

North Manchester General Hospital Delaunays Road, Manchester



Planning Compliance Report
Report 22848.PCR.01

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Appendix B	Acoustic Calculations
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1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by S I Sealy & Associates, Inwood Court, Stuart Road, Bredbury, Stockport, SK6 2SR, to undertake a noise impact assessment of a proposed plant unit installation serving the building at North Manchester General Hospital, Delaunays Road, Crumpsall, Manchester M8 5RB.

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 Manchester City Council.

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 receiver. Mitigation measures will be outlined as appropriate.

2.0 SITE SURVEYS

2.1 Site Description

As shown in Figure 2.1, the site is within the main North Manchester General Hospital site, surrounded by hospital use buildings and receivers.



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 15:00 on 17/06/2021 and 15:00 on 18/06/2021

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

Icon	Descriptor	Location Description
	Noise Measurement Position 1	The meter was installed on the existing flat roof of the Endoscopy Facility as shown in Figure 2.1. A correction of 3dB has been applied to account for non-free field conditions
	Noise Measurement Position 2	The meter was installed on the existing flat roof of the ERCP Facility as shown in Figure 2.1. A correction of 3dB has been applied to account for non-free field conditions
	Closest Noise Sensitive Receiver 1	Office window within adjacent Endoscopy Facility
	Closest Noise Sensitive Receiver 2	Office window within adjacent ERCP Facility
	Proposed Plant Installation Locations	Proposed plant installations are outlined in Section 5.1

Table 2.1 Measurement position and description

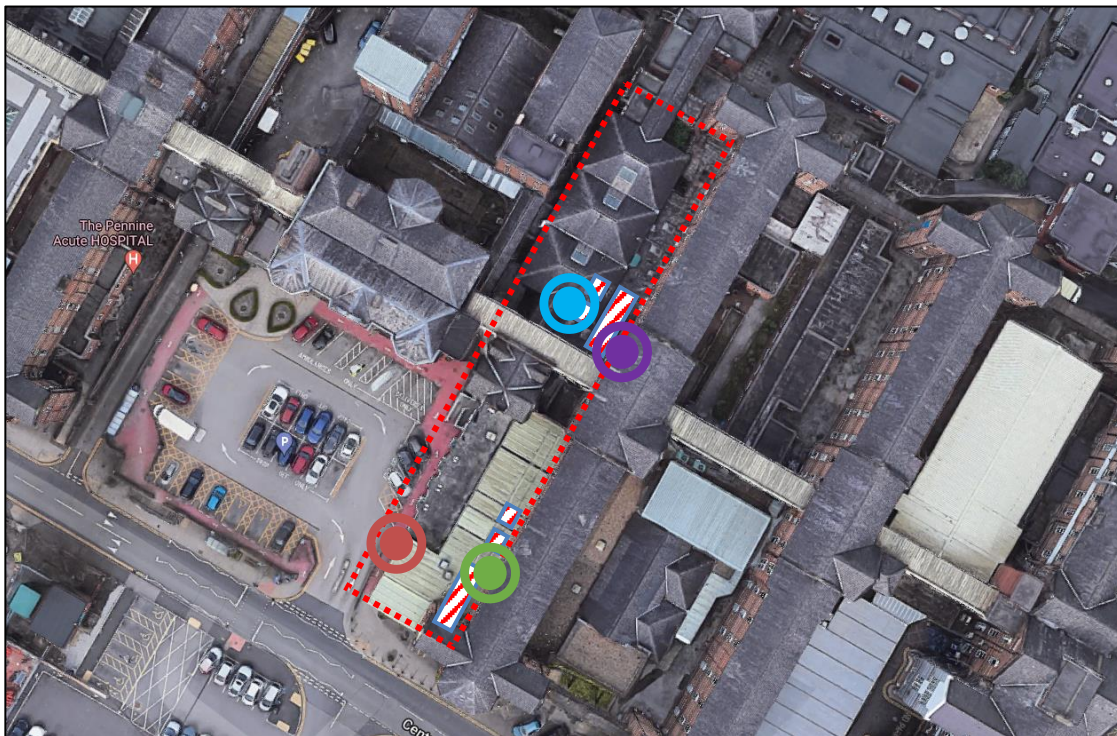


Figure 2.2 Site measurement position, identified receiver and proposed plant unit installation (Image Source: Google Maps)

The choice of the position was based both on accessibility and on collecting representative noise data in relation to the nearest noise sensitive receiver relative to 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 2.3.

Measurement instrumentation		Serial no.	Date	Cert no.
Noise Kit 1	Svantek Type 957 Class 1 Sound Level Meter	12399	12/03/2020	14015015-1
	Free-field microphone Aco Pacific 7052E	55951		
	Preamp Svantek 2v12L	33537		
	Svantek External windshield	-	-	-

Noise Kit 3	Svantek Type 977 Class 1 Sound Level Meter	34104	12/03/2020	14015015-2
	Free-field microphone Aco Pacific 7052E	66830		
	Preamp Svantek 2v12L	17293		
	Svantek External windshield	-	-	-
B&K Type 4231 Class 1 Calibrator		2147411	04/02/2021	05223/2

Table 2.3 Measurement instrumentation

3.0 RESULTS

The L_{Aeq} : 5min, L_{Amax} : 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 22848.TH1-2.

The measured representative background noise levels are shown in Table 3.1 for daytime and night-time.

Time Period	Noise Measurement Position 1	Noise Measurement Position 2
Daytime (07:00-23:00)	46	44
Night-time (23:00-07:00)	43	44

Table 3.1 Representative background noise levels for daytime and night time

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.

5.0 NOISE IMPACT ASSESSMENT

5.1 Proposed Plant Installations

It is understood that the proposed plant installation is comprised of the following units:

Plant Location 1

- 1 No. S&E AHU 01 (HTM 03-01) Double decked Air Handling Unit
- 2 No. Fujitsu AOYG90LRLA Air Condenser Unit

The proposed installation location for the AHU will be on the existing Endoscopy Facility flat roof, as shown in Figure 2.2 above.

Plant Location 2

- 1 No. S&E AHU 02 (HTM 03-01) Double decked Air Handling Unit
- 2 No. Fujitsu AOYG90LRLA Air Condenser Unit

The proposed installation location for the AHU will be on the existing ERCP Facility flat roof, as shown in Figure 2.2 above.

The noise emission levels as provided by the manufacturer 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	
S&E AHU 01	Supply Inlet SWL	76	76	83	78	73	70	67	60	80
	Extract Outlet SWL	71	70	78	76	77	74	69	62	81
S&E AHU 02	Supply Inlet SWL	71	73	79	77	73	70	68	62	79
	Extract Outlet SWL	71	67	72	72	73	74	71	64	79

Fujitsu AOYG90LRLA	SPL @1m	64	57	59	55	51	50	45	42	58
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Table 5.1 Plant Units Noise Emission Levels as provided by the manufacturer

5.2 Closest Noise Sensitive Receiver

The closest noise sensitive receiver to the proposed Plant Location 1 has been identified as being a receiver window of the adjacent hospital building, located approximately 3 metres from the proposed plant installation location, as shown in Figure 2.2.

The closest noise sensitive receiver to the proposed Plant Location 2 has been identified as being a receiver window of the adjacent hospital building, located approximately 3 metres from the proposed plant installation location, as shown in Figure 2.2.

5.3 Calculations

The ‘Specific Sound Level’ of each plant unit installation has been calculated at 1m from the closest receiver using the noise levels shown in Table 5.1, and corrected due to different acoustic propagation features such as distance, reflective surfaces, screening elements, etc. Detailed calculations for each plant unit installation are shown in Appendix B.

The ‘Rating Level’ of each plant installation have been assessed following the guidelines of BS4142 for the daytime period when the plant would be operational, with a subsequent conclusion taking into consideration the above context. The full BS4142 assessment is presented in Tables 5.1 and 5.2 for Plant Locations 1 and 2 respectively.

BS4142 Assessment		
Source:	Plant units installed at Plant Location 1	
Operating Period:	Daytime	
Reference time interval (T_r):	1 h	
Receiver:	Office window within adjacent Endoscopy Facility	
Element	Level (dB)	Comment
Specific Sound Level $L_s = L_{Aeq, T_r}$	51	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r . In this case, the specific sound levels take into consideration published noise data from the manufacturers, with appropriate corrections for attenuation due to distance, reflections, and any screening or proposed mitigation

Acoustic Feature Correction	+0	Due to the constant nature and low noise level of the plant unit's operation, it is not necessary to apply any acoustic feature corrections for intermittency in this instance. Due to the above and also the inherent existence of an inverter within the plant unit type, it is not necessary to apply any acoustic feature corrections for impulsivity in this instance. As visible in the spectral plant noise emissions in the attached Appendix B, the level within each frequency band is consistent with no individual bands peaking higher, therefore it is not necessary to apply any acoustic feature corrections for tonality in this instance.
Rating Level	51	Rating Level = Specific Sound Level + Acoustic Feature Corrections
Representative background noise level <i>L</i> _{A90}	46	Sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, <i>T</i> . Derived using the most common occurring levels <i>L</i> _{A90, 5min} during the environmental noise survey undertaken on site
Excess of rating over background sound level	+5	
Assessment Indication		
Noise from the AHU operation would exceed the existing background sound level at 1m from the façade of the closest hospital use receiver by up to 5dB. This could be an indication of potential adverse impact, depending upon the context of the environment. In this case, as the receivers are office windows as opposed to private residences, the sensitivity would be expected to be reduced, and therefore an exceedance of 5dB would not be expected to present any adverse impact provided that internal levels stipulated in HTM 08-01 are not affected.		

Table 5.1 BS4142 assessment for plant location 1

As shown in Table 5.1, the AHU 01 installation in Plant Location 1 would be expected to have a low likelihood of adverse impact on the amenity of proposed nearby noise sensitive receivers.

BS4142 Assessment		
Source:	Plant units installed at Plant Location 2	
Operating Period:	Daytime	
Reference time interval (<i>T_r</i>):	1 h	
Receiver:	Office window within adjacent Endoscopy Facility	
Element	Level (dB)	Comment

Specific Sound Level $L_s = L_{Aeq, T_r}$	46	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r . In this case, the specific sound levels take into consideration published noise data from the manufacturers, with appropriate corrections for attenuation due to distance, reflections, and any screening or proposed mitigation
Acoustic Feature Correction	+0	Due to the constant nature and low noise level of the plant unit's operation, it is not necessary to apply any acoustic feature corrections for intermittency in this instance. Due to the above and also the inherent existence of an inverter within the plant unit type, it is not necessary to apply any acoustic feature corrections for impulsivity in this instance. As visible in the spectral plant noise emissions in the attached Appendix B, the level within each frequency band is consistent with no individual bands peaking higher, therefore it is not necessary to apply any acoustic feature corrections for tonality in this instance.
Rating Level	46	Rating Level = Specific Sound Level + Acoustic Feature Corrections
Representative background noise level L_{A90}	44	Sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T . Derived using the most common occurring levels $L_{A90, 5min}$ during the environmental noise survey undertaken on site
Excess of rating over background sound level	+2	
Assessment Indication		
Noise from the AHU operation would exceed the existing background sound level at 1m from the façade of the closest hospital use receiver by 2dB. This would be an indication of a low likelihood of adverse impact.		

Table 5.2 BS4142 assessment for plant location 2

As shown in Table 5.2, the AHU 02 installation in Plant Location 2 would be expected to have a low likelihood of adverse impact on the amenity of proposed nearby noise sensitive receivers.

As shown in Appendix B and Tables 5.1-5.2, transmission of noise to the nearest sensitive windows due to the effects of the AHU unit installation satisfies the emissions criterion of Manchester City Council, providing that the mitigation measures outlined in Section 6 are implemented.

5.4 Department of Health: HTM 08-01 Assessment

Further calculations have been undertaken to assess whether the noise emissions from the plant unit installation would be expected to meet the recognised British Standard recommendations internally within the closest receiver space, in order to further ensure the amenity of nearby noise sensitive receivers.

The calculated noise emission value of 51dB(A) is to be considered externally at 1m from the closest receiver window within the Endoscopy Facility and the calculated noise emission value of 46dB(A) is to be considered externally at 1m from the closest receiver window within the ERCP Facility. Windows may be closed or partially closed leading to further attenuation, as follows.

The Departments of Health's '*Health Technical Memorandum 08-01: Acoustics*' provides recommendations for acceptable internal noise levels in hospital spaces, shown in Table 5.3.

Room Type	Example	07:00 to 23:00	23:00 to 07:00
Small office-type spaces	Private offices, small treatment rooms, interview rooms, consulting rooms	40 dB(A)	--

Table 5.3 Department of Health recommended internal background noise levels

It is understood that the adjacent receiver windows will be private offices. The Department of Health recommends 40dB(A) for working conditions during daytime hours.

With a calculated external level of 51dB(A), the closest office window within the Endoscopy Facility would need to provide an additional 11dB attenuation in order for the recommended internal noise conditions to be achieved.

With a calculated external level of 46dB(A), the closest office window within the ERCP Facility would need to provide an additional 6dB attenuation in order for the recommended internal noise conditions to be achieved.

According to BS8233:2014, even a partially open window offers 12-15dB attenuation, thus leading to a further reduced interior noise level as shown in Table 5.4.

Receiver	Room Type	Department of Health HTM 08-01 Criterion	Noise Level Inside Nearest Office Receiver
Office window within adjacent Endoscopy Facility	Private office	40dB(A)	36-39dB(A)

Office window within adjacent ERCP Facility	Private office	40dB(A)	31-34dB(A)
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Table 5.4 Noise levels and criteria inside nearest office space

Predicted levels are shown in Table 5.4, with detailed calculations shown in Appendix B. It can therefore be stated that, as well as complying with the noise emissions criterion, the noise emissions from the plant unit installation would be expected to comfortably meet the most stringent recommendations as provided by the Department of Health.

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 AHU's Installed in Plant Location 1 & 2

In order to control the noise emissions from the AHU 01 and 02 supply inlet and extract outlet exhausts, an acoustic silencer should be installed within each ducting route, providing the minimum insertion loss values outlined in Table 6.1 below.

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
AHU Silencer	2	6	12	18	22	18	14	10

Table 6.1 Insertion loss figures to be provided by acoustic silencer

6.2 Condenser Units Installed in Plant Location 1 & 2

In order to control the noise emissions from the Fujitsu AOYG90LRLA condenser units installed at plant location 1 and 2, we would recommend that a plant enclosure is installed which should provide the minimum insertion loss levels shown in Table 6.2.

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Louvres of acoustic enclosure	3	9	11	17	21	23	17	15

Table 6.2 Insertion loss figures to be provided by acoustic enclosure

We would recommend the following suppliers of the aforementioned enclosure/silencer:

- Environmental Equipment Corporation
- Noico Ltd

- Waterloo Acoustics
- Allaway Acoustics
- Wakefield Acoustics
- Caice

6.3 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 North Manchester General Hospital, Delaunays Road, Crumpsall, Manchester M8 5RB, by KP Acoustics Ltd between 15:00 on 17/06/2021 and 15:00 on 18/06/2021. The results of the survey have enabled a representative background noise level to be set.

Manufacturer's noise data of proposed plant units has been used to obtain Specific and Rated Noise Level at the nearest noise sensitive receiver in accordance with British Standard BS4142:2014 for compliance with Manchester City 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 would not have an adverse impact on the nearest office receivers provided that the noise control strategy presented in Section 6 is followed.