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Project: J 04352
Mechanical Noise Impact Assessment (desktop):
GDK – Manchester, Wilmslow Road

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Dated: Tuesday 9th February, 2021

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1.0 BACKGROUND

1.1 The proposal for 311-313 Wilmslow Road, Fallowfield, Manchester includes the introduction of new mechanical plant (supply/extract fans, heat pumps (AC) and external condenser units).

1.2 The proposed operational times are 11:00 – 23:00 hours.

1.3 Sound Planning has been retained to carry out a desktop noise impact evaluation of proposed mechanical plant using background noise data from an existing report at the premises: *RPS Planning, Transport & Environment.*[1]

See APPENDIX 6 – Background Noise Measurements

1.4 Localised Environment

An evaluation of Google Earth screenshots around the localised area shows typical high street commercial premises including, bars, restaurants and take-aways; this would suggest relatively high levels of background noise well into the evening due to kitchen extract and air conditioning systems, as well as customer and road traffic noise.

1.5 Proposed Mechanical Plant:

Equipment/System	Serving
Supply Air System	Kitchen/Store/Office/Toilets
Extract Air System	Kitchen/Toilet
Heat Pumps/Condensers	(AC)
External Condensers	Cold Rooms

1.6 Sound Planning has been retained to evaluate potential noise impact on the nearest noise sensitive receivers using appropriate methodologies and assessment criteria.

[1] The background noise measurements were carried out in January 2006 i.e. no lockdown, or tier restrictions at this time; background noise levels are not thought to have decreased since this time/date.

1.6.1 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.

1.6.2 Qualifications

Dan has been working within the noise and vibration industry for fourteen 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 British Standard 4142: 2014.[2] [3]

2.2 BS 4142: 2014 – Scope

2.2.1 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

[2] British Standard 4142: 2014 – Methods for rating and assessing industrial and commercial sound.
[3] BS 4142: 1997 superseded by BS 4142: 2014.

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.

2.2.2 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.

2.3 BS 4142: 2014 – Assessment of Impacts

2.3.1 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.

2.3.2 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.

2.3.3 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.

2.3.4 Objective method for assessing the audibility of tones in sound: One-third octave method

The test for the presence of a prominent, discrete-frequency spectral component (tone) typically compares the $L_{Zeq,T}$ sound pressure level averaged over the time when the tone is present in a one-third-octave band with the time-average linear sound pressure levels in the adjacent one-third-octave bands.

For a prominent, discrete tone to be identified as present, the time-averaged sound pressure level in the one-third-octave band of interest is required to exceed the time-averaged sound pressure levels of both adjacent one-third-octave bands by some constant level difference. The level differences between adjacent one-third-octave bands that identify a tone are:

• 15 dB in the low-frequency one-third-octave bands (25 Hz to 125 Hz);

• 8 dB in the middle-frequency one-third-octave bands (160 Hz to 400 Hz);

• 5 dB in the high-frequency one-third-octave bands (500 Hz to 10 000 Hz).

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2.3.5 Rating Level

Subjective Method:

Tonality

For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.

Impulsivity

A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible.

One-third octave method:

Identify tones using the method given in Annex C, then add a correction of 6 dB if a tone is present.

Reference methods

When the one-third octave method is not sufficient, use the reference method for assessing the audibility of tones given in Annex D, which produces a penalty on a sliding scale from 0 dB to 6 dB.

Use the reference method given in Annex E for measuring the prominence of impulsive sounds, which produces penalties in the range 0.0 dB to 9.0 dB.

Other Sound Characteristics

Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Intermittency

When the specific sound has identifiable on/off conditions a penalty of 3 dB can be applied.

2.4 Guidance on the Control of Odour and Noise from Commercial Kitchen Exhaust Systems (DEFRA January 2005).

2.4.1 Minimum Requirements for Noise Control

For new premises or premises covered by planning conditions restricting the impact of noise the system shall be designed to prevent an acoustic impact on the external environment and therefore harm to the amenity.

For existing premises not covered by planning conditions restricting the impact of noise, the system shall be designed to avoid statutory nuisance and shall comply with the principles of Best Practicable Means.

To achieve these objectives the noise control system shall include:

- Control of noise at source to the greatest extent possible, and
- Control of noise to the environment by taking acoustic considerations into account within duct, grille and termination design.

The control system should meet the requirements laid down in BS 4142: 1997 *"Method for rating industrial noise affecting mixed residential and industrial areas"*.

2.4.2 Types of noise in industrial kitchens

Factors that influence magnitude of noise in a commercial kitchen are:

Size and format of the exhaust: The bulk flow leaving the exhaust diffuser generates broadband aero-acoustic noise. The sound level increases with increase in air speed and decreases with increase in area. The presence of grilles will generate tonal components. The sound levels are inversely proportional to the increase in area and increase with the eighth power of the flow speed.

- Heat release from kitchen: this influences the size of the exhaust system required and the flow rate of air to be handled by the system. Increase in flow rates can increase the pressure perturbations that can generate noise or can excite other parts of the system leading to noise.

- Type of cooking appliances used: this dictates the overall noise level as each individual appliance might contribute significantly to the total noise.

- Position of exhaust fan in the system: this may influence the noise radiated by the fan to the interior or exterior of the building and the transmission of sound energy into the exhaust duct system.

- Fitting and dimensions of the exhaust flow ducts: exhaust duct dimensions, fixings and insulation can all influence the amount of noise these structures will transmit and propagate. Selection of appropriate noise attenuating materials, avoidance of flow restrictions, and vibration isolators between the ducts and the fan are some of the aspects to be considered.

- Fan type and speed: Type of fan used (e.g. centrifugal fan with blades that are backward curved, forward curved or radial, or axial fan) will influence the level and nature of noise emitted. The fan characteristic needs to be chosen so that it is operating at its most efficient duty point as this tends to be the region of minimum noise.

  If fan speed is too high it will be operating away from that point which can lead to increases in level of up to 10 dB, as well as inefficient air management. It is often also desirable acoustically to use larger fans operating at low speeds rather than smaller fans operating at higher speeds

2.4.3 Extract System Design

The following points should be taken into account when designing a ventilation system to minimise noise emissions:

- The fan and its installation should be designed as a complete package for a specific task. Fans generally produce less noise if operated at the optimum efficiency relative to their characteristics;

- Fans should be located within buildings at low level, that is, on side walls, rather than in the roofs of buildings, as ground effect and the local topography will far more readily reduce the noise transmission;

- Correct selection of duct size and type;

- Lined or lagged ducts, including bends, elbows or spigots, may be required if additional noise reduction is necessary; and

- The recommended maximum supply and return velocities for grilles and terminals should be applied.

- Silencers may be required where additional attenuation is necessary. A range of silencers is available and it may be necessary to insert in-duct silencers both upstream and downstream to prevent radiation of fan noise through ductwork. These should be fitted as close to the fan as possible (but not so close as to lead to a non-uniform air flow velocity across the face of the silencer). Where this is not possible, the intervening ductwork should be acoustically lagged. It may also be necessary to enclose or lag the fan. Where fans are used to push gases up a stack, silencers containing absorbent material can sometimes be mounted directly on top of the stack. However, where gases are hot, wet or dirty, the infill may need to be protected.

- Acoustic louvres on exhausts and inlets can greatly reduce environmental noise. However, their performance can sometimes increase back-pressure or the velocity of the air flow leading to increased noise.

3.0 METHODOLOGY

3.1 Background Noise Assessment (Sound Planning)

3.1.1 Sound Planning has been retained to carry out a desktop noise impact evaluation of proposed mechanical plant using background noise data from an existing report at the premises: *RPS Planning, Transport & Environment*.[4]

[4] The background noise measurements were carried out in January 2006 i.e. no lockdown, or tier restrictions at this time; background noise levels are not thought to have decreased since this time/date.

3.1.2 Noise measurements were carried out to the rear of Revolution Bar on middle of alleyway between 2 Standish Road and 4 Carill Drive.

3.1.3 Sound Planning has used the lowest (L_{A90}) 5 minute periods measured during the equipment's proposed operation times.

See paragraph 4.1 - Background Noise Levels and APPENDIX 6 – Background Noise Measurements

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:

$SPL_2 = SPL_1 – 20log_r – 11 + DI$[5] +/- MISC

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

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 volume[6].

3.3.2 The fan sound power level (SWL) will be attenuated by internal system (duct) losses and end reflection on reaching the exhaust termination[7].

3.3.3 Duct Break-Out[8] calculations will utilise the formula:

$SWL_{break\text{-}out} = SWL_{duct} – R + 10log(S/A)$[9]

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[5] DI = Directivity Index.
[6] Sound Research Laboratories: *Noise Control in Building Services*. Pergamon Press 1988.
[7] Sound Research Laboratories: *Noise Control in Building Services*. Pergamon Press 1988.
[8] See APPENDIX 7 – Plant Noise Calculations.
[9] Sound Research Laboratories: *Noise Control in Building Services*. Pergamon Press 1988.

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

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:

$SPL_2 = SPL_1 - 20\log_r - 11 + DI$[10] [point source] and $SPL_2 = SPL_1 - 10\log_r - 11 + DI$ [line source].

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

3.3.5 The directionality of the duct opening[11] relative to the receiver should also be considered; the approximate directivity attenuation can be found by comparing fd/c with the angle to the receiver[12].

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 $(2.\delta/\lambda)$[13].

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

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

[10] DI = Directivity Index.
[11] The configuration of the duct termination is currently unknown e.g. cowl etc.
[12] 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.
[13] Attenborough, K. et al. *Predicting Outdoor Sound*. Copyright Taylor & Francis Group 2007.

3.4 Noise Level Evaluation

3.4.1 Extract Duct - Acoustic Features

Kitchen extract fans (attenuated) sound emissions contain minimal *tonality* (+2 dB penalty) and should not display *'impulsive'* sound characteristics; however they do emit 'other sound characteristics (+3 dB penalty) in operation.

Total sound characteristic penalties are 5 dB.

3.4.2 Target Noise Level

Due to the total sound penalties of 5 dB (for both noise sources), it would seem reasonable to target 10 dB below the lowest background level as required in BS 4142: 1997 (this equates to a Rating level of 5dB below background in the context of BS 4142: 2014).

This target level equates to an evaluation of *'complaints unlikely'* [BS 4142: 1997] and the sound source having *'low impact'* [BS 4142: 2014].

4.0 RESULTS

4.1 Background Noise Levels[14]:

4.1.1 Time Period Results (RPS Planning, Transport & Environment Report)[15]

Time Period (hours)	Background Level (dB L_{A90})	Time Occurred (Time Period) Hours
11:00 to 23:00	52	22:40 – 22:45
11:00 to 00:00	50	23:55 – 00:00
24 hours	43	01:50 – 01:50

[14] See APPENDIX 6 for full results.
[15] RPS Planning, Transport & Environment report dated 30 January 2006.

4.1.2 The quietest background level during the proposed operational period of the supply/extract system/AC is 52 dB L_{A90}; the refrigeration condensers can operate any time in 24 hour period with a quietest background level of 43 dB L_{A90}.

See APPENDIX 6 – Background Noise Measurements

4.2 Noise Sensitive Receivers

External Mechanical Plant	NSR Window Distance (m)	Screened from Nearest NSR[16]
Extract System - Outlet Duct (1)	4	Yes
Extract System - Outlet Duct (2)	2.5	No
Extract System - Outlet Duct (3)	4	No
Extract System - Termination Cowl	6	No
Supply System - Atmosphere Intake	4	Yes
Freezer Condenser	4.5	Yes
Chiller Condenser	5	Yes
Heat Pump (AC1)	6	Yes
Heat Pump (AC2)	6	Yes

See APPENDIX 2 – Site Location and APPENDIX 3 – Site Plans/Elevations

[16] 'Line of sight' screening results in a minimum attenuation level of 5dB.

4.3 Levels of Uncertainty

Category	Notes
Complexity of Sound Source	Extract Duct Break-Out. Supply/Extract Air to Atmosphere Heat Pumps (fan/compressor) Condensers (fan/compressor)
Complexity of Acoustic Environment (Residual)	Site positioned to the rear of busy high street with commercial buildings including bars & restaurants.
Level of Residual Sound (including Specific)	n/a

5.0 NOISE LEVEL CALCULATIONS

5.1 Combined Sound Pressure Level at Nearest Noise Sensitive Façade (before attenuation)

5.1.1 Nearest Noise Sensitive Receiver (window) – Restaurant Opening Hours

System Area	Level @ NSR
(Opening Times)	**dB(A)**
Extract System - Outlet Duct (Area 1)	49
Extract System - Outlet Duct (Area 2)	61
Extract System - Outlet Duct (Area 3)	56
Extract System - Termination Cowl	55
Supply System - Atmosphere Intake	57
Freezer Condenser	50
Chiller Condenser	48
Heat Pump (AC1)	40
Heat Pump (AC2)	40
Combined	**64**
Background	**52**
Excess	**12**

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5.1.2 Nearest Noise Sensitive Receiver (window) – 24 hrs (refrigeration condensers)

System Area	Level @ NSR
(24 hours)	**dB(A)**
Freezer Condenser	50
Chiller Condenser	48
Combined	**52**
Background	**43**
Excess	**9**

6.0 NOISE MITIGATION (recommended)

6.1 Nearest Noise Sensitive Receiver (window) – Restaurant Opening Hours

System Area	Attenuation	Level @ NSR
(Opening Times)		**dB(A)**
Extract System - Outlet Duct (1)	Silencer 100mm Air Way x 1200mm (L)	28
Extract System - Outlet Duct (2)	Silencer 100mm Air Way x 1200mm (L)	39
Extract System - Outlet Duct (3)	Silencer 100mm Air Way x 1200mm (L)	34
Extract System - Termination Cowl	Silencer 100mm Air Way x 1200mm (L)	27
Supply System - Atmosphere Intake	Silencer 100mm Air Way x 1200mm (L)	35
Freezer Condenser	Acoustic Louvre Enclosure (-19dB)	31
Chiller Condenser	Acoustic Louvre Enclosure (-19dB)	29
Heat Pump (AC1)	Acoustic Louvre Enclosure (-12dB)	28
Heat Pump (AC2)	Acoustic Louvre Enclosure (-12dB)	28
Combined		**42**
Background		**52**
Excess		**-10**

See APPENDIX 7 - Plant Noise Calculations for further calculation detail

6.2 Nearest Noise Sensitive Receiver (window) – 24 hrs (refrigeration condensers)

System Area		Level @ NSR
(24 hours)		dB(A)
Freezer Condenser	Acoustic Louvre Enclosure (-19dB)	31
Chiller Condenser	Acoustic Louvre Enclosure (-19dB)	29
Combined		**33**
Background		**43**
Excess		**-10**

See APPENDIX 7 - Plant Noise Calculations for further calculation detail

6.3 Noise Mitigation Notes

6.3.1 Flakt Woods Splitter Attenuators and Spigot Silencers should be fitted as close as possible to the fan (inlet and outlet side) as specified.

6.3.2 The cross-sectional area of the attenuator may have to be larger than the duct in order to restrict pressure drop to permissible levels[17]; if this is the case duct transitions may be required before and after the attenuator.

6.3.3 The acoustic enclosures should be separated to allow for air flow in and out of enclosures (please seek advice from supplier).

6.4 Suppliers

Flakt Woods	TEL: 01206 222614 (Silencers)
Sound Planning	TEL: 01252 711972 (Acoustic Enclosures)
Elta Fans	TEL: 01489 566500 (Silencers)

[17] The contractor should verify pressure drop with Flakt Woods.

7.0 CONCLUSIONS

7.1 Sound Planning has carried out a noise impact assessment in accordance with BS 4142 (desktop analysis).

See section 3.0 - METHODOLOGY

7.2 Background Noise Levels

7.2.1 Sound Planning has been retained to carry out a desktop noise impact evaluation of proposed mechanical plant using background noise data from an existing report at the premises: *RPS Planning, Transport & Environment.*[18]

7.2.2 Time Period Results (RPS Planning, Transport & Environment Report)[19]

Time Period (hours)	Background Level (dB L_{A90})	Time Occurred (Time Period) Hours
11:00 to 23:00	52	22:40 – 22:45
11:00 to 00:00	50	23:55 – 00:00
24 hours	43	01:50 – 01:50

See APPENDIX 6 – Background Noise Measurement

7.3 Predicted Sound Levels at Nearest Noise Sensitive Receivers

Nearest Residential Windows (rear elevation overlooking external plant)

The predicted combined plant noise at the nearest noise sensitive receiver (rear elevation) exceeds background noise levels by 12 dB(A) during the operational hours of the restaurant (11:00 – 23:00 hours) and 9 dB(A) during the night time when refrigeration plant (Chiller & Freezer) will need to be operational.

See paragraph 5.1

[18] The background noise measurements were carried out in January 2006 i.e. no lockdown, or tier restrictions at this time; background noise levels are not thought to have decreased since this time/date.
[19] RPS Planning, Transport & Environment report dated 30 January 2006.

7.4 The introduction of noise mitigation measures (noise control products) results in a combined external mechanical plant noise level at the worst affected noise sensitive window which meets target levels during restaurant opening hours and overnight (refrigeration plant) i.e. 10 dB below background.

The proposed noise mitigation measures result in a *low impact* at the worst affected noise sensitive receiver and meet the requirements of BS 4142: 2014.

See paragraph 6.1 – 6.4

7.5 Noise Mitigation Products

7.5.1 Supply Air Fan (kitchen)

Inlet (atmosphere): 100mm Air x 1200mm (L) Flakt Woods Splitter Silencer

7.5.2 Extract Fan (kitchen)

Outlet (atmosphere): 100mm Air x 1200mm (L) Flakt Woods Splitter Silencer

7.5.3 External Condenser Units

Acoustic Louvre Enclosures (sized to suit)

7.6 Levels of Uncertainty

7.6.1 The complexity and screening of the sound sources would lead to the greatest uncertainty. Sound Planning has evaluated each source in detail, its position relative to the nearest noise sensitive receivers and used appropriate calculation methodology in order to accurately predict specific noise (and noise rating level) at the nearest noise sensitive receiver.

7.6.2 Sound Planning has taken the lowest background noise levels for equipment operational times from the RPS Planning, Transport & Environment report dated January 2006 (pre-COVID-19 restrictions).

7.6.2 Sound Planning has designed to a minimum 10 dB below background (assumed), this should allow for any penalties which could be applied for '*Tonality*', '*Impulsivity*', '*Intermittency*' and *'Other Sound Characteristics'*.

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APPENDIX 1

Terms & Definitions

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).

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).

BS 4142 - Noise Descriptors

For the purposes of this British Standard, the following terms and definitions apply.

NOTE All the measurements and values used throughout this standard are "A"-weighted. Where "A" weighting is not explicit in the descriptor, it is to be assumed in all cases, except where it is clearly stated that it is not applicable, as in the case of tones.

Acoustic Environment

Sound from all sound sources as modified by the environment [BS ISO 12913-1:2013].

Ambient Sound

Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far .

NOTE The ambient sound comprises the residual sound and the specific sound when present.

Ambient Sound Level, $L_a = L_{Aeq,T}$

Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, *T*.

NOTE The ambient sound level is a measure of the residual sound and the specific sound when present.

Background Sound Level, $L_{A90,T}$

A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, *T*, measured using time weighting F and quoted to the nearest whole number of decibels.

Equivalent Continuous A-weighted Sound Pressure Level, $L_{Aeq,T}$

Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t2 - t1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

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$$L_{\mathrm{Aeq},T} = 10\lg_{10}\left\{(1/T)\int_{t_1}^{t_2}[p_{\mathrm{A}}(t)^2/p_0^2]\mathrm{d}t\right\}$$

where:

p_0 is the reference sound pressure (20 µPa); and
$p_{\mathrm{A}}(t)$ is the instantaneous A-weighted sound pressure (Pa) at time t.

NOTE The equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number of decibels.

Measurement Time Interval, T_{m}

Total time over which measurements are taken.

NOTE This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.

Rating Level, $L_{\mathrm{Ar},T\mathrm{r}}$

Specific sound level plus any adjustment for the characteristic features of the sound.

Reference Time Interval, T_{r}

Specified interval over which the specific sound level is determined.

NOTE This is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h.

Residual Sound

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

Residual Sound Level, $L_{\mathrm{r}} = L_{\mathrm{Aeq},T}$

Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T.

Specific Sound Level, $L_s = L_{Aeq,Tr}$

Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, *T*r.

Specific Sound Source

Sound source being assessed.

Frequency Analysis

Octave Band	*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…*
One Third Octave	*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.*

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.

APPENDIX 2

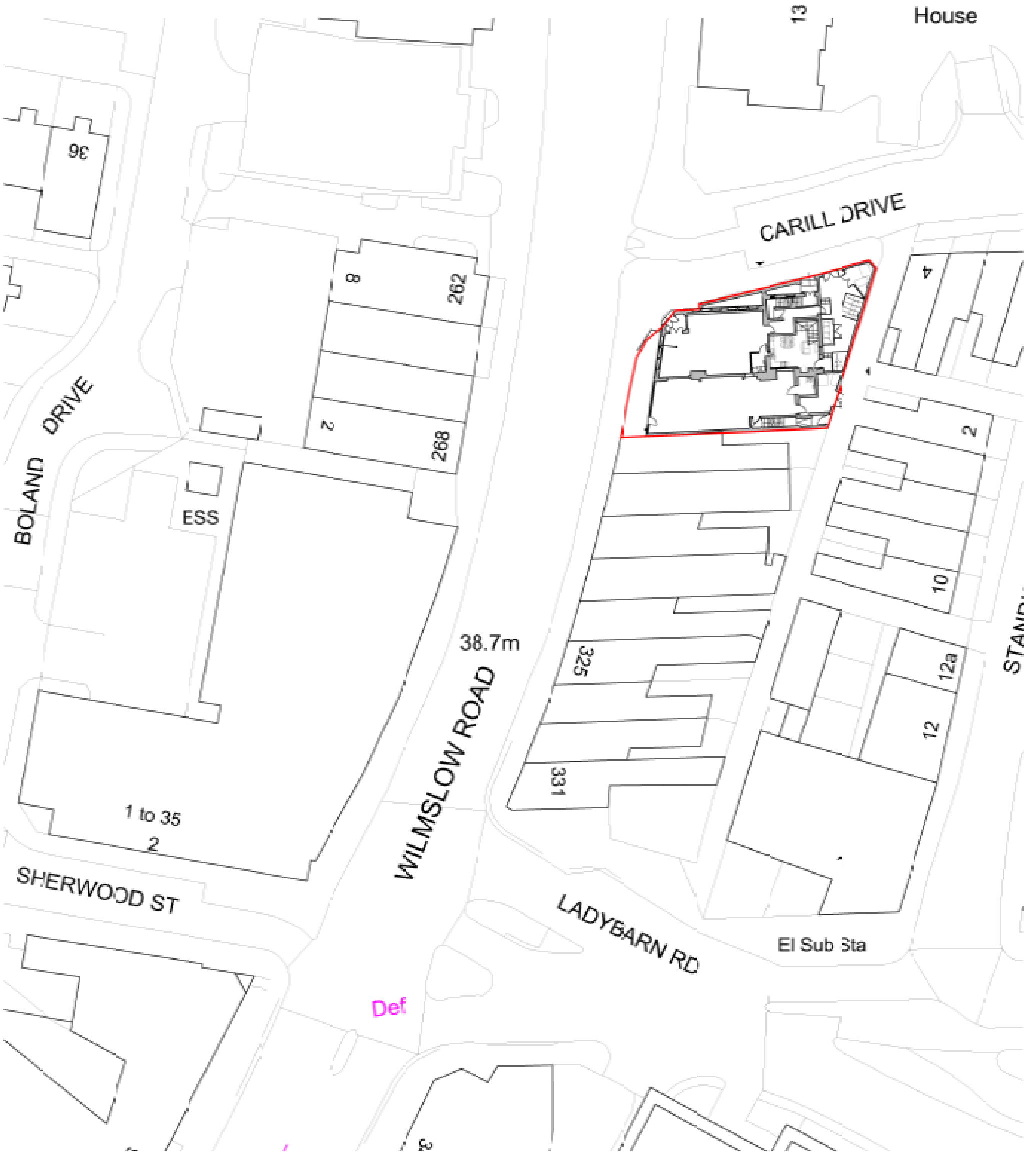
Site Location

Google Earth - Screenshot

311-313 Wilmslow Road, Fallowfield, Manchester

Site Location

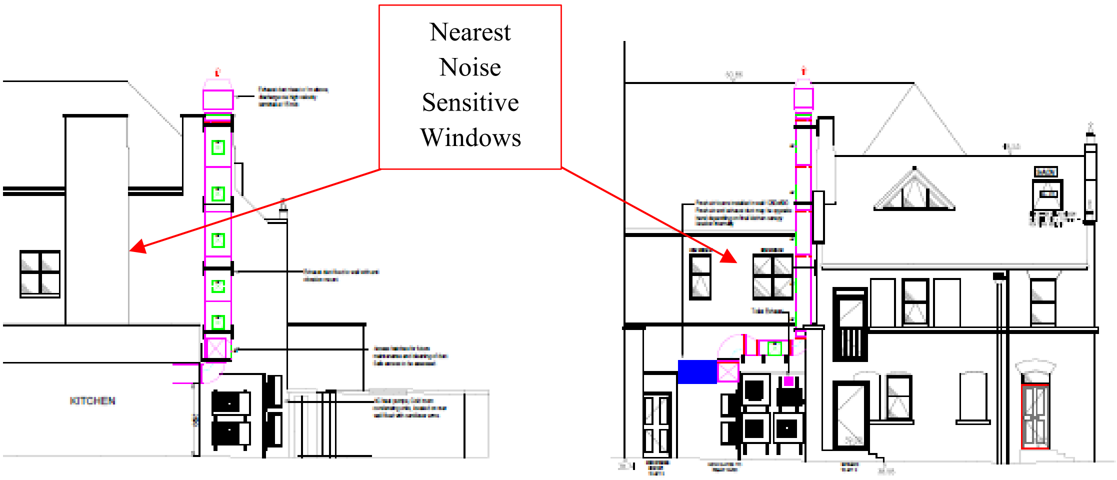
Site Plot



APPENDIX 3

Site Plans/Elevations (proposed)

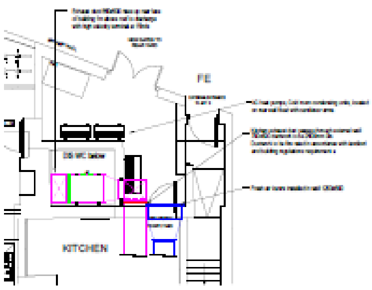
Mechanical Plant Layout



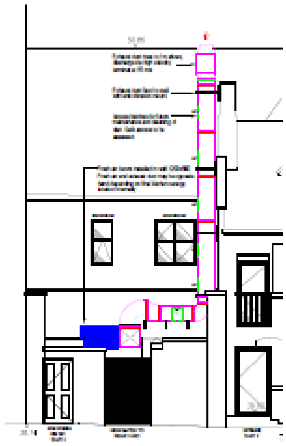
SIDE ELEVATION

REAR ELEVATION

LOCATION OF DUCT PENETRATIONS



GROUND FLOOR



REAR ELEVATION INC YARD BOUNDARY
(actual view from street)

APPENDIX 4

Site Photographs

Localised Area to Proposed Mechanical Plant

Localised Area to Proposed Mechanical Plant

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APPENDIX 5

Equipment Noise Data

Extract Fan

Flakt Wood MaXfan

MAXFAN COMPAC

Woods
A Fläkt Woods Brand

MAXFAN COMPAC - THE NEXT GENERATION IN KITCHEN FANS

Designed and Manufactured in the UK

FEATURES

- 400 - 630 mm diameter
- Volumes up to 4.9m³/s
- Static Pressures up to 900 Pa (Non-stalling characteristic)
- Fans tested to ISO5801 and BS848
- High efficiency energy saving IE2 motor
- Low breakout noise levels
- Motor protection and terminal block IP55 (DW172 & Defra Compliant)
- Ambient temperatures up to 80ºC (Dependant on size)
- Overheat protection as standard
- Compact robust light weight construction
- Galvanised casing for high corrosion resistance
- Full inverter control and flexibility

ELECTRICAL SUPPLY

230v/50Hz/1 Ph (3 Ph Motor) - L Type

TEMPERATURE RANGE

Suitable for temperatures up to 80ºC*

*dependent on the fan size, please refer to the specific fan technical page

SIZES

400, 450, 500, 560 and 630 mm

Smaller 315 & 355 mm available on request

IMPELLERS

A unique high efficiency aerofoil section blade with a smoothed hub and clamp plate offers a high efficiency solution.

The Fläkt Woods impellers are all high pressure die cast to offer thin aerofoil sections for low generation of noise. Every cast aluminium component is X-ray examined using Real Time Radiography inspection prior to assembly. The maximum pitch angles shown allow for speed control by frequency inverter.

MOTORS

All motors are totally enclosed air stream rated with class F insulation. Constructed from aluminium or cast iron as standard with special pad mounted fixings. Although this product incorporates a three phase electric motor, by using a matched inverter solution it is suitable for use with a single phase electrical supply on site. In addition, using a frequency inverter allows the speed to be turned down to 20% of maximum speed. Suitable for horizontal or vertical shaft operation. Supplied IP55, with removable drain plugs.

Sealed for life bearings lubricated with wide temperature range grease. The complete range of motors are fitted with Thermistor OHP as standard. Motors are IE2 efficiency class as standard.

CASINGS

The MaXfan Compac is available with a galvanised casing, complete with an externally mounted pre-wired electrical terminal box. Casings are spun from sheet steel with integral pre-drilled and radiused inlet flanges. The galvanised finish gives a high resistance to corrosion and is ideal for external as well as internal use.

PRODUCT CODE

40 MaXfan Compac

- 40 - denotes the fan impeller diameter in centimetres

ACCESSORIES

e³
ENVIRONMENT ECONOMICAL EXPERTISE

Equipment Noise Data

Extract Fan

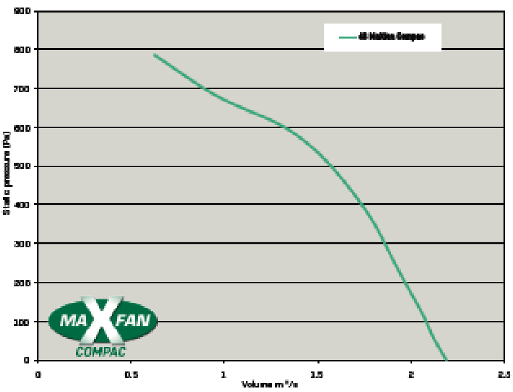
Flakt Wood 45 MaXfan Compac

Woods
A Fläkt Woods Brand

MAXFAN COMPAC

230 V/50HZ/1 PH - L TYPE

PERFORMANCE CHART - 45 MaXfan Compac (EJ463266)



ADDITIONAL ACCESSORIES

PRODUCT AND ELECTRICAL TABLE - 45 MaXfan Compac

Part Number	Fan Description	Temperature (°C)	Frame	kW	FLC (A)	SC (A)	Phase	Voltage	Inverter Model	Wiring Diagram	Breakout Sound Level dB(A) @ 3m	Fan Weight (kg)	Casing Length (mm)
EJ463266	45 MaXfan Compac	55	80	1.32	5.1	25.5	1	230	6.8	OD0040	40	37	375

SOUND DATA - 45 MaXfan Compac

	Sound Spectrum (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 3m**
Inlet*	79	81	88	82	80	80	79	75	81	66
Outlet*	79	81	88	82	81	80	79	77	81	67
Breakout*	69	63	66	59	58	52	57	53	72	43

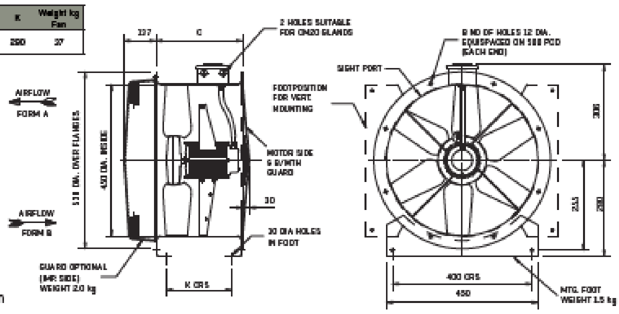
*Lw dB re 10^{-12} W

Ps Sound data at 1.88m3/s @ 200Pa (static)

**dBA re $2x10^{-5}$ Pa

DRAWING - 45 MaXfan Compac

Size	Motor Frame	C	K	Weight kg Fan
450	80	375	280	37



All dimension in mm

Equipment Noise Data

Supply Fan

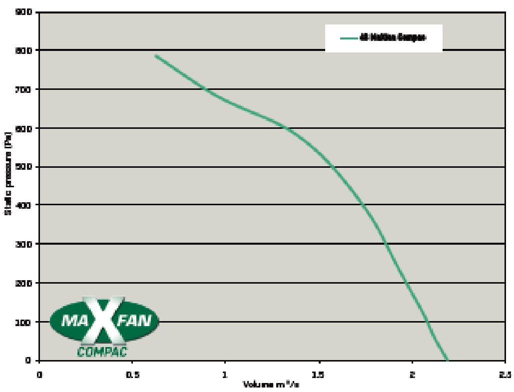
Flakt Wood 45 MaXfan Compac

Woods
A Fläkt Woods Brand

MAXFAN COMPAC

230 V/50HZ/1 PH - L TYPE

PERFORMANCE CHART - 45 MaXfan Compac (EJ463266)



ADDITIONAL ACCESSORIES

PRODUCT AND ELECTRICAL TABLE - 45 MaXfan Compac

Part Number	Fan Description	Temperature (°C)	Frame	kW	FLC (A)	SC (A)	Phase	Voltage	Inverter Model	Wiring Diagram	Breakout Sound Level dB(A) @ 3m	Fan Weight (kg)	Casing Length (mm)
EJ463266	45 MaXfan Compac	55	80	1.32	5.1	25.5	1	230	6.8	CD0042	40	37	375

SOUND DATA - 45 MaXfan Compac

	Sound Spectrum (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 3m**
Inlet*	79	81	89	92	90	90	79	75	91	66
Outlet*	79	81	91	92	91	90	79	77	91	67
Breakout*	69	83	66	59	56	52	57	53	72	43

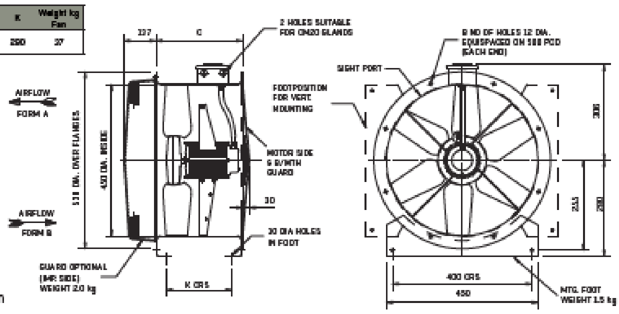
*Lw dB re 10^{-12} W

Ps Sound data at 1.88m3/s @ 200Pa (static)

**dBA re $2x10^{-5}$ Pa

DRAWING - 45 MaXfan Compac

Size	Motor Frame	C	K	Weight kg Fan
450	80	375	290	37



All dimension in mm

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Equipment Noise Data

Toilet Extract Fan

systemair

K 100 EC sileo

Systemair Circular duct fan K 100 EC
Item Number: 16955
Variant: 230V 1~ 50/60Hz

EC-motors, high level of efficiency
100% speed controllable
Integrated motor protection
Supplied with mounting bracket
EC technology is intelligent technology; using integral electronic control which eliminates the slip losses in the motor and ensures that the motor always runs at optimal load and guarantees that the proportion of energy utilised effectively is many times higher and the energy usage considerably lower compared with AC motors.
EC fans are notable for their economical use of energy and excellent ease of control. They can be varied in speed to match the airflow demand, and operate at high efficiency levels. For the same air volume, they consume distinctly less energy than AC fan drives.
Another special feature of EC fans is their energy-saving potential not only at full load, but especially at part-load. When operating at part-load, the energy used is much lower than with an asynchronous motor of equivalent output.
Reduced energy usage guarantees a drop in operating costs.
The K EC series is designed for installation in ducts. All the K-fans have minimum 25 mm long spigot connections. The fans have backward-curved blades and external rotor motors (EC). The FK mounting clamp facilitates easy installation and removal, and prevents the transfer of vibration to the duct. The fans are delivered with a pre-wired potentiometer(0-10V) that allows you to easily find the desired working point.
Motor protection is integrated in the electronics of the motor. The casing is manufactured from galvanised sheet steel with the seams folded to give the fan a close to air tight casing.

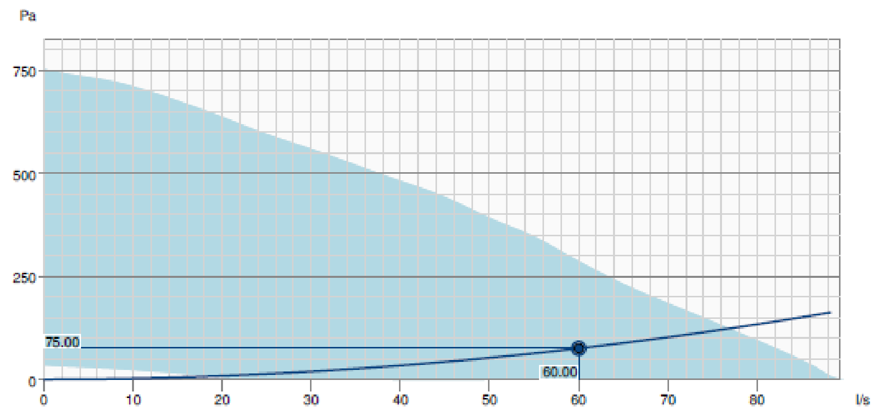
Technical parameters

Nominal data		
Voltage (nominal)	230	V
Frequency	50; 60	Hz
Phase(s)	1~	
Input power	83	W
Input current	0.69	A
Impeller speed	3,479	r.p.m.
Air flow	max 321	m³/h
Temperature of transported air	max 60	°C

Equipment Noise Data

Toilet Extract Fan

Performance curve



Hydraulic data	
Required air flow	60.00 l/s
Required static pressure	75 Pa
Working air flow	60.00 l/s
Working static pressure	75 Pa
Air density	1.204 kg/m³
Power	37.7 W
Fan control - RPM	2442 rpm
Current	0.31 A
SFP	0.628 kW/m³/s
Control voltage	6.9 V
Supply voltage	230 V

Sound power level		63	125	250	500	1k	2k	4k	8k	Total
Inlet	dB(A)	52	61	66	66	63	59	50	38	71
Outlet	dB(A)	53	63	63	61	63	59	51	38	69
Surrounding	dB(A)	12	11	25	43	44	42	37	22	48
Sound pressure level at 3m (20m² Sabine)	dB(A)	-	-	-	-	-	-	-	-	41
Sound pressure level at 3m free field	dB(A)	-	-	-	-	-	-	-	-	27

rticle name: K 100 EC sileo | Item Number: 16955 | Variant: 230V 1~ 50/60Hz | Document type: Product card | Date: 2020-06-25 | Generated by: systemair Online atalogue | Language: English

Page 3 of 4

Equipment Noise Data

Coldroom Condensers[20]

Type	Winsys outdoor	Wintsys outdoor
Model	WINAJ4519Z	WINFH2511ZFZ
Dimensions	W 942mm D 574mm H 690mm	W 1174 mm D 531 mm H 710mm
Weight	65 kg	83kg
Compressor Model	CAJ4519Z	CAJ4531Z HR
Pipe sizes	Gas 5/8 liquid 3/8"	Gas 7/8" Liquid ½"
Power supply S/Phase	20amp	30amp
Refrigerant	16amp per phase	16amp per phase
Gas	R404a	R404a
Noise Level	41 dBA	42 dBA

[20] 'Noise Level' measured at 10m - Conversion to SPL@ 1m. + 20 log (10/1).

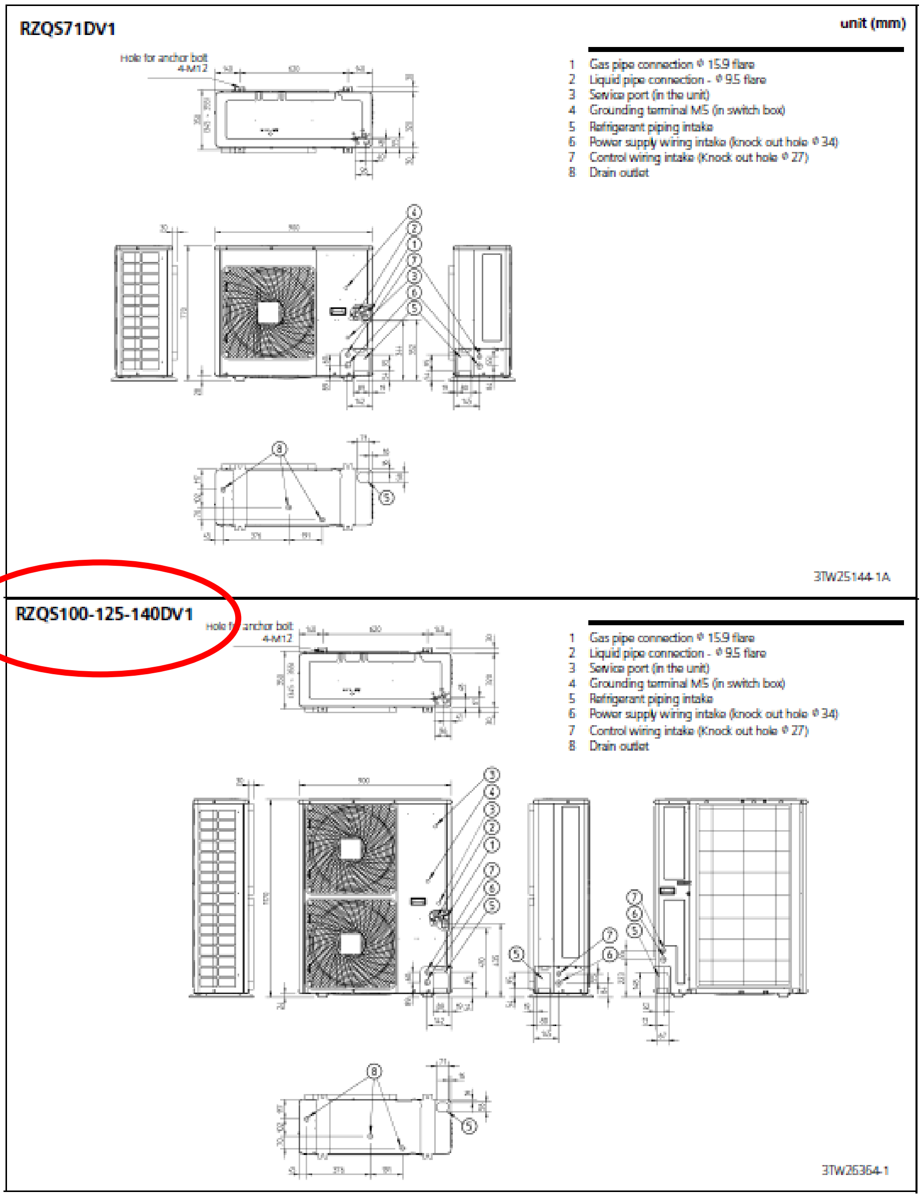
Equipment Noise Data

External Condenser Units

Daikin RZQS100

6 Dimensional drawing & centre of gravity

6 - 1 Dimensional drawing



Equipment Noise Data

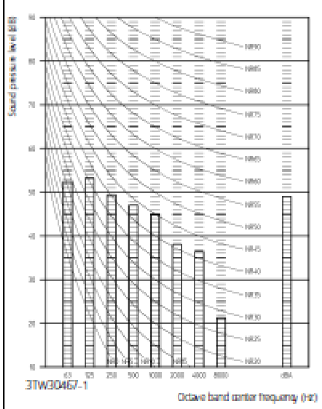
External Condenser Units

Daikin RZQS100

9 Sound data

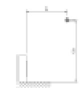
9 - 1 Sound pressure spectrum

RZQS71DV1 - Cooling

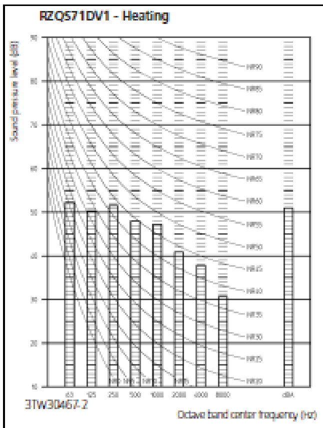


NOTES

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



RZQS71DV1 - Heating



NOTES

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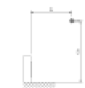
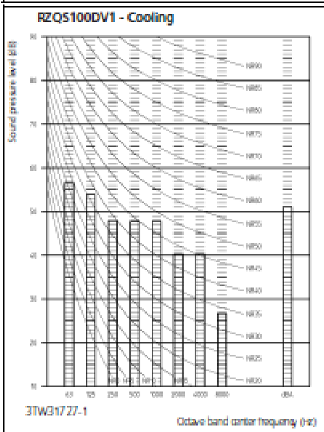
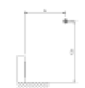


RZQS100DV1 - Cooling

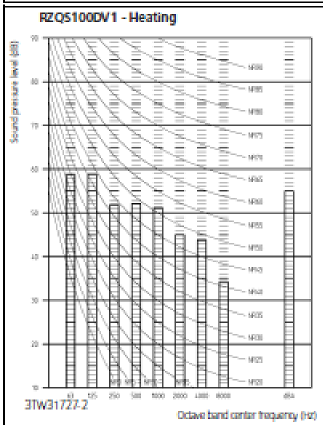


NOTES

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



RZQS100DV1 - Heating



NOTES

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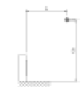
2. Data is valid at nominal conditions.
3. dB(A) = A-weighted sound pressure level (A-scale according to IEC)
4. Reference acoustic pressure 0dB = 20μPa



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APPENDIX 6

Background Noise Measurements

Report by RPS Planning, Transport & Environment Jan 2006

RPS

NOISE ASSESSMENT
REVOLUTION BAR
311 – 313 WILMSLOW ROAD, FALLOWFIELD

Prepared by:
S Bangue BEng(Hons) AMIOA

Checked by:
A E Charles M.Phil., M.I.O.A., M.I.H.T.

34 Lisbon Street
Leeds
West Yorkshire
LS1 4LX

RPS Ref: DLN0385
Date: 30 January 2006

Tel 0113 220 6190
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Email rpsld@rpsgroup.com

Planning, Transport & Environment

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Background Noise Measurements

Report by RPS Planning, Transport & Environment Jan 2006

311-313 Wilmslow Road, Fallowfield

Summary

It is proposed to extend the licensing hours for Revolution Bar, 311-313 Wilmslow Road, Manchester from 00:00 hours until 02:00 hours Monday – Saturday and from 23:30 hours until 02:00 hours Sunday.

The noise monitoring indicated that noise levels were relatively consistent over the monitoring period and little variation was exhibited between the time Revolution Bar was open and closed.

Although music and activities from within the Revolution Bar were audible during the monitoring period they were not the main contributor to the noise climate of the area. Sources such as traffic noise and the general public were the main contributors to the noise climate.

It was also observed that there was little or no significant difference in the monitored peak levels between the time the bar was open and when it was closed when monitoring took place.

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Background Noise Measurements

Report by RPS Planning, Transport & Environment Jan 2006

4 Analysis of Existing Noise Climate

4.1 In order to determine the existing noise climate of the area, noise monitoring was carried out at the subject site, from 22:56 hours on Saturday 11 November 2005 until 03:01 hours on Sunday 12 November 2005 and from 22:35 hours on Sunday 13 November 2005 until 02:04 hours on Monday 14 November 2005.

4.2 The instrumentation used for the on site noise survey was a Quest Technologies 1900 Precision Integrating/Logging Sound Level Meter, serial number: CC50500009. The instrument was calibrated before and after the monitoring periods and no significant deviations were noted. The instrumentation calibration documentation is included in Appendix A.

4.3 During all measurements, the microphone was mounted on a tripod at a height of 1.5m above the site ground level and was set to measure L_{Aeq}, L_{A90}, L_{A10} and L_{Amax} levels.

4.4 The weather conditions during the survey period were dry with very little wind and all noise monitoring undertaken was attended by an RPS trained technician.

4.5 The following table summarises the average L_{Aeq}, highest L_{Amax} and L_{A10} values, and the lowest L_{A90} dB values recorded during the day and night time periods, and gives the resulting NEC classification for both periods:

Table 4.1: Summary of Noise Monitoring Results

Location	Date	Time Period	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90}
Rear of Revolution Bar in middle of alleyway between No. 2 Standish Road and No.4 Carill Drive, Fallowfield, Manchester	11.11.05	23:01 – 23:56	55.3	71.6	56.5	53.7
	12.11.05	00:01 – 00:56	53.0	74.8	54.2	51.0
	12.11.05	01:01 – 01:56	53.0	81.7	54.4	49.8
	12.11.05	02:01 – 03:01	52.1	74.7	53.6	49.6
	13.11.05	22:35 – 23:30	54.8	79.2	56.2	52.8
	14.11.05	23:35 – 23:55	52.0	71.7	52.9	50.3
	14.11.04	00:00 – 00:55	50.1	77.2	51.8	47.0
	14.11.05	01:00 – 02:00	47.2	64.7	48.8	45.3

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Background Noise Measurements

Report by RPS Planning, Transport & Environment Jan 2006

311-313 Wilmslow Road, Fallowfield

LOGGING (5 MIN)	LEQ	LMAX	L10	L90
Study 1				
22:40:09	55.2dB	79.2dB	55.0dB	52.0dB
22:45:09	54.3dB	62.1dB	55.7dB	52.7dB
22:50:09	54.1dB	61.1dB	55.5dB	52.6dB
22:55:09	54.4dB	61.0dB	55.7dB	52.9dB
23:00:09	55.2dB	65.2dB	56.7dB	53.5dB
23:05:09	56.4dB	62.5dB	58.2dB	54.1dB
23:10:09	55.2dB	71.6dB	56.6dB	53.2dB
23:15:09	54.8dB	65.0dB	56.4dB	52.9dB
23:20:09	55.4dB	62.4dB	57.2dB	53.2dB
23:25:09	55.1dB	61.9dB	56.8dB	52.6dB
23:30:09	54.2dB	68.1dB	55.7dB	52.2dB
23:35:09	53.3dB	67.9dB	54.5dB	52.2dB
23:40:09	51.7dB	60.8dB	52.8dB	50.7dB
23:45:09	51.6dB	62.5dB	52.6dB	50.2dB
23:50:09	53.0dB	68.1dB	53.7dB	50.6dB
23:55:09	51.5dB	71.1dB	52.5dB	49.7dB
00:00:09	50.8dB	72.2dB	52.2dB	47.0dB
00:05:09	51.2dB	58.4dB	52.9dB	47.7dB
00:10:09	55.4dB	77.2dB	57.6dB	49.1dB
00:15:09	50.1dB	69.6dB	52.7dB	46.8dB
00:20:09	50.2dB	64.8dB	51.6dB	47.2dB
00:25:09	50.5dB	63.2dB	52.3dB	46.7dB
00:30:09	48.1dB	58.4dB	49.4dB	46.3dB
00:35:09	50.9dB	58.7dB	52.6dB	47.4dB
00:40:09	48.6dB	59.1dB	50.3dB	46.6dB
00:45:09	48.2dB	59.5dB	49.1dB	46.8dB
00:50:09	48.5dB	65.3dB	50.0dB	46.7dB
00:55:09	48.3dB	59.6dB	50.3dB	46.2dB
01:00:09	47.7dB	56.9dB	49.4dB	45.6dB
01:05:09	47.3dB	58.4dB	48.8dB	46.1dB
01:10:09	47.5dB	54.6dB	49.5dB	45.8dB
01:15:09	47.3dB	56.3dB	49.0dB	45.8dB
01:20:09	47.2dB	55.9dB	48.9dB	45.5dB
01:25:09	48.4dB	67.1dB	49.5dB	46.4dB
01:30:09	47.4dB	56.4dB	48.9dB	45.8dB
01:35:09	47.2dB	56.7dB	49.1dB	45.2dB
01:40:09	46.4dB	51.9dB	47.6dB	45.2dB
01:45:09	47.0dB	64.7dB	48.8dB	44.5dB
01:50:09	46.2dB	52.3dB	48.2dB	43.2dB
01:55:09	47.5dB	54.6dB	49.5dB	45.8dB
02:00:09	46.3dB	51.4dB	47.4dB	44.2dB

APPENDIX 7

Plant Noise Calculations

Extract Outlet Duct (1)

Duct Break-Out	Frequency (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k		
45 MaXfan	79	81	88	82	81	80	79	77	91	dB
A-Weighted	52.8	64.9	79.4	78.8	81	81.2	80	75.9	88	dB(A)
Flakt Woods 100 x 1200mm	-6	-12	-23	-40	-51	-51	-41	-29		
Duct Length (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Duct Loss per m	0.07	0.07	0.07	0.10	0.16	0.16	0.16	0.16		
Duct Attenuation	-0.2	-0.2	-0.2	-0.3	-0.5	-0.5	-0.5	-0.5		
90° Duct Bend				-1.0	-2.0	-3.0	-3.0	-3.0		
Corrected L_{WA}	72.8	68.8	64.8	40.7	27.5	25.5	34.5	44.5		
Duct Skin (22g)	-3	-8	-14	-20	-23	-26	-27	-35		
ALLEN Formula										
Visible Perimeter (m)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45		
Length (m)	2	2	2	2	2	2	2	2		
Perimeter x Length (S)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9		
Duct Cross Section (m^2) (A)	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16		
10log(S/A)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5		
Losses	4.5	-0.5	-6.5	-12.5	-15.5	-18.5	-19.5	-27.5		
Minimum -3	-3.0	-3.0	-6.5	-12.5	-15.5	-18.5	-19.5	-27.5		
$L_{W(radiated)}$	69.8	65.8	58.3	28.2	12.0	7.0	15.0	17.0	71	dB(A)
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	-5	-5	-5	-5	-5	-5	-5	-5		
Attenuated Level	44.7	40.7	33.3	3.2	-13.0	-18.0	-10.0	-8.0	46	dB
A-Weighted	18.5	24.6	24.7	0.0	-13.0	-16.8	-9.0	-9.1	28	dB(A)

Plant Noise Calculations

Extract Outlet Duct (2)

Duct Break-Out	Frequency (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k		
45 MaXfan	79	81	88	82	81	80	79	77	91	dB
A-Weighted	52.8	64.9	79.4	78.8	81	81.2	80	75.9	88	dB(A)
Flakt Woods 100 x 1200mm	-6	-12	-23	-40	-51	-51	-41	-29		
Duct Length (m)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		
Duct Loss per m	0.07	0.07	0.07	0.10	0.16	0.16	0.16	0.16		
Duct Attenuation	-0.4	-0.4	-0.4	-0.6	-1.0	-1.0	-1.0	-1.0		
90° Duct Bend				-1.0	-2.0	-3.0	-3.0	-3.0		
				-1.0	-2.0	-3.0	-3.0	-3.0		
Corrected L_{WA}	72.6	68.6	64.6	39.4	25.0	22.0	31.0	41.0		
Duct Skin (22g)	-3	-8	-14	-20	-23	-26	-27	-35		
ALLEN Formula										
Visible Perimeter (m)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45		
Length (m)	4	4	4	4	4	4	4	4		
Perimeter x Length (S)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8		
Duct Cross Section (m^2) (A)	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16		
10log(S/A)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5		
Losses	7.5	2.5	-3.5	-9.5	-12.5	-15.5	-16.5	-24.5		
Minimum -3	-3.0	-3.0	-3.5	-9.5	-12.5	-15.5	-16.5	-24.5		
$L_{W(radiated)}$	69.6	65.6	61.1	29.9	12.6	6.6	14.6	16.6	71	dB(A)
Distance (m)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5		
DI	3	3	3	3	3	3	3	3		
Point Source Attenuation	-19	-19	-19	-19	-19	-19	-19	-19		
Screening	0	0	0	0	0	0	0	0		
Attenuated Level	53.6	49.6	45.1	14.0	-3.4	-9.4	-1.4	0.6	55	dB
A-Weighted	27.4	33.5	36.5	10.8	-3.4	-8.2	-0.4	-0.5	39	dB(A)

Plant Noise Calculations

Extract Outlet Duct (3)

Duct Break-Out	Frequency (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k		
45 MaXfan	79	81	88	82	81	80	79	77	91	dB
A-Weighted	52.8	64.9	79.4	78.8	81	81.2	80	75.9	88	dB(A)
Flakt Woods 100 x 1200mm	-6	-12	-23	-40	-51	-51	-41	-29		
Duct Length (m)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0		
Duct Loss per m	0.07	0.07	0.07	0.10	0.16	0.16	0.16	0.16		
Duct Attenuation	-0.7	-0.7	-0.7	-1.0	-1.6	-1.6	-1.6	-1.6		
90° Duct Bend				-1.0	-2.0	-3.0	-3.0	-3.0		
				-1.0	-2.0	-3.0	-3.0	-3.0		
Corrected L_{WA}	72.3	68.3	64.3	39.0	24.4	21.4	30.4	40.4		
Duct Skin (22g)	-3	-8	-14	-20	-23	-26	-27	-35		
ALLEN Formula										
Visible Perimeter (m)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45		
Length (m)	4	4	4	4	4	4	4	4		
Perimeter x Length (S)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8		
Duct Cross Section (m^2) (A)	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16		
10log(S/A)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5		
Losses	7.5	2.5	-3.5	-9.5	-12.5	-15.5	-16.5	-24.5		
Minimum -3	-3.0	-3.0	-3.5	-9.5	-12.5	-15.5	-16.5	-24.5		
$L_{W(radiated)}$	69.3	65.3	60.8	29.5	11.9	5.9	13.9	15.9	71	dB(A)
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	0	0	0	0	0	0	0	0		
Attenuated Level	49.3	45.3	40.8	9.5	-8.1	-14.1	-6.1	-4.1	51	dB
A-Weighted	23.1	29.2	32.2	6.3	-8.1	-12.9	-5.1	-5.2	34	dB(A)

Plant Noise Calculations

Extract System – Termination Cowl

TERMINATION	Frequency (Hz)								Overall	
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**		
45 MaXfan	79	81	88	82	81	80	79	77	91	dB
A-Weighted	52.8	64.9	79.4	78.8	81	81.2	80	75.9	88	dB(A)
Flakt Woods 100 x 1200mm	-6	-12	-23	-40	-51	-51	-41	-29		
Corrected L_{WA}	73.0	69.0	65.0	42.0	30.0	29.0	38.0	48.0		dB
Duct Length (m)	11	11	11	11	11	11	11	11		
Duct Loss per m	0.07	0.07	0.07	0.10	0.16	0.16	0.16	0.16		
Duct Attenuation	-0.8	-0.8	-0.8	-1.1	-1.8	-1.8	-1.8	-1.8		Ref SRL
90° Duct Bend				-1.0	-2.0	-3.0	-3.0	-3.0		
				-1.0	-2.0	-3.0	-3.0	-3.0		
End Reflection 0.4mØ	-11	-7	-3	-1	0	0	0	0.0		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		DI
Point Source Attenuation	-27	-27	-27	-27	-27	-27	-27	-27		
Attenuated Level	34.7	34.7	34.7	11.3	-2.3	-5.3	3.7	13.7	39	dB
A-Weighted	8.5	18.6	26.1	8.1	-2.3	-4.1	4.7	12.6	27	dB(A)

Plant Noise Calculations

Supply System – Atmosphere Intake

TERMINATION	Frequency (Hz)								Overall	
	63	125	250	500	1000	2000	4000	8000		
45 MaXfan	78	81	88	82	80	80	78	75	91	dB
A-Weighted	51.8	64.9	79.4	78.8	80	81.2	79	73.9	87	dB(A)
Flakt Woods 100 x 1200mm	-6	-12	-23	-40	-51	-51	-41	-29		
Corrected L_{WA}	72.0	69.0	65.0	42.0	29.0	29.0	37.0	46.0	74	dB
Duct Length (m)	1	1	1	1	1	1	1	1		
Duct Loss per m	0.07	0.07	0.07	0.10	0.16	0.16	0.16	0.16		
Duct Attenuation	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2		Ref SRL
90° Duct Bend										
End Reflection 0.5m2	-6	-2	0	0	0	0	0	0		
Screening	5	5	5	5	5	5	5	5		
Directionality 120°										
Opening	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
fd/c	0.1	0.2	0.4	0.7	1.5	2.9	5.8	11.6		
Attenuation	0	-2	-6	-10	-15	-20	-22	-22		
Distance (m)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		DI
Point Source Attenuation	-23	-23	-23	-23	-23	-23	-23	-23		
Attenuated Level	47.9	46.9	40.9	13.9	-4.2	-9.2	-3.2	5.8	51	dB
A-Weighted	21.7	30.8	32.3	10.7	-4.2	-8.0	-2.2	4.7	35	dB(A)

Plant Noise Calculations

Condenser Units

Serving	Equipment			
	Freezer	Chiller	AC1	AC2
Manufacturer	/	/	Daikin	Daikin
Model	WINFH2511ZFZ	WINAJ4519Z	RZQS100	RZQS100
SPL @ 1m dB(A)	62	61	55	55
Acoustic Louvre	-19	-19	-12	-12
DI	6	6	6	6
NSR Distance (m)	4.5	5	6	6
Screening	-5	-5	-5	-5
NSR SPL @ 1m dB(A)	30.9	29.0	28.4	28.4

APPENDIX 8

Noise Mitigation Products

Flakt Wood Attenuators

Splitter Silencers

Coding: Type WS/WSE Silencers

Code

Variant

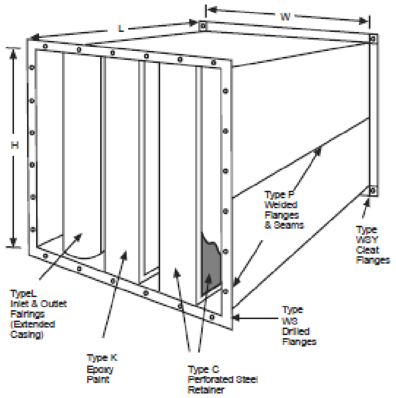
- WS Drilled Flanges (with Side Liners)
- WSY Cleat Flanges (with Side Liners)
- M Moisture Resistant Lining
- L Low Pressure Loss
- P High System Pressure
- K Fume Resistant
- C Perforated Linings
- CC Stainless Perforated Linings

Example

WSY LM/75-X-X-X

- Type
- Variants
- Airway Width mm
- Silencer Length mm
- Width mm
- Height mm

Figure 1



Coding: Type WBS Silencers

CODE WBS (H or V)
Plus Variants
as for type WS

H or V = Bend in Horizontal or Vertical Plane

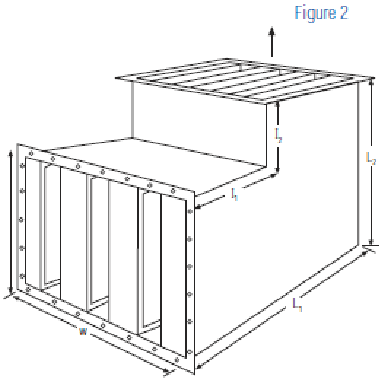
Example

WBS (H) or (V) M/75-X-X-X-X

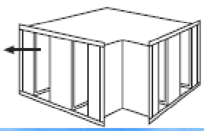
- Type
- Variants
- Airways Width mm
- Air Entry leg Dimension L_1 mm
- Air exit leg Dimension L_2 mm
- Silencer Width mm
- Height mm

Figure 2

Type WBSV



Type WBSH



l_1+l_2 Minimum Dimension 100mm
(300mm fairings Type WBSHL)

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Noise Mitigation Products

Flakt Wood Attenuators

Splitter Silencers

Performance

Type WS/WSY
Intermediate airway widths can be provided to suit individual requirements. Please enquire.
Care should be taken in use of 50mm Airway Silencer. Perforated Linings are required on airways of 75mm or less. Please enquire.

The following airway velocities should not be exceeded for the ventilation space noise levels tabulated, in order to avoid possible noise regeneration in the silencer.

Airway Velocity=

$$\frac{\text{Volume Flow Rate } m^3/s}{\text{Number of Airways x Airway Width X Height (metres)}}$$

TABLE C

Velocity m/s	NC/NR Level
15	45-50
13	35-40
10	30

For special applications please enquire.

Table A

Airways mm	Length mm	Octave Band Mid Frequencies Frequency Hz 63	125	250	500	1K	2K	4K	8K
50	600	6	12	22	31	40	40	40	30
	900	8	16	27	45	55	55	55	50
	1200	10	20	36	55	55	55	55	55
	1500	13	24	42	55	55	55	55	55
	1800	15	30	51	55	55	55	55	55
	2100	17	34	55	55	55	55	55	55
	2400	19	38	55	55	55	55	55	55
75	600	5	8	11	24	31	32	24	20
	900	6	11	19	34	45	45	39	28
	1200	7	14	26	46	55	55	52	38
	1500	9	17	30	48	55	55	55	42
	1800	10	20	34	50	55	55	55	46
	2100	12	23	40	55	55	55	55	55
	2400	13	24	45	55	55	55	55	55
100	600	4	7	11	21	31	29	21	20
	900	5	9	16	30	39	39	31	26
	1200	6	12	23	40	51	51	41	29
	1500	8	15	26	43	53	53	45	32
	1800	9	17	30	47	55	55	49	36
	2100	11	20	35	55	55	55	55	43
	2400	12	23	40	55	55	55	55	47
150	600	2	5	8	12	15	15	11	7
	900	3	6	11	20	25	25	15	8
	1200	4	7	15	26	33	33	19	11
	1500	5	9	18	33	41	41	24	13
	1800	6	11	22	39	49	49	29	16
	2100	7	13	26	45	55	55	34	19
	2400	8	15	30	52	55	55	39	21

Type WBS

The value of additional attenuation due to the mitred bend should be deducted from the attenuation required.

To obtain the attenuation, dimensions L_2+L_2 must be equal or greater than 2.5 x height for Type WBSV or 2.5 width for Type WBSH.

Table B

Silencer Height for WBSV or width for WBSH	Additional Attenuation in Octave Bands Hz 63	125	250	500	1K	2K	4K	8K
300	0	0	2	8	6	3	3	3
450	0	1	5	7	4	3	3	3
600	0	2	8	6	0	3	3	3
750	0	3	8	5	0	3	3	3
900	0	5	7	4	0	3	3	3
1050	0	7	7	4	0	3	3	3
1200	1	8	6	4	0	3	3	3
1350	2	8	6	3	0	3	3	3
1500	3	8	5	3	0	3	3	3

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Noise Mitigation Products

Spigot Silencers

SPIGOT SILENCER

Overview

- Small metric range of attenuators with spigot connection
- Ideal for small fans
- Ideal for cross talk elimination
- Ideal for flexible or spiral ducting

Construction

Both types are rigidly constructed in galvanised sheet steel, with a highly absorbent sound attenuating lining between the outer casing and the inner perforated steel lining. The end faces of the silencer do not have threaded holes for fixings, but has a steel spigot for ease of mounting.

Melinex lined silencers must be used to prevent grease impregnation into the acoustic media for kitchen extract applications as prescribed in DW/172 HVAC Specification For Kitchen Ventilation Systems. For Melinex insertion losses, please contact Elta Fans. Silencers can be provided with differing lengths: 300, 600, 900 and 1200mmm.

Silencer Attenuation

To determine the sound level of a fan fitted with a silencer, the dynamic insertion loss should be subtracted from the sound power level spectrum (dBW) of the fan. This should be done for the entire octave band mid-frequency spectrum. The fan dBW ratings and silencer attenuation apply equally to in duct applications, with a silencer connected between the fan and the duct system.

Dynamic Insertion Loss

The silencer attenuation is defined as the "dynamic insertion loss". The values quoted in the tables represent the difference between the sound power level of a fan and silencer combination (dBW) and that of the fan alone (dBW). The dynamic insertion losses shown are the attenuations recorded under ideal working conditions. The achieved attenuation will vary according to the air velocity and flow pattern in the airways. Noise regeneration can occur at higher velocities, especially in EP silencers.

Square / Rectangular Silencers

In highly noise sensitive areas, where the circular silencers cannot achieve the necessary attenuation levels, Elta Fans can design and build optional splitter silencers for greater effect.

Tel 01384 275800 Fax 01384 275810 Email info@eltafans.co.uk Website eltafans.com

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Noise Mitigation Products

Spigot Silencers

SPIGOT SILENCER

Dynamic Insertion Loss

Spigot Ø100-500

Product Code	Length	Insertion Loss @ Octave band (Hz)							
		63	125	250	500	1K	2K	4K	8K
068-0100-JF1	300mm	-3	-4	-9	-17	-23	-26	-25	-14
068-0100-JF2	600mm	-6	-8	-15	-33	-39	-40	-36	-20
068-0100-JF3	900mm	-10	-13	-21	-40	-46	-40	-36	-24
068-0100-JF4	1200mm	-12	-15	-23	-42	-47	-42	-38	-26
068-0125-JF1	300mm	-3	-3	-8	-16	-21	-24	-22	-12
068-0125-JF2	600mm	-4	-8	-13	-30	-36	-35	-31	-15
068-0125-JF3	900mm	-9	-12	-18	-37	-41	-38	-34	-20
068-0125-JF4	1200mm	-11	-15	-21	-40	-46	-41	-36	-23
068-0150-JF1	300mm	-3	-3	-6	-14	-19	-23	-22	-11
068-0150-JF2	600mm	-4	-7	-12	-23	-30	-36	-31	-15
068-0150-JF3	900mm	-8	-9	-15	-31	-37	-37	-34	-18
068-0150-JF4	1200mm	-10	-14	-17	-34	-41	-40	-36	-20
068-0160-JF1	300mm	-3	-3	-6	-14	-19	-23	-22	-11
068-0160-JF2	600mm	-4	-7	-12	-23	-29	-35	-30	-15
068-0160-JF3	900mm	-8	-9	-15	-31	-37	-37	-34	-18
068-0160-JF4	1200mm	-10	-14	-18	-33	-40	-39	-35	-18
068-0200-JF1	300mm	-2	-3	-6	-13	-17	-20	-18	-9
068-0200-JF2	600mm	-4	-6	-10	-20	-27	-32	-20	-11
068-0200-JF3	900mm	-7	-9	-14	-32	-39	-36	-26	-15
068-0200-JF4	1200mm	-10	-12	-17	-36	-41	-44	-28	-16
068-0250-JF1	300mm	-2	-3	-6	-12	-16	-19	-17	-8
068-0250-JF2	600mm	-3	-6	-10	-19	-25	-29	-18	-10
068-0250-JF3	900mm	-5	-8	-12	-24	-30	-30	-22	-14
068-0250-JF4	1200mm	-7	-10	-15	-31	-37	-38	-26	-15
068-0315-JF1	300mm	-1	-3	-6	-12	-15	-18	-16	-8
068-0315-JF2	600mm	-3	-5	-8	-16	-21	-22	-16	-14
068-0315-JF3	900mm	-4	-7	-10	-20	-31	-28	-17	-14
068-0315-JF4	1200mm	-6	-9	-14	-23	-32	-32	-18	-15
068-0355-JF1	300mm	-1	-3	-6	-12	-15	-18	-16	-8
068-0355-JF2	600mm	-3	-4	-7	-15	-19	-20	-15	-13
068-0355-JF3	900mm	-4	-7	-9	-19	-28	-25	-16	-13
068-0355-JF4	1200mm	-5	-8	-13	-22	-31	-29	-17	-14
068-0400-JF1	300mm	-1	-2	-4	-11	-15	-15	-12	-8
068-0400-JF2	600mm	-2	-4	-7	-14	-17	-18	-14	-11
068-0400-JF3	900mm	-3	-6	-9	-18	-26	-23	-15	-12
068-0400-JF4	1200mm	-5	-8	-13	-22	-30	-27	-17	-12
068-0500-JF1	300mm	-1	-1	-3	-10	-14	-14	-11	-7
068-0500-JF2	600mm	-2	-4	-6	-14	-16	-16	-13	-11
068-0500-JF3	900mm	-3	-6	-8	-17	-24	-21	-15	-11
068-0500-JF4	1200mm	-4	-8	-12	-19	-28	-23	-16	-12

For sizes 560-710, please contact Elta Fans.

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Noise Mitigation Products

Environ Environlite ELV1.1.25AC

environ™
Dynamic Acoustic Technology

Acoustic Enclosure Systems for Air Conditioning and Refrigeration Plant

environlite 1.2.25AC SPLIT

Versatile yet cost effective noise control solutions for small and medium sized Split Air Conditioning and Heat Pump systems that have horizontal air flow characteristics.
This attractive range of units combines superior noise reduction characteristics and application versatility with a user friendly design for ease of assembly.

An introduction:

environlite is not only physically compact and discrete; its flexibility allows for a wide range of AC applications and is particularly suited to 'difficult to access' locations. Available as a new build or retro-fit solution, environlite is supplied to the user palletised as a simple on-site self build kit.

All Environ products are a proven solution for the elimination of noise where commercial establishments coexist with domestic neighbours and environlite is especially suited to the ever growing domestic AC market.

By design, environlite applies its patented noise control features to best advantage, ensuring maximum acoustic performance.

With advanced noise control technology underpinned by quality engineering and manufacturing standards, environlite solutions help alleviate local authority approval issues, whilst eliminating the air conditioning noise problem for the user.

With almost infinite plant application compatibility and deriving its name from its design, environlite is matched to provide unparalleled acoustic performance to light commercial and domestic AC applications. The range is available in a variety of sizes, allowing it to by tailored to meet specific applications for new build or retro-fit noise abatement.

The integrated airways are sized to suit the requirements of the enclosed plant and full service and maintenance access is provided by the provision of removable and hinged access panels.

environlite is secure and gives greater flexibility regarding the positioning of plant and machinery, especially where space is at a premium. Being 'Visually Quiet', no moving parts are visible - so the enclosed plant remains out of sight and out of mind......

STEPS 1-4 - Structure

STEPS 5-6 - Air In Grilles

STEP 7 - Locate AC unit

STEP 8 - Fit RH Airway

STEP 9 - Fit LH Airway

STEPS 11-12 - Complete Assembly

The Environ Integra, Modula and Lite acoustic designs are protected under patent

soundplanning

Noise Mitigation Products

Environ Environlite ELV1.1.25AC

environ™
Acoustic Enclosures

Environ Technologies Ltd
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environlite ELV1.1.25AC 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 x 10^{-5} Pascal's)							
63	125	250	500	1K	2K	4K	8K
14	16	23	30	37	39	38	39
Summary 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

Environ acoustic enclosure designs are protected under patent

Noise Mitigation Products

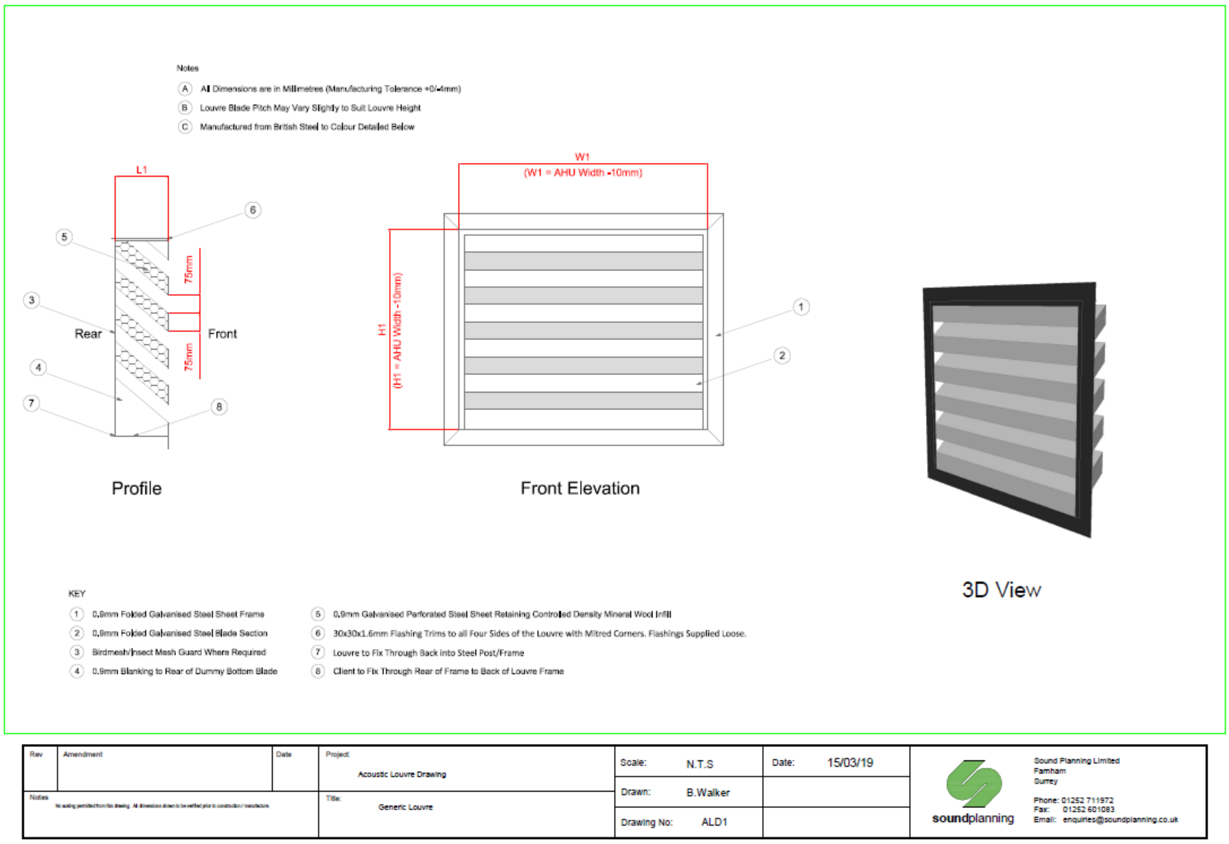
Acoustic Louvre Enclosures

Example Photographs

Noise Mitigation Products

Acoustic Louvre Enclosures

Acoustic Louvres



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Noise Mitigation Products

Acoustic Louvre Enclosures

Acoustic Louvres (19dB Rw)

SRL

UKAS TESTING 0444

Test Report No: 24567-SRL-RP-XT-002-P1

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Date: 12/05/2020

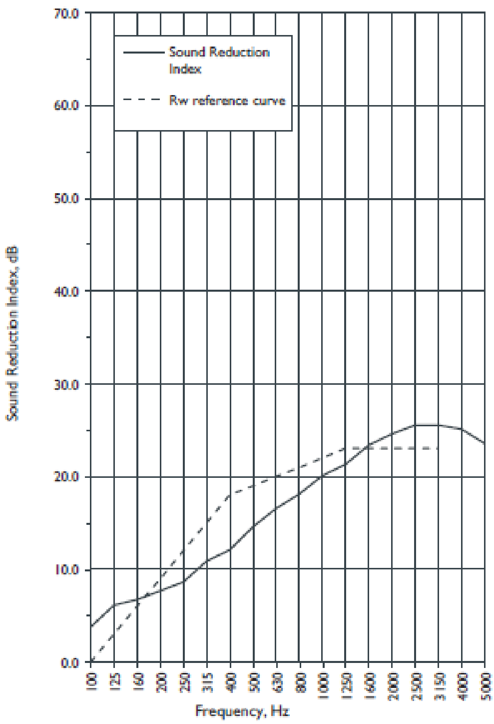
Data Sheet 9

Test Number:	10
Client:	Sound Planning Ltd
Test Date:	17/02/2020
Sample Height:	1.1 m
Sample Width:	1.1 m
Sample Weight:	N/A kg/m²

Test Room:	**Source**	**Receiving**
Air Temperature:	10.7 °C	11.4 °C
Air Humidity:	65 %	59 %
Volume:	55 m³	50 m³
Air Pressure:		999 mbar

Product Identification: Louvre AL300 100/75 P45

Freq, f Hz	Sound Reduction Index, dB ⅓ Oct	Octave
50+	20.5	
63+	19.3	12.7
80+	8.6	
100	3.8	
125	6.1	5.4
160	6.7	
200	7.7	
250	8.6	8.9
315	10.9	
400	12.1	
500	14.6	14.0
630	16.6	
800	18.1	
1000	20.1	19.6
1250	21.3	
1600	23.4	
2000	24.6	24.4
2500	25.5	
3150	25.5	
4000	25.1	24.7
5000	23.6	
6300+	21.7	
8000+	20.1	20.1
10000+	18.8	
Average 100-3150	15.4	Version v3.1



Rating according to BS EN ISO 717-1:2013

$R_w(C;C_{tr})$= 19 (-1 ; -4) dB

* shows measurement corrected for background
> shows measurement limited by background
\+ shows Frequency beyond standard and not UKAS accredited

Template Ref: Lab Edition 3 – 14/10/2019

Noise Mitigation Products

Acoustic Louvre Enclosures

Acoustic Louvres (12dB Rw)

SRL

UKAS TESTING 0444

Test Report No: 24567-SRL-RP-XT-002-P1
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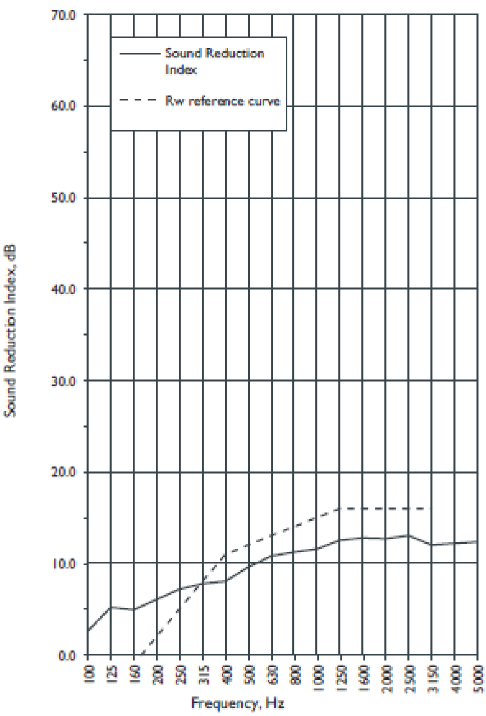
Date: 12/05/2020

Data Sheet 2

Test Number:	3	**Test Room:**	**Source**	**Receiving**
Client:	Sound Planning Ltd	**Air Temperature:**	10.3 °C	11.2 °C
Test Date:	17/02/2020	**Air Humidity:**	60 %	55 %
Sample Height:	1.1 m	**Volume:**	55 m³	50 m³
Sample Width:	1.1 m			
Sample Weight:	N/A kg/m²	**Air Pressure:**		998 mbar

Product Identification: Louvre AL150 100/75 P45

Freq, f Hz	Sound Reduction Index, dB ⅓ Oct	Octave
50+	16.7	
63+	20.2	11.1
80+	7.0	
100	2.6	
125	5.2	4.0
160	4.9	
200	6.0	
250	7.2	6.9
315	7.8	
400	8.0	
500	9.6	9.3
630	10.8	
800	11.2	
1000	11.6	11.7
1250	12.5	
1600	12.8	
2000	12.7	12.8
2500	13.0	
3150	12.0	
4000	12.2	12.2
5000	12.3	
6300+	12.4	
8000+	11.9	11.9
10000+	11.4	
Average 100-3150	9.2	Version v3.1



Rating according to BS EN ISO 717-1:2013

$R_w(C;C_{tr})$= 12 (-1 ; -2) dB

* shows measurement corrected for background
> shows measurement limited by background
+ shows Frequency beyond standard and not UKAS accredited

Template Ref: Lab Edition 3 – 14/10/2019