



Azymuth Acoustics UK

Professional Acoustic Services

Approved by: Matthew Gibson
Date: 18/08/2020

Noise Assessment Report

Ref: AA0265

Noise Impact Assessment

Proposed Air Source Heat Pumps at:

Merridge Walk

Cheetham Hill

Manchester

M8 0TG

For

Northwards Housing

Hexagon Tower

Crumpsall Vale

M9 8GQ



Azymuth Acoustics UK

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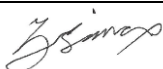
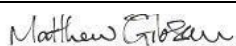
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1.0 Introduction

Azymuth Acoustics UK is appointed by Northwards Housing to provide an acoustic assessment of proposed new outdoor air source heat pumps to be installed to 6 no. of dwellings on an existing housing estate on Merridge Walk in Cheetham Hill, Manchester.

The scheme involves installation of 6 no. units, each unit serving an individual dwelling (no commercial use). Individual domestic air source heat pump installations typically come under permitted development rights, assuming compliance with Microgeneration Certification Scheme installation requirements.

This report is intended to provide information required in order to comply with environmental noise criteria relating to the potential noise impact of outdoor plant at nearby receptors. In particular, the report sets out the following details:

- The results of a baseline noise survey undertaken at Merridge Walk, Cheetham Hill.
- The appropriate assessment criteria and guidance relating to noise in the environment as associated with this kind of development.
- Suitable limits for noise levels from externally mounted plant, which could potentially affect the wider environment.
- An assessment of the proposed plant items with calculated noise impact.
- Noise mitigation measures recommended with the aim of compliance with noise limits.
- It is understood that the plant items will operate during both daytime and night-time periods. As such, night-time periods are assessed, being the worst-case scenario when background noise levels in the area would be lowest.

2.0 Baseline Noise Survey

2.1 Measurement Procedures

The instrumentation used for the environmental noise survey consisted of a SvanTek 959 Type 1 precision sound level meter and SvanTek SV 33B calibrator. The meter was calibrated before and after the noise measurements. The sound level meter records A-weighted (fast response) noise levels as well as octave band data for all measurements recorded.

The daytime and night-time survey was undertaken between 11:40 – 11:55 and 23:28 – 00:03 on 03rd August 2020. Weather at the time of surveys was dry with low wind speeds (consistently below 5 m/s).

The ambient, and background sound level measurements were undertaken using the sound level meter microphone at the location shown in Figure 1 below.

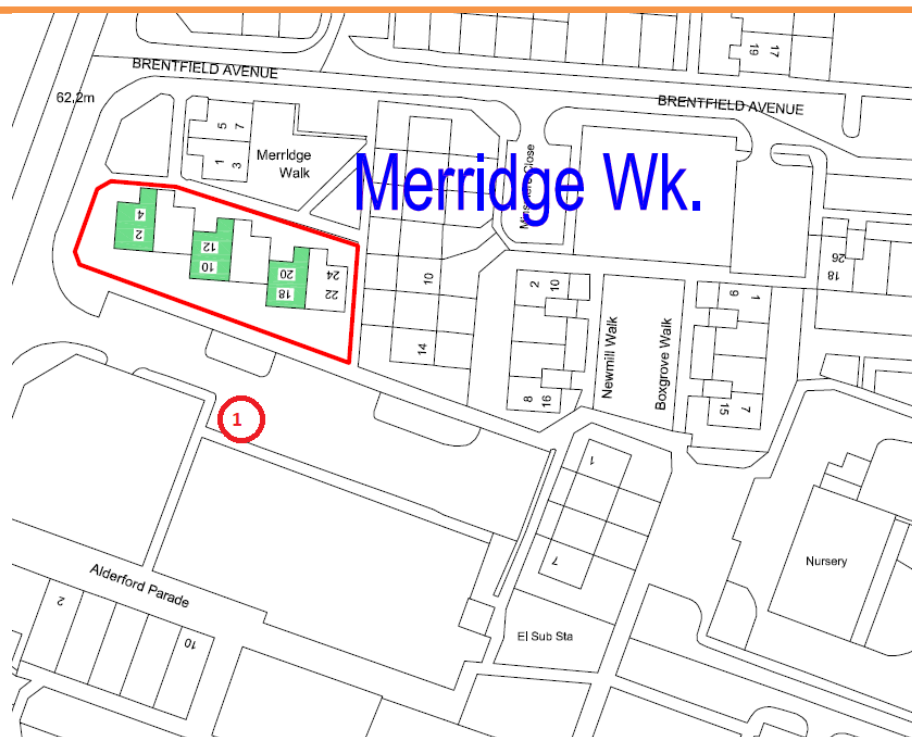


Figure 1: Block plan with noise measurement position marked in red circle

2.2 Results of Noise Measurements

Full results of the noise levels recorded during the survey are included in Appendix B of this report.

The following table summarises the results of the noise measurements undertaken at the proposed site in terms of the average daytime (07:00 – 23:00) and night-time (23:00 – 07:00 hours) statistical noise levels.

Location	Period	L _{Aeq}	L _{A1}	L _{A10}	L _{A50}	L _{A90}
1 – Merridge Walk	Day	54	63	58	52	48
1 – Merridge Walk	Night	50	60	54	44	36

Table 1: Results of Azymuth Acoustics UK noise measurements, August 2020

2.3 Description of Noise Climate

The noise climate in the area is dominated by the substation to the south east of the dwellings and by road traffic noise from the local roads and wider area. No cars passed close to measurement positions during night-time noise survey periods; as such, background sound levels would be assessed to be representative of the quietest periods.

3.0 Assessment Criteria

In order to assess the extent of any measures which may be necessary in order to comply with suitable conditions relating to the potential noise sources, Azymuth Acoustics UK has reviewed various guidance documents and standards, these include:

- British Standard 4142:2014
- WHO Environmental Noise Guidelines 2018
- British Standard 8233:2014
- Micro-generation Certification Scheme (MCS 020)
- Manchester City Council Planning & Noise Technical Guidance December 2015

3.1 British Standard 4142:2014

The test that is generally applied to assess the potential for noise from fixed installations (e.g. externally mounted plant) to give rise to community response is contained in British Standard BS 4142: 2014. This standard predicts the likelihood of complaint due to noise from a new or modified source.

BS 4142 describes a method for determining the specific source and background noise levels outside residential buildings and for assessing whether the noise is likely to give rise to complaints from the occupants. The specific noise level from the commercial source is rated based on any tonal or intermittent characteristics of the sound.

BS 4142 assessment methodology involves comparing the existing background level with the predicted noise from the new development. This predicted level is adjusted to allow for any tonal or impulsive characteristics and is called the Rating Level. The difference between the two levels can be used to indicate the likelihood of complaints arising, e.g. a predicted level of 10dB greater than the background level indicates a significant adverse impact; an increase of around 5dB is indicates an adverse impact and where the rating level does not exceed the background sound level (BSL) this is an indication of the source having a low impact.

Where background sound levels are low (nominally <30dB L_{A90} in an urban setting) it may be argued that absolute noise limits may be more appropriate; BS 4142 contains the following comment:

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

3.2 World Health Organisation Environmental Noise Guidelines (ENG) 2018

The main purpose of the 2018 WHO guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from the following sources: transportation (road traffic, railway and aircraft), wind turbines and leisure activities.

The 2018 guidelines supersede the Community Noise Guidelines from 1999. Nevertheless, the document recommends that all CNG indoor guideline values and any values not covered by the current guidelines should remain valid. As such, the following guidance would remain appropriate:

For protection against sleep disturbance inside dwellings, night-time noise levels should not exceed 30dB L_{Aeq} for continuous noise and 45dB L_{Amax} for single sound events.

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise (interpreted as noise from all sources combined) should not exceed 55dB L_{Aeq} on balconies, terraces and in outdoor living areas. It should be noted that exposure levels defined in ENG and CNG are for guidance purposes as relates potential adverse health impacts and should not be interpreted as absolute limits or regulations.

3.3 British Standard 8233:2014

BS 8233 provides a code of practice for the sound insulation of a variety of building types affected by general environmental noise.

It provides recommendations for control of noise in and around buildings and suggests appropriate criteria / limits for a variety of different situations including within residential properties.

The following table summarises the noise limits suggested by BS 8233:2014 applying to residential properties.

Room Type	Noise limit 07:00-23:00 $L_{Aeq,16hr}$	Noise limit 23:00-07:00 $L_{Aeq,8hr}$
Living Room	35	-
Dining Room	40	-
Bedroom	35	30

Table 2: Noise Limits for Residential Properties Suggested in BS 8233:2014



3.4 MCS 020: Micro-generation Certification Scheme

UK government has put forward noise limits for maximum noise limit for wind turbines and air source heat pump installed under permitted development as part of the Micro-generation Certification Scheme. The noise limit is 42dB $L_{Aeq, 5 \text{ min}}$ at 1 metre from a window or door opening of a habitable room on the façade of a neighbouring residential property (but ignoring the effect of that façade).

The 42dBA noise limit would equate to an internal noise level $\leq 30\text{dBA}$ within rooms i.e. in line with target night-time limits for bedrooms described in BS 8233 and WHO Guidelines.

3.5 Manchester City Council Planning & Noise Technical Guidance

Manchester City Council Planning & Noise Guidance 2015 details noise limit criteria for industrial and commercial developments (Section 3.6.1.5) along with specific noise limits for externally mounted plant associated with industrial / commercial premises (Section 3.6.1.5.1).

The following paragraphs are reproduced from the December 2015 guidance document issued by Manchester City Council:

BS 4142 should be used to assess the likely impact of noise from industrial and commercial sources at noise sensitive premises.

Many of the noise complaints Environmental Health receive about noise from plant, equipment and machinery specifically concern the character of the noise emitted. Any noise assessment needs to consider not only the overall level of noise emitted but also its particular characteristics. The noise assessment should be based on BS 4142: 2014 and any application for fixed plant, equipment or machinery must demonstrate that:

‘Externally mounted ancillary plant, equipment and servicing shall be selected and / or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location’.

As a general comment Azymuth Acoustics UK would note that all of the Manchester City Council guidance quoted here appears to be aimed at commercial premises and the plant or equipment associated with the operation of commercial premises. This is quite different in nature to a heating system associated with a domestic property or individual heating systems for a group of domestic properties (as is the case here). Hence, whilst the Manchester City Council guidance is considered in this report it is not deemed wholly applicable to the current proposals.

3.6 Recommended Assessment Criteria

Based on the guidance reviewed above, Azymuth Acoustics UK would put forward the following noise limit criteria for day and night-time operating periods:

1. Microgeneration Certification Scheme plant noise limit of 42dB $L_{Aeq, 5 \text{ min}}$ externally at the nearest noise sensitive receptor (window to living or bedroom).
2. It is understood that Manchester City Council requires plant noise to be limited to 5dBA below the typical Background Sound Level (BSL, L_{A90}) at the nearest receptor. However, it would be asserted that this limit would only apply to noise from industrial / commercial sources.

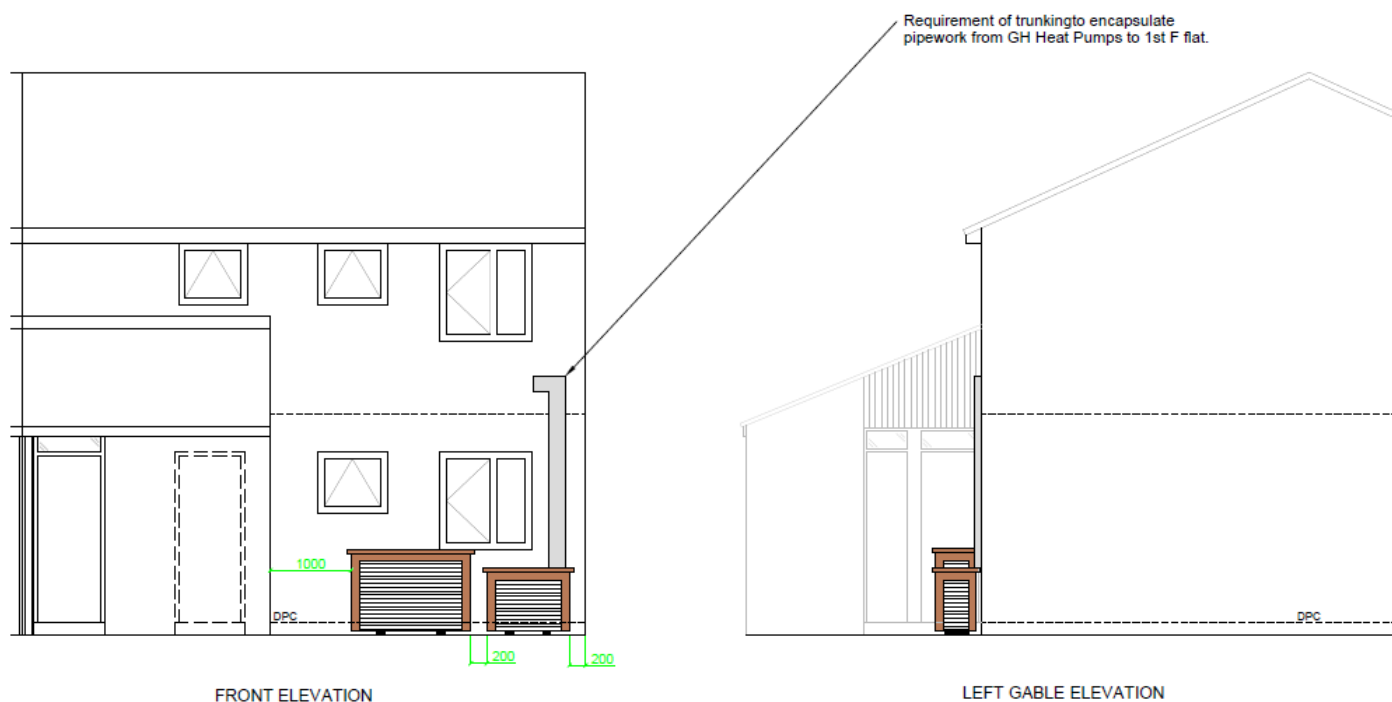
3. Based on the domestic nature of the proposal it would be recommended that worst case cumulative ASHP noise levels should not exceed the typical night-time background sound level at the nearest noise sensitive receptor.
4. An absolute cumulative receptor rating noise limit of 32dB would be recommended for the site (as suggested in BS 4142), which experiences unusually low background sound levels at night for an urban area. An absolute external receptor limit of 32dBA would equate to internal levels approx. 20dBA inside bedrooms i.e. comfortably compliant with the BS 8233 recommended noise limit of 30dBA in bedrooms at night.

Compliance with the night time noise limit criteria recommended above would result in automatic compliance for daytime periods where background sound levels are approx. 12 dBA higher. As such, the noise impact assessment below considers night time periods only.

4.0 Noise Assessment

4.1 Layout Strategy & Receptor Locations

Figure 2 below indicates the general proposed locations of outdoor units on rear façade of building (marked in brown). The flats are laid out with habitable rooms (bedrooms and living rooms) to the front elevation; ASHPs would be installed to rear façade only.



Option 1 (rev. A) - both units on GF with individual timber surrounds.

Figure 2: Elevation drawing showing general proposed ASHP locations to pairs of dwellings

The extent of the scheme is indicated in Figure 1 (boundary outlined in red); Some dwellings within the site boundary are understood not to be having ASHPs installed and as such may be considered noise sensitive receptors.

4.2 Proposed Air Source Heat Pump Assessment

The proposed outdoor units are understood to be as follows (worst case values):

Ground floor Panasonic WH-MD monoblock: Full load heating sound power level = 65dB L_{WA}
First floor Panasonic WC05 split system: Full load heating sound power level = 65dB L_{WA}

Based on Azymuth Acoustics UK's experience and measurement of this type of ASHP unit, the normal sound emissions could be characterised as broad band air movement over fan blades along with low level compressor noise, with no obvious narrow band tonality.

It is understood that no cooling provision would be included with ASHP units and that units would be fitted with a sound reduction kit (CZ-UG30) which reduces sound output by approx. 3dBA.

During night time periods the units would be managed to run in 'night mode' – noise data has been provided by Panasonic for night mode operation, as follows:

Frequency f [Hz]	L_w 1/3 octave [dB]	1/1 oct [dB]
100	47.6	
125	58.0	59.4
160	52.7	
200	55.2	
250	53.7	58.4
315	50.8	
400	45.9	
500	49.6	52.3
630	46.1	
800	48.2	
1000	53.0	54.8
1250	45.7	
1600	44.7	
2000	39.8	46.8
2500	39.3	
3150	35.3	
4000	35.9	40.2
5000	35.2	
6300	39.6	
8000	38.4	42.3
10000	29.2	

Night mode 3 – independent noise output test data

The Panasonic data shown here do not include for the proposed CZ-UG30 sound reduction kit.

Panasonic Technical has confirmed the 3dB reduction via the proposed Sound Reduction Kit should be applied to these levels i.e. 58dB less 3dB = 55dB L_{WA}

Table 3: Panasonic noise data for the proposed ASHPs running in night mode 3

4.2.1 Noise Assessment Using the MCS 020 Assessment Methodology

The following table provides a summary of noise impact based on MCS 020 assessment methodology. NB the MCS methodology uses the worst-case noise levels and does not include features such as Night Mode 3 which are included in section 4.2.2.

Parameter (MCS 020 Method)	Corrected Level (dBA)
Ground floor ASHP, receptor level @8 m (nearest) distance	26
First floor ASHP, receptor level @8 m distance	26
MCS assessment receptor noise limit	≤42
Assessment result	Each unit compliant re. permitted development

Table 4: MCS Noise assessment, proposed outdoor ASHP units

It can be seen that noise levels from each unit would be below 42dBA at the nearest noise sensitive receptor (approx. 8 m) and as such would be compliant with MCS recommended noise limits.

4.2.2 Noise Assessment (Night-time) Using Manchester City Council Criteria for Commercial Plant

Table 4 below details the predicted cumulative noise impact of the proposed air source heat pumps at the nearest off-site receptors during night time periods, in the context of BS 4142 assessment methodology.

Statistically analysed background sound levels in the area range between 35 - 37dB L_{A90} during the quietest night time periods. The logarithmic average of the calculated BSL at each measurement position i.e. 36 dB L_{A90} is used in calculations; notwithstanding adoption of absolute level limits, this BSL figure would be seen as reasonable.

The units are understood to have no intermittent characteristics (e.g. no significant fan start-up noise because the system is under inverter control rather than relay control). As such, an assessment of potential L_{Amax} noise impact would not be seen as necessary in this case.

Azymuth Acoustics UK has assessed the 1/3 octave band noise level data for the ASHP units using the method in Annex C of BS 4142 – objective method for assessing the audibility of tones in sound; no significant tonality is evident in the spectrum data.

Due to the broadband and likely non-intermittent nature of noise from the proposed unit it would not be seen as necessary to add a rating penalty to the source level as per the method for rating commercial sources described in BS 4142:2014 and the similar Manchester City Council criteria. As such, the rating level would be the same as the specific level.



Parameter (night time)	Octave Band Centre Frequency (Hz)						Total
	125	250	500	1k	2k	4k	
Calculated sound power @1m for single WH-UD05HE5 unit operating in Night Mode 3 plus CZ-UG30 Sound reduction kit (SRK) -3dB	56	55	49	52	44	37	55 dB L_{WA}
Specific receptor sound pressure level at worst-case receptor, 6-8 Merridge Walk (8 m from nearest source)	17	19	26	20	13	13	Rating level 29 dB
Background Sound Level (BSL)							36 dB L_{A90}
Difference: Rating / Background Sound Level							-7 dB

Table 5: Calculated cumulative night time noise impact, ground and first floor ASHP unit pairs

It can be seen that noise levels from each pair of units would not exceed the prevailing night time background sound level at 8 m (i.e. closest proposed source – receiver distance), when all units are in operation.

The rating level as per the BS 4142 assessment would suggest:

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.

4.2.3 Summary of Noise Impact Predictions

Table 3 below provides a schedule of addresses proposed for ASHP installation, along with information on distance and number of units affecting the nearest receptor as relates the source location.

Where the receptor is defined as a non-habitable room within site boundary, the next nearest receptor would be >30m and / or screened and angled sufficiently to be compliant with all criteria defined in Section 3.6.

The cumulative number of ASHPs affecting the nearest receiver at the source location has been defined between 1 – 3 pairs (ground and 1st floor).

ASHP noise source location address	Source - Receiver distance approx. (m)	Compliance Notes (re Section 3.6) RL = Rating Level GREEN shading = compliant
6 – 8 Merridge Walk	8	RL ≈ 29 dBA Compliant
14 – 16 Merridge Walk	8	RL ≈ 28 dBA Compliant
22 – 24 Merridge Walk	8	RL ≈ 26 dBA Compliant

Table 6: Schedule of dwellings under proposal for new ASHP units with notes on compliance

* One pair would be an installation with 2 no. units serving ground and 1st floor stacked dwellings

Figure 3 shows a grid noise map of the predicted worst-case levels from the ASHP units.



Figure 3: Grid Noise Map of Merridge Walk



5.0 Conclusions & Recommendations

Azymuth Acoustics UK has undertaken an assessment of noise from proposed outdoor air source heat pumps at various locations on and near Merridge Walk, Cheetham Hill.

Background sound levels on the site were measured to be 36dB L_{A90} during night-time periods covered by the survey.

Predicted noise levels at the nearest noise sensitive receptors would be up to 29 dB(A). This is 7 dB below the measured night-time background sound level during periods where all units are working under Night Mode 3 operation. However, it should be noted that background levels are very low as relates an urban area. BS 4142 would suggest this level would be below that where an adverse impact would be indicated.

A night-time absolute receptor rating level noise limit of 32dB $L_{Aeq, 5min}$ (ie 10dB below the MCS target level) would be recommended with the aim of compliance with all suggested assessment criteria in Section 3.6 above. As such, all installations in the proposed scheme would meet requirements assuming permanent adoption of 'night mode' operation and installation of sound reduction kits.

It can be seen that the proposed installation would comply with MCS 020 and WHO / BS 8233 night-time noise limit criteria assuming a habitable room receptor with window open. Compliance with MCS criteria would suggest that the units are eligible for installation under permitted development rights.

Recommendation

It would be recommended that all air source heat pumps installed at the site incorporate the CZ-UG30 noise reduction kit. In addition, it is recommended that the Night Mode 3 setting is applied on the set-back timer for the ASHP heating system as this provides a further noise reduction for night-time running. This would ensure that noise output would not exceed the recommended assessment criteria at any habitable room receptor on or off site.

In addition, WHO guidance daytime noise limits for outdoor amenity areas would be complied with i.e. cumulative noise from ASHPs would generally fall at or below 55dBA in neighbouring gardens.



Appendix A – Glossary of Terms

Decibel (dB)

this is the unit used to measure sound. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro Pascal to 100 Pascal).

dB (A)

This is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (i.e. A-weighting) to compensate for the sensitivity of the human ear to sound of different frequencies. The A-weighting curve is implemented in sound level meters using an electronic filter that approximately corresponds to the frequency response of the ear.

Octave Band Noise Level

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz. The ear is also generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum can be divided into frequency bands. The most commonly used frequency bands are octave bands, in which the mid-frequency of each band is twice that of the band below it.

L_{Aeq}

this is the equivalent steady sound level in dB (A) containing the same acoustic energy as the actual fluctuating sound level over a given time period.

Reverberation Time (RT or sometimes T_{30} or T_{60})

This is the time taken for the reverberant sound energy in an enclosure to decay one millionth of its equilibrium value, i.e. by 60 dB, after the source has been switched off, is known as the reverberation time. The reverberation time is frequency dependent and it is customary to measure its value in octave or one-third octave bands. Reverberation occurs when sound waves are repeatedly reflected from each surface of the room.

Sound Reduction Index (SRI)

Difference measured between the amount of energy flowing towards the wall in the source room and the total amount of energy flowing towards the wall in the source room and the total amount of energy entering the receiving room (usual range 100 - 3150 Hz for one third octave band values). The SRI varies with frequency and is measured in a laboratory in either octave or one-third octave bands.

$$SRI = L1 - L2 + 10 \log (S/A)$$

Where: L1 = Noise level in the source room

L2 = Noise levels in the receiving room

S = Surface area of test specimen

A = Equivalent acoustic absorption area in the receiving room

Weighted Sound Reduction Index (R_w)

this is a weighted single figure descriptor of the sound insulation performance of a partition measured under laboratory conditions. The procedure used to quantify the R_w is to compare the sound reduction index (SRI) in each of the one-third octave bands from 100Hz to 3150Hz against a set of standard reference curves. Appendix B – Graphical Results of Sound Insulation Tests

Appendix B – Full Tabulation of Noise Survey Results

Result Number	Date & time	LAeq	L10	L50	L90
1	03/08/2020 23:28	49.3	53.5	44.6	35.6
2	03/08/2020 23:33	50	54.4	45.7	38.2
3	03/08/2020 23:38	48.4	52.7	42	35.2
4	03/08/2020 23:43	49.4	53.4	42.9	36.5
5	03/08/2020 23:48	50.5	54.8	46.5	37
6	03/08/2020 23:53	48.4	53	39.8	34.8
7	03/08/2020 23:58	52.3	54.9	44.1	35.5

Appendix B1: Full results of night time noise survey, Merridge Walk, August 2020

Result Number	Date & time	LAeq	L10	L50	L90
1	03/08/2020 11:40	54.9	57.8	53	48.6
2	03/08/2020 11:45	53.3	56.5	51.4	47.7
3	03/08/2020 11:50	54.4	58.1	51.1	47.8

Appendix B2: Full results of daytime noise survey, Merridge Walk August 2020