Philip Acoustics Ltd.

Consultants in Noise and Vibration

**REPORT TITLE:** ACOUSTIC REPORT IN SUPPORT OF PLANNING APPLICATION FOR NEW ROOF TOP MECHANICAL SERVICES EQUIPMENT AT HEAL'S BUILDING (PHASE 2) ALFRED MEWS, TOTTENHAM COURT ROAD, LONDON W1P

*Report Also Provides Design Stage Schedule of Evidence Reference BREEAM Offices 2008: Pol 08 Noise Attenuation*

**REPORT REF:** 14078-002

**ISSUED TO:** Tuffin Ferraby Taylor LLP
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**ISSUED BY:** David R Philip BEng (Hons) MIOA

**DATE:** June 2014

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## SUMMARY


- Philip Acoustics Ltd has been commissioned to carry out an assessment of noise from proposed new and replacement mechanical services equipment at roof level of Heal's Building (Phase 2), Alfred Mews, Tottenham Court Road, London W1P. The new equipment will consist of an Air Handling Unit (AHU) and VRF condenser units to serve tenant and landlord spaces within the building. The assessment considers London Borough of Camden's planning consent noise conditions for mechanical services equipment.

- London Borough of Camden's requirement is nominally that noise from mechanical services equipment shall be designed to at least 5dBA below the lowest background noise level at 1m outside windows of nearest potentially affected noise sensitive (residential) properties. Additionally, where it is anticipated any equipment will have a noise that has a distinguishable discrete note (whine, hiss, screech or hum) and/or there are distinct impulses (bangs, clicks, clatters and thumps) then the requirement is slightly more onerous and is at least 10dBA below the lowest background noise level.

- It is anticipated the new equipment will potentially operate at any time over 24 hours. A survey has therefore been carried out to establish lowest existing background noise levels at a location representative of outside windows of nearest noise sensitive (residential) properties to proposed location of the new equipment.

- Background noise levels in the vicinity are dominated by traffic and general activity on surrounding roads. The area along Tottenham Court Road has traffic during the entire 24 hour period. Based on results of the background noise measurements and London Borough of Camden's requirement, noise limits for the new equipment have been established to outside nearest noise sensitive (residential) properties to proposed location of the new equipment.

- Based on acoustic calculations using equipment manufacturer's noise data, corrections to account for location of the equipment at roof level and noise reduction from noise attenuation treatments included within the equipment manufacturer's proposals, the overall dBA noise level due to operation of the equipment is at least 10dBA below the lowest night-time background noise and complies with London Borough of Camden's more onerous noise condition limit. Noise from the equipment will not be audible or disturbing to occupants in nearest noise sensitive (residential) properties.

- Noise attenuation treatments within the equipment manufacturer's proposals include atmosphere side attenuators to the Air Handling Unit supply and discharge sections which are confirmed in Section 5 of the report.

- Location for the new equipment is not directly structurally linked to any noise sensitive (residential) properties. Notwithstanding this, it is recommended the new equipment be installed using vibration isolators as good practice and to minimise vibration to office areas that are within Heal's Building itself. Outline performance specifications for suitable vibration isolators are provided in the report.

- This report also provides Design Stage Schedule of Evidence as required under BREEAM Offices 2008: Pol 08 Noise Attenuation (refer Section 7 of the report).

## 1. INTRODUCTION

New and replacement mechanical services equipment is proposed to be installed externally at roof level of Heal's Building, Alfred Mews, Tottenham Court Road, London W1P. The equipment is part of Phase 2 refurbishment works for the building. The new equipment will consist of an Air Handling Unit (AHU) and VRF condenser units to serve tenant and landlord spaces within the building.

As part of a planning application for the Phase 2 refurbishment works and associated new mechanical services equipment, the Planning Department of London Borough of Camden requires information in the form of an acoustic report regarding noise from the equipment. Philip Acoustics Ltd has therefore been commissioned to provide an acoustic assessment for the equipment. This report presents results of the assessment and includes:-

- Confirmation of London Borough of Camden's planning consent acoustic requirements;
- Measurement of existing background noise levels;
- Calculation of equipment noise levels;
- Consideration of vibration from the equipment;
- Review of any noise/vibration control treatments necessary to comply with London Borough of Camden's planning consent acoustic requirements.
- Design Stage Schedule of Evidence reference BREEAM Offices 2008: Pol 08 Noise Attenuation.

*As forward to this report it is noted that the proposed new and replacement equipment is nominally of the same function as existing old equipment to be removed; it is expected that the new and replacement (more modern) equipment will have lower noise output than the existing equipment to be removed. Notwithstanding this, assessment of noise from the proposed new and replacement equipment in this report is only with reference to London Borough of Camden's currently applicable planning consent acoustic requirements for new mechanical services equipment and takes no particular account of the benefit that will anyway occur through replacement of old existing equipment.*

## 2. LONDON BOROUGH OF CAMDEN NOISE CONDITIONS

Policy DP28 – Noise and Vibration of Section 3 of Camden Development Policies 2010-2025 covers in detail noise issues relating to a wide range of planning and noise pollution scenarios, including mechanical services equipment.

Policy DP28 includes the statement *"The Council will only grant permission for plant or machinery if it can be operated without cause harm to amenity and does not exceed our noise thresholds"*. Camden's noise limit thresholds for plant and machinery are listed in Table E of Policy DP28. A copy of page 133 from Camden Development Policies 2010-2025 Policy DP28 showing Table E is included in Appendix A.

In summary, London Borough of Camden's noise conditions are:

i. That overall dBA noise from equipment shall be designed to at least 5dB below the existing $L_{A90}$ dB background noise level;

ii. That, where it is anticipated any equipment will have a noise that has a distinguishable discrete note (whine, hiss, screech or hum) and/or there are distinct impulses (bangs, clicks, clatters and thumps) then the overall dBA noise from equipment shall be designed to at least 10dB below the existing $L_{A90}$ dB background noise level. *Note that although it is the author's experience and opinion that the type of modern equipment subject to this assessment generates a typically broadband type of noise (i.e. without any of the characteristics described above) and therefore this condition item is not considered applicable in this instance, nevertheless to provide a robust noise assessment the more onerous condition of 10dB below the existing $L_{A90}$ dB background noise level is used for this assessment;*

Although not specifically included within Table E of Policy DP28, Philip Acoustics Ltd is aware that London Borough of Camden also has noise conditions guidance that for each octave band (63Hz to 8KHz) then noise from equipment shall be designed to not add more than 1dB to the existing lowest $L_{90}$ dB octave band background noise level.

All of the above (i to iii) are applicable over a period of 60 minutes and measured at 1m external to noise sensitive facades (for this development noise sensitive facades are windows of nearest residential properties).

## 3. BACKGROUND NOISE SURVEY

In order to assess noise from the proposed new equipment it is necessary to establish representative background noise levels at nearest noise sensitive (residential) properties. Details of the background noise survey carried out by Philip Acoustics are provided in Sections 3.1 to 3.3. The background noise survey has been carried out generally in accordance with procedures of British Standard BS4142:1997.

### 3.1 Instrumentation

Details of the noise survey instrumentation used are provided in Appendix B. The sound level meters were calibrated before and after the survey measurements using the UKAS certified calibrator.

### 3.2 Measurement Procedure

The survey was carried out at a location to obtain background noise levels representative of outside nearest noise sensitive (residential) properties to the proposed location for the new equipment. Nearest noise sensitive (residential) properties to proposed location of the new equipment are flats on upper floor levels above commercial / retail premises immediately to the opposite side of Tottenham Court Road.

A plan drawing of Heal's Building showing the noise survey location and direction to the nearest noise sensitive (residential) properties to the opposite side of Tottenham Court Road is provided in Appendix C.

The measurement location was selected at roof level of Heal's Building well away from any operational existing mechanical equipment (so as not to influence the noise survey results) and directly facing the direction of nearest noise sensitive residential properties opposite. The measurement location was achieved using a telescopic extension pole and microphone extension cable arrangement.

It is anticipated the new equipment will potentially operate at anytime over 24 hours and therefore background noise levels were recorded over at least a 24 hour period. The background noise survey was carried out over the three day period 03 June 2014 to 05 June 2014. The weather included dry and clam periods during the day and also night time.

In accordance with London Borough of Camden's noise conditions item 1c, the Rion NL-31 logging sound level meters were set up to record background noise levels over 60 minute periods (split into 12 x 5 minute periods to enable more accurate analysis of results as required). Measurements of background noise were recorded as overall $L_{A90}$ dB values.

In addition to the overall $L_{A90}$ dB values, several manual samples of linear $L_{90}$ dB octave band background noise were also recorded using the Bruel & Kjaer 2260 sound level meter to establish typical background noise octave band spectra.

### 3.3 Measurement Results

Existing background noise levels in the vicinity are dominated by traffic and general activity on surrounding roads. The area along Tottenham Court Road has traffic during the entire 24 hour period.

The typical lowest measured background noise level in terms of overall $L_{A90}$ dB and associated octave band values expected over 60 minutes during the survey is shown in Table 1. A graph showing the raw data overall $L_{A90}$ dB measurements over the entire monitoring period is provided in Appendix D.

| Description | Overall $L_{A90}$ dB | Octave Band Centre Frequency (Hz) (linear $L_{90}$ dB) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Lowest background noise level measured around 3 to 4am $L_{90\ (60\ minutes)}$ | 53 | 64 | 60 | 54 | 51 | 48 | 43 | 34 | 23 |
| London Borough of Camden noise limit | 43 | 60 | 56 | 50 | 47 | 44 | 39 | 30 | 19 |

**Table 1:** Lowest measured background noise levels and London Borough of Camden's noise conditions (*overall noise limit is set at 10dBA below background level and octave band limit to not add more than 1dB to existing octave band noise levels*)

The overall dBA noise limit to comply with London Borough of Camden's more onerous planning consent noise condition is set to 10dB below the lowest existing background noise level during the times of operation for the equipment. At this level, noise from the equipment will be significantly below the existing lowest night time background noise and would not be expected to be audible nor disturbing to occupants of any nearby noise sensitive (residential) properties.

## 4. NOISE FROM MECHANICAL SERVICES EQUIPMENT

The proposed new equipment comprises an EasyAir Air Handling Unit model CTL 100 and Panasonic VRF condenser units.

A proposed roof plant layout drawing showing the equipment locations is provided in Appendix E. A schedule of equipment including summary noise levels from manufacturer noise data is also included in Appendix E.

A complete copy of received manufacturer noise data for the equipment is provided in Appendix F.

To calculate the overall cumulative noise contribution from the equipment to outside the windows nearest noise sensitive (residential) properties to the opposite side of Tottenham Court Road a spreadsheet noise model has been used.

The model takes account of the distance between each equipment location and residential properties, acoustic directivity/reflections and any line of sight acoustic screening from the equipment location to windows due to building orientation and elevation differences.

The acoustic calculations are considered extremely cautious and in practice noise from the equipment will be further below London Borough of Camden's noise limit than that calculated for the following reasons:

- The calculations assume that all the equipment will be operating simultaneously and constantly all of the time including during the middle of the night. In practice VRF condenser units operate "on demand" and even when providing significant cooling during the middle of a hot day tend to operate only 60 to 70% of the time, during the night they would typically operate only about 20 to 30% of the time, if at all. This means that it is extremely unlikely that all VRF condenser units would be operating simultaneously at any one time especially during the middle of the night when cooling requirement is less than during the middle of the day. The author has visited many sites with multiple condensers providing air conditioning to offices and has observed that even of very hot days typically less than half of the condensers at a property operate at any one time and during the middle of the night there are long periods where no condensers operate;
- The calculations allow only a modest level of natural acoustic screening and no directivity for the equipment, whereas location for the equipment is screened by orientation of the buildings and difference in elevations of the equipment location and residential properties. In most cases the actual level of natural screening and directivity benefit for the equipment will be greater than the values used;
- The noise limit used for the assessment is cautiously based on the lowest measured background noise levels occurring for a limited period during the very middle of the night. The background noise levels for most of the night (11pm to 7am) and for all the daytime and for all of the evening are higher, and correspondingly for these times any equipment noise would be significantly lower than a noise limits applicable to these times based on the background noise occurring during these times.

Summary overall dBA acoustic calculation details are provided in Appendix G. The overall dBA calculated noise level from the equipment to outside the windows of nearest noise sensitive (residential) properties compared with London Borough of Camden's noise condition is shown in Table 2.

| **Description** | **Equipment Noise Level (all items operating)** | **London Borough of Camden Noise Limit** |
|---|---|---|
| Assessment Position = Nearest windows of noise sensitive (residential) properties on opposite side of Tottenham Court Road | ≤ 40.2dBA | 43dBA |

**Table 2:** Equipment noise at nearest non-associated residential properties compared with London Borough of Camden's noise limit

Note that the equipment noise level value is expressed as ≤ (less than or equal to value) as the noise level is calculated based on assumption that all equipment is operating simultaneously. In practice this is unlikely to be the case and therefore the actual noise level is expected to be lower than that in Table 2.

Table 2 shows that the overall equipment noise level is at least 10dBA below the lowest background noise, therefore the equipment as specified complies with London Borough of Camden's more onerous noise condition limit. In addition, the equipment octave band noise levels are calculated to also comply with London Borough of Camden's octave band noise condition limits. Noise from the equipment will not be audible or disturbing to occupants of nearby noise sensitive (residential) properties.

## 5. NOISE ATTENUATION

### 5.1 Panasonic VRF Condenser Units

The proposed Panasonic VRF condenser units comply with the noise requirements and do not require any additional noise attenuation treatments.

### 5.2 EasyAir Air Handling Unit

Noise attenuation treatment is included within the Air Handling Unit manufacturer's proposals and includes factory pre-fitted atmosphere side attenuators to the supply and also the discharge sections of the unit (i.e. attenuators to reduce noise to atmosphere from the supply side and discharge side fans within the unit). These attenuators are as routinely fitted as normal / standard practice to Air Handling Units.

The manufacturer's specified insertion loss performance for the attenuators is included within the data in Appendix F and is shown in Table 4.

| Description | Octave Band Centre Frequency (Hz) | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | |
| Supply and discharge atmosphere side attenuators to EasyAir AHU CTL 100 | 6 | 10 | 14 | 23 | 32 | 26 | 20 | 15 | Attenuators 700mm long |

**Table 3:** AHU atmosphere side attenuator performance specification

## 6. VIBRATION FROM MECHANICAL SERVICES EQUIPMENT

Location for the new equipment is not directly structurally linked to any noise sensitive (residential) properties. Notwithstanding this, it is recommended the new equipment be installed using vibration isolators as good practice and to minimise vibration to office areas that are within Heal's Building itself.

### 6.1 Panasonic VRF Condenser Units

It is recommended the VRF condenser units be mounted using high deflection proprietary rubber or neoprene turret type vibration isolators. The isolators should be selected to each have a static deflection not less than 5mm under load of the units.

Suitable turret type vibration isolators are approximately 30mm high and are available in various load capacities. The isolators are colour coded to indicate the load capacity and four isolators are required per unit (one to each corner).

### 6.2 EasyAir Air Handling Unit

As normal practice the AHU will be supplied with factory pre-fitted with vibration isolator mountings to the fans internally within the unit and with ductwork flexible connections.

## 7. BREEAM OFFICES 2008: POL 08 NOISE ATTENUATION

Although this report is primarily intended to be submitted to the Local Planning Authority (London Borough of Camden) to assist planning application for the new equipment, this report also provides suitable Design Stage Schedule of Evidence required under BREEAM Offices 2008: Pol 08 Noise Attenuation. Commentary of the Design Stage Schedule of Evidence Required is provided below:

- Req 1: The report includes a drawing indicating noise sensitive buildings local to the site and proposed location for the new equipment. The report also provides the distance from the location for the new equipment to noise sensitive buildings;

- Req 2&3: Acousticians qualifications and professional status. This report is prepared and issued by David Philip of Philip Acoustics Ltd. David Philip graduated in 1989 from The University of Salford department of Applied Acoustics with a BEng Honours degree in Electroacoustics. David Philip has some 25 years experience as an Acoustic Consultant and Engineer both in the UK and internationally and has been a full elected Member of the Institute of Acoustics (MIOA) since 1995. David Philip has been the Managing Director of Philip Acoustics since the firm was formed in 2002. Philip Acoustics has held full membership of the Association of Noise Consultants (ANC) since 2003 and is registered under the ANC registration scheme for Building Regulations Pre-Completion Testing (ANC registration number 125).

- Req 4: This noise assessment report is based on seeking compliance with the more onerous noise limit requirement of the Local Planning Authority (London Borough of Camden) which applied to this site is taken to be that noise from the proposed new equipment shall be lower than the existing background level by at least 10dBA at nearest noise sensitive properties and with consideration of noise contribution within individual octave bands (refer Section 2 item i) and ii) of this report). This noise limit requirement is considerably more onerous than the requirement of BREEAM Offices 2008: Pol 08 Noise Attenuation which under Assessment Criteria item 3 requires only that the Rating Level of noise source(s) be equivalent to or less than the background noise level. Therefore in achieving compliance with the more onerous noise limit requirement of London Borough of Camden to be lower than the existing background level by at least 10dBA, by default the noise requirement of BREEAM Offices 2008: Pol 08 Noise Attenuation is also readily complied with.

# APPENDIX A

London Borough Of Camden Noise Conditions For Mechanical Services Equipment

**Table D: Noise levels from places of entertainment on adjoining residential sites at which planning permission will not be granted**

| Noise description and measurement location | Period | Time | Sites adjoining places of entertainment |
|---|---|---|---|
| Noise at 1 metre external to a sensitive façade | Day and evening | 0700-2300 | $L_{Aeq}$, 5m shall not increase by more than 5dB* |
| Noise at 1 metre external to a sensitive façade | Night | 2300-0700 | $L_{Aeq}$, 5m shall not increase by more than 3dB* |
| Noise inside any living room of any noise sensitive premises, with the windows open or closed | Night | 2300-0700 | $L_{Aeq}$, 5m (in the 63Hz Octave band measured using the 'fast' time constant) should show no increase in dB* |

* As compared to the same measure, from the same position, and over a comparable period, with no entertainment taking place

**Table E: Noise levels from plant and machinery at which planning permission will not be granted**

| Noise description and location of measurement | Period | Time | Noise level |
|---|---|---|---|
| Noise at 1 metre external to a sensitive façade | Day, evening and night | 0000-2400 | 5dB(A) <LA90 |
| Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade. | Day, evening and night | 0000-2400 | 10dB(A) <LA90 |
| Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade. | Day, evening and night | 0000-2400 | 10dB(A) <LA90 |
| Noise at 1 metre external to sensitive façade where LA90>60dB | Day, evening and night | 0000-2400 | 55dB$L_{Aeq}$, |

## Key evidence and references

- Camden's Noise Strategy, 2002
- The London Plan (Consolidated with Alterations since 2004), 2008
- Planning Policy Guidance 24: Planning and noise

# APPENDIX B

Noise Survey Instrumentation

**Site:** Heal's Building (Phase 2), Alfred Mews, Tottenham Court Road, London W1P

**Report:** 14078-002 Appendix B

**Date:** June 2014

## NOISE SURVEY INSTRUMENTATION

Three Day Background Noise Survey:

- Rion sound level meter type NL-31 Class 1 serial number 00773045 plus Rion microphone type UC-53A serial number 313002 and Rion Preamp type NH-21 serial number 25056 complete with weatherproof and lockable outdoor environmental kit, microphone extension lead and extension boom arrangement;
- Bruel & Kjaer calibrator type 4231 serial number 2642929 (UKAS certified).

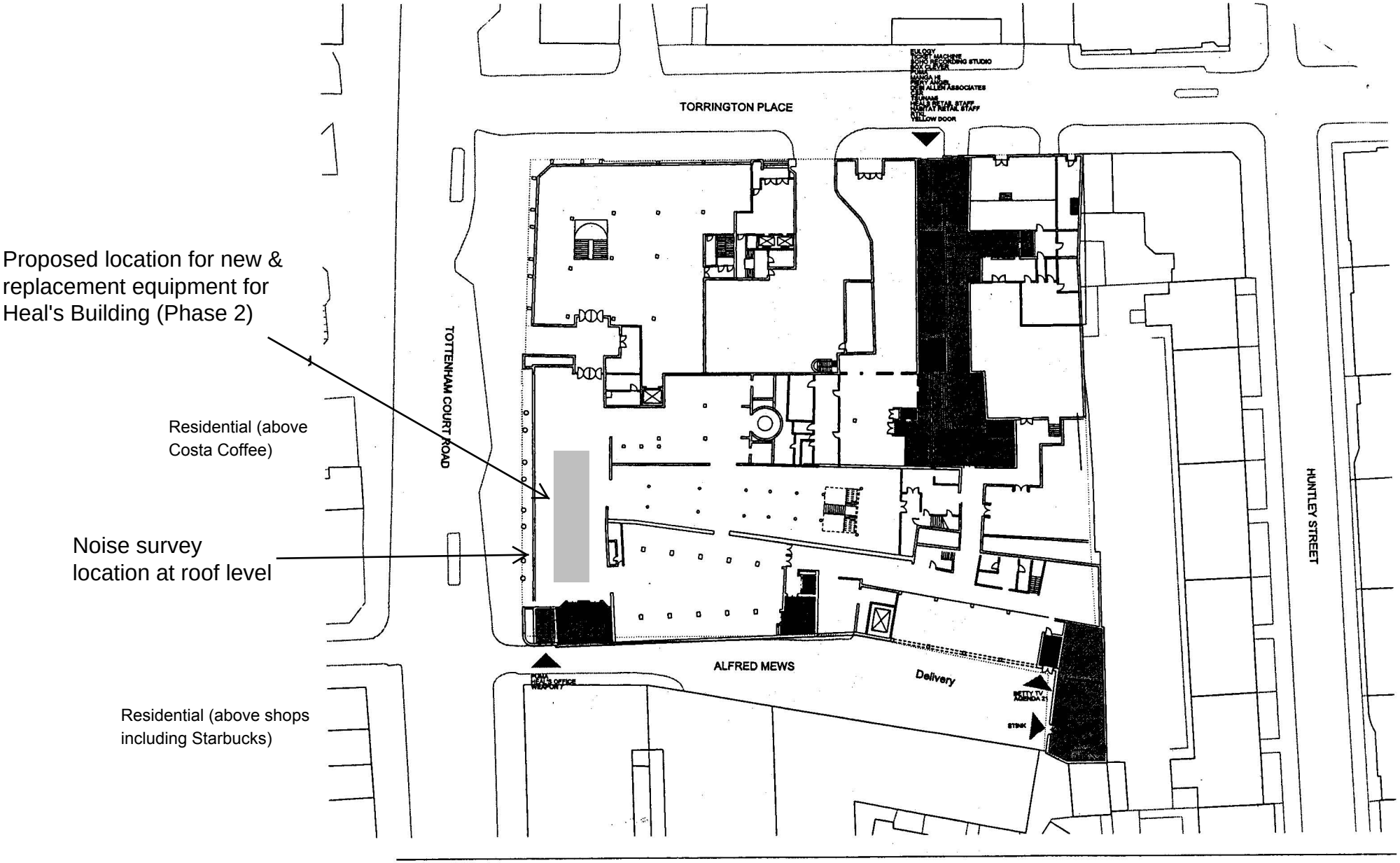
Background Noise Sample Octave Band Levels:

- Bruel & Kjaer sound level meter type 2260 serial number 2627604 plus Bruel & Kjaer microphone type 4189 serial number 2625249, tripod;
- Bruel & Kjaer calibrator type 4231 serial number 2642929 (UKAS certified).

# APPENDIX C

Plan Drawing Showing Heal's Building, Noise Survey Location And Direction Of Nearest Residential Properties

HEAL'S BUILDING (Phase 2), ALFRED MEWS, TOTTENHAM COURT ROAD



# APPENDIX D

Graph Of Noise Survey Results

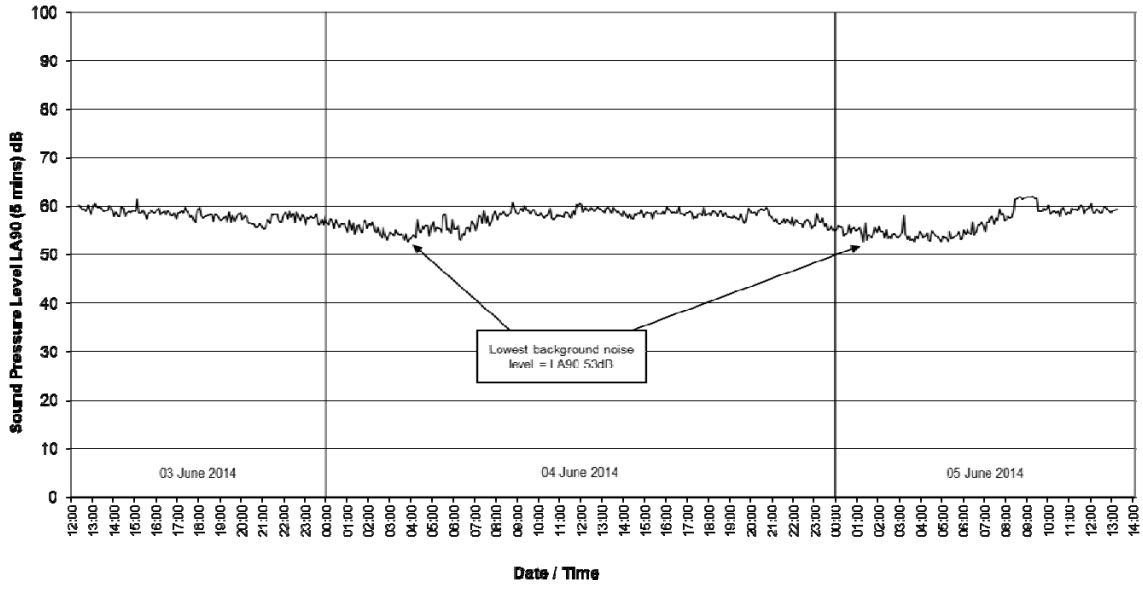
**Site:** Heal's Building (Phase 2), Alfred Mews, Tottenham Court Road, London W1P

**Report:** 14078-002 Appendix D

**Date:** June 2014

## BACKGROUND NOISE SURVEY RESULTS

Raw data results of three day background noise survey at position representative of outside nearest noise sensitive (residential) properties to proposed location of the new and replacement equipment Heal's Building (Phase 2)

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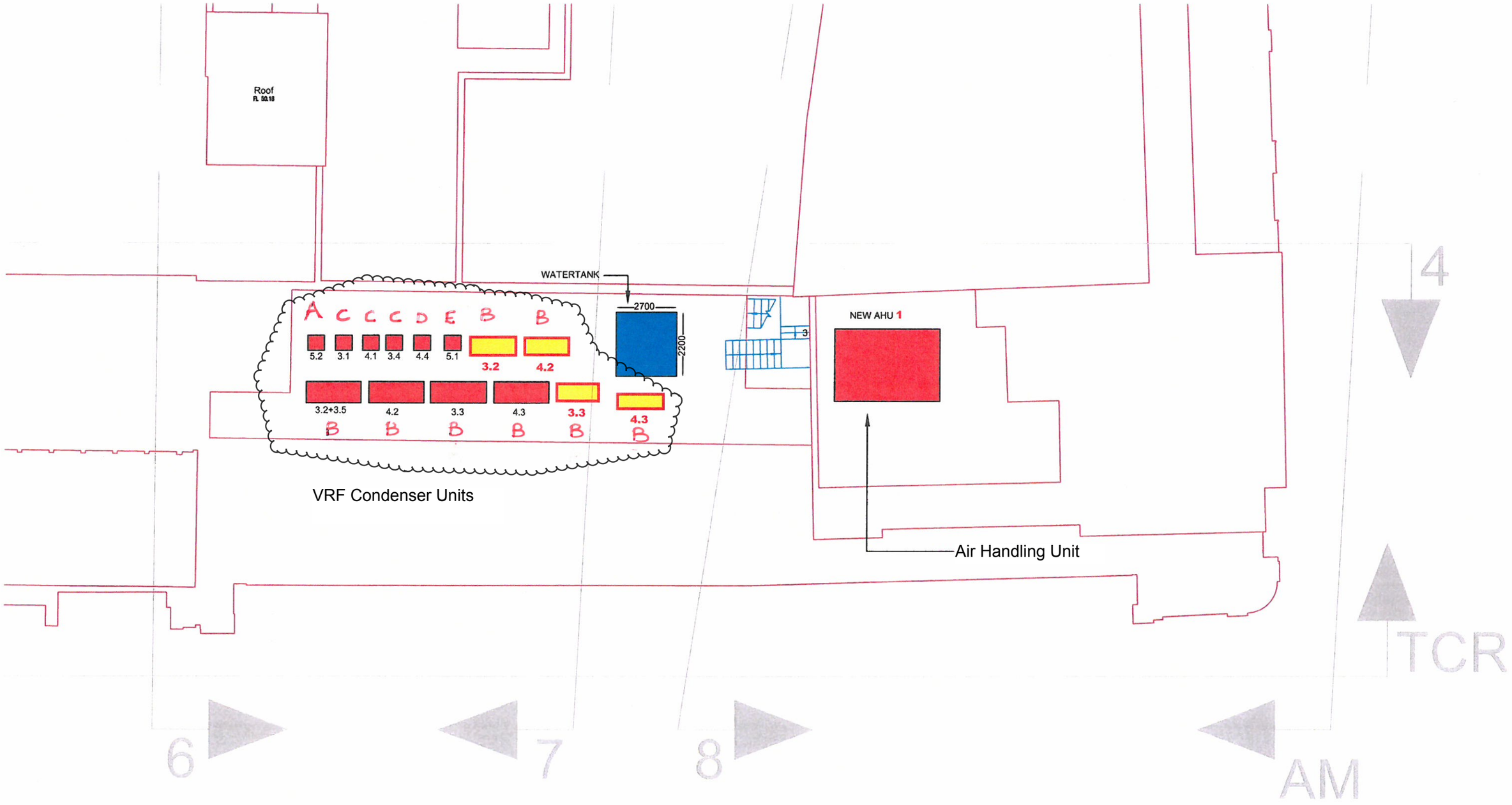
# APPENDIX E

Proposed Equipment Layout And Schedule Of Equipment


Roof
RL 50.18
WATERTANK
2700
2200
NEW AHU 1
A C C C D E B B
5.2 3.1 4.1 3.4 4.4 5.1 3.2 4.2
3.2+3.5 4.2 3.3 4.3 3.3 4.3
B B B B B B
VRF Condenser Units
Air Handling Unit
4
TCR
6
7
8
AM

**Site:** Heal's Building (Phase 2), Alfred Mews, Tottenham Court Road, London W1P

**Report:** 14078-002 Appendix E

**Date:** June 2014

## SCHEDULE OF EQUIPMENT & SUMMARY SOUND POWER LEVEL DATA

**SOUND POWER LEVELS**

| Plant Item | Overall dBA | Lin dB at Octave Band Hz 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|---|
| **AHU 1 EasyAir CTL 100 air volume 9000m³/h** | | | | | | | | | |
| ***Supply*** | | | | | | | | | |
| Atmosphere Aperture [1] | 47 | 52 | 52 | 53 | 29 | 28 | 28 | 33 | 41 |
| Casing Breakout [2] | 62 | 64 | 68 | 65 | 57 | 56 | 51 | 46 | 42 |
| ***Discharge*** | | | | | | | | | |
| Atmosphere Aperture [1] | 51 | 63 | 63 | 54 | 35 | 36 | 31 | 36 | 43 |
| Casing Breakout [2] | 62 | 64 | 68 | 65 | 57 | 56 | 51 | 46 | 42 |
| **Panasonic VRF Condenser Units [3]** | | | | | | | | | |
| VRF Unit 3.1 (type C) Panasonic Model U-8ME1E81 (8HP) | 71 | 71 | 71 | 72 | 70 | 65 | 58 | 52 | 47 |
| VRF Unit 3.2 (type B) Panasonic Model U-16MF2E8 (16HP) | 76.5 | 76.5 | 76.5 | 77.5 | 75.5 | 70.5 | 63.5 | 57.5 | 52.5 |
| VRF Unit 3.2+3.5 (type B) Panasonic Model U-16MF2E8 (16HP) | 76.5 | 76.5 | 76.5 | 77.5 | 75.5 | 70.5 | 63.5 | 57.5 | 52.5 |
| VRF Unit 3.3 (type B) Panasonic Model U-16MF2E8 (16HP) | 76.5 | 76.5 | 76.5 | 77.5 | 75.5 | 70.5 | 63.5 | 57.5 | 52.5 |
| VRF Unit 3.4 (type C) Panasonic Model U-8ME1E81 (8HP) | 71 | 71 | 71 | 72 | 70 | 65 | 58 | 52 | 47 |
| VRF Unit 4.1 (type C) Panasonic Model U-8ME1E81 (8HP) | 71 | 71 | 71 | 72 | 70 | 65 | 58 | 52 | 47 |
| VRF Unit 4.2 (type B) Panasonic Model U-16MF2E8 (16HP) | 76.5 | 76.5 | 76.5 | 77.5 | 75.5 | 70.5 | 63.5 | 57.5 | 52.5 |
| VRF Unit 4.2 (type B) Panasonic Model U-16MF2E8 (16HP) | 76.5 | 76.5 | 76.5 | 77.5 | 75.5 | 70.5 | 63.5 | 57.5 | 52.5 |
| VRF Unit 4.3 (type B) Panasonic Model U-16MF2E8 (16HP) | 76.5 | 76.5 | 76.5 | 77.5 | 75.5 | 70.5 | 63.5 | 57.5 | 52.5 |
| VRF Unit 4.3 (type B) Panasonic Model U-16MF2E8 (16HP) | 76.5 | 76.5 | 76.5 | 77.5 | 75.5 | 70.5 | 63.5 | 57.5 | 52.5 |
| VRF Unit 4.4 (type D) Panasonic Model U-8MF2EB + U-14MF2E8 (22HP) | 77.5 | 77.5 | 77.5 | 78.5 | 76.5 | 71.5 | 64.5 | 58.5 | 53.5 |
| VRF Unit 5.1 (type E) Panasonic Model U-10MF2E8 (10HP) | 73.5 | 73.5 | 73.5 | 74.5 | 72.5 | 67.5 | 60.5 | 54.5 | 49.5 |
| VRF Unit 5.2 (type A) Panasonic Model U-8MF2E8 + U-10MF2E8 (18HP) | 75.5 | 75.5 | 75.5 | 76.5 | 74.5 | 69.5 | 62.5 | 56.5 | 51.5 |
| VRF Unit 5.2 (type A) Panasonic Model U-8MF2E8 + U-10MF2E8 (18HP) | 75.5 | 75.5 | 75.5 | 76.5 | 74.5 | 69.5 | 62.5 | 56.5 | 51.5 |

*Notes:* *(1) No manufacturer data for AHU atmosphere sound power levels at values at 63Hz, values at 63 Hz are indicative. Sound power levels include benefit of manufacturer specified factory pre-fitted attenuation (see Section 5 of report 14078-002);*

*(2) Manufacturer data for AHU casing breakout sound power levels (Airborne power level quoted in manufacturer data) is applied equally to supply & discharge sides of the unit;*

*(3) VRF noise data is at "high" mode. No manufacturer data for VRF unit octave band values, octave band vales shown are typical for this type of equipment.*

# APPENDIX F

Manufacturer Noise Data For Equipment

AHU 1

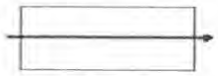
EasyAir HANDLING

# TECHNICAL SCHEDULE

| | |
|---|---|
| Offer N° | 1012-14 |
| Date | 30-05-2014 |
| Unit model: | CTL 100 |
| Q.ty | 1 |
| Air volume: | 9000 m³/h |
| Revision: | 01 |
| Date: | 30-05-2014 |

| | |
|---|---|
| Client | EASYAIR |
| Reference | HEAL - phase 2 |
| Reference | AHU1 PHX side by side |

## AHU general features and manufacturing options




| | Inspection side: | Connection side: |
|---|---|---|
| Left | | |
| Right | V | V |

**Panel :** External side in prepainted sheet 10/10 Internal side in galvanized steel 8/10 Thickness 48 [mm]
**Profile :** Anodized aluminium profile
**Insulation :** in mineral wool density 90 kg/m³.
**Corners :** die-cast black aluminium
Corner profile : 50
Omega profile : 50
**Internal guides and supports:** Galvanized steel
**Base frame :** Continuous basement H. 120 mm galvanized sheet
**Barometric pressure Kpa** 101.3

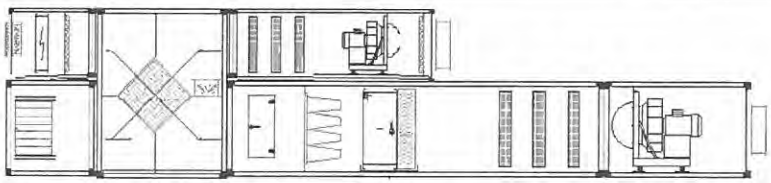
**Length mm** 7565 **Width mm** 3100 **Height mm** 1050+100+120 **Weight Kg** 2509

With sloped drain pan, section heigth can be slightly different from original

**Panels acoustic attenuation - frequency analysis**

| F [Hz] | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|
| db | - | 13 | 18 | 24 | 24 | 23 | 26 | 30 |

| Mechanical characteristics of structure according EN1886 | | | |
|---|---|---|---|
| Mechanical strength | Leakage | Thermal transmittance | Thermal bridging |
| D2(M) | L2 | T4 | TB4 |



| SECTIONS DIMENSIONS | Length | Width | Height | Weight |
|---|---|---|---|---|
| **Section 1 T** | 975 mm | 1550 mm | 1050+120 mm | 243 kg |
| **Section 2 B** | 1140 mm | 1550 mm | 1050+120 mm | 190 kg |
| **Section 3 B** | 1985 mm | 1550 mm | 1050+120 mm | 609 kg |
| **Section 4 B** | 2820 mm | 3100 mm | 1050+120 mm | 601 kg |
| **Section 5 T** | 2455 mm | 1550 mm | 1050+120 mm | 529 kg |
| **Section 6 B** | 1620 mm | 1550 mm | 1050+120 mm | 337 kg |

**Sections are numbered accordingly with air flow; B means " Bottom " , T means " Top "**

EasyAir HANDLING

# TECHNICAL SCHEDULE

| | | | |
|---|---|---|---|
| | | Offer N° | 1012-14 |
| | | Date | 30-05-2014 |
| | | Unit model: | CTL 100 |
| | | Q.ty | 1 |
| Client | EASYAIR | Air volume: | 9000 m³/h |
| Reference | HEAL - phase 2 | Revision: | 01 |
| Reference | AHU1 PHX side by side | Date: | 30-05-2014 |

| Code | | **Intake section** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 1 | Regulation damper, frame made of aluminium, fins made of aluminium, dim. 1200x810 mm. Air volume 9000 m³/h<br>With internal damper | |
| 1 | Aluminium grid P50 hole dimensions 1200x810 mm<br>Dampers with tight gaskets | |

| Code | | **Electric coil** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 1 | Number of connection stages 1<br>Installed electric power 15.00 kW<br>Electric source trifase 400 V. 50 Hz | |

| Code | | **Panel filter** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 4 | Panel filter corrugated synthetic type, thick. 48 mm, eff. G4 - >=90% Dim. 500 x 400 x 48 mm | |
| 2 | Panel filter corrugated synthetic type, thick. 48 mm, eff. G4 - >=90% Dim. 400 x 400 x 48 mm<br>Filter pressure drop: Clean 47 Pa - Average 98 Pa - Recommended dirty 150 Pa | |
| 1 | Differential manometer magnehelic type | |

| Code | | **Intake section** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 1 | Regulation damper, frame made of aluminium, fins made of aluminium, dim. 500x810 mm. Air volume 9000 m³/h<br>With internal damper<br>Dampers with tight gaskets | |

| Code | | **Air diffusion plenum** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| | Length 200 mm. | |

EasyAir HANDLING

# TECHNICAL SCHEDULE

| | | | |
|---|---|---|---|
| | | Offer N° | 1012-14 |
| | | Date | 30-05-2014 |
| | | Unit model: | CTL 100 |
| | | Q.ty | 1 |
| Client | EASYAIR | Air volume: | 9000 m³/h |
| Reference | HEAL - phase 2 | Revision: | 01 |
| Reference | AHU1 PHX side by side | Date: | 30-05-2014 |

| Code | | **Plate heat recovery unit** | | | | | |
|---|---|---|---|---|---|---|---|
| **n° pc.** | **Description** | | | | | | **Brand - Code** |
| 1 | FI AL 12 N 0820 N 1 AE SM | | | | | | |
| | **Exhaust air** | | | | | | |
| | Exhaust air temperature in | 23 | °C | Exhaust relative humidity in | 50 | % | |
| | Exhaust air temperature out | 10.80 | °C | Exhaust relative humidity out | 97 | % | |
| | Exhaust air volume | 9000 | m³/h | Exhaust air side pressure drop | 162 | Pa | |
| | **Supply air** | | | | | | |
| | External air temperature in | 1 | °C | External relative humidity in | 70 | % | |
| | External air temperature out | 15.60 | °C | External relative humidity out | 25 | % | |
| | External air volume | 9000 | m³/h | External air side pressure drop | 156 | Pa | |
| | **Capacity** | 43.98 | kW | Heat Recovery Efficiency | 66.4 | % | |
| | | | | Temperature ratio | 66.4 | % | |
| | | | | Efficiency at flow balanced | 66.4 | % | |
| | | | | Ricirculation factor | 0.0 | % | |
| | Aluminium recovery unit | | | | | | |
| | With frame made of Galvanized steel | | | | | | |
| | SLOPED drain pan in stainless steel AISI 304 | | | | | | |
| | Dampers with tight gaskets | | | | | | |
| | **Ricirculation damper** | | | | | | |
| 1 | Regulation damper, frame made of aluminium, fins made of aluminium,dimensions 1210x310 mm. | | | | | | |
| | **Summer conditions** | | | | | | |
| | **Exhaust air** | | | | | | |
| | Exhaust air temperature in | 23 | °C | Exhaust relative humidity in | 50 | % | |
| | Exhaust air temperature out | 26.72 | °C | Exhaust relative humidity out | 39 | % | |
| | Exhaust air volume | 9000 | m³/h | Exhaust air side pressure drop | 168 | Pa | |
| | **Supply air** | | | | | | |
| | External air temperature in | 29 | °C | External relative humidity in | 44 | % | |
| | External air temperature out | 25.28 | °C | External relative humidity out | 54 | % | |
| | External air volume | 9000 | m³/h | External air side pressure drop | 169 | Pa | |
| | Capacity | 11.20 | kW | Heat Recovery Efficiency | 62.0 | % | |
| | | | | Temperature ratio | 62.0 | % | |

| Code | **Inspection section** | |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| | Inspection section | |

EasyAir HANDLING

# TECHNICAL SCHEDULE

| | | | |
|---|---|---|---|
| | | Offer N° | 1012-14 |
| | | Date | 30-05-2014 |
| | | Unit model: | CTL 100 |
| | | Q.ty | 1 |
| Client | EASYAIR | Air volume: | 9000 m³/h |
| Reference | HEAL - phase 2 | Revision: | 01 |
| Reference | AHU1 PHX side by side | Date: | 30-05-2014 |

| Code | | **Rigid bag filter** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 2 | Rigid bag filter efficiency F7 - 80-90% Dim. 592 x 592 x 292 mm | |
| 2 | Rigid bag filter efficiency F7 - 80-90% Dim. 592 x 287 x 292 mm | |
| 2 | Counterframes made of Galvanized steel Dim. 610 x 610 x 100 mm | |
| 2 | Counterframes made of Galvanized steel Dim. 610 x 305 x 100 mm | |
| | Filter pressure drop: Clean 68 Pa - Average 159 Pa - Recommended dirty 250 Pa | |
| 1 | Differential manometer magnehelic type | |

| Code | | **Direct expansion coil IN HEAT PUMP** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 1 | BAF30x26 T28 L1250 R4 C12 P2.5<br>Material Copper x 0.6 mm - pre-painted Al. 0.12 mm - Galvanized frame<br>Air flow 9000 [m³/h], Air speed 2.3 [m/s], Air pressure drop 113 [Pa]<br>Air density 1.183 [Kg/m³]<br>Entering air: DBT 25.3 [°C], WBT 18.8 [°C], RH 54 [%], enthalpy 53.2 [kj/kg]<br>Leaving air: DBT 16.7 [°C], WBT 14.9 [°C], RH 83 [%], enthalpy 41.7 [kj/kg]<br>Type of fluid:R410A<br>Expansion temp. 6.0 C°<br>Fluid volume: 777 [kg/h], Fluid speed: 0.2 [m/s], Pressure drop: 12.0 [kPa]<br>Total capacity: 34.6 [kW]<br>Sensible capacity: 26.3 [kW]<br>Headers diameter: 35 mm<br>Exchange surface 78.69 [m²]<br>Inside volume (header excluded) 16.90 [l]<br>N° circuits : 1<br>PVC 2-fold droplet eliminator<br>SLOPED drain pan in stainless steel AISI 304 | |

| Code | | **Air diffusion plenum** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| | Length 500 mm. | |

| Code | | **Sound attenuator** |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 1 | Sound attenuator length 700 mm<br>Galvanized mesh | |

**Acoustic attenuation of sound attenuator frequency analysis**

| F [Hz] | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|
| db | 6 | 10 | 14 | 23 | 32 | 26 | 20 | 15 |

EasyAir HANDLING

# TECHNICAL SCHEDULE

| | | | |
|---|---|---|---|
| | | Offer N° | 1012-14 |
| | | Date | 30-05-2014 |
| | | Unit model: | CTL 100 |
| | | Q.ty | 1 |
| Client | EASYAIR | Air volume: | 9000 m³/h |
| Reference | HEAL - phase 2 | Revision: | 01 |
| Reference | AHU1 PHX side by side | Date: | 30-05-2014 |

Code

## Sound attenuator

| n° pc. | Description | Brand - Code |
|---|---|---|
| 1 | Sound attenuator length 700 mm<br>Galvanized mesh | |

**Acoustic attenuation of sound attenuator frequency analysis**

| F [Hz] | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|
| db | 6 | 10 | 14 | 23 | 32 | 26 | 20 | 15 |

Code

## Return fan

| n° pc. | Description | Brand - Code |
|---|---|---|
| 1 | Size 500 Fan type Plug fan | ER50C-4DN.E7.CR |
| | Air flow 9000 m³/h, External static pres. 200 Pa, Total static pres. 505 Pa | |
| | N. of revolutions 1574 RPM, Sound power level Lw (Inlet) 76.9 db(A), Efficiency 80.73% | |
| | Dynamic Press. 64 Pa, Total Press. 569 Pa, Request mechanical power1.76 kW | |
| | Air speed on fan outlet 10.32 m/s | |
| | **MOTOR Class IE2** | |
| 1 | 3 KW 4 Poles 230-400/3/50 V/ph/Hz | |
| | Size 100L | |
| | Efficiency 83 % | |
| | Mechanical power input 1.76 kW | |
| | Actual electrical power absorption 2.1 kW | |
| | Freq. Nominal / Max 55 / 65 Hz | |
| 1 | With round window | |
| 1 | With complete internal light | |
| 1 | With PTC probe integrated | |
| 1 | with frequency converter | |
| 1 | Mainswitch mounted and wired to the electric motor | |
| 1 | Safety microswitch + wire mesh door guard. | |
| 4 | Rubber shock absorber | |
| | **Design for wet conditions** | |

**Octave bands sound power level (dB) single fan**

| F [Hz] | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
|---|---|---|---|---|---|---|---|---|---|
| dB | 67 | 76 | 78 | 73 | 69 | 68 | 67 | 69 | **Suction** |
| dB | 73 | 81 | 83 | 81 | 80 | 74 | 72 | 72 | **Discharge** |

Code

## Panel filter

| n° pc. | Description | Brand - Code |
|---|---|---|
| 4 | Panel filter corrugated synthetic type, thick. 48 mm, eff. G4 - >=90% Dim. 500 x 400 x 48 mm | |
| 2 | Panel filter corrugated synthetic type, thick. 48 mm, eff. G4 - >=90% Dim. 400 x 400 x 48 mm | |
| | Filter pressure drop: Clean 47 Pa - Average 98 Pa - Recommended dirty 150 Pa | |
| 1 | Differential manometer magnehelic type | |

EasyAir HANDLING

# TECHNICAL SCHEDULE

| | | | |
|---|---|---|---|
| | | Offer N° | 1012-14 |
| | | Date | 30-05-2014 |
| | | Unit model: | CTL 100 |
| | | Q.ty | 1 |
| Client | EASYAIR | Air volume: | 9000 m³/h |
| Reference | HEAL - phase 2 | Revision: | 01 |
| Reference | AHU1 PHX side by side | Date: | 30-05-2014 |

| Code | Intake section | |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 1 | With anti-vibrating flexible connections | |

| Code | Supply fan | |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 1 | Size 500 Fan type Plug fan<br>Air flow 9000 m³/h, External static pres. 200 Pa, Total static pres. 865 Pa<br>N. of revolutions 1814 RPM, Sound power level Lw (Inlet) 78.9 db(A), Efficiency 79.64%<br>Dynamic Press. 64 Pa, Total Press. 929 Pa, Request mechanical power2.92 kW<br>Air speed on fan outlet 10.32 m/s | ER50C-4DN.G7.CR |
| 1 | **MOTOR Class IE2**<br>5.5 KW 4 Poles 400/3/50 V/ph/Hz | |
| | Size 132S<br>Efficiency 86 %<br>Mechanical power input 2.92 kW<br>Actual electrical power absorption 3.3 kW<br>Freq. Nominal / Max 62 / 78 Hz | |
| 1 | With round window | |
| 1 | With complete internal light | |
| 1 | With PTC probe integrated | |
| 1 | with frequency converter | |
| 1 | Mainswitch mounted and wired to the electric motor | |
| 1 | Safety microswitch + wire mesh door guard. | |
| 4 | Rubber shock absorber | |
| | **Design for wet conditions** | |

**Octave bands sound power level (dB) single fan**

| F [Hz] | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
|---|---|---|---|---|---|---|---|---|---|
| dB | 65 | 70 | 82 | 75 | 72 | 71 | 69 | 70 | **Suction** |
| dB | 73 | 75 | 88 | 84 | 83 | 77 | 74 | 74 | **Discharge** |

| Code | Intake section | |
|---|---|---|
| **n° pc.** | **Description** | **Brand - Code** |
| 1 | With anti-vibrating flexible connections | |

Octave band (Hz) - Octave band corrected Sound power level (dB)

| **AHU sound levels** | Tot.dB(A) | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|
| Sound power level inlet (supply side) | 47 | 52 | 53 | 29 | 28 | 28 | 33 | 41 |
| Sound power level discharge (supply side) | 87 | 75 | 88 | 84 | 83 | 77 | 74 | 74 |
| Sound power level inlet (return side) | 77 | 76 | 78 | 73 | 69 | 68 | 67 | 69 |
| Sound power level discharge (return side) | 51 | 63 | 54 | 35 | 36 | 31 | 36 | 43 |
| Airborne power level | 62 | 68 | 65 | 57 | 56 | 51 | 46 | 42 |

Calculated sound pressure level at 1 mt free field (50 dBA)

EasyAir HANDLING

# TECHNICAL SCHEDULE

| | | | |
|---|---|---|---|
| | | Offer N° | 1012-14 |
| | | Date | 30-05-2014 |
| | | Unit model: | CTL 100 |
| | | Q.ty | 1 |
| Client | EASYAIR | Air volume: | 9000 m³/h |
| Reference | HEAL - phase 2 | Revision: | 01 |
| Reference | AHU1 PHX side by side | Date: | 30-05-2014 |

| | Additional elements |
|---|---|
| **Q.ty** | **Description** |
| 1 | Side by side unit |
| 1 | DX coil in heat pump 3/8 tube - in 13°C out 18°C, cond. 40°C |
| 1 | Electric frost coil wired to external main-switch |
| 1 | PITCHED ROOF |
| 1 | pre-wiring for frequency converter included |
| 1 | technical space for controls |

**This design was done according to specific customer's requirements therefore different, operating conditions could result in sensible changes in performances.**

CONDENSER

## 3-PIPE ECOi MF2
## 6N SERIES
COMBINATION FROM
18 TO 48 HP

**With simultaneous heating and cooling operation heat recovery type**

ECOi 3-Pipe is one of the most advanced VRF systems available. Not only offering high-efficiency and performance for simultaneous heating and cooling, its sophisticated design makes installation and maintenance much easier.

- Achieves COP 4.63 as the top class in the industry (Average cooling and heating value for 18 HP outdoor unit).
- Simultaneous cooling or heating operation for up to 52 indoor units.
- Small installation space, top class in the industry.
- Rotation operation function and back-up operation function provided.


5 YEARS COMPRESSOR WARRANTY: Only for PRO partners.

| HP | | | 18 HP | 20 HP | 22 HP | 24 HP | 26 HP | 28 HP | 30 HP |
|---|---|---|---|---|---|---|---|---|---|
| Standard model | | | U-8MF2E8 U-10MF2E8 | U-8MF2E8 U-12MF2E8 | U-8MF2E8 U-14MF2E8 | U-8MF2E8 U-16MF2E8 | U-12MF2E8 U-14MF2E8 | U-14MF2E8 U-14MF2E8 | U-14MF2E8 U-16MF2E8 |
| Power supply | | | 380 / 400 / 415 V - Three Phase / 50 Hz | | | | | | |
| Cooling capacity | | kW | 50.4 | 56.0 | 61.5 | 68.0 | 73.0 | 78.5 | 85.0 |
| EER [1] | Nominal | W/W | 4.27 | 3.97 | 3.80 | 3.68 | 3.58 | 3.49 | 3.41 |
| Running current | 380 / 400 / 415 V | A | 19.7 / 18.9 / 18.4 | 23.8 / 22.9 / 22.3 | 27.0 / 26.0 / 25.3 | 30.9 / 29.7 / 28.9 | 33.7 / 32.4 / 31.5 | 37.2 / 35.7 / 34.8 | 41.1 / 39.5 / 38.5 |
| Power input | | kW | 11.8 | 14.1 | 16.2 | 18.5 | 20.4 | 22.5 | 24,90 |
| Heating capacity | | kW | 56.5 | 63.0 | 69.0 | 76.5 | 81.5 | 87.5 | 95.0 |
| COP [1] | Nominal | W/W | 4.63 | 4.47 | 4.57 | 4.20 | 4.38 | 4.49 | 4.20 |
| Running current | 380 / 400 / 415 V | A | 20.4 / 19.6 / 19.1 | 23.8 / 22.9 / 22.3 | 25.2 / 24.2 / 23.6 | 30.4 / 29.2 / 28.5 | 31.1 / 29.8 / 29.1 | 32.6 / 31.3 / 30.5 | 37.7 / 36.2 / 35.3 |
| Power input | | kW | 12.2 | 14.1 | 15.1 | 18.2 | 18.6 | 19.5 | 22.6 |
| Air volume | | $m^3$/min | 336 | 370 | 370 | 370 | 424 | 424 | 424 |
| Sound pressure level | High / Low | dB(A) | 61.0 / 58.0 | 62.5 / 59.5 | 63.0 / 60.0 | 63.0 / 60.0 | 64.5 / 61.5 | 65.0 / 62.0 | 65.0 / 62.0 |
| Sound power level | Normal mode | dB | 75.5 / 72.5 | 77.0 / 74.0 | 77.5 / 74.5 | 77.5 / 74.5 | 79.0 / 76.0 | 79.5 / 76.5 | 79.5 / 76.5 |
| Dimensions | H x W x D | mm | 1,758 x 2,060 x 930 | 1,758 x 2,060 x 930 | 1,758 x 2,060 x 930 | 1,758 x 2,060 x 930 | 1,758 x 2,060 x 930 | 1,758 x 2,060 x 930 | 1,758 x 2,060 x 930 |
| Net weight | | kg | 538 | 538 | 591 | 591 | 636 | 644 | 644 |
| Piping connections | Suction pipe | mm (Inch) | 28.58 (1-1/8) | 28.58 | 28.58 | 28.58 | 31.75 (1-1/4) | 31.75 | 31.75 |
| | Discharge pipe | mm (Inch) | 22.22 (7/8) | 22.22 | 25.40 (1) | 25.40 | 25.40 | 28.58 | 28.58 |
| | Liquid pipe | mm (Inch) | 15.88 (5/8) | 15.88 | 15.88 | 15.88 | 19.05 (3/4) | 19.05 | 19.05 |
| | Balance pipe | mm (Inch) | 6.35 (1/4) | 6.35 (1/4) | 6.35 (1/4) | 6.35 (1/4) | 6.35 (1/4) | 6.35 (1/4) | 6.35 (1/4) |
| Refrigerant amount at shipment | | kg | 16.8 | 17.1 | 17.6 | 17.6 | 18.1 | 18.6 | 18.6 |
| Operating range | Cooling Min / Max | °C | -10°C DB / +46°C DB | -10°C DB / +46°C DB | -10°C DB / +46°C DB | -10°C DB / +46°C DB | -10°C DB / +46°C DB | -10°C DB / +46°C DB | -10°C DB / +46°C DB |
| | Heating Min / Max | °C | -20°C WB / +18°C WB | -20°C WB / +18°C WB | -20°C WB / +18°C WB | -20°C WB / +18°C WB | -20°C WB / +18°C WB | -20°C WB / +18°C WB | -20°C WB / +18°C WB |
| | Simultaneous operation | °C | -10°C DB / +24°C DB | -10°C DB / +24°C DB | -10°C DB / +24°C DB | -10°C DB / +24°C DB | -10°C DB / +24°C DB | -10°C DB / +24°C DB | -10°C DB / +24°C DB |

| Solenoid valve kit | | |
|---|---|---|
| KIT-P56HR3 | KIT-P56HR3 | 3-Pipe control Solenoid valve kit (up to 5.6kW) |
| | CZ-P56HR3 | Solenoid valve kit (up to 5.6kW) |
| | CZ-CAPE2 | 3-Pipe control PCB |
| KIT-P160HR3 | KIT-P160HR3 | 3-Pipe control Solenoid valve kit (from 5.6kW to 10.6kW) |
| | CZ-P160HR3 | Solenoid valve kit (from 5.6kW to 10.6kW) |
| | CZ-CAPE2 | 3-Pipe control PCB |
| CZ-CAPEK2 | | 3-Pipe control PCB for wall mounted |

Rating Conditions: Cooling Indoor 27°C DB / 19°C WB. Cooling Outdoor 35°C DB / 24°C WB. Heating Indoor 20°C DB. Heating Outdoor 7°C DB / 6°C WB.
DB: Dry Bulb; WB: Wet Bulb

1) EER and COP classification is at 400 V in accordance with EU directive 2002/31/EC.
Specifications subject to change without notice.
For detailed information about ErP, please visit our page http://www.ptc.panasonic.eu

CONDENSER

## 3-PIPE ECOi MF2
## 6N SERIES
8-16 HP

**With simultaneous heating and cooling operation heat recovery type**

ECOi 3-Pipe is one of the most advanced VRF systems available. Not only offering high-efficiency and performance for simultaneous heating and cooling, but also its sophisticated installation and maintenance much easier.

- Achieves COP 4.77 as the top class in the industry (Average cooling and heating value for 8 HP outdoor unit).
- Simultaneous cooling or heating operation for up to 52 indoor units.
- Small installation space, top class in the industry.
- Rotation operation function and back-up operation function provided.


5 YEARS COMPRESSOR WARRANTY: Only for PRO partners.

E

B

| HP | | | 8 HP | 10 HP | 12 HP | 14 HP | 16 HP |
|---|---|---|---|---|---|---|---|
| Standard model | | | U-8MF2E8 | U-10MF2E8 | U-12MF2E8 | U-14MF2E8 | U-16MF2E8 |
| Power supply | | | 380 / 400 / 415 V - Three Phase / 50 Hz | 380 / 400 / 415 V - Three Phase / 50 Hz | 380 / 400 / 415 V - Three Phase / 50 Hz | 380 / 400 / 415 V - Three Phase / 50 Hz | 380 / 400 / 415 V - Three Phase / 50 Hz |
| Cooling capacity | | kW | 22.4 | 28.0 | 33.5 | 40.0 | 45.0 |
| EER [1] | Nominal | W/W | 4.50 | 4.10 | 3.70 | 3.45 | 3.38 |
| Running current | 380 / 400 / 415 V | A | 8.60 / 8.20 / 8.00 | 11.3 / 10.8 / 10.6 | 15.1 / 14.5 / 14.1 | 19.2 / 18.4 / 17.9 | 22.0/ 21.1 / 20.6 |
| Power input | | kW | 4.98 | 6.83 | 9.05 | 11.00 | 13.00 |
| Heating capacity | | kW | 25.0 | 31.5 | 37.5 | 45.0 | 50.0 |
| COP [1] | Nominal | W/W | 4.77 | 4.55 | 4.30 | 4.41 | 4.03 |
| Running current | 380 / 400 / 415 V | A | 8.95 / 8.50 / 8.30 | 11.6 / 11.0 / 10.7 | 14.7 / 14.1 / 13.8 | 17.0 / 16.4 / 15.9 | 20.7 / 19.9 / 19.4 |
| Power input | | kW | 5.24 | 6.92 | 8.72 | 10.2 | 12.4 |
| Air volume | | $m^3$/min | 158 | 178 | 212 | 212 | 212 |
| Sound pressure level | High / Low | dB(A) | 57.0 / 54.0 | 59.0 / 56.0 | 61.0 / 58.0 | 62.0 / 59.0 | 62.0 / 59.0 |
| Sound power level | Normal mode | dB | 71.5 / 68.5 | 73.5 / 70.5 | 75.5 / 72.5 | 76.5 / 73.5 | 76.5 / 73.5 |
| Dimensions | H x W x D | mm | 1,758 x 1,000 x 930 | 1,758 x 1,000 x 930 | 1,758 x 1,000 x 930 | 1,758 x 1,000 x 930 | 1,758 x 1,000 x 930 |
| Net weight | | kg | 269 | 269 | 314 | 322 | 322 |
| Piping connections | Suction pipe | mm (Inch) | 19.05 (3/4) | 22.22 (7/8) | 25.40 (1) | 25.40 (1) | 28.58 (1-1/8) |
| | Discharge pipe | mm (Inch) | 15.88 (5/8) | 19.05 (3/4) | 19.05 (3/4) | 22.22 (7/8) | 22.22 (7/8) |
| | Liquid pipe | mm (Inch) | 9.52 (3/8) | 9.52 (3/8) | 12.70 (1/2) | 12.70 (1/2) | 12.70 (1/2) |
| | Balance pipe | mm (Inch) | 6.35 (1/4) | 6.35 (1/4) | 6.35 (1/4) | 6.35 (1/4) | 6.35 (1/4) |
| Refrigerant amount at shipment | | kg | 8.3 | 8.5 | 8.8 | 9.3 | 9.3 |
| Operating range | Cooling Min / Max | °C | -10°C DB / +46°C DB | -10°C DB / +46°C DB | -10°C DB / +46°C DB | -10°C DB / +46°C DB | -10°C DB / +46°C DB |
| | Heating Min / Max | °C | -20°C WB / +18°C WB | -20°C WB / +18°C WB | -20°C WB / +18°C WB | -20°C WB / +18°C WB | -20°C WB / +18°C WB |
| | Simultaneous operation | °C | -10°C DB / +24°C DB | -10°C DB / +24°C DB | -10°C DB / +24°C DB | -10°C DB / +24°C DB | -10°C DB / +24°C DB |

| Solenoid valve kit | | |
|---|---|---|
| KIT-P56HR3 | KIT-P56HR3 | 3-Pipe control Solenoid valve kit (up to 5.6kW) |
| | CZ-P56HR3 | Solenoid valve kit (up to 5.6kW) |
| | CZ-CAPE2 | 3-Pipe control PCB |
| KIT-P160HR3 | KIT-P160HR3 | 3-Pipe control Solenoid valve kit (from 5.6kW to 10.6kW) |
| | CZ-P160HR3 | Solenoid valve kit (from 5.6kW to 10.6kW) |
| | CZ-CAPE2 | 3-Pipe control PCB |
| CZ-CAPEK2 | | 3-Pipe control PCB for wall mounted |

Rating Conditions: Cooling Indoor 27°C DB / 19°C WB. Cooling Outdoor 35°C DB / 24°C WB. Heating Indoor 20°C DB. Heating Outdoor 7°C DB / 6°C WB.
DB: Dry Bulb; WB: Wet Bulb

1) EER and COP classification is at 400 V in accordance with EU directive 2002/31/EC.
Specifications subject to change without notice.
For detailed information about ErP, please visit our page http://www.ptc.panasonic.eu

CONDENSER

## 2-PIPE ECOi 6N SERIES
8-12 HP

**Next generation VRF newly-redesigned!**

At start up stage a unit can have Hi COP function selected - this lowers capacity but increases the COP. It's your choice.

- Top class COP= 4.56 (In case of 8 HP heating)
- Heating operation at outdoor temperatures down to –25°C
- Extended pipe runs of up to 180 m


5 YEARS COMPRESSOR WARRANTY: Only for PRO partners.

| HP | | | 8 HP | 10 HP | 12 HP |
|---|---|---|---|---|---|
| Standard model | | | U-8ME1E81 | U-10ME1E81 | U-12ME1E81 |
| Power supply | | | 400 V / Three Phase / 50 Hz | 400 V / Three Phase / 50 Hz | 400 V / Three Phase / 50 Hz |
| Cooling capacity | | kW | 22.4 | 28.0 | 33.5 |
| EER [1] | Nominal | W/W | 4.04 | 3.60 | 3.61 |
| Operating current | | A | 8.5 | 12.2 | 14.6 |
| Power input cooling | | kW | 5.54 | 7.78 | 9.29 |
| Heating capacity | | kW | 25.0 | 31.5 | 37.5 |
| COP [1] | Nominal | W/W | 4.56 | 4.10 | 4.10 |
| Operating current | | A | 8.4 | 12.1 | 14.4 |
| Power input heating | | kW | 5.48 | 7.68 | 9.15 |
| Starting current | | A | 1 | 1 | 1 |
| External static pressure | | Pa | 80 | 80 | 80 |
| Air volume | | $m^3/h$ | 8,820 | 9,180 | 11,400 |
| Sound pressure level | Normal mode | dB(A) | 56.5 | 59.0 | 61.0 |
| | Silent mode | dB(A) | 53.5 | 56.0 | 58.0 |
| Sound power level | Normal mode | dB | 71.0 | 73.5 | 75.5 |
| Dimensions | H x W x D | mm | 1,758 x 770 x 930 | 1,758 x 770 x 930 | 1,758 x 770 x 930 |
| Net weight | | kg | 234 | 234 | 281 |
| Piping connections | Gas pipe | mm | 19.05 | 22.22 | 25.4 |
| | Liquid pipe | mm | 9.52 | 9.52 | 12.7 |
| | Balance pipe | mm | 6.35 | 6.35 | 6.35 |
| Refrigerant amount at shipment | | kg | 6.5 | 6.8 | 6.8 |
| Demand control | | | 13 steps (0 – 100 %) | 13 steps (0 – 100 %) | 13 steps (0 – 100 %) |
| Operating range | Cooling Min / Max | °C | -10°C DB / +43°C DB | -10°C DB / +43°C DB | -10°C DB / +43°C DB |
| | Heating Min / Max | °C | -25°C WB / +15°C WB | -25°C WB / +15°C WB | -25°C WB / +15°C WB |

Rating Conditions: Cooling Indoor 27°C DB / 19°C WB. Cooling Outdoor 35°C DB / 24°C WB. Heating Indoor 20°C DB. Heating Outdoor 7°C DB / 6°C WB.
DB: Dry Bulb; WB: Wet Bulb

1) EER and COP classification is at 400 V in accordance with EU directive 2002/31/EC.
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# APPENDIX G

Noise Calculation

**Site:** Heal's Building (Phase 2), Alfred Mews, Tottenham Court Road, London W1P

**Report:** 14078-002 Appendix G

**Date:** June 2014

## ACOUSTIC CALCULATION SHEET

**ASSESSMENT POSITION: Nearest residential properties on opposite side Tottenham Court Road**

**NOISE CONDITION: All equipment operating simultaneously**

**NOISE MITIGATION: With noise reduction treatments fitted as specified in Section 5 of report 14078-002**

| Equipment | Lw | Distance to assesment position m | Correction for distance to assessment position dB | Correction for additional noise attenuation dB | Correction for line of sight screening dB | Correction for acoustic directivity dB | Individual Contributions dB |
|---|---|---|---|---|---|---|---|
| ***Heal's Building (Phase 2) Roof Plant*** | | | | | | | |
| AHU 1 Supply Atmosphere Aperture | 47.0 | 33 | -41 | 0 | -5 | 0 | 1 |
| AHU 1 Supply Casing Breakout | 62.0 | 33 | -41 | 0 | -5 | 0 | 16 |
| AHU 1 Discharge Atmosphere Aperture | 51.0 | 33 | -41 | 0 | -5 | 0 | 5 |
| AHU 1 Discharge Casing Breakout | 62.0 | 33 | -41 | 0 | -5 | 0 | 16 |
| VRF Unit 3.1 (type C) | 71.0 | 34 | -42 | 0 | -5 | 0 | 24 |
| VRF Unit 3.2 (type B) | 76.5 | 34 | -42 | 0 | -5 | 0 | 30 |
| VRF Unit 3.2+3.5 (type B) | 76.5 | 33 | -41 | 0 | -5 | 0 | 30 |
| VRF Unit 3.3 (type B) | 76.5 | 33 | -41 | 0 | -5 | 0 | 30 |
| VRF Unit 3.3 (type B) | 76.5 | 33 | -41 | 0 | -5 | 0 | 30 |
| VRF Unit 3.4 (type C) | 71.0 | 34 | -42 | 0 | -5 | 0 | 24 |
| VRF Unit 4.1 (type C) | 71.0 | 34 | -42 | 0 | -5 | 0 | 24 |
| VRF Unit 4.2 (type B) | 76.5 | 34 | -42 | 0 | -5 | 0 | 30 |
| VRF Unit 4.2 (type B) | 76.5 | 33 | -41 | 0 | -5 | 0 | 30 |
| VRF Unit 4.3 (type B) | 76.5 | 33 | -41 | 0 | -5 | 0 | 30 |
| VRF Unit 4.3 (type B) | 76.5 | 33 | -41 | 0 | -5 | 0 | 30 |
| VRF Unit 4.4 (type D) | 77.5 | 34 | -42 | 0 | -5 | 0 | 31 |
| VRF Unit 5.1 (type E) | 73.5 | 34 | -42 | 0 | -5 | 0 | 27 |
| VRF Unit 5.2 (type A) | 75.5 | 34 | -42 | 0 | -5 | 0 | 29 |
| **Overall SPL from sources at assessment position:** | **40.2 dB(A)** | | | | | | |

**PHILIP ACOUSTICS LTD**

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**E-mail: admin@philipacoustics.co.uk**

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