NOISE Control

Acoustic products

Designs to minimise noise transmission

Design advice

Problem solving

Beldan Art Gallery
Brunel University

VES Andover®

The Art of Silence

The Objective: *A quiet installation*

VES can help:

- Products include fitted or built in silencers, acoustically lined plenums, special air handling unit cases.
- Assistance with design calculations of the ventilation system to ensure required NR levels achieved.
- Calculations, advice and equipment to avoid environmental noise problems.
- Problem solving - site survey, report, quotation and installation of solutions to ventilation noise problems.

Tips from our experience:

- Single phase motors are noisier than three phase. Inverters and electronic speed controllers can shorten the life of a motor, and motors that become noisy may be about to fail.
- Locate plant to avoid causing noise and vibration problems, and fit silencers at day one if recommended.
- Plant such as condensing units are difficult to attenuate because of the large amount of heat rejection and air volume. Specify low noise units if necessary and/or screen from likely complainants.

Other considerations:

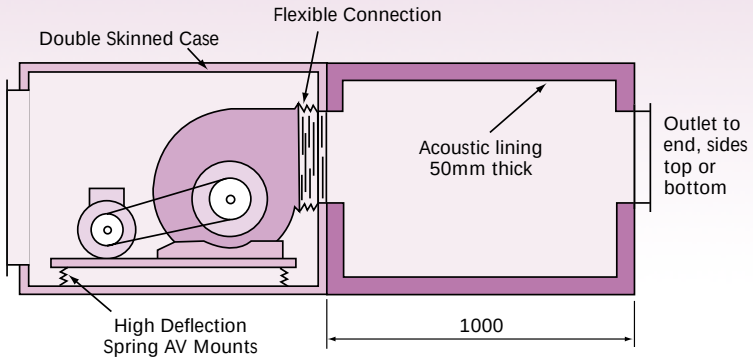
- Breakout from plant housings, through ducting or flexible connectors.
- Vibration transmission through walls and floors.
- Duct borne noise to conditioned space.
- Environmental noise from externally mounted plant or through louvres.

VES can solve these problems at design stage or by retrofitting tailored solutions.

Design Ideas

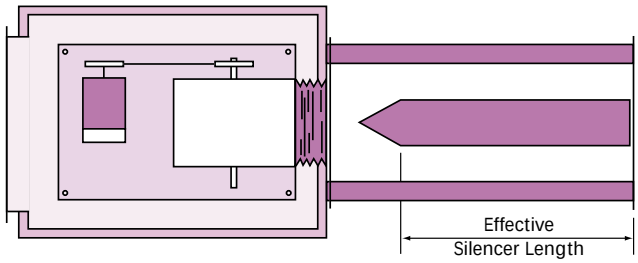
Acoustic Plenums

Noise
Reduction
8-10 dB



Fitted Silencers

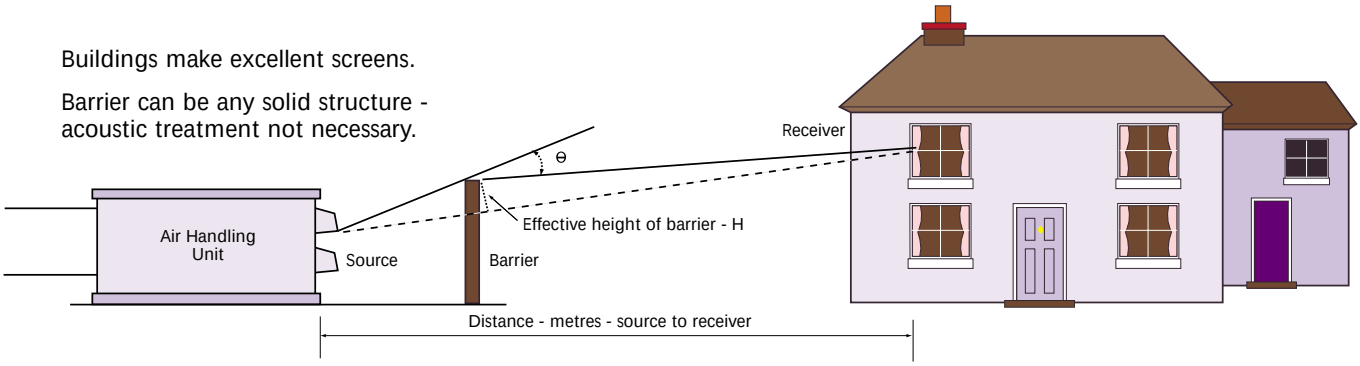
- Fitted silencers minimise noise breakout.
- Silencers can be fitted to inlet and outlet of AHU's with weather cowls to suit if unit is outside



Barriers/Screens

Buildings make excellent screens.

Barrier can be any solid structure - acoustic treatment not necessary.

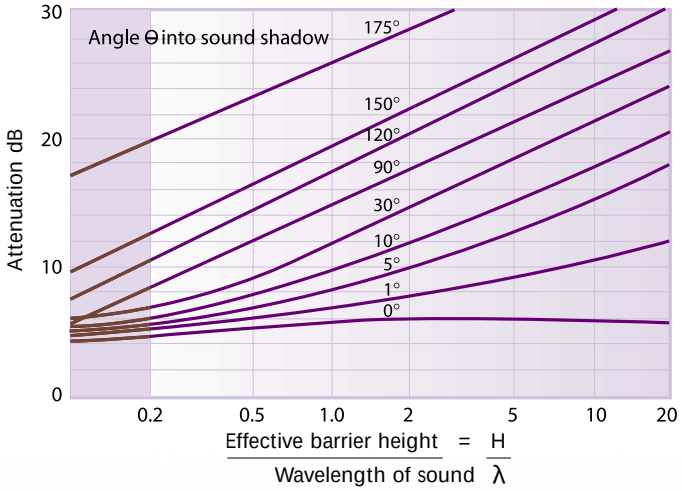


Determine the sound reduction due to barrier as follows:

i) Estimate effective barrier height - H.
ii) Estimate the angle θ sound shadow.
iii) Divide H by wavelength of sound λ at each frequency from table below.
iv) Read off attenuation from chart for each calculation of $\frac{H}{\lambda}$.

Length of Sound Waves

Frequency Hz:	63	125	250	500	1k	2k	4k	8k
Wavelength m:	5.5	2.8	1.4	0.7	0.35	0.17	0.09	0.04



Example:

If effective barrier height is 1.0 metre and angle θ is 20°, sound attenuation due to barrier is:

Frequency Hz:	63	125	250	500	1k	2k	4k	8k
Attenuation dB:	6	7	9	12	14	17	20	22

Attenuation due to distance

Deduct 20 x log D + 8 dB from noise at source.
When D = distance in metres.
∴ Attenuation at 12 metres is 30 dB.
This figure can be applied to each frequency band.
Rule of thumb - *noise decreases at the rate of 6 dB per doubling of distance from a source.*

3 metres	18 dB
6 metres	24 dB
12 metres	30 dB
24 metres	36 dB
48 metres	42 dB

Silencer quick selection guide

VES can undertake an acoustic analysis of a system design to ensure that silencers are correctly selected.

However, the following rapid silencer selection table will be accurate for most ventilation systems.

- If you are using a VES air handling unit, take the single figure sound power level in dBW from page 13 of the MAX air handling unit leaflet.
- Alternatively, take the sound power level spectrum PWL, dB from your VES quote or for any other make of AHU.
- Combine the spectrum to give a single figure as follows:

Combining Sound Levels

Difference between level	Add to higher level
0, 1	+3
2, 3	+2
4, 5, 6, 7, 8, 9	+1
10 or more	0

Example:

Centre Frequency Hz:	63	125	250	500	1k	2k	4k	8k
Typical spectrum, PWL, dB:	85	84	81	79	74	76	72	64

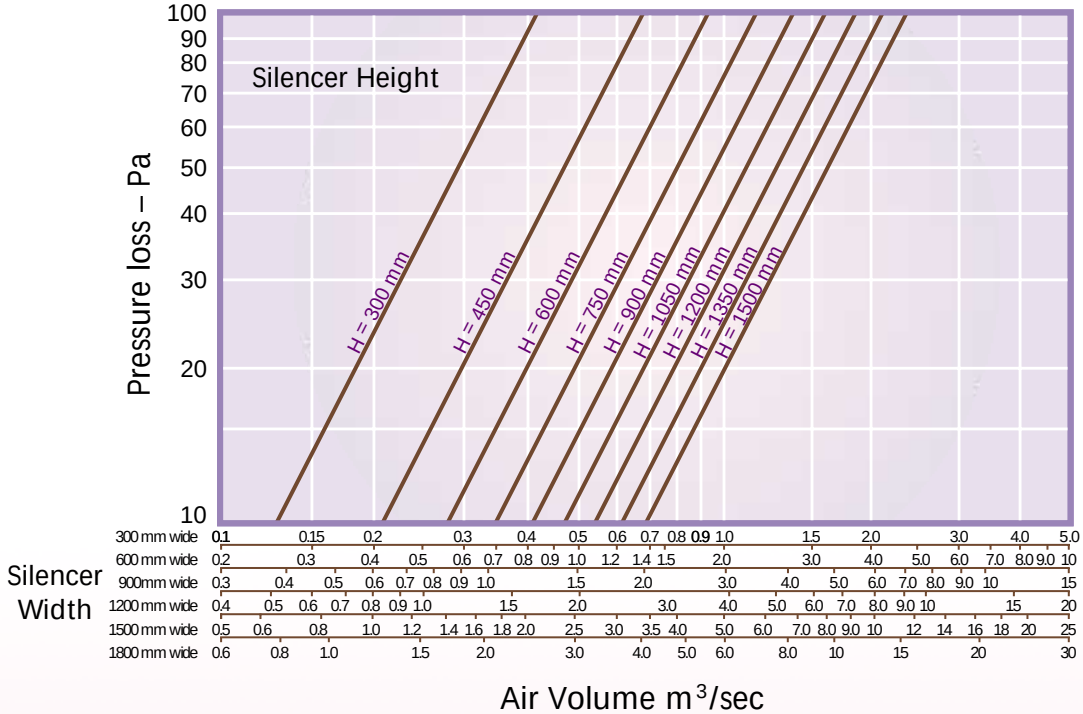
77
79
82
85
88
PWL = 90 dB

Note: You can combine the spectrum numbers in any order to achieve the final figure.

From this Sound Power Level reference number, deduct the required NR level in the conditioned space. Determine length of silencer from difference as follows:

Difference Factor	Silencer Length
40-50	1200 mm
51-60	1500 mm
61-70	1800 mm
71-80	2100 mm
80+	2400 mm

i.e. PWL 90 – NR 35 = 55 = 1500 mm long silencer.



Silencer Height and Width

If possible do not select a silencer above 50Pa resistance to avoid noise regeneration within silencer.
VES silencers are described as follows-
VA4 - Width - Height - Length (in cms)
e.g. 1.75m³/sec airflow. VA4 - 90 - 60 - 150 Apd 42Pa.

VES also manufacture bend silencers, cylindrical silencers, crosstalk attenuators, acoustic louvres, and special attenuators.

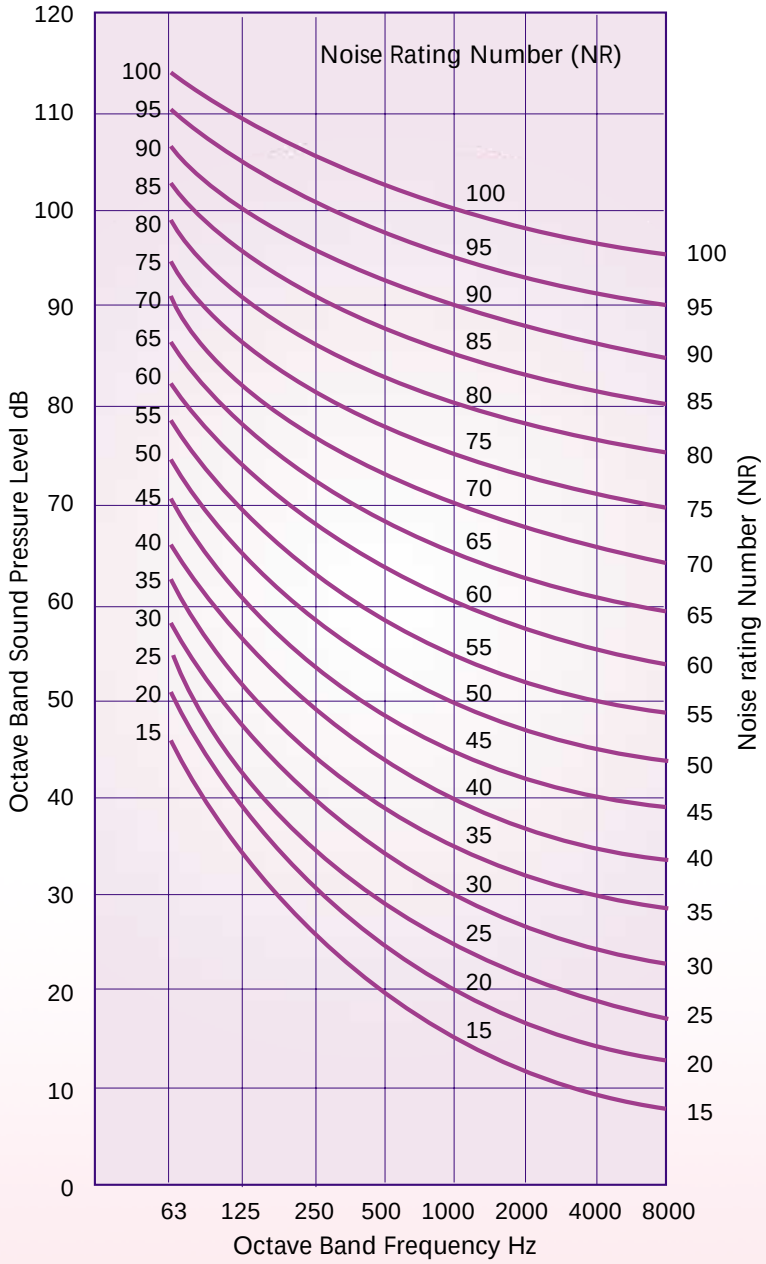
Noise Rating Table

NR Rating	Centre Frequencies (Hz) 63	125	250	500	1k	2k	4k	8k
15	47	35	26	19	15	12	9	7
20	51	39	31	24	20	17	14	13
25	55	44	35	29	25	22	20	18
30	59	48	40	34	30	27	25	23
35	63	52	45	39	35	32	30	28
40	67	57	49	43	40	37	35	33
45	71	61	54	49	45	42	40	38
50	75	66	59	54	50	47	45	44
55	79	70	63	58	55	52	50	49
60	83	74	68	63	60	57	55	54
65	87	79	72	68	65	63	61	59
70	91	83	77	73	70	68	66	64
75	95	87	82	78	75	73	71	69
80	99	92	86	83	80	78	76	74
85	103	96	91	88	85	83	81	80
90	107	100	96	93	90	88	86	85
95	111	105	200	97	95	93	91	90
100	115	109	105	102	100	98	96	95

Noise Rating Curves

NR figures can be applied to calculated or measured sound pressure levels within a conditioned space, or at a distance from a noise source outside.

They should not be applied to a sound power level spectrum.



Noise Fact File

- Sound power level; PWL, db re 10^{-12} watts.
  Sound power is expressed as PWL, the W stands for Watts, and represents the acoustic power at the source. The amount of energy is extremely small and is Watts to the power of minus 12.
  The sound power is the base figure from which all calculations are started to establish the resultant sound pressure level at a distance or in a conditioned space.

- Sound is measured in Bells, decibel being a tenth of a bell.

- Sound pressure level; SPL is what is detected by the human ear, and measured at a distance from the source. Sound measurements can be shown as a sound spectrum, or a single figure NR level or dBA level.

- NR stands for noise rating, and NR curves or tables across eight octave bands provide a weighted indication of measured noise which can be used to determine acceptable noise levels in various environments.
  NR 35-40 is a target level for most general offices, and areas where communication has to be clearly heard. For particularly quiet areas such a courtrooms, libraries, conference rooms, classrooms and private residences NR 30-35 would be required. Even lower levels may be specified for TV and radio studios, concert halls, theatres and diagnostic clinics. It becomes increasingly difficult to measure a noise level below NR 30 in the absence of extraneous background noise.
  NC, PNC, NCB, and RC noise curves are broadly similar to NR curves, varying at low frequencies of 31.5 Hz octave band and below.

- The dBA is a single figure number weighted to match the response of the human ear to varying sound frequencies. The weighting to be applied to a linear spectrum of measured noise is as follows:

Centre of Frequency Hz:	63	125	250	500	1k	2k	4k	8k
'A' Weighting	-26	-16	-9	-3	0	+1	+1	-1

  The resultant spectrum should then be combined to get to a single dBA number as shown on page 4.

  Note that when dealing with noise problems such as an audible tone or a prominent low frequency sound, a single figure dBA measurement would not reveal the nature of the problem.

- The 8 octave bands: noise is generated over all frequencies, these have been grouped just 8 bands, in each of which the upper limit is twice the frequency of the lower limit. Calculations and sound measurements are banded in these groups.
  Most HVAC noise calculations are focussed on the lower frequencies, which are also the most difficult to attenuate.

- Leq is the recorded steady level of noise over a period of time that has the same energy as the fluctuating level actually occurring during that time. The A-weighted equivalent level, L_{Aeq} is used for legislative purposes. L_{eq} measurements are used to assess daily noise exposure in work and other environments.

Silence is Golden

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