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ACOUSTICS PLUS

Proposed Installation of Mechanical Plant

116 King Henry's Road, London, NW3 3SN

Environmental Noise Assessment

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Issue/Revision Record

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	Signature:	Print:	Title:	Date:
Author:		**Phil Huffer**	**Principal Consultant**	**17/08/2017**
Reviewer:		**Andy Dodd**	**Senior Consultant**	**17/08/2017**

1. INTRODUCTION

1.1 Acoustics Plus Ltd (APL) is an independent firm of multi-disciplinary acoustic engineers. APL is engaged by both private and public sector clients.

1.2 APL is a registered member of The Association of Noise Consultants (ANC) and the author is a corporate member of The Institute of Acoustics (IOA).

1.3 APL has been instructed by the applicant's architect, Andrew Jones Associates, to consider and advise upon the noise implications of the proposed installation of a climate control system.

1.4 The climate control system will consist of 2No. external condenser units that will be mounted within a disused water tank enclosure on the roof of the property.

1.5 It is understood the Local Planning Authority (LPA) require further information on noise levels from the proposed installation in order to fully assess the noise impact upon the surrounding neighbourhood.

1.6 This report provides the response to the LPA, on behalf of the Applicant.

2. BASELINE SITUATION

2.1 The Application Site (the "site") is situated at 116 King Henry's Drive, London, NW3 3SN. The site is a semi-detached property arranged over two levels. The rear of the site is shown in Figures 1 to 8 attached.

2.2 It is understood that the proposal is the complete refurbishment of the property. As part of this refurbishment, it is proposed to install a mechanical climate control system that will provide heating/cooling to the property.

2.3 The external condenser units associated with the climate control system will be located in an upgraded water tank enclosure on the roof of the property. The proposed location of the enclosure and condensers can be seen in Diagram 1 overleaf. Ventilation to the enclosure will be provided naturally through acoustic weather louvres.

2.4 In order to prevent the generation of reverberant sound within the enclosure, acoustic lining panels will be installed on the internal walls of the enclosure (see Appendix A).

2.5 The nearest window to the roof mounted enclosure is the first floor window of the nearest noise sensitive property considered to be No.114 King Henry's Road (see Figure 6).

2.6 The proposed condenser units are 2No. Fujitsu AOY24. The noise data for this unit was obtained from published data from manufacturer Fujitsu (a copy of the data sheet is provided in Appendix A).

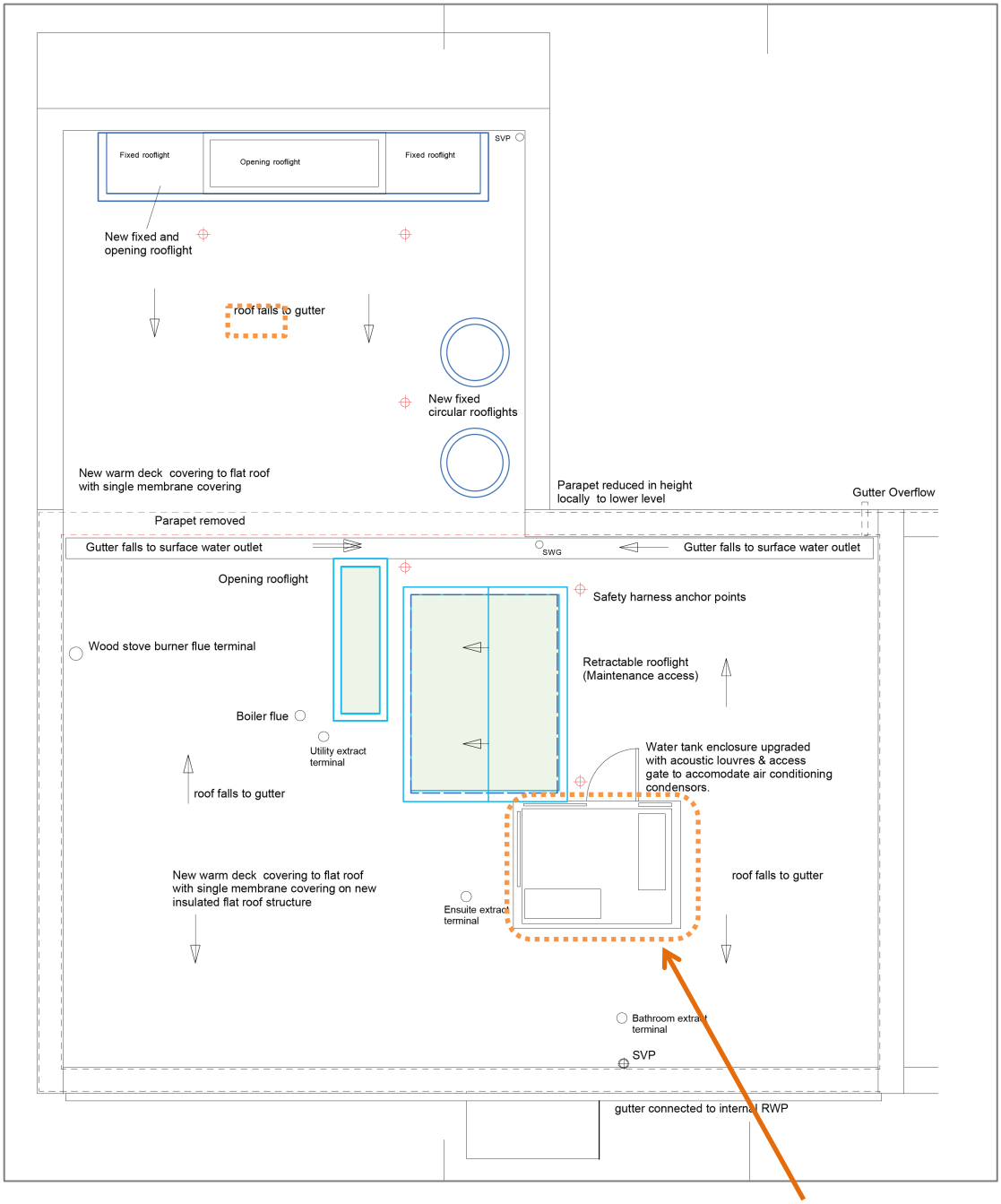


Diagram 1

3. NOISE OUTLINE

3.1 In order to produce an environmental noise assessment, consideration must be given to the prevailing background noise in the locality of the installation.

3.2 Measurements of background noise were obtained over a 72 hour period at a location deemed representative of background noise levels experienced at the nearest noise sensitive façade. The measurements obtained during the exercise were obtained at roof level (see Figure 8).

3.3 The particulars of the measurement exercise are recorded below. The weather conditions were considered appropriate to monitor environmental noise.

Date: 16th – 19th December 2016
Start Time: 13:15 hrs
Location: roof level 116 King Henry's Road

Weather conditions (obtained from www.wunderground.com)

Date	Precipitation	Wind	Temperature
16/12/16	0.0mm	7km/h	8 ºC
17/12/16	0.0mm	4km/h	6 ºC
18/12/16	0.0mm	5km/h	6 ºC
19/12/16	0.8mm	6km/h	5 ºC

3.4 Minimum background and average noise levels are shown in Table 1 below with the full 24 hour time history shown in Diagram 2 (L_{Aeq} and L_{A90}). Daytime levels were influenced by nearby construction noise.

Time period	Lowest $L_{A90,15min}$	Average $L_{Aeq,T}$
16th December 1315-2400	40	50
17th December 0000-2400	38	49
18th December 0000-2400	35	48
19th December 0000-1315	33	51

Table 1

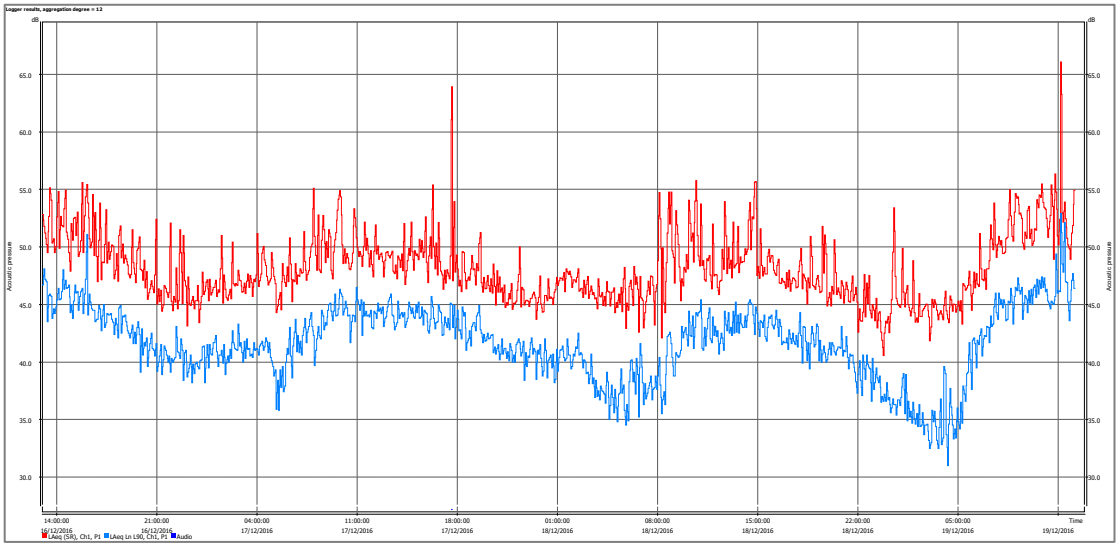


Diagram 2

4. DESIGN CRITERIA

4.1 Information regarding the noise levels not to be exceeded by the proposed installation was extracted from the LPA (London Borough of Camden) Local Plan Adopted version June 2017 (Appendix 3 Noise thresholds).

Industrial and Commercial Noise Sources

A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).

Table C: Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Existing noise sensitive receptor	Assessment Location	Design Period	LOAEL (green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dB L_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dB L_{Amax}

*10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

**levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.

The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

4.1 The procedure contained in BS4142 is to quantify the "specific sound level", which is the measured or predicted level of sound from the source in question over a one hour period for the daytime and a 15 minute period for the night-time. Daytime is defined in the standard as 07:00 to 23:00 hours, and night-time as 23:00 to 07:00 hours.

4.2 The specific sound level is converted to a rating level by adding penalties to account for either tonality or impulsivity. The standard sets out objective methods for determining the presence of tones or impulsive elements, but notes that it is acceptable to subjectively determine these effects.

4.3 The penalty for tonal elements is between 0dB and 6dB, and the standard notes:

"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."

4.4 The penalty for impulsive elements is between 0dB and 9dB, and the standard notes:

"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."

4.5 The background sound level should be established in terms of the LA90 noise index. The standard states that the background sound level should be measured over a period of sufficient length to obtain a representative value. This should not normally be less than 15 minute intervals. The standard states that:

"A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."

4.6 The assessment outcome results from a comparison of the rating level with the background sound level. The standard states:

a) Typically, the greater this difference, the greater the magnitude of the impact.
b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
d) 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."

4.7 The standard goes on to note that:

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

4.8 In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014 edition places emphasis upon an appreciation of the context, as follows:

"An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."

4.9 The background noise levels were assessed using statistical analysis of the measured data, as directed in BS4142. The histogram for the operational hours of the condenser units can be seen in Diagram 4.

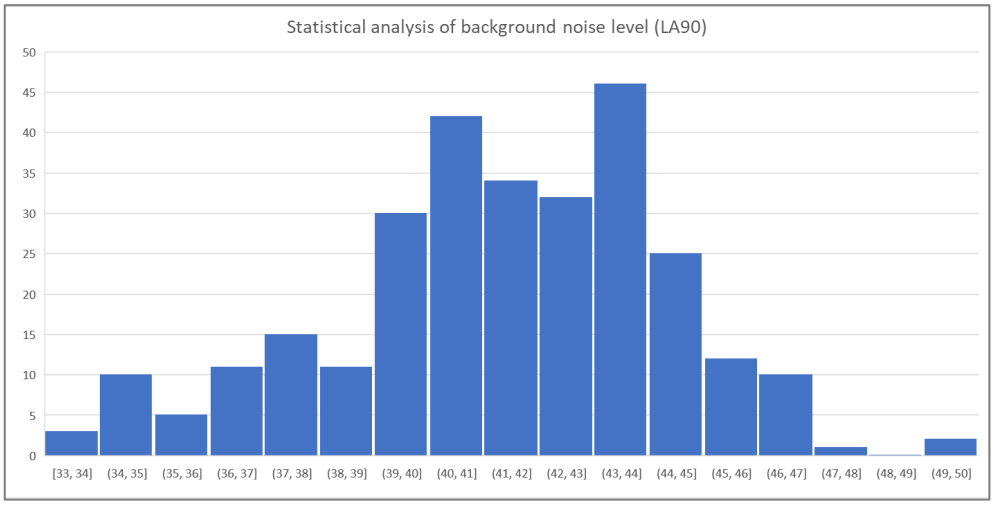


Diagram 3

4.10 The background noise level varied significantly during the considered operational hours of the proposed climate control system. While the most commonly occurring background noise level during the operational hours of the condenser was 43dB $L_{A90,15min}$, the level to be considered within this assessment is 39dB $L_{A90,15min}$. Whilst this is not the lowest level, the likelihood of the condensers being operational at full load during the period when background noise is at its lowest (02:00 – 05:00hrs) is minimal. In the context in which the sound occurs, 39dB $L_{A90,15min}$ is considered appropriate.

4.11 In determining a rating level, corrections to account for tonality and impulsivity must be added to the specific noise level of the unit. The octave band sound levels of the condenser (see Appendix A) do not seem to indicate any tonal component and no other correction for acoustic features were considered applicable.

4.12 The plant noise emission criteria that should not be exceeded is therefore based on Table 1 and is shown in Table 2 below. This level should not be exceeded at the nearest noise sensitive façade and is indicative of 10dB below the considered background noise.

Noise emission limit for mechanical plant
L_{Aeq} 29dB

Table 2

5. EQUIPMENT

5.1 All background noise measurements were obtained using the following equipment:

- Svantek Svan971 Class 1 Serial No. 51704
- Rion Calibrator Type NC-74 Class 1 Serial No. 00410215

5.2 The relevant equipment carries full and current traceable calibration. The equipment, where necessary, was calibrated prior to and after the measurements were carried out.

6. CALCULATIONS

6.1 In order to predict the noise impact of the climate control system, consideration has been given to noise egress from the condenser units to the nearest noise sensitive façade.

6.2 In considering the propagation of noise from the condensers, consideration was given to their location within the water tank enclosure, attenuation through the acoustic louvre and point source propagation to the nearest noise sensitive window. The following formulas were utilised:

$$L_p = L_w + 10log_{10}T - 10log_{10}V + 14$$

Where L_p *is the reverberant sound pressure level in the enclosure*
L_w *is the sound power level of the condenser unit*
T is the enclosure reverberation time, s
V is the enclosure volume, m^3

$$L_{p_2} = L_{p_1} - R - 6$$

Where L_{p_2} *is the sound pressure level close to the enclosure on the outside*
L_{p_1} *is the reverberant sound pressure level in the enclosure*
R is the sound reduction index of the acoustic louvre

6.3 The calculation is based on the sound reduction indices (SRI) provided by Caice for a SH150 acoustic louvre. These values are shown in Table 3. The manufacturers data sheet is shown in Appendix A. Distances were obtained from scaled drawings.

Acoustic louvre	SRI Octave Band Centre Frequency (Hz)								R_w
	63	125	250	500	1k	2k	4k	8k	
Caice SH150	5	5	7	9	13	13	13	12	13

Table 3

6.4 A further (conservative) correction to account for building edge diffraction of -5dB was assumed. This was extracted from the Department of Energy and Climate Change Planning Standard MCS020. The planning standard MCS020 states the following (Note 5):

"Note 5: Barriers between the heat pump and the assessment position (STEP 5)
A correction should be made for attenuation due to barriers between the air source heat pump and an assessment position. A correction will be necessary if an installer is unable to see an assessment position from the top edge of the air source heat pump. Use the following instructions to determine whether a correction is appropriate:

- *For a solid barrier (e.g. a brick wall or a fence) that completely obscures an installer's vision of an assessment position from the top edge of the air source heat pump attenuation of -10 dB may be assumed.*
- *Where a solid barrier completely obscures an installer's vision of an assessment position from the top or side edges of the air source heat pump, but moving a maximum distance of 25 cm in any direction to the air source heat pump allows an assessment position to be seen, attenuation of -5 dB may be assumed.*
- *If it is possible for an installer to see any part of an assessment position from the top or side edges of the air source heat pump no attenuation may be assumed. "*

6.5 The calculation exercise provided the following results. The calculation is based on the units operating in heating mode which represents a worst case scenario as heating mode is noisier than cooling mode.

Heating Mode	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Fujitsu AOY24	55	56	51	48	46	36	37	31	50
2No. AOY24	58	59	54	51	49	39	40	34	53
Reverberant L_p in enclosure	59	60	55	52	50	40	41	35	55
Caice SH150 SRI	4	5	7	12	16	16	16	16	
Level outside of enclosure	49	49	42	34	28	18	19	13	38
Distance attenuation	-12	-12	-12	-12	-12	-12	-12	-12	
Building edge diffraction	-5	-5	-5	-5	-5	-5	-5	-5	
Reflecting plane (x1)	+3	+3	+3	+3	+3	+3	+3	+3	
Façade level	35	35	28	20	14	4	6	3	24

Table 4

6.6 In order to comply with the requirements of the LPA, any noise from the proposed installation of mechanical plant should not exceed a level of 29 dBA (10dB below the statistically considered measured background noise over the operational hours of the plant) at 1m from the nearest noise sensitive façade.

6.7 The calculated noise impact is 24dBA. The calculation exercise (Table 4) demonstrates that the proposed installation meets the LPA criteria by 5dB with the noise impact 15dB lower than the statistically considered measured background noise level of 39dB L_{A90}.

7. CONCLUSION

7.1 The foregoing assessment indicates that the proposed installation meets the requirements imposed by the LPA. Additional mitigation measures will not be required.

7.2 Lest there be any misunderstanding, the mitigation measures included in this report are as follows:

(a) Caice SH150 acoustic louvre on enclosure to provide ventilation

(b) Enclosure lined with acoustically absorbent material (CMS plant room wall lining panel)

7.3 It is understood that an alternative condenser unit consisting of a single Fujitsu AJY040 is being considered. The noise level of this unit is 54dBA (in heating mode) which is 1dB louder than 2No. AOY24s. This also meets the LPA noise requirement.

Figures

Proposed installation of external condenser units, 116 King Henry's Road, London, NW3

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8

Appendix A

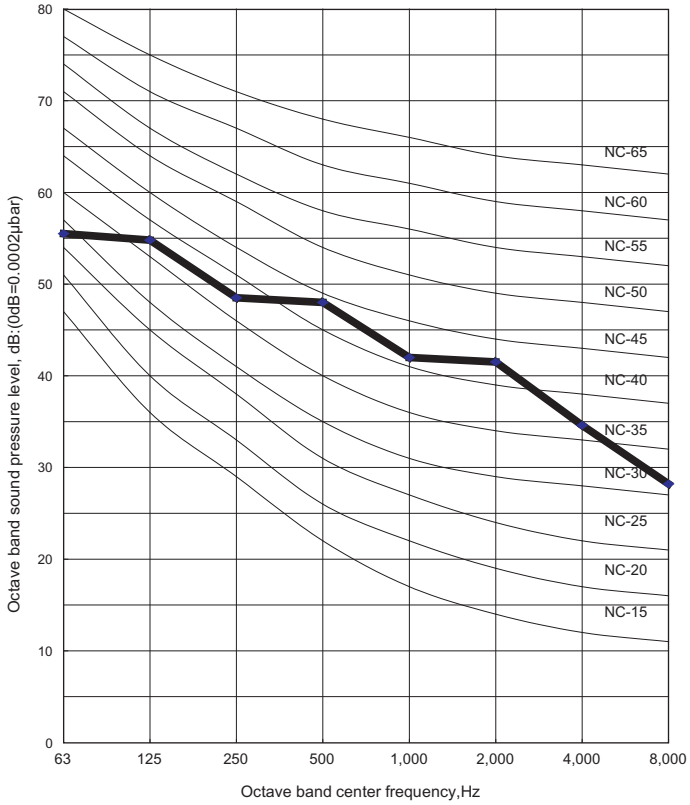
OUTDOOR UNIT
AO∗18-24L2

8. OPERATION NOISE

8-1. NOISE LEVEL CURVE

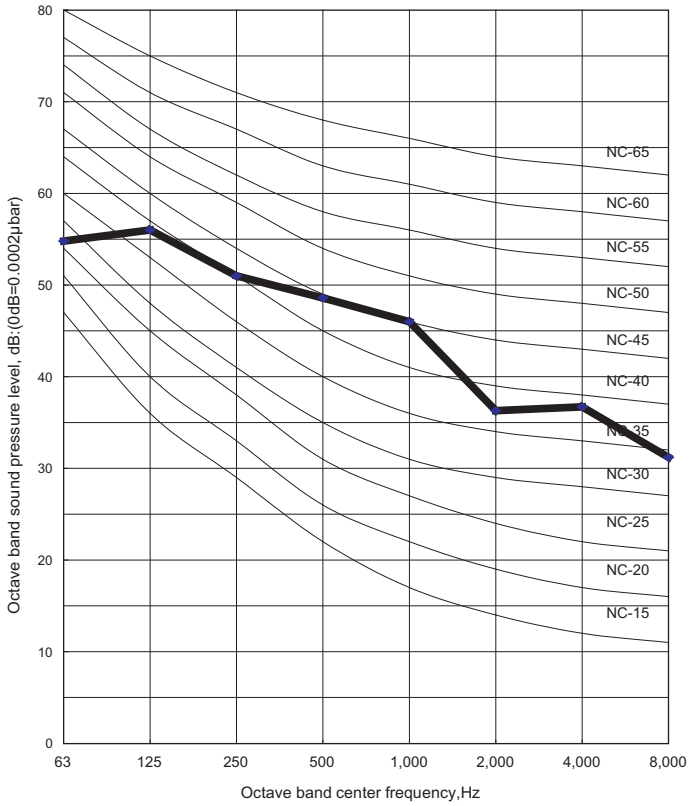
■COOLING

●MODELS : AO∗18L2, AO∗24L2



■HEATING

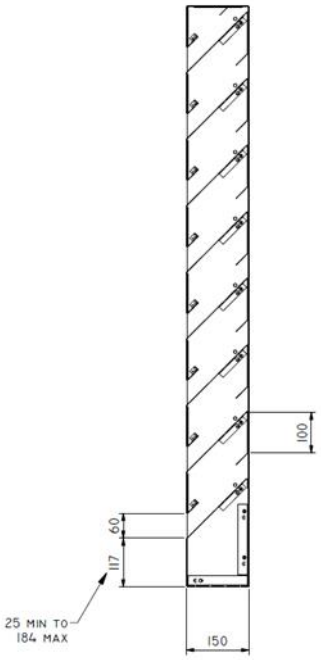
●MODELS : AO∗18L2, AO∗24L2



Technical Data For SH150 Acoustic Louvre

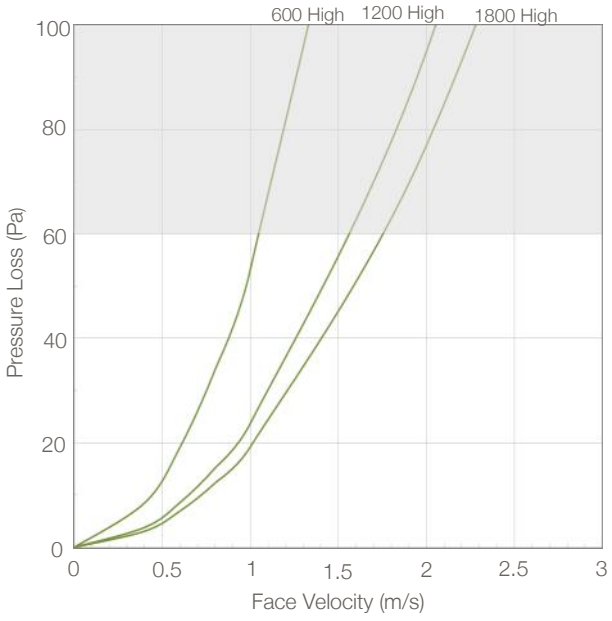
Single Bank Acoustic Louvre, Higher Performance Profile, 150mm Deep

Typical weight 35kg/ m^2



Performance

Acoustic Data	dB in each Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Sound reduction index	5	5	7	9	13	13	13	12
Weighted sound reduction index (Rw)	13							
Static insertion loss	4	5	7	12	16	16	16	18
Regenerated sound power level at 1m/s face velocity	53	47	38	36	33	29	18	12
Regenerated sound power level at 2m/s face velocity	70	65	58	53	51	51	45	35



Acoustic Louvres should not be selected in the shaded area above.

Aerodynamic coefficient at 1200 high is 18.38k

Free Area and Height Range			
Height (mm)	Airway Free Area (%)	Face Free Area (%)	Airways (43mm)
505-664	17-13	24-18	2
665-824	19-15	27-22	3
825-984	21-17	29-24	4
985-1144	22-19	30-26	5
1145-1304	22-20	31-28	6
1305-1464	23-20	32-29	7
1465-1624	23-21	33-30	8
1625-1784	23-21	33-30	9
1785-1944	24-22	34-31	10
1945-2104	24-22	34-31	11
2105-2264	24-22	34-32	12
2265-2424	24-23	34-32	13

Plant Room Wall Lining

Advantages

- ***Excellent sound absorption***
- ***Light reflective***
- ***Good thermal insulation***
- ***Easy to handle, install, and clean***
- ***Cost effective sound treatment***
- ***High quality finish***
- ***Fire rated***

Applications

CMS Plan Room Wall Lining Panels provide an effective means of controlling reverberation time and reflected sound in plant rooms. They have an aesthetically pleasing appearance and are typically suitable for industrial applications such as engine enclosures, test cells and workshops

Installation Service

In addition to supply of this product CMS Acoustic Solutions offers a competitively-priced installation service anywhere in the UK. Use of our service ensures that installation is performed to the highest standards by tradesmen fully experienced in the specialist skills of fitting acoustic materials correctly. For further details contact our technical team on 01925 577711.

Description

Plantroom Wall Lining Panels consist of borosilicate mineral fibres impregnated with a suitable resin binder faced with Type E alkali glass cloth.

Physical Information

Dimensions

Thickness (mm)	Weight (kg/m^2)	Sheet Size (mm)
25	2.5	1200 x 600
50	5.0	1200 x 600
75	7.5	1200 x 600
100	10.0	1200 x 600

The above sizes and weights are nominal

Fire Performance

The borosilicate mineral fibres impregnated with a suitable resin binder core and its facing Type E alkali glass cloth are non combustible when tested to BS 476: Part 4.

When tested to BS 476: Part 6 & 7 the system will comply with a Class "0 Surface Spread Of Flame.

Resistance to Vibration

When tested in accordance with BS 2972 the liner (all thickness) is free from fibre fall out and delamination.

Toxicity and Oxygen Index

The finished liner has passed the test in NES 713 (toxic) and NES 714 (oxygen)

Water Resistance

The borosilicate mineral fibres repel water due to the presence of water repellent additives. Moisture condensing from the air within the core is less than 0.02% by volume at 95% relative humidity.

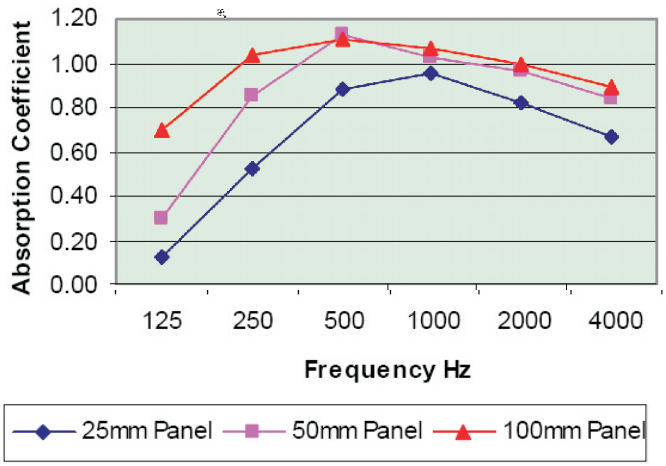
Acoustic Performance

The noise absorption co-efficient is expressed as a factor between 0 and 1.0. The more sound that a material absorbs, the higher the noise absorption co-efficient.

The noise absorption co-efficient for our Plant Room Wall Lining Panels, as tested to BS 3638:1987 is:

Thickness	Frequency						
	125	250	500	1k	2k	4k	NRC
25mm	0.12	0.52	0.88	0.95	0.82	0.67	0.80
50mm	0.30	0.85	1.13	1.03	0.96	0.84	0.99
100mm	0.70	1.04	1.11	1.07	0.99	0.89	1.05

See overleaf for performance graph.



Thermal Conductivity

When tested in accordance with BS 874

Thickness (mm)	Thermal Conductivity W/mC at 50C
25	0.038
50	0.039
75	0.040
100	0.040

Installation Guidelines

CMS has many years experience manufacturing and supplying wall panels, and often the site limitations or restrictions require a non-standard means of supporting the panels to be developed. If you have any concerns concerning installation, please do not hesitate to discuss your requirements with our engineers.

The most common methods of installation methods are:

1.Using a template mark the wall with the hole centres to the same centres as the panels (see in the pattern shown in Diagram A. Apply adhesive to each pin and push on to the wall where marked, ensuring excess adhesive flows through the perforations.

2. For ceiling applications or where the panels are to be used in a plant room exposed to return air, perforated spindle pins are again bonded to the existing plastered wall and applied to 90% of the wall/ceiling surface.

In each case, the wall surface should be sound and level. It is important to keep hands clean when working with the panels, or wear gloves to avoid soiling the panel.

Installation

The pins and button washers are supplied loose with the Wall Lining panels. in the pattern shown in Diagram A

2. Allow the adhesive to cure.

3. Randomly test the bond strength of the glued pins prior to installing the Plant Room Absorption Panels.

4 Push the panels on and apply the self locking washers.

5. Where bespoke size panels are required, peel back the Type E Alkali Glass Cloth facing; cutting the acoustic insulation to the correct size and laminate the Type E Alkali Glass Cloth facing with general purpose adhesive overlapping the rear of the panel.

Diagram A

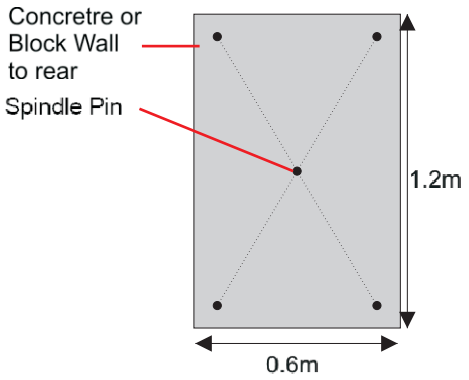
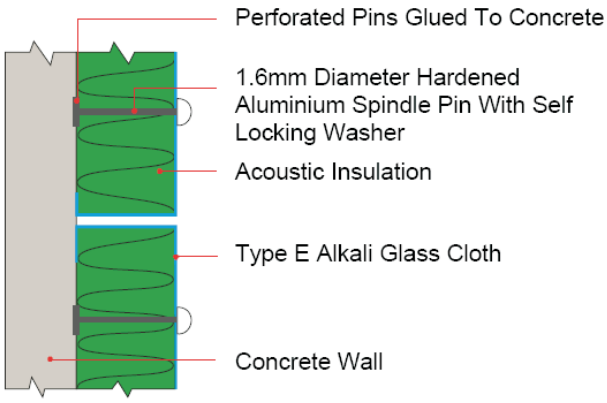


Diagram B



vacuum cleaner Do not use water to clean the panels.

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