/2018 23:50	00:05:00	36.4
04/06/2018 23:50	04/06/2018 23:55	00:05:00	37.7
04/06/2018 23:55	05/06/2018 00:00	00:05:00	38.6
05/06/2018 00:00	05/06/2018 00:05	00:05:00	37.4
05/06/2018 00:05	05/06/2018 00:10	00:05:00	38.9
05/06/2018 00:10	05/06/2018 00:15	00:05:00	64.1
05/06/2018 00:15	05/06/2018 00:20	00:05:00	36.8
05/06/2018 00:20	05/06/2018 00:25	00:05:00	37.6
05/06/2018 00:25	05/06/2018 00:30	00:05:00	38.6
05/06/2018 00:30	05/06/2018 00:35	00:05:00	64.7
05/06/2018 00:35	05/06/2018 00:40	00:05:00	37.4
05/06/2018 00:40	05/06/2018 00:45	00:05:00	38.8
05/06/2018 00:45	05/06/2018 00:50	00:05:00	39.5
05/06/2018 00:50	05/06/2018 00:55	00:05:00	38.1
05/06/2018 00:55	05/06/2018 01:00	00:05:00	37.3
05/06/2018 01:00	05/06/2018 01:05	00:05:00	36.8
05/06/2018 01:05	05/06/2018 01:10	00:05:00	38.0
05/06/2018 01:10	05/06/2018 01:15	00:05:00	40.2
05/06/2018 01:15	05/06/2018 01:20	00:05:00	37.1
05/06/2018 01:20	05/06/2018 01:25	00:05:00	35.0
05/06/2018 01:25	05/06/2018 01:30	00:05:00	37.6
05/06/2018 01:30	05/06/2018 01:35	00:05:00	36.2
05/06/2018 01:35	05/06/2018 01:40	00:05:00	38.4
05/06/2018 01:40	05/06/2018 01:45	00:05:00	39.0
05/06/2018 01:45	05/06/2018 01:50	00:05:00	36.5
05/06/2018 01:50	05/06/2018 01:55	00:05:00	38.1
05/06/2018 01:55	05/06/2018 02:00	00:05:00	37.7
05/06/2018 02:00	05/06/2018 02:05	00:05:00	37.7
05/06/2018 02:05	05/06/2018 02:10	00:05:00	37.8
05/06/2018 02:10	05/06/2018 02:15	00:05:00	40.4
05/06/2018 02:15	05/06/2018 02:20	00:05:00	38.3
05/06/2018 02:20	05/06/2018 02:25	00:05:00	36.4
05/06/2018 02:25	05/06/2018 02:30	00:05:00	38.5



05/06/2018 02:30	05/06/2018 02:35	00:05:00	37.4
05/06/2018 02:35	05/06/2018 02:40	00:05:00	39.4
05/06/2018 02:40	05/06/2018 02:45	00:05:00	38.6
05/06/2018 02:45	05/06/2018 02:50	00:05:00	38.2
05/06/2018 02:50	05/06/2018 02:55	00:05:00	39.1
05/06/2018 02:55	05/06/2018 03:00	00:05:00	39.2
05/06/2018 03:00	05/06/2018 03:05	00:05:00	41.8
05/06/2018 03:05	05/06/2018 03:10	00:05:00	38.5
05/06/2018 03:10	05/06/2018 03:15	00:05:00	41.2
05/06/2018 03:15	05/06/2018 03:20	00:05:00	39.2
05/06/2018 03:20	05/06/2018 03:25	00:05:00	38.2
05/06/2018 03:25	05/06/2018 03:30	00:05:00	38.1
05/06/2018 03:30	05/06/2018 03:35	00:05:00	38.0
05/06/2018 03:35	05/06/2018 03:40	00:05:00	37.7
05/06/2018 03:40	05/06/2018 03:45	00:05:00	40.0
05/06/2018 03:45	05/06/2018 03:50	00:05:00	43.5
05/06/2018 03:50	05/06/2018 03:55	00:05:00	48.5
05/06/2018 03:55	05/06/2018 04:00	00:05:00	45.9
05/06/2018 04:00	05/06/2018 04:05	00:05:00	45.9
05/06/2018 04:05	05/06/2018 04:10	00:05:00	48.5
05/06/2018 04:10	05/06/2018 04:15	00:05:00	48.4
05/06/2018 04:15	05/06/2018 04:20	00:05:00	43.8
05/06/2018 04:20	05/06/2018 04:25	00:05:00	49.8
05/06/2018 04:25	05/06/2018 04:30	00:05:00	54.7
05/06/2018 04:30	05/06/2018 04:35	00:05:00	54.7
05/06/2018 04:35	05/06/2018 04:40	00:05:00	54.6
05/06/2018 04:40	05/06/2018 04:45	00:05:00	54.3
05/06/2018 04:45	05/06/2018 04:50	00:05:00	52.4
05/06/2018 04:50	05/06/2018 04:55	00:05:00	53.5
05/06/2018 04:55	05/06/2018 05:00	00:05:00	54.4
05/06/2018 05:00	05/06/2018 05:05	00:05:00	50.6
05/06/2018 05:05	05/06/2018 05:10	00:05:00	51.8
05/06/2018 05:10	05/06/2018 05:15	00:05:00	50.2
05/06/2018 05:15	05/06/2018 05:20	00:05:00	50.7
05/06/2018 05:20	05/06/2018 05:25	00:05:00	52.6
05/06/2018 05:25	05/06/2018 05:30	00:05:00	49.8
05/06/2018 05:30	05/06/2018 05:35	00:05:00	50.4
05/06/2018 05:35	05/06/2018 05:40	00:05:00	49.1
05/06/2018 05:40	05/06/2018 05:45	00:05:00	49.8
05/06/2018 05:45	05/06/2018 05:50	00:05:00	53.5
05/06/2018 05:50	05/06/2018 05:55	00:05:00	46.5
05/06/2018 05:55	05/06/2018 06:00	00:05:00	51.2
05/06/2018 06:00	05/06/2018 06:05	00:05:00	52.0
05/06/2018 06:05	05/06/2018 06:10	00:05:00	50.7



05/06/2018 06:10	05/06/2018 06:15	00:05:00	49.3
05/06/2018 06:15	05/06/2018 06:20	00:05:00	50.2
05/06/2018 06:20	05/06/2018 06:25	00:05:00	51.6
05/06/2018 06:25	05/06/2018 06:30	00:05:00	54.8
05/06/2018 06:30	05/06/2018 06:35	00:05:00	51.9
05/06/2018 06:35	05/06/2018 06:40	00:05:00	52.2
05/06/2018 06:40	05/06/2018 06:45	00:05:00	54.5
05/06/2018 06:45	05/06/2018 06:50	00:05:00	59.1
05/06/2018 06:50	05/06/2018 06:55	00:05:00	51.1
05/06/2018 06:55	05/06/2018 07:00	00:05:00	52.1
05/06/2018 23:00	05/06/2018 23:05	00:04:59	44.9
05/06/2018 23:05	05/06/2018 23:10	00:05:00	45.2
05/06/2018 23:10	05/06/2018 23:15	00:05:00	43.5
05/06/2018 23:15	05/06/2018 23:20	00:05:00	42.7
05/06/2018 23:20	05/06/2018 23:25	00:05:00	43.3
05/06/2018 23:25	05/06/2018 23:30	00:05:00	43.9
05/06/2018 23:30	05/06/2018 23:35	00:05:00	60.9
05/06/2018 23:35	05/06/2018 23:40	00:05:00	48.5
05/06/2018 23:40	05/06/2018 23:45	00:05:00	65.2
05/06/2018 23:45	05/06/2018 23:50	00:05:00	41.2
05/06/2018 23:50	05/06/2018 23:55	00:05:00	48.9
05/06/2018 23:55	06/06/2018 00:00	00:05:00	42.0
06/06/2018 00:00	06/06/2018 00:05	00:05:00	42.4
06/06/2018 00:05	06/06/2018 00:10	00:05:00	41.7
06/06/2018 00:10	06/06/2018 00:15	00:05:00	41.8
06/06/2018 00:15	06/06/2018 00:20	00:05:00	38.5
06/06/2018 00:20	06/06/2018 00:25	00:05:00	62.5
06/06/2018 00:25	06/06/2018 00:30	00:05:00	61.4
06/06/2018 00:30	06/06/2018 00:35	00:05:00	64.8
06/06/2018 00:35	06/06/2018 00:40	00:05:00	43.0
06/06/2018 00:40	06/06/2018 00:45	00:05:00	41.2
06/06/2018 00:45	06/06/2018 00:50	00:05:00	39.3
06/06/2018 00:50	06/06/2018 00:55	00:05:00	42.7
06/06/2018 00:55	06/06/2018 01:00	00:05:00	43.5
06/06/2018 01:00	06/06/2018 01:05	00:05:00	40.5
06/06/2018 01:05	06/06/2018 01:10	00:05:00	38.3
06/06/2018 01:10	06/06/2018 01:15	00:05:00	38.0
06/06/2018 01:15	06/06/2018 01:20	00:05:00	35.0
06/06/2018 01:20	06/06/2018 01:25	00:05:00	38.5
06/06/2018 01:25	06/06/2018 01:30	00:05:00	36.9
06/06/2018 01:30	06/06/2018 01:35	00:05:00	38.5
06/06/2018 01:35	06/06/2018 01:40	00:05:00	38.7
06/06/2018 01:40	06/06/2018 01:45	00:05:00	37.4
06/06/2018 01:45	06/06/2018 01:50	00:05:00	38.1



06/06/2018 01:50	06/06/2018 01:55	00:05:00	40.0
06/06/2018 01:55	06/06/2018 02:00	00:05:00	41.4
06/06/2018 02:00	06/06/2018 02:05	00:05:00	44.4
06/06/2018 02:05	06/06/2018 02:10	00:05:00	40.4
06/06/2018 02:10	06/06/2018 02:15	00:05:00	59.2
06/06/2018 02:15	06/06/2018 02:20	00:05:00	40.2
06/06/2018 02:20	06/06/2018 02:25	00:05:00	59.6
06/06/2018 02:25	06/06/2018 02:30	00:05:00	59.2
06/06/2018 02:30	06/06/2018 02:35	00:05:00	41.7
06/06/2018 02:35	06/06/2018 02:40	00:05:00	64.1
06/06/2018 02:40	06/06/2018 02:45	00:05:00	41.1
06/06/2018 02:45	06/06/2018 02:50	00:05:00	67.0
06/06/2018 02:50	06/06/2018 02:55	00:05:00	61.4
06/06/2018 02:55	06/06/2018 03:00	00:05:00	48.6
06/06/2018 03:00	06/06/2018 03:05	00:05:00	68.2
06/06/2018 03:05	06/06/2018 03:10	00:05:00	39.4
06/06/2018 03:10	06/06/2018 03:15	00:05:00	40.3
06/06/2018 03:15	06/06/2018 03:20	00:05:00	39.4
06/06/2018 03:20	06/06/2018 03:25	00:05:00	39.8
06/06/2018 03:25	06/06/2018 03:30	00:05:00	41.5
06/06/2018 03:30	06/06/2018 03:35	00:05:00	40.4
06/06/2018 03:35	06/06/2018 03:40	00:05:00	42.0
06/06/2018 03:40	06/06/2018 03:45	00:05:00	45.2
06/06/2018 03:45	06/06/2018 03:50	00:05:00	49.6
06/06/2018 03:50	06/06/2018 03:55	00:05:00	55.3
06/06/2018 03:55	06/06/2018 04:00	00:05:00	52.7
06/06/2018 04:00	06/06/2018 04:05	00:05:00	49.1
06/06/2018 04:05	06/06/2018 04:10	00:05:00	47.6
06/06/2018 04:10	06/06/2018 04:15	00:05:00	46.1
06/06/2018 04:15	06/06/2018 04:20	00:05:00	45.3
06/06/2018 04:20	06/06/2018 04:25	00:05:00	51.8
06/06/2018 04:25	06/06/2018 04:30	00:05:00	49.4
06/06/2018 04:30	06/06/2018 04:35	00:05:00	54.7
06/06/2018 04:35	06/06/2018 04:40	00:05:00	55.5
06/06/2018 04:40	06/06/2018 04:45	00:05:00	56.0
06/06/2018 04:45	06/06/2018 04:50	00:05:00	55.2
06/06/2018 04:50	06/06/2018 04:55	00:05:00	51.4
06/06/2018 04:55	06/06/2018 05:00	00:05:00	51.3
06/06/2018 05:00	06/06/2018 05:05	00:05:00	51.7
06/06/2018 05:05	06/06/2018 05:10	00:05:00	51.1
06/06/2018 05:10	06/06/2018 05:15	00:05:00	54.0
06/06/2018 05:15	06/06/2018 05:20	00:05:00	52.3
06/06/2018 05:20	06/06/2018 05:25	00:05:00	54.0
06/06/2018 05:25	06/06/2018 05:30	00:05:00	53.9



06/06/2018 05:30	06/06/2018 05:35	00:05:00	53.0
06/06/2018 05:35	06/06/2018 05:40	00:05:00	51.2
06/06/2018 05:40	06/06/2018 05:45	00:05:00	50.4
06/06/2018 05:45	06/06/2018 05:50	00:05:00	51.5
06/06/2018 05:50	06/06/2018 05:55	00:05:00	53.2
06/06/2018 05:55	06/06/2018 06:00	00:05:00	51.5
06/06/2018 06:00	06/06/2018 06:05	00:05:00	51.5
06/06/2018 06:05	06/06/2018 06:10	00:05:00	53.3
06/06/2018 06:10	06/06/2018 06:15	00:05:00	52.5
06/06/2018 06:15	06/06/2018 06:20	00:05:00	51.6
06/06/2018 06:20	06/06/2018 06:25	00:05:00	51.3
06/06/2018 06:25	06/06/2018 06:30	00:05:00	59.4
06/06/2018 06:30	06/06/2018 06:35	00:05:00	51.3
06/06/2018 06:35	06/06/2018 06:40	00:05:00	50.5
06/06/2018 06:40	06/06/2018 06:45	00:05:00	49.9
06/06/2018 06:45	06/06/2018 06:50	00:05:00	56.1
06/06/2018 06:50	06/06/2018 06:55	00:05:00	49.8
06/06/2018 06:55	06/06/2018 07:00	00:05:00	50.7
MEDIAN			45.05



Appendix B – Calibration Certificates

Certificate of Calibration



Equipment Details

Instrument Manufacturer Cirrus Research Plc
Instrument Type CR:171C
Description Sound Level Meter
Serial Number G080402

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

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

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

Calibrated by

Calibration Date

19 March 2018

Calibration Certificate Number

258205

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

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



Certificate of Calibration

Certificate Number: **117501**
Date of Issue: **19 March 2018**



Microphone Capsule

Manufacturer: **Cirrus Research plc** Serial Number: **210324A**
Model Number: **MK:224**

Calibration Procedure

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to the National Physical Laboratory, Middlesex, UK.

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

Date of Calibration: **20 February 2018**
Open Circuit **45.6 mV/Pa**
Sensitivity at 1 kHz: **-26.8 dB rel 1 V/Pa**

Environmental Conditions

Pressure: **101.20 kPa**
Temperature: **22.0 °C**
Humidity: **31.0 %**

Calibration Laboratory

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

Test Engineer: Debra Swalwell

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





Certificate of Calibration

Certificate Number: **117499**

Date of Issue: **19 March 2018**



Instrument

Manufacturer: **Cirrus Research plc**

Serial Number: **83296**

Model Number: **CR:515**

Calibration Procedure

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC 60942:2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

Date of Calibration: **28 February 2018**

Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	94.00	1000.0	1.30
2	94.00	1000.0	1.23
3	93.98	1000.0	1.27
Average	93.99	1000.0	1.27
Uncertainty	± 0.13	± 0.1	± 0.10

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

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