

HERRING STORER ACOUSTICS

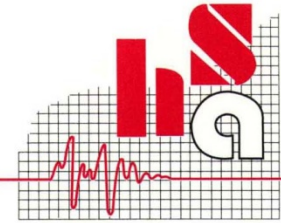
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Acoustics: Back to basics

Fundamentals of Acoustics

Presented by

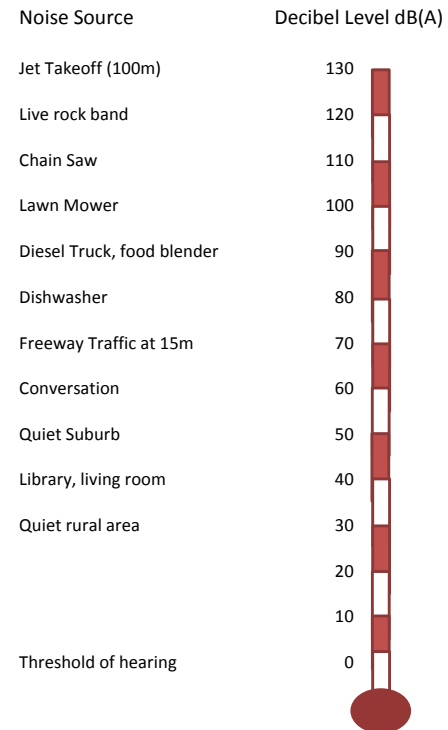
Tim Reynolds



Fundamentals To Cover

- Some Basic Definitions
- Basic Terminology
- Criteria
- Noise Sources and Typical Examples
- Basic Noise Controls

Common Noise Sources

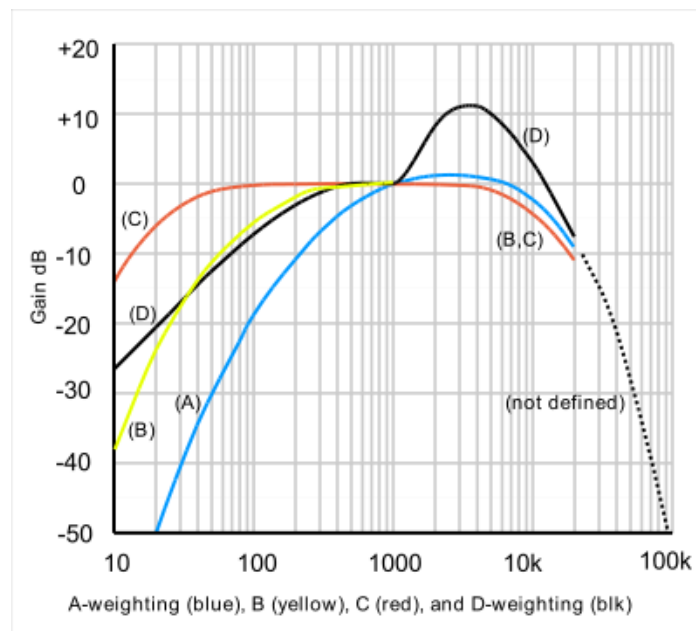


Definitions

Decibel (dB) The human ear has a vast sound-sensitivity range of a thousand billion to one. The decibel is a logarithmic unit that allows this range to be compressed into a somewhat more comprehensible range. The decibel is ten times the logarithm of the ratio of a sound level to a reference sound level. Decibel noise levels cannot be added arithmetically since they are logarithmic numbers.

dB(lin) Decibel measurement without any adjustment.

dB(A) Decibel measurement according to the "A" weighted scale. The human ear does not respond equally to the same sound pressure at different frequencies. The "A" weighting has predetermined adjustments made at certain frequencies to make the measured sound level approximate to the response of the ear.



- L_{eq}** Equivalent Continuous Sound Level. The L_{eq} measurement integrates these fluctuations in noise to give the equivalent continuous level containing an equal amount of energy over the time of measurement.
- L_{A1}** Represents the A-weighted noise level which is exceeded for 1 per cent of the measurement period.
- L_{A10}** Represents the A-weighted noise level which is exceeded for 10 per cent of the measurement period.
- L_{A90}** Represents the A-weighted noise level which is exceeded for 90 per cent of the measurement period. Also often used to represent background noise level.

Sound Pressure Level (SPL) The sound pressure level is the noise level of a sound measured at a point using a standard noise level meter relative to a standard noise level ($2 \times 10^{-5} \text{ N/m}^2$).

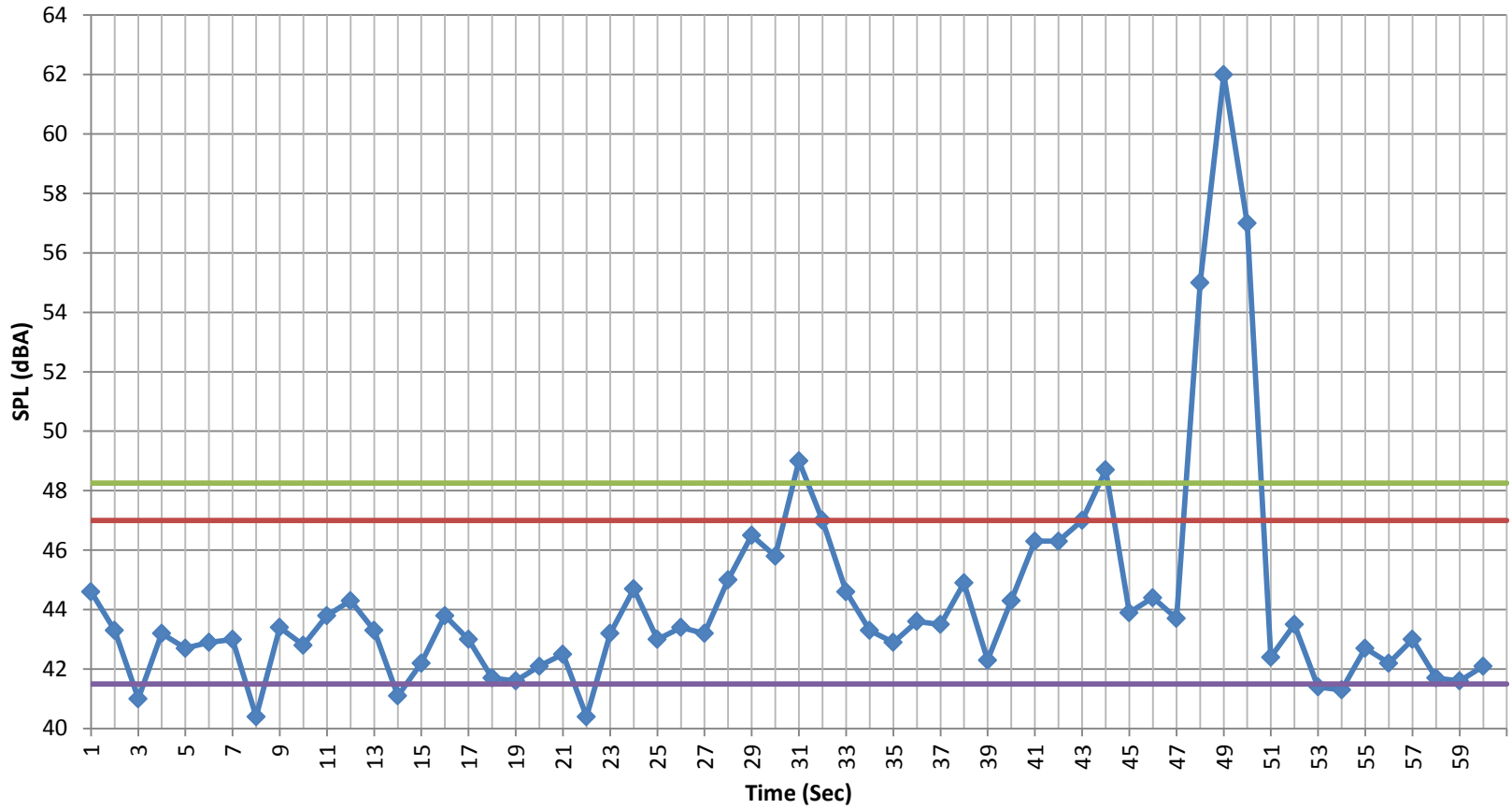
Sound Power Level (SWL) The sound power level of a source is the sound energy emitted by the source. The sound power level of a source cannot be measured directly, but is calculated based on measured sound pressure levels at a known distance (10^{-12} W).

Noise level measurements can be broken down into Octave or 1/3 Octave Bands, with the following centre frequencies.

	Centre Frequency (Hz)																										
Octave Band	31.5		63			125			250			500			1k			2k			4k			8k			
1/3 OctaveBand	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k

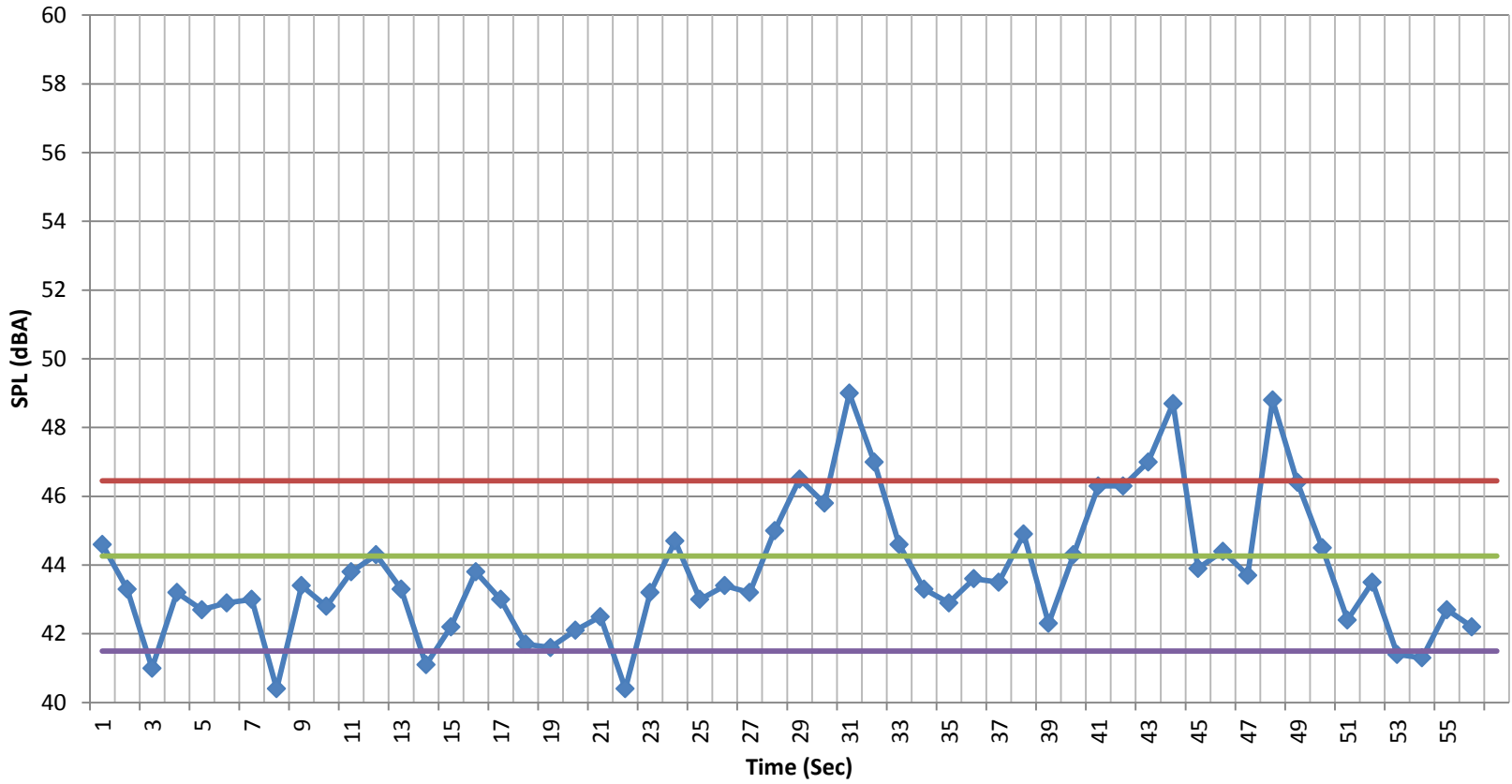
Measurement 1 - Time History

◆ Noise Level — LA10 Overall — LAEq Overall — LA90 Overall



Measurement 2 - Time History

◆ Noise Level — LA10 Overall — LAEq Overall — LA90 Overall



CRITERIA

Environmental Noise

Environmental Protection (Noise) Regulations 1997

Internal Noise Levels

AS/NZ 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors

Others

Building Code of Australia (BCA) – Part F5
GreenStar

ENVIRONMENTAL PROTECTION (NOISE) REGULATIONS 1997

The allowable or assigned noise level at the surrounding locales is prescribed by the *Environmental Protection (Noise) Regulations 1997*.

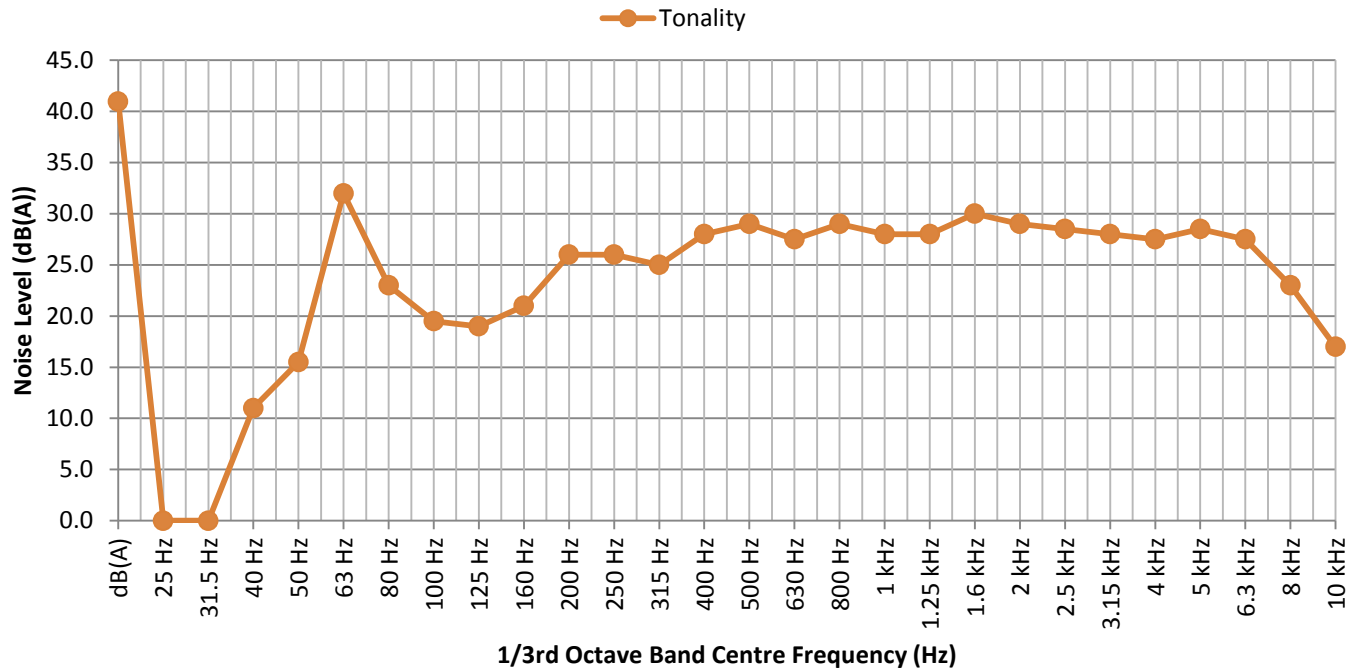
Baseline Assigned Outdoor Noise Level

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L _{A10}	L _{A1}	L _{Amax}
Noise sensitive premises	0700 - 1900 hours Monday to Saturday (Day)	45 + IF	55 + IF	65 + IF
	0900 - 1900 hours Sunday and Public Holidays (Sunday / Public Holiday Day)	40 + IF	50 + IF	65 + IF
	1900 - 2200 hours all days (Evening)	40 + IF	50 + IF	55 + IF
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays (Night)	35 + IF	45 + IF	55 + IF
Commercial premises	All hours	60	75	80

The influencing factor is calculated for the usage of land within two circles, having radii of 100m and 450m from the premises of concern.

Penalties are also applied for annoying characteristics.

- Tonality
- Modulating
- Impulsiveness



Penalties

Where tonality is present	Where modulation is present	Where impulsiveness is present
+5 dB(A)	+5 dB(A)	+10 dB(A)

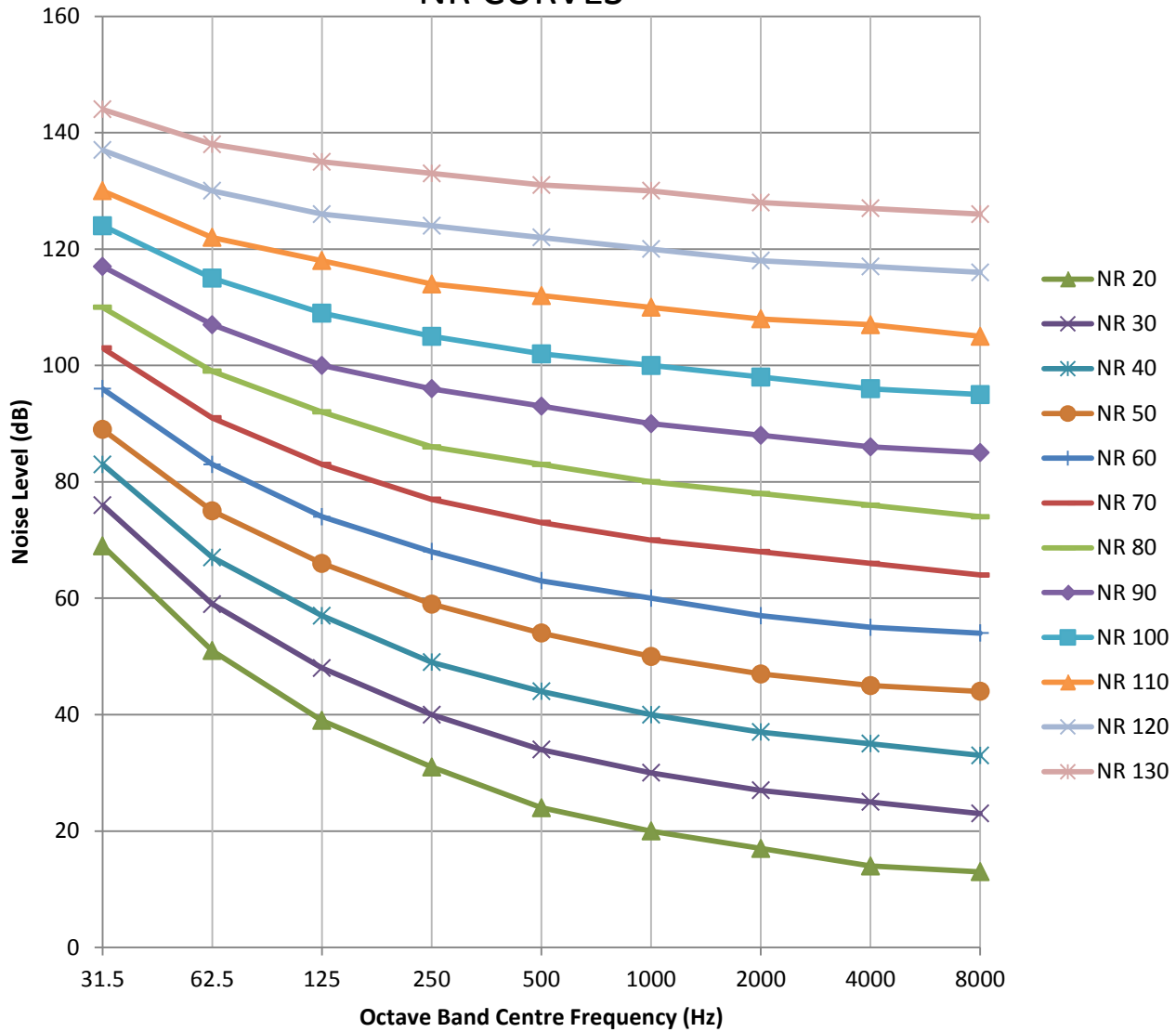
AS/NZ 2107:2000

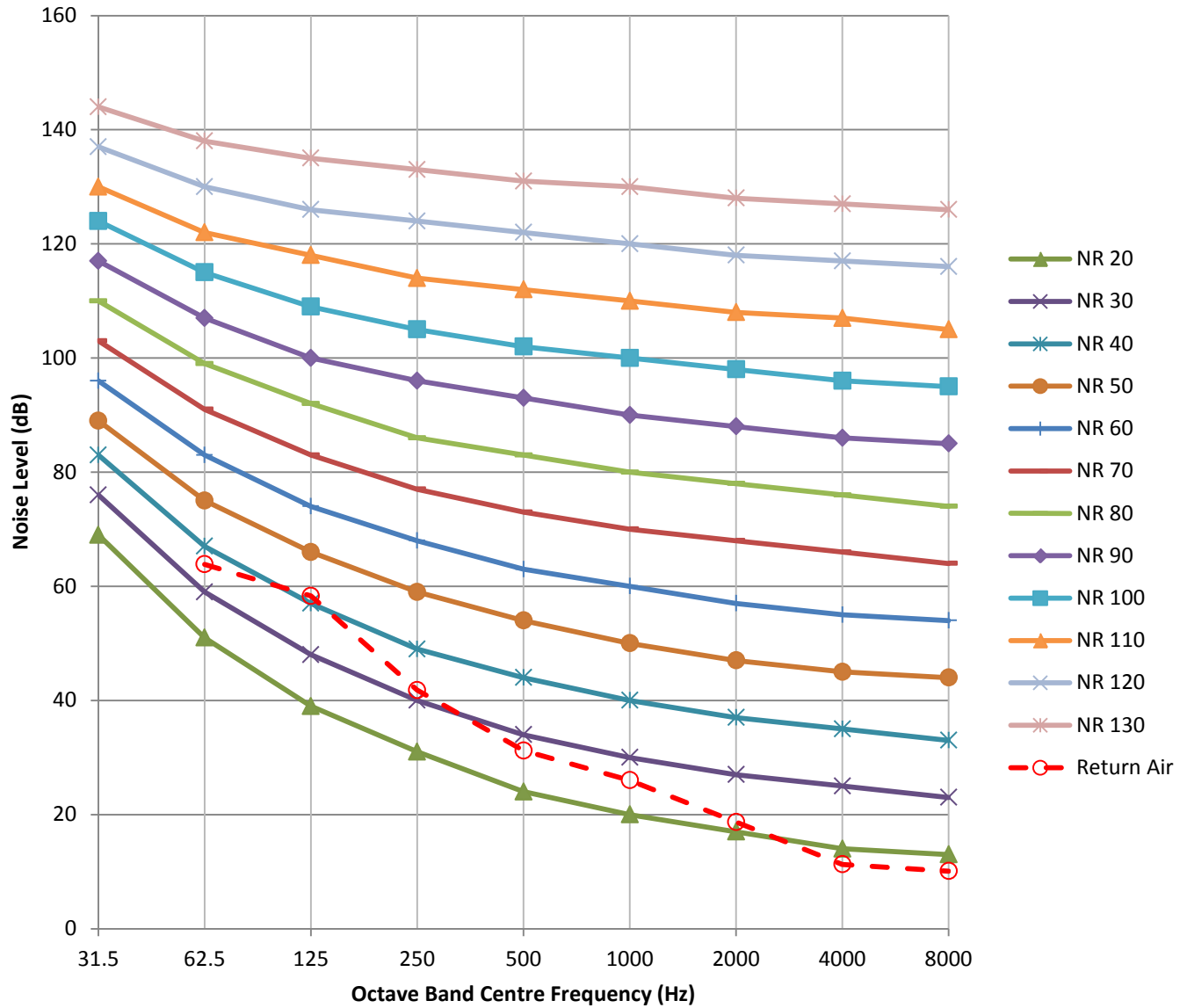
AS2107 has the following recommended noise levels within an office building:

	Satisfactory	Maximum
Boardrooms and conference rooms	30 dB(A)	40 dB(A)
Corridors and Lobbies	45 dB(A)	55 dB(A)
General Office Areas	40 dB(A)	45 dB(A)
Private Offices	35 dB(A)	40 dB(A)
Reception Areas	40 dB(A)	45 dB(A)
Tea Rooms	40 dB(A)	45 dB(A)
Toilets	50 dB(A)	55 dB(A)

Other Criteria Used are Noise Ratings (NR) Curves

NR CURVES





GREENSTAR

For Example, under Office Design there are point available for Acoustics.

Under IEQ-12 there are up to two points available where it is demonstrated that for 95% of the project's NLA does not exceed the 'Satisfactory' ambient internal noise levels in accordance with AS/NZS 2107:2000.

One point is awarded for building services design, where within the entire base building general office space, noise from the building services does not exceed 40 dB(A) Leq.

One point is awarded for the overall building, where within the base building office space, the sound level does not exceed 40 dB(A) Leq (assuming open plan offices).

Building Code Of Australia

Part F5 of the BCA 2013 'Sound Transmission and Insulation'.

Part F5 of the BCA 2013 details the requirements for sound transmission and insulation of residential type buildings.

It is noted that Part F5 of the BCA 2013 is only applicable to the residential sections of the development.

Basic Criteria

Walls between Apartments

Rw + Ctr not less than 50

Walls to corridor

Rw not less than 50

Floors

Rw +Ctr not less than 50

ENVIRONMENTAL NOISE

Typical Example of Exhaust Fan

Being 67 dB(A) at 3 metres
(This is Sound Power of 87 dB(A))

Neighbour at 50 metres away

Reduction for distance is 24 dB(A)

Noise level at residence is 43 dB(A)

However, with penalty of +5 dB(A) for tonality,
assessable noise level would be 48 dB(A).

Say Influencing Factor was 1 dB(A),
then assigned noise level would be :

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L _A 10	L _A 1	L _A max
Noise sensitive premises	0700 - 1900 hours Monday to Saturday	46	56	66
	0900 - 1900 hours Sunday and Public Holidays	41	51	66
	1900 - 2200 hours all days	41	51	56
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	36	46	56

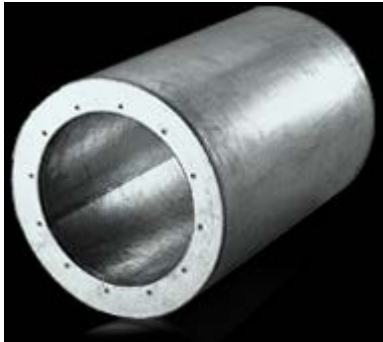
Noise emissions from mechanical services are :

- Steady state
- Would operate for more than 10% of time

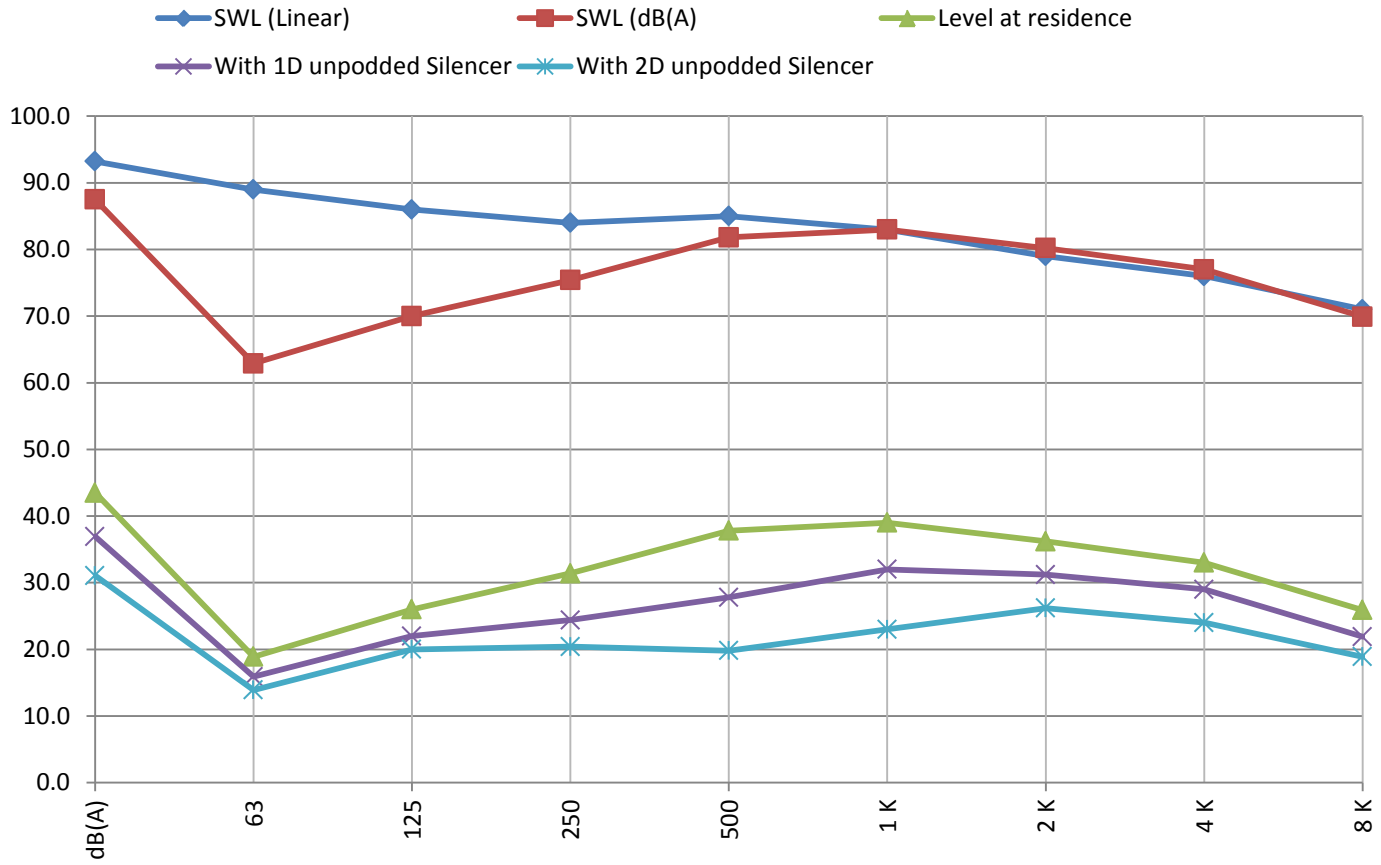
Assessable Noise Level, dB(A)	Applicable Times of Day	Applicable Assigned L _{A10} Noise Level (dB)	Exceedance to Assigned Noise Level (dB)
48	0700 - 1900 hours Monday to Saturday	46	+2
	0900 - 1900 hours Sunday and Public Holidays	41	+7
	1900 - 2200 hours all days	41	+7
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	36	+12

Possible Noise Control :

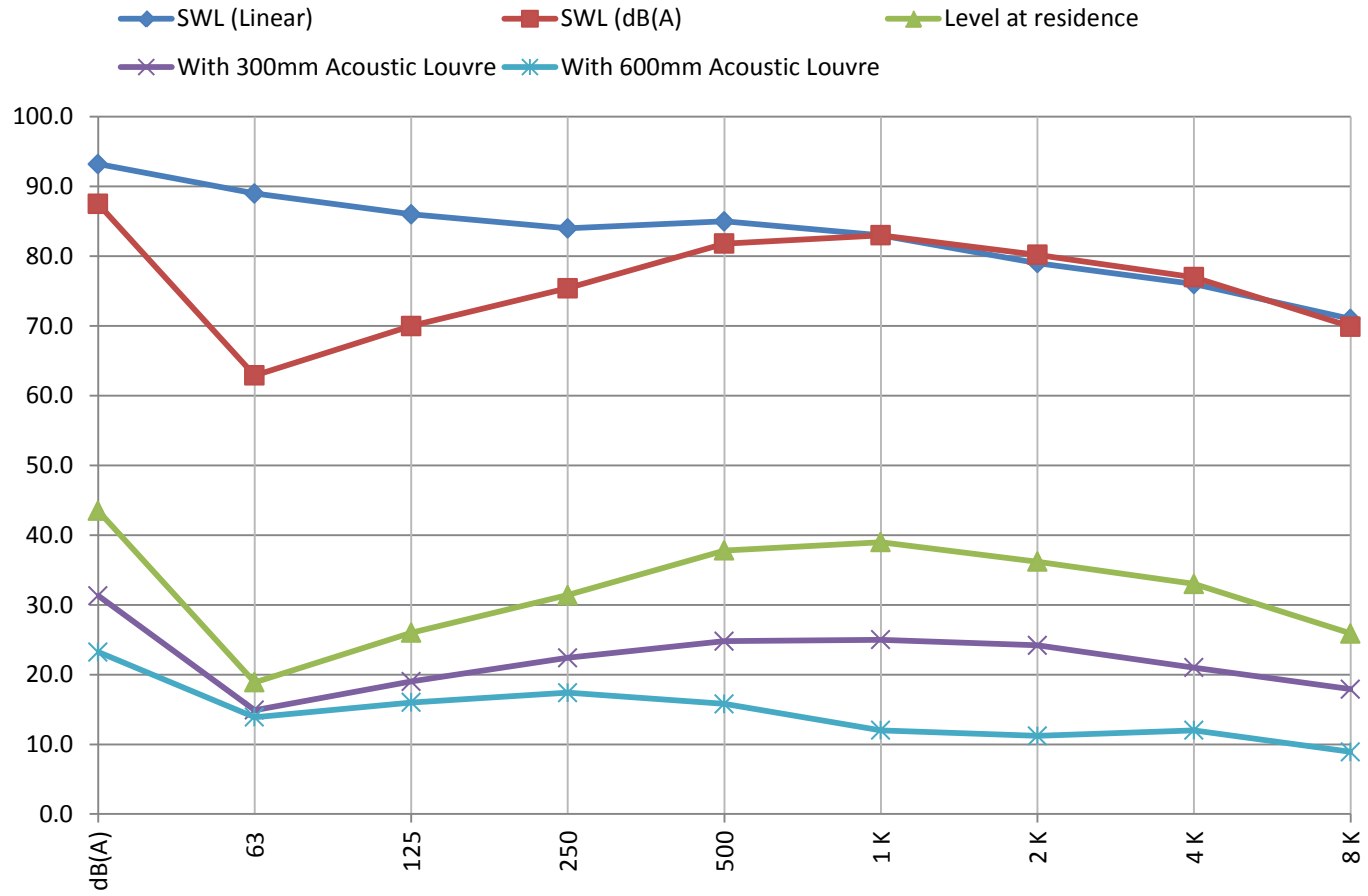
- Barrier
- Enclose in plantroom
- Reduce speed
- Located equipment further away from neighbours
- Attenuators
- Acoustic Louvres



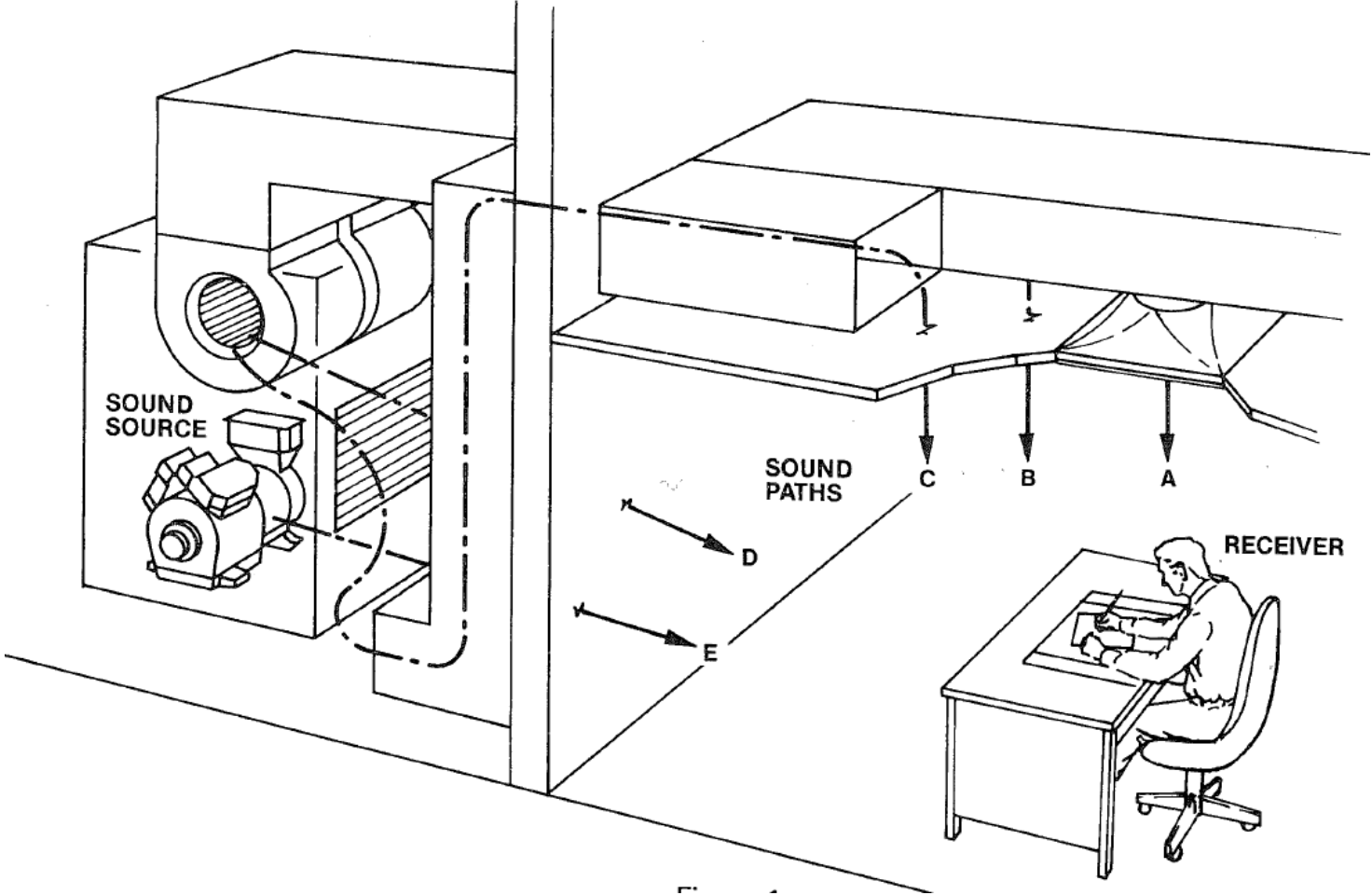
Noise Reductions with Unpodded Silencers



Noise Reductions with Acoustic Louvres



NOISE PATHS



Also need to consider regenerated noise.

INTERNAL DESIGN TO CONTROL NOISE

Supply Air

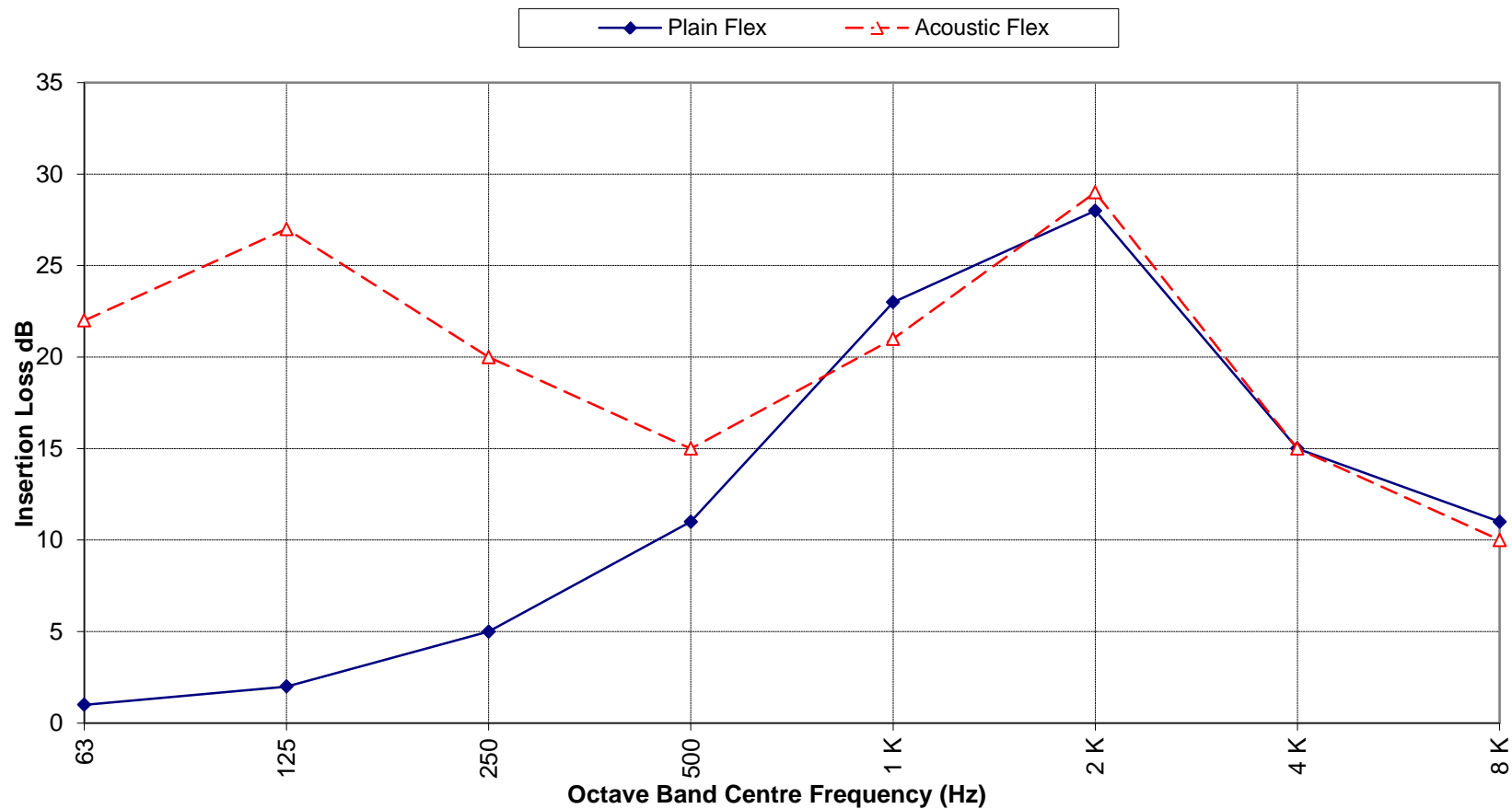
- Bends
- Internal Insulation
- Acoustic Type Flexible Ductwork
- Add attenuators

Also consider :

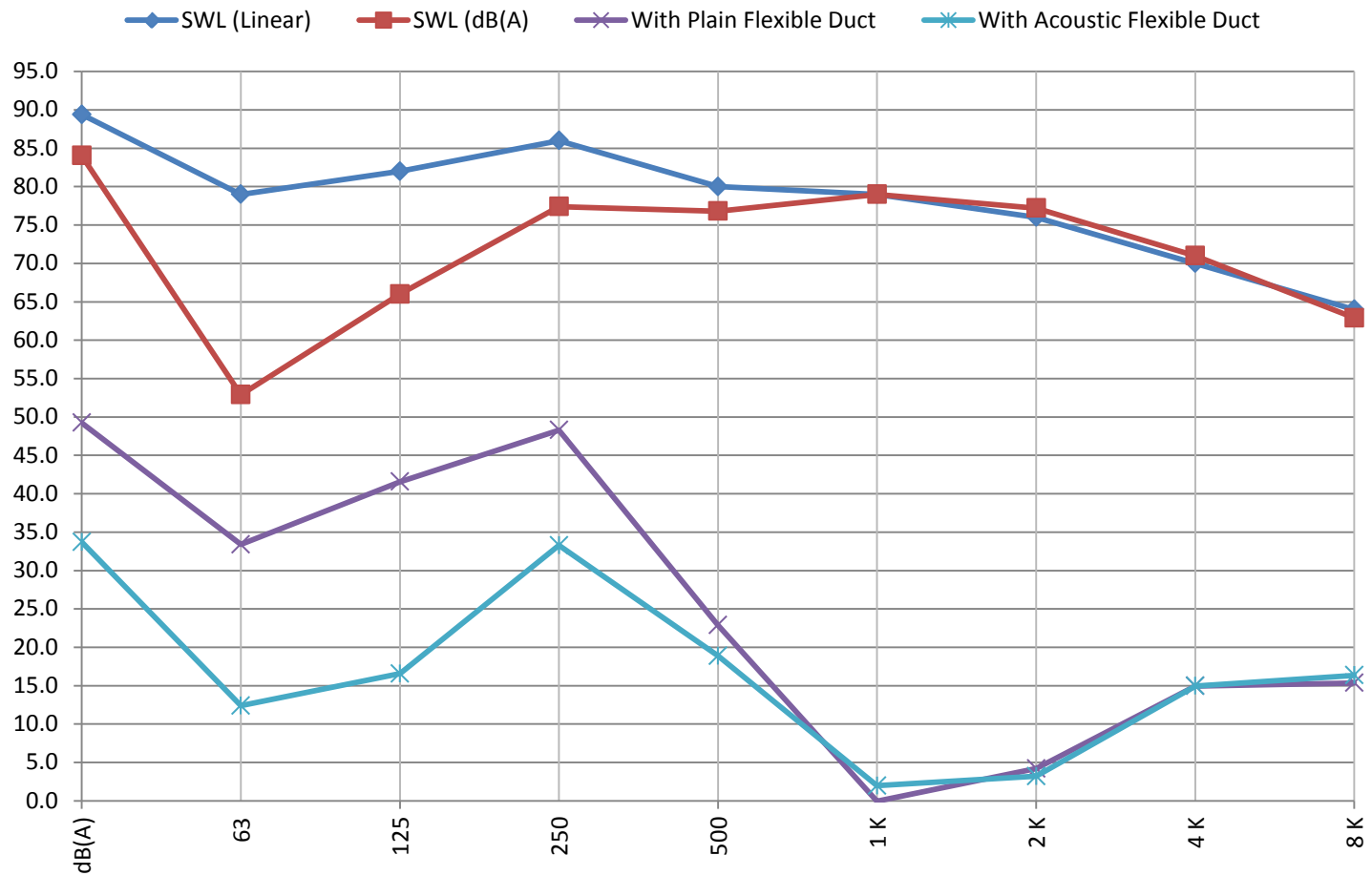
- Air velocity
- Design to registers



INSERTION LOSS OF FLEXIBLE DUCT 300 Diameter, 3m length



Noise Reductions with Flexible Duct



RETURN AIR

- Bends without Turning Vanes
- Return Air plenums
- Add attenuators

Noise Reductions - Bends



Breakout

Need to consider :

- From flexible connections
- Flexible ductwork

Also need to consider Regenerated Noise

