



Project: J 03041
Environmental Noise Impact Assessment:
465 Oxford Road, Reading

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Client: Mehar Group

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Signed:

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Dated: Monday 24th July, 2017



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1.0 BACKGROUND

1.1 The application concerns the installation of a kitchen ventilation, commercial refrigeration and air conditioning systems at 465 Oxford Road, Reading.

1.2 The application site address falls under the jurisdiction of Reading Borough Council who have requested a noise impact assessment.

1.3 Reading Borough Council - Standard Noise Conditions

No mechanical plant shall be installed until a noise assessment of the proposed mechanical plant has been submitted and approved by this Council. The assessment shall be carried out for in accordance with BS4141: 2014 methodology. The predicted rating level, $L_{Ar,Tr}$ (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre external to sensitive facades shall be at least 10dB below the existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation. The plant shall thereafter only be installed in accordance with the assessment.

Reason: To safeguard the amenities of the adjoining premises and the area generally, in accordance with Policy CS34 of the Reading Borough LDF Core Strategy 2008 (Altered 2015) and Policy DM4 of the Reading Borough LDF Sites and Detailed Policies Document 2012 (Altered 2015).

1.4 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 if required.

1.4.1 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.

1.4.2 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)

1.5 Sound Planning understands that the following equipment will contribute to the noise emissions from the proposed kitchen ventilation, refrigeration and air conditioning systems:

- Supply Fan - Northern Fan Supplies 50JM/20/4/6/20 (axial fan) - 1.08m³/sec
- Extract Fans - Northern Fan Supplies 50JM/20/4/6/20 (axial fan) - 1.27m³/sec
- AC Condenser Unit - Daikin RZQSG100LV
- Coldroom Condenser Unit 1 - Scandia TECOOL E100B
- Coldroom Condenser Unit 2 - Scandia TECOOL EL150(H)

See APPENDIX 2 - Site Location/Plans and APPENDIX 5 - Equipment Noise Level Data for further information

1.6 Site and Location

1.6.1 The Supply Fan (externally mounted) and ducting will be located above the Coldroom screened from the worst affected noise sensitive receiver (1st floor flat) at a distance of around 4 metres.

1.6.2 The Extract Fan (externally mounted) and ducting will be located to the side of the worst affected noise sensitive receiver (1st floor flat) at a distance of around ranging from 1 - 3 metres.

1.6.3 The AC and Coldroom condensers will be located on the ground beneath the 1st floor flat at distance between 2 - 3 metres.

See APPENDIX 2 - Site Location/Plans and APPENDIX 3 - Site Photographs

1.7 Operation Times

Monday - Sunday

10:00 – 22:00 hours



2.0 ASSESSMENT CRITERIA

- 2.1 The noise assessment and acoustic report should be carried out in accordance with relevant standards and guidelines in conjunction with the Local Authority's validation Unitary Development Plan (UDP).
- 2.2 Noise Measurement Protocol - British Standard 7445-1: 2003¹
 - 2.2.1 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.
 - 2.2.2 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.
 - 2.2.3 BS 7445 does not specify limits for environmental noise.
- 2.3 Noise emissions from mechanical plant should be assessed in accordance with the requirements of British Standard 4142: 1997^{2,3}.
 - 2.3.1 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.
 - 2.3.2 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: ($L_{A90,T}$).

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

² British Standard 4142: 1997 – *Method for rating industrial noise affecting mixed residential and industrial areas*. © BSI 1997. ISBN 0 580 28300 3.

³ Superseded by BS 4142: 2014.

- 2.3.3 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.
- 2.3.4 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.
- 2.3.5 If the Rating Level is more than 10dB below the background noise this is a positive indication that *complaints are unlikely*.
- 2.4 BS 4142: 1997 discusses potentially increased levels of annoyance when a human receiver hears noise which contains an acoustic feature.
- 2.4.1 An acoustic feature or ‘tone protrusion’ in a measured spectrum is the amount by which the band level containing a particular tone exceeds the adjacent band levels on either side. The amount of tone protrusion depends on the analysis bandwidth.
- 2.4.2 A criterion for assessing noise spectra is that a tone in a broadband spectrum is considered subjectively prominent if the band level of the one-third octave containing the tone exceeds the average of the two adjacent band levels by 5dB or more⁴.
- 2.4.3 Acoustic features can also be defined as noise emitted which contains distinguishable, discrete continuous notes (*whine, hiss, screech, hums*) and/or distinct impulses (*bangs, clicks, clatters, thumps*)⁵.
- 2.4 Noise emissions from mechanical plant should be assessed in accordance with the requirements of British Standard 4142: 2014.⁶
- 2.4.1 BS 4142: 2014 – Scope

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

⁴ Morfey, C. *Dictionary of Acoustics*. © ACADEMIC PRESS 2001. ISBN 0-12-506940-5

⁵ BS 4142 – Paragraph 8: ‘Rating Level’, Page 6.

⁶ British Standard 4142: 2014 – Methods for rating and assessing industrial and commercial sound.



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



2.4.2 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.

3.0 METHODOLOGY

3.1 Background Noise Assessment

- 3.1.1 Background noise measurements were undertaken as close as possible to the worst affected noise sensitive receiver (1st floor residential apartment) nearest to the proposed kitchen ventilation system intake/extract air vents and external condenser units.

See APPENDIX 2 – Site Location



- 3.1.2 Background noise levels were measured over a 24 hour period from 11:30 hours Monday 10th July - 12:45 hours Tuesday 11th July, 2017.
- 3.1.3 The measurement period incorporated a time period which is thought to have the quietest existing background noise levels within the proposed operational times of the kitchen ventilation, refrigeration and air conditioning systems.
- 3.1.4 Measurements were undertaken in accordance with BS 7445⁷ and BS 4142⁸. The sound level meter was Type 1 – details provided in 3.1.8.
- 3.1.5 The microphone was fixed at 1.2m above rear flat roof level in a position representative of the nearest (worst affected) noise sensitive windows (1st floor apartment).
- 3.1.6 The A-weighted L₉₀ parameter was measured using the Fast (F) setting, and logged periodically every 15 minutes.
- 3.1.7 Meteoric conditions were dry with calm winds, and generally acceptable in accordance with BS 7445.

See paragraph 4.2 – Meteorological Conditions

3.1.8 Equipment:

Equipment	Make	Model	Class	Serial Number	UKAS Calibration
SLM	Norsonic	Nor140	1	1405819	U21376 (18/4/16)
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				

⁷ British Standard 7445-1: 2003 – *Description and measurement of environmental noise*. © BSI 1997. ISBN 0 580 19736 0.

⁸ British Standard 4142 – *Method for rating industrial noise affecting mixed residential and industrial areas*. © BSI 1997. ISBN 0 580 28300 3.



The Sound Level Meters (SLM) are Class 1 and have real time one third octave capability; compliant to IEC 61672⁹.

3.2 Equipment Noise Level Calculations (General)

3.2.1 All calculations will utilise the manufacturers' sound power level (SWL) or sound pressure level (SPL) data.

3.2.2 Noise calculations will subtract system losses, distance corrections and propagation corrections to the nearest noise sensitive receivers (NSR) based on spherical divergence:

$$SPL_2 = SPL_1 - 20\log r - 11 + DI^{10} \pm MISC$$

Where 'r' = radius; SPL = Sound Pressure Level.

3.2.3 The resultant sound pressure level (SPL) will be compared to the measured background noise level in accordance with the requirements of BS 4142.

3.3 Extraction Noise Level Calculations

3.3.1 All calculations will utilise the manufacturers' sound power level (SWL) data or calculated SWL based on the fan type, pressure and air volume¹¹.

3.3.2 The fan sound power level (SWL) will be attenuated by internal system (duct) losses and end reflection on reaching the exhaust termination¹².

3.3.3 Duct Break-Out calculations will utilise the formula:

$$SWL_{break-out} = SWL_{duct} - R + 10\log(S/A)^{13}$$

Where	SWL	Sound Power Level
	S	Surface Area (Visible Duct)
	A	Cross Section
	R	Sound Reduction Index

⁹ International Standard IEC 61672-1: 2002. Electroacoustics – Sound level meters – Part 1: Specifications.

¹⁰ DI = Directivity Index.

¹¹ Sound Research Laboratories: *Noise Control in Building Services*. Pergamon Press 1988.

¹² Sound Research Laboratories: *Noise Control in Building Services*. Pergamon Press 1988.

¹³ Sound Research Laboratories: *Noise Control in Building Services*. Pergamon Press 1988.



The term 'R' cannot give a greater break-out level than there is inside the duct. Therefore at low frequency the effective reduction is taken as 3dB.

- 3.3.4 The noise level at the nearest external noise sensitive receivers (NSR's) will be calculated using the formula:

$$SPL_2 = SPL_1 - 20\log r - 11 + DI^{14} \text{ [point source]}$$

and

$$SPL_2 = SPL_1 - 10\log r - 11 + DI \text{ [line source]}.$$

Where 'r' = radius; SPL = Sound Pressure Level.

- 3.3.5 The directionality of the duct opening¹⁵ relative to the receiver should also be considered; the approximate directivity attenuation can be found by comparing fd/c with the angle to the receiver¹⁶.

- 3.3.6 Screening attenuation is based on Maekawa's formula (if required), where the expected insertion loss the barrier is the function of the Fresnel number $(2.8/\lambda)^{17}$.

'Line of sight' screening achieves a 5 dB reduction through frequencies.

- 3.3.7 The resultant (combined) sound pressure level (SPL) will be compared to the measured background noise level in accordance with BS 4142.

- 3.3.8 Noise mitigation calculations will utilise sound reduction indices or insertion loss data from the manufacturer's specification data sheets.

¹⁴ DI = Directivity Index.

¹⁵ The configuration of the duct termination is currently unknown e.g. cowl etc.

¹⁶ f = frequency; d = duct opening (m); and c = speed of sound 344m/s. Reference: Watson et al. *The Little Red Book of Acoustics*. BTA 2007.

¹⁷ Attenborough, K. et al. *Predicting Outdoor Sound*. Copyright Taylor & Francis Group 2007.



4.0 RESULTS

4.1 Background Noise Levels

Microphone Position	Time Period (hours)	Background Noise Level dB L _{A90}
NSR (Representative)	10:00 - 22:00	42
	24 hours	30

See APPENDIX 4 for full results.

4.2 Meteorological Conditions

Wind Speed/Direction	SW 1-2m/s
Likelihood of Temperature Inversion ¹⁸	No - Relatively short distances – Little effect
Precipitation	No
Fog	No
Wet Ground	No
Frozen Ground/Snow Coverage	No
Temperature	12-25°C
Cloud Cover	Clear

¹⁸ i.e. Calm night with little cloud cover.

4.3 Levels of Uncertainty

Category	Notes
Complexity of Sound Source	Supply/Extract Fan System: Inlet Duct Break Out Outlet Duct Break Out Fan Case Break Out Termination Grille Break Out External Condenser Units Supply Air Exhaust Air Compressor
Complexity of Acoustic Environment (Residual)	Road traffic noise and existing commercial noise (including mechanical plant)
Level of Residual Sound (including Specific)	n/a
Measurement Locations	Representative
Distance Between Sound Source & Measurement Position	n/a
Number of Measurements Taken	24 hours
Measurement Time Intervals	n/a
Range of Times	1 measurement period selected; 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 DISCUSSION

5.1 Noise Calculations

Calculations include losses provided by end reflection, duct losses, attenuators (noise control products) directivity index (DI), screening and distance attenuation.

5.2 Combined Noise Levels

Supply/Extract Fans and External Condenser Units' predicted sound levels have been combined in order to predict the overall mechanical equipment noise level at the worst affected noise sensitive receivers for both daytime and night time operation.

6.0 CRITERIA ASSESSMENT

6.1 Combined Mechanical Equipment Sound Levels (NSR)

6.1.1 Daytime 10:00 - 22:00 hours Equipment Operation

Source	Level at NSR
	dB L _{Aeq}
Supply Fan Inlet	36.1
Supply Fan Outlet	36.8
Extract Fan Inlet	44.5
Extract Fan Outlet	47.8
Extract Fan Discharge	45.2
AC Condenser	50.4
CR Condenser 1	43.5
CR Condenser 1	45.0
Combined Total	54.2
Daytime BG	42
Excess	12.2

6.1.2 24 hours Equipment Operation

Source	Level at NSR
	dB L _{Aeq}
Supply Fan Inlet	<i>Not operational</i>
Supply Fan Outlet	<i>Not operational</i>
Extract Fan Inlet	<i>Not operational</i>
Extract Fan Outlet	<i>Not operational</i>
Extract Fan Discharge	<i>Not operational</i>
AC Condenser	<i>Not operational</i>
CR Condenser 1	43.5
CR Condenser 1	45.0
Combined Total	47.3
Night Time BG	30
	17.3

7.0 NOISE MITIGATION

7.1 Reading Borough Council (RBC) Requirements:

The predicted rating level, $L_{A,r,T}$ as measured at a point 1 metre external to sensitive facades shall be at least 10dB below the existing background sound level, $L_{A90,T}$ when all plant/equipment (or any part of it) is in operation.

7.2 Noise Mitigation Requirements

7.2.1 The predicted mechanical daytime equipment sound level at the worst affected noise sensitive receiver is 54 dB L_{Aeq} - 12 dB(A) above the reference background. A 22 dB(A) noise reduction is required.

7.2.2 The predicted mechanical 24 hour equipment sound level at the worst affected noise sensitive receiver is 47 dB L_{Aeq} - 17 dB(A) above the reference background. A 27 dB(A) noise reduction is required.



7.3 Noise Control Products¹⁹

7.3.1 Daytime 10:00 - 22:00 hours Equipment Operation

Source	Noise Mitigation	Level at NSR
	Product	dB L _{Aeq}
Supply Fan Inlet	Silencer 1DP/AcoustiShield P10	19.3
Supply Fan Outlet	Silencer 1DP/AcoustiShield P10	19.8
Extract Fan Inlet	Silencer 2DP/AcoustiShield P10	21.9
Extract Fan Outlet	Silencer 2DP/AcoustiShield P10	25.9
Extract Fan Discharge	Silencer 2DP	27.9
AC Condenser	Environ Enclosure	25.4
CR Condenser 1	Environ Enclosure/Screening	14.0
CR Condenser 1	Environ Enclosure/Screening	16.0
Combined Total		32
Daytime BG		42
Excess		-10

7.3.2 24 hours Equipment Operation

Source	Noise Mitigation	Level at NSR
	Product	dB L _{Aeq}
Supply Fan Inlet		
Supply Fan Outlet		
Extract Fan Inlet		
Extract Fan Outlet		
Extract Fan Discharge		
AC Condenser		
CR Condenser 1	Environ Enclosure/Screening	14
CR Condenser 1	Environ Enclosure/Screening	16
Combined Total		18.1
Daytime BG		30
Excess		-12

¹⁹ See APPENDIX 6 - Calculation Charts for full calculation details; APPENDIX 7 - Noise Mitigation Products.



7.4 Noise Control Product Installation

7.4.1 Attenuators

The circular silencers should be installed within the duct on the inlet and outlet sides of the fan, as close to the fan as possible (preferably bolted on/connected).

7.4.2 Acoustic Ductwrap

The acoustic ductwrap should fully cover all external ductwork including fan and silencers.

7.4.3 Acoustic Enclosures

Acoustic louvres/panels should be fitting in accordance with Original Equipment Manufacturers' (OEM) guidelines.

7.4.4 Acoustic Screening

In order to achieve the 5 dB(A) sound reduction the acoustic screen should be positioned to (at least) block line of sight from the source to the receiver.

See APPENDIX 7 - Noise Mitigation Products

8.0 CONCLUSIONS

8.1 Sound Planning has carried out an environmental noise impact assessment in accordance with the requirements of BS 4142: 1997 and BS 7445: 2003.

See section 3.0 METHODOLOGY

8.2 The reference background noise level during proposed operational times is:

24 hours: 30 dB L_{A90}

Operational Hours: 42 dB L_{A90}

See paragraph 4.1



8.3 BS 4142: 2014 - Evaluation

8.3.1 Daytime 10:00 - 22:00 hours Operation

The predicted mechanical daytime equipment sound level at the worst affected noise sensitive receiver is 54 dB L_{Aeq} - 12 dB(A) above the reference background. A 22 dB(A) noise reduction is required.

8.3.2 24 hours Operation

The predicted mechanical 24 hour equipment sound level at the worst affected noise sensitive receiver is 47 dB L_{Aeq} - 17 dB(A) above the reference background. A 27 dB(A) noise reduction is required.

8.4 Noise Mitigation Products

In order to achieve a Rating level of 10 dB below background the recommended noise control products should be installed.

See Section 7.0 – NOISE MITIGATION



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.



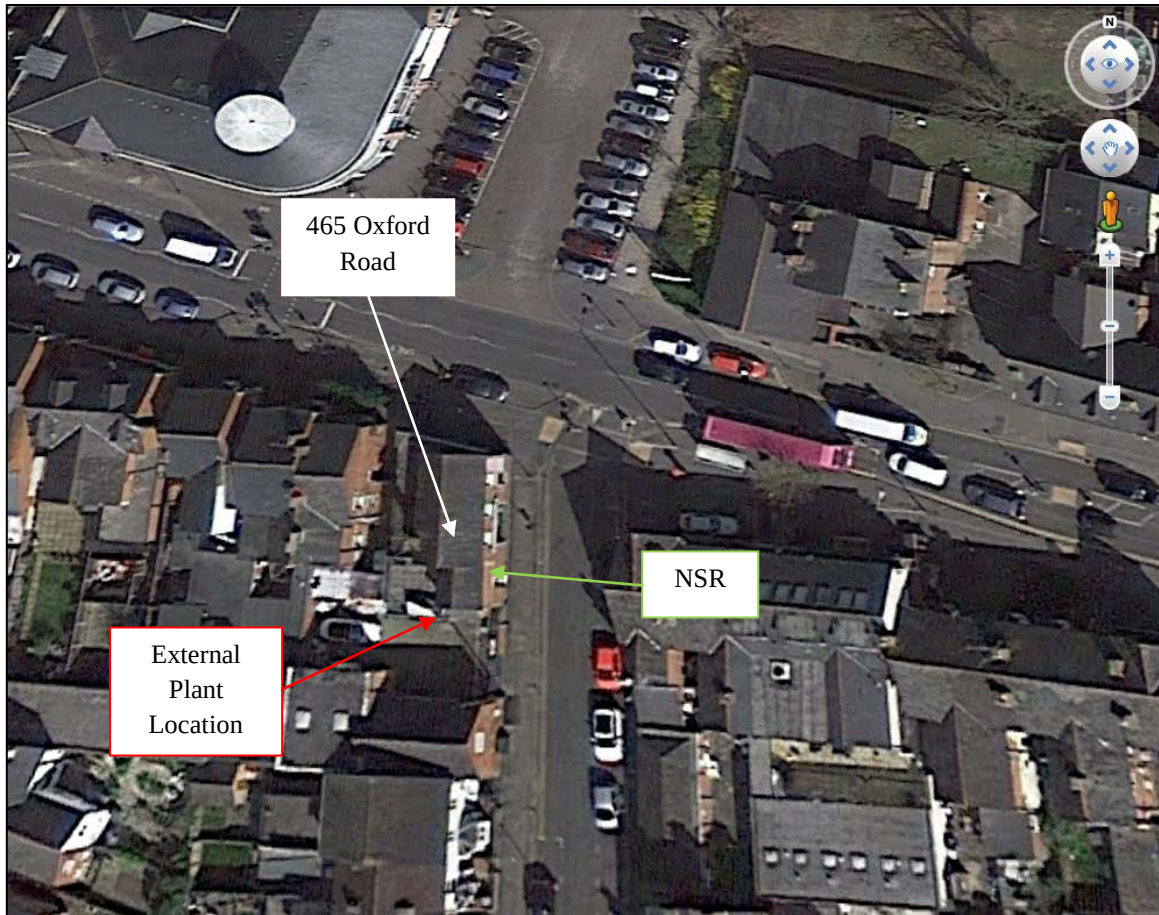
Meteorological Effects

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/Plans

Google Earth Screenshot



Site Location/Plans

Proposed Rear Elevation



Site Location/Plans

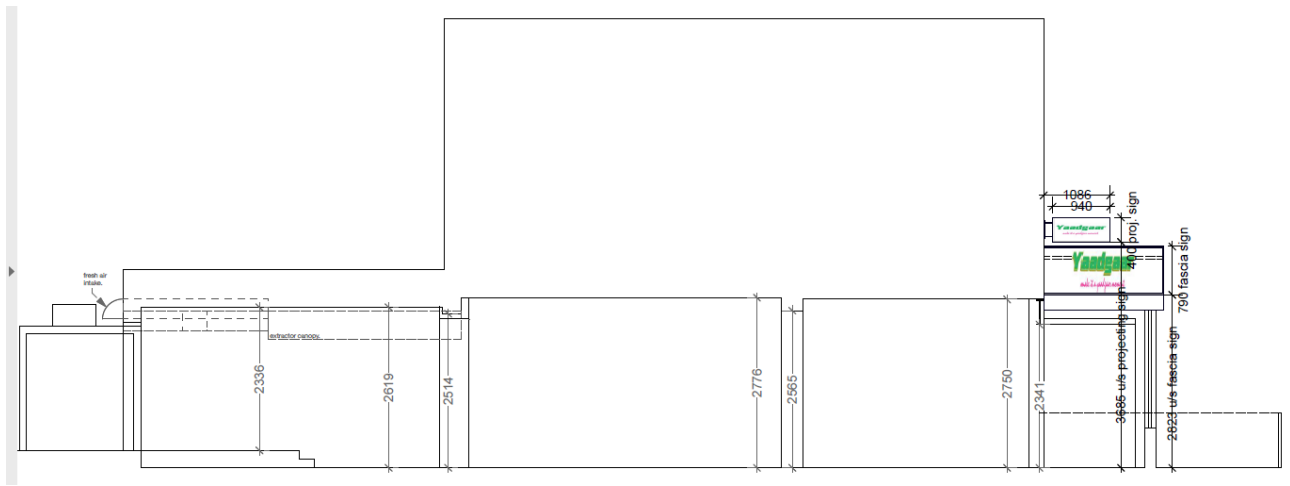
Proposed Side Elevation





Site Location/Plans

Proposed Side Elevation



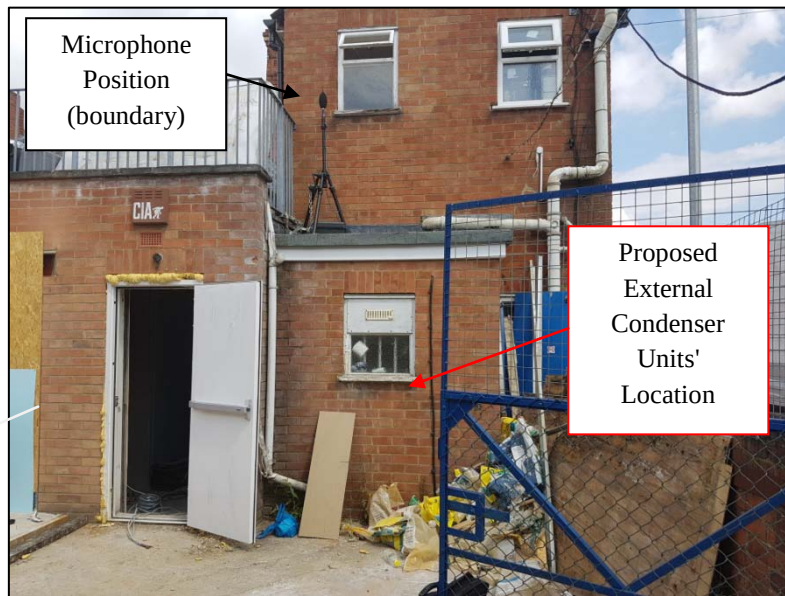


Proposed Plan View



APPENDIX 3

Site Photographs



Background Noise Measurement Position



Background Noise Measurement Position



APPENDIX 4

Background Noise Levels

Table

File	Date	Time	L _{Aeq}	L _{AFmax}	L _{AFmin}	L _{AF50}	L _{AF90}
2	10/7/2017	11:30	59.2	78.4	40.3	54.4	46
3	10/7/2017	11:45	56	80	39.1	50.9	45.4
4	10/7/2017	12:00	53.4	77.9	38.4	50.4	45.7
5	10/7/2017	12:15	53.2	69.1	39.8	49.7	46
6	10/7/2017	12:30	54	75.3	39.8	50	45.3
7	10/7/2017	12:45	55.1	75.1	39.8	49.6	44.6
8	10/7/2017	13:00	66.7	79	42	66	48.1
9	10/7/2017	13:15	67.7	74.7	46.6	67.4	52.6
10	10/7/2017	13:30	65.5	74.3	41.4	64.3	48.7
11	10/7/2017	13:45	67.4	76.3	41.1	67.6	49.3
12	10/7/2017	14:00	64.9	76.4	41.8	64.7	48.3
13	10/7/2017	14:15	63.7	75.4	42.7	64.4	48.8
14	10/7/2017	14:30	55.8	72.9	40.4	49.7	45.5
15	10/7/2017	14:45	55.5	76.2	39.8	50.5	46.3
16	10/7/2017	15:00	64.6	86.1	42.4	58	48.3
17	10/7/2017	15:15	58.8	73.2	40.5	51.7	47.7
18	10/7/2017	15:30	55.6	74.8	42.1	52	47.5
19	10/7/2017	15:45	55.9	79.7	41.5	49.8	46.2
20	10/7/2017	16:00	58	77.7	41.3	51.9	47.5
21	10/7/2017	16:15	68.2	84.6	42.1	56.2	47.6
22	10/7/2017	16:30	54	76.1	40.7	50.1	45.9
23	10/7/2017	16:45	56.4	72.6	40.3	50.3	45.4
24	10/7/2017	17:00	55.3	72.9	40.4	50	45.8
25	10/7/2017	17:15	57.7	83.1	41.8	51.7	47.3
26	10/7/2017	17:30	60.7	82.6	43.2	52.6	48
27	10/7/2017	17:45	71.3	84.8	43.5	62.8	49.6
28	10/7/2017	18:00	65.9	85	39.5	52.3	47.1
29	10/7/2017	18:15	77.4	86.2	42	53	47
30	10/7/2017	18:30	54.6	71.5	40.6	51.1	47.4
31	10/7/2017	18:45	52.7	73.7	41.1	49.3	45.8
32	10/7/2017	19:00	55.3	75.4	40.8	49	45.3
33	10/7/2017	19:15	54.8	73.2	41.1	50.7	45.4
34	10/7/2017	19:30	59.9	84	39	50.9	46.1



35	10/7/2017	19:45	52.9	72.6	39.9	49.3	44.9
36	10/7/2017	20:00	51.8	71.6	40.4	49.1	45.4
37	10/7/2017	20:15	53.5	72.5	39.7	49.5	45
38	10/7/2017	20:30	52.2	71.6	40.2	48.7	44.6
39	10/7/2017	20:45	53.8	77.2	38.5	49.4	44.5
40	10/7/2017	21:00	58.3	86.8	36	47.8	42.3
41	10/7/2017	21:15	58.9	82	38.8	51.7	45.5
42	10/7/2017	21:30	53.9	78.8	39.7	49.5	44.2
43	10/7/2017	21:45	51.8	70.1	37.9	48.3	43
44	10/7/2017	22:00	56.2	81.1	37.2	49.2	43.6
45	10/7/2017	22:15	53.1	77.4	38.5	48	43
46	10/7/2017	22:30	55	80.7	35.3	46.7	41
47	10/7/2017	22:45	52.9	80.7	34.5	46.3	39.7
48	10/7/2017	23:00	51.3	77.9	35.2	46	40
49	10/7/2017	23:15	50	70.8	32.4	44.7	36.8
50	10/7/2017	23:30	48.9	67.6	32.7	44.8	37.8
51	10/7/2017	23:45	47	65.6	33.2	41.8	36.3
52	11/7/2017	0:00	47.9	67.1	32	41.7	36
53	11/7/2017	0:15	48.9	67.2	32.1	44.9	38
54	11/7/2017	0:30	51.4	79.2	30.4	39.9	33.7
55	11/7/2017	0:45	47.5	78.1	28.4	37.3	31
56	11/7/2017	1:00	43.6	64.1	28.3	35.8	31.2
57	11/7/2017	1:15	47.6	67.9	29.8	36.4	32
58	11/7/2017	1:30	45.8	62.3	28.6	36.7	31.3
59	11/7/2017	1:45	50.6	76.9	28.7	36.5	31
60	11/7/2017	2:00	45.4	64.2	28.1	36	30.2
61	11/7/2017	2:15	45.1	63.2	30.6	35.6	32.8
62	11/7/2017	2:30	46.9	66.2	26.6	37	29.5
63	11/7/2017	2:45	43.7	67.5	29.2	32.7	30.6
64	11/7/2017	3:00	44.3	62.6	28.3	34.3	30.8
65	11/7/2017	3:15	51.4	76.9	29.5	37.1	31.3
66	11/7/2017	3:30	45.5	64	27.4	35.3	30.6
67	11/7/2017	3:45	46.7	70.8	28	33.5	30.3
68	11/7/2017	4:00	45	64.8	27.7	34.7	30.1
69	11/7/2017	4:15	45.5	64.3	29.5	34.3	31.5
70	11/7/2017	4:30	45.8	63	30.2	37.6	32.8
71	11/7/2017	4:45	45.8	61.5	29.8	36.9	32.1
72	11/7/2017	5:00	46.4	64.6	32.5	40.1	34.8
73	11/7/2017	5:15	49.9	67.1	32.5	42.9	36.1
74	11/7/2017	5:30	49.8	66.1	33.6	44.1	37.3
75	11/7/2017	5:45	49.5	65	34.7	44.9	37.9
76	11/7/2017	6:00	49.7	68.6	37.5	46.4	40.4

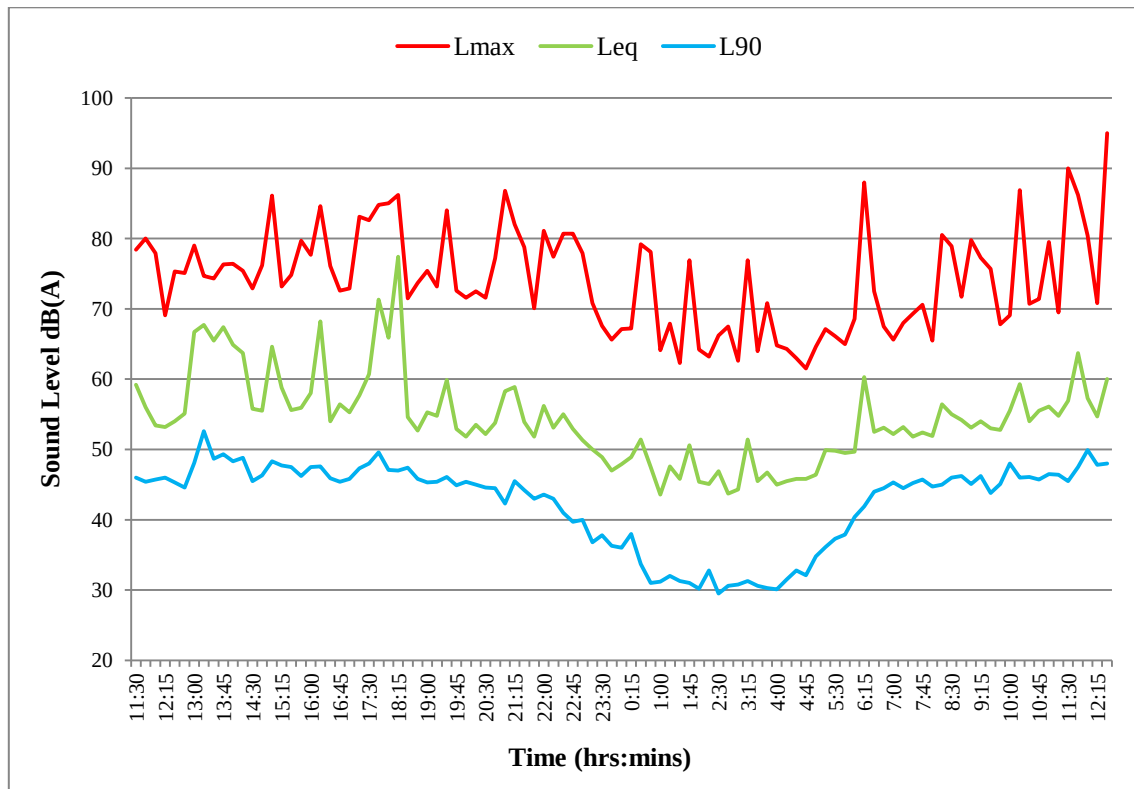


soundplanning

77	11/7/2017	6:15	60.3	88	37.9	48.2	41.9
78	11/7/2017	6:30	52.5	72.5	39	49.2	44
79	11/7/2017	6:45	53.1	67.5	40	50.4	44.5
80	11/7/2017	7:00	52.2	65.6	40.8	50.2	45.3
81	11/7/2017	7:15	53.2	68	39.1	49.8	44.5
82	11/7/2017	7:30	51.8	69.3	41.2	48.7	45.2
83	11/7/2017	7:45	52.4	70.6	40	50	45.7
84	11/7/2017	8:00	51.9	65.5	40.8	49.5	44.7
85	11/7/2017	8:15	56.4	80.5	39.9	50	45
86	11/7/2017	8:30	55	78.9	42.6	50.4	46
87	11/7/2017	8:45	54.2	71.7	43.3	50.9	46.2
88	11/7/2017	9:00	53.1	79.8	39.8	49.9	45.1
89	11/7/2017	9:15	54	77.3	41.3	50.5	46.2
90	11/7/2017	9:30	53	75.7	38.3	49	43.8
91	11/7/2017	9:45	52.8	67.8	38.6	50	45.1
92	11/7/2017	10:00	55.5	69.1	40.1	53.6	48
93	11/7/2017	10:15	59.3	86.9	41.9	52	46
94	11/7/2017	10:30	54	70.7	39.8	51.7	46.1
95	11/7/2017	10:45	55.5	71.4	38.5	51.3	45.7
96	11/7/2017	11:00	56.1	79.5	41.4	52.2	46.5
97	11/7/2017	11:15	54.8	69.5	42.3	52.1	46.4
98	11/7/2017	11:30	56.9	90	41.2	50.8	45.5
99	11/7/2017	11:45	63.7	86.2	41.6	53.4	47.5
100	11/7/2017	12:00	57.3	80.4	42.9	54.9	49.9
101	11/7/2017	12:15	54.7	70.8	42.4	52.3	47.8
102	11/7/2017	12:30	60	95	42.1	53.8	48

Background Noise Levels

Graph



APPENDIX 5

Equipment Noise Level Data

Supply Fan



Northern Fan Supplies Ltd
Technical Data Sheet
JM Aerofoil



Quotation Number	: KP47439	Project Code	:																																																						
Project Name	: Reading	Customer	: Improvair																																																						
Item Reference:	:	Date:	: Monday, June 26, 2017																																																						
Fan Code	50JM/20/4/6/20	Performance data has been derived from tests carried out in a Flakt Woods laboratory, in accordance with ISO 5801 and is specifically applicable for Ducted installations. When an electronic controller is incorporated, enhanced motor noise can occur - particularly when the operating speed is well below maximum. FWL therefore recommend using an auto transformer speed controller for noise sensitive applications. Bifurcateds are Erp exempt when used continuously at >100C. They are not for use in the EEA at lower temperatures.																																																							
Fan Diameter / Size	500 Size / mm																																																								
Blades	6																																																								
Fan Speed	1420 rpm																																																								
Velocity	5.7 m/s																																																								
Blade Angle	20°																																																								
Installation Type / Form of Running	C / B																																																								
Fan Casing	Long	Acoustic data has been derived from tests carried out in a Flakt Woods laboratory, in accordance with BS 848 Pt 2, 1985 / ISO 5136 under Ducted conditions. The LpA figure provided is the overall Inlet sound pressure level calculated at the specified distance, under spherical, free field conditions. Breakout levels stated are estimated from induct sound power levels and are provided for guidance.																																																							
Requested Duty	1.08m³/s @ 167 Pa (static)																																																								
Actual Duty	1.11m³/s @ 178 Pa (static)																																																								
Outlet Dynamic Pressure	19 Pa																																																								
Duty Shaft Power	0.330 kW																																																								
Max Shaft Power	0.339 kW																																																								
Total Efficiency	66.4 %																																																								
Motor Frame	BT9	Acoustic figures for adjusted running speeds have been interpolated and are for reference only.																																																							
Motor Rating	0.320 kW																																																								
Full Load Current	2.2 A																																																								
Starting Current	5 A																																																								
Motor Mounting	Pad																																																								
Electrical Supply	220-240 Volts 50 Hz 1 Phase																																																								
Start Type	DOL																																																								
Motor Winding	Standard	Terms and Conditions: This offer is made subject to the terms and conditions detailed on the accompanying letter.																																																							
Enclosure	Standard All																																																								
ErP (FMEG) Rating	N 48 (ErP Compliant 2015)																																																								
ErP (FMEG) Target	N 40																																																								
FMEG Blade Angle (Range)	18° [16° - 20°]																																																								
Measurement Category	C (Static)																																																								
VSD	N																																																								
Fan + Motor Efficiency	39.6% (1.15 m³/s @ 156 Pa)	<table><tr><th rowspan="2"></th><th colspan="8">Sound Spectrum (Hz)</th><th colspan="2">Overall</th></tr><tr><th>63</th><th>125</th><th>250</th><th>500</th><th>1k</th><th>2k</th><th>4k</th><th>8k</th><th>Lw*</th><th>LpA @ 3 m**</th></tr><tr><td>Inlet*</td><td>70</td><td>75</td><td>75</td><td>73</td><td>71</td><td>67</td><td>64</td><td>58</td><td>81</td><td>56</td></tr><tr><td>Outlet*</td><td>71</td><td>77</td><td>75</td><td>73</td><td>72</td><td>68</td><td>64</td><td>58</td><td>82</td><td>56</td></tr><tr><td>Breakout*</td><td>71</td><td>77</td><td>75</td><td>73</td><td>72</td><td>68</td><td>64</td><td>58</td><td>82</td><td>56</td></tr></table>			Sound Spectrum (Hz)								Overall		63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 3 m**	Inlet*	70	75	75	73	71	67	64	58	81	56	Outlet*	71	77	75	73	72	68	64	58	82	56	Breakout*	71	77	75	73	72	68	64	58	82	56
	Sound Spectrum (Hz)								Overall																																																
	63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 3 m**																																															
Inlet*	70	75	75	73	71	67	64	58	81	56																																															
Outlet*	71	77	75	73	72	68	64	58	82	56																																															
Breakout*	71	77	75	73	72	68	64	58	82	56																																															
Motor Input Power (ErP)	0.453 kW																																																								
SFP value	0.46 W/(l/s) @ Actual Duty	* Lw dB re 10 ⁻¹² W Sound data at actual duty.																																																							
Power from mains	0.52 kW																																																								
Energy Consumption	1546 kWh (3000 h/year)																																																								
Running Cost / Year	£186																																																								
Air Density	1.2 kg/m³ / 20 °C / 0 m / 50% RH																																																								
Smoke Venting	Non Smoke Venting																																																								
Product Number	DX511435																																																								

Equipment Noise Level Data

Extract Fan



Northern Fan Supplies Ltd
Technical Data Sheet
JM Aerofoil



Quotation Number	: KP47439	Project Code	:
Project Name	: Reading	Customer	: Improvair
Item Reference:	:	Date:	: Monday, June 26, 2017

Fan Code	50JM/20/4/6/20	Performance data has been derived from tests carried out in a Flakt Woods laboratory, in accordance with ISO 5801 and is specifically applicable for Ducted installations. When an electronic controller is incorporated, enhanced motor noise can occur - particularly when the operating speed is well below maximum. FWL therefore recommend using an auto transformer speed controller for noise sensitive applications. Biturcateds are Erp exempt when used continuously at >100C. They are not for use in the EEA at lower temperatures. Acoustic data has been derived from tests carried out in a Flakt Woods laboratory, in accordance with BS 848 Pt 2, 1985 / ISO 5136 under Ducted conditions. The LpA figure provided is the overall Inlet sound pressure level calculated at the specified distance, under spherical, free field conditions. Breakout levels stated are estimated from induct sound power levels and are provided for guidance. Acoustic figures for adjusted running speeds have been interpolated and are for reference only. Terms and Conditions:This offer is made subject to the terms and conditions detailed on the accompanying letter.																																																						
Fan Diameter / Size	300 Size / mm																																																							
Blades	6																																																							
Fan Speed	1420 rpm																																																							
Velocity	6.3 m/s																																																							
Blade Angle	20°																																																							
Installation Type / Form of Running	C / B																																																							
Fan Casing	Long																																																							
Requested Duty	1.27m³/s @ 152 Pa (static)	<table><tr><th colspan="8">Sound Spectrum (Hz)</th><th colspan="2">Overall</th></tr><tr><th></th><th>63</th><th>125</th><th>250</th><th>500</th><th>1k</th><th>2k</th><th>4k</th><th>8k</th><th>Lw*</th><th>LpA @ 3 m**</th></tr><tr><td>Inlet*</td><td>69</td><td>74</td><td>74</td><td>72</td><td>70</td><td>66</td><td>62</td><td>56</td><td>80</td><td>55</td></tr><tr><td>Outlet*</td><td>70</td><td>76</td><td>74</td><td>72</td><td>71</td><td>67</td><td>63</td><td>57</td><td>81</td><td>55</td></tr><tr><td>Breakout*</td><td>70</td><td>76</td><td>74</td><td>72</td><td>71</td><td>67</td><td>63</td><td>57</td><td>81</td><td>55</td></tr></table> * Lw dB re 10⁻¹² W ** dBA re 2x10⁻⁵ Pa Sound data at requested duty.	Sound Spectrum (Hz)								Overall			63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 3 m**	Inlet*	69	74	74	72	70	66	62	56	80	55	Outlet*	70	76	74	72	71	67	63	57	81	55	Breakout*	70	76	74	72	71	67	63	57	81	55
Sound Spectrum (Hz)								Overall																																																
	63		125	250	500	1k	2k	4k	8k	Lw*	LpA @ 3 m**																																													
Inlet*	69		74	74	72	70	66	62	56	80	55																																													
Outlet*	70		76	74	72	71	67	63	57	81	55																																													
Breakout*	70		76	74	72	71	67	63	57	81	55																																													
Outlet Dynamic Pressure	23 Pa																																																							
Duty Shaft Power	0.323 kW																																																							
Max Shaft Power	0.339 kW																																																							
Total Efficiency	70.7 %																																																							
Motor Frame	BT9																																																							
Motor Rating	0.320 kW																																																							
Full Load Current	2.2 A																																																							
Starting Current	5 A																																																							
Motor Mounting	Pad																																																							
Electrical Supply	220-240 Volts 50 Hz 1 Phase																																																							
Start Type	DOL																																																							
Motor Winding	Standard																																																							
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ErP (FMEG) Rating	N 48 (ErP Compliant 2013)																																																							
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Fan + Motor Efficiency	39.6% (1.15 m³/s @ 156 Pa)																																																							
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SFP value	0.40 W/(l/s) @ Requested Duty																																																							
Power from mains	0.5 kW																																																							
Energy Consumption	1515 kWh (3000 h/year)																																																							
Running Cost / Year	£182																																																							
Air Density	1.2 kg/m³ / 20 °C / 0 m / 50% RH																																																							
Smoke Venting	Non Smoke Venting																																																							
Product Number	DX511453																																																							



Equipment Noise Level Data

Air Conditioning External Condenser Units

Daikin RZQSG100LV

2 Specifications

2-8 Technical Specifications				RZQSG71L3V1	RZQSG100L9V1	RZQSG125L9V1	RZQSG140L9V1	
Sound pressure level	Cooling	Nom.	dBA	49	53	54	53	
		Silent operation	dBA	47	-			
	Heating	Nom.	dBA	51	57	58	54	
	Night quiet mode	Level 1	dBA	-	49			
Operation range	Cooling	Ambient	Min.	*CDB -15.0				
			Max.	*CDB 46				
	Heating	Ambient	Min.	*CWB -15				
			Max.	*CWB 15.5				
Refrigerant	Type				R-410A			
	Charge	kg	2.75	2.9	4.0			
		TCO ₂ eq	5.7	6.1	8.4			
	Control	Expansion valve (electronic type)						
	GWP	2,087.5						
	Circuits	Quantity	1					
Refrigerant oil	Type				FVC50K			
	Charged volume	l	0.75	0.9	1.35			
Piping connections	Liquid	Quantity	1					
		Type	Flare connection					
		OD	mm	9.52				
	Gas	Quantity	1					
		Type	Flare connection					
		OD	mm	15.9				
	Drain	Quantity	3	5				
		Type	Hole					
		ID	mm	-				
	Piping length	OU - IU	Min.	m	5			
			Max.	m	50			
		System	Equivalent	m	70			
			Charges	m	30			
		Additional refrigerant charge	kg/m	See installation manual				
		Level difference	IU - OU	Max.	m	15	30.0	
		IU - IU	Max.	m	0.5			
Heat insulation	Both liquid and gas pipes							
Defrost method				Pressure equalising	Reversed cycle			
Defrost control				Sensor for outdoor heat exchanger temperature				
Safety devices	Item	01	High pressure switch					
		02	Fan motor thermal protection	Low pressure switch				
		03	Fuse	Fan driver overload protector				
		04	-	Fuse				

2-9 Electrical Specifications				RZQSG71L3V1	RZQSG100L9V1	RZQSG125L9V1	RZQSG140L9V1
Power supply	Name	V1					
	Phase	1~					
	Frequency	Hz	50				
	Voltage	V	220-240				
	Voltage range	Min.	%	-10			
		Max.	%	10			
Current	Zmax	List	-	Complies to EN61000-3-11			
	A	Recommended fuses	25	40			
Current - 50Hz	Maximum fuse amps (MFA)	A	20	-			
Current - 60Hz	Maximum fuse amps (MFA)	A	-				
Wiring connections	For power supply	Remark	See installation manual outdoor unit				
	For connection with indoor	Remark	See installation manual outdoor unit				
Power supply intake	Outdoor unit only						

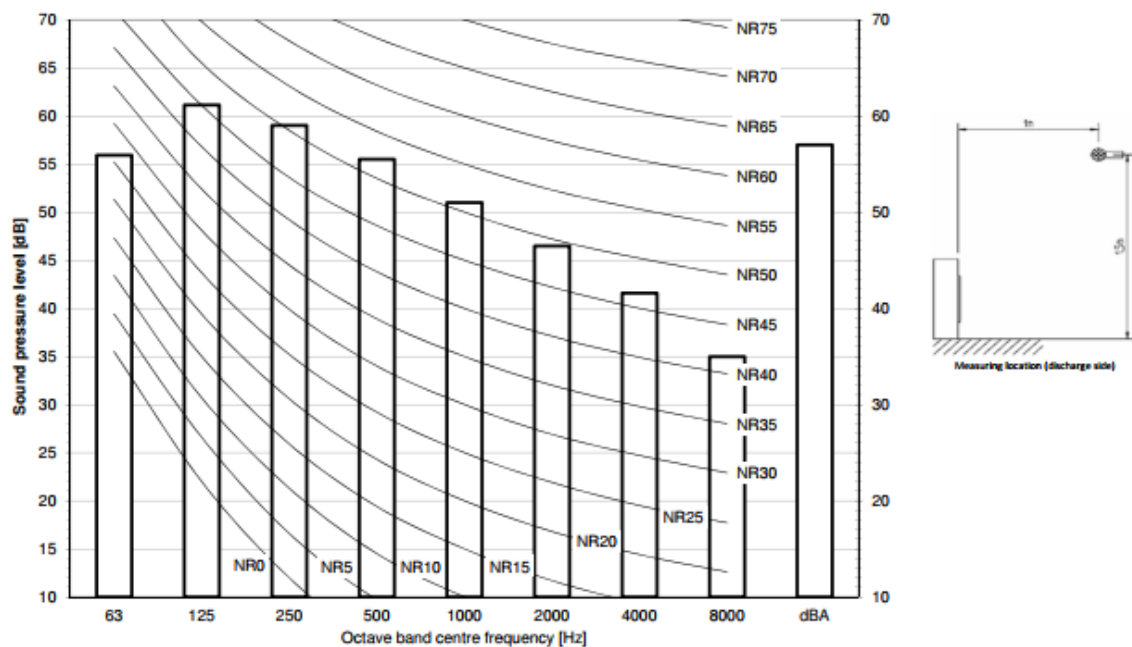
Equipment Noise Level Data

Air Conditioning External Condenser Units

Daikin RZQSG100LV

Normal Mode

RZQSG100LV1



Notes

- Data is valid at free field condition.
- Data is valid at nominal operation condition.
- dBA = A-weighted sound pressure level (A scale according to IEC).
- Reference acoustic pressure 0 dB = 20 μ Pa

3D090871

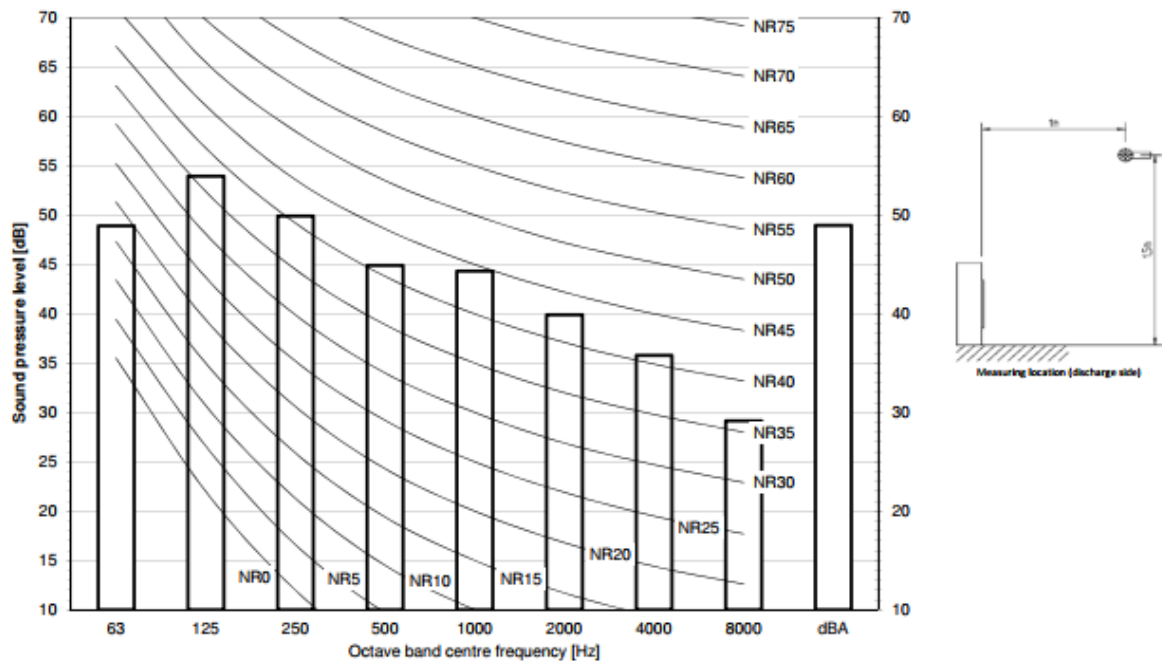
Equipment Noise Level Data

Air Conditioning External Condenser Units

Daikin RZQSG100LV

Quiet Mode

RZQSG100LV1



Notes

- Data is valid at free field condition.
- Data is valid at nominal operation condition.
- dBA = A-weighted sound pressure level (A scale according to IEC).
- Reference acoustic pressure 0 dB = 20 µPa

3D090861



Equipment Noise Level Data

Coldroom External Condenser Units

Scandia TECOOL E100H-B



Medium/High B.P Condensing Units Specification

~ condensing units, compressor models, power

Model	Unit Of Measurement	E100H-B	E1150H-B	E200H-B	E250H-B	E250S/H-B	E300H-B	E300S/H-B	E400S/H-B	E500S/H-B	E600S/H-B
Comp. Power	HP	1HP	1.5HP	2HP	2.5HP	2.5HP	3HP	3HP	4HP	5HP	6HP
Nominal Capacity	W	1800	2300	3800	4800	4950	5750	5600	7700	9700	11300
Input Power	W	1000	1200	2000	2000	2120	2720	2650	3670	4430	5200
Rate Current	A	5.7	6.9	9.5	10.5	4.5	17.6	6	8	9.7	12.7
Max.Load Current	A	8.5	10.5	16.8	18.8	6.8	24	9	11.5	14	18.5
Start Current	A	33	36.5	58	65	36	85	46	56	71	79
Voltage/Hz	V/Hz	230 - 240V ~ 50	230 - 240V ~ 50	230 - 240V ~ 50	230 - 240V ~ 50	400 - 415V 3N ~ 50	230 - 240V ~ 50	400 - 415V 3N ~ 50	400 - 415V 3N ~ 50	400 - 415V 3N ~ 50	400 - 415V 3N ~ 50
Evaporating Temp.	°C	-15 ~ 10°C	-15 ~ 10°C	-15 ~ 5°C	-15 ~ 5°C	-15 ~ 5°C	-15 ~ 5°C	-15 ~ 5°C	-15 ~ 5°C	-15 ~ 5°C	-15 ~ 5°C
Ambient Temp.	°C	10 ~ 45°C	10 ~ 45°C	10 ~ 45°C	10 ~ 45°C	10 ~ 45°C	10 ~ 45°C	10 ~ 45°C	10 ~ 45°C	10 ~ 45°C	10 ~ 45°C
Condenser Air Vol.	M3/hour	1000	1500	2200	2200	2200	3200	3200	4200	5400	6400
Condenser Fan Power	W	110	130	180	180	180	320	320	320	340	640
Fan Diameter	mm	φ350	φ350	φ450	φ450	φ450	φ450	φ450	φ450	2xφ450	2xφ450
Gas Pipe Diameter	in.	1/2	1/2	5/8	5/8	5/8	5/8	5/8	3/4	7/8	7/8
Liquid Pipe Diameter	in.	3/8	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2
Refrigerant	Type	R404A/R449A	R404A/R449A	R404A/R449A	R404A/R449A	R404A/R449A	R404A/R449A	R404A/R449A	R404A/R449A	R404A/R449A	R404A/R449A
Refrigerant Injection	kg	1.1	1.5	2.3	3	3	3.6	3.6	4.5	5.6	6.5
Dimensions [WxDxH]	mm	850x320x500	850x320x500	1030x360x700	1030x360x700	1030x360x700	1030x360x700	1030x360x700	1120x430x800	1120x430x1255	1120x430x1255
Noise @ 1m	dB(A)	50	50	59	59	59	68	68	68	62	72
Noise @ 10m	dB(A)	36	36	38	38	38	41	41	41	40	43
Net Weight	Kg	50	50	70	72	72	72	72	88	105	110
Reference Cool Vol.	M3	16	20	40	50	50	60	60	80	105	125
Reference Evap. Area	M2	9	12	18	26	26	30	30	35	42	55



Equipment Noise Level Data

Coldroom External Condenser Units

Scandia TECOOL EL150DG

ESSENTEC

Technical Data Serial : EI***M/H-B:

Tab.2 REFRIGERATION SERIES (COLD ROOM TEMP. -10°C ~ 10°C), R404A

Model	Unit	EI100DG M/H-B	EI150DG M/H-B	EI200DG M/H-B	EI200SG M/H-B	EI250DG M/H-B	EI250SG M/H-B	EI300DG M/H-B	EI300SG M/H-B	EI350DG M/H-B	EI350SG M/H-B	EI400SG M/H-B	EI500SG M/H-B	EI600SG M/H-B
Comp. Power	HP	1HP	1.5HP	2HP	2HP	2.5HP	2.5HP	3HP	3HP	3.5HP	3.5HP	4HP	5HP	6HP
Nominal Capacity	W	1800	2300	3800	3800	4800	4950	5750	5600	6300	6600	7700	9700	11300
Input Power	W	1000	1200	2000	1800	2000	2120	2720	2650	3200	3100	3670	4430	5200
Rate Current	A	5.7	6.9	9.5	4.5	10.5	4.5	17.6	6	20.2	7.5	8	9.7	12.7
Max. Load Current	A	8.5	10.5	16.8	6.8	18.8	6.8	24	9	25	11	11.5	14	18.5
Start Current	A	33	36.5	58	30	65	36	85	46	102	51	56	71	79
Voltage/Hz	V/Hz	230-240V~50	230-240V~50	230-240V~50	400-415V, 3N~50	230-240V~50	400-415V, 3N~50	230-240V~50	400-415V, 3N~50	230-240V~50	400-415V, 3N~50	400-415V, 3N~50	400-415V, 3N~50	400-415V, 3N~50
Evaporating Temp.	℃	-15~10℃			-15~5℃									
Ambient Temp.	℃	10~45℃												
Condenser Air Volume	M³/hr	1000	1500	2200	2200	2200	2200	3200	3200	3200	3200	4200	5400	6400
Condenser Fan Power	W	110	130	180	180	180	180	320	320	320	320	320	340	640
Fan Diameter	mm	Φ350	Φ350	Φ450	Φ450	Φ450	Φ450	Φ450	Φ450	Φ450	Φ450	Φ450	2×Φ450	2×Φ450
Gas Pipe Diameter	in.	1/2	1/2	5/8	5/8	5/8	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8
Liquid Pipe Diameter	in.	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2	1/2	1/2
Refrigerant		R404A												
Refrigerant Injection	Kg	1.1	1.5	2.3	2.3	3	3	3.6	3.6	4.2	4.2	4.5	5.6	6.5
DIMENSIONS	mm	850×320×500	850×320×500	1030×360×700	1030×360×700	1030×360×700	1030×360×700	1030×360×700	1030×360×700	1120×430×800	1120×430×800	1120×430×800	1120×430×1255	1120×430×1255
W×D×H														
Noise @1m	dB(A)	50	50	59	59	59	59	68	68	68	68	68	62	72
Noise @10m	dB(A)	36	36	38	38	38	38	41	41	41	41	41	40	43
Net Weight	Kg	50	50	70	70	72	72	72	72	80	80	88	105	110
Reference Cool Volume	M³	16	20	40	40	50	50	60	60	70	70	80	105	125
Reference Evaporation Area	M²	9	12	18	18	26	26	30	30	32	32	35	42	55

Note: 1. The specs are subject to change, with technology improvement.

2. Test condition of Nominal Capacity: Evaporating Temp.: -7°C, Ambient Temp.: 32°C, Suction Temp.: 5°C.

<http://www.essentecool.com>



APPENDIX 6

Calculation Charts

Supply Fan

Supply Fan Inlet Duct	Frequency (Hz)								Overall
	63	125	250	500	1k	2k	4k	8k	
50JM/20/4/6/20	70	75	75	73	71	67	64	58	80.6
A-Weighted	43.8	58.9	66.4	69.8	71	68.2	65	56.9	75.7
Circular Silencer 1D Podded	-2	-7	-9	-17	-24	-24	-20	-16	
Corrected SWL	68.0	68.0	66.0	56.0	47.0	43.0	44.0	42.0	
AcoustiShield P10	-19.2	-19.2	-19.4	-24.1	-32.8	-41.6	-53.3	-49.5	
ALLEN Formula									
Visible Perimeter (m)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Length (m)	1	1	1	1	1	1	1	1	
Perimeter x Length (S)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Duct Cross Section (m ²) (A)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
10log(S/A)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	
Losses	-14.4	-14.4	-14.6	-19.3	-28.0	-36.8	-48.5	-44.7	
Minimum -3	-14.4	-14.4	-14.6	-19.3	-28.0	-36.8	-48.5	-44.7	
L _{W(radiated)}	53.6	53.6	51.4	36.7	19.0	6.2	-4.5	-2.7	
NSR Distance (m)	4	4	4	4	4	4	4	4	
DI	3	3	3	3	3	3	3	3	
Point Source Attenuation	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (NSR)	-5	-5	-5	-5	-5	-5	-5	-5	
Sound Level @ NSR	28.5	28.5	26.3	11.6	-6.1	-18.9	-29.6	-27.8	32.7
A-Weighted	2.3	12.4	17.7	8.4	-6.1	-17.7	-28.6	-28.9	19.3

Calculation Charts

Supply Fan

Supply Fan Inlet Duct	Frequency (Hz)								Overall
	63	125	250	500	1k	2k	4k	8k	
50JM/20/4/6/20	71	77	75	73	72	68	64	58	81.4
A-Weighted	44.8	60.9	66.4	69.8	72	69.2	65	56.9	76.3
Circular Silencer 1D Podded	-2	-7	-9	-17	-24	-24	-20	-16	
Corrected SWL	69.0	70.0	66.0	56.0	48.0	44.0	44.0	42.0	
AcoustiShield P10	-19.2	-19.2	-19.4	-24.1	-32.8	-41.6	-53.3	-49.5	
ALLEN Formula									
Visible Perimeter (m)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Length (m)	1	1	1	1	1	1	1	1	
Perimeter x Length (S)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Duct Cross Section (m ²) (A)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
10log(S/A)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	
Losses	-14.4	-14.4	-14.6	-19.3	-28.0	-36.8	-48.5	-44.7	
Minimum -3	-14.4	-14.4	-14.6	-19.3	-28.0	-36.8	-48.5	-44.7	
L _{W(radiated)}	54.6	55.6	51.4	36.7	20.0	7.2	-4.5	-2.7	
NSR Distance (m)	4	4	4	4	4	4	4	4	
DI	3	3	3	3	3	3	3	3	
Point Source Attenuation	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (NSR)	-5	-5	-5	-5	-5	-5	-5	-5	
Sound Level @ NSR	29.5	30.5	26.3	11.6	-5.1	-17.9	-29.6	-27.8	33.9
A-Weighted	3.3	14.4	17.7	8.4	-5.1	-16.7	-28.6	-28.9	19.8

Calculation Charts

Extract Fan

Extract Fan Inlet Duct	Frequency (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k		
50JM/20/4/6/20	69	74	74	72	70	66	62	56	79.5	dB
A-Weighted	42.8	57.9	65.4	68.8	70	67.2	63	54.9	74.7	dB(A)
Circular Silencer 2D Podded	-4	-10	-16	-26	-29	-29	-29	-20		
Corrected SWL	65.0	64.0	58.0	46.0	41.0	37.0	33.0	36.0		
AcoustiShield P10	-19.2	-19.2	-19.4	-24.1	-32.8	-41.6	-53.3	-49.5		
ALLEN Formula										
Visible Perimeter (m)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
Length (m)	1	1	1	1	1	1	1	1		
Perimeter x Length (S)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
Duct Cross Section (m ²) (A)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		
10log(S/A)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Losses	-16.2	-16.2	-16.4	-21.1	-29.8	-38.6	-50.3	-46.5		
Minimum -3	-16.2	-16.2	-16.4	-21.1	-29.8	-38.6	-50.3	-46.5		
L _{W(radiated)}	48.8	47.8	41.6	24.9	11.2	-1.6	-17.3	-10.5		
NSR Distance (m)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4		
DI	0	0	0	0	0	0	0	0		
Point Source Attenuation	-14	-14	-14	-14	-14	-14	-14	-14		
Screening (NSR)										
Sound Level @ NSR	34.9	33.9	27.7	11.0	-2.7	-15.5	-31.2	-24.4	37.9	dB
A-Weighted	8.7	17.8	19.1	7.8	-2.7	-14.3	-30.2	-25.5	21.9	dB(A)

Calculation Charts

Extract Fan

Extract Fan Outlet Duct	Frequency (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k		
50JM/20/4/6/20	70	76	74	72	71	67	63	57	80.4	dB
A-Weighted	42.8	57.9	65.4	68.8	70	67.2	63	54.9	74.7	dB(A)
Circular Silencer 2D Podded	-4	-10	-16	-26	-29	-29	-29	-20		
Corrected SWL	66.0	66.0	58.0	46.0	42.0	38.0	34.0	37.0		
AcoustiShield P10	-19.2	-19.2	-19.4	-24.1	-32.8	-41.6	-53.3	-49.5		
ALLEN Formula										
Visible Perimeter (m)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
Length (m)	2	2	2	2	2	2	2	2		
Perimeter x Length (S)	1	1	1	1	1	1	1	1		
Duct Cross Section (m ²) (A)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		
10log(S/A)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		
Losses	-13.2	-13.2	-13.4	-18.1	-26.8	-35.6	-47.3	-43.5		
Minimum -3	-13.2	-13.2	-13.4	-18.1	-26.8	-35.6	-47.3	-43.5		
L _{W(radiated)}	52.8	52.8	44.6	27.9	15.2	2.4	-13.3	-6.5		
NSR Distance (m)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4		
DI	0	0	0	0	0	0	0	0		
Point Source Attenuation	-14	-14	-14	-14	-14	-14	-14	-14		
Screening (NSR)										
Sound Level @ NSR	38.9	38.9	30.7	14.0	1.3	-11.5	-27.2	-20.4	42.2	dB
A-Weighted	12.7	22.8	22.1	10.8	1.3	-10.3	-26.2	-21.5	25.9	dB(A)

Calculation Charts

Extract Fan

Extract System - Discharge	Frequency (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k		
50JM/20/4/6/20	70	76	74	72	71	67	63	57	80.4	dB
A-Weighted	43.8	59.9	65.4	68.8	71	68.2	64	55.9	75.3	dB(A)
Circular Silencer 2D Podded	-4	-10	-16	-26	-29	-29	-29	-20		
Duct (m)	3	3	3	3	3	3	3	3		
Duct Losses per m	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		
Duct Losses	-0.21	-0.21	-0.21	-0.21	-0.21	-0.21	-0.21	-0.21		
End Reflection	-9	-5	-2	0	0	0	0	0		
Directionality	0	-2	-6	-10	-15	-20	-22	-22		
NSR Distance (m)	3	3	3	3	3	3	3	3		
DI	3	3	3	3	3	3	3	3		
Point Source Attenuation	-21	-21	-21	-21	-21	-21	-21	-21		
Sound Level @ NSR	39.2	41.2	32.2	18.2	9.2	0.2	-5.8	-2.8	43.7	dB
A-Weighted	13.0	25.1	23.6	15.0	9.2	1.4	-4.8	-3.9	27.9	dB(A)



Calculation Charts

AC Condenser

AC Standard Mode	Frequency (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k		
Daikin RZQSG100LV	56	61	59	55	51	46	42	35	64.7	dB
A-Weighted	29.8	44.9	50.4	51.8	51	47.2	43	33.9	56.9	dB(A)
Environ Enclosure	-14	-16	-23	-30	-37	-39	-38	-39		
NSR Distance (m)	3	3	3	3	3	3	3	3		
DI	3	3	3	3	3	3	3	3		
Point Source Attenuation	-10	-10	-10	-10	-10	-10	-10	-10		
Sound Level @ NSR	35.5	38.5	29.5	18.5	7.5	0.5	-2.5	-10.5	40.6	dB
A-Weighted	9.3	22.4	20.9	15.3	7.5	1.7	-1.5	-11.6	25.4	dB(A)



Calculation Charts

Coldroom Condensers

E100B	dB(A)
SPL 1m	50
Distance Measured	1
DI	3
Distance	2.5
Distance Attenuation	-8.0
Enclosure	-26.0
Screening	-5.0
Level @ NSR	14.0

EL150(H)	dB(A)
SPL 1m	50
Distance Measured	1
DI	3
Distance	2
Distance Attenuation	-6.0
Enclosure	-26.0
Screening	-5.0
Level @ NSR	16.0

APPENDIX 7

Noise Mitigation Products

Circular Silencers



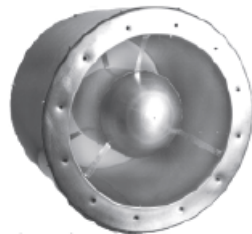
CDA - Circular Duct Attenuators

APPLICATIONS

For installation within air conditioning or ventilation ductwork systems to reduce the transmission of airborne ducted noise. Attenuators of 315 dia and above can be directly connected to axial flow fans. Attenuators from 100 dia to 400 dia are particularly suitable for terminal equipment or crosstalk applications.

SIZE RANGE

Diameter :From 100mm to 1000mm in a multitude of metric increments
Length :625, 925, 1225 for spigotted units
:One or two diameter for flanged units



Flanged Type



Spigotted Type

CONSTRUCTION

Model codes are used to define the specific constructional properties of each product. The coding system operates as follows:

PRIMARY CODE / OPTIONAL FEATURES / OPTIONAL EXTRAS

The coding definitions for CDA are as follows:

PRIMARY CODE:

CDA - galvanised sheet steel casing with lock formed joints
- internal liners and central pod (where applicable) faced with perforated or XPM sheet steel
- controlled density mineral wool infill with tissue facing to reduce fibre egress

OPTIONAL FEATURES

Casing pressure and leakage options:

1 - DW/TM1 Class B leakage and upto +1000 / -750 Pa pressure rating

Casing end connection options:

E - end spinning connections with threaded inserts from 315mm diameter upwards

P - plain spigot end connections (or flanged type units with spigot adaptors)

Central pod options:

U - unpodded straight through attenuator

C - central internal pod fitted within attenuator

OPTIONAL EXTRAS

M - melinex wrapped infill for grease, diluted chemical or moisture laden air and also to ensure zero fibre egress for hospital applications

W - wrapped casing ends with polythene to prevent ingress of rubble on site

X - denotes special optional extra as shown overleaf

EXAMPLE CODING

CDA / 1EC / MW



Noise Mitigation Products

Circular Silencers



CDA - Circular Duct Attenuators

Flanged Type Circular Attenuator															
Internal Diameter	External Diameter	Pod O.D	Length	Octave Band Static Insertion Loss(dB)								Weight (kg)	End Drilling Details		
				63	125	250	500	1k	2k	4k	8k		N	D	P.C.D
315	465	N/A	315	1	2	4	9	11	10	9	7	9	8	MB	355
			630	2	2	5	13	18	12	11	10	15			
315	465	170	315	2	7	8	14	22	25	22	19	11	8	MB	355
			630	3	13	14	23	30	30	28	25	17			
355	505	N/A	355	2	3	5	11	13	11	10	8	11	8	MB	395
			710	3	4	7	14	18	15	11	10	18			
355	505	170	355	2	6	8	11	22	24	21	16	13	8	MB	395
			710	3	10	15	22	29	30	29	22	21			
400	550	N/A	400	2	3	5	10	13	11	9	8	13	8	M10	450
			800	3	4	8	14	18	14	11	9	22			
400	550	210	400	2	7	9	15	23	25	21	17	16	8	M10	450
			800	3	10	14	24	30	29	28	21	26			
450	600	N/A	450	2	3	6	12	13	11	9	7	15	8	M10	500
			900	3	4	8	17	18	15	11	10	27			
450	600	210	450	2	6	8	16	23	23	21	16	18	8	M10	500
			900	3	7	12	22	29	29	25	20	31			
500	650	N/A	500	2	3	6	14	14	12	10	5	18	12	M10	560
			1000	3	7	8	19	20	17	14	11	22			
500	650	265	500	2	7	9	17	24	24	20	16	22	12	M10	560
			1000	4	10	16	26	29	29	29	20	37			
560	710	N/A	560	2	4	7	14	14	9	9	7	22	12	M10	620
			1120	3	6	10	19	20	14	12	10	39			
560	710	265	560	3	7	9	18	24	24	20	15	26	12	M10	620
			1120	4	9	17	27	29	28	23	23	46			
630	780	N/A	630	2	5	7	15	13	9	9	8	26	12	M10	690
			1260	4	7	13	21	21	14	13	12	48			
630	780	315	630	3	5	9	18	25	22	18	13	32	12	M10	690
			1260	5	9	18	28	30	29	24	19	57			
710	860	N/A	710	3	5	9	15	14	10	9	8	32	16	M10	770
			1420	4	9	16	22	23	17	13	9	59			
710	860	365	710	3	5	10	19	25	22	18	14	39	16	M10	770
			1420	5	9	17	28	29	30	26	20	71			
800	950	N/A	800	3	5	9	16	14	10	8	8	40	16	M10	860
			1600	4	6	10	21	23	17	12	10	74			
800	950	365	800	4	5	10	15	25	22	19	14	49	16	M10	860
			1600	5	8	18	29	30	29	27	19	90			
900	1100	N/A	900	3	5	10	17	15	11	9	8	55	16	M12	970
			1800	4	6	13	22	21	14	12	11	102			
900	1100	420	900	5	6	11	21	23	22	17	13	67	16	M12	970
			1800	5	11	18	29	30	26	19	16	123			
1000	1200	N/A	1000	4	6	11	17	15	11	9	8	66	16	M12	1070
			2000	5	10	16	23	23	16	13	11	124			
1000	1200	500	1000	5	6	13	22	25	21	17	14	82	16	M12	1070
			2000	5	10	19	29	30	27	22	18	151			



Noise Mitigation Products

Acoustic Enclosures

Environ Enclosures





Noise Mitigation Products

Acoustic Enclosures

Environ Enclosures



Environ Technologies Ltd

Regus House, 1010 Cambourne Business Park
Cambourne, Cambridgeshire, UK, CB23 6DP
Tel: +44 (0)870 383 3344
Fax: +44 (0)1223 598001
www.environ.co.uk

environlite ELV1.1.25ASHP Acoustic Performance Data (March 2010)

Noise Measurement Information:

Test: Environ Lite Acoustic Enclosure — W 1700mm x D 1000mm x H 1550mm

Test Standard:

BS EN ISO 140-3 Acoustics - Measurement of Sound Insulation in Buildings and of Building Elements - Part 1: Airborne Sound Insulation

Sound Level Measuring Equipment:

Norsonic 830 RTA Precision Sound Analyser Type 1
CEL 284/2 Acoustic Calibrator Type 1
JBL Loudspeaker driven by CEL Loudspeaker driven by 830 White Noise Source

Transmission Loss Data:

Transmission Loss — Environ ELV1.1.25AC Acoustic Enclosure							
Octave Frequency in Hertz (dB ref 2×10^{-5} Pascal's)							
63	125	250	500	1K	2K	4K	8K
14	16	23	30	37	39	38	39
<u>Summary</u>							
Transmission Loss Equates to an Overall Reduction of 26 dB(A)							

Support Information:

Monitoring was carried out using the BS3740 technique, insofar as measurements were taken in each quadrant and the results averaged. Internal Test Room: W 6m x D 16m x H 5m. Background noise in the semi-reverberant test room was such as not to interfere with the practical measurements

Noise Mitigation Products

Acoustic DuctWrap



Sound Research Laboratories

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Sudbury, Suffolk CO10 0TH
Tel: +44(0)1787 247595
e-mail: srl@srlsl.com



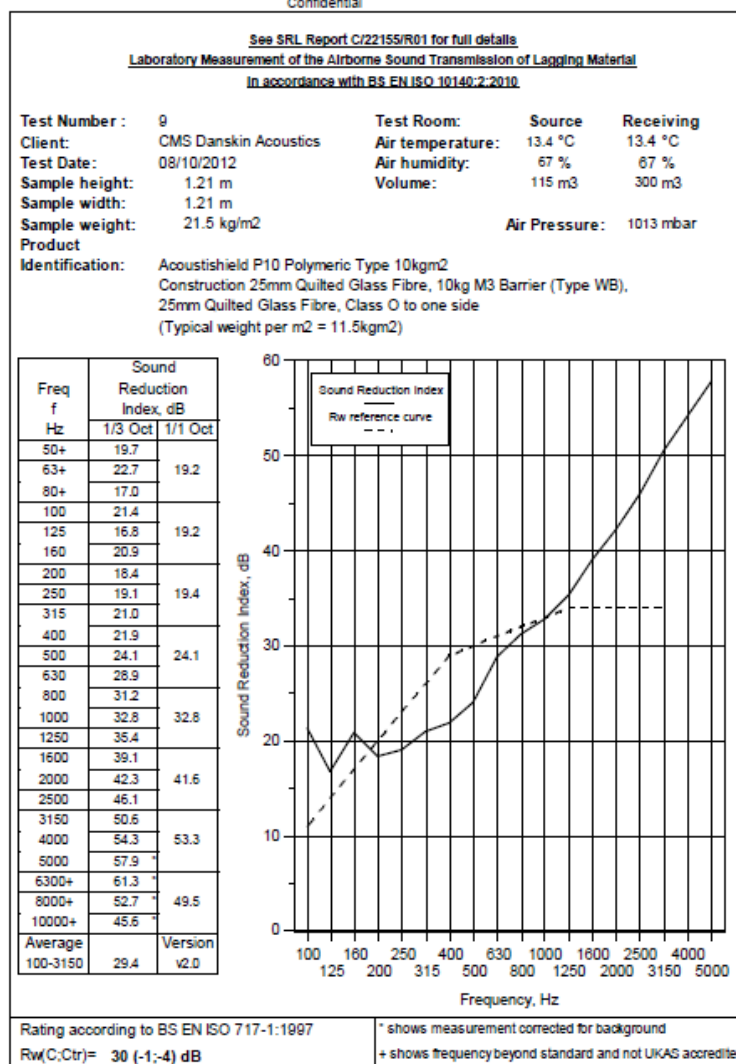
Test Certificate No: 7581

Contract: C/22155/R01

Page: 1 of 2

Date: 30 January 2013

Confidential




George Thomson
Tester



Allen Smalls
Quality Manager



Noise Mitigation Products

Acoustic DuctWrap



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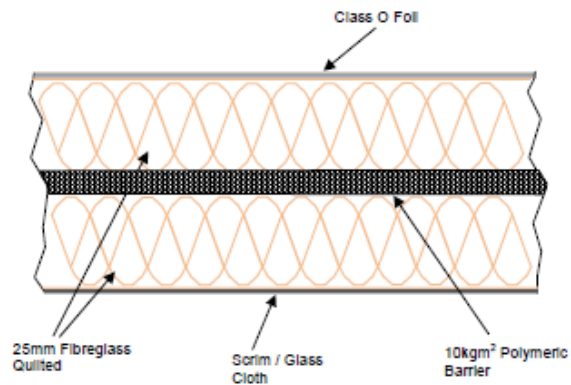
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Page: 2 of 2

Date: 30 January 2013

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Test 9 – Acoustishield P10

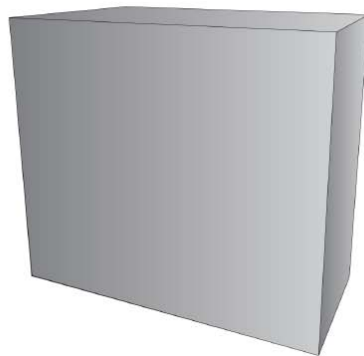
Noise Mitigation Products

Acoustic Screen

Panel
50mm deep



50mm



Front



Back

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:

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Noise Mitigation Products

Acoustic Screen

