



Project: J 02229
AC Noise Impact Assessment:
Tankerton Works, 12 Argyle Walk

Consultants: Sound Planning Ltd
48 Windermere Way
Farnham
Surrey
GU9 0DE

Client: JLR Star

Prepared by: D. M. Thomas

Signed:

A handwritten signature in blue ink, consisting of several overlapping loops and a long horizontal stroke extending to the right.

D. M. Thomas MSc M.I.O.A
Acoustic Consultant

Dated: Friday 3rd July, 2015



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1.0 BACKGROUND

1.1 Planning permission is sought for the installation of external AC units to the flat roof of Tankerton Works, 12 Argyle Walk, London WC1H 8HA.

See APPENDIX 2 – Site Location

1.2 The location falls under the jurisdiction of the London Borough of Camden; a noise impact assessment should be carried out in accordance with their Unitary Development Plan (UDP).

1.3 The proposed external AC units are Mitsubishi MXZ-2D53VA (7 number), located on the flat roof at 1st floor level and will operate between 08:00 – 18:00 hours (office hours).

See APPENDIX 3 - Site Plans

1.4 The external AC units' position will be 10 metres away from the nearest noise sensitive windows (residential).

1.5 Sound Planning has been retained to evaluate potential noise impact on the nearest noise sensitive receivers using appropriate methodologies and assessment criteria and design a suitable noise mitigation strategy

1.5.1 Participating Acoustic Consultant

Dan Thomas is a Member of the Institute of Acoustics (M.I.O.A) having attained appropriate qualifications in acoustics and experience within the workplace.

1.5.2 Qualifications

Dan has been working within the noise and vibration industry for ten years and has attained the following qualifications within the field of acoustics:

- Institute of Acoustics (IOA) Diploma
- Post Graduate Diploma in Applied Acoustics and Noise Control (University of Surrey)
- Masters Degree in Applied Acoustics and Noise Control (University of Surrey)



2.0 ASSESSMENT CRITERIA

2.1 Noise emissions from mechanical plant should be assessed in accordance with the requirements of the Local Planning Authority; and relevant national standards:

2.2 BS 4142: 1997^{1,2}

2.2.1 Noise from industrial sources radiated to residential areas is usually assessed against British Standard BS 4142: 1997, '*Method for rating industrial noise affecting mixed residential and industrial areas*'. This standard describes a method for assessing whether the 'specific noise' from an industrial source is likely to give rise to complaints from residents of the adjacent dwellings.

2.2.2 The 'specific noise' levels are determined outside dwellings. The specific noise level is determined for reference time periods of 1 hour for the *daytime* (07:00 to 23:00) and 5 minutes for the *night time* (23:00 to 07:00). Tonal or impulsive characteristics of a noise are likely to increase the scope for complaints and this taken into account by adding +5dB to the specific noise source level to obtain the 'Rating Level'. BS 4142: 1997 requires that the Rating Level of a noise is compared with the existing background noise: ($L_{A90, T}$).

2.2.3 Guidance given in the standard states that if the difference between the Rating Level and the background noise ($L_{A90, T}$) is +5dB, it would be considered as being of *marginal significance*. This is usually taken as being an acceptable situation, as it is a reasonable compromise between the requirements of commerce and the amenity of residents.

2.2.4 A difference of around +10dB or more indicates that *complaints are likely*. Most Local Authorities use a difference of +10dB as the point at which they will take action against the organisation producing the noise.

2.2.5 If the Rating Level is more than 10dB below the background noise this is a positive indication that *complaints are unlikely*.

¹ British Standard 4142: 1997 – *Method for rating industrial noise affecting mixed residential and industrial areas*. © BSI 1997. ISBN 0 580 28300 3.

² Superseded by BS 4142: 2014.



2.3 British Standard 4142: 2014.³

2.3.1 BS 4142: 2014 – Scope

This British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- a) sound from industrial and manufacturing processes;
- b) sound from fixed installations which comprise mechanical and electrical plant and equipment;
- c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

This standard is applicable to the determination of the following levels at outdoor locations:

- a) rating levels for sources of sound of an industrial and/or commercial nature and
- b) ambient, background and residual sound levels, for the purposes of:
 - investigating complaints;
 - assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and

³ British Standard 4142: 2014 – Methods for rating and assessing industrial and commercial sound.



- assessing sound at proposed new dwellings or premises used for residential purposes.

2.3.2 BS 4142: 2014 – Assessment of Impacts

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

Evaluation of Adverse Impact

- 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.
- 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.

Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

2.4 Noise Measurement Protocol - British Standard 7445-1: 2003⁴

2.4.1 The methods and procedures described in BS 7445 are intended to be applicable to sounds from all sources, individually and in combination, which contribute to the total noise at a site.

⁴ Description and measurement of environmental noise. Part 1 – Guide to quantities and procedures.



2.4.2 The aim of the BS 7445 series is to provide authorities with material for the description of noise in community environments. Based on the principles described in this standard, acceptable limits of noise can be specified and compliance with these limits can be controlled.

2.4.3 BS 7445 does not specify limits for environmental noise.

2.5 Camden Replacement Unitary Development Plan (UDP)

2.5.1 *The Council will only grant planning permission for plant or machinery, including ventilation or air handling equipment, if it can be operated without causing a loss to local amenity and does not exceed the thresholds set out in Appendix 1 - Noise and Vibration (Table E).*

2.5.2 Noise levels from plant and machinery at which planning permission will not be granted⁵.

Noise description and location of measurement	Period	Time (hours)	Noise Level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000 - 2400	5dB(A) < L _{A90}
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade	Day, evening and night	0000 - 2400	10dB(A) < L _{A90}
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade	Day, evening and night	0000 - 2400	10dB(A) < L _{A90}
Noise at 1 metre external to a sensitive façade where L _{A90} > 60dB	Day, evening and night	0000 - 2400	55dB L _{Aeq}

⁵ Camden Replacement Unitary Development Plan. Appendix 1 – Noise and Vibration Thresholds.



3.0 METHODOLOGY

3.1 Existing Noise Climate

Tankerton Works is situated in a mixed commercial and residential environment, with the existing noise climate dominated by low level road traffic noise.

See APPENDIX 2 – Site Location

3.2 Background Noise Assessment

3.2.1 An extended background noise assessment was conducted over the period: 13:45 hours, Monday 29th June – 14:15 hours, Tuesday 30th June, 2015.

3.2.3 The 24 hour measurement period includes the proposed operational hours for the external AC units 08:00 – 18:00 hours.

3.2.4 The microphone was located as close as possible to the nearest noise sensitive windows but not directly underneath trees.

See APPENDIX 4 – Site Photographs

3.2.5 Measurements were undertaken in accordance with BS 7445⁶ and BS 4142⁷.

3.2.6 The Sound Level Meter (SLM) used for the assessment is Class 1 with real time octave band measurement capability; and compliant to IEC 61672⁸.

3.2.6 The A-weighted L_{90} , L_{eq} and L_{max} descriptors were measured every 15 minutes using the Fast (F) setting, and logged periodically over the extended measurement period.

3.3 Noise levels at the nearest noise sensitive façade (windows) will be calculated using the manufacturers' sound pressure level (SPL) data corrected for distance, directivity and screening effects.

See CRITERIA ASSESSMENT section 5.0.

⁶ British Standard 7445-1: 2003 – *Description and measurement of environmental noise*. © BSI 1997. ISBN 0 580 19736 0.

⁷ British Standard 4142: 1997 – *Method for rating industrial noise affecting mixed residential and industrial areas*. © BSI 1997. ISBN 0 580 28300 3.

⁸ International Standard IEC 61672-1: 2002. *Electroacoustics – Sound level meters – Part 1: Specifications*.



3.4 Distance corrections will be applied in accordance with BS 7445 and BS 4142. The resultant sound pressure level (L_p) will be compared to the measured background noise level in accordance with the requirements of BS 4142.

3.5 Instrumentation/Equipment

3.5.1 Equipment

Equipment	Make	Model	Class	Serial Number	UKAS Calibration
SLM	Norsonic	Nor140	1	1405819	U15573 (25/2/14)
Field Calibrator	Casella	CEL 110/1	1	077948	U18561 (16/4/15)
Environmental Tripod					
Wind/Weather Shield					
Laser Measurer	Leica	Disto A5		1073750838	
Digital Camera	Samsung				

3.5.2 Field Calibration

A field calibration was conducted for the SLM microphone; no deviation was detected (1kHz).

3.5.3 UKAS Calibration

UKAS calibration certificates are available on request.

4.0 RESULTS

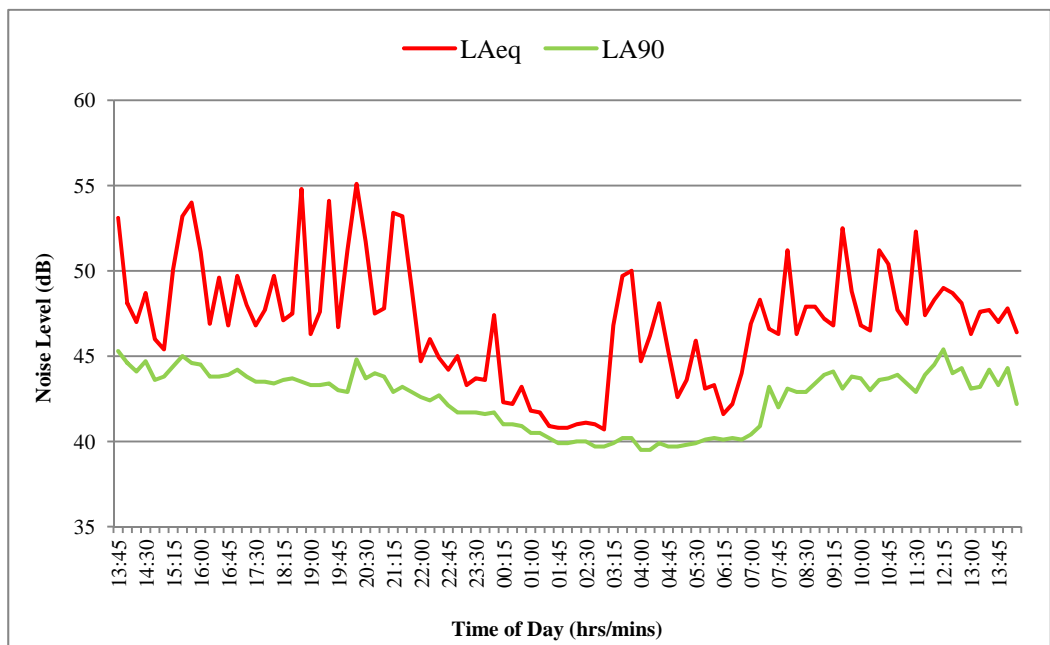
4.1 Background Noise Levels

4.1.1 Table – Lowest Background Noise Levels

Time Period (Hours)	Description	Lowest Background Noise Level dB L _{A90, 15mins}	Time Period Occurred
08:00 – 18:00	Office Hours	42.9	08:15 – 08:45
24 Hours	24 Hours	39.5	04:00 – 04:30

See APPENDIX 6 – Background Noise Levels for full results.

4.1.2 Graph – Background Noise Levels





4.2 External AC Equipment

Manufacturer	Model	Sound Pressure Level dB L _{PA} @1m		Number of Units
		Heating	Cooling	
Mitsubishi	MXZ-2D53VA	53	50	7

4.3 Meteorological Conditions

Wind Speed/Direction	Variable - 1-2m/s
Likelihood of Temperature Inversion⁹	No - Relatively short distances – Little effect
Precipitation	No
Fog	No
Wet Ground	No
Frozen Ground/Snow Coverage	No
Temperature	17 - 29°C
Cloud Cover	Clear

⁹ i.e. Calm night with little cloud cover.

4.4 Levels of Uncertainty

Category	Notes
Complexity of Sound Source	Supply Air (rear) Exhaust Air – Single Fan (front)
Complexity of Acoustic Environment (Residual)	Varying traffic flows (reverberant environment)
Level of Residual Sound (including Specific)	n/a
Measurement Locations	Representative of nearest noise sensitive receivers
Distance Between Sound Source & Measurement Position	n/a
Number of Measurements Taken	24 hours (15 min periods)
Measurement Time Intervals	Continuous
Range of Times	Representative of quietest likely times of proposed operation
Range of Suitable Weather Conditions	1 measurement period – Suitable weather conditions
Measurement Method/Practitioners	1 measurement period (Dan Thomas)
Level of Rounding	Rounded to nearest DP; 0.5 rounded up
Instrumentation	Type 1 SLM (suitable)



5.0 CRITERIA ASSESSMENT

5.1 Noise Sensitive Receiver (Residential Windows) – See APPENDIX 2 – Site Location

Mitsubishi MXZ-2D53VA	53 dB(A) @ 1m [heating mode]
Number of units	7 Units
Sound Pressure Level Correction	53 + 10 log(7) = 61 dB(A) @ 1m
Directivity Index	+ 3 dB ¹⁰ = 64 dB(A) @ 1m
Distance to NSR (10m)	64 – 20 log (10/1)
Level at NSR Window	44 dB(A)
Acoustic Feature	YES
Lowest Background Noise Level	43 dB L _{A90}
Target Level (Camden)	43 – 10 = 33 dB(A)
Excess over Target Level	+11 dB (44 - 33)
Noise Mitigation Required	11 dB

¹⁰ AC units located over hard reflective surface (hemi-spherical).



6.0 NOISE MITIGATION STRATEGY

6.1 Noise Control Requirements

- 6.1.1 The predicted noise level for 7 number Mitsubishi MXZ-2D53VA units is 44 dB L_{Aeq} at the nearest (and most noise sensitive) noise sensitive window.
- 6.1.2 The target noise level is 10 dB below the reference background level of 43 dB L_{A90} ; therefore a minimum 11 dB noise reduction is required.
- 6.1.3 In order to achieve an 11 dB noise reduction the external AC units should be fully enclosed within acoustic enclosures.
- 6.1.4 The enclosure should facilitate required air flow as well as achieve the requisite noise reduction (insertion loss).

6.2 Acoustic Enclosure 1 (4 Units)

6.2.1 Enclosure Description

The enclosure should be constructed from acoustic louvres to all 4 sides with and acoustic panel roof; the internal supply and exhaust air ways should be separated by internal septum panels to negate supply/exhaust air recirculation within the enclosure.

6.2.2 Enclosure Dimensions

Width	2300mm
Height	700mm
Depth	2300mm

6.2.3 Components

- Acoustic Louvres 300mm (D) [See APPENDIX 7]
- Acoustic Panel Roof (100mm thick Rockwool 45kg/m³)
- 50mm Acoustic Panel Septums [See APPENDIX 7]



6.3 Acoustic Enclosure 2 (3 Units)

6.3.1 Enclosure Description

The enclosure should be constructed from acoustic louvres front and back with acoustic panel sides & roof; the internal supply and exhaust air ways should be separated by internal septum panels to negate supply/exhaust air recirculation within the enclosure.

6.3.2 Enclosure Dimensions

Width	2700mm
Height	700mm
Depth	1400mm

6.3.3 Components

- Acoustic Louvres 300mm (D) [See APPENDIX 7]
- Acoustic Panels (100mm thick Rockwool 45kg/m³)
- 50mm Acoustic Panel Septums [See APPENDIX 7]

6.4 Noise Reduction

6.4.1 The Acoustic Enclosures have been designed to meet the target level of 10 dB below background at the nearest noise sensitive windows.

6.4.2 See APPENDIX 7 for individual component specification.

7.0 CONCLUSIONS

7.1 Sound Planning has carried out an environmental noise assessment in accordance with BS 7445: 2003 and BS 4142: 2014.

7.2 A 24 hour background noise assessment provided a reference background noise level of 43 dB L_{A90, 15mins} (to 1DP) during the proposed operational hours (08:00 – 18:00 hours).



- 7.3 The introduction of a 7 number Mitsubishi MXZ-2D53VA external AC units in the proposed location would result in a noise level of 44 dB(A) at the nearest sensitive receiver (window).
- 7.4 The target noise level is 10 dB below the reference background level of 43 dB L_{A90} ; therefore a minimum 11 dB noise reduction is required.
- 7.5 In order to achieve an 11 dB noise reduction the external AC units should be fully enclosed within acoustic enclosures.
- 7.6 Noise Mitigation Measures
 - 7.6.1 In order to meet the target noise criteria at the nearest noise sensitive window the external AC units should be fully enclosed within an acoustic enclosure.
 - 7.6.2 Section 7.0 – NOISE MITIGATION STRATEGY for enclosure specification details.



APPENDIX 1

Glossary of Acoustic Terms

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2×10^{-5} pascals) and the threshold of pain is around 120 dB. The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

Noise Rating

The Noise Rating (NR) system is a set of octave band sound pressure level curves used for specifying limiting values for building services noise. The Noise Criteria (NC) and Preferred Noise Criteria (PNC) systems are similar.

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).



Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

- $L_{Aeq, T}$ *The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq, T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.*
- L_{AE} *Where the overall noise level over a given period is made up of individual noise events, the $L_{Aeq, T}$ can be predicted by measuring the noise of the individual noise events using the sound exposure level, L_{AE} (or SEL or L_{AX}). It is defined as the level that, if maintained constant for a period of one second, would deliver the same A-weighted sound energy as the actual noise event.*
- L_{A1} *The level exceeded for 1% of the time is sometimes used to represent typical noise maxima.*
- L_{A10} *The level exceeded for 10% of the time is often used to describe road traffic noise.*
- L_{A90} *The level exceeded for 90% of the time is normally used to describe background noise.*

Sound Transmission Descriptors

- D_{nT} Standardised level difference
- $D_{nT, w}$ Weighted standardised level difference
- L_1 The average sound pressure level in the source room
- L_2 The average sound pressure level in the receiving room
- T Reverberation time (receiving room)
- T_0 Reference reverberation time = 0.5s
- C_{tr} Adaption spectrum which takes account for low to medium speed road/rail/air traffic; disco music; and factory noise (medium to low frequency noise).
- C Adaptation spectrum which takes account of domestic activities including speech, music, radio and television.



Frequency Analysis

Octave Band	<i>A band of frequencies the upper limit of which is twice the lower limit. They are known by their centre frequency, e.g., 63, 125, 250, 500, 1000, 2000 Hz...</i>
One Third Octave	<i>The logarithmic frequency interval between a lower frequency f_2, when f_2/f_1 equals $2^{1/3}$ apart. Frequencies include: 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000Hz.</i>

Sound Transmission in the Open Air

Most sources of sound can be characterised as a single point in space. The sound energy radiated is proportional to the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law.

In decibel terms, every time the distance from a point source is doubled, the sound pressure level is reduced by 6 dB. Road traffic noise is a notable exception to this rule, as it approximates to a line source, which is represented by the line of the road. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

Factors Affecting Sound Transmission in the Open Air

Reflection

When sound waves encounter a hard surface, such as concrete, brickwork, glass, timber or plasterboard, it is reflected from it. As a result, the sound pressure level measured immediately in front of a building façade is approximately 3 dB higher than it would be in the absence of the façade.

Screening and Diffraction

If a solid screen is introduced between a source and receiver, interrupting the sound path, a reduction in sound level is experienced. This reduction is limited, however, by diffraction of the sound energy at the edges of the screen. Screens can provide valuable noise attenuation however. For example, a timber boarded fence built next to a motorway can reduce noise levels on the land beyond, typically by around 10 dB(A). The best results are obtained when a screen is situated close to the source or close to the receiver.



Meteorological Effects

Temperature and wind gradients affect noise transmission, especially over large distances. The wind effects range from increasing the level by typically 2 dB downwind, to reducing it by typically 10 dB upwind – or even more in extreme conditions. Temperature and wind gradient are variable and difficult to predict.

APPENDIX 2

Site Location

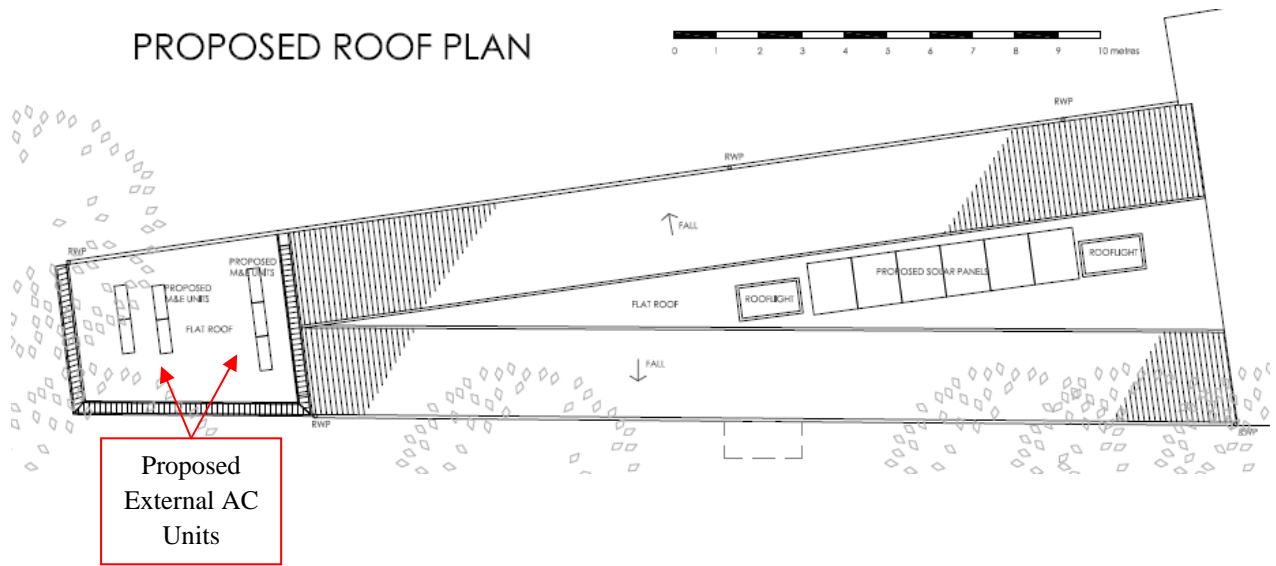
Tankerton Works



APPENDIX 3

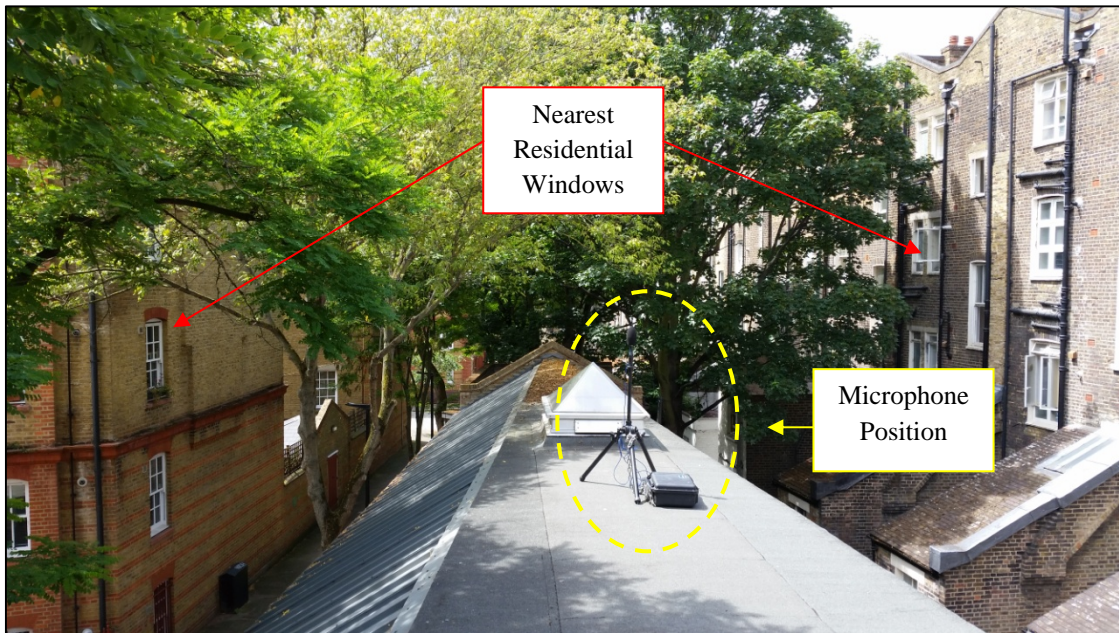
Site Plans

Roof Plan



APPENDIX 4

Site Photographs



Site Location



soundplanning

APPENDIX 5

AC Equipment

External AC Units

1.4.4 Air Conditioning

Multi-Splits

MXZ-D/C Inverter Heat Pump (5.3-12.2kW)
Multi-Split Units

MULTI SPLIT - INDOOR UNITS	WALL MOUNTED	FLOOR MOUNTED	DUCTED	CEILING CASSETTE	Ceilings ducted
MXZ-2000VA	MSZ-FP2005/05VE / MSZ-FP2005/05VE MSZ-FP2005/05VE/2S/5W	MFZ-KA2005/05VE	SEZ-HD2005/05AQ* FEAD-FP2005/05AQ*	SLZ-KA2005/05AQ	-
MXZ-3000VA2	MSZ-FP3005/05NVE / MSZ-FP3005/05NVE MSZ-FP3005/05NVE/2S/5W	MFZ-KA3005/05VE	SEZ-HD3005/05AQ* FEAD-FP3005/05AQ*	SLZ-KA3005/05AQ FLA-RP3005A	PCA-RP3005AQ
MXZ-4000VA	MSZ-FP4005/05NVE / MSZ-FP4005/05NVE MSZ-FP4005/05NVE/2S/5W	MFZ-KA4005/05VE	SEZ-HD4005/05AQ* FEAD-FP4005/05AQ*	SLZ-KA4005/05AQ FLA-RP4005A	PCA-RP4005AQ
MXZ-4000VA	MSZ-FP2005/05NVE / MSZ-FP2005/05NVE/2S/5W MSZ-FP2005/05NVE / MSZ-FP2005/05NVE/2S/5W	MFZ-KA2005/05VE	SEZ-HD2005/05AQ* FEAD-FP2005/05AQ*	SLZ-KA2005/05AQ FLA-RP2005A	PCA-RP2005AQ
MXZ-6000VA	MSZ-FP6005/05NVE / MSZ-FP6005/05NVE MSZ-FP6005/05NVE/2S/5W	MFZ-KA6005/05VE	SEZ-HD6005/05AQ* FEAD-FP6005/05AQ*	SLZ-KA6005/05AQ FLA-RP6005A	PCA-RP6005AQ
MXZ-8000VA	MSZ-FP8005/05NVE / MSZ-FP8005/05NVE MSZ-FP8005/05NVE/2S/5W	MFZ-KA8005/05VE	SEZ-HD8005/05AQ* FEAD-FP8005/05AQ*	SLZ-KA8005/05AQ FLA-RP8005A	PCA-RP8005AQ
MXZ-12000VA	MSZ-FP1205/05NVE / MSZ-FP1205/05NVE MSZ-FP1205/05NVE/2S/5W	MFZ-KA1205/05VE	SEZ-HD1205/05AQ* FEAD-FP1205/05AQ*	SLZ-KA1205/05AQ FLA-RP1205A	PCA-RP1205AQ

MXZ-D/C - OUTDOOR UNITS	MXZ-2000VA	MXZ-3000VA2	MXZ-4000VA	MXZ-4000VA	MXZ-6000VA	MXZ-8000VA	MXZ-12000VA
NUMBER OF CONNECTABLE INDOOR UNITS	2	2-3	2-4	2-4	2-4	2-5	2-5
CAPACITY (kW)							
Heating (nominal)	5.4 (3.0-7.0)	7.0 (3.8-9.0)	9.0 (5.4-10.7)	9.4 (5.4-11.6)	10.3 (6.1-14.0)	14.0 (8.5-16.0)	18.0 (11.0-21.0)
Cooling (nominal)	5.3 (3.1-6.6)	6.4 (3.9-8.8)	7.1 (3.7-8.8)	8.3 (3.7-9.5)	10.3 (6.0-11.6)	12.2 (8.5-13.8)	16.0 (10.0-18.7)
Heating (J/E)	3.2 (2.03-5.81)	3.8 (2.19-7.47)	7.1 (2.82-8.00)	7.8 (3.00-8.65)	8.7 (3.40-11.63)	11.1 (6.90-13.71)	12.1 (6.47-15.39)
Cooling (J/E)	3.2 (1.00-5.59)	5.3 (3.87-8.74)	7.6 (3.67-8.72)	8.2 (3.67-9.12)	10.1 (3.88-10.99)	12.1 (8.47-13.39)	16.0 (10.0-18.71)
ODP / SEER (nominal)*	3.16 / 3.44	4.40 / 4.86	3.77 / 3.20	3.72 / 3.50	3.62 / 3.61	3.67 / 3.01	- / -
SEER / SEER (SEER1482)	4.2 / 7.1	4.8 / 6.4	3.8 / 3.7	3.9 / 3.2	3.8 / 3.3	- / -	- / -
ENERGY EFFICIENCY CLASS	A+ / A++	A+ / A++	A- / A+	A-	A / A	A / A	N/A
MAX. REFR. CHG. (kg/Year)	33.2 / 32.8	40.8 / 42.1	41.0 / 40.1	43.0 / 42.1	59.3 / 56.8	69.8 / 58.5	69.8 / 58.5
NOISE PRESSURE LEVEL (dB)	53 / 53	53 / 50	53 / 50	50 / 49	51 / 53	57 / 55	57 / 55
SCAM POWER LEVEL (dB)	64	64	64	64	66	66	66
DIMENSIONS (mm)	Width x Depth x Height	800 x 300 x 700	840 x 300 x 700	840 x 300 x 700	900 x 300 x 815	1000 x 300 x 815	1000 x 320 x 1070
WEIGHT (kg)		57	58	58	69	79	87
ELECTRICAL SUPPLY	230-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz
PHASE	Single	Single	Single	Single	Single	Single	Single
POWER INPUT (kW)	Heating/Cooling (nominal)	1.59 / 1.20	1.99 / 1.20	2.29 / 2.25	2.42 / 2.83	2.90 / 3.91	3.61 / 4.05
STARTING CURRENT (A)	Heating/Cooling (J/E)	1.54 / 1.23	1.84 / 1.03	2.07 / 1.80	2.26 / 2.26	2.83 / 3.12	3.46 / 3.21
RUNNING CURRENT (A)		7.8	7.0	10.3	12.4	17.2	18.0
INTERCONNECTING CABLE No. CORES		4 Cores	4 Cores	4 Cores	4 Cores	4 Cores	4 Cores
TOTAL PIPE LENGTH (m)		30	30	30	30	30	30
MAX PIPE LENGTH PER INDOOR UNIT (m)		25	25	25	25	25	25
MAX HEIGHT DIFFERENCE (m)		15 (10 if O.U. higher than I.U.)	15 (10 if O.U. higher than I.U.)	15 (10 if O.U. higher than I.U.)	15 (10 if O.U. higher than I.U.)	15 (10 if O.U. higher than I.U.)	15 (10 if O.U. higher than I.U.)
CHARGE RATIO (kg) - Precharged Length		1.30 (30m)	2.70 (40m)	2.70 (40m)	3.50 (50m)	4.8 (60m)	4.8 (60m)
FUSE RATING (A) - IEC (A)		15	25	25	25	25	25
OUTDOOR PRICE		£823	£991	£1,468	£1,704	£1,990	£2,601



Notes:
 1) Certified max running current of all indoor units on system is all not exceed 35 FPNOC (A) to avoid
 2) System COP / EER when not used by MXZ-D/C indoor and connections
 3) The SEER/EER/COP values are for use when the total indoor capacity is equal to the outdoor capacity i.e. when the capacity ratio is 1.

MXZ-D/C models with light pipes 11 and 15 (15kW) are not to be used in 100% (100%) Dry (Dry) climates.



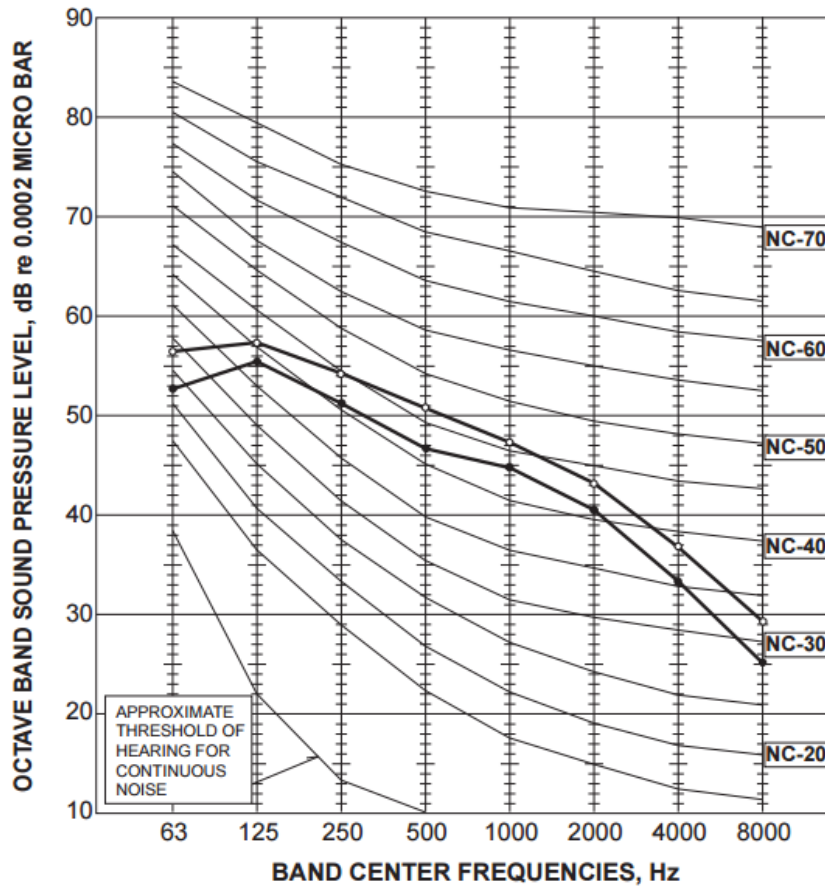
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AC Equipment

Noise Spectrum

MXZ-2D53VA
MXZ-2D53VAH

FAN SPEED	FUNCTION	SPL(dB(A))	LINE
High	Cooling	50	●—●
High	Heating	53	○—○





APPENDIX 6

Background Noise Measurements

Table

Date	Time	Duration	L _{Aeq}	L _{AFmax}	L _{AFmin}	L _{AF50}	L _{AF90}	Notes
29/06/2015	13:45	15:00	53.1	82.3	43.1	47.4	45.3	Office Hours
29/06/2015	14:00	15:00	48.1	65.2	42.8	46.6	44.6	Office Hours
29/06/2015	14:15	15:00	47	65.2	42.4	45.8	44.1	Office Hours
29/06/2015	14:30	15:00	48.7	72.3	42.9	46.6	44.7	Office Hours
29/06/2015	14:45	15:00	46	65	42	44.7	43.6	Office Hours
29/06/2015	15:00	15:00	45.4	59.1	42.4	44.8	43.8	Office Hours
29/06/2015	15:15	15:00	50.1	67.7	42.7	46.2	44.4	Office Hours
29/06/2015	15:30	15:00	53.2	74.5	43	47.6	45	Office Hours
29/06/2015	15:45	15:00	54	75.5	42.1	46.7	44.6	Office Hours
29/06/2015	16:00	15:00	51.1	69.4	42.7	46.3	44.5	Office Hours
29/06/2015	16:15	15:00	46.9	62.9	42.3	45.4	43.8	Office Hours
29/06/2015	16:30	15:00	49.6	69.4	42.2	45.3	43.8	Office Hours
29/06/2015	16:45	15:00	46.8	64.5	42	45.3	43.9	Office Hours
29/06/2015	17:00	15:00	49.7	74.5	42.4	46	44.2	Office Hours
29/06/2015	17:15	15:00	48	66.6	42.4	45.3	43.8	Office Hours
29/06/2015	17:30	15:00	46.8	63.2	41.9	45.3	43.5	Office Hours
29/06/2015	17:45	15:00	47.7	62	42.1	45.2	43.5	Office Hours
29/06/2015	18:00	15:00	49.7	74.5	41.9	45.2	43.4	
29/06/2015	18:15	15:00	47.1	63.7	42.2	45.3	43.6	
29/06/2015	18:30	15:00	47.5	64.7	41.8	45.6	43.7	
29/06/2015	18:45	15:00	54.8	76.1	41.9	46	43.5	
29/06/2015	19:00	15:00	46.3	68.6	41.6	44.9	43.3	
29/06/2015	19:15	15:00	47.6	66.4	41.7	45.2	43.3	
29/06/2015	19:30	15:00	54.1	74.4	41.6	45.6	43.4	
29/06/2015	19:45	15:00	46.7	67.4	41.6	44.5	43	
29/06/2015	20:00	15:00	51.2	71.3	41.6	44.4	42.9	
29/06/2015	20:15	15:00	55.1	81	42.2	48.8	44.8	
29/06/2015	20:30	15:00	51.7	70.9	42.3	45.8	43.7	
29/06/2015	20:45	15:00	47.5	60.4	42.3	45.9	44	
29/06/2015	21:00	15:00	47.8	64.5	42.1	45.5	43.8	
29/06/2015	21:15	15:00	53.4	71.8	41.1	44.6	42.9	
29/06/2015	21:30	15:00	53.2	69.3	41.5	45.9	43.2	
29/06/2015	21:45	15:00	49	70.4	41.7	44.1	42.9	



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29/06/2015	22:00	15:00	44.7	63	41.4	43.7	42.6	
29/06/2015	22:15	15:00	46	59.5	41.2	43.6	42.4	
29/06/2015	22:30	15:00	44.9	59.3	41.2	43.9	42.7	
29/06/2015	22:45	15:00	44.2	68.3	40.8	43.1	42.1	
29/06/2015	23:00	15:00	45	66	40.8	42.7	41.7	
29/06/2015	23:15	15:00	43.3	57.2	40.7	42.5	41.7	
29/06/2015	23:30	15:00	43.7	69.3	40.8	42.5	41.7	
29/06/2015	23:45	15:00	43.6	62.8	40.5	42.6	41.6	
30/06/2015	00:00	15:00	47.4	68.9	40.3	43.5	41.7	
30/06/2015	00:15	15:00	42.3	54	39.7	41.8	41	
30/06/2015	00:30	15:00	42.2	53.7	40.3	41.6	41	
30/06/2015	00:45	15:00	43.2	62.6	39.6	42.3	40.9	
30/06/2015	01:00	15:00	41.8	58.6	39.6	41.1	40.5	
30/06/2015	01:15	15:00	41.7	52.5	39.6	41.2	40.5	
30/06/2015	01:30	15:00	40.9	51.1	39.4	40.8	40.2	
30/06/2015	01:45	15:00	40.8	56.7	39.1	40.4	39.9	
30/06/2015	02:00	15:00	40.8	55.1	39.1	40.4	39.9	
30/06/2015	02:15	15:00	41	54.6	39.3	40.6	40	
30/06/2015	02:30	15:00	41.1	53.8	39.1	40.6	40	
30/06/2015	02:45	15:00	41	57.2	38.6	40.3	39.7	
30/06/2015	03:00	15:00	40.7	53.6	38.9	40.2	39.7	
30/06/2015	03:15	15:00	46.8	60.8	38.7	41.9	39.9	
30/06/2015	03:30	15:00	49.7	61.1	39	44.4	40.2	
30/06/2015	03:45	15:00	50	63.6	38.6	44.6	40.2	
30/06/2015	04:00	15:00	44.7	62.3	38.4	40.4	39.5	
30/06/2015	04:15	15:00	46.2	65.3	38.5	40.5	39.5	
30/06/2015	04:30	15:00	48.1	72.2	38.9	41.3	39.9	
30/06/2015	04:45	15:00	45.3	59	38.7	40.6	39.7	
30/06/2015	05:00	15:00	42.6	61	38.6	40.7	39.7	
30/06/2015	05:15	15:00	43.6	64.4	38.9	40.7	39.8	
30/06/2015	05:30	15:00	45.9	71.4	38.9	40.8	39.9	
30/06/2015	05:45	15:00	43.1	56	38.9	41.4	40.1	
30/06/2015	06:00	15:00	43.3	55.5	39.1	41.1	40.2	
30/06/2015	06:15	15:00	41.6	54.6	39.2	40.7	40.1	
30/06/2015	06:30	15:00	42.2	64.4	39.4	41.2	40.2	
30/06/2015	06:45	15:00	44	72.3	39	41	40.1	
30/06/2015	07:00	15:00	46.9	60.7	39.2	41.8	40.4	
30/06/2015	07:15	15:00	48.3	61.2	39.5	43.6	40.9	
30/06/2015	07:30	15:00	46.6	58	40.8	45.3	43.2	
30/06/2015	07:45	15:00	46.3	64.8	40.3	43.5	42	
30/06/2015	08:00	15:00	51.2	70.5	41.2	45.9	43.1	Office Hours
30/06/2015	08:15	15:00	46.3	61.2	41.6	44.5	42.9	Office Hours



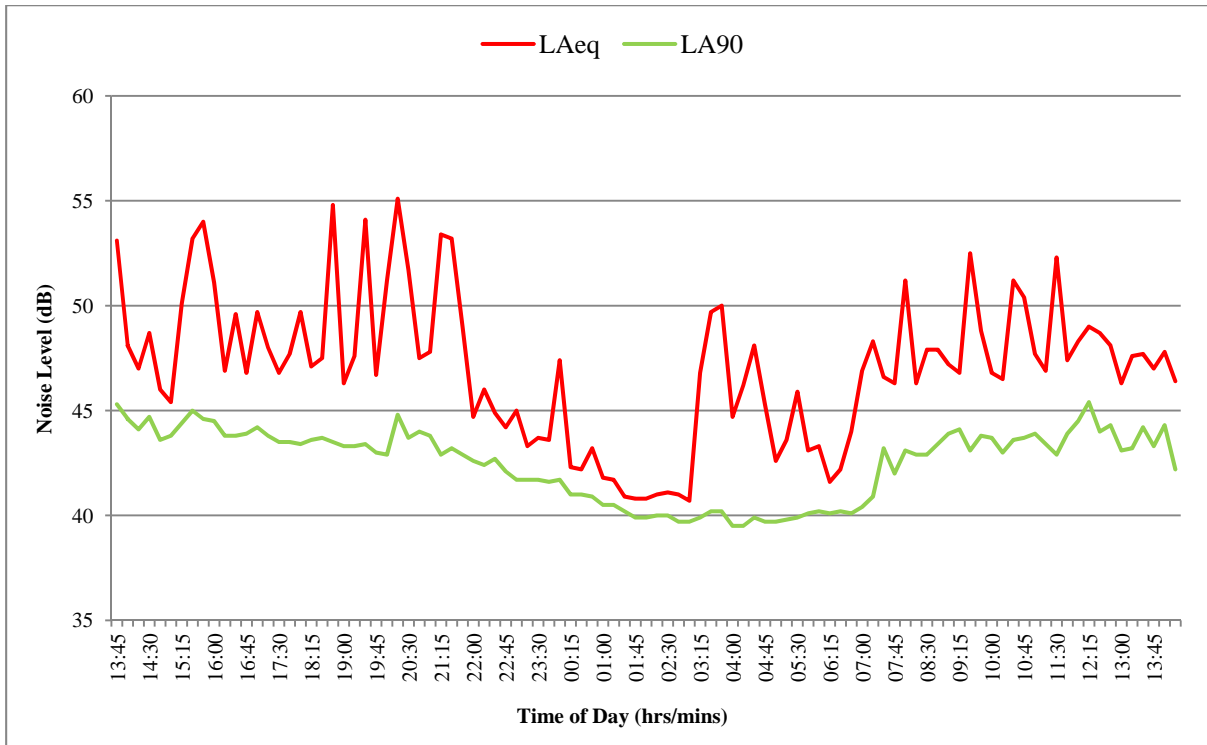
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30/06/2015	08:30	15:00	47.9	66.1	41.1	44.7	42.9	Office Hours
30/06/2015	08:45	15:00	47.9	66.8	41.3	45.9	43.4	Office Hours
30/06/2015	09:00	15:00	47.2	63.8	41.3	46.1	43.9	Office Hours
30/06/2015	09:15	15:00	46.8	64.9	41.8	45.6	44.1	Office Hours
30/06/2015	09:30	15:00	52.5	75.7	41.5	44.9	43.1	Office Hours
30/06/2015	09:45	15:00	48.8	69	41.3	45.9	43.8	Office Hours
30/06/2015	10:00	15:00	46.8	63.4	41.9	45.8	43.7	Office Hours
30/06/2015	10:15	15:00	46.5	60.1	41.1	44.9	43	Office Hours
30/06/2015	10:30	15:00	51.2	72.5	42.4	46.3	43.6	Office Hours
30/06/2015	10:45	15:00	50.4	71.9	42.1	45.3	43.7	Office Hours
30/06/2015	11:00	15:00	47.7	57.4	42.1	46.4	43.9	Office Hours
30/06/2015	11:15	15:00	46.9	59.8	41.7	45.7	43.4	Office Hours
30/06/2015	11:30	15:00	52.3	72.9	40.9	44.8	42.9	Office Hours
30/06/2015	11:45	15:00	47.4	69.3	41.8	46.3	43.9	Office Hours
30/06/2015	12:00	15:00	48.3	61.3	42.1	47.6	44.5	Office Hours
30/06/2015	12:15	15:00	49	62.2	42.3	48.3	45.4	Office Hours
30/06/2015	12:30	15:00	48.7	65.3	42.1	46.5	44	Office Hours
30/06/2015	12:45	15:00	48.1	62.5	42.2	46.5	44.3	Office Hours
30/06/2015	13:00	15:00	46.3	58.9	41.4	45.1	43.1	Office Hours
30/06/2015	13:15	15:00	47.6	67.3	41.4	45.6	43.2	Office Hours
30/06/2015	13:30	15:00	47.7	63.9	41.7	47.1	44.2	Office Hours
30/06/2015	13:45	15:00	47	68.8	41.5	45.6	43.3	Office Hours
30/06/2015	14:00	15:00	47.8	65.8	41.5	46.6	44.3	Office Hours



Background Noise Measurements

Graph

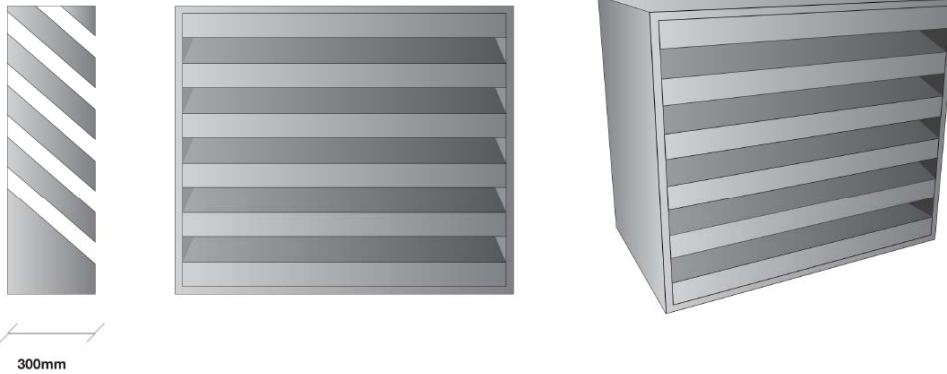


APPENDIX 7

Enclosure Components

Acoustic Louvres

Acoustic Louvre
Single Blade
300mm deep



CONSTRUCTION DETAIL:

- 1.2mm folded galvanised sheet steel frame
- 0.9mm folded galvanised sheet steel blade section
- Birdmesh/insect mesh guard where required
- 0.9mm blanking to rear of dummy bottom blade
- Material Options: Stainless Steel 316 & 304 Grade, and Aluminium

- 0.9mm galvanised perforated sheet retaining controlled density mineral wool infill
- Modules to be bolt fixed together on site by others
- Suitable, non-hardening sealant by others around the perimeter on louvre

CONTACT:

Sound Planning Ltd
Farnham
Surrey
Tel: 01252 711972
E: enquiries@soundplanning.co.uk

Enclosure Components

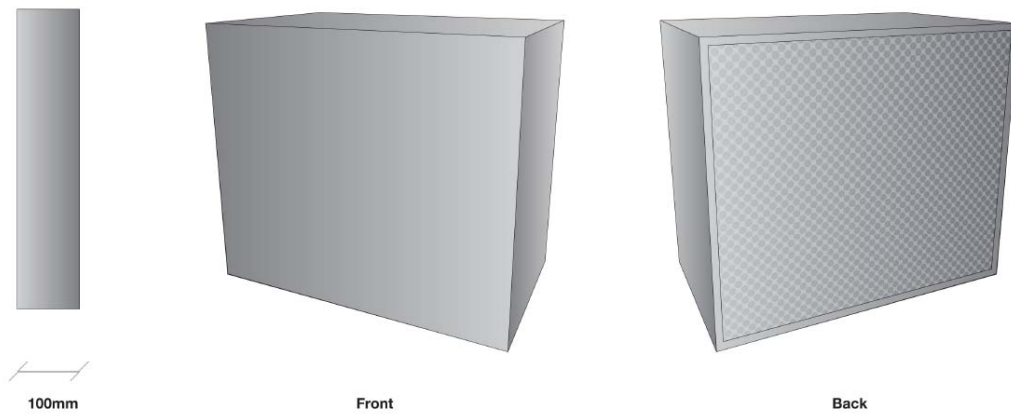
Acoustic Louvres



Enclosure Components

Acoustic Panels

Panel
100mm deep



CONSTRUCTION DETAIL:

- 1.2mm folded galvanised sheet steel frame
- 0.9mm galvanised steel perforated sheet retaining controlled density mineral wool infill

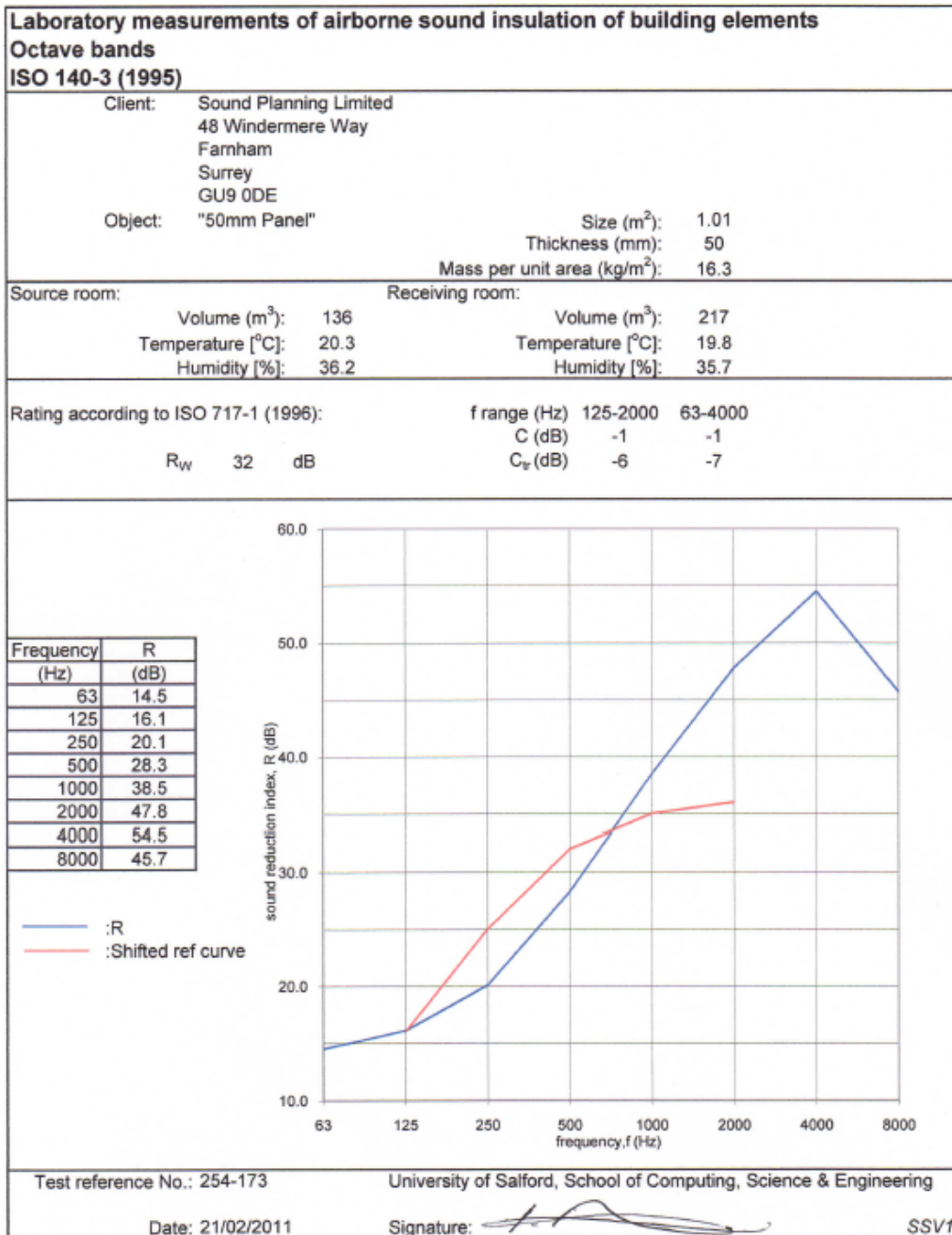
- Stainless Steel (grade 316 & 304) and Aluminium options
- Suitable, non-hardening sealant around the perimeter, by others

CONTACT:

Sound Planning Ltd
Farnham
Surrey
Tel: 01252 711972
E: enquiries@soundplanning.com

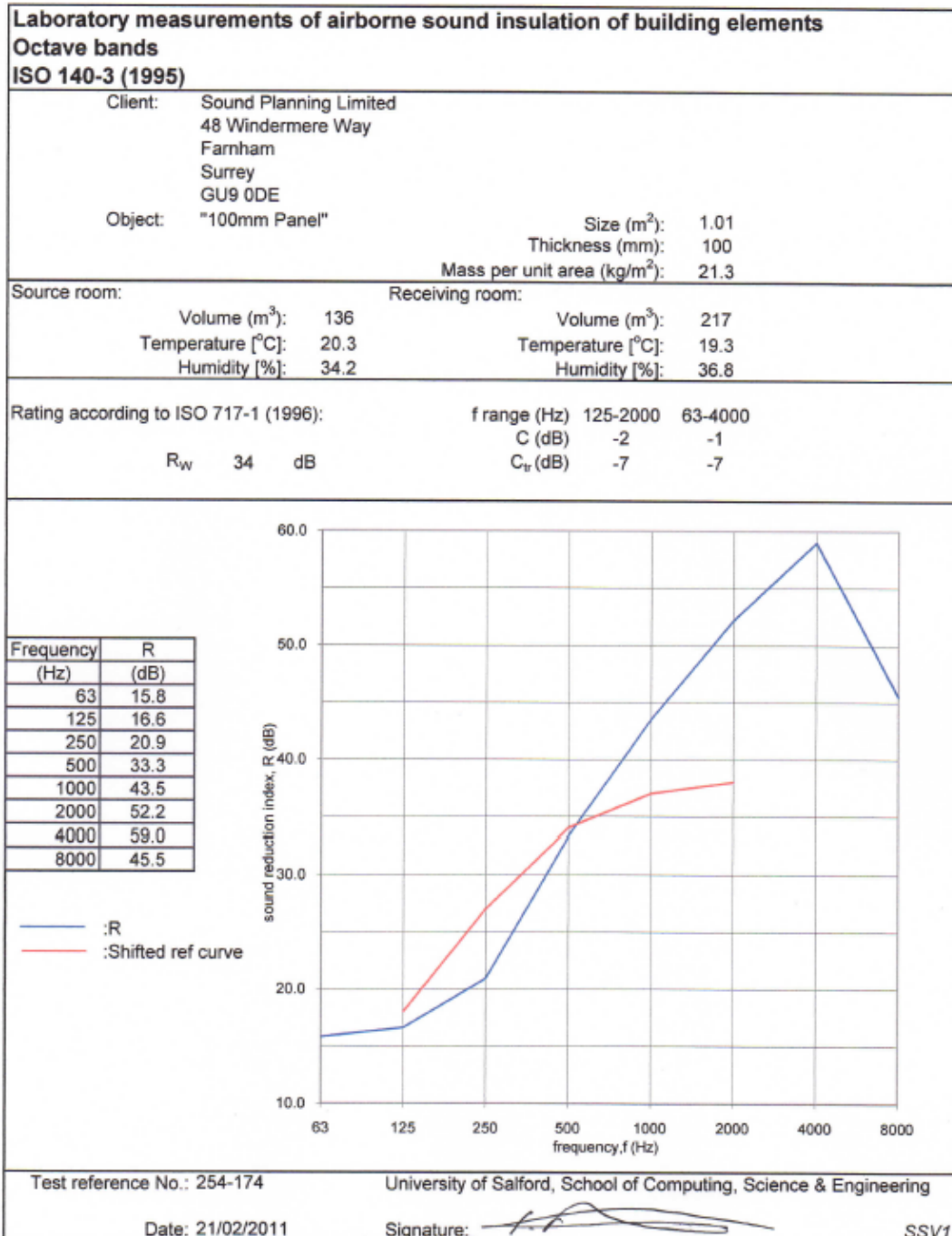
Enclosure Components

Acoustic Panels



Enclosure Components

Acoustic Panels



Test reference No.: 254-174

University of Salford, School of Computing, Science & Engineering

Date: 21/02/2011

Signature: 

SSV1



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Enclosure Components

Acoustic Enclosure

