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Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

Planning Compliance Report
Report 26677.PCR.01 Rev I

Pinnacle Power Limited
Castletown Office
Rockcliffe, Carlisle
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Registered in England Company No. 7947892. KP Acoustics is the Trading Name of KP Acoustics Limited

Report 26677.PCR.01 Revision History			
First Issue Date: 12/10/2023			
A	**17/11/2023:** Updated the list of proposed plant units	E	**05/07/2024** Amended Section 5.2 to include additional text on noise mitigation outlined in Section 6.
B	**18/03/2024** Amended the report and the calculations to reflect the changes of outdoor unit installation location and the proposed energy centre's external building fabric.	F	**24/07/2024** Updated Appendices B to include up to date proposed plant units and spectral noise data. Updated the report throughout to reflect changes to acoustic calculations, proposed external building fabric details and Appendices B.
C	**08/04/2024** Amended the report and the calculations to include corrections for the number of outdoor plant units.	G	**27/08/2024** Amended Appendices B3 and B5 and revised Sections 5.3, 6.2 and 6 to include new proposed louvres.
D	**17/04/2024** Amended the Appendix B to include a new outdoor unit position and the acoustic screen for the outdoor units.	H	**09/04/2025** Amended Appendices B2-B5 to revise the SRI of each façade of the Energy Centre with updated buildup details. Included Appendix B6 to assess noise breakout through the proposed ground floor slab. Included Appendix B7 to assess noise breakout through the proposed roof. Amended the report throughout to reflect the above changes.
I	**13/10/2024 –** Address updated		
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1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by Pinnacle Power Limited, Castletown Office, Rockcliffe, Carlisle, Cumbria, CA6 4BN, to undertake a noise impact assessment of a proposed plant unit installation serving the multistorey carpark, a proposed energy centre and a proposed RMU building at the Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

A 24-hour environmental noise survey has been undertaken on site in order to prepare a noise impact assessment in accordance with BS4142:2014 '*Method for rating and assessing industrial and commercial sound'* as part of the planning requirements of Worthing Borough Council.

An additional attended environmental noise survey has been undertaken on site in order to assess the current noise profile in the proposed energy centre location.

This report presents the methodology and results from the environmental survey, followed by calculations in accordance with BS4142 to provide an indication as to the likelihood of the noise emissions from the proposed plant unit installation having an adverse impact on the closest noise sensitive receivers.

It should be noted that many plant selections are not available at the time of issue and therefore the results of the assessment and recommended mitigation measures are preliminary and subject to change.

2.0 SITE SURVEYS

2.1 Site Description

As shown in Figure 2.1, the site is bounded by Chatsworth Road and commercial businesses to the north, 'The Guildbourne Centre' shopping centre to the west, Ann Street, commercial businesses and residential dwellings to the south, and A259 Road, commercial businesses and residential dwellings to the east.



Figure 2.1 Site Location Plan (Image Source: Google Maps)

Initial inspection of the site revealed that the background noise profile at the monitoring location was typical of an urban cityscape environment, with the dominant source being road traffic noise from the surrounding roads.

2.2 Environmental Noise Survey Procedure

Continuous automated monitoring was undertaken for the duration of the noise survey between 14:11 on 19/06/2023 and 14:02 on 20/06/2023.

The environmental noise measurement position, proposed plant installation locations, and the closest noise sensitive receivers relative to the plant installations are described within Table 2.1 and shown within Figures 2.2, 2.3 and 2.4.

Icon	Descriptor	Location Description
1	Noise Measurement Position 1	The microphone was installed on a tripod on the rooftop at High Street Multi-Storey car park, as shown in the figure 2.2 below. The microphone was located within 1.5 metres of the nearest surface and therefore includes local reflections.
2	Noise Measurement Positions 2	The microphone was installed on a tripod at a ground floor level near the entrance/exit to the multistorey, facing the High Street, as shown in the figure 2.2 below. The microphone was located within 1.5 metres of the nearest surface and therefore includes local reflections.

Icon	Descriptor	Location Description
3	Noise Measurement Positions 3	The microphone was installed on a tripod at a ground floor level near the entrance/exit to the multistorey, facing the High Street, as shown in the figure 2.2 below. The microphone was located within 1.5 metres of the nearest surface and therefore includes local reflections.
4	Noise Measurement Positions 4	The microphone was installed on a tripod at a ground floor level near the entrance/exit to the multistorey, facing the High Street, as shown in the figure 2.2 below. The microphone was located within 1.5 metres of the nearest surface and therefore includes local reflections.
	Closest Noise Sensitive Receivers	Residential windows to the west facing the High Street Multi-Storey. Rear façade, top floor residential windows at 18 Ann Street. Front façade, top floor windows at 30 High Street. Front façade, top floor windows at 26 High Street.
	Proposed Plant Installation Location	Proposed plant installations are outlined in Section 5.1.

Table 2.1 Measurement positions and description

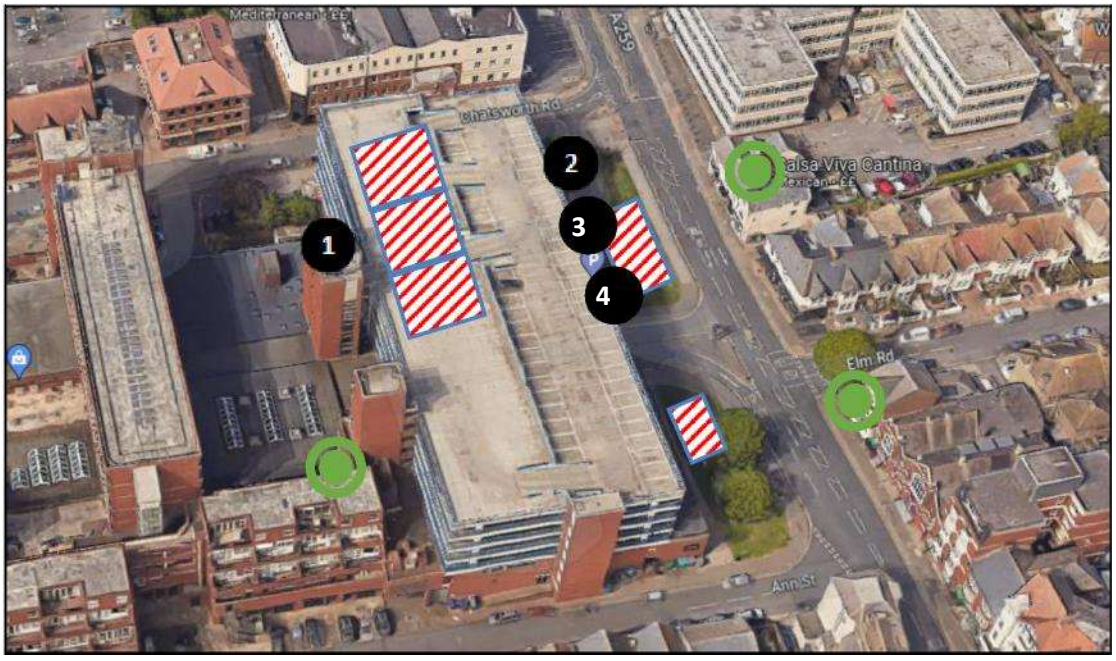


Figure 2.2 Site measurement positions, identified receivers and proposed plant unit installations (Image Source: Google Maps)

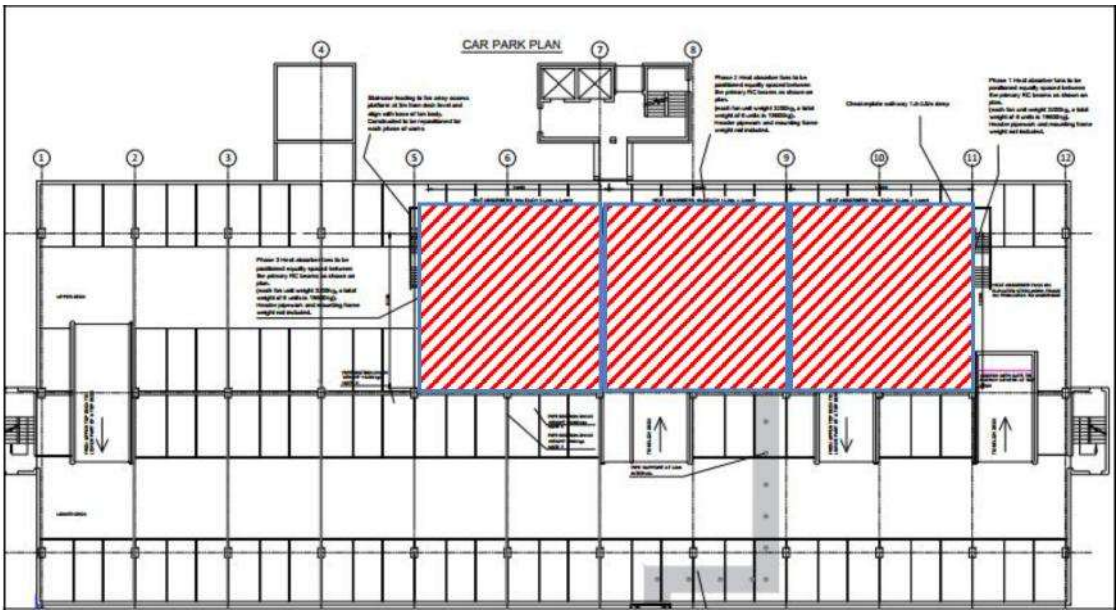


Figure 2.3 Proposed plant unit installation on multistorey carpark rooftop (Image Source: Pinnacle Power Limited)

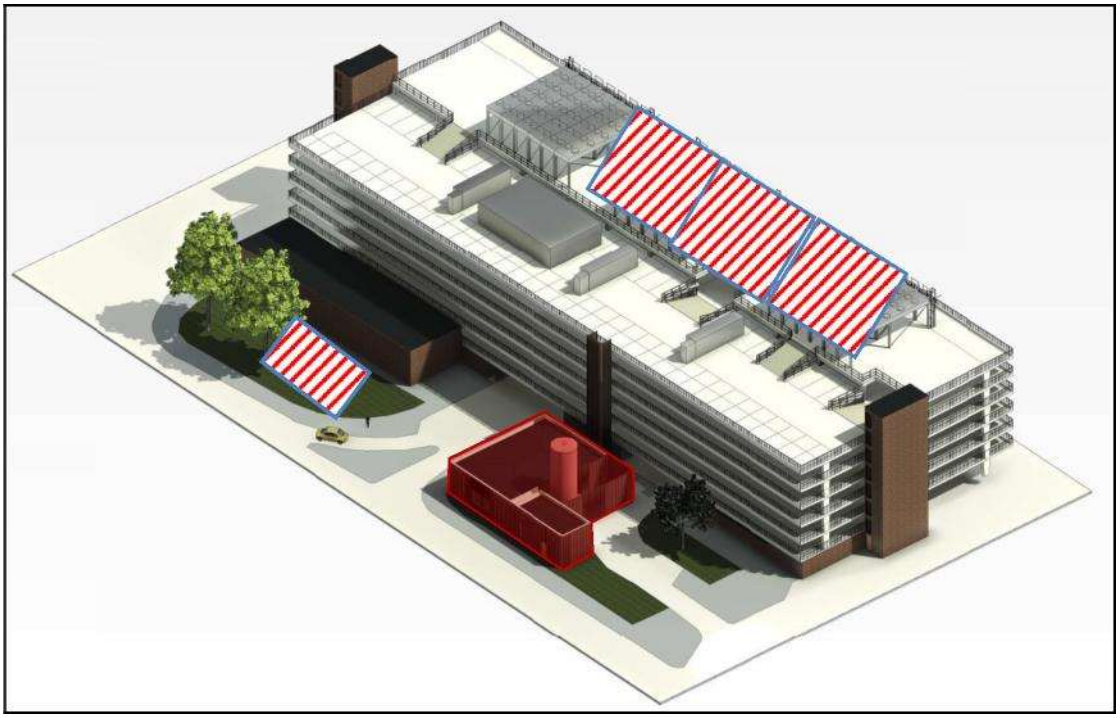


Figure 2.4 3D render of proposed plant unit installation on multistorey carpark rooftop (Image Source: Pinnacle Power Limited)

The proposed location of the energy centre and the RMU building are marked in red on Figure 2.4 above.

The choice of the position was based both on accessibility and on collecting representative noise data in relation to the nearest noise sensitive receiver and the proposed plant installation.

Weather conditions were generally dry with light winds and therefore suitable for the measurement of environmental noise. The measurement procedure complied with ISO 1996-2:2017 Acoustics '*Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels*'.

2.3 Equipment

The equipment calibration was verified before and after use and no abnormalities were observed. The equipment used is described within Table 2.2.

Measurement instrumentation		Serial no.	Date	Cert no.
Noise Kit 27	NTI Audio XL2 Class 1 Sound Level Meter	A2A-21174-E0	21/07/2022	UK-22-070
	Free-field microphone NTI Acoustics MC230A	A23539		
	Preamp NTI Acoustics MA220	11025		
	NTI Audio External Weatherproof Shroud	-	-	-
Larson Davis CAL200 Class 1 Calibrator		17148	21/03/2023	UCRT23/1363

Table 2.2 Measurement instrumentation

3.0 RESULTS

The $L_{Aeq:\,5min}$, $L_{Amax:\,5min}$, $L_{A10:\,5min}$ and $L_{A90:\,5min}$ acoustic parameters were measured throughout the duration of the survey. Measured levels are shown as a time history in Figure 26677.TH1.

Representative background noise levels are shown in Table 3.1 for daytime and night-time.

It should be noted that the representative background noise level has been derived from the most commonly occurring $L_{A90,5\ min}$ levels measured during the environmental noise survey undertaken on site, as shown in 26677.Daytime L90.TH1 and 26677.Daytime L90.TH1 attached.

Time Period	Representative background noise level $_{LA90}$ dB(A)
Daytime (07:00-23:00)	45
Night-time (23:00-07:00)	39

Table 3.1 Representative background noise levels for receptors to west of site

Please note that measurements at the noise measurement position are located at a distance less than 1.5 metres from the nearest reflective surface and therefore a 3dB correction has been applied to the results in Table 3.1 to obtain a free-field measurement as per ISO1996 Part 2.

An additional attended environmental survey was undertaken at the proposed location of the energy centre, near the entrance to the multistorey carpark, as outlined in Section 2.2.

Attended environmental monitoring was undertaken for the duration of the survey between 12:36 on 25/09/2023 and 15:36 on 25/09/2023.

The $L_{Aeq,5min}$, $L_{Amax,5min}$, $L_{A10,5min}$ and $L_{A90,5min}$ acoustic parameters were measured throughout the duration of the attended survey.

Measured noise levels are representative of the noise levels expected to be experienced at the proposed location of the energy centre and the RMU building during the day. Night-time noise levels have been derived from the daytime levels by applying the level difference between the daytime and night-time levels measured during the 24-hour noise survey as demonstrated in Table 3.1 above.

Measured noise levels expected to be experienced at the proposed location of the energy centre and the RMU building are shown in Table 3.2.

Time Period	Representative background noise level L_{A90} dB(A)
Daytime (07:00-23:00)	56
Night-time (23:00-07:00)	50

Table 3.2 Representative background noise levels for receptors to east of site

4.0 NOISE ASSESSMENT GUIDANCE

4.1 BS4142: 2014 '*Methods for rating and assessing industrial and commercial sound*'

British Standard BS4142:2014 '*Methods for rating and assessing industrial and commercial sound*' describes a method for rating and assessing sound of an industrial and/or commercial nature, which includes:

- Sound from industrial and manufacturing processes
- Sound from fixed installations which comprise mechanical and electrical plant and equipment

- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises, and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes.

This Standard compares the Rating Level due to the noise source/s under assessment for a one-hour period during the daytime (07:00 – 23:00 hours) and a fifteen-minute period during the night-time (23:00 – 07:00 hours) with the existing background noise level in terms of an L_{A90} when the noise source is not operating.

It should be noted that the Rating Level is the Specific Sound Level in question ($L_{Aeq,\ Tr}$), including any relevant acoustic feature corrections, as follows:

- **Tonality** – '*For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible'*
- **Impulsivity** – '*A correction of up to +9dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible'*
- **Intermittency** – '*If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied'*
- **Other sound characteristics** – '*Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied*'

Once the Rating Level has been obtained, the representative background sound level is subtracted from the Rating Level to obtain an initial estimate of the impact, as follows:

- 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 could 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 there will be an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound having a low impact, depending on the context

NOTE: Adverse impacts may include but not be limited to annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

The initial estimate of the impact may then be modified by taking consideration of the context in which the sound occurs.

4.2 Local Authority Guidance

The guidance provided by Worthing Borough Council for noise emissions of new plant in this instance is as follows:

The rating level of the industrial or commercial sound source should, where practicable, achieve a level no greater than the representative background sound, when measured in accordance with BS 4142:2014 + A1: 2019. There may be instances, for specific sites, where a rating level below background is deemed appropriate. This can be determined through discussion with the Local Planning Authority (LPA). A rating level below background may be required if there are concerns for potential noise creep, for example in a High Street setting. It is considered that meeting this criterion would avoid adverse noise impacts, in the interests of ensuring a good standard of amenity and protecting human health. Where these criteria are not attainable, the noise report should explain why, and how best practicable means will be implemented to control noise in order to satisfy the LPA that the development is acceptable. At all times the reports shall have regard to the context.

4.3 Noise Emissions Criterion

As the proposed plant units could be used at any time of the day or night, the criterion has been set as shown in Table 4.1 in order to comply with the above requirements.

The Worthing Borough Council states that the rating level should be below background in some cases, for example, when the site is near the high street and there are concerns for potential noise creep. In this case the site at the Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex, would fall in that category and the criterion has been set 5dB below the background level.

Time period	Noise Criterion at Nearest Residential Receivers to West of Site	Noise Criterion at Nearest Residential Receiver to East of Site
Night-time (23:00 to 07:00)	34 dB(A)	45 dB(A)

Table 4.1 Proposed noise emissions criterion

5.0 NOISE IMPACT ASSESSMENT

5.1 Proposed Plant Installations

It is understood that the proposed plant installation will be comprised of the following units in the locations indicated:

Roof of the multistorey carpark

- 1 x 18 bank of 10 No. Guntner Fans (180 fans in total) (model currently unknown)

Proposed energy centre (ground floor)

- 3 banks of 6 No. Fenagy CO2-chillers/Heat Pumps (6 Compressors) (1500kW)
- 3 No. Systemair AXC 400 Axial Fans

Proposed energy centre (first floor)

- 4 No. Armstrong Pumps – Design Envelope Sensorless 4300 8019-020.0
- 1 No. Armstrong Pump – Design Envelope Sensorless 4380 5012-003.0
- 1 No. Systemair AXC 560 Axial Fan

Proposed RMU building

- 1 No. Proposed Transformer (make and model currently unknown)

The installation locations are indicated in Figure 2.2 above.

It should be noted that at this stage the list of the proposed plant units to be installed in all proposed locations is incomplete and that this assessment and report will need to be updated once full details of the proposed plant units, and their installation locations are confirmed. The recommended mitigation measures may need to be revised.

The noise emission levels as provided by the client for the units are shown in Table 5.1.

Unit	Descriptor	Octave Frequency Band (Hz)								Overall (dBA)
		63	125	250	500	1k	2k	4k	8k	
Guntner Fans (Model currently unknown) (400 rpm)	SWL (dBA)	46	60	55	60	63	62	57	55	67
Fenagy Reversible CO2-chiller/Heat Pump (6 Compressors) (1500kW) *₁	SWL (dBA)	80	81	87	93	92	85	79	77	95
Systemair AXC 400 Axial Fan	SWL (dBA)	64	71	86	81	81	77	74	62	89
Armstrong Pumps *₂	SWL (dBA)	72	73	75	75	78	75	71	65	82
System air AXC 560 Axial Fan	SWL (dBA)	44	53	65	81	79	76	71	64	84
Proposed Transformer	SWL (dBA)	No Spectral Data available								75

Table 5.1 Plant units noise emission levels as provided by the manufacturer

₁ It should be noted that the total Sound Power Level for the proposed Fenagy (6 compressor) Heat Pump is 105.7 dB(A) as specified by the manufacturer. However, no spectral noise data was provided. In order to produce an accurate assessment, the spectral noise data for the quieter Fenagy (4 compressor) Heat Pump was used and normalised to meet the total noise level of 105.7 dB(A).

₂ The noise data for the proposed Armstrong pumps was not provided at the time of this assessment, therefore indicative noise levels from the study (J. P. Guyer, 'An Introduction to Sound Level Data for Mechanical and Electrical Equipment', 2013) have been used in the acoustic calculations. The acoustic calculations will need to be revised once the noise data for Armstrong Pumps has been obtained from the manufacturer.

The closest noise sensitive receiver to the proposed outdoor unit installation has been identified as a rear façade residential window of 18 Ann Street, located approximately 17 metres from the closest plant installation location and approximately 57 metres from the furthest plant installation location on the roof of the multistorey car park, as shown in Figure 2.2.

The closest noise sensitive receiver to the proposed energy centre has been identified as being front façade, first floor residential windows of at 30 High Street located approximately 13 metres from the proposed east façade of the energy centre, as shown in Figure 2.2. According to the acoustic calculations, the worst case noise breakout at the proposed energy centre will be from the north façade.

It should be noted that the proposed outdoor plant units, installed on the roof of the multistorey car park would be out of line of sight of the receiving window due to screening from the building envelope.

5.2 Calculations for the Proposed Outdoor Units Installed at the Multistorey Carpark

Taking all acoustic corrections into consideration, the noise level contribution expected at the closest residential window from the proposed outdoor units to be installed at the multistorey carpark would be as shown in Table 5.2. Detailed calculations are shown in Appendix B1.

Receiver	Criterion	Noise Level at 1m From the Closest Noise Sensitive Window
Rear façade, top floor residential windows at 18 Ann Street.	34 dB(A)	32 dB(A)

Table 5.2 Predicted noise level and criterion at nearest noise sensitive location

As shown in Appendix B1 and Table 5.2, transmission of noise to the nearest sensitive windows due to the effects of the proposed plant unit installation satisfies the emissions criterion of Worthing Borough Council providing that the mitigation measures outlined in Section 6 are implemented.

5.3 Proposed Energy Centre Breakout to External Environment

It is understood that the ground floor of the proposed energy centre will be used primarily as a pump room and the first floor will be used as a plant room.

The calculated total reverberant sound pressure level on the ground floor of the energy centre due to the proposed plant units is 108 dB(A).

The calculated total reverberant sound pressure level on the first floor of the energy centre due to the proposed plant units is 90 dB(A).

It is currently understood that the proposed external building fabric will provide the composite sound reduction performance shown within Table 5.3 based on the construction details provided by Studio Four Architects, Hemiko, and product manufacturers.

The anticipated sound reduction index of the external walls has been modelled using Insul and the composite sound reduction index has been calculated by adding the sound reduction indices of other elements such as louvres and doors. The composite sound reduction index of each facade would be expected to provide the minimum figures shown in the following table when tested in accordance with BS EN ISO 10140 series of standards.

	Composite Sound Reduction Index (dB) per octave band (Hz)							
	63Hz	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**
East facade ground floor	36	32	30	33	45	56	60	60
East façade first floor	38	34	32	35	47	57	60	60
North facade ground floor	24	28	28	32	44	54	59	59
North façade first floor	26	29	29	32	44	54	59	59
West facade ground floor	17	18	20	23	31	31	30	29
West façade first floor	19	20	21	25	33	33	32	31
South façade ground floor	34	32	32	45	41	46	52	52
South façade first floor	39	35	33	38	50	59	60	60
Roof	26	25	32	40	50	61	72	67
Ground floor slab	41	43	49	55	60	60	60	60

Table 5.3 Composite sound reduction performance of proposed elements for each façade of the proposed energy centre

According to the Studio Four Architects the proposed general wall buildup will comprise of the following elements. It should be noted that east façade of the energy centre will include thinner ‘knock out’ locations.

Thicker wall type (north, west and south facades)

- Block outer skin (100mm)
- Cavity and Full fill insulation (100mm)
- Block inner skin (140mm)

Thinner wall type (east façade only)

- Block outer skin (100mm)
- Cavity and Full fill insulation (100mm)
- Block inner skin (100mm) at knock out locations on the east façade (block inner skin (140mm) everywhere else on east façade.

Roof

- Rockwool Hardrock (DD) Multi-Fix (210mm)

Ground floor slab

- Concrete slab (300mm)

Proposed louvres

- 2 No. Caice 300mm louvres – North façade
- 4No. Caice 300mm louvres – West facade

Other

- Proposed doors – North and south facades only

Table 5.4 shows the predicted sound pressure level at 1m from the top floor residential windows on the façade of the nearest noise sensitive receiver due to noise breakout from the proposed energy centre.

This figure takes into account the approximate dimensions and the calculated sound insulation performance of the external building fabric of the worst-case north façade. Detailed calculations of the proposed energy centre façade breakout are shown in Appendices B2 – B7.

Receiver	Noise Emissions Target	Noise Level at 1m From Receiving Window
Front façade, top floor windows at 30 High Street	45 dB(A)	45 dB(A)

Table 5.4 Predicted noise level at 1m from the closest noise sensitive window due to the proposed energy centre noise breakout of worst-case north facade

5.4 RMU Building Breakout to External Environment

It is understood that the separate RMU building will be reserved for HV RMU, HV/LV transformer and LV panels.

It is currently understood that the external façade on all elevations of the proposed RMU will provide the sound reduction performance as shown within Table 5.5 based on the construction details provided. The anticipated sound reduction index has been calculated and would be expected to provide the minimum figures shown in the following table when tested in accordance with BS EN ISO 10140 series of standards.

	Composite Sound Reduction Index (dB) per octave band (Hz)							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
East facade of the proposed RMU building	28	33	68	66	69	77	81	81

Table 5.5 Assumed sound reduction performance of facade

It is currently understood that the proposed buildup elements of the proposed RMU building will comprise of the following:

Wall type EW06

- 215mm fully bonded brickwork. Frogged flettons constructed in English bond with neat struck joints. Fair faced on the inside.
- Vapour Control Layer
- 40mm Vertical cladding rail
- 20mm EC 19-76-990 13.5_3 Sinusoidal steel profile laid horizontally with Colour coat Prisma RAL 7016 Anthracite Grey finish

The calculated total reverberant sound pressure level due to the proposed transformer installed in the RMU building is 72 dB(A). Table 5.6 shows the predicted sound pressure level

at 1m from the top floor residential windows on the façade of the nearest noise sensitive receiver due to noise breakout from the proposed RMU building. This figure takes into account the approximate dimensions and the predicted sound insulation performance of the external building fabric of the east façade. Detailed calculations are shown in Appendix B8

It should be noted that the east façade of the proposed RMU building will be closest to the noise sensitive receivers and no additional attenuation will be available from screening due to the building envelope. Therefore, noise at the receivers closest to the east façade of the proposed RMU building are considered as worst-case scenario when compared to all other facades.

Receiver	Noise Emissions Target	Noise Level at 1m From Receiving Window
Front façade, top floor windows at 26 High Street	45 dB(A)	Non-significant

Table 5.6 Predicted noise level at 1m from the closest noise sensitive window due to first floor of the proposed energy centre noise breakout

6.0 NOISE CONTROL MEASURES

In order to achieve the specific sound level and subsequent rating level shown in the assessment above, the following noise control strategy should be adopted.

6.1 Outdoor units

To control the noise emissions from the outdoor plant installation, we would recommend that an acoustic screen is installed around all the proposed outdoor rooftop fans. It is understood that the acoustic screen can only be installed at the fan level, approximately 3m above the ground.

The acoustic screen should be constructed from 18.5kg/m^2 pre-galvanised mild steel sheet. The acoustic screen must completely enclose the units at 3m above the ground level and extend 1m above the top of the units. There should not be any gaps or openings in the acoustic screen.

6.2 Ground Floor of the Proposed Energy Centre

In order to control the noise breakout from the ground floor west and north facades of the proposed energy centre, it is understood that acoustic louvres will be installed with the dimensions stated below and the insertion loss values specified in Table 6.1.

It is currently understood that the proposed louvres at the ground floor of the proposed energy centre would be as follows:

- 2 no. Ground floor west façade louvres – 1000mm x 1500mm x 300mm
- 1 no. Ground floor north façade louvres – 1400mm x 1800mm x 300mm

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Ground floor louvres of west and north facades	5	6	8	12	19	19	18	17

Table 6.1 Insertion loss figures to be provided by proposed acoustic louvres on ground floor

The proposed louvres are sufficient for the control of breakout noise. It is understood that the proposed louvres for the ground floor west and north facades will be Caice CS300.

It is understood that a plenum box will be installed around the ground floor north façade louvre. The plenum box should provide the insertion loss values stated below:

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Ground floor plenum box of north facade	11	17	23	32	45	50	54	53

Table 6.2 Insertion loss figures to be provided by a plenum box

It is also recommended that the external doors at the ground floor of the north and south facades meet the following sound reduction index:

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Ground floor doors of north and south facades	36	32	29	32	53	52	50	50

Table 6.3 Insertion loss figures to be provided by proposed doors on ground floor (North and south facades)

6.3 First Floor of the Proposed Energy Centre

In order to control the noise breakout from the first floor west and north facades of the proposed energy centre, it is understood that acoustic louvres will be installed with the dimensions stated below and the insertion loss values specified in Table 6.2.

It is currently understood that the proposed louvres at the first floor of the proposed energy centre would be as follows:

- 2 no. First floor west façade louvres – 1000mm x 1000mm x 300mm
- 1 no. First floor north façade louvre – 1000mm x 2000mm x 300mm

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
First floor louvres of west and north facades	5	6	8	12	19	19	18	17

Table 6.4 Insertion loss figures to be provided by proposed acoustic louvres on first floor

The proposed louvres are sufficient for the control of breakout noise. It is understood that the proposed louvres for the first floor west and north facades will be Caice CS300.

It is understood that a plenum box will be installed around the first floor north façade louvre. The plenum box should provide the insertion loss values stated below:

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
First floor plenum box of north facade	11	17	23	32	45	50	54	53

Table 6.5 Insertion loss figures to be provided by a plenum box

It is also recommended that the external doors at the first floor of the north facades meet the following sound reduction index:

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
First floor doors of north facade	36	32	29	32	53	52	50	50

Table 6.6 Insertion loss figures to be provided by proposed doors on ground floor (North and south facades)

6.4 Anti-Vibration Mounting Strategy

In the case of all plant units, appropriate anti-vibration mounts should be installed in order to ensure that vibrations do not give rise to structure-borne noise. Appendix C outlines detailed advice in order to ensure that the system installer selects the appropriate anti-vibration mount for the installation.

It is the supplier's responsibility to ensure that all mountings offered are suitable for the loads, operating and environmental conditions which will prevail.

7.0 CONCLUSION

An environmental noise survey has been undertaken at the Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex., by KP Acoustics Ltd between 14:11 on 19/06/2023 and 14:02 on 20/06/2023. The results of the survey have enabled criteria to be set for noise emissions due to the proposed plant unit installation on the roof of the multistorey car park.

An additional attended environmental noise survey was undertaken between 12:36 on 25/09/2023 and 15:36 on 25/09/2023. The results of the survey have enabled criteria to be set for a proposed energy centre and the proposed RMU building noise breakout assessment.

Noise data of proposed plant units as provided by the client has been used to obtain Specific and Rated Noise Level at the identified nearest noise sensitive receivers in accordance with British Standard BS4142:2014 for compliance with the Worthing Borough Council requirements.

The rating level was compared with the representative background noise level to assess the likelihood of impact considering the environmental noise context of the area as per the requirements of BS4142:2014.

It has been concluded that noise emissions from the proposed plant units assessed in this report would not have an adverse impact on the nearest residential receivers provided that the noise control measures detailed in section 6.0 are followed. It should be noted that some of the plant selections are not available at the time of issue and therefore the results of the assessment and recommended mitigation measures are preliminary and subject to change.

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.- Position 1 Environmental Time History
19/06/2023 to 20/06/2023

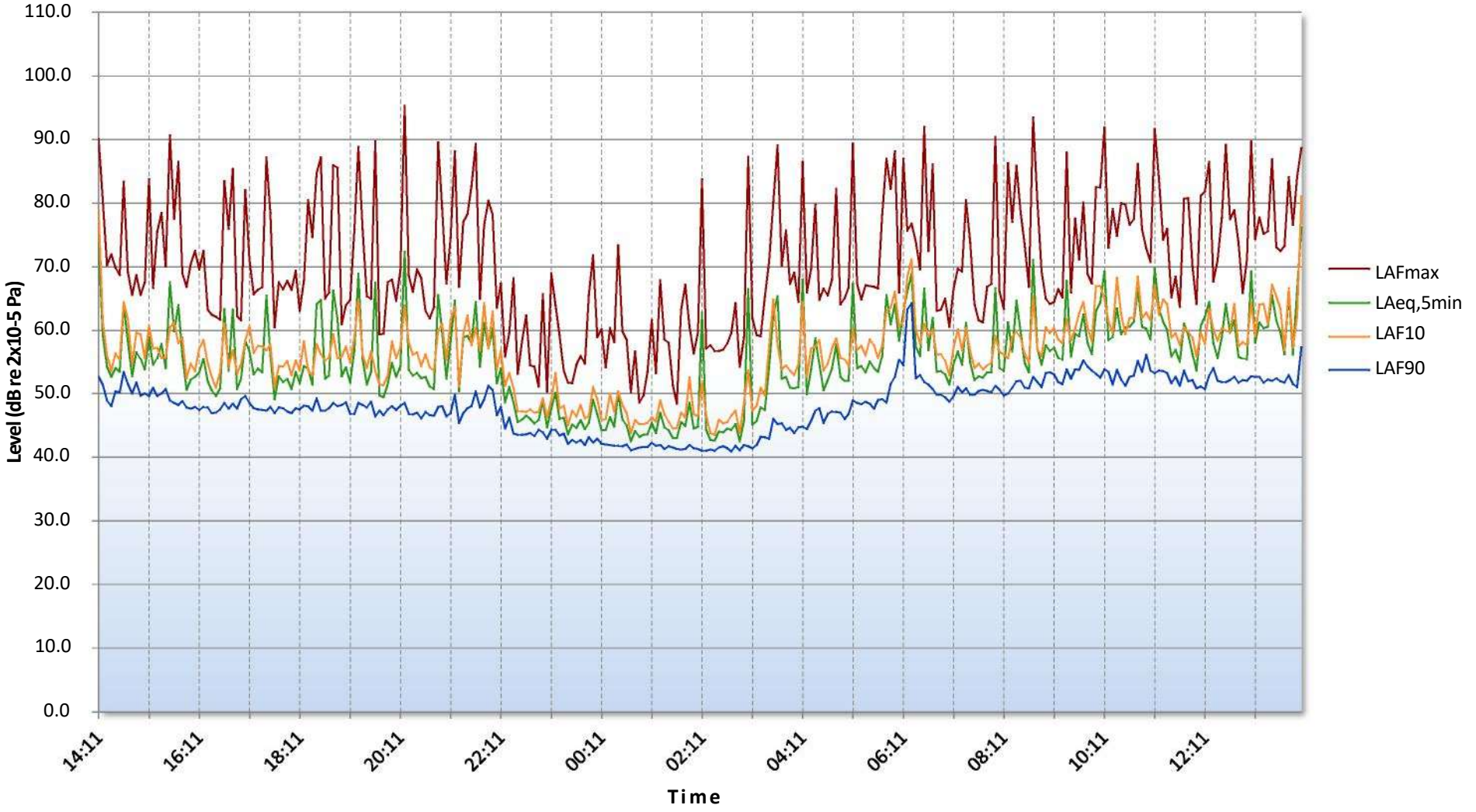


Figure 26677.TH1

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.- Position 1 Representative Daytime Background

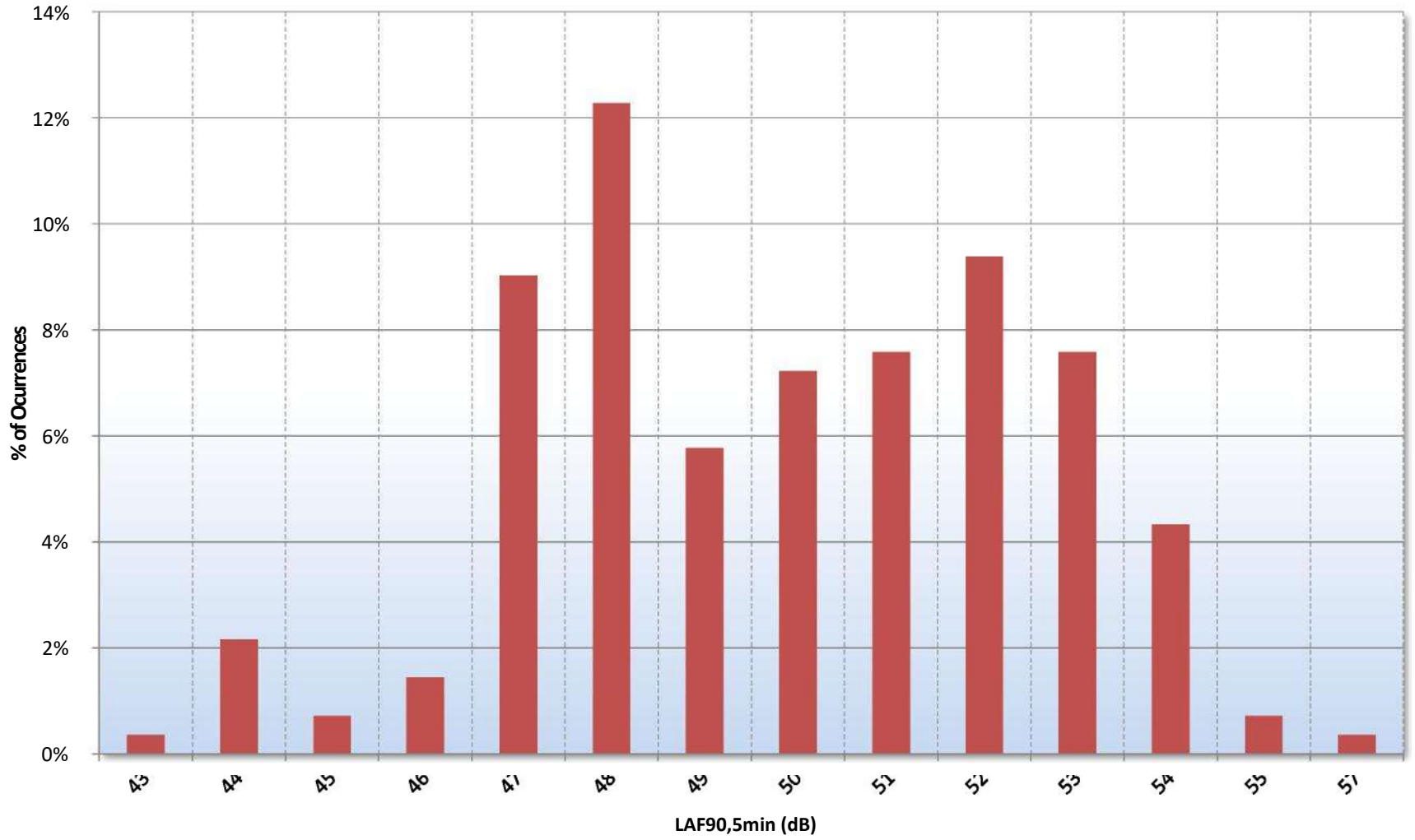


Figure 26677.Daytime L90.TH1

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.- Position 1 Representative Night-time Background Noise

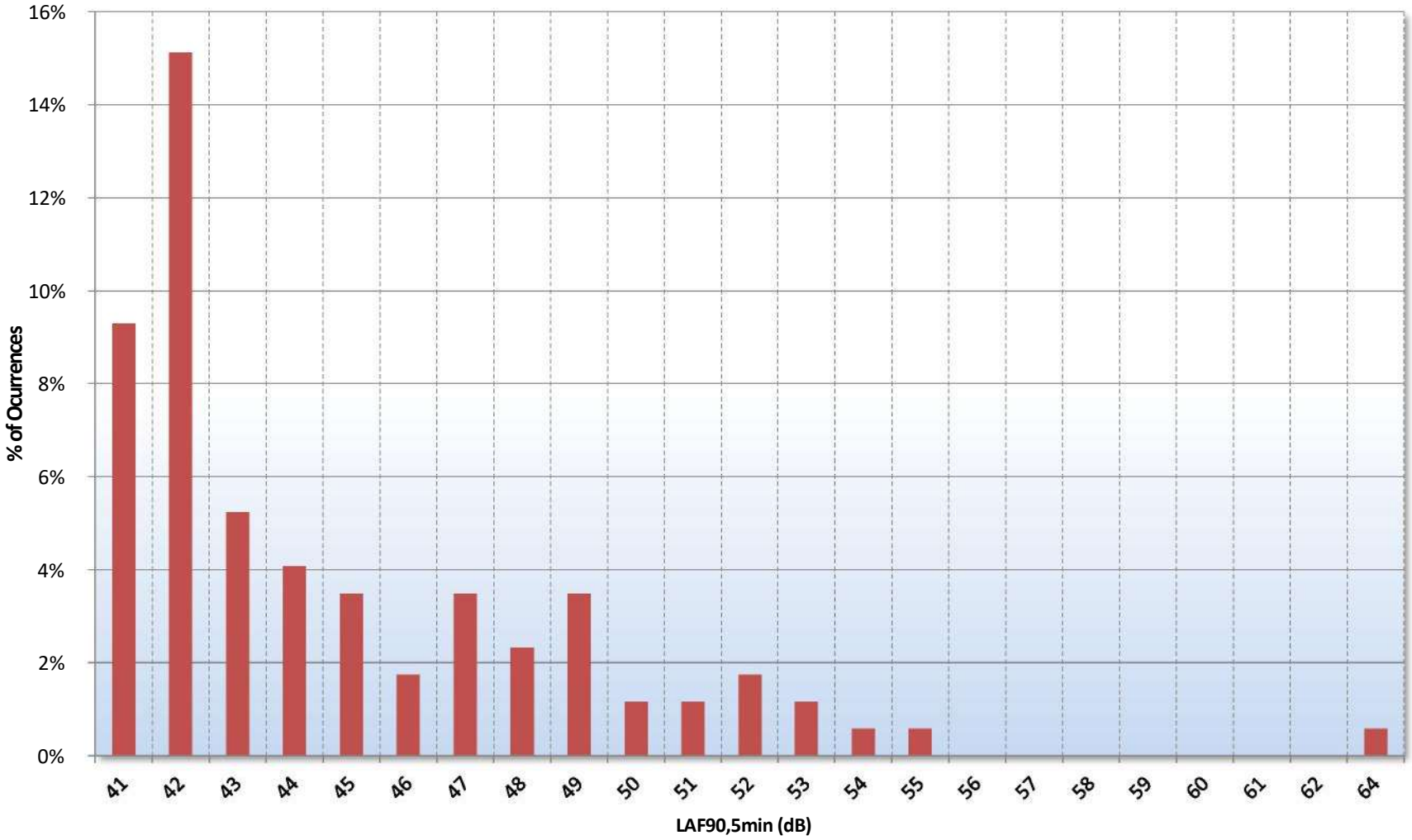


Figure 26677.Night-time L90.TH1

APPENDIX A

GENERAL ACOUSTIC TERMINOLOGY

Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of 10^{13} units, that only a logarithmic scale is the sensible solution for displaying such a range.

Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level $L_{eq.}$ ^{The} L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for no more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise.

L_{90}

This is the level exceeded for no more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Environmental noise terms are defined in BS7445, *Description and Measurement of Environmental Noise*.

APPENDIX A

APPLIED ACOUSTIC TERMINOLOGY

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud

Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.

APPENDIX B1 Rev I

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

PLANT NOISE EMISSIONS CALCULATIONS

Source: Proposed Plant units installed on the high Street multistorey car park roof, Worthing Receiver: Rear façade, top floor residential windows at 18 Ann Street	Frequency, Hz 63	125	250500	1k	2k	4k	8k	dB(A)
Guntner Fan (model currently unknown) (400rpm) (SWL)	**46**	**60**	**55**	**60**	**63**	**62**	**57**	**55**	**67**
Conversion to SPL @1m, dB	-11	-11	-11	-11	-11	-11	-11	-11	
Correction for number of units (75),dB	19	19	19	19	19	19	19	19	
Minimum attenuation due to building envelope, dB	-6	-7	-9	-12	-16	-19	-22	-25	
Minimum attenuation provided by distance (34m), dB	-31	-31	-31	-31	-31	-31	-31	-31	
Minimum attenuation due to screening from acoustic screen, dB	-5	-5	-5	-6	-6	-6	-3	0	
Total SPL after screening from acoustic screen, dB	12	25	18	19	18	14	9	7	
Minimum attenuation due to SRI of acoustic screen, dB	-15	-17	-25	-37	-48	-53	-56	-46	
Total SPL after transfer through acoustic screen, dB	-44	-47	-57	-72	-87	-95	-101	-94	
SPL @1m due to fan installation	12	25	18	20	18	14	9	7	22
Guntner Fan (model currently unknown) (400rpm) (SWL)	**46**	**60**	**55**	**60**	**63**	**62**	**57**	**55**	**67**
Conversion to SPL @1m, dB	-11	-11	-11	-11	-11	-11	-11	-11	
Correction for number of units (30),dB	15	15	15	15	15	15	15	15	
Minimum attenuation due to building envelope, dB	0	0	0	0	0	0	0	0	
Minimum attenuation provided by distance (43m), dB	-33	-33	-33	-33	-33	-33	-33	-33	
Minimum attenuation due to screening from acoustic screen, dB	-5	-5	-5	-6	-6	-7	-10	-13	
Total SPL after screening from acoustic screen, dB	12	26	21	26	28	26	18	13	
Minimum attenuation due to SRI of acoustic screen, dB	-15	-17	-25	-37	-48	-53	-56	-46	
Total SPL after transfer through acoustic screen, dB	-44	-46	-54	-66	-77	-82	-85	-75	
SPL @1m due to fan installation	12	26	21	26	28	26	19	13	31
Guntner Fan (model currently unknown) (400rpm) (SWL)	**46**	**60**	**55**	**60**	**63**	**62**	**57**	**55**	**67**
Conversion to SPL @1m, dB	-11	-11	-11	-11	-11	-11	-11	-11	
Correction for number of units (75),dB	19	19	19	19	19	19	19	19	
Minimum attenuation due to building envelope, dB	-6	-7	-9	-12	-16	-19	-22	-25	
Minimum attenuation provided by distance (62m), dB	-36	-36	-36	-36	-36	-36	-36	-36	
Minimum attenuation due to screening from acoustic screen, dB	-5	-5	-5	-6	-6	-6	-3	0	
Total SPL after screening from acoustic screen, dB	7	20	13	14	13	9	4	2	
Minimum attenuation due to SRI of acoustic screen, dB	-15	-17	-25	-37	-48	-53	-56	-46	
Total SPL after transfer through acoustic screen, dB	-49	-52	-62	-77	-92	-100	-106	-99	
SPL @1m due to fan installation	7	20	13	14	13	9	4	2	17
Total SPL @1m due to proposed units	**17**	**30**	**24**	**27**	**29**	**26**	**19**	**15**	**32**

Design Criterion	34

APPENDIX B2 Rev I

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

PLANT NOISE BREAKOUT CALCULATIONS, ENERGY CENTRE EAST FAÇADE

Source: East façade ground floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Fenagy CO2-chiller/heatpump (6 compressors) (1500kW) (SWL)	**8**	**97**	**1**	**103**	**1**	**96**	**92**	**8**	**106**
Correction for number of units (3),dB	**0**	5	**0**	5	**0**	5	5	**4**	
Reverberation time (1s), dB	5	2-	**1**	2	**4**	2	2-	5	
Room volume (616m³), dB	2-	14	5	-14	5	-14	14	2	
Reverberant SPL in Plant Room due to plant unit	1	**90**	2	**96**	2	**89**	**85**	-	**99**
Systemair EXC 400 axial fan , SWL, dB	**6**	**71**	**86**	**81**	**81**	**77**	**74**	**6**	**85**
Correction for number of units (3),dB	**4**	5	5	5	5	5	5	**2**	
Reverberation time (1s), dB	5	2-	2 -	2	2-	2	2-	5	
Room volume (616m³), dB	2-	14	14	-14	14	-14	14	2	
Reverberant SPL in Plant Room due to plant unit	1	**64**	**79**	**74**	**74**	**70**	**67**	-	**78**
Total Reverberant SPL in Ground Floor of Energy Centre due to plant units	**73**	**90**	**94**	**96**	**97**	**89**	**85**	**77**	**99**
Approximate area (S) of the façade overlooking receiver location (48m²)	48	48	48	48	48	48	48	48	
Correction for area (S), dB	17	17	17	17	17	17	17	17	
On site composite SRI of façade, dB	-36	-32	-30	-33	-45	-56	-60	-60	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**17**	**38**	**44**	**43**	**32**	**13**	**5**	**-3**	**42**

Source: East façade first floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Armstrong Pump (model curently unknown), SPL @1m, dB	**72**	**73**	**75**	**75**	**78**	**75**	**71**	**65**	**82**
Conversion to SWL, dB	11	11	11	11	11	11	11	11	
Correction for number of units (5),dB	7	7	7	7	7	7	7	7	
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m³), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Systemair EXC 560 axial fan, SWL, dB	**44**	**53**	**65**	**81**	**79**	**76**	**71**	**64**	**83**
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m³), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**33**	**42**	**54**	**70**	**68**	**65**	**60**	**53**	**72**
Total Reverberant SPL in First Floor of Energy Centre due to plant units	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Approximate area (S) of the façade overlooking receiver location (36m²)	36	36	36	36	36	36	36	36	
Correction for area (S), dB	16	16	16	16	16	16	16	16	
On site composite SRI of façade, dB	-38	-34	-32	-35	-47	-57	-60	-60	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**20**	**25**	**29**	**27**	**17**	**4**	**-3**	**-9**	**26**

Design Criterion	45

APPENDIX B3 Rev I

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

PLANT NOISE BREAKOUT CALCULATIONS, ENERGY CENTRE NORTH FAÇADE

Source: North façade ground floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Fenagy CO2-chiller/heatpump (6 compressors) (1500kW) (SWL)	**8**	**97**	**1**	**103**	**1**	**96**	**92**	**8**	**106**
Correction for number of units (3),dB	**0**	5	**0**	5	**0**	5	5	**4**	
Reverberation time (1s), dB	5	2-	**1**	2	**4**	2	2-	5	
Room volume (616m³), dB	2-	14	5	-14	5	-14	14	2	
Reverberant SPL in Plant Room due to plant unit	1	**90**	2	**96**	2	**89**	**85**	-	**99**
Systemair EXC 400 axial fan , SWL, dB	**6**	**71**	**86**	**81**	**81**	**77**	**74**	**6**	**85**
Correction for number of units (3),dB	**4**	5	5	5	5	5	5	**2**	
Reverberation time (1s), dB	5	2-	2 -	2	2-	2	2-	5	
Room volume (616m³), dB	2-	14	14	-14	14	-14	14	2	
Reverberant SPL in Plant Room due to plant unit	1	**64**	**79**	**74**	**74**	**70**	**67**	-	**78**
Total Reverberant SPL in Ground Floor of Energy Centre due to plant units	**73**	**90**	**94**	**96**	**97**	**89**	**85**	**77**	**99**
Approximate area (S) of the façade overlooking receiver location (64m²)	64	64	64	64	64	64	64	64	
Correction for area (S), dB	18	18	18	18	18	18	18	18	
On site composite SRI of façade (louvre with plenum box),	-24	-28	-28	-32	-44	-54	-59	-59	
dB Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**30**	**43**	**48**	**45**	**34**	**16**	**7**	**-1**	**45**

Source: North façade first floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Armstrong Pump (model curently unknown), SPL @1m, dB	**72**	**73**	**75**	**75**	**78**	**75**	**71**	**65**	**82**
Conversion to SWL, dB	11	11	11	11	11	11	11	11	
Correction for number of units (5),dB	7	7	7	7	7	7	7	7	
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m³), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Systemair EXC 560 axial fan, SWL, dB	**44**	**53**	**65**	**81**	**79**	**76**	**71**	**64**	**83**
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m³), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**33**	**42**	**54**	**70**	**68**	**65**	**60**	**53**	**72**
Total Reverberant SPL in First Floor of Energy Centre due to plant units	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Approximate area (S) of the façade overlooking receiver location (48m²)	48	48	48	48	48	48	48	48	
Correction for area (S), dB	17	17	17	17	17	17	17	17	
On site composite SRI of façade, dB	-26	-29	-29	-32	-44	-54	-59	-59	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to building envelope, dB	-12	-15	-18	-21	-25	-25	-25	-25	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**21**	**17**	**16**	**10**	**-3**	**-16**	**-25**	**-31**	**11**
						Design Criterion			**45**

APPENDIX B4 Rev I

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

PLANT NOISE BREAKOUT CALCULATIONS, ENERGY CENTRE WEST FAÇADE

Source: West façade ground floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Fenagy CO2-chiller/heatpump (6 compressors) (1500kW) (SWL)	**80**	**97**	**101**	**103**	**104**	**96**	**92**	**84**	**106**
Correction for number of units (3),dB	5	5	5	5	5	5	5	5	
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (616m³), dB	-14	-14	-14	-14	-14	-14	-14	-14	
Reverberant SPL in Plant Room due to plant unit	**73**	**90**	**94**	**96**	**97**	**89**	**85**	**77**	**99**
Systemair EXC 400 axial fan , SWL, dB	**64**	**71**	**86**	**81**	**81**	**77**	**74**	**62**	**85**
Correction for number of units (3),dB	5	5	5	5	5	5	5	5	
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (616m³), dB	-14	-14	-14	-14	-14	-14	-14	-14	
Reverberant SPL in Plant Room due to plant unit	**57**	**64**	**79**	**74**	**74**	**70**	**67**	**55**	**78**
Total Reverberant SPL in Ground Floor of Energy Centre due to plant units	**73**	**90**	**94**	**96**	**97**	**89**	**85**	**77**	**99**
Approximate area (S) of the façade overlooking receiver location (48m²)	48	48	48	48	48	48	48	48	
Correction for area (S), dB	17	17	17	17	17	17	17	17	
On site composite SRI of façade, dB	-17	-18	-20	-23	-31	-31	-30	-29	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to building envelope, dB	-15	-17	-21	-24	-25	-25	-25	-25	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**22**	**35**	**34**	**29**	**21**	**13**	**10**	**3**	**30**

Source: West façade first floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Armstrong Pump (model curently unknown), SPL @1m, dB	**72**	**73**	**75**	**75**	**78**	**75**	**71**	**65**	**82**
Conversion to SWL, dB	11	11	11	11	11	11	11	11	
Correction for number of units (5),dB	7	7	7	7	7	7	7	7	
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m³), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Systemair EXC 560 axial fan, SWL, dB	**44**	**53**	**65**	**81**	**79**	**76**	**71**	**64**	**83**
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m³), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**33**	**42**	**54**	**70**	**68**	**65**	**60**	**53**	**72**
Total Reverberant SPL in First Floor of Energy Centre due to plant units	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Approximate area (S) of the façade overlooking receiver location (36m²)	36	36	36	36	36	36	36	36	
Correction for area (S), dB	16	16	16	16	16	16	16	16	
On site composite SRI of façade, dB	-19	-20	-21	-25	-33	-33	-32	-31	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to building envelope, dB	-12	-15	-18	-21	-25	-25	-25	-25	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	

Sound Pressure Level at Receiver due to ground floor units Units, dB	**27**	**24**	**22**	**15**	**6**	**3**	**0**	**-5**	**18**
							Design Criterion		**45**

APPENDIX B5 Rev I

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

PLANT NOISE BREAKOUT CALCULATIONS, ENERGY CENTRE SOUTH FAÇADE

Source: South façade ground floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Fenagy CO2-chiller/heatpump (6 compressors) (1500kW) (SWL)	**8**	**97**	**1**	**103**	**1**	**96**	**92**	**8**	**106**
Correction for number of units (3),dB	**0**	5	**0**	5	**0**	5	5	**4**	
Reverberation time (1s), dB	5	2-	**1**	2	**4**	2	2-	5	
Room volume (616m³), dB	2-	14	5	-14	5	-14	14	2	
Reverberant SPL in Plant Room due to plant unit	1	**90**	2	**96**	2	**89**	**85**	-	**99**
Systemair EXC 400 axial fan , SWL, dB	**6**	**71**	**86**	**81**	**81**	**77**	**74**	**62**	**85**
Correction for number of units (3),dB	**4**	5	5	5	5	5	5	5	
Reverberation time (1s), dB	5	2-	2 -	2	2-	2	2-	2	
Room volume (616m³), dB	2-	14	14	-14	14	-14	14	-14	
Reverberant SPL in Plant Room due to plant unit	1	**64**	**79**	**74**	**74**	**70**	**67**	**55**	**78**
Total Reverberant SPL in Ground Floor of Energy Centre due to plant units	**73**	**90**	**94**	**96**	**97**	**89**	**85**	**77**	**99**
Approximate area (S) of the façade overlooking receiver location (64m²)	64	64	64	64	64	64	64	64	
Correction for area (S), dB	18	18	18	18	18	18	18	18	
On site composite SRI of façade, dB	-34	-32	-32	-45	-41	-46	-52	-52	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**20**	**39**	**44**	**32**	**37**	**24**	**14**	**6**	**40**

Source: South façade first floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Armstrong Pump (model curently unknown), SPL @1m, dB	**72**	**73**	**75**	**75**	**78**	**75**	**71**	**65**	**82**
Conversion to SWL, dB	11	11	11	11	11	11	11	11	
Correction for number of units (5),dB	7	7	7	7	7	7	7	7	
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m³), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Systemair EXC 560 axial fan, SWL, dB	**44**	**53**	**65**	**81**	**79**	**76**	**71**	**64**	**83**
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m³), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**33**	**42**	**54**	**70**	**68**	**65**	**60**	**53**	**72**
Total Reverberant SPL in First Floor of Energy Centre due to plant units	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Approximate area (S) of the façade overlooking receiver location (48m²)	48	48	48	48	48	48	48	48	
Correction for area (S), dB	17	17	17	17	17	17	17	17	
On site composite SRI of façade, dB	-39	-35	-33	-38	-50	-59	-60	-60	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to building envelope, dB	-12	-15	-18	-21	-25	-25	-25	-25	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**8**	**11**	**12**	**4**	**-9**	**-21**	**-26**	**-32**	**6**
							Design Criterion		**45**

APPENDIX B2 Rev I

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

PLANT NOISE BREAKOUT CALCULATIONS, ENERGY CENTRE ROOF

Source: Roof of Energy Centre (1st floor plant units) Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Armstrong Pump (model curently unknown), SPL @1m, dB	**72**	**73**	**75**	**75**	**78**	**75**	**71**	**65**	**82**
Conversion to SWL, dB	11	11	11	11	11	11	11	11	
Correction for number of units (5),dB	7	7	7	7	7	7	7	7	
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m^3), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Systemair EXC 560 axial fan, SWL, dB	**44**	**53**	**65**	**81**	**79**	**76**	**71**	**64**	**83**
Reverberation time (1s), dB	2	2	2	2	2	2	2	2	
Room volume (462m^3), dB	-13	-13	-13	-13	-13	-13	-13	-13	
Reverberant SPL in Plant Room due to plant unit	**33**	**42**	**54**	**70**	**68**	**65**	**60**	**53**	**72**
Total Reverberant SPL in First Floor of Energy Centre due to plant units	**79**	**80**	**82**	**82**	**85**	**82**	**78**	**72**	**89**
Approximate area (S) of the roof (154m^2)	154	154	154	154	154	154	154	154	
Correction for area (S), dB	22	22	22	22	22	22	22	22	
On site composite SRI of roof, dB	-16	-15	-22	-20	-40	-50	-62	-57	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to building envelope (parapet), dB	-10	-13	-15	-18	-21	-24	-25	-25	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**38**	**38**	**31**	**30**	**10**	**-6**	**-23**	**-24**	**29**
						Design Criterion			**45**

APPENDIX B2 Rev I

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

PLANT NOISE BREAKOUT CALCULATIONS, ENERGY CENTRE FLOOR

Source: Floor of Energy Centre Receiver: Front façade, top floor windows at 30 High Street	Frequency, Hz								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Fenagy CO2-chiller/heatpump (6 compressors) (1500kW) (SWL)	**8**	**97**	**1**	**103**	**10**	**96**	**92**	**8**	**106**
Correction for number of units (3),dB	**0**	5	**0**	5	**4**	5	5	**4**	
Reverberation time (1s), dB	5	2-	**1**	2	5	2	2-	5	
Room volume (702m³), dB	2	14	5	-14	2 -	-14	14	2	
Reverberant SPL in Plant Room due to plant unit	-	**89**	2	**95**	14	**88**	**84**	-	**99**
Systemair EXC 400 axial fan , SWL, dB	**64**	**71**	**86**	**81**	**81**	**77**	**74**	**6**	**85**
Correction for number of units (3),dB	5	5	5	5	52	5	5	**2**	
Reverberation time (1s), dB	2	2-	2-	2	-	2	2-	5	
Room volume (702m³), dB	-14	14	14	-14	14	-14	14	2	
Reverberant SPL in Plant Room due to plant unit	**56**	**63**	**78**	**73**	**73**	**69**	**66**	-	**78**
Total Reverberant SPL in Ground Floor of Energy Centre due to plant units	**72**	**89**	**93**	**95**	**96**	**88**	**84**	**76**	**99**
Approximate area (S) of the façade overlooking receiver location (48m²)	48	48	48	48	48	48	48	48	
Correction for area (S), dB	17	17	17	17	17	17	17	17	
On site composite SRI of façade, dB	-41	-43	-49	-55	-60	-60	-60	-60	
Correction for distance (13m), dB	-22	-22	-22	-22	-22	-22	-22	-22	
Correction due to building envelope, dB	-15	-17	-21	-24	-25	-25	-25	-25	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	-14	-14	-14	-14	-14	-14	-14	-14	
Sound Pressure Level at Receiver due to ground floor units Units, dB	**-3**	**9**	**4**	**-3**	**-8**	**-16**	**-20**	**-28**	**0**
						Design Criterion			**45**

APPENDIX B8 Rev I

Energy Centre and Roof, Multi Storey Car Park, High Street, Worthing, West Sussex.

PLANT NOISE BREAKOUT CALCULATIONS, ENERGY CENTRE EAST FAÇADE

Source: Proposed Plant units installed in the proposed RMU building Receiver: Front façade, top floor windows at 26 High Street	*Frequency, Hz* *63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*	*dB(A)*
Transformer (make and model currently unknown) (SWL)									**75**
Reverberation time (1.5s), dB									2
Room volume (75.6m^3), dB									-5
Reverberant SPL in Plant Room due to plant unit									**72**
Approximate area (S) of the façade overlooking receiver location (14m^2)									14
Correction for area (S), dB									**11**
On site composite SRI of façade, dB									**-66**
Correction for distance (20m), dB									**-26**
Correction due to no reverberant field externally + propagation effect of the wall surface, dB									**-14**
Sound Pressure Level at Receiver due to Proposed Unit, dB									**0**

Design Criterion	**45**

APPENDIX C

ANTI-VIBRATION MOUNTING SPECIFICATION REFERENCE DOCUMENT

1.0 General

1.1 All mountings shall provide the static deflection, under the equipment weight, shown in the schedules. Mounting selection should allow for any eccentric load distribution or torque reaction, so that the design deflection is achieved on all mountings under the equipment, under operating conditions.

1.2 It is the supplier's responsibility to ensure that all mountings offered are suitable for the loads, operating and environmental conditions which will prevail. Particular attention should be paid to mountings which will be exposed to atmospheric conditions to prevent corrosion.

1.3 All mountings shall be colour coded, or otherwise marked, to indicate their load capacity, to facilitate identification during installation.

Where use of resilient supports allows omission of pipe flexible connections for vibration/noise isolation, it shall be the Mechanical Service Consultant's or Contractor's responsibility to decide whether such devices are required to compensate for misalignment or thermal strain.

2.1 Type A Mounting (Caged Spring Type)

2.1.1 Each mounting shall consist of cast or fabricated telescopic top and bottom housings enclosing one or more helical steel springs as the principle isolation elements, and shall incorporate a built-in levelling device. The housing should be designed to permit visual inspection of the springs after installation, i.e. the spring must not be totally enclosed.

2.1.2 The springs shall have an outside diameter of not less than 75% of the operating height, and be selected to have at least 50% overload capacity before becoming coil-bound.

2.1.3 The bottom plate of each mounting shall have bonded to it a rubber/neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

2.1.4 Mountings incorporating snubbers or restraining devices shall be designed so that the snubbing, damping or restraining mechanism is capable of being adjusted to have no significant effect during the normal running of the isolated machine.

2.1.5 All nuts, bolts or other elements used for adjustment of a mounting shall incorporate locking mechanisms to prevent the isolator going out of adjustment as a result of vibration or accidental or unauthorised tampering.

2.2 Type B Mounting (Open Spring Type)

2.2.1 Each mounting shall consist of one or more helical steel springs as the principal isolation elements, and shall incorporate a built-in levelling device.

2.2.2 The springs shall be fixed or otherwise securely located to cast or fabricated top and bottom plates, shall have an outside diameter of not less than 75% of the operating height, and shall be selected to have at least 50% overload capacity before becoming coil-bound.

2.2.3 The bottom plate shall have bonded to it a rubber/ neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

APPENDIX C

2.3 Type C Mounting (Rubber/Neoprene Type)

Each mounting shall consist of a steel top plate and base plate completely embedded in oil resistant rubber/neoprene. Each mounting shall be capable of being fitted with a levelling device, and should have bolt holes in the base plate and a threaded metal insert in the top plate so that they can be bolted to the floor and equipment where required.

3.0 Plant Bases

3.1 **Type A Bases (A.V. Rails)**

An A.V. Rail shall comprise a steel beam with two or more height-saving brackets. The steel sections must be sufficiently rigid to prevent undue strain in the equipment and if necessary should be checked by the Structural Engineer.

3.2 **Type B Bases (Steel Plant Bases)**

Steel plant bases shall comprise an all-welded steel framework of sufficient rigidity to provide adequate support for the equipment, and fitted with isolator height saving brackets. The frame depth shall be approximately 1/10 of the longest dimension of the equipment with a minimum of 150 mm. This form of base may be used as a composite A.V. rail system.

3.3 **Type C Bases (Concrete Inertia Base: for use with steel springs)**

These shall consist of an all-welded steel pouring frame-work with height saving brackets, and a frame depth of approximately 1/12 of the longest dimension of the equipment, with a minimum of 100 mm. The bottom of the pouring frame should be blanked off, and concrete (2300 kg/m^3) poured in over steel reinforcing rods positioned 35 mm above the bottom. The inertia base should be sufficiently large to provide support for all parts of the equipment, including any components which over-hang the equipment base, such as suction and discharge elbows on centrifugal pumps.