BURO HAPPOLD

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Noise Impact Assessment

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Document1

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Glossary

Term	Definition
Ambient noise (as defined in BS 4142)	Totally encompassing noise in a given situation at a given time; it is usually composed of noise from many sources, near and far.
Background Noise (as defined in BS 4142)	A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T, measured using time weighting, F, and quoted to the nearest whole number of decibels.
Decibel, dB	Commonly used unit used for the comparison of the powers of levels sound. Abbreviation dB. For sound pressure level (L_p) the reference quantity is $2x10^{-5}$ N/m^2. The sound pressure level existing when microphone measured pressure is $2x10^{-5}$ N/m^2 is 0 dB, the threshold of hearing.
Frequency	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
L_{eq} (& L_{Aeq})- Equivalent continuous noise level of a time-varying noise	Equivalent continuous sound pressure level (A-weighted) over a period of time, T.
L_p - sound pressure level	Sound pressure level, in decibels, of a sound is 20 times the logarithm to the base of 10 of the ratio of the sound pressure to the reference pressure. The reference pressure shall be explicitly stated and is defined by standard.
$L_{90,T}$ ($L_{A90,T}$)	Sound pressure level exceeded for 90% of the measurement period. Referred to as background noise level.
Statistical noise levels	Noise levels that vary greatly over time are usually expressed using statistical values of the level exceeded for a stated percentage of the time. These are denoted Lx, showing the level that is exceeded x% of the time. L_{A90} is considered to be the (A-weighted) background noise level with unusually loud events being excluded. L_{A10} is usually used for the measurement of traffic noise.
Weightings (as defined in IEC 61672:2003):	A-Weighting: Frequency weighting devised to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies; it consists of an electronic filter in a sound level meter, which attempts to build in this variability into the indicated noise level reading so that it will correlate, approximately, with human response.). C-Weighting: One of the frequency weightings corresponding to the 100-phon contour and the closest to the linear or un-weighted value.
$L_{Ar,T}$	Rating Noise Level (as defined in BS 4142:2014+A12019), the specific noise level plus any adjustment for the characteristic features of the noise.

1 Introduction

1.1 Overview

Buro Happold has been commissioned by University College London (UCL) to carry out a Noise Impact Assessment to support a Planning Application for the continued refurbishment of the Institute of Education (IoE) building, 20 Bedford Way, London, WC1H 0AL.

Specifically this report considers the proposed replacement of a condenser unit on the Level 09 roof top, positioned in Core A.

1.2 Content

This report covers the following elements, those being most relevant to planning:

- Comparison of the noise levels of the existing and new units
- Predicted noise levels at the nearby noise-sensitive receptors (NSR)
- Background noise levels captured during the survey carried out by Buro Happold in June 2023 in the vicinity of the proposed site
- Maximum permissible noise impact levels for fixed mechanical plant, based on the Camden Local Planning Authority target compliance and results of the external noise survey.

1.1 Site Overview

The site, as shown in Figure 1—1, is located at 20 Bedford Way, London, WC1H 0AL. The local sound environment at the site consists primarily of vehicle movements on the local road network and existing plant items at the IoE and neighbouring academic buildings.

The site is neighboured by the following:

- North – the Royal National Hotel, which is identified as the closest **NSR** to the site
- East – residential, commercial, and other UCL academic buildings, with Russel Square further afield
- West – residential, commercial, and other UCL academic buildings, with Gordon Square further afield
- South – residential, commercial, and other UCL academic buildings.

1.1 Proposal

A number of existing plant items are situated on the Level 9 Core A external terrace, it is proposed to remove one of the existing condenser units and replace it by installing a new condenser unit in this same location.

Figure 1—1 Aerial view of IoE site and nearby sensitive receivers (Source: Google Earth)

1.2 Comparison of condenser units

The noise data provided by the manufacturer for the existing, Daikin, and replacement, Mitsubishi, condensers are detailed in Table 1—1. The new condenser is 9 dB and 10 dB quieter than the existing unit in heating and cooling modes respectively, and therefore no increase to existing background noise levels is expected from this replacement.

Nevertheless, the remainder of this report outlines compliance with Local Authority criteria for the sake of completeness.

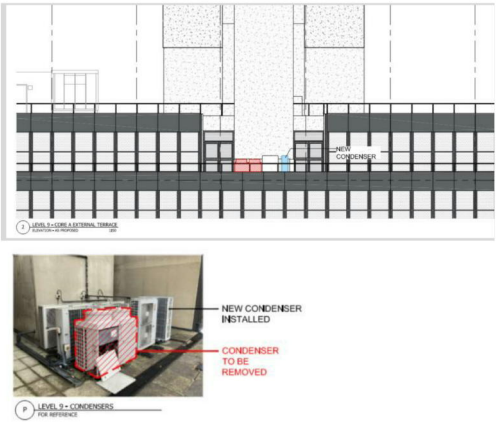

Figure 1—2 Proposed plans for Level 9 Core A terrace (Source: Overbury Planning Issue Drawing 3147-P7-2905 P1)

Table 1—1 Sound Power Levels of existing and replacement condenser unit

Condenser Unit		Sound Power Level dBA	
		Heating	Cooling
Existing	Daikin RYP200B7W1	78	77
Replacement	Mitsubishi PUZ-ZM60VHA	69	67

2 Acoustic Design Criteria

2.1 Reference Codes & Standards

This report is based on guidance from the following documents:

- National Planning Policy Framework, 2023
- Noise Policy Statement for England, 2010
- The London Plan *The Spatial development strategy for London consolidated with alterations since 2011*, 2016
- The London Plan, Policy D13 Agent of Change and D14 Noise, 2021
- Camden Planning Guidance – Amenity, 2019
- Camden Local Plan, 2017
- BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound

2.2 English Planning Policies on Noise Impacts

The National Planning Policy Framework (NPPF) is the overarching planning policy document for developments in England. The document contributes to sustainable development, aiming to protect or enhance the natural, built and historic environment, including minimising pollution and waste.

The NPPF document refers to the Noise Policy Statement for England (NPSE) specifically for noise impact. The NPSE provides guidance, which enables decisions to be made regarding the acceptable noise burden to place on society, using the three key phrases:

- No Observed Effect Level (NOEL)
- Lowest Observed Adverse Effect Level (LOAEL)
- Significant Observed Adverse Effect Level (SOAEL).

It is proposed that noise emissions generated by the scheme achieve NOEL to LOAEL upon nearby NSRs.

2.3 The London Plan 2021

2.3.1 Policy D14 - Noise

Provides qualitative methods for the management of noise, stating:

- *"In order to reduce, manage and mitigate noise to improve health and quality of life, residential and other non-aviation development proposals should manage noise by:*
    1. *avoiding significant adverse noise impacts on health and quality of life*
    2. *reflecting the Agent of Change principle as set out in Policy D13 Agent of Change*
    3. *mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses*
    4. *improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquillity)*
    5. *separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening or internal layout – in preference to sole reliance on sound insulation*
    6. *where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through applying good acoustic design principles*
    7. *promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver.*
- Boroughs, and others with relevant responsibilities, should identify and nominate new Quiet Areas and protect existing Quiet Areas and protecting existing Quiet Areas in line with the procedure in Defra's Noise Action Plan for Agglomerations"

Response to The London Plan

Noise emissions from the proposed scheme are primarily from newly introduced fixed plant installations. The fixed plant noise target are based on Camden borough requirements (refer to the following section).

Calculations have been undertaken to assess the impact of the proposed plant and equipment on existing noise-sensitive receptors. Noise mitigation measures are proposed to meet the local authority's noise target.

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

BS 4142:2014+A1:2019 provides methods for rating and assessing sound of an industrial and/or commercial nature, which includes sound from industrial and manufacturing processes, fixed services plant, sound generated by the loading/unloading of goods and sound from mobile plant / vehicles associated with industrial / commercial premises (e.g. forklift trucks).

The standard utilises various descriptors to assess complaints, the impact of sound associated with proposed industrial / commercial activities on existing noise-sensitive receptors, or the impact and likely suitability of siting new noise-sensitive receptors in the vicinity of existing industrial / commercial noise sources.

The standard is specifically precluded from being used to determine likely internal sound levels arising from external noise, or from the assessment of various sound sources for which other (more relevant) guidance exists, including music/entertainment noise, person noise and construction noise.

The magnitude of impact is assessed by subtracting the measured background sound level at a location representative of the nearest noise-sensitive receptor, from the 'rating level' (the specific sound source to be introduced into the locality, corrected for acoustically distinguishing characteristics which may make it more subjectively prominent).

Typically, the greater the difference between the background and rating level, the greater the magnitude of impact, although BS 4142 emphasises that this is highly context-specific.

As a guideline, BS 4142 states that:

- *A difference (between the background and rating level) of around +10 dB or more is likely to be indicative of significant adverse impact, depending on context*
- *A difference (between the background and rating level) of around +5 dB or more is likely to be indicative of adverse impact, depending on context*
- *The lower the rating level relative to the background level, the less likely it is that the specific sound will have an adverse impact*
- *Where the rating level does not exceed the background level, this is an indication that the specific sound will have a low impact, depending on context.*

It should be noted that BS 4142:2014+A1:2019 draws a clear distinction between the detailed and flexible assessment methods contained within, and the more limited versions contained in the previous (1997) edition.

Above all, BS 4142:2014+A1:2019 requires qualified engineering consultants and technical planning professionals (e.g. Environmental Health Officers) to use a combination of quantitative assessment techniques and rational qualitative judgements to come to a reasoned conclusion.

2.4.1 Definitions

BS 4142 uses several specific terms to define the various levels used in assessments, as follows:

- **Specific sound** – the commercial / industrial noise source under consideration
- **Residual sound** – the sound level at the noise-sensitive receivers in the absence of the specific sound
- **Ambient sound** – the sound level at the noise-sensitive receivers in the presence of the specific sound (i.e. ambient = residual + specific)
- **Background level** - the sound pressure level which is exceeded by the residual sound for 90% of the measurement period
- **Rating level** – the specific sound, corrected for acoustically distinguishing characteristics.

Background level

BS 4142 emphasises that the background level ($L_{A90,T}$) is in fact a range of levels, not one absolute value. Whilst stating that the measurements of background sound should be normally not less than 15 mins, the focus is on obtaining a level for use in assessment that is representative of typical conditions at the noise-sensitive receivers.

An example methodology by which this typical value may be obtained is given in the document. In this example, monitoring of $L_{A90,15mins}$ is undertaken during periods which represent when the specific noise will be operational. After obtaining a sequence of representative contiguous or disaggregated results, it is then proposed that the modal value is representative of the 'typical' background level.

Specific sound

BS 4142 requires that the specific sound ($L_{Aeq,Tr}$) is obtained over a reference period of 1 hour (daytime) and 15 mins (at night). Ideally, measurements would be taken of the ambient sound and residual sound at the assessment location, with these measurements used to accurately calculate the specific sound (ambient – residual = specific).

Where the source (specific sound) is not yet operational, it is permissible to measure the specific sound elsewhere (or to use known manufacturers' or library data) and then model the impact of this against the known background level.

Rating level

Once the specific sound level has been determined, this must be corrected in terms of the need to consider the subjective prominence of the impact of the sound at noise-sensitive receivers, and the extent to which acoustically distinctive characteristics will attract attention.

BS 4142 states that this is normally possible to carry out a subjective assessment of characteristics, based on the following correction guidelines:

- **Tonality:** +2 dB for a 'just perceptible' tone, +4 dB for 'clearly perceptible', and rising to +6 dB for 'highly perceptible' tones
- **Impulsivity (rapidity of change and overall change in level):** +3 dB for 'just perceptible' impulsivity, +6 dB for 'clearly perceptible', rising to +9 dB for 'highly perceptible' impulsivity
- **Intermittency:** if the on/off-time of the specific sound is readily distinctive at the noise-sensitive receivers, +3 dB
- **Other sound characteristics:** (see page 14 or 20 in PDF file of 4142).

It should be noted that where one feature is clearly perceived as dominant, it may be applicable to correct for that feature only. Where multiple features are likely to affect perception and response, each should be added arithmetically.

2.5 Camden Borough Guidelines

Camden Planning Guidance – Amenity (2019) highlights how any development involving External Air extraction / conditioning equipment requires a formal acoustic assessment. It goes on to state that:

> *"developments proposing plant, ventilation, air extraction or conditioning equipment and flues will need to provide the system's technical specifications to the Council accompanying any acoustic report. 'BS4142 Method for rating Industrial and Commercial Sound' contains guidance and standards which should also be considered within the report."*

The Camden Local Plan also asks for BS4142 to be used for cases relating to industrial and commercial noise sources and states that:

> *"For such cases, a 'Rating Level' of **10 dB below background** (15 dB if tonal components are present) should be considered as the design criterion)."*

This information is summarised in Figure 2—1.

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 57dBL_{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 88dBL_{Amax}

Figure 2—1 Summary of Camden Borough guidance on industrial and commercial noise (Source: Camden Local Plan, Appendix 3)

3 Noise Survey

3.1 Introduction

Buro Happold Engineering conducted external noise surveys on Tuesday 27th and Wednesday 28th June 2023, within the vicinity of the development site.

This survey gives an indication of the typical background noise levels in this area including those experienced by the nearest NSRs.

Figure 3—1 Site Overview – measurement location & surrounding NSRs (Source: Google Earth)

3.2 Survey Methodology

3.2.1 Attendance

The following Buro Happold staff members visited the site to undertake the noise survey:

- Leonardo Fernandez MEng, Graduate Acoustic Engineer and associate member of the Institute of Acoustics (IOA)
- Rhiannon Hawkins BSc, Graduate Acoustic Engineer and student member of the IOA

3.2.2 Survey Equipment

A list of equipment used during the noise survey is presented in Table 3—1.

3.2.3 Measurement Location

A single measurement location was selected (Google Maps coordinates of (51.5235457, -0.1283269), which consisted of a 24 hour automated measurement, sampling every 15 minutes, capturing noise data from 10:00 Tuesday 27th June to 11:00 Wednesday 28th June 2023.

This measurement location at rooftop level of the IoE Core B is shown in Figure 3—2.

The values measured on-site are averages of a background noise level descriptor during the relevant measurement period, $L_{A90,15min}$ (dB). This can be described as an A-weighted sound pressure level exceeded for 90% of the measurement period i.e. a level that would be perceived as a constant, background noise level. Typically, largely unaffected by local traffic pass-by or by transient events. More usually attributable to constantly-running building services plant or distant road traffic. What you would hear when there is no local traffic present (or other readily-identifiable noise sources).

Table 3—1 Environmental noise survey equipment

Name	Type	Serial Number
Sound Level Meter	Bruel & Kjaer 2250	2449831
Microphone	Bruel & Kjaer 4189	1837044
Pre-Amplifier	Bruel & Kjaer ZC 0032	02116
Acoustic Calibrator	Bruel & Kjaer 4231	1898067

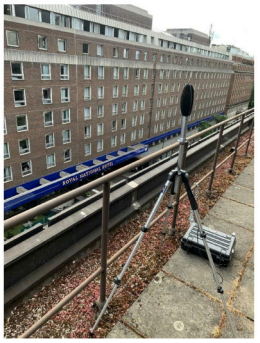

Figure 3—2 Noise measurement location at rooftop level of Core B

3.2.4 Noise Survey Results & Discussion

As previously described, the main objective of the noise survey is to obtain background noise levels representative of the nearest noise-sensitive receivers (NSR).

Data analysis has been performed on the measured background sound levels to determine the typical value required for a BS 4142 assessment.

As can be seen from Figure 3—3, the most frequent background level of $L_{A90,T}$ 55 dB was used to define typical day-time background sound levels at the measurement location.

As for night-time measurements shown in Figure 3—4, the lowest and most frequent background level of $L_{A90,T}$ 46 dB was used to define typical night-time background sound levels at the measurement location.

It was noted that road traffic along Bedford Way dominated the noise climate at the site location, with the ambient noise climate also comprising existing rooftop plant items

These typical background $L_{A90,T}$ noise levels will be used to set plant noise limits for the surrounding NSRs based on the Camden Borough guidance.

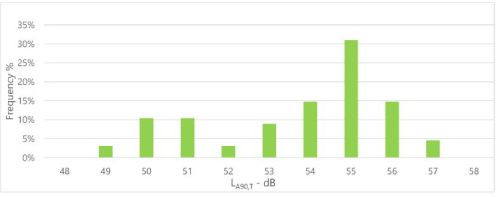

Figure 3—3 Modal analysis of daytime background levels captured during the noise survey

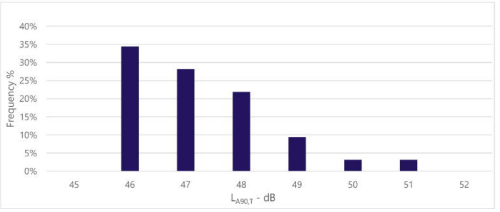

Figure 3—4 Modal analysis of night-time background levels at LT1

3.3 External Plant Noise Limits

For the purposes of this assessment, it is assumed that the plant will operate 24 h.

Based on the analysis above, a summary of the representative background sound levels and associated plant noise limits can be found in .

Plant noise targets are based on achieving a rating level that is 10 dB below the background sound level, which should see that the amenity of local NSRs is suitably protected.

This is in the situation where plant selections do not have acoustically distinguishable features as defined in BS 4142:2014+A1:2019.

Note: these are rating levels in accordance with BS 4142:2014+A1:2019, which requires that penalty corrections are made to the noise source for acoustically distinguishable features. Therefore, if the selections include plant with tonal, impulsive, or intermittent noise features, these targets would reduce accordingly. They are cumulative levels that apply to all plant items operating simultaneously – individual items may need to be attenuated to less than these values such that the cumulative level is achieved.

Table 3—2 Representative background sound levels and associated plant noise target

Period	Representative background $L_{A90,T}$ sound levels	Camden Borough guidance	$L_{Ar,Tr}$ (dB) Rating Level – limiting noise level for fixed plant @ 1 m from NSR façade
Day (07:00-23:00)	55	-10 dB	45
Night (23:00-07:00)	46	-10 dB	36

4 Plant noise calculation

4.1 Noise Level at NSRs

Using the manufacturer's data, shown in Table 1—1, for the replacement condenser unit the resulting noise level incident on the façade of the closest NSR can be calculated.

The nearest NSR is the Royal National Hotel opposite to the IoE building, the distance to the nearest façade is approximately 30m, as shown in Figure 4—1.

The formula shown in Figure 4—2 has been used, with the following assumptions:

- Two reflecting surfaces, below and behind the condenser unit ($Q = 4$)
- Distance of 30m from condenser to façade
- No screening
- No air absorption
- NSR façade glazing achieves a minimum broadband sound reduction index of R_w 25 dB
- A partially open window achieves an external to internal level difference of 15 dB

Based on these assumptions, the predicted levels incident on the façade are $L_{Aeq,Tr}$ 32 dB and $L_{Aeq,Tr}$ 34 dB when cooling and heating respectively.

This complies with the more stringent night time plant noise level criteria of $L_{Aeq,Tr}$ 32 dB as set out in Table 3—2. The above calculation assumes no correction for tonality. This is considered a reasonable assumption as the plant is at least 12 dB below the background noise level. In addition no correction for impulsivity or other attention catching characteristics has been allowed for.

The predicted internal ambient levels in the nearest residential receptors are shown in Table 4—1, the maximum internal level is expected to be L_{Aeq} 19 dB, assuming partially open windows, which is below the recommended night-time internal noise level of L_{Aeq} ≤30 dB for bedrooms (BS 8233:2014).

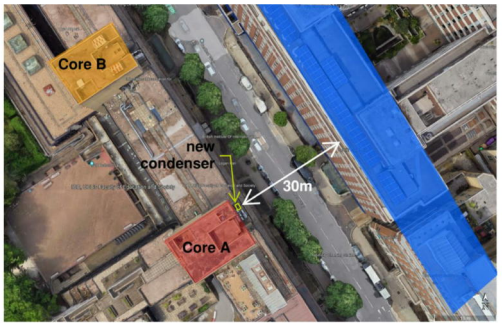

Figure 4—1 Distance to nearest façade of NSR from new condenser (Source: Google Earth)

$$L_{treat} = L_w + 10\log\left(\frac{Q}{4\pi r^2}\right)$$

L_w = sound power level
Q = directivity factor
r = distance from source

Figure 4—2 Formula for sound pressure level at façade

Table 4—1 Calculated noise levels at NSR

Condenser Operating Mode	Noise level incident on the façade $L_{Aeq,T}$	Internal Noise Level $L_{Aeq,T}$	
		Closed Window	Partially Open Window
Cooling	32 dBA	7 dBA	17 dBA
Heating	34 dBA	9 dBA	19 dBA

5 Assessment of Proposal

5.1 Comparison between condenser units

The sound power levels of both the existing and replacement units, shown in Table 1—1, indicate that the new condenser is 9 dB / 10 dB (heating / cooling) quieter than the existing unit.

1.3 Noise levels at NSRs relative to background noise levels

The predicted noise levels incident on the façade, Table 4—1, of the NSRs from the new condenser unit are L_{Aeq} 32 dB / L_{Aeq} 34 dB (heating / cooling), these are both below the night-time rating limit of $L_{Ar,Tr}$ 36 dB.

5.2 Noise levels at NSRs

The predicted internal noise levels resulting from the new unit, Table 4—1, all fall at least 11 dB below the recommended night-time internal noise level of L_{Aeq} 30 dB (8233:2014).

6 Conclusion

It is proposed to replace an existing condenser unit with a new condenser unit on the Level 9 Core A external terrace of the Institute of Education (IoE) building.

The new condenser unit is quieter than the unit it is replacing and therefore is not expected to increase the existing background noise level.

A calculation has been carried out to predict the noise levels resulting from the unit itself at the NSRs and these are below the rating limits determined from a previous noise survey taken in the vicinity of the site.

Appendix A Manufacturer's Data

TECHNICAL SPECIFICATIONS									
OUTDOOR UNITS					RYP71B7V1/W1	RYP100B7V1/W1	RYP125B7W1	RYP200B7W1	RYP250B7W1
DIMENSIONS	Unit	H	mm		860	1,215	1,215	1,220	1,440
		W	mm		880	880	880	1,290	1,290
		D	mm		320	320	320	700	700
WEIGHT			kg		89/86	104/99	102	196	210
MATERIAL	Unit				Painted galvanised steel plate				
COLOUR	Unit				Ivory white				
SOUND LEVEL	Sound pressure (1) (cooling/heating)	high	dBA		50/52	53/56	53/56	57/57	57/57
		low	dBA		-	-	-	-	-
	Sound power (2) (cooling/heating)		dBA		63/-	66/-	67/-	77/78	77/78

Figure 6—1 Existing: Daikin Condenser Noise Data, Sound Pressure Level taken at 1m from unit, outlined in red.

PUZ-ZM OUTDOOR UNITS		PUZ-ZM35VKA	PUZ-ZM50VKA	PUZ-ZM60VHA
SOUND PRESSURE LEVEL (dBA)	Heating/Cooling	46 / 44	46 / 44	49 / 47
SOUND POWER LEVEL (dBA)	Cooling	65	65	67
WEIGHT (kg)		46	46	70
DIMENSIONS (mm)	Width x Depth x Height	809 x 300 x 630	809 x 300 x 630	950 x 330 + 25 x 943
ELECTRICAL SUPPLY		220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz
PHASE		Single	Single	Single
SYSTEM POWER INPUT (kW)	Heating/Cooling (nominal)	1.040 / 0.869	1.347 / 1.239	1.732 / 1.560
	Heating/Cooling (UK)	0.81 / 0.84	1.12 / 1.12	1.25 / 1.65
STARTING CURRENT (A)		5.0	5.0	6.0
SYSTEM RUNNING CURRENT (A)	Heating/Cooling [MAX]	4.97 / 4.31 [13.4]	5.98 / 5.57 [13.4]	7.41 / 6.65 [19.4]
FUSE RATING (BS88) - HRC (A)		16	16	25
MAINS CABLE No. CORES		3	3	3
MAX PIPE LENGTH (m)		50	50	55
MAX HEIGHT DIFFERENCE (m)		30	30	30
CHARGE REFRIGERANT (kg) / CO_2 EQUIVALENT (t) - R32 (GWP 675) - 30m		2.0 / 1.35	2.00 / 1.35	2.80 / 1.89
MAX ADDITIONAL REFRIGERANT (kg) / CO_2 EQUIVALENT (t) - R32 (GWP 675)		0.30 / 0.20	0.30 / 0.20	0.80 / 0.54

Figure 6—2 Proposed: Mitsubishi Condenser Noise Data, Sound Pressure Level taken at 1m from unit, highlighted in yellow.

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