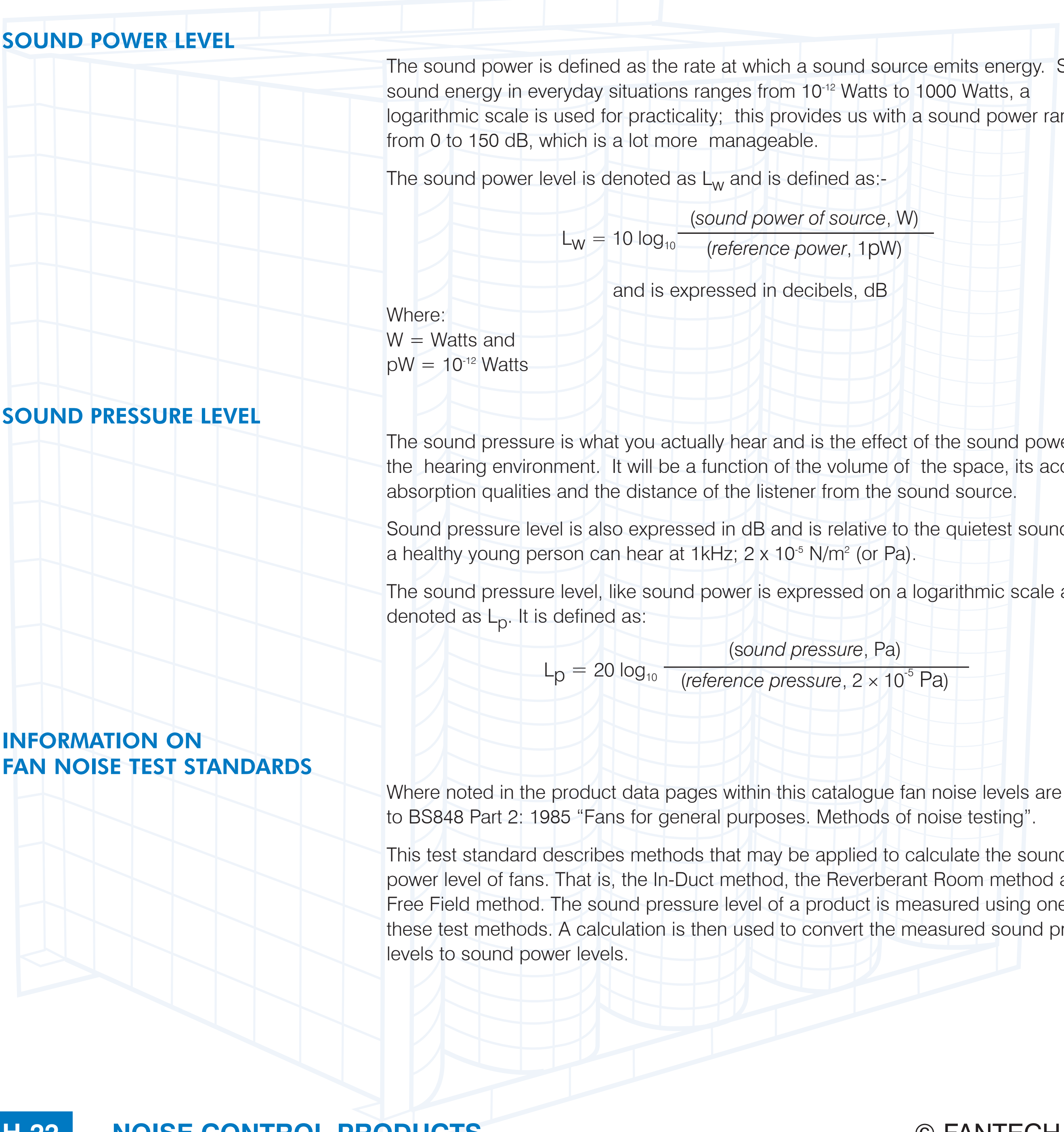
INTRODUCTION

GENERAL

Since 1991, Fantech under the Q-Tech Acoustic Products brand has continuously invested in research and development programs. The investment in this program results in Fantech continuously testing new designs and materials in its own ISO7235:2003 and BS4718:1971 acoustic attenuator test rig. The results of this program include the first published test data for a range of attenuators based on Australian sourced materials and the advent of the unique Q-Seal range of specialised attenuators. Our continued investments in the research and development of acoustic products results in the most accurate and dependable data for acoustic products, unrivalled by any other supplier in the industry.

Fantech maintains strong relationships with universities, testing houses and the industry to ensure that the experience gained from the use of our products in the real world feeds back into the design of our new products. We will continue to be involved in the latest acoustic technology and innovation and we will continue to provide our customers with products they can rely upon.

The following pages, incorporates a glossary of acoustic terms to assist the user of the Fans By Fantech catalogue in understanding the depth of technical information supplied for our fans and attenuators.



SOUND POWER LEVEL

The sound power is defined as the rate at which a sound source emits energy. Since sound energy in everyday situations ranges from 10^{-12} Watts to 1000 Watts, a logarithmic scale is used for practicality; this provides us with a sound power range from 0 to 150 dB, which is a lot more manageable.

The sound power level is denoted as L_W and is defined as:-

$$L_W = 10 \log_{10} \frac{(\textit{sound power of source}, \text{W})}{(\textit{reference power}, 1\text{pW})}$$

and is expressed in decibels, dB

Where:
W = Watts and
pW = 10^{-12} Watts

SOUND PRESSURE LEVEL

The sound pressure is what you actually hear and is the effect of the sound power in the hearing environment. It will be a function of the volume of the space, its acoustic absorption qualities and the distance of the listener from the sound source.

Sound pressure level is also expressed in dB and is relative to the quietest sound which a healthy young person can hear at 1kHz; 2×10^{-5} N/m^2 (or Pa).

The sound pressure level, like sound power is expressed on a logarithmic scale and denoted as L_p. It is defined as:

$$L_p = 20 \log_{10} \frac{(\textit{sound pressure}, \text{Pa})}{(\textit{reference pressure}, 2 \times 10^{-5}\ \text{Pa})}$$

INFORMATION ON FAN NOISE TEST STANDARDS

Where noted in the product data pages within this catalogue fan noise levels are tested to BS848 Part 2: 1985 “Fans for general purposes. Methods of noise testing”.

This test standard describes methods that may be applied to calculate the sound power level of fans. That is, the In-Duct method, the Reverberant Room method and the Free Field method. The sound pressure level of a product is measured using one of these test methods. A calculation is then used to convert the measured sound pressure levels to sound power levels.

ATTENUATOR INFORMATION

STATIC INSERTION LOSSES

BS 4718 : 1971 "Methods of Test for Attenuators for Air Distribution Systems" requires manufacturers to test and publish static insertion loss figures.

An insertion loss is defined as "the reduction in noise level at a given location due to the placement of an attenuator in the sound path between the sound source and that location". A static insertion loss is the insertion loss with no air flow passing through the attenuator.

Therefore placing an attenuator in between a fan and the measuring position, will reduce the noise level at the measuring position by the insertion loss.

DYNAMIC INSERTION LOSSES

Fantech test attenuators to BS4718: 1971 "Methods of Test for Attenuators for Air Distribution Systems". This test standard sets out a procedure for the testing of static insertion losses; i.e. the measuring of insertion losses without air flow.

Some overseas companies publish dynamic insertion losses; that is the testing of insertion losses with air flow involved. At higher passage velocities the static insertion loss can vary from the dynamic insertion loss by a small margin, depending on the direction of the air flow compared to the noise propagation direction.

For typical velocities associated with a HVAC system, the static insertion losses and dynamic insertion losses are virtually identical and can be assumed to be the same.

AIRWAY VELOCITY

For a given attenuator size a higher air flow results in a higher airway passage velocity. Higher passage velocities will increase the regenerated noise level of the attenuator. This is particularly critical when the attenuator is serving a low noise level zone; i.e. film studio. A number of suggested maximum passage velocities with the appropriate room NR level are tabulated. Critical noise applications should be checked by an Acoustics Engineer.

		Approx.	
NR25	Do not exceed	8 m/s	In attenuator airway
NR30	“	10 m/s	“
NR35	“	13 m/s	“
NR40	“	15 m/s	“
NR45	“	18 m/s	“

Critical noise level application should be checked by an acoustics engineer

TYPICAL APPLICATIONS AND BENEFITS OF ATTENUATOR TYPES

Model	**Application**	**Benefits**
Small Circular Type Attenuators		
CC	Bathroom and Toilet exhaust fans	Lightweight
	Tenancy fit outs	Low cost
	Apartment fans	Semi-Flexible
Circular & Rectangular Attenuators		
C./C.P & RT/RS	Car park exhaust fans	Circular: Easy fitting
	Return Air fans	Circular Open: Low pressure drop
	Swimming Pools	Circular Pod: High performance
	Kitchen Exhausts	
	Smoke Spill fans	Rectangular: High performance
Cross-talk Attenuators		
CS/T/U/Z	Room to room air transfer ducts	Different designs to suit a wide range of wall/roof configurations
	Police stations	
	Office areas	
Sound Bar Acoustic Louvres		
SBL1/2 ASB	Plant rooms	Short lengths
		Weatherproof

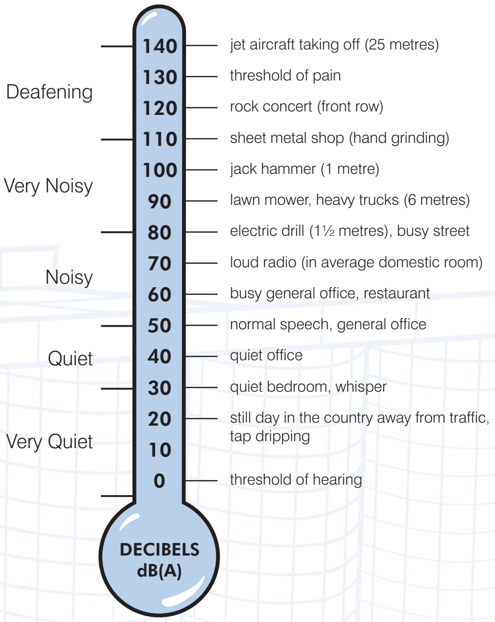
NOISE RATINGS

dB(A) LEVELS

The ear responds not only to the absolute sound pressure level of a sound, but also to its frequency content. It actually gives a weighting to the level of sound according to its frequency content, and ascribes a certain loudness. This means that if we want to know how a person will judge the sound, we must somehow translate our objective measured units of sound pressure level and frequency content into subjective units of loudness.

A sound level meter accepts all of the frequency components of a sound, and adds all their absolute levels together to give an overall sound pressure level, dB (Linear).

The illustration below shows typical overall sound pressure levels produced by some everyday sources.



However the ear is not as sensitive to lower frequency sound pressure levels as it is to higher frequency sound pressure levels. In the 1930's, experiments were carried out on 11 people by Harvey Fletcher at the Bell Telephone Laboratories in New York to determine how loud tones of different frequencies sounded subjectively. Therefore the "A" weighting (or the "A" in dB(A)) was devised so that the sound meter would filter each frequency of sound by a certain amount before adding them together to give a loudness that more closely follows the sensitivity of the human ear.

Octave Band Centre Frequency, Hz	63	125	250	500	1000	2000	4000	8000
'A' frequency weighting corrections	-26	-16	-9	-3	0	+1	+1	-1

The 'A' frequency weighting corrections are shown below.

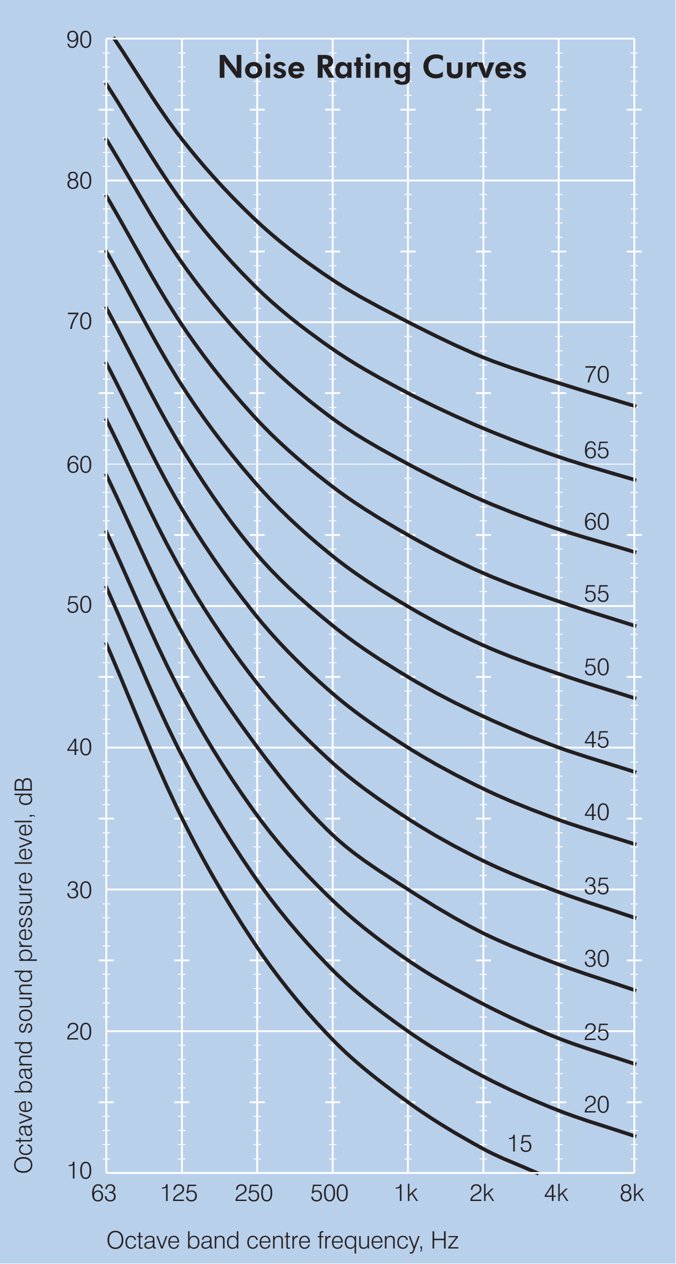
The 'A' frequency weighting suggests that if a tone of 40 dB is played at 1000 Hz, a 40 dB tone played at 63 Hz would sound 26 dB quieter, or be 14 dB(A). Due to its simplicity and convenience, the 'A' frequency weighting has become popular and is now used for many different noise sources at different levels. In fact, most legislation regarding noise is written using dB(A)s, in addition nearly all manufacturers of fans and other noise generating machines quote their noise levels in dB(A)s at 1, 1.5, or 3 metres assuming spherical distribution. It is therefore important that we understand the 'A' frequency weighting and how dB(A)s are calculated.

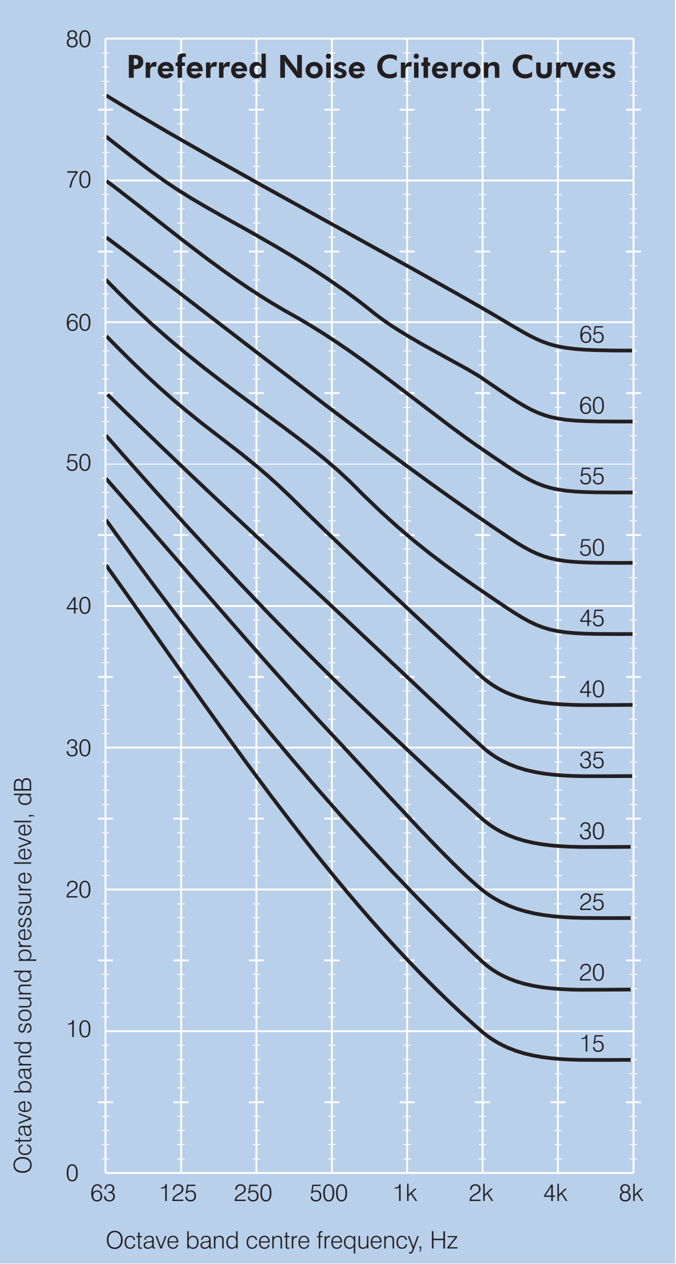
CALCULATING dB(A) LEVELS

Published dB(A), or 'A' frequency weighted, sound pressure levels are theoretical values. These are, in fact, calculated from the sound power level data and are quoted at a specified distance i.e. 1, 1.5, or 3 metres. For example, using the Fantech model AP0804AP10/23 (duty 7000 L/s @ 80 Pa, inlet side), by applying an 'A' frequency weighting correction to the fan sound power levels for each frequency and then logarithmically adding the values from left to right the resultant overall sound power level for this unit will be 98 dB(A). A further calculation is required to convert this value from the 'A' weighted sound power level to an 'A' weighted sound pressure level at a prescribed distance from the noise source i.e. 77 dB(A) @ 3m.

See next page for a detailed example of this calculation.

NR & PNC Ratings





The Noise Rating (or NR contour) curves were proposed by Kosten and Van Os (1962) to rate internal noise levels.

To use the curves, plot the noise spectrum onto the NR curves grid. The Noise Rating is defined as that curve which touches the highest point on the sound pressure spectrum.

Some acoustic consultants prefer to use the Preferred Noise Criterion (PNC) curves. These curves were designed by Beranek (1971) to achieve a more acceptable noise quality and lower the allowable levels of low and high frequency noises.

To use the curves, plot the noise spectrum onto the PNC curves grid. The Preferred Noise Criterion is defined as that curve which touches the highest point on the sound pressure spectrum.

Notes

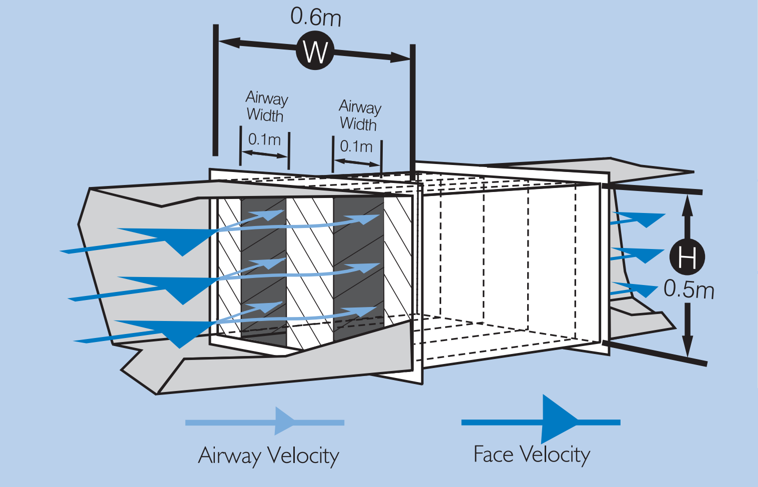
The dB(A) equivalent of the NR values would be approximately 5 dB(A) higher in each instance.

NR and PNC curves are designed to be used with broadband, constant noise sources (eg. motors, engines), and do not allow for the increased annoyance associated with tonal, or pulsating noises.

GENERAL ACOUSTIC INFORMATION

ATTENUATOR PASSAGE VELOCITY

For industrial applications and to determine attenuator re-generated noise, the passage velocity must be found as described below:



$$\text{Open Area Ratio} = \frac{\text{2 Passages X Airway Width}}{\text{Width}}$$

$$= \frac{2(0.1\text{m})}{0.6\text{m}} = \frac{0.1\text{m}^2}{0.3\text{m}^2} = 0.33 \text{ (i.e. 33\%)}$$

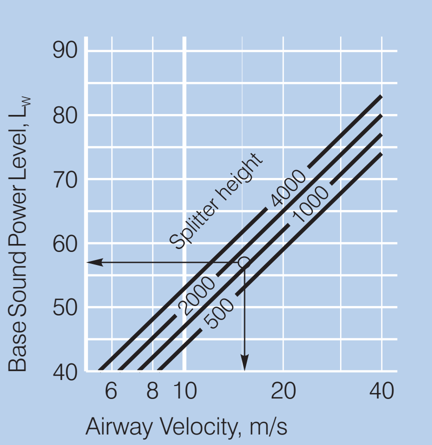
$$\text{Face Area} = 0.6\text{m X } 0.5\text{m} = 0.3\text{m}^2$$

$$\text{Face Velocity} = \frac{\text{Airflow}}{\text{Face Area}} = \frac{1.5\text{m}^3/\text{s}}{0.3\text{m}^2} = 5\text{m/s}$$

$$\text{Airway Velocity} = \frac{\text{Face Velocity}}{\text{Open Area Ratio}} = \frac{5\text{m/s}}{0.33} = 15\text{m/s}$$

ATTENUATOR RE-GENERATED/ AIR FLOW GENERATED NOISE :

As air passes through an attenuator it will frequently pass at speeds as much as 2 to 4 times the air flow speed in the duct. Moving air creates noise, so in noise sensitive rooms and installations where attenuators are placed close to air grilles and terminals, particular care must be taken to ensure that this does not become the dominating noise source. The relationship between airway velocity and generated noise is shown below for rectangular attenuators.



SPECTRUM CORRECTIONS FOR AIRWAY VELOCITY :

Airway Velocity m/sec	**Octave Band Centre Frequency, Hz**							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
<8	-2	-6	-7	-10	-12	-16	-19	-22
≥8 & ≤32	-3	-5	-8	-7	-8	-10	-13	-15
>32	-3	-6	-10	-7	-7	-8	-10	-12

REFERENCE INFORMATION: ACOUSTIC LOSSES OF LINED DUCT & BENDS

Table 1: 25mm lined duct

Width (mm)	Height (mm)	Insertion Loss, dB/metre Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
100	**100**	6.7	6.8	7.1	11.6	33.1	34.0	15.4	9.0
100	**150**	5.0	5.4	6.2	10.6	29.2	29.4	14.2	8.6
100	**200**	4.2	4.7	5.7	10.1	27.1	27.0	13.5	8.4
100	**250**	3.8	4.4	5.4	9.7	25.9	25.5	13.1	8.3
150	**150**	3.6	4.1	5.2	9.5	25.0	24.6	12.8	8.2
150	**250**	2.7	3.2	4.4	8.5	21.4	20.6	11.6	7.8
150	**300**	2.5	3.0	4.2	8.3	20.5	19.5	11.3	7.7
150	**400**	2.3	2.7	3.9	7.9	19.3	18.2	10.9	7.6
200	**200**	2.5	3.0	4.2	8.3	20.5	19.5	11.3	7.7
200	**300**	2.1	2.4	3.7	7.6	18.1	16.9	10.4	7.4
200	**400**	2.0	2.2	3.4	7.2	16.8	15.5	9.9	7.3
200	**600**	1.8	2.0	3.1	6.8	15.5	14.1	9.4	7.1
250	**250**	2.1	2.4	3.6	7.4	17.6	16.3	10.2	7.4
250	**400**	1.8	1.9	3.1	6.7	15.2	13.8	9.3	7.0
250	**500**	1.7	1.8	2.9	6.5	14.4	13.0	9.0	6.9
250	**600**	1.7	1.7	2.8	6.3	13.9	12.4	8.7	6.8
300	**300**	1.8	2.0	3.1	6.8	15.5	14.1	9.4	7.1
300	**400**	1.7	1.8	2.9	6.4	14.1	12.7	8.9	6.9
300	**600**	1.6	1.6	2.6	5.9	12.7	11.2	8.3	6.6
300	**800**	1.4	1.5	2.5	5.8	12.1	10.5	8.0	6.6
400	**400**	1.6	1.6	2.6	5.9	12.7	11.2	8.3	6.6
400	**600**	1.2	1.3	2.3	5.5	11.3	9.8	7.7	6.4
400	**800**	1.1	1.2	2.1	5.2	10.5	9.0	7.3	6.3
400	**1000**	1.0	1.1	2.0	5.0	10.0	8.5	7.1	6.2
500	**500**	1.2	1.3	2.2	5.4	11.0	9.5	7.5	6.4
500	**600**	1.1	1.2	2.1	5.2	10.3	8.8	7.2	6.2
500	**800**	1.0	1.0	1.9	4.8	9.5	8.0	6.9	6.1
500	**1000**	0.9	0.9	1.8	4.7	9.0	7.5	6.6	6.0
600	**600**	1.0	1.1	1.9	4.9	9.7	8.2	6.9	6.1
600	**800**	0.9	0.9	1.7	4.6	8.8	7.3	6.5	5.9
600	**1200**	0.8	0.8	1.5	4.2	7.9	6.5	6.1	5.7
600	**1600**	0.7	0.7	1.4	4.1	7.5	6.1	5.8	5.6
800	**800**	0.8	0.8	1.5	4.2	7.9	6.5	6.1	5.7
800	**1000**	0.7	0.7	1.4	4.0	7.4	6.0	5.8	5.6
800	**1200**	0.6	0.6	1.3	3.9	7.0	5.6	5.6	5.5
800	**1600**	0.6	0.6	1.2	3.7	6.5	5.2	5.3	5.4
1000	**1000**	0.6	0.6	1.3	3.8	6.8	5.4	5.5	5.5
1000	**1200**	0.6	0.6	1.2	3.6	6.4	5.1	5.3	5.3
1000	**1600**	0.5	0.5	1.1	3.4	5.9	4.6	5.0	5.2
1000	**2000**	0.5	0.5	1.0	3.3	5.5	4.3	4.8	5.1
1200	**1200**	0.5	0.5	1.1	3.4	6.0	4.7	5.1	5.2
1200	**1600**	0.5	0.5	1.0	3.2	5.4	4.2	4.8	5.1
1200	**2000**	0.4	0.4	0.9	3.1	5.1	3.9	4.6	5.0
1200	**2400**	0.4	0.4	0.9	3.0	4.9	3.7	4.4	4.9

Table 2: 50mm lined duct

Width (mm)	Height (mm)	Insertion Loss, dB/metre Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
100	**100**	11.8	12.6	14.8	24.4	33.1	34.0	15.4	9.0
100	**150**	8.5	9.9	12.8	22.3	29.2	29.4	14.2	8.6
100	**200**	7.1	8.6	11.7	21.2	27.1	27.0	13.5	8.4
100	**250**	6.4	7.9	11.1	20.5	25.9	25.5	13.1	8.3
150	**150**	5.9	7.4	10.7	20.0	25.0	24.6	12.8	8.2
150	**250**	4.2	5.6	9.0	17.9	21.4	20.6	11.6	7.8
150	**300**	3.9	5.1	8.5	17.3	20.5	19.5	11.3	7.7
150	**400**	3.4	4.6	8.0	16.6	19.3	18.2	10.9	7.6
200	**200**	3.9	5.1	8.5	17.3	20.5	19.5	11.3	7.7
200	**300**	3.1	4.1	7.4	15.9	18.1	16.9	10.4	7.4
200	**400**	2.7	3.7	6.8	15.1	16.8	15.5	9.9	7.3
200	**600**	2.4	3.2	6.2	14.2	15.5	14.1	9.4	7.1
250	**250**	2.9	3.9	7.2	15.5	17.6	16.3	10.2	7.4
250	**400**	2.4	3.1	6.1	14.0	15.2	13.8	9.3	7.0
250	**500**	2.2	2.9	5.7	13.5	14.4	13.0	9.0	6.9
250	**600**	2.1	2.7	5.5	13.1	13.9	12.4	8.7	6.8
300	**300**	2.4	3.2	6.2	14.2	15.5	14.1	9.4	7.1
300	**400**	2.2	2.8	5.6	13.3	14.1	12.7	8.9	6.9
300	**600**	2.0	2.4	5.0	12.3	12.7	11.2	8.3	6.6
300	**800**	1.6	2.2	4.8	11.9	12.1	10.5	8.0	6.6
400	**400**	2.0	2.4	5.0	12.3	12.7	11.2	8.3	6.6
400	**600**	1.5	2.0	4.4	11.4	11.3	9.8	7.7	6.4
400	**800**	1.3	1.7	4.0	10.8	10.5	9.0	7.3	6.3
400	**1000**	1.2	1.6	3.8	10.4	10.0	8.5	7.1	6.2
500	**500**	1.4	1.9	4.3	11.1	11.0	9.5	7.5	6.4
500	**600**	1.3	1.7	4.0	10.7	10.3	8.8	7.2	6.2
500	**800**	1.1	1.5	3.6	10.0	9.5	8.0	6.9	6.1
500	**1000**	1.0	1.3	3.4	9.6	9.0	7.5	6.6	6.0
600	**600**	1.1	1.5	3.7	10.2	9.7	8.2	6.9	6.1
600	**800**	1.0	1.3	3.3	9.5	8.8	7.3	6.5	5.9
600	**1200**	0.8	1.1	2.9	8.8	7.9	6.5	6.1	5.7
600	**1600**	0.8	1.0	2.7	8.4	7.5	6.1	5.8	5.6
800	**800**	0.8	1.1	2.9	8.8	7.9	6.5	6.1	5.7
800	**1000**	0.8	1.0	2.7	8.3	7.4	6.0	5.8	5.6
800	**1200**	0.7	0.9	2.5	8.0	7.0	5.6	5.6	5.5
800	**1600**	0.6	0.8	2.3	7.6	6.5	5.2	5.3	5.4
1000	**1000**	0.7	0.8	2.4	7.8	6.8	5.4	5.5	5.5
1000	**1200**	0.6	0.8	2.3	7.5	6.4	5.1	5.3	5.3
1000	**1600**	0.6	0.7	2.0	7.1	5.9	4.6	5.0	5.2
1000	**2000**	0.5	0.6	1.9	6.8	5.5	4.3	4.8	5.1
1200	**1200**	0.6	0.7	2.1	7.2	6.0	4.7	5.1	5.2
1200	**1600**	0.5	0.6	1.9	6.7	5.4	4.2	4.8	5.1
1200	**2000**	0.5	0.5	1.7	6.4	5.1	3.9	4.6	5.0
1200	**2400**	0.4	0.5	1.7	6.2	4.9	3.7	4.4	4.9

Table 3: Square lined bend with turning vanes

d (mm)	Insertion Loss, dB/bend Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
100	0	0	0	1	4	7	7	7
150	0	0	0	1	4	7	7	7
200	0	0	1	4	7	7	7	7
250	0	0	1	4	7	7	7	7
300	0	0	1	4	7	7	7	7
400	0	1	4	7	7	7	7	7
500	0	1	4	7	7	7	7	7
600	0	1	4	7	7	7	7	7
800	1	4	7	7	7	7	7	7
1000	1	4	7	7	7	7	7	7
1200	1	4	7	7	7	7	7	7
1600	4	7	7	7	7	7	7	7
2000	4	7	7	7	7	7	7	7
2400	4	7	7	7	7	7	7	7

Table 4: Square lined bend without turning vanes

d (mm)	Insertion Loss, dB/bend Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
100	0	0	0	1	6	11	10	10
150	0	0	0	1	6	11	10	10
200	0	0	1	6	11	10	10	10
250	0	0	1	6	11	10	10	10
300	0	0	1	6	11	10	10	10
400	0	1	6	11	10	10	10	10
500	0	1	6	11	10	10	10	10
600	0	1	6	11	10	10	10	10
800	1	6	11	10	10	10	10	10
1000	1	6	11	10	10	10	10	10
1200	1	6	11	10	10	10	10	10
1600	6	11	10	10	10	10	10	10
2000	6	11	10	10	10	10	10	10
2400	6	11	10	10	10	10	10	10