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Archbishop Cranmer Church of England Primary Academy, Nottingham

Noise Impact Assessment

For:
Archbishop Cranmer C of E Primary Academy

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Contents

1 Introduction

1.1 Overview

Environmental Noise Solutions Ltd (ENS) has been commissioned by Archbishop Cranmer Church of England School (hereafter referred to as 'the client') to undertake a noise impact assessment for a new fixed plant installation at Archbishop Cranmer Church of England Primary Academy, 1 School Lane, Aslockton, Nottingham, NG13 9AW (hereafter referred to as 'the site').

This report presents:

- The methodology and results of a noise survey conducted at the site
- The assessment of potential impact of noise emission from the plant on nearby noise sensitive receptors

This report has been prepared on behalf of the client for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties referring to the report should consult the client and ENS as to the extent to which the findings may be appropriate for their use.

A glossary of acoustic terms used in the main body of the text is contained in Appendix A.

1.2 Site Description

The site is located to the south of Main Road, Kirkby-in-Ashfield, in an area of primarily residential land uses, and is bounded on all sides by existing residential dwellings

The site location is presented on Figure 1.1 below, along with the approximate location of the proposed plant.

Figure 1.1: Site Location

2 Noise Criteria

2.1 Assessment Guidance

British Standard 4142: 2014 +A1:2019 "Methods for rating and assessing industrial and commercial sound"

BS 4142[1] presents methods for rating and assessing the potential impact of commercial and industrial sound upon noise sensitive receptors. The Standard is appropriate for the consideration of industrial and manufacturing processes, fixed installations which comprise mechanical and electrical plant and equipment and mobile plant / vehicles that form an intrinsic part of the industrial/commercial including the loading and unloading of goods and materials at the premises.

The noise impact magnitude is derived from the numerical subtraction of the representative[2] background noise level from the measured or calculated rating level of the specific sound under consideration. 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

The 'rating level' must be determined considering the need for any 'character corrections' to the specific industrial/commercial noise level to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency. This can be done using a subjective, objective or reference methods. Where multiple features are present the corrections should be added in a linear fashion to the specific level.

The subjective method is based on the corrections presented in Table 2.1.

Table 2.1: BS4142 Subjective Method 'Acoustic Feature' / Rating Corrections

Level of Perceptibility	Tonal Correction	Impulsivity Correction	Intermittency Correction	Other
None	0 dB	0 dB	+3 dB Where intermittency is readily identifiable	+3 dB Where neither tonal nor impulsive but clearly identifiable against prevailing soundscape
Just Perceptible	+ 2 dB	+ 3 dB		
Clearly Perceptible	+ 4 dB	+ 6 dB		
Highly Perceptible	+ 6 dB	+ 9 dB		

BS 4142 requires separate analysis for day and night time periods, evaluating the Rating level over an appropriate reference time interval (T_r) of:

- 1 hr during the day (between 07:00 – 23:00 hrs)
- 15 min during the night (between 23:00 – 07:00 hrs)

[1] British Standard 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound. British Standards Institution (2019)

[2] 'Representative' is generally considered to be 'typical' (e.g. formed by analysis of modal / mean average values) rather than the lowest measured

2.2 Noise Sensitive Receptors

The closest residential noise sensitive receptors are dwellings to the south of the Site boundary, indicated on the site location plan included as Appendix B, and described in Table 2.2 below.

Table 2.2: Noise Sensitive Receptors

NSR	Description	Direction	Approximate minimum distance to plant location (m)
A	Residential dwellings on Walnut Close	South	57
B	Residential dwellings on Main Street	North-east	135

3 Noise Survey and Results

3.1 Representative Noise Levels

Noise monitoring was undertaken between Wednesday 13th and Thursday 14th December 2023. Long-term unattended measurements were made at the southern site boundary, where noise conditions are considered representative of the closest identified noise sensitive receptors. Additional short term measurements were made on School Lane to the south of the site entrance, and proximate to Noble Lane to the north-east of the site.

The approximate monitoring locations are presented on the site location plan included as Appendix B and described below:

- Position 1 – at the southern boundary, approximately 4m above ground level
- Position 2 – on School Lane, approximately 20m south of the school boundary at 4m above ground level
- Position 3 – at the north-eastern site boundary adjacent to Noble Lane at 4m above ground level

Observations made whilst installing and collecting the equipment indicate that the noise climate was controlled by a mixture of distant road traffic and noise from the school itself.

Noise measurements were undertaken using a Bruel & Kjaer 2250 Type 1 integrating sound level meter. The meter was connected to a windshield covered microphone positioned at 4 metres height above ground, in 'free-field' conditions (i.e. > 3.5 metres from a vertical reflective surface), at the locations detailed above.

The calibration of each measurement system was verified immediately before and after the survey period using a Bruel & Kjaer Type 4231 calibrator. No drift in calibration levels greater than 0.5 dB was noted. Measurements consisted of A–weighted broadband parameters including L_{Aeq}, L_{A10} and L_{AFmax} together with linear octave band data.

As the survey was unattended, weather conditions were not directly recorded. However, analysis of historic online weather data indicates that conditions throughout the survey were considered appropriate for noise monitoring.

3.2 Summary of Results

Table 3.1 presents a summary of the noise data for the day and night time periods, rounded to the nearest decibel.

Table 3.1: Summary of Noise Measurement Data

Position	Date	Time (hh:mm)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
1	13/12/23	13:00-23:00	62	40
	13/12/23-14/12/23	23:00-07:00	42	35
	14/10/23	07:00-14:00	67	47
2	13/12/23	11:20-12:20	58	40
3	13/12/23	12:26-13:26	51	46

4 Assessment

4.1 Introduction

The proposals are for the installation of 2 no. new air source heat pumps (ASHP) to the north-western façade of the southern teaching block. A datasheet excerpt for the proposed ASHP is presented as Appendix D.

4.2 Fixed Plant Noise Limits

With reference to the BS 4142 guidance set out in Section 2, where the rating noise level from an item or items of fixed plant exceeds the existing background noise level by 5 dB or more, this is an indication that the noise would have an adverse impact at the noise sensitive receptors. On this basis, fixed plant noise should not exceed a rating noise level which is 5 dB above the existing representative background noise level.

Whilst the plant would typically be expected to operate during school hours only, it is possible that it may also operate during the night time for frost protection, or to begin heating the building prior to students/staff arriving. On this basis, the assessment also considers noise from plant against background noise levels during the night time.

Table 4.1 below presents a summary of the day and night time background noise levels and proposed Rating limits. Representative background noise levels are derived from the average dB $L_{A90,T}$ during the day, and average dB $L_{A90,T}$ during the night time. The noise level presented below should be achieved at 1m from the façade of nearby noise sensitive receptors.

Averaging periods (T) are 1 hour for the daytime, and 15 minutes for the night time.

Table 4.1: BS4142 Rating Noise Limits

NSR	Period	Representative background noise level (dB $L_{A90,T}$)	Proposed Rating Noise Limit (dB $L_{Ar,Tr}$)
All NSRs	Daytime (07:00-23:00)	37	≤ 42
	Night time (23:00-07:00)	35	≤ 40

4.3 Plant Noise Assessment

To calculate specific noise levels at the nearest noise sensitive receptors, a three-dimensional Cadna-A noise model has been developed. Noise model geometry is based on Ordnance Survey mapping data and drawings supplied by the client.

A noise contour plot illustrating the propagation of noise from the site is presented as Appendix C.

Propagation of noise has been calculated in octave bands according to ISO 9613: 1996, at a height of 4m above ground level, representative of a first-floor bedroom. All buildings within the model are assumed to be acoustically reflective, and second order reflections have been considered. The noise model assumes mixed hard/soft ground for propagation corrections and all dwellings outside the site boundary have an assumed height of 8m. All plant is assumed to be operating continuously and concurrently throughout the assessment period.

The proposed ASHPs are located a minimum of 60m from the closest habitable façade of the NSRs identified in Section 2.

The noise model includes a noise barrier surrounding the plant area at a height of 2.5m above ground, with the barrier location indicated in blue on the noise contour plot.

The noise model considers the following items of fixed plant:

- 2 no. Mitsubishi EAHV-M1500YCL air source heat pumps

Each of the two ASHPs has been assigned a sound power level of 83 dB L_{wA}, with spectral noise emission derived from the frequency data set out in Section 2 of the product datasheet presented in Appendix D

The following assumptions were used in the model:

- Meteorological conditions: Temp. 10 °C, Relative Humidity 70%
- Reflections: 2nd order reflections considered
- Propagation of noise has been calculated at a height of 4m above ground level

All plant is assumed to be operating continuously and concurrently throughout the assessment period.

4.4 BS 4142 Assessment

The calculated highest specific noise levels have been calculated at 4m above ground level, representing a first-floor window, with the results presented in Table 4.2.

Noise levels during the night time should be assessed over a time period (T) of 15 minutes, whilst daytime noise levels are assessed over a one-hour period, as recommended in BS 4142.

Table 4.2: Calculated Specific Noise Levels at NSRs

Noise Sensitive Receptor	Specific Noise Level [dB $L_{Aeq,T}$] at Receptor
NSR A	≤ 38
NSR B	≤ 33

With regard to potential 'acoustic feature' corrections, the following is considered:

- Air source heat pumps generally do not operate intermittently, and would be expected to operate continuously throughout the assessment periods. The assessment also assumes all plant is operating concurrently, representing worst case noise emission.
- Plant of this type is generally not impulsive, and typically produces a steady noise level when operating.
- Source noise levels used in the assessment are not considered tonal, therefore no correction is required.

Based on the above, no acoustic feature corrections have been applied.

The calculated servicing noise levels have been assessed in accordance with the methodology set out in BS 4142. The results of the assessment are presented in Tables 4.3 and 4.4 for day and night, respectively.

Table 4.3: BS4142 Assessment - Day

Parameter	NSR A	NSR B
Typical background sound level (dB $L_{A90,1hour}$)	37	37
Specific noise level (dB $L_{Aeq,1hr}$) (See Table 4.2)	38	33
Acoustic feature correction (dB)	0	0
Rating level (dB $L_{Ar,Tr}$)	38	33
Excess of rating over background sound level (dB)	+1	-4

Table 4.4: BS4142 Assessment - Night

Parameter	NSR A	
Typical background sound level (dB $L_{A90,15min}$)	35	35
Specific noise level (dB $L_{Aeq,15min}$) (See Table 4.2)	38	34
Acoustic feature correction (dB)	0	0
Rating level (dB $L_{Ar,Tr}$)	38	34
Excess of rating over background sound level (dB)	+3	-1

The results presented in Tables 4.3 and 4.4 indicate that noise from the proposed ASHPs will exceed the representative background noise level by ≤1 dB during the daytime, and ≤3 dB during the night time.

With reference to the BS 4142 guidance set out in Section 2.2, the predicted noise levels are below the level at which adverse impacts are expected.

4.5 BB93 Noise Impact

Noise levels from the proposed plant are predicted to be ≤ 46 dB $L_{Aeq,30min}$ at the closest school façade and are therefore suitable for naturally ventilated classrooms according to the guidance set out in Building Bulleting 93: Acoustic design of schools: Performance standards (BB93).

Based on the above, the proposals are considered to satisfy the requirements of BB93 with regards to noise in teaching spaces.

5 Summary and Conclusions

A noise impact assessment has been undertaken for a new fixed plant installation at the existing Archbishop Cranmer Church of England Primary Academy, 1 School Lane, Aslockton, Nottingham, NG13 9AW.

Noise monitoring was undertaken on Wednesday 13th and Thursday 14th December 2023 to assess prevailing background noise levels in the vicinity of nearby noise sensitive receptors.

Rating noise limits have been set for nearby noise sensitive receptors based on the representative background noise levels measured during the day and night time periods at the closest noise sensitive receptors.

Noise emission from the new items of fixed plant has been calculated using a three-dimensional noise model, based on information provided by the client.

Predicted noise levels at the façade of the nearest identified noise sensitive receptors are below the level at which adverse impacts are likely to occur.

Noise levels at the façade of the closest teaching spaces to the proposed plant are also predicted to satisfy the guideline noise levels of BB93.

Appendix A – Abbreviations and Definitions

Sound Pressure Level (L_p)
The basic unit of sound measurement is the sound pressure level. As the pressures to which the human ear responds can range from 20 μPa to 200 Pa, a linear measurement of sound levels would involve many orders of magnitude. Consequently, the pressures are converted to a logarithmic scale and expressed in decibels (dB) as follows:

$L_p = 20 \log_{10}(p/p_o)$

Where L_p = sound pressure level in dB; p = rms sound pressure in Pa; and p_o = reference sound pressure (20 μPa).

A-weighting
A frequency filtering system in a sound level meter, which approximates under defined conditions the frequency response of the human ear. The A-weighted sound pressure level, expressed in dB(A), has been shown to correlate well with subjective response to noise.

Equivalent continuous A-weighted sound pressure level, $L_{Aeq,\,T}$
The value of the A-weighted sound pressure level in decibels of continuous steady sound that within a specified time interval, *T*, has the same mean-square sound pressure as a sound that varies with time. $L_{Aeq,\,16h}$ (07:00 to 23:00 hours) and $L_{Aeq,\,8h}$ (23:00 to 07:00 hours) are used to qualify daytime and night time noise levels.

$L_{A10,\,T}$
The A-weighted sound pressure level in decibels exceeded for 10% of the measurement period, T. $L_{A10,\,18h}$ is the arithmetic mean of the 18 hourly values from 06:00 to 24:00 hours.

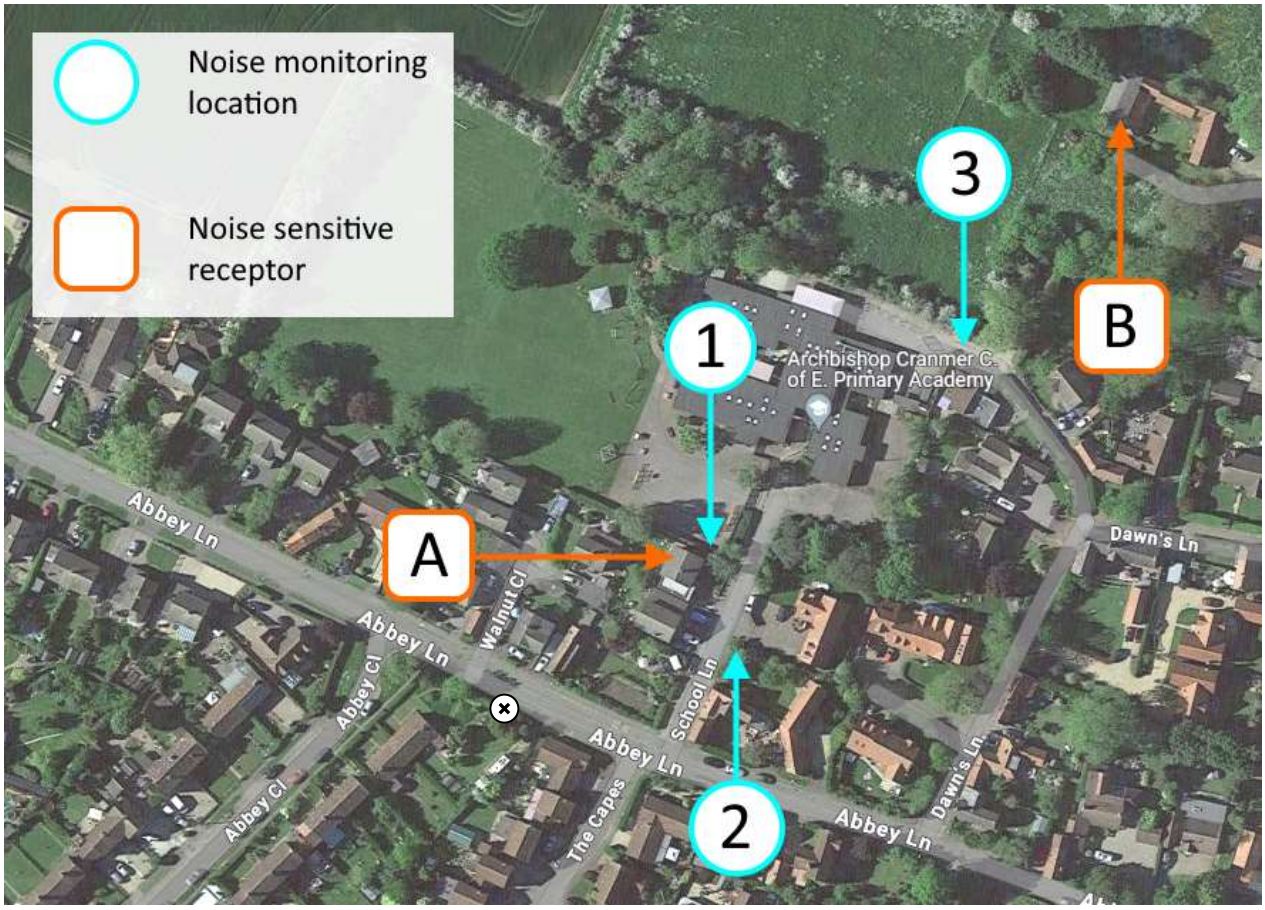
$L_{A90,\,T}$
The A-weighted sound pressure level of the residual noise in decibels exceeded 90% of a given time interval, T. L_{A90} is typically taken as representative of background noise.

$L_{AF\,max}$
The maximum A-weighted noise level recorded during the measurement period. The subscript 'F' denotes fast time weighting, slow time weighting 'S' is also used.

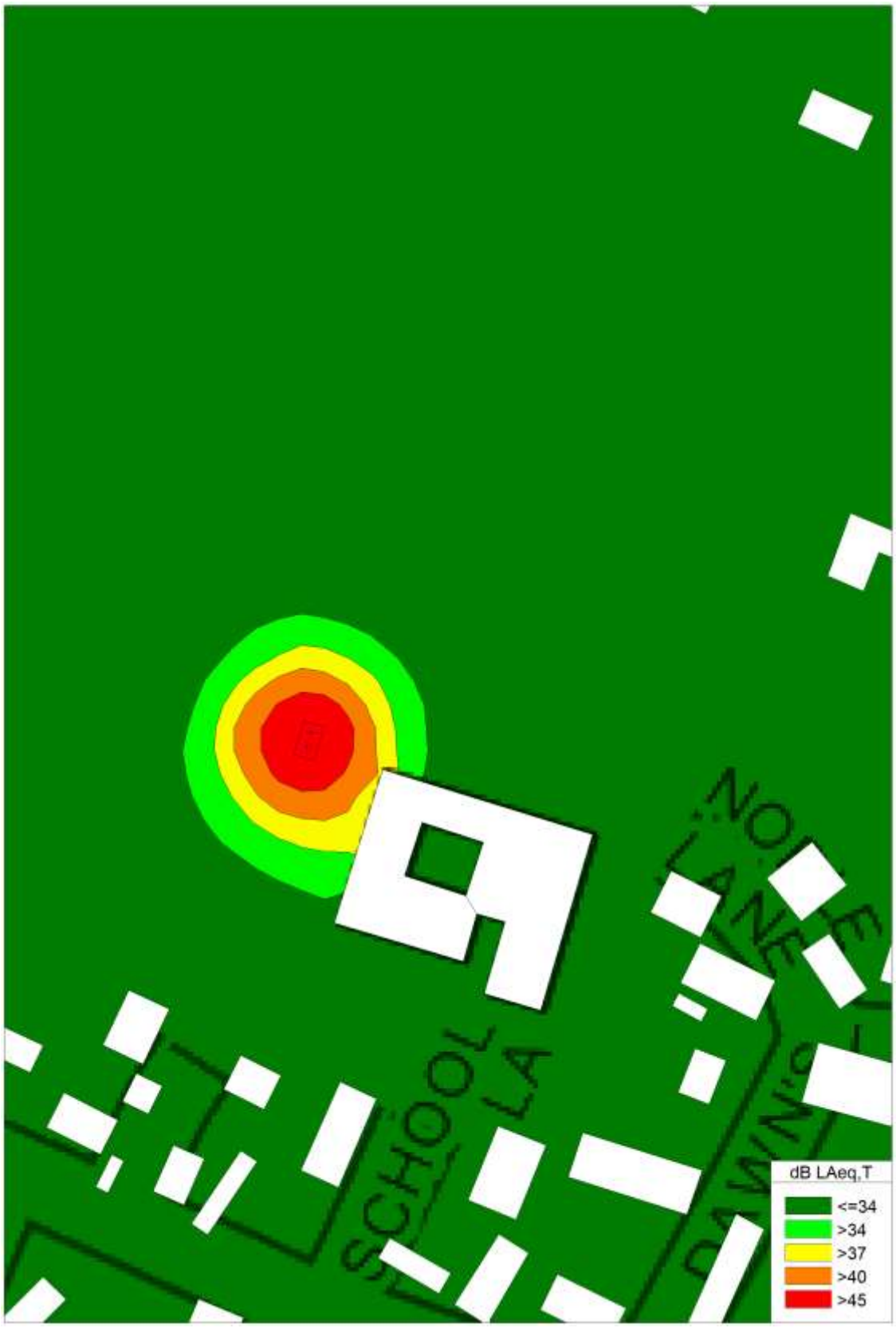
Single Event Level / Sound Exposure Level (SEL or L_{AE})
The energy produced by a discrete noise event averaged over one second, regardless of the event duration. This allows for comparison between different noise events which occur over different lengths of time.

Weighted Sound Reduction Index (R_W)
Single number quantity which characterises the airborne sound insulation properties of a material or building element over a defined range of frequencies (R_W is used to characterise the insulation of a material or product that has been measured in a laboratory).

Appendix B –Site Location Plan and Monitoring Positions



Appendix C –Noise Contour Plot (dB $L_{Aeq,T}$) at 4m AGL



Appendix D –Datasheet

1. Product Specifications

1-1. Specifications

EAHV-M-YCL(-N), EACV-M-YCL(-N)

Model			EAHV-M1500YCL(-N)(-BS)
Power source			3-phase 4-wire 380-400-415V 50/60Hz
Cooling capacity *1		kW	150.00
		kcal/h	129,000
		BTU/h	511,800
	Power input	kW	44.73
	EER		3.35
	IPLV *6		6.42
	Water flow rate	m^3/h	25.8
Cooling capacity (EN14511) *2		kW	149.18
		kcal/h	128,295
		BTU/h	509,002
	Power input	kW	45.55
	EER		3.28
	Eurovent efficiency class		A
	SEER		5.52
	Water flow rate	m^3/h	25.8
Heating capacity *3		kW	150.00
		kcal/h	129,000
		BTU/h	511,800
	Power input	kW	42.61
	COP		3.52
	Water flow rate	m^3/h	25.8
Heating capacity (EN14511) *4		kW	150.82
		kcal/h	129,705
		BTU/h	514,598
	Power input	kW	43.43
	COP		3.47
	SCOP Low/Medium		3.31/2.88
	Water flow rate	m^3/h	25.8
Current input	Cooling current 380-400-415V *1	A	76 - 72 - 69
	Heating current 380-400-415V *3	A	72 - 68 - 66
	Maximum current	A	120
Water pressure drop *1		kPa	55
Temp range	Cooling	°C	Outlet water 4~30 *7
		°F	Outlet water 39.2~86 *7
	Heating	°C	Outlet water 25~55 *7
		°F	Outlet water 77~131 *7
	Outdoor (Cooling)	°C	-15~52 *7
		°F	5~125.6 *7
	Outdoor (Heating)	°C	-20~43 *7
		°F	-4~109.4 *7
Circulating water volume range		m^3/h	12.9~43.0
Sound pressure level (measured in anechoic room) at 1m *1		dB (A)	65
Sound power level (measured in anechoic room) *1		dB (A)	83
Diameter of water pipe	Inlet	mm (in)	65A (2 1/2B) housing type joint
(Standard piping)	Outlet	mm (in)	65A (2 1/2B) housing type joint
Diameter of water pipe	Inlet	mm (in)	150A (6B) housing type joint
(Inside header piping)	Outlet	mm (in)	150A (6B) housing type joint
External finish			Polyester powder coating steel plate
External dimension H × W × D		mm	2350 × 3400 × 1080
Net weight	Standard piping	kg (lbs)	1280 (2822)
	Inside header piping	kg (lbs)	1307 (2881)
Design pressure	R32	MPa	4.15
	Water	MPa	1.0
Heat exchanger	Water side		Stainless steel plate and copper brazing
	Air side		Salt-resistant cross fin & aluminium tube
Compressor	Type		Inverter scroll hermetic compressor
	Maker		MITSUBISHI ELECTRIC CORPORATION
	Starting method		Inverter
	Quantity		4
	Motor output	kW	11.5 × 4
	Lubricant		MEL46EH
Fan	Air flow rate	m^3/min	270 × 4
		L/s	4500 × 4
		cfm	9534 × 4
	Type, Quantity		Propeller fan × 4
	Starting method		Inverter
	Motor output	kW	0.92 × 4
	External static press.	Pa	20
Protection	High pressure protection		High pres.Sensor & High pres.Switch at 4.15MPa (601psi)
	Inverter circuit		Over-heat protection, Over current protection
	Compressor		Over-heat protection
Refrigerant	Type × charge		R32 × 11.5 (kg) × 4 *5
	Control		LEV

Notes:

*1 Under normal cooling conditions at outdoor temp 35°CDB/24°CWB (95°FDB / 75.2°FWB) outlet water temp 7°C (44.6°F) inlet water temp 12°C (53.6°F). Pump input is not included in cooling capacity and power input.
*2 Under normal cooling conditions at outdoor temp 35°CDB/24°CWB (95°FDB/75.2°FWB) outlet water temp 7°C (44.6°F) inlet water temp 12°C (53.6°F). Pump input is included in cooling capacity and power input based on EN14511.
*3 Under normal heating conditions at outdoor temp 7°CDB/6°CWB (44.6°FDB/42.8°FWB) outlet water temp 45°C (113°F) inlet water temp 40°C (104°F). Pump input is not included in heating capacity and power input.
*4 Under normal heating conditions at outdoor temp 7°CDB/6°CWB (44.6°FDB/42.8°FWB) outlet water temp 45°C (113°F) inlet water temp 40°C (104°F). Pump input is included in heating capacity and power input based on EN14511.
*5 Amount of factory-charged refrigerant is 3 (kg) × 4. Please add the refrigerant at the field.
*6 IPLV is calculated in accordance with AHRI 550-590.
*Please don't use the steel material for the water piping.
*Please always make water circulate, or pull the circulation water out completely when not in use.
*Please do not use groundwater or well water in direct.
*The water circuit must be closed circuit.
*Due to continuous improvement, the above specifications may be subject to change without notice.
*This model doesn't equip with a pump.
*7 Please refer to 2-1-6. Operation temperature range.

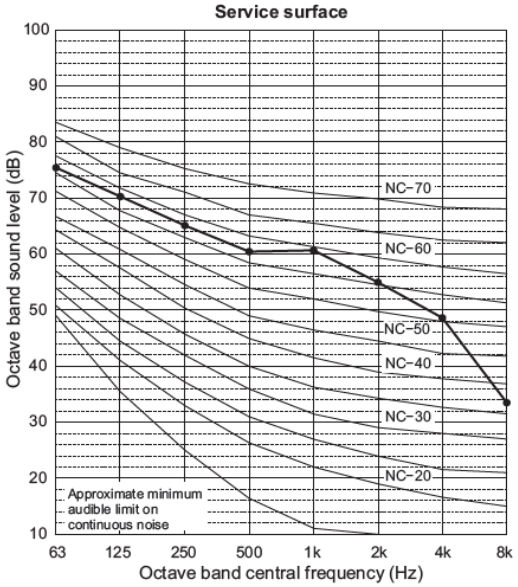
Unit converter

kcal/h	= kW × 860
BTU/h	= kW × 3,412
lbs	= kg/0.4536
cfm	= m^3/min × 35.31

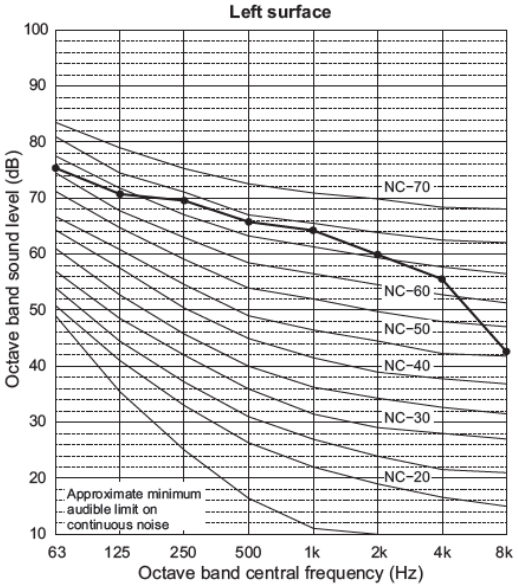
2. Product Data

EAHV-M1500YCL
EACV-M1500YCL

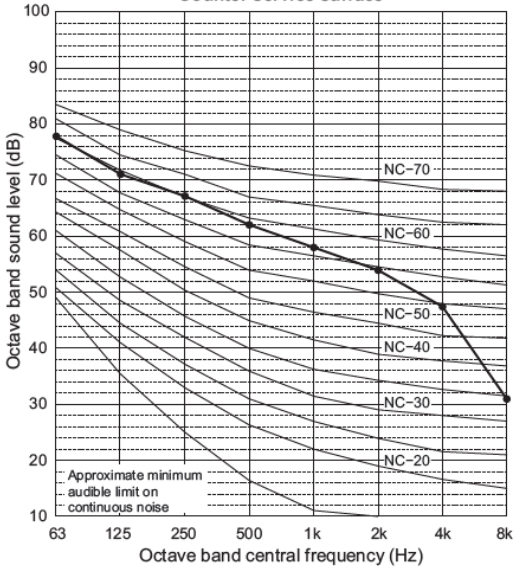
Service surface



Left surface



Counter service surface



Right surface