



Noise Impact Assessment

Site Address: Manchester Royal Infirmary, Oxford Road, Manchester, M13 9WL

Client Name: CM Oxendale Ltd.

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Authorisation and Version Control

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Delivering sustainable development by promoting good health and well-being through effective management of noise.

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1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise impact assessment for the replacement of chiller plant units and the screening surrounding the rooftop plant deck ('the Proposed Development') at Manchester Royal Infirmary, Oxford Road, Manchester, M13 9WL ('the Site').

A noise survey has been undertaken to establish the prevailing background sound levels at the closest Noise Sensitive Receptors ('NSRs') and measurements have been taken of the existing chiller plant units that service the hospital. Measures required to mitigate noise impact have been recommended where necessary and assessed in accordance with the relevant performance standards, legislation, policy and guidance.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.1 Standards, Legislation, Policy & Guidance

The following performance standards, legislation, policy and guidance have been considered to ensure good acoustic design in the assessment:

- The Local Planning Authorities ('LPA') policies and guidance, specifically; Manchester City Council's 'Planning and Noise – Technical Guidance (October 2022)'.
- National Planning Policy Framework (2021).
- Noise Policy Statement for England (2010).
- BS4142:2014+A1:2019 – 'Methods for rating and assessing commercial and industrial sound'.

Further information on the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for the replacement of 5no. existing McQuay ALS 426.4 chiller units with York YVAA1650 units. The hospital currently has 1no. York unit installed, which has been measured in-situ.

Further to this, the existing aluminium barriers installed around the rooftop plant deck are to be replaced with acoustic louvre panelling. The panelling is expected to be approximately 3m in height and will be installed around the perimeter of the rooftop. Some sections of the barriers will be replaced with aluminium panelling that is similar to the existing, as required.

It is also intended for 4no. new impulse fans to be installed. This is expected to take place in phases over an extended period of time. It is understood that all plant could operate at any time of the day or night depending on the demands of the hospital.

The purpose of this assessment is to predict the effects of the chiller unit replacements and louvre panelling exclusively. As such, assessing the noise emissions of the impulse fans is outside of the scope of this assessment.

The figure below shows the locations of the existing chiller units.



Figure 1 – Existing Chiller Locations

2. Environmental Noise Survey

2.1 Measurement Methodology

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1	09/06/2023 – 12/06/2023	Equipment mounted on a lamppost along Swinton Gove approximately 4m above the ground and at least 3.5m from any other large reflective surface. High performance 130mm diameter windshield fitted.

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and long-term measurement location:



Imagery ©2023 Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The area surrounding the NSRs contains a mixture of commercial and residential properties. The acoustic environment would be classed as of a moderate to high level and the dominant source of noise was found to be traffic noise from Upper Brook Street and other surrounding roads. The noise emissions from secondary sources include a continuous tonal hum, which was assumed to emanate from multiple plant noise sources associated with the hospital building.

2.3 Environmental Noise Survey Results

Background Sound Level Analysis

The following section outlines the measured background sound levels that have been used as the baseline for the subsequent BS4142 noise assessment.

The 'typical' background noise level has been calculated in accordance with Manchester City Council guidance (Appendix A of Planning and Noise – Technical Guidance) and has been found to be **55 dBA**. The arithmetic averages of the night-time measurement periods are shown in the graph below.

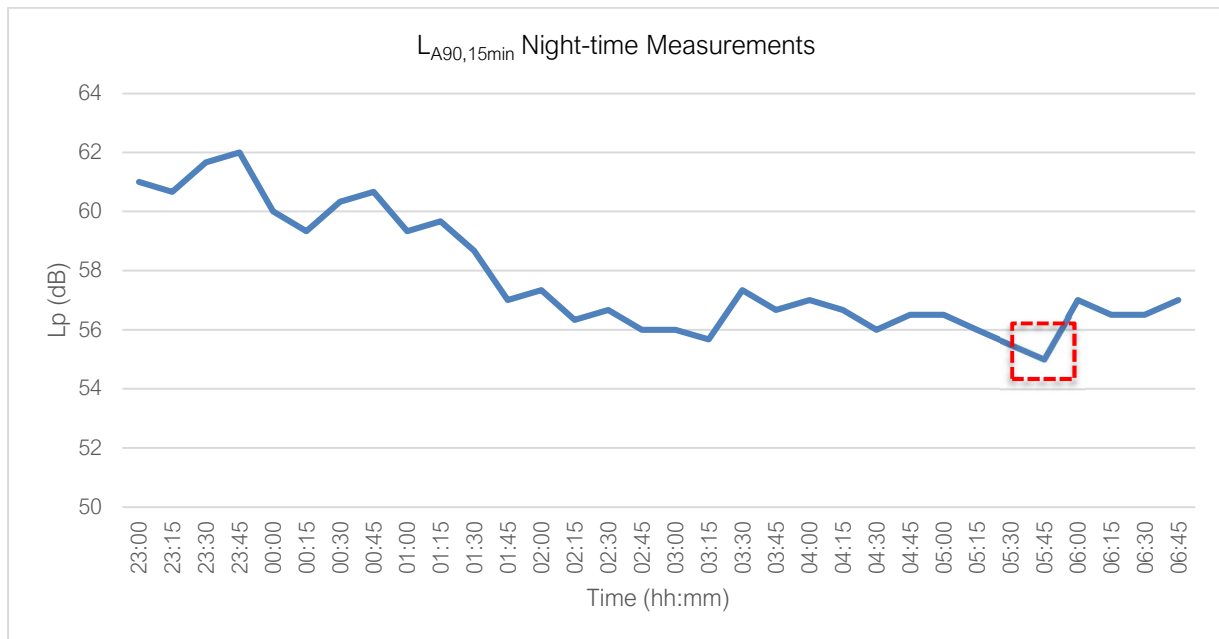


Figure 3 – MP1 Night-time Background Sound Level Analysis

A full time history graph can be seen in Appendix D.

3. Noise Impact Assessment

In the following section of the report, the change in impact level due to the Proposed Development is calculated and assessed.

3.1 Specific Sound Levels & Noise Modelling Data

Spot measurements were taken on site varying distances from the existing chiller units (depending on access). The results are shown in the table below.

Description	1/1 Octave Frequency Band (Hz, $L_{eq,T}$ dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Chiller Unit 3 – McQuay ALS 426.4 at 5m	71	65	73	64	61	58	51	69
Chiller Unit 5 – McQuay ALS 426.4 at 2m	75	72	83	75	73	69	61	79
Chiller Unit 6 – York YVAA1650 at 3m	81	73	79	77	81	76	66	83

Table 2 – On Site Measurements of Chiller Units

Sound power levels for the McQuay ALS 426.4 units have been calculated using the formula: $L_W = L_P + 20 \log(r) + 5$. An overall sound power level for the York YVAA1650 is provided in the manufacturer's datasheet, and the octave band measurements have been increased equally to sum to the overall A-weighted value. The sound power levels are shown in the table below.

Description	1/1 Octave Frequency Band (Hz, L_w dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Chiller Units 1 to 5 – McQuay ALS 426.4*	86	83	94	86	84	80	72	90
Chiller Unit 6 – York YVAA1650*	99	91	97	95	99	94	84	101

Table 3 – Calculated Sound Power Levels of Chiller Units

* L_w per unit.

For reference, pictures of the McQuay ALS 426.4 and York YVAA1650 units taken on site are shown below.

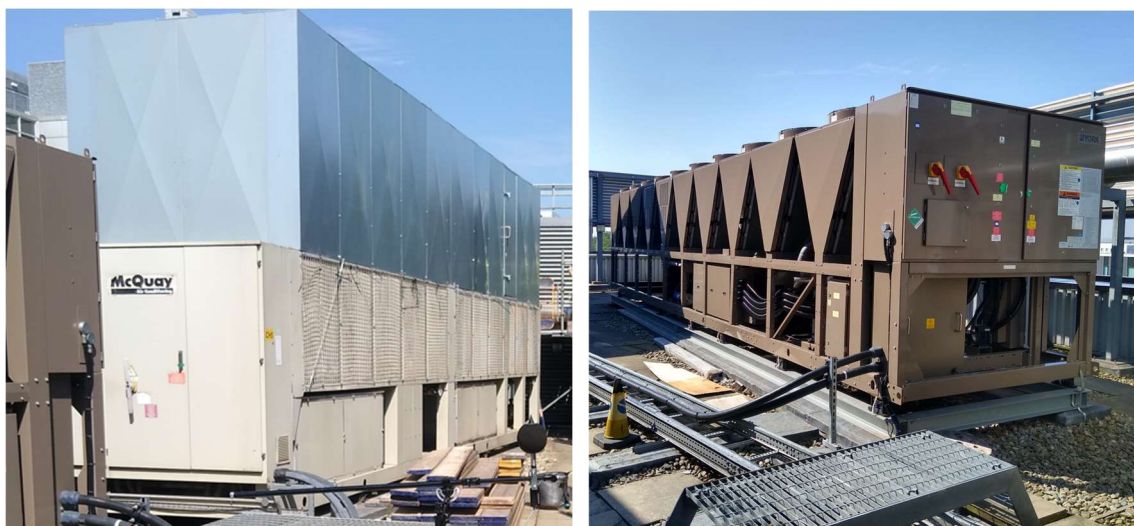


Figure 4 – In-situ Chiller Unit Photographs – McQuay (Picture Left) and York (Pictured Right)

3.2 Existing Screening

The existing barriers located around the inner perimeter of the plant deck are constructed from corrugated single-skin aluminium (assumed to have a thickness of 0.7mm). There are large gaps approximately 1.7m tall at the bottom of the barriers that allow for airflow to the chiller units. The barriers extend to a height of approximately 2.8m from roof level. At the boundary of the roofline is a 1.4m tall wall, which follows the outer perimeter of the building. The predicted sound reduction provided by the aluminium panelling is shown in the table below.

Description	1/1 Octave Frequency Band (Hz, SRI, dB)							Overall (R _w , dB)
	63	125	250	500	1k	2k	4k	
Corrugated 0.7mm Single-Skin Aluminium	5	5	8	12	17	22	27	17

Table 4 – Aluminium Panelling SRI

Pictures of the existing barriers taken on site are shown below.

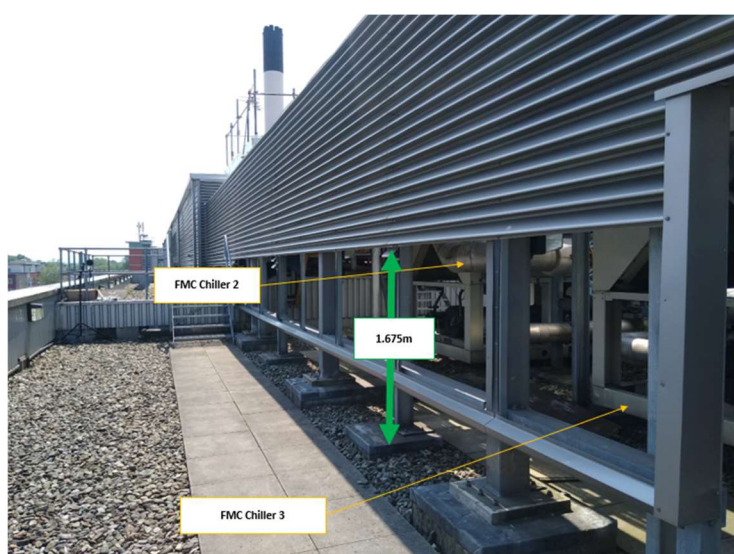


Figure 5 – Annotated Site Photograph 1



Figure 6 – Annotated Site Photograph 2

3.3 Proposed Acoustic Louvre Screening

It is proposed that areas of acoustic louvre panelling and single skin aluminium sheeting (min. thickness of 0.7mm as existing) are installed to replace the current screening.

The locations of the louvre panelling and aluminium sheeting are shown in the figures below. The areas of steel sheeting are shown in blue, and the acoustic louvres are shown in green.

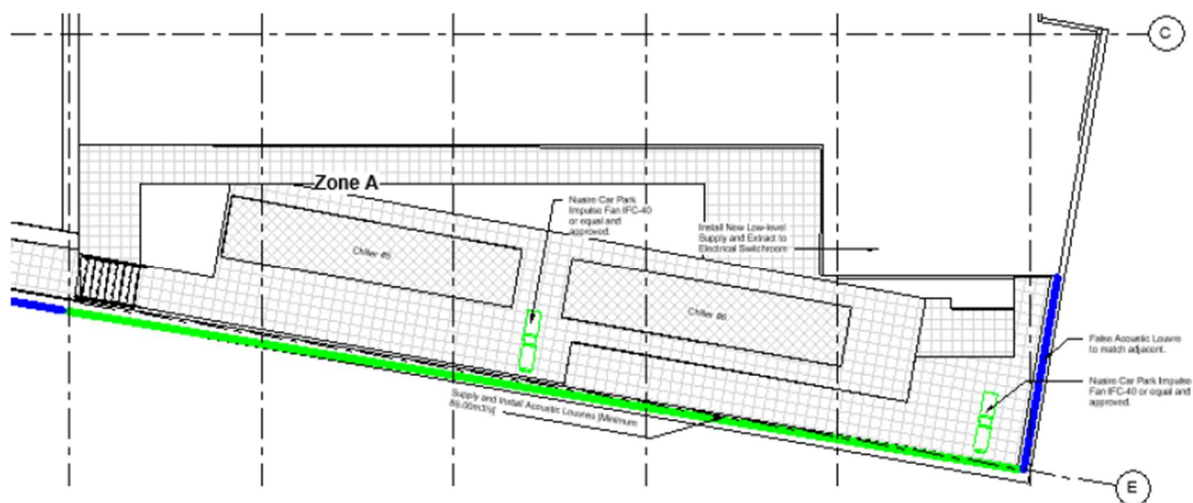


Figure 7 – Zone A Barrier Locations

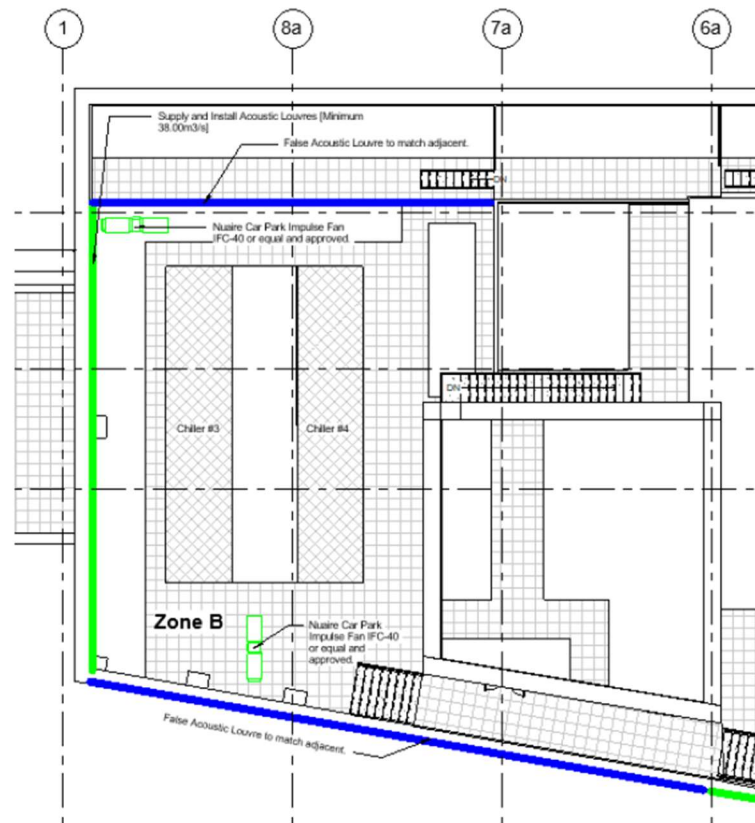


Figure 8 – Zone B Barrier Locations

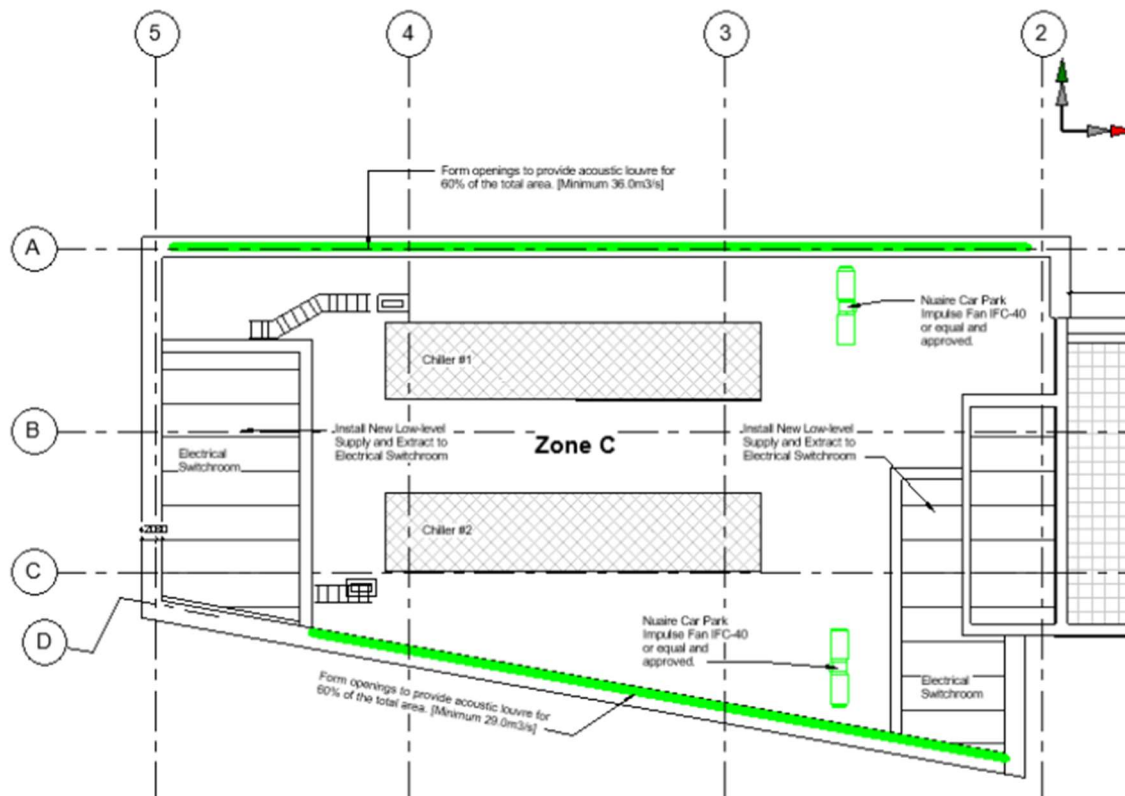


Figure 9 – Zone C Barrier Locations

It is specified that BA2SL300 acoustic louvre panelling provided by Bespoke Acoustic Solutions will be installed. The sound reduction values stated in the manufacturer's datasheet are shown in the table below.

Description	1/1 Octave Frequency Band (Hz, SRI, dB)							Overall (R _w , dB)
	63	125	250	500	1k	2k	4k	
BA2SL300 Acoustic Louvre	7	9	12	23	33	41	32	25

Table 5 – Acoustic Louvre SRI

3.4 Predictive Noise Modelling

The noise emissions from the chiller units been modelled within SoundPlan 9.0 prediction software. The following assumptions have been made within the model:

- Topographical data has been taken from Google maps and is assumed to have an accuracy of with 3 years.
- For the purpose of the assessment, the ground between the source and receivers is considered to be primarily acoustically 'hard' surfaces.
- ISO 9613-2 assumes a 'downwind' model to the NSRs.
- The sound map grid height has been set to 1.5m, however, the noise levels used in the assessment has been taken from the most exposed point of each façade.
- Point source emitters have been used to represent all the chiller units. Each source has been modelled at 2m above roof level.
- The noise passing through the aluminium panelling / louvre panelling is calculated considering the noise level incident on the panel and the sound reduction provided by the panel element. Full calculations can be seen in Appendix E.

The sound maps showing the specific sound levels emission from the Site can be seen in the following figures.

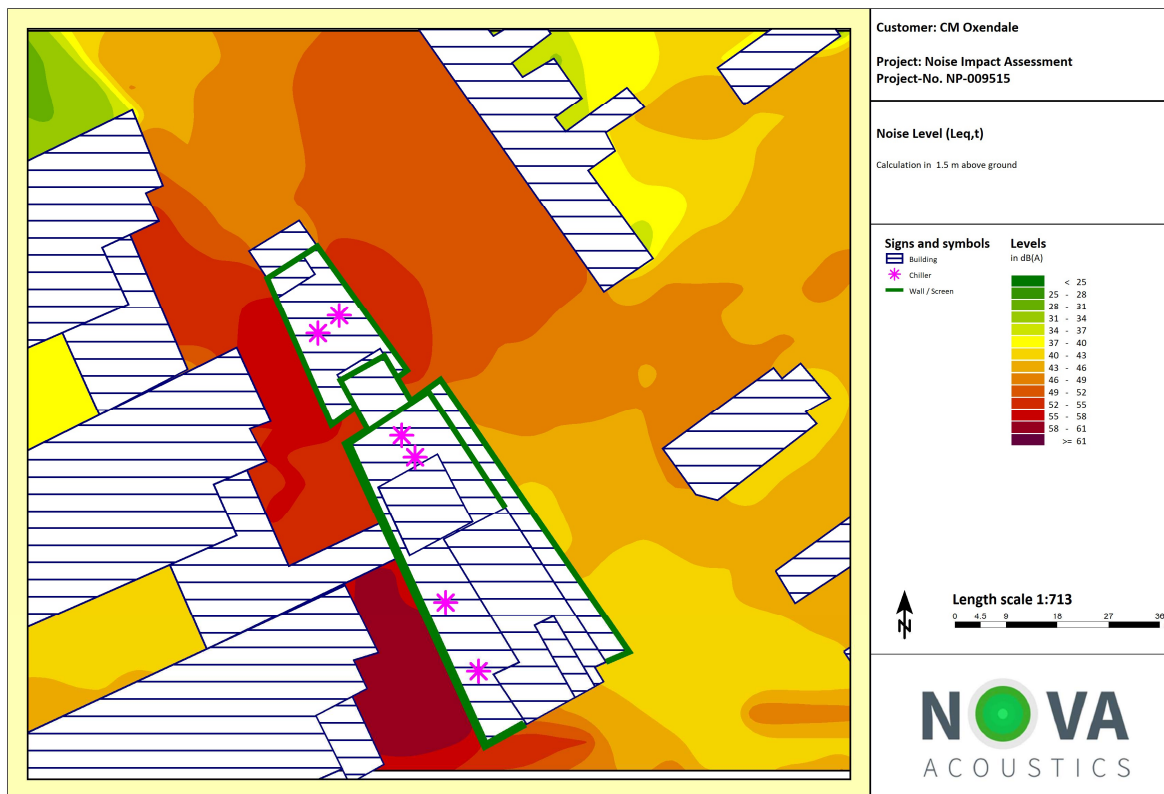


Figure 10 – Specific Sound Level Map – Existing – 2D



Figure 11 – Specific Sound Level Map – Existing – 3D

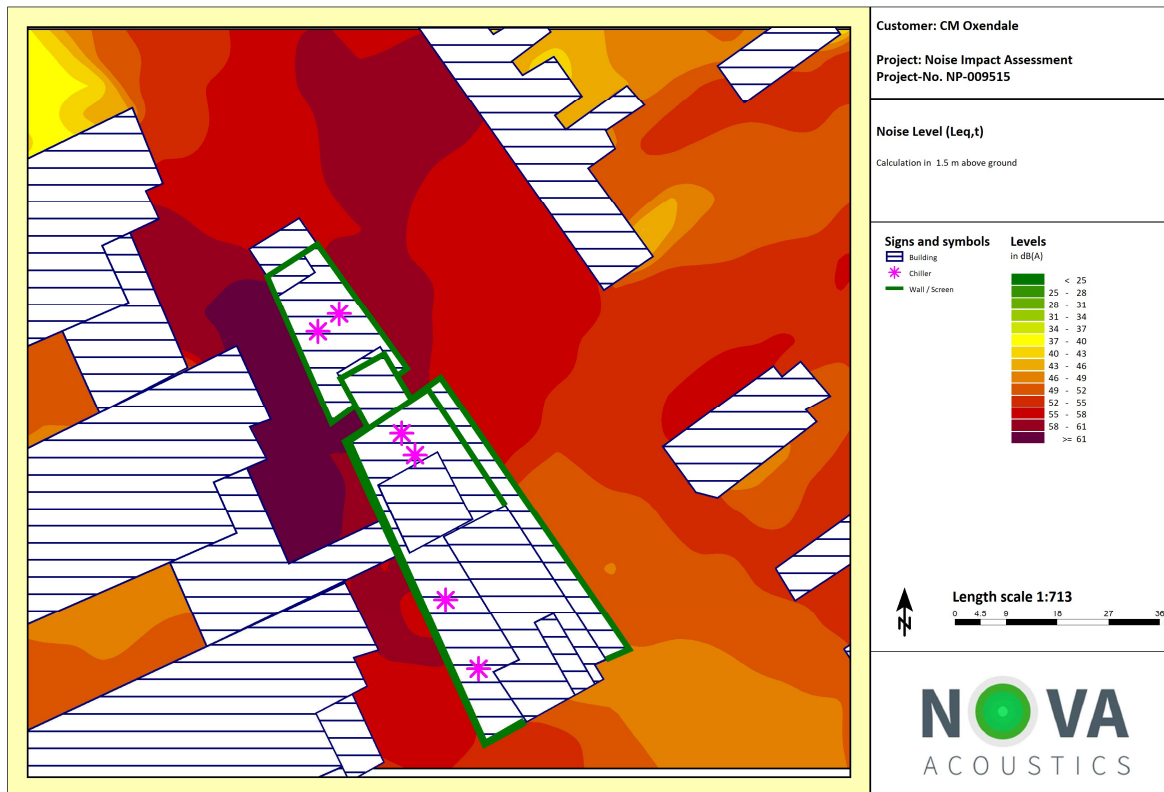


Figure 12 – Specific Sound Level Map – Proposed – 2D



Figure 13 – Specific Sound Level Map – Proposed – 3D

The results of the predictive noise modelling are shown in the table below.

NSR Number	Description	1/1 Octave Frequency Band (Hz, $L_{eq,T}$, dB)							Overall (dBA)
		63	125	250	500	1k	2k	4k	
NSR1	Existing Chiller Units and Screening	50	44	54	45	43	37	26	49
	Proposed Chiller Units and Louvre Screening	60	50	56	53	55	48	35	57
Hospital (Top Floor)	Existing Chiller Units and Screening	63	57	66	62	64	59	49	67
	Proposed Chiller Units and Louvre Screening	72	63	68	67	71	66	55	73
Hospital (Adjacent to Plant Deck)	Existing Chiller Units and Screening	64	57	65	61	63	58	48	66
	Proposed Chiller Units and Louvre Screening	71	63	69	67	70	65	55	73

Table 6 – Results

As can be seen in the table above, the overall A-weighted plant noise emissions are predicted to increase by 6 – 8 dB depending on the location of the receptor. This is equivalent to approximately a doubling in sound pressure level.

3.5 BS4142 Noise Impact Assessment

The BS4142 noise impact assessment is conducted at the most affected NSR in the table below.

Description	1/1 Octave Frequency Band (Hz, $L_{eq,T}$, dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Specific Sound Level at NSR1	60	50	56	53	55	48	35	57
Acoustic Feature Correction	+2 dB for the potential of a 'just perceptible' low frequency tonality and +3 dB to account for the intermittent nature of the units.							+5
Rating Sound Level ($L_{A,r,T}$)	Specific sound level + rating penalty.							62
Background Sound Level	Lowest measured arithmetic average $L_{A90,15min}$ at MP1 during the night.							55
Exceedance of L_{A90}								+7
BS4142 Assessment Outcome	The assessment indicates the potential for a 'Adverse Impact, dependent on context' at the most affected NSR.							
NPPF & NPSE Outcome	The assessment outcome would be classed as 'Lowest Observed Adverse Effect Level ('LOAEL') in accordance with the NPPF and NPSE.							
Recommendations	Further mitigation is required.							

Table 7 – BS4142 Noise Impact Assessment

3.6 Recommendations and Mitigation

In order to ensure that there is no increase from the existing noise emissions and to achieve low impact at the closest residential NSRs, it is recommended that the noise from the chiller units is reduced at source by the following values:

Description	1/1 Octave Frequency Band (Hz, dB)						
	63	125	250	500	1k	2k	4k
Chiller Attenuation (Insertion Loss)	10	6	4	8	12	11	9

Table 8 – Recommended Attenuation

It is assumed that these insertion loss values can be achieved by installing appropriate attenuator packages that are likely to be available from the manufacturer.

4. Conclusion

The Proposed Development has been assessed against the requirements of BS4142 and the LPA's policies and guidance.

The rating noise level of the proposed plant units is predicted to be 7 dB above the background noise level, which is an 8 dB increase from the existing situation. This is an indication of 'adverse impact' when assessed in accordance with BS4142. Further to this, the noise levels incident on the adjacent hospital building are expected to increase by up to 7 dB. As such, mitigation measures have been specified in Section 3.

Providing the required attenuation is achieved, 'low impact' is expected during the daytime and night-time periods. This would be classed as 'No Observed Effect Level' ('NOEL') when assessed in accordance with the NSPE and NPPF.

The findings of this report will require written approval from the Local Authority prior to work commencing.

Appendix A – Acoustic Terminology

A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$. Where: pA is the A-weighted sound pressure in pascals (Pa) and p_0 is the reference sound pressure (20 μ Pa)
Background Sound	Underlying level of sound over a period, T , which might in part be an indication of relative quietness at a given location
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T , has the same mean-squared sound pressure as the sound under consideration that varies with time
Facade level	Sound pressure level 1 m in front of the facade
Free-field level	Sound pressure level away from reflecting surfaces
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants
Noise Criteria	Numerical indices used to define design goals in a given space
Noise Rating (NR)	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves
Octave Band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit
Percentile Level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting “F”, which is exceeded for $N\%$ of a specified time interval
Rating Level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise
Reverberation time, T	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped
Sound Pressure, p	root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound
Sound Pressure Level, L_p	Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10 \log_{10} (p/p_0)^2$. Where: p is the root-mean-square sound pressure in pascals (Pa) and p_0 is the reference sound pressure (20 μ Pa)
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies

Appendix B – Standards, Legislation, Policy, and Guidance

This report is to be primarily based on the following standards, legislation, policy and guidance.

B.1 – National Planning Policy Framework (2021)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2021. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 174e, it states:

Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;

Paragraph 185 states:

Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- a) Mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
- c) Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

B.2 – Noise Policy Statement for England (2010)

Paragraph 185 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life;
- Where possible, contribute to the improvement of health and quality of life.

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that “significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development”.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: “all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.”

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: “where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.”

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

B.3 – BS4142:2014+A1:2019 – ‘Methods for rating and assessing industrial and commercial sound’

Overview

BS4142:2014 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142:2014 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ ‘specific sound level’, immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the

specific sound level to obtain the $L_{A,r,Tr}$ 'rating sound level'. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

Rating Penalty

Section 9 of BS4142:2014 describes how the rating sound level should be derived from the specific sound level, by deriving a rating penalty.

BS4142:2014 states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:

- a) subjective method;*
- b) objective method for tonality;*
- c) reference method."*

Due to the nature of the development the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014, which states:

"Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed. Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources."

BS4142:2014 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

a) Tonality

A rating penalty of +2 dB is applicable for a tone which is "just perceptible", +4 dB where a tone is "clearly perceptible", and +6 dB where a tone is "highly perceptible".

b) Impulsivity

A rating penalty of +3 dB is applicable for impulsivity which is "just perceptible", +6 dB where it is "clearly perceptible", and +9 dB where it is "highly perceptible".

c) Other Sound Characteristics

BS4142:2014 states that where "the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distance against the residual acoustic environment, a penalty of +3 dB can be applied."

d) Intermittency

BS4142:2014 states that when the "specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time ... if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied."

Background Sound Level

The background sound level is the underlying level of sound over a period, T, and is indicative of the relative quietness at a given location. It does not reflect the occurrence of transient and/or higher sound level events and is generally governed by continuous or semi-continuous sounds.

To ensure the background sound level values used within the assessment are reliable and suitably represent both the particular circumstance and periods of interest, efforts have been made to quantify a 'typical' background sound level for a given period. The purpose has not been to simply select the lowest measured value. Diurnal patterns have also been considered as they can have a major influence on background sound levels, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night time period for sleep purposes.

Since the intention is to determine a background sound level in the absence of the specific sound that is under consideration, it is necessary to understand that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds that are present as separate to the specific sound.

Assessment of Impact

BS4142:2014 states: "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". An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

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

Interpreting the guidance given in BS4142:2014, with consideration of the guidance given in the NPSE and NPPG Noise, an estimation of the impact of the rating sound is summarised in the following text:

- A rating sound level that is +10 dB above the background sound level is likely to be an indication of a Significant Observed Adverse Effect Level;
- A rating sound level that is +5 dB above the background sound level is likely to be an indication of a Lowest Observed Adverse Effect Level;
- The lower the rating sound 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 sound level does not exceed the background sound level, this is an

indication of the specific sound source having a negligible impact and would therefore classified as No Observed Adverse Effect Level.

During the daytime, the assessment is carried out over a reference time period of 1-hour. The periods associated with day or night, for the purposes of the Standard, are 07.00 to 23.00 and 23.00 to 07.00, respectively.

Appendix D – Environmental Survey

D.1 – Time History Noise Data

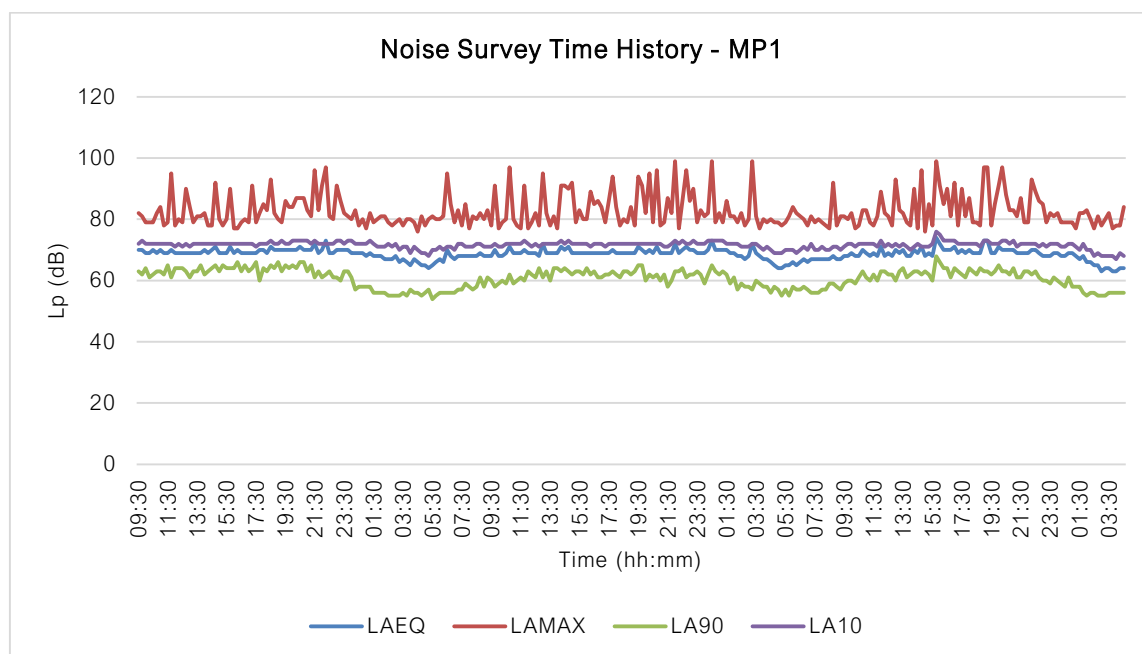


Figure 15 – MP1 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
CESVA SC420 Class 1 Sound Level Meter	T250681	≤0.1
CESVA CB006 Class 1 Calibrator	902442	

Table 9 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤ 0.1 dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

D.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted. The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445

Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Heaton Mersey (Approx. 6kmm South of Site)				
Time Period	Air Temp (°C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
09/06/23 – 00:00 – 23:59	9.6 – 23.9	0.0	SSE	0.0 – 1.7
10/06/23 – 00:00 – 23:59	11.2 – 30.0	0.0	SSE	0.0 – 1.3
11/06/23 – 00:00 – 23:59	18.5 – 31.3	0.0 – 2.5*	SSE	0.0 – 2.6
12/06/23 – 00:00 – 23:59	17.0 – 32.0	0.0 – 5.6*	SSE	0.0 – 1.0

Table 10 – Weather Conditions

*High rainfall rate occurred assessment time period used for background sound level.

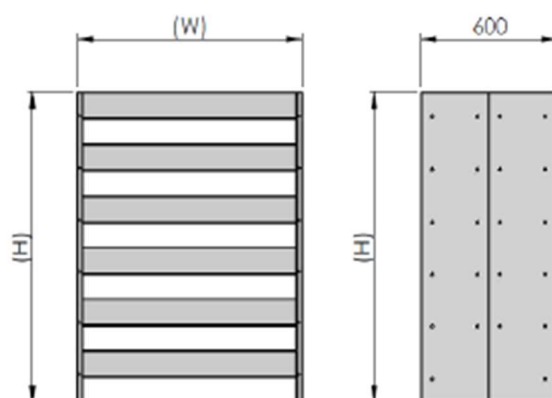
Appendix E – Manufacturers' Datasheets

BA2SL300

Acoustic Louvre



www.bas-ltd.co.uk



WIDTH (W) AND HEIGHT (H) DIMENSIONS GIVEN ON THE EQUIPMENT SCHEDULE ARE AS MANUFACTURED. ADEQUATE CLEARANCE MUST BE ALLOWED WHEN CONSTRUCTING THE BUILDERSWORK OPENING. A MINIMUM CLEARANCE OF 10 mm ALL ROUND IS RECOMMENDED. WHERE WINDPLATES ARE USED PLEASE CONSULT THE OFFICE FOR SPECIFIC RECOMMENDATIONS. LOUVRES WILL BE SUPPLIED WITHOUT SUPPORT STEELWORK, CLEATS, BRACKETS, FIXINGS, FLASHING, MASTIC, OR OTHER SUCH ITEMS, UNLESS OTHERWISE STATED. EXCESSIVELY LARGE OR HEAVY LOUVRES MAY BE MANUFACTURED AS MULTI MODULE SECTIONS FOR EASE OF HANDLING. LOUVRES ARE MANUFACTURED TO STANDARD SHEET METAL TOLERANCES OF +/- 3mm.

SPECIFICATION

LOUVRES ARE CONSTRUCTED FROM FOLDED SHEET METAL AND HAVE A SERIES OF HORIZONTAL BLADES CONTAINED WITHIN TWO SIDE FRAMES. THE MATERIAL OF CONSTRUCTION MAY BE PRE-GALVANISED STEEL, ALUMINIUM OR STAINLESS STEEL. LOUVRE BLADES HAVE LOWER/REAR FACES OF PERFORATED SHEET METAL, CONTAINING A FIBROUS SOUND ABSORBENT INFILL THAT IS NON-SHEDDING, NON-COMBUSTIBLE, NON-HYGROSCOPIC AND CHEMICALLY INERT. THE INFILL IS CAN BE FACED WITH GLASS CLOTH TO MINIMISE FIBRE MIGRATION. GALVANISED BIRD SCREENS OR NYLON COATED INSECT MESH CAN BE FITTED TO THE REAR OF THE LOUVER IF REQUIRED. CASING SIDES ARE PROVIDED WITH 11mm DIA HOLES FOR FIXING ADJACENT SECTIONS TOGETHER, OR FIXING THE LOUVER INTO THE BUILDERSWORK OPENING. LOUVRES ARE SUPPLIED SELF FINISH AS STANDARD OR WITH AN OPTIONAL POLYESTER POWDER FINISH TO A STANDARD RAL/BS COLOUR.

Sound Reduction Indices (SRI's) obtained from test at Salford University to BS EN ISO 10140-2 : 2010.

SRI is equivalent to the Transmission Loss of the Louvre.

Frequency Hz	63	125	250	500	1k	2k	4k	8k	Rw
SRI dB	7	9	12	23	33	41	32	28	25
Face Velocity m/s	0.5	0.75	1	1.25	1.5	1.75	2.0	2.25	2.5
Pressure Drop Pa	6	13	23	35	51	69	90	115	141
Weight	82kg/m ²								
Visual Free Area *	50%								
Actual Free Area	34%								

Bespoke Acoustic Solutions Ltd
12 Shield Drive
Wardley Industrial Estate
Worsley
Manchester
M28 2QB
Tel : 0161 804 4440

Available Options :
Peripheral Flanges
Birdguard / Insect Mesh
Inclined or Sloping Louvres



YVAA1650 - Technical Information

Unit ID		YVAA1650
Quantity		1
Net Cooling Capacity (according to EN14511)	kW	1534kw
Entering Chilled Water Temperature	°C	12
Leaving Chilled Water Temperature	°C	7
Ambient	°C	35
Total Flow Rate	L/s	73.466
SEER	kW/kW	4.31
n s,c (according to EU regulation 2016/2281)	kW/kW	179.63
Sound Power	dBA	101
Sound Pressure (Parallelepiped Method)	dBA	75
Sound Pressure Measured at	m	3
Refrigerant Type		R-513a

Standard Features

- ✦ Variable Speed Drive Screw Compressor
- ✦ Acoustic enclosure for compressors
- ✦ High Power Factor Correction at all load stages
- ✦ Electronic expansion valves
- ✦ Inverter drive per compressor resulting in starting currents below the units full load current
- ✦ Step-less capacity control from 10% to 100%
- ✦ Full R513a refrigerant charge (Low GWP refrigerant)
- ✦ Low Ambient Head Pressure Control.
- ✦ Low noise levels with insulated compressor housings
- ✦ Low Sound Fans with Variable Speed Control
- ✦ Dual Pressure relief valves
- ✦ Volt Free Contacts for remote on/off, general fault, run and pump start.
- ✦ Single Point Non – Fused Disconnect Switch with individual system fuses (CE)
- ✦ C.E. & P.E.D. approval Commissioning
- ✦ Multiple Refrigerant Circuits
- ✦ Eurovent Certification
- ✦ Enviroguard 'e' coated aluminum MCHX coils
- ✦ Micro-Processor control panel factory fitted and tested with volt free contacts for BMS interface complete with all starting equipment and standalone controls
- ✦ BACnet Card
- ✦ Load limiting controls ensure that when the machine is asked to operate outside its limits it will unload just sufficiently to bring it back within limitations and continue to run.
- ✦ 50% fewer moving parts than conventional screw compressor resulting in increased reliability and simplified maintenance.
- ✦ Chiller end of line run test (Non – Witness)

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Appendix F – Full Calculations

The calculations used to derive the output from the proposed louvre panelling are presented in the tables below.

Description	1/1 Octave Frequency Band (Hz, L _{eq,T} , dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Chiller 1/2 Lp at Louvre	83	74	80	79	82	77	67	85
Chiller 3/4 Lp at Louvre	79	72	78	78	81	76	65	83
Chiller 5/6 Lp at Louvre	79	71	77	76	80	75	64	82
Louvre SRI	7	9	12	23	33	41	32	25
Louvre 1/2 Output	76	65	68	56	49	36	35	61
Louvre 3/4 Output	72	63	66	55	48	35	33	59
Louvre 5/6 Output	72	62	65	53	47	34	32	58

Description	1/1 Octave Frequency Band (Hz, L _{eq,T} , dB)							Overall (dBA)
	63	125	250	500	1k	2k	4k	
Chiller 1/2 Lp at Aluminium Barrier	83	74	80	79	82	77	67	85
Chiller 3/4 Lp at Aluminium Barrier	79	72	78	78	81	76	65	83
Chiller 5/6 Lp at Aluminium Barrier	79	71	77	76	80	75	64	82
Aluminium SRI	5	5	7	11	15	20	26	15
Aluminium Barrier 1/2 Output	78	69	73	68	67	57	41	71
Aluminium Barrier 3/4 Output	74	67	71	67	66	56	39	69
Aluminium Barrier 5/6 Output	74	66	70	65	65	55	38	68



NOVA
ACOUSTICS