

Wheelwright's Arms Havant

ENVIRONMENTAL NOISE SURVEY & PLANT NOISE ASSESSMENT REPORT 20409/PNA1 (Rev A)

For:

Simmons Interiors
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APPENDIX A

Revision No.	Date	Description
0	26/06/2014	First issue
A	10/07/2014	Updated assessment to include atmospheric in-duct attenuation

This report has been prepared by Hann Tucker Associates Limited (HTA) with all reasonable skill, care and diligence in accordance with generally accepted acoustic consultancy principles and the purposes and terms agreed between HTA and our Client. Any information provided by third parties and referred to herein may not have been checked or verified by HTA unless expressly stated otherwise. This document contains confidential and commercially sensitive information and shall not be disclosed to third parties. Any third party relies upon this document at their own risk.

1.0 INTRODUCTION

Wheelwrights Arms is undergoing a refurbishment, with new items of mechanical plant proposed. Hann Tucker Associates have been appointed to undertake an environmental noise survey to establish the existing environmental noise levels around the site, to assess the suitability of the plant in accordance with the Local Authority's requirements and to recommend mitigation measures where possible.

This report presents the survey methodology and findings. The survey data has been used as the basis for various acoustic assessment purposes.

2.0 OBJECTIVES

To establish the existing noise levels by means of fully automated noise monitoring over a period of approximately 72 hours at up to one secure and accessible position.

To assess the noise emissions from the proposed plant, based upon data with which we are provided, and comment upon the acceptability.

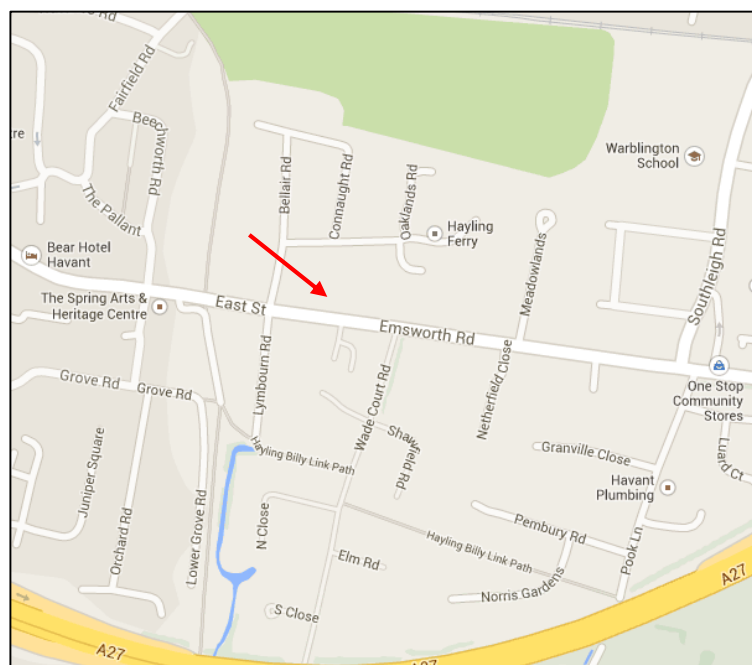
To advise on noise control measures if required with reference to the requirements of the Local Authority.

These objectives are as set out in our letter dated 10 June 2014 and Simmons Interiors written instructions received on 12 June 2014.

3.0 SITE DESCRIPTION

3.1 Location

The site is located at 27 Emsworth Road, Havant, Hampshire, PO9 2SN and falls within Havant Borough Council's jurisdiction. See Location Map below.



Location Map (maps.google.co.uk)

3.2 Description

The site comprises of upper and lower ground floors facing Emsworth Road at the front and overlooking residential buildings to the rear, west and east. The ground floor of the building is to be used for commercial purposes and the first floor is to be residential. Around the western side and rear of the property, a flat roof, single storey extension has been built and so does not appear on the site plan below. See Site Plan below.



4.0 ACOUSTIC TERMINOLOGY

For an explanation of the acoustic terminology used in this report please refer to Appendix A enclosed.

5.0 METHODOLOGY

The survey was undertaken by Robin Honey BA(Hons) MIOA AMIEnvSc.

5.1 Procedure

Fully automated environmental noise monitoring was undertaken from approximately 12:15 hours on Thursday 19 June 2014 to 09:15 hours on Monday 23 June 2014.

Due to the nature of the survey, i.e. unmanned, it is not possible to accurately comment on the weather conditions throughout the entire survey period. However at the beginning and end of the survey period the wind conditions were calm and the sky was generally clear. We understand that generally throughout the survey period the weather conditions were similar. These conditions are considered suitable for obtaining representative measurement results.

Measurements were taken continuously of the A-weighted (dBA) L_{10} , L_{90} , L_{eq} and L_{max} sound pressure levels over full 15 minute periods.

5.2 Measurement Position

The noise level measurements were undertaken at 1No. position on site. The sound level meter was positioned horizontally out of a window on the first floor at the rear of the property. The microphone was approximately 1m away from the window, 1m above the flat roof below and 1.5m from all other reflective surfaces.

The position was selected in order to assess the lowest noise levels at the development site for subsequent use in setting plant noise emission criteria and is shown on the plan below.



Plan Showing Unmanned Measurement Positions (maps.google.co.uk)

5.3 Instrumentation

The instrumentation used during the survey is presented in the table below:

Description	Manufacturer	Type	Serial Number	Latest Verification
Type 1 Data Logging Sound Level Meter	Larson Davis	824	3721	LD calibration on 24/04/2014
Type 1 ½" Condenser Microphone	PCB	PCB377 A02	105393	LD calibration on 24/04/2014

The sound level meter, including the extension cable, was calibrated prior to and on completion of the surveys. No significant change was found to have occurred (no more than 0.1dB).

The sound level meter was located in an environmental case with the microphone connected to the sound level meter via an extension cable. The microphone was fitted with a Larson Davis windshield.

6.0 RESULTS

The results have been plotted on Time History Graphs 20409/PNA1/TH1 to 20409/PNA1/TH2 enclosed, presenting the 15 minute A-weighted (dBA) L_{10} , L_{90} , L_{eq} and L_{max} levels at each measurement position throughout the duration of the survey.

We understand from Simmons Interiors that the proposed plant will be operational from 11:00 hours until 23:00 hours Monday-Sunday. During our survey the lowest L_{A90} measured during the proposed operational hours was 36dBA.

7.0 DISCUSSION OF NOISE CLIMATE

Due to the nature of the survey, i.e. unmanned, it is not possible to accurately describe the dominant noise sources, or specific noise events throughout the entire survey period. However at the beginning and end of the survey period the dominant noise source was noted to be road traffic road from the adjacent Emsworth Road. Site works were in operation at the start and end of the survey however we understand these were not operational late in the evenings when the lowest L_{A90} measurement during proposed operational hours was recorded.

8.0 PLANT NOISE EMISSION CRITERIA

We understand from Simmons Interiors that the requirements of Havant Borough Council are: *"the noise resulting from plant, machinery or equipment (including extraction system) shall not exceed a level of 5dB(A) below the existing background level (or 10dB(A) below if there is a particular tonal quality) when measured to British Standard BS4142-1997."*

Based on the above criteria, results of the environmental noise survey and proposed plant operational hours we therefore propose plant noise emission criteria of 31dBA to be achieved at 1m from the nearest residential window.

9.0 PLANT NOISE ASSESSMENT

9.1 Proposed Plant

We understand that the following items of plant are to be installed at the Wheelwright's Arms.

Plant Description	Location	Qty	Plant Make	Model Number
Kitchen Extract Fan	Western First Floor Flat Roof	1	System Air	MUB062560D4-A2 IE2
Kitchen Supply Fan	Western First Floor Flat Roof	1	System Air	AW/AR sileco 450E4

We understand the manufacturer's noise data for the equipment to be as follows:

Plant Description	In Duct Sound Power Level (dB re: 10 ⁻¹² W) at Octave Band Centre Frequency (Hz)								dB
	63	125	250	500	1k	2k	4k	8k	
MUB062560D4-A2 IE2 Outlet	67	69	73	75	74	71	66	59	80
AW/AR Sileco 450E4 Inlet	42	53	63	61	64	64	60	52	70

9.2 Proposed Attenuation

We understand the following atmospheric in-duct attenuation has been proposed in order to mitigate noise from the extract and supply fans.

Plant Description	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
720x720x1150 Extract Fan in-duct attenuation	-	7	13	20	19	11	10	-
450x450x650 Supply Fan in-duct attenuation	-	4	7	13	20	23	22	-

In order to be suitable, the above attenuators should not exceed a maximum pressure drop of 50Pa and should be compliant with our General Specification for Acoustic and Vibration Isolation Materials and Products (attached).

9.3 Location of Plant

We understand the above items of plant are to be installed on a first storey flat roof on the western side of the site. The nearest residential window is situated at first floor level, on the rear of the adjacent building approximately 10m away and screened by the boundary of the plant area and the edge of the adjacent building.

9.4 Plant Noise Impact Assessment

The following tables present our calculations relating to the proposed plant installation. We have used our in-house ventilation analysis software in order to calculate a sound pressure level at a distance from each grille representative of the nearest potentially affected window.

Barrier losses have been calculated based on a worst case line of site screening from the surrounding edge of the plant area and corner of opposite residential property to a point 1m away from the rear window of this property.

	Sound Pressure Level (dB re 2x10 ⁻⁵ Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Calculated MUB062560D4-A2 IE2 Sound Pressure Level at 12m from Grille	25	30	38	42	36	19	14	7	41
Reflection From Facade Facing Grille	+3	+3	+3	+3	+3	+3	+3	+3	
Barrier Correction	-5	-5	-5	-5	-5	-5	-5	-5	
720x720x1150 Extract Fan in-duct attenuation	-	-7	-13	-20	-19	-11	-10	-	
Calculated MUB062560D4-A2 IE2 Fan Noise Level at 1m From Window	-	21	23	20	15	6	2	-	21

	Sound Pressure Level (dB re 2x10 ⁻⁵ Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Calculated MUB062560D4-A2 IE2 including Standard Gage Casing Loss at 10m from Duct	35	34	34	32	23	17	11	2	32
Barrier Correction	-5	-5	-5	-5	-5	-5	-5	-5	
Calculated MUB062560D4-A2 IE2 Duct Breakout Noise Level at 1m From Window	30	29	29	27	18	12	6	-	27

	Sound Pressure Level (dB re 2x10 ⁻⁵ Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Calculated AW/AR Sileco 450E4 2 IE2 Sound Pressure Level at 14m from Grille	-	14	28	29	33	29	22	14	36
Barrier Correction	-5	-5	-5	-5	-5	-5	-5	-5	
450x450x650 Supply Fan in-duct attenuation	-	-4	-7	-13	-20	-23	-22	-	
Calculated AW/AR Sileco 450E4 Fan Noise Level at 1m From Window	-	5	16	11	8	1	-	-	13

	Sound Pressure Level (dB re 2x10 ⁻⁵ Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Calculated AW/AR sileco 450E4 including Standard Gage Casing Loss at 13m from Duct	8	16	22	16	10	7	2	0	18
Barrier Correction	-5	-5	-5	-5	-5	-5	-5	-5	
Calculated AW/AR Sileco 450E4 Duct Breakout Noise Level at 1m From Window	3	11	17	11	5	2	-	-	13

	Sound Pressure Level (dB re 2x10 ⁻⁵ Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Calculated MUB062560D4-A2 IE2 Fan Noise Level at 1m From Window	-	21	23	20	15	6	2	-	21
Calculated MUB062560D4-A2 IE2 Duct Breakout Noise Level at 1m From Window	-	29	29	27	18	12	6	-	27
Calculated AW/AR Sileco 450E4 Fan Noise Level at 1m From Window	-	5	16	11	8	1	-	-	13
Calculated AW/AR Sileco 450E4 Duct Breakout Noise Level at 1m From Window	-	11	17	11	5	2	-	-	13
Total Calculated Noise Level at 1m From Window	-	29	29	27	19	13	7	-	27

We understand that the proposed plant will be operational the hours 11:00 – 23:00, Monday - Sunday. Our calculations indicate that the proposed plant with atmospheric induct attenuation achieves the requirements of the Local Authority outlined in Section 8.0.

10.0 CONCLUSIONS

A detailed 72 hour daytime and night-time fully automated environmental noise survey has been undertaken in order to establish the currently prevailing roof level environmental noise climate around the site.

Plant noise emission criteria have been recommended based on the results of the noise survey and with reference to the requirements of the Local Authority.

An assessment has been carried out to determine the plant noise emissions at the nearest noise sensitive window.

Our calculations indicate that the proposed plant with atmospheric induct attenuation achieves the requirements of the Local Authority outlined in Section 8.0.



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Appendix A

The acoustic terms used in this report are as follows:

dB : Decibel - Used as a measurement of sound pressure level. It is the logarithmic ratio of the noise being assessed to a standard reference level.

dBA : The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dBA level.

Because of being a logarithmic scale noise levels in dBA do not have a linear relationship to each other. For similar noises, a change in noise level of 10dBA represents a doubling or halving of subjective loudness. A change of 3dBA is just perceptible.

L₁₀ & L₉₀: If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time, hence L₁₀ is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L₉₀ is the average minimum level and is often used to describe the background noise.

It is common practice to use the L₁₀ index to describe traffic noise, as being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic noise.

L_{eq} : The concept of L_{eq} (equivalent continuous sound level) has up to recently been primarily used in assessing noise in industry but seems now to be finding use in defining many other types of noise, such as aircraft noise, environmental noise and construction noise.

L_{eq} is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 1 hour).

The use of digital technology in sound level meters now makes the measurement of L_{eq} very straightforward.

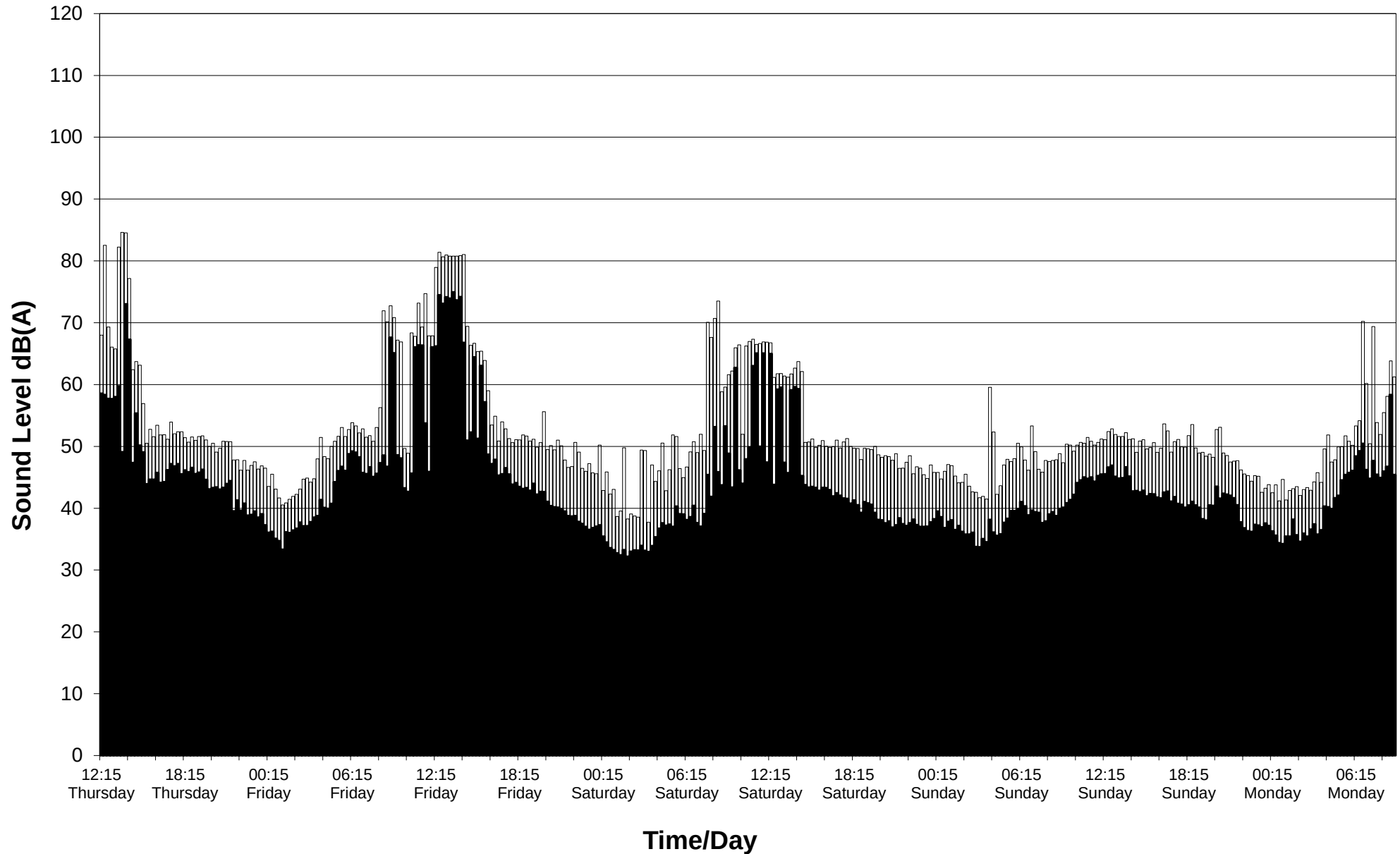
L_{max} : L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

Wheelwright's Arms, Havant

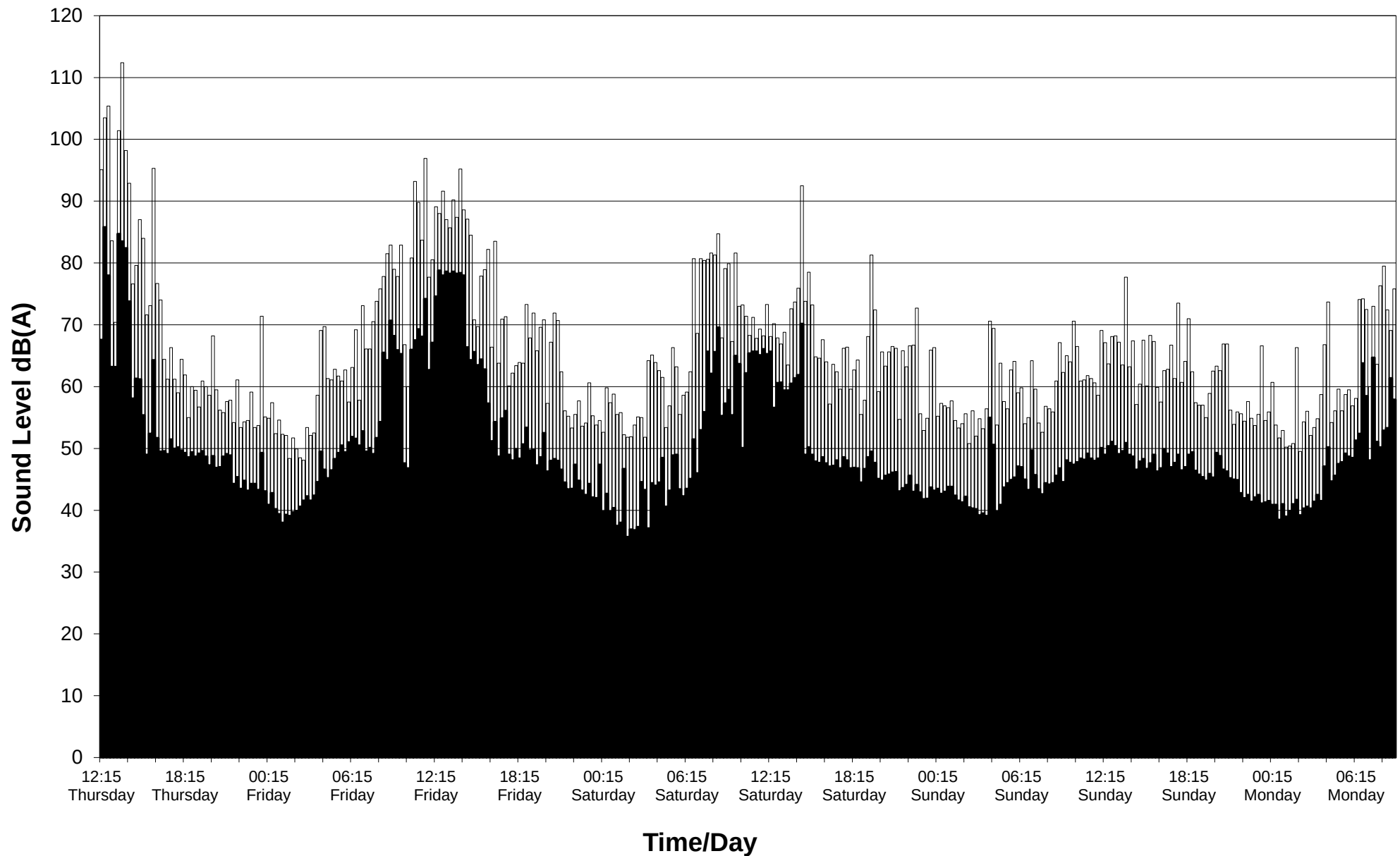
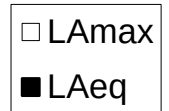
L_{A10} and L_{A90} Noise Levels

Thursday 19/06/2014 - Monday 23/06/2014

□ L_{A10}
■ L_{A90}



Wheelwright's Arms, Havant
 L_{Aeq} and L_{Amax} Noise Levels
Thursday 19/06/2014 - Monday 23/06/2014



GENERAL SPECIFICATION FOR ACOUSTIC AND VIBRATION ISOLATION MATERIALS AND PRODUCTS

ISSUE GS/2013

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GENERAL SPECIFICATION FOR ACOUSTIC AND VIBRATION ISOLATION MATERIALS AND PRODUCTS

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1. ATTENUATORS/SILENCERS (ABSORPTIVE TYPE)

N.B. Attenuators are often referred to as silencers.

1.1 Performance

- 1.1.1 Each attenuator shall provide an insertion loss under operating conditions of not less than that indicated on the relevant acoustic hardware schedule. Manufacturers shall specify the insertion losses expected from the attenuators offered, under the operating conditions, with the data derived from tests carried out in accordance with BS EN ISO 7235.
- 1.1.2 Each attenuator shall have a pressure loss at the design flow and temperature of not greater than that shown in the schedules. The manufacturer's quoted pressure losses shall be derived from tests carried out in accordance with BS EN ISO 7235. Where the attenuator location is known, the supplier shall indicate the expected effect of turbulence due to adjacent duct elements on the quoted pressure losses.
- 1.1.3 Suppliers of attenuators shall provide, with the certified insertion loss data, information relating to the attenuator generated octave band sound power levels (125 - 8kHz) at the operating conditions.

1.2 Construction

- 1.2.1 The outer casing of all duct attenuators shall be constructed in accordance with the current relevant ductwork specification in terms of thickness and seams.
- 1.2.2 All attenuators shall be fitted with drilled angle flange connections, unless alternative connections are specified in the schedule or by the Mechanical Services Consultant or Contractor. Flanges should also conform to the relevant code or its equivalent.
- 1.2.3 Acoustic elements in rectangular attenuators of length equal to or greater than 900mm shall incorporate faired leading and trailing edges (not square ends). Attenuators having a length of less than 900mm should have a faired leading edge, unless otherwise specified.
- 1.2.4 The inert, rot and vermin proof, non-hygroscopic and non-combustible mineral wool or glass fibre acoustic medium shall be packed to a density of not less than 48kg/m^3 . This shall be faced with a glass fibre cloth, or other approved infill protection membrane, retained by punch-perforated (round-hole) galvanised sheet steel facing, having a minimum thickness of 0.5mm fixed at 200mm (max) centres. Flattened-expanded ("Expamet") sheet shall not be used, unless all edges of the sheet are mechanically fixed to the splitter casing and galvanised steel cover strips are used to prevent rivet heads pulling

through the perforated sheet (trapping the Expamet between two solid steel layers).

The manufacturer will also note any particular requirements, e.g. painting, special materials, etc., indicated in the schedules or on the drawings.

- 1.2.5 Where acoustic elements form splitters within the attenuator, the arrangement shall be with a half-width splitter fixed to each side wall of the casing and preferably with the splitters vertical. The configuration should have a regular splitter/airway dimension across the full width of the attenuator. However, it is the responsibility of the supplier to ensure that the parallel splitter elements in the attenuator are correctly orientated for the adjacent duct geometry, particularly when attenuators are located near bends, bifurcations, etc. Horizontal splitters should be suitably stiffened to prevent flexing and restriction of the airways and will normally be limited to silencers having a module width of 900mm or less.
- 1.2.6 In the case of circular attenuators, all internal acoustic elements shall comprise mineral or glass fibre as the acoustic medium, as specified above for rectangular attenuators, retained by punch-perforated (round-hole) galvanised sheet steel facing, having a minimum thickness of 0.5mm fixed at 200mm (max) centres. Flattened-expanded ("Expamet") sheet shall not be used, unless all edges of the sheet are mechanically fixed to the splitter casing and galvanised steel cover strips are used to prevent rivet heads pulling through the perforated sheet (trapping the Expamet between two solid steel layers).
- 1.2.7 When attenuators are manufactured in modules each unit shall be shop assembled (unless the Mechanical Services Contractor instructs to the contrary) and this specification, together with the manufacturer's own guarantee and performance ratings, shall apply to the unit as a whole.
- 1.2.8 Attenuator units shall be delivered to site with blocked ends to prevent ingress of rubble, etc., while on site and to reduce the risk of damage. The direction of airflow through the attenuator shall be clearly marked on the casing.
- 1.2.9 Attenuators for high temperature applications (e.g. diesel exhausts, boiler flues, etc.) should have casings manufactured from a suitable gauge steel, with adequate precautions taken to cater for expansion and thermal shock. The internal elements shall be packed with an inert, rot and vermin proof, non-hygroscopic and non-combustible mineral or glass fibre acoustic medium of at least 96kg/m³ density. This shall be faced with glass fibre cloth retained by punch-perforated (round-hole) galvanised sheet steel facing, having a minimum thickness of 0.5mm fixed at 200mm (max) centres. Flattened-expanded ("Expamet") sheet shall not be used, unless all edges of the sheet are mechanically fixed to the splitter casing and galvanised steel cover strips are used to

prevent rivet heads pulling through the perforated sheet (trapping the Expamet between two solid steel layers). For very high temperatures, steel wool or equivalent approved materials may be used as the acoustic medium.

- 1.2.10 The attenuator cross-sectional sizes shown in the schedules are to be followed exactly, since they often relate to duct sizes and thus avoid the unnecessary use of transition sections. However, subject to agreement with the Mechanical Services Consultant or Contractor, the supplier may propose alternative dimensions in line with his own standard sizes, provided the acoustic and aerodynamic requirements are met.
- 1.2.11 The use of Melinex or other plastic film between the perforated sheet steel facing and the infill medium may be required for certain applications. It should be noted that such materials may reduce the acoustic performance of the attenuator significantly and this must be taken into account when interpreting the schedules. Film thicknesses greater than 0.05mm will not be permitted, and use of very thin films (0.008-0.010mm) is preferred.
- 1.2.12 Where corrosive or toxic gases or substances are being handled, special constructions and materials may be specified as an addendum to this specification.
- 1.2.13 The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure fibre migration is prevented.

2. ENGINE EXHAUST SILENCERS (REACTIVE TYPE)

2.1 Performance

- 2.1.1 All silencers shall provide an insertion loss at the operating temperatures of not less than that indicated on the relevant acoustic hardware schedules.
- 2.1.2 All silencers shall have a static pressure loss, under maximum operating conditions, of not greater than that shown in the schedules.

2.2 Construction

- 2.2.1 The outer casings of all silencers shall be constructed from a suitably heavy gauge steel with all seams and joints continuously welded. Acoustic elements within the silencer shall be designed and constructed with due allowance for differential expansion and thermal shock.

- 2.2.2 All silencers shall also be fitted with suitable flanges and drain plugs and shall be manufactured and finished with due allowance made for the operating temperatures and environmental conditions.
- 2.2.3 Silencers shall be delivered to site with blocked ends to prevent ingress of rubble, etc., during installation and to reduce the risk of damage. The direction of gas flow through the silencer shall be clearly marked on the casing.
- 2.2.4 The silencer sizes shown in the schedules are indicative only, and the supplier may modify these in line with his own standard sizes, provided the acoustic and aerodynamic requirements are met. It is the supplier's responsibility to ensure that the Client is advised of the actual sizes being offered, where these differ from the schedules.
- 2.2.5 The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure fibre migration is prevented.

3. ACOUSTIC WEATHER LOUVRES

3.1 Performance

- 3.1.1 All acoustic weather louvres shall provide an insertion loss under the operating conditions of not less than that indicated in the relevant acoustic hardware schedules. In addition, the static pressure loss, under maximum operating duty, shall not exceed that shown in the schedules.
- 3.1.2 The louvre shall be designed to prevent the ingress of rain, etc. under normally encountered meteorological conditions.

3.2 Construction

- 3.2.1 The louvre frame shall be constructed from a suitable gauge of galvanised mild steel, or aluminium, supporting louvre blades of like material. The acoustic material in the blades shall have a density of 60-100kg/m³ and be inert, rot and vermin proof, non-hygroscopic incombustible mineral fibre. This shall be faced with glass fibre cloth, or other approved infill protection membrane, and retained on the lower blade face by punch-perforated (round-hole) galvanised sheet steel facing, having a minimum thickness of 0.5mm fixed at 200mm (max) centres. Flattened-expanded ("Expamet") sheet shall not be used, unless all edges of the sheet are mechanically fixed to the splitter casing and galvanised steel cover strips are used to prevent rivet heads pulling through the perforated sheet (trapping the Expamet between two solid steel layers).

- 3.2.2 When the louvres are actually manufactured in sections, each unit shall be shop assembled as a whole unit (unless the Mechanical Services Contractor instructs to the contrary) and this specification, together with the manufacturer's own guarantee and performance ratings, must apply to the unit as a whole.
- 3.2.3 Acoustic weather louvres shall be supplied with an integral bird screen of galvanised mild steel or aluminium mesh, fixed to its internal face. The mesh pitch shall be a maximum of 25mm.
- 3.2.4 The louvres shall be supplied complete with all necessary fixings, flanges, etc., for fitting into the louvred opening as required by the Mechanical Services Contractor.
- 3.2.5 All gaps between the outside of the louvre frame and the wall or duct shall be made good and sealed with a heavy grout and/or non-hardening dense mastic.
- 3.2.6 The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure fibre migration is prevented.

4. ANTI-VIBRATION MOUNTINGS

4.1 General

- 4.1.1 Where so indicated in the schedules by the code /R, the mountings/hangers shall be provided with a positioning or restraining device, which will prevent the equipment position changing if its load changes; for example, during draining down of the equipment or other maintenance. The device shall consist of a stud passing through an oversize hole with a nut and locknut providing restraint. A fibre or neoprene washer should be fitted between nut and restraining member, leaving a clearance of at least 3mm. Alternative methods of restraint must be approved by the Acoustic Consultant in writing.
- 4.1.2 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 operating conditions.
- 4.1.3 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.

- 4.1.4 All mountings shall be colour coded, or otherwise marked, to indicate their load capacity to facilitate identification during installation.
- 4.1.5 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.

4.2 Caged Steel Spring Mountings (CSS)

- 4.2.1 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.
- 4.2.2 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.
- 4.2.3 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.
- 4.2.4 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.
- 4.2.5 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.

4.3 Open Steel Spring Mountings (OSS)

- 4.3.1 Each mounting shall consist of one or more helical steel springs as the principal isolation elements and shall incorporate a built-in levelling device.
- 4.3.2 The springs shall be fixed or otherwise securely located to cast or fabricated top and bottom plates having 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.
- 4.3.3 The bottom plate shall have bonded to it a rubber/ neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

4.4 Neoprene-in-Shear Mountings (NIS)

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, have bolt holes in the base plate and have a threaded metal insert in the top plate so they can be bolted to the floor and equipment where required.

4.5 Hangers with Steel Springs (HSS)

- 4.5.1 The hanger shall incorporate a helical steel spring securely located in a steel cage.
- 4.5.2 The clearance hole in the bottom of the cage should allow a lateral movement of the lower hanger rod of at least 15° included angle.
- 4.5.3 Where hangers incorporate a positioning device, the adjustment system should incorporate a locking mechanism to prevent the hanger going out of adjustment as a result of vibration, or accidental/unauthorised tampering.

4.6 Hangers with Neoprene Turrets (HNT)

The hanger shall be essentially as described in 4.5 above except it shall incorporate a neoprene in shear element as described in 4.4.

4.7 Plant Bases

4.7.1 AV Rails (AVR)

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.

4.7.2 Steel Frame Base (SFB)

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 150mm. This form of base may be used as a composite A.V. Rail system.

4.7.3 Concrete Inertia Base (CIB)

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 100mm. The bottom of the pouring frame should be blanked off and concrete (2300

kg/m³) poured in over steel reinforcing rods positioned 35mm above the bottom. The inertia base should be sufficiently large to provide support for all parts of the equipment, including any components which overhang the equipment base, such as suction and discharge elbows on centrifugal pumps.

4.7.4 Concrete Split Plinth Bases (CIB) (For neoprene mounts/pads)

These should comprise a concrete inertia base of sufficient size to permit support for all parts of the equipment, including any components which overhang the equipment base, such as suction and discharge elbows on centrifugal pumps. The inertia base should be cast onto a permanent bottom shuttering and supported on the specified neoprene mounts or pads, the whole resting on a plinth as required. It should be noted that the construction of concrete bases on cork, expanded polystyrene or mineral wool slabs is not normally permitted. Where neoprene pads are used, small areas of pad must be equally spaced to provide the correct deflection. The number, dimensions and locations of such pads should be advised by the supplier.

5. ACOUSTIC DOORS

5.1 Performance

- 5.1.1 All acoustic doors shall provide a sound reduction index (SRI) as tested in accordance with BS EN ISO 140-3: 1995 of not less than that shown in the relevant schedule. Where the schedule refers to a mean SRI, the equivalent SRI spectrum should not be less than indicated below:-

Mean SRI dB (100-3150Hz)	SRI (dB) at Octave Band Centre Frequencies (Hz)					
	125	250	500	1k	2k	4k
30	21	26	30	33	35	36
35	24	30	35	38	39	40
40	27	35	40	42	46	47
45	33	36	44	48	52	54
50	35	40	50	54	60	60

- 5.1.2 The manufacturer or supplier of acoustic doors shall guarantee the specified SRI and ensure the method of installation does not detract from the guaranteed performance. Any failure to meet the specification because of faulty design, manufacture or installation, will result in the manufacturer or supplier being held liable for remedial or replacement costs including consequential liability.

5.2 Construction

- 5.2.1 The acoustic doors shall be of hardwood or steel and be complete with all seals, frames and furniture as specified by the Architect.
- 5.2.2 It is recommended that, where a mean SRI equal to or greater than 35dB is required, the door should be of steel construction with double neoprene/rubber compression (or knife-edge) seals to head, jambs and threshold. Double doors should incorporate a central jamb or overlapping leaves to ensure a good seal at the middle joint. Lower performance doors (35dB or less) may be fitted with magnetic seals.
- 5.2.3 The door fastener or lock should be designed to ensure the seals operate over the whole periphery of the door.
- 5.2.4 Wiper seals will not be permitted at thresholds; doors must be fitted with a raised threshold and a compression seal, or with a mechanical drop-down seal for doors with ratings up to 35dB.

6. ACOUSTIC ENCLOSURES (MODULAR)

6.1 Performance

- 6.1.1 The acoustic enclosure shall provide in its as-installed condition an overall sound reduction index (SRI) of not less than that shown in the relevant schedule. Full allowance shall be taken of any loss of insulation due to doors, windows, ventilation openings and panel joints.
- 6.1.2 The manufacturer or supplier shall guarantee the specified SRI, and ensure that the method of installation does not detract from the guaranteed performance.
- 6.1.3 The internal surfaces of the enclosure panels shall be designed to give the following minimum average absorption coefficients (ISO) when tested in accordance with BS EN ISO 354:2003.

Frequency	125	250	500	1k	2k	4k
Minimum average absorption coefficient	0.5	0.5	0.8	0.95	0.95	0.95

6.2 Construction

- 6.2.1 The enclosed outer panels shall be constructed from galvanized sheet steel having a minimum thickness of 1.6mm and fixed at 300mm (max) centres. The enclosure inner panels shall be constructed from punch-perforated (round-hole) galvanised sheet steel facing, having a minimum thickness of 0.7mm fixed at 300mm (max) centres.

Flattened-expanded ("Expamet") sheet shall not be used, unless all edges of the sheet are mechanically fixed to the panel casing and galvanised steel cover strips are used to prevent rivet heads pulling through the perforated sheet (trapping the Expamet between two solid steel layers).

- 6.2.2 The inert, rot and vermin proof, non-hygroscopic and non-combustible mineral wool or glass fibre acoustic medium shall be packed to a density of not less than 48kg/m³. This shall be faced with a glass fibre cloth, or other approved infill protection membrane. Panels shall be constructed and assembled so that no egress of the acoustic medium will occur under the operating conditions.
- 6.2.3 Doors, access panels, windows and ventilation ducts or electrical cable penetrations shall be treated so as to maintain the specified acoustic insulation of the assembled enclosure.
- 6.2.4 Demountable sections shall be designed to allow easy disassembly and reassembly by unskilled personnel without affecting the acoustic performance.
- 6.2.5 The supplier shall ensure that the assembled enclosure is designed and constructed to withstand site operating conditions such as wind and snow loads, roof mounted plant, etc., as appropriate, and if outside, to be suitably weatherproofed.
- 6.2.6 The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure that fibre migration is prevented.

7. LIABILITY

All tenderers are advised that failure to comply with any part of the above specification may result in either their tender being discounted or liability for any resulting remedial or replacement costs on site, including consequential liability, unless variations are accepted in writing by their client and/or the Acoustic Consultant.

It is recommended that all tenderers shall have undergone the necessary assessment and registration procedure to BS EN ISO 9001:2008 and shall not sub-contract the manufacture of any products to an unregistered third party fabricator.

It is also recommended that the purchaser of acoustic equipment checks the manufacturer's standard conditions of sale forming part of his quotation do not contravene this specification.