RAPID SYSTEM ANALYSIS MASTER SHEET

Rapid Acoustic Design

Job: ____________________ **System:** ____________________ **Duty:** ____________________

Fan: ____________________ **Date:** ____________________ **Location:** ____________________

Octave Band Centre Frequency (Hz)

		Ref.	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Establish in-duct sound power level, (L_W) of fan Ref. a.	L_W entering system (fan L_W)	a.								
Enter losses due to transmission through duct system Ref. b.to f.										
	outlet area m²	f.								
Enter sound power level, L_W, leaving system Ref. a. + (b. to f.) = g.	L_W leaving system	g.								
Enter direct sound pressure, L_p, room corrections Ref. h. to j.	direct L_p sound to grille (Fig.6) %	h.								
	distance to listener (Fig.7) m	i.								
	directivity area (Figs 8-10) m² grille position	j.								
Enter direct sound pressure, L_p in room Ref. g. + (h. to j.) = k.	direct L_p in room	k.								
Enter reverberant sound pressure, L_p, room corrections Ref. l.to m.	reverberant L_p sound to room (Fig. 11) %	l.								
	room type (Figs. 12-16) room volume m³	m.								
Enter reverberant sound pressure, L_p, room corrections Ref g. + (l. to m.) = n.	reverberant L_p in room	n.								
Calculate difference in L_p, between k and m. Add correction from Fig. 17 to higher L_p	combined L_p in room (Fig. 17)	o.								
Enter total L_p all systems in room Ref. p.	total all systems in room	p.								
Enter required NR level Ref. q	design criteria (page G-32/33) NR	q.								
Enter required performance of attenuator Ref. p. - q = r.	attenuation required	r.								
Enter attenuator selection Ref. s.	attenuator selection	s.								
Enter resultant L_p in room Ref. p.- s. = t	resultant L_p in room	t.								
Compare resultant L_p in room Ref. t.to NR curve and enter achieved criteria Ref. u.	criteria achieved (page G-33) NR	u.								

Rapid Acoustic Design

Job: Sample **System:** Car Park Exhaust **Duty:** 6m³/s @ 300Pa

Fan: AP0804CA9/21 **Date:** 26/03/03 **Location:** CPEF

Octave Band Centre Frequency (Hz)

		Ref.	63	125	250	500	1k	2k	4k	8k
Enter in-duct sound power level, (L_W) of fan Ref. a.	L_W entering system (fan L_W)	a.	91	88	89	87	87	83	79	73
Enter losses due to transmission through duct system Ref. b. to f.	rect. duct 1200 x 1000 x 4m (Fig. 3)	b.	-2	-1	-1	0	0	0	0	0
	rect. duct 800 x 600 x 4m (Fig. 3)	b.	-2	-2	-1	-1	-1	-1	-1	-1
	800 x 600radius bend	c.	0	0	0	0	0	0	0	0
	800 x 600 bend w/o turning vanes (Fig. 4)	c.	0	-2	-5	-5	-3	-3	-3	-3
	1200 x 1000 lined duct, 25mm insulation x 1m	d.	-1	-1	-1	-4	-6	-5	-5	-5
	Largest transition dimension used (Table 1)									
	tolerance (see note on page G-27)	e.	+3	+3	+3	+3	+3	+3	+3	+3
	outlet area (Fig. 5) 0.28m²	f.	-9	-5	-2	0	0	0	0	0
Enter sound power level, L_W, leaving system Ref. a. + (b. to f.) = g.	L_W leaving system	g.	80	80	82	80	80	77	73	67
Enter direct sound pressure, L_p, room corrections Ref. h. to j.	direct L_p sound to grille (Fig. 6) 15%	h.	-8	-8	-8	-8	-8	-8	-8	-8
	distance to listener (Fig. 7) 3m	i.	-21	-21	-21	-21	-21	-21	-21	-21
	directivity area (Fig. 10)>0.1 & <1m² grille position - at edge of 2 surfaces	j.	+8	+9	+9	+9	+9	+9	+9	+9
Enter direct sound pressure, L_p, in room Ref. g. + (h. to j.) = k.	direct L_p in room	k.	59	60	62	60	60	57	53	47
Enter reverberant sound pressure, L_p, room corrections Ref. l. to m.	reverberant L_p sound to room (Fig. 11) 50%	l.	-3	-3	-3	-3	-3	-3	-3	-3
	room type (Fig. 12-16) live room room volume 2000m³	m.	-3	-3	-3	-6	-7	-8	-11	-13
Enter reverberant sound pressure, L_p, room corrections Ref g. + (l. to m.) = n.	reverberant L_p in room	n.	74	74	76	71	70	66	59	51
Calculate difference in L_p, between k and m. Add correction from Fig. 17 to higher L_p	combined L_p in room (Fig. 17)	o.	74	74	76	71	70	67	60	52
Enter total L_p all systems in room Ref. p.	total all systems in room	p.	74	74	76	71	70	67	60	52
Enter required NR level Ref. q	design criteria (page G-32/33) NR50	q.	75	66	59	53	50	47	45	43
Enter required performance of attenuator Ref. p. - q = r.	attenuation required	r.	-1	8	17	18	20	20	15	9
Enter attenuator selection Ref. s.	attenuator selection RT20E-120-100	s.	4	11	23	34	38	26	16	10
Enter resultant L_p in room Ref. p.- s. = t	resultant L_p in room	t.	70	63	53	37	32	41	44	42
Compare resultant L_p in room Ref. t. to NR curve and enter achieved criteria Ref. u.	criteria achieved (page G-33) NR50	u.	75	65	58	53	50	47	45	44

Example

Airflow required = 6000 l/sec

Estimated static pressure = 300 Pa

Fan selected = AP0804CA9/21

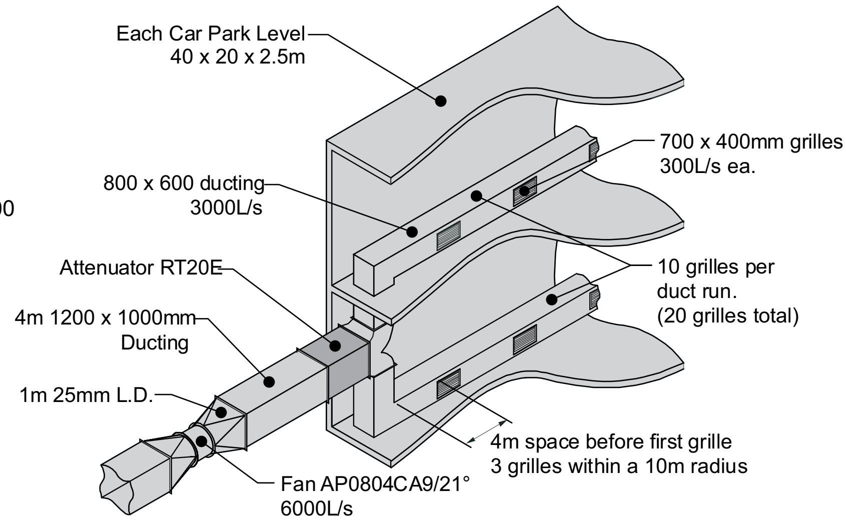
Attenuator selection

- Page G-8 Model RT20E- 120-100

Pressure drop from graph

- Page G-7 a 18 P

Re-check selection for new duty of 6000 l/sec @ 318 Pa - selection OK.



RAPID SYSTEM ANALYSIS EXAMPLE

Ref a.

Sound Power Level of Fan

The sound power level is defined as the rate of acoustic energy flow. While sound power levels are a good reference level due to the fact that they do not change due to surroundings, the ear only hears sound pressure.

Therefore, we must perform an acoustic analysis to convert the fan's sound power levels into a sound pressure level so that we can determine the actual noise level that the listener will hear.

Enter losses due to transmission through duct system. (Ref b. to f.)

Ref b.

Approximate attenuation in plain sheet metal ducts with the minimum cross sectional dimension d.

Losses in plain duct are shown in Figure 3.

Lengths of ductwork will provide small amounts of attenuation, therefore we have to allow for any attenuation effects along our duct run.

For each section of duct determine the minimum cross sectional dimension (d in mm), along with the length of duct.

Ref c.

Approximate attenuation of 90° bends without turning vanes (unlined).

Losses in 90° branches and bends are shown in Fig 4.

Determine the d dimension of the bend in mm.

It is assumed that only 90° square bends without turning vanes will have attenuation effects. For all other types of bends, assume the attenuation effects to be 0 dB.

Ref d.

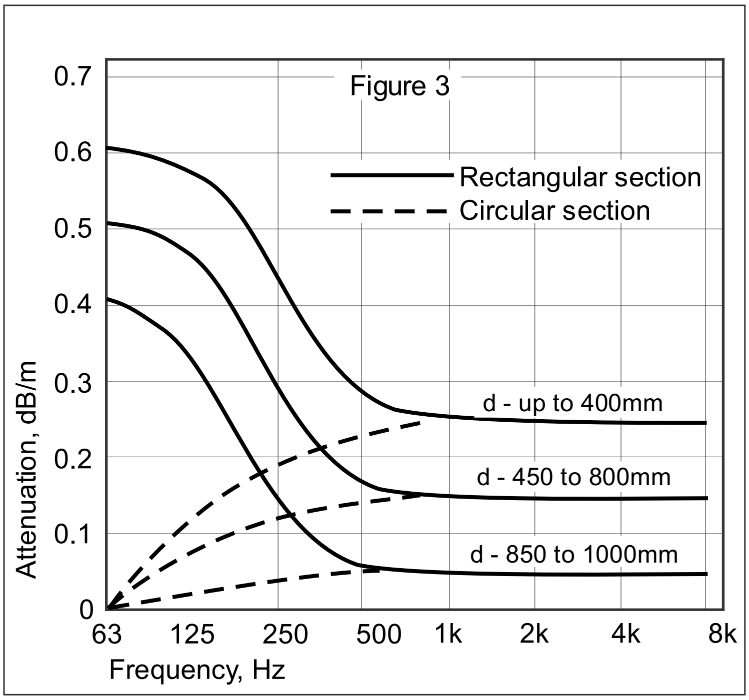
Approximate attenuation of internally lined ducts and bends

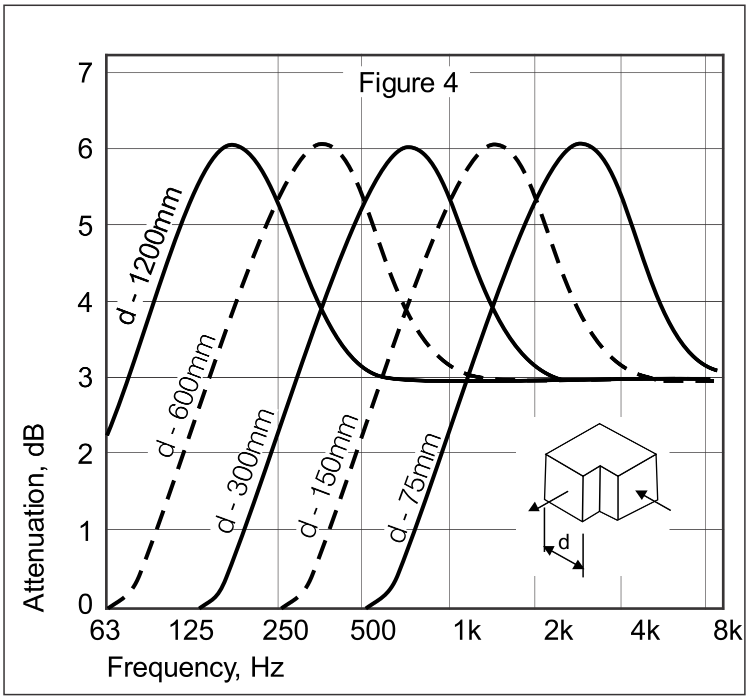
Lined Ducts

Lined duct attenuation data is shown on page G-24.

Width (mm): The internal width of the internally insulated duct.
Height (mm): The internal height of the internally insulated duct.
Length (m): The length of lined duct in meters.
Insulation thickness (mm): The thickness of the acoustic insulation lining the ductwork.

These insertion losses are based on data from the 1995 A.S.H.R.A.E. Application Manual. This is based on standard duct lining with insulation densities between 24 and 48kg/m³.
It is good practice to limit the maximum insertion loss achievable with lined duct to 40 dB in any frequency to account for flanking losses.





Lined Bends

Lined bend attenuation data is shown on page G-26.

Determine the width (d) of the bend in mm.

Choose whether the bend is with or without turning vanes.

To achieve the data shown, the bend must be lined for a length of 2d before and after the bend, and the insulation thickness should be 10% of d.

These insertion losses are based on data form the 1995 A.S.H.R.A.E. Application Manual. These figures are for standard duct lining between 24 and 48kg/m³.

Table 1: 25mm lined duct

Width	Height	Insertion Loss, dB/metre							
		Octave Band Centre Frequency (Hz)							
(mm)	(mm)	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	Height	Insertion Loss, dB/metre							
		Octave Band Centre Frequency (Hz)							
(mm)	(mm)	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

	Insertion Loss, dB/bend							
	Octave Band Centre Frequency (Hz)							
d (mm)	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

	Insertion Loss, dB/bend							
	Octave Band Centre Frequency (Hz)							
d (mm)	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

Ref e.

Additional Effects.
The additional Effects section is designed to allow the user to enter extra attenuation / amplification components where no data is available in this Rapid System Analysis.

Typical additional effects could be:
- Factors of safety or tolerances
- Other lined duct / bend data not shown in the tables.
- Radius bends, bends with turning vanes, etc.
- Additional level due to multiple fans.
- Extra lengths of duct, or additional bends.

For attenuation effects, negative values must be used, while amplification requires positive values to be used.

Tolerance

It is always safe to add a safety tolerance to calculations to ensure that the calculation includes factors such as fan and silencer testing tolerances, and any other uncertainties in the calculation.

Ref f.
Attenuation at duct outlet
Losses at noise outlets are shown in Fig 5.
When a sound reaches an opening, some of the sound reflects back up the duct from where it came due to a phenomenon called end reflection.

Use the noise path outlet size in square meters (m²).

Reg g.
Sound Power Leaving System
Sound power leaving system is the total sound power which is at the outlet grille.

Note: Calculating the noise at the nearest grille will, in most cases, give a worst case scenario for noise calculations.
Enter sound power leaving system g. - a.-(b. to f.)

Sound pressure level at any point has two components (Direct and Reverberant sound pressure levels)
Direct Sound Pressure - due to energy radiated directly form outlet to receiver depends upon the following.
Enter direct sound pressure corrections (Ref h. to k.)

Ref h.

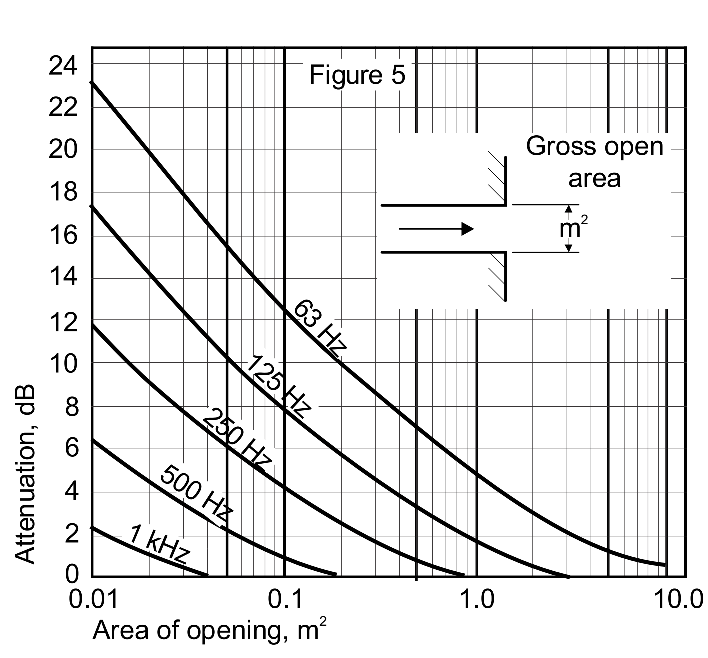
Percentages of total Sound Pressure reaching outlet.

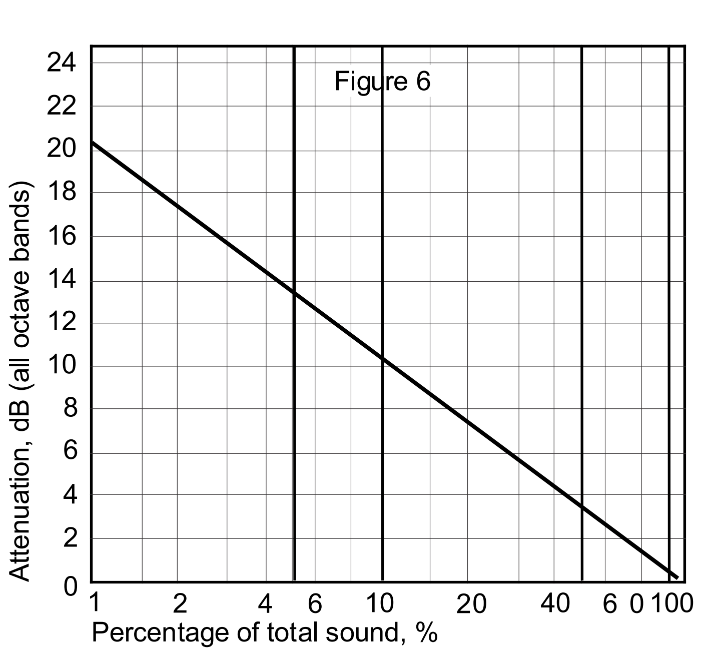
Percentages of sound pressure reaching outlet are shown in Fig 6. Determine the percentage of noise reaching the outlet.
Hint: The percentage of noise reaching the outlet is virtually the same as the percentage of airflow reaching an outlet.
It should be noted that if noise from more than one grille exhausts into an area, the noise from these extra grilles will need to be accounted for by performing an acoustic analysis for each grille and logarithmically adding the resultant noises together.

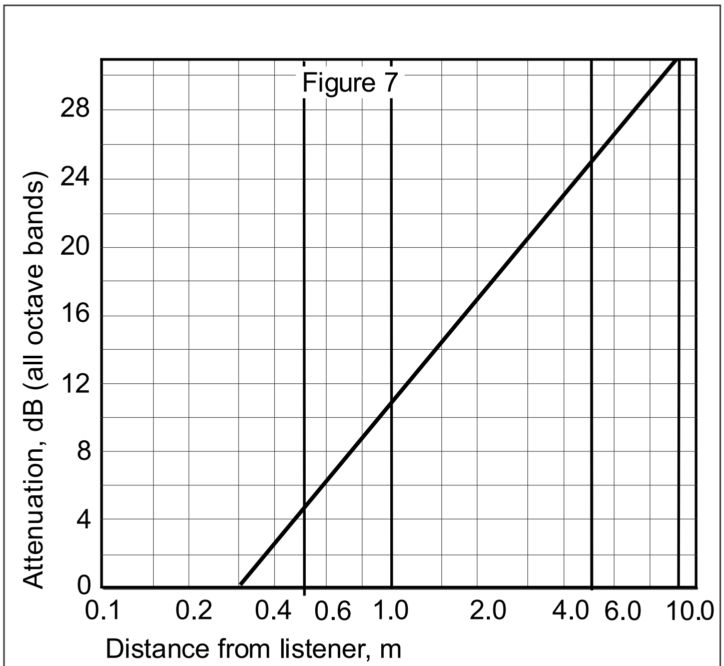
Another method is to consider the number of grilles that have direct sound pressures within 10 dB of the noisiest grille by calculating the reduction in noise due to distance. (eg. increasing the distance from 3m to 10m gives a 10 dB reduction in direct sound pressure levels.)

Ref I.
Attenuation of direct sound with distance from terminal.
The further you are away from a noise source, the less direct noise will be present.

Distance from listener to outlet corrections shown in Fig 7.







Ref j.

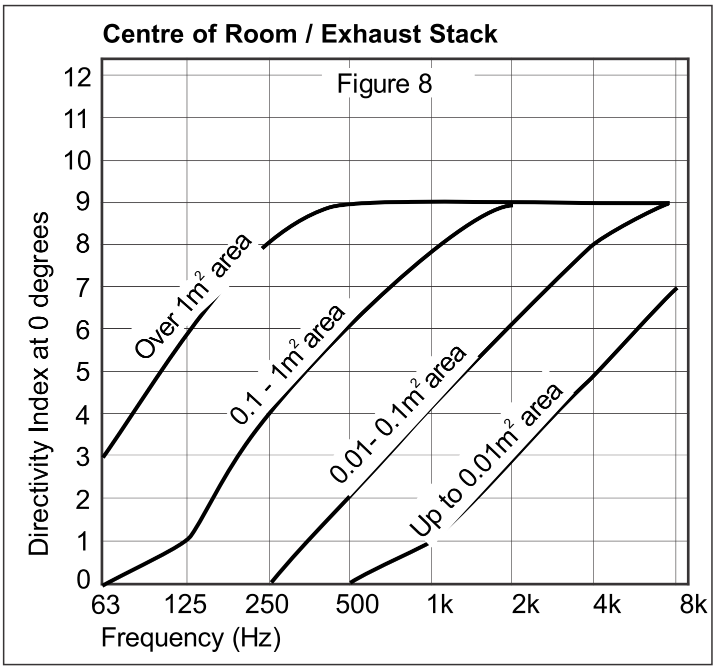
Approximate correction for directivity on terminal unit axis.

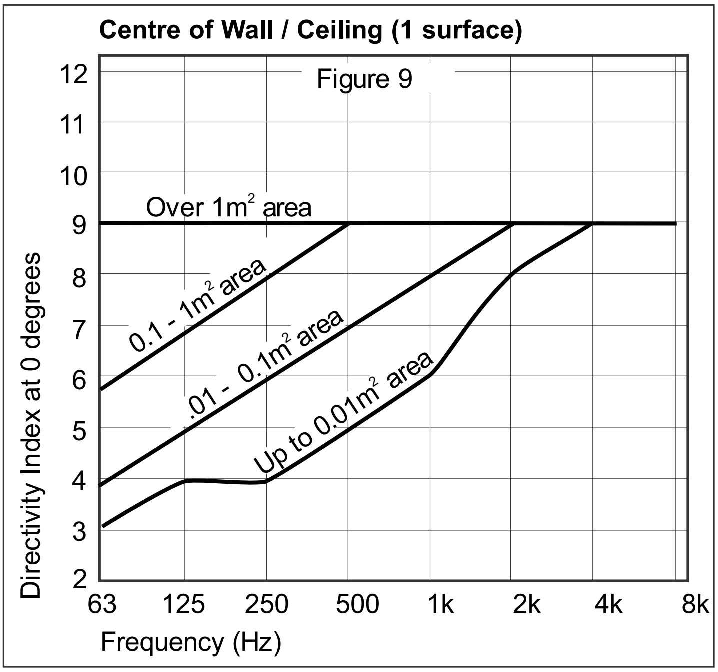
Directivity corrections shown in Fig 8 to 10
Directivity is a measure of the directional effects of a noise source.
Directivity is a combination of the position of the grille relative to walls, and the size of the grille.
Determine the grille size, and the position of the grille.
Hint: For the 'position of grille' options, if the grille is within 1m of each surface, it is considered to be near that surface. For instance, if a grille is in the ceiling, and less than 1m from the closest wall, but all other surfaces are greater than 1m away, the grille is close to 2 surfaces (Ceiling and 1 Wall)
If the grille is in the corner of a room, (adjacent to 3 surfaces)
add 9 dB at all frequencies.

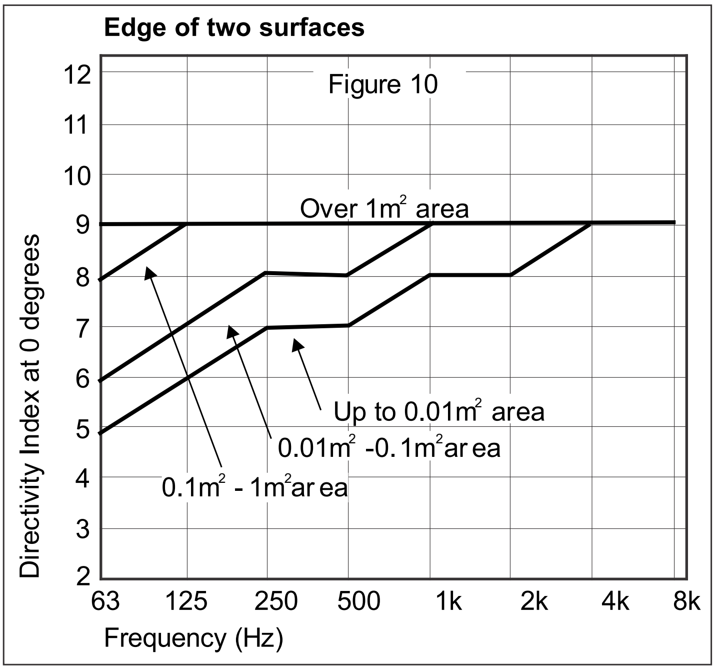
Ref k.

Direct sound pressure level at a distance.

The direct sound pressure level at a distance from the noise terminal
If the area being analyzed is outside there is generally very little reverberant sound, and the direct sound would therefore be the total sound level.
Enter direct sound pressure level in area Ref g + (h to j)







Reverberant Sound Pressure Level - due to energy reaching the receiver after multiple reflections from room surfaces and depends on the following. Note that reverberant sound pressure will not exist in the open air and will be zero at all frequencies.
Enter reverberant sound corrections (Ref l. to m)

Ref l.

Percentages of total sound pressure reaching the area.

The Percentages of sound pressure reaching an area are shown in Fig 11.
The percentage of noise (flow) which enters the area.
If, for instance, one fan was serving a room with 4 grilles then 100% of the reverberant sound would go to the room, while only 25% of the direct sound would reach each grille.
If a fan served two rooms (with equal flow to each room), the percentage of reverberant sound reaching each room would only be 50%.

Ref m.

Correction for room volume and acoustic absorption.

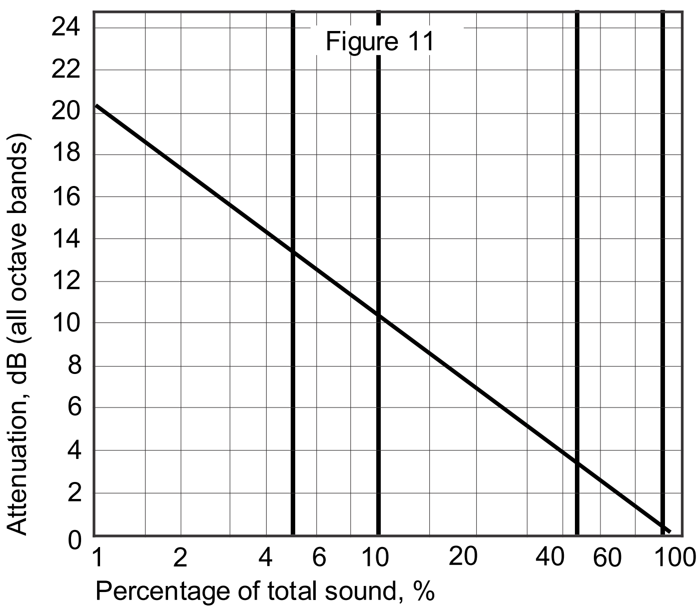
The corrections for room volume and acoustic absorption are shown in Fig 12 to 16.
The amount of acoustical absorption in a room and the volume of abn area will affect the amount of reverberant sound in the room, but will not affect the direct sound level. Increased amounts of acoustic absorption and large areas will reduce the amount of reverberant sound pressure level. Typical examples of acoustic absorption in rooms are as follows.
Live Room:
Factories, Plant Rooms, Swimming Pools and Gymnasiums.
Medium Live Room:
Bathrooms, Kitchens, Schoolrooms, and Hospitals.
Average Room (Office Environment):
Offices, Libraries, Homes, Hotel Rooms, and Lecture Halls,
Medium Dead Room:
Cinemas, and Music Practice Rooms.
Dead Room:
Examples of this type of room are recording studios and TV. studios.

The correction for reverberant sound pressure depends on both the amount of acoustic absorption in an area and the room volume (in m³).

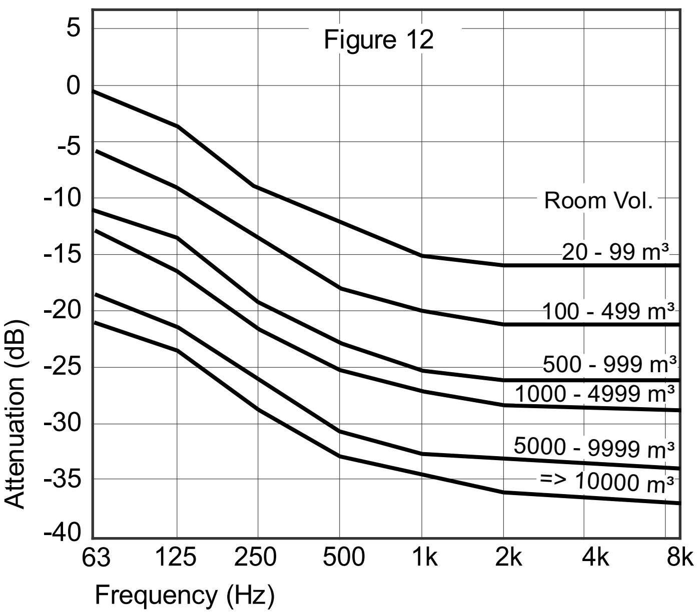
The options available to choose from are as follows:

Small	20 - 99 m³
Small - Medium	100 - 499 m³
Medium	500 - 999 m³
Large	1,000 - 4,999 m³
Very Large	5,000 - 9,999 m³
Extra Large	=> 10000 m³

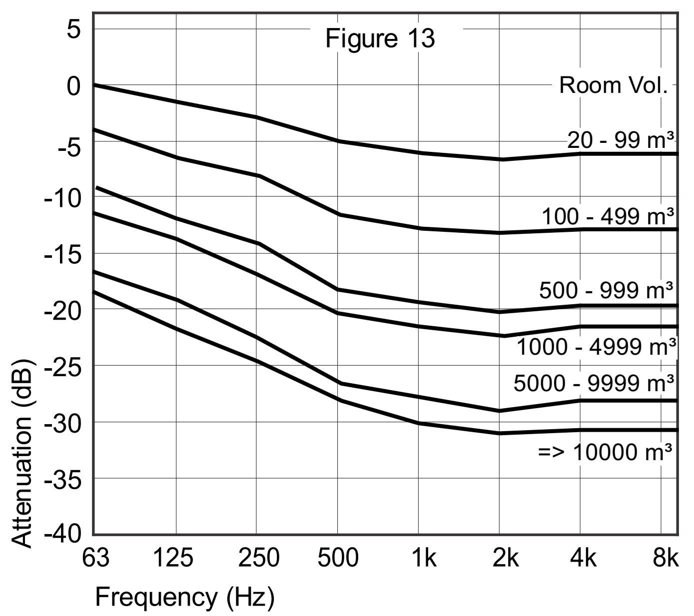
Percentages of total sound pressure



Dead room



Medium Dead Room



Average Room (Office Environment)

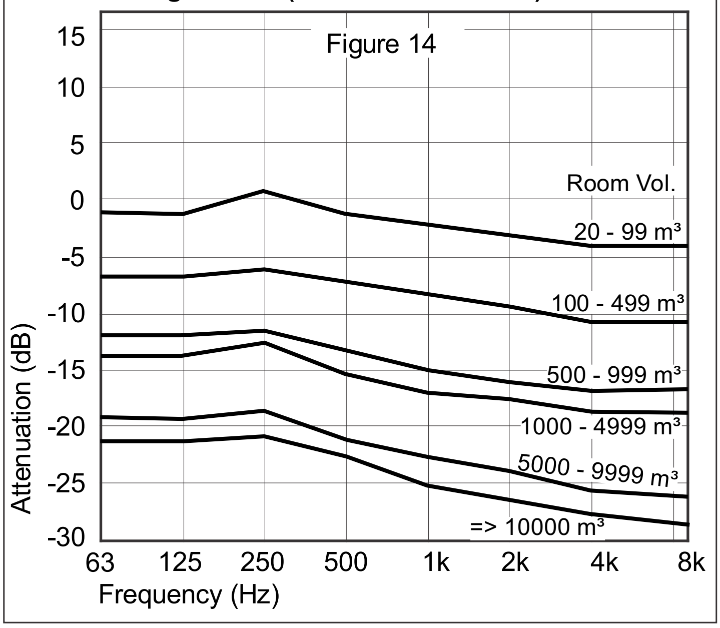


Figure 14

Medium Live Room

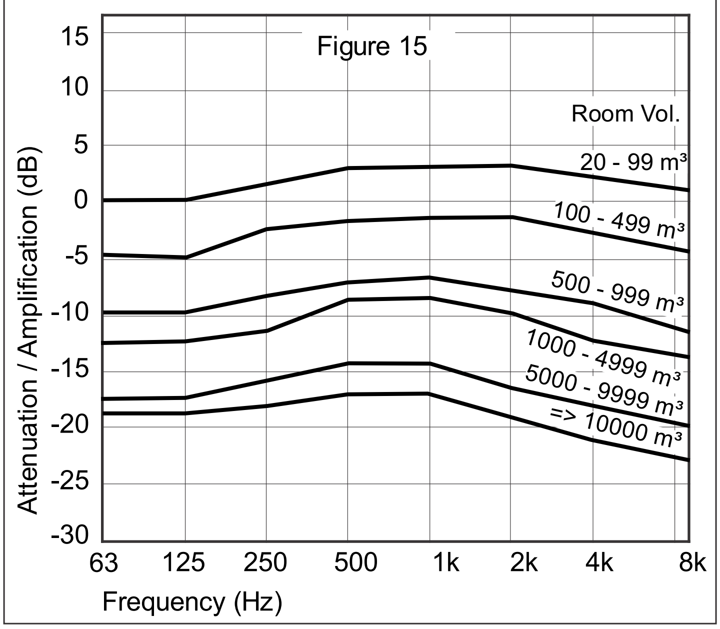


Figure 15

Live Room

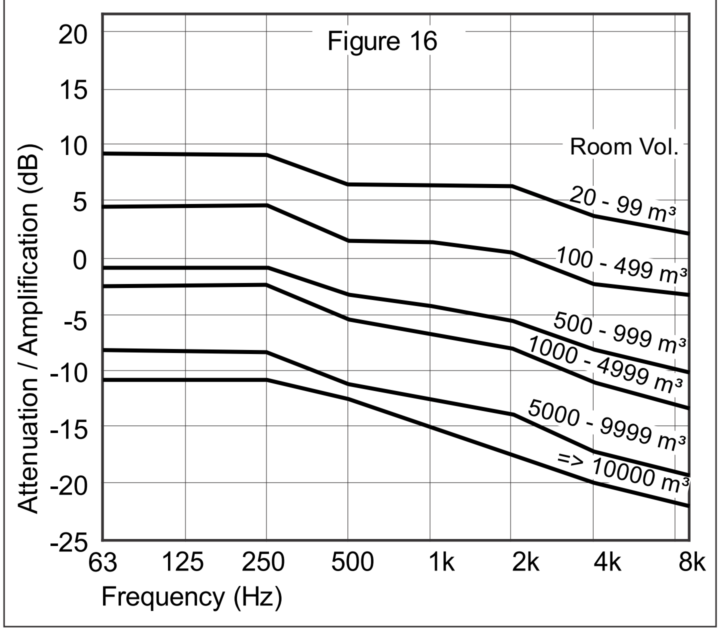


Figure 16

Ref n.

Reverberant Sound Pressure to Area.

This is the total reverberant sound pressure level reaching the room. The total sound pressure level is the sum of the direct and reverberant levels.
Enter reverberant sound pressure level in area. Reg g. + (l. to m)

Ref o.

Total Sound Pressure at Distance.

The total sound pressure level is the combination of direct sound pressure and reverberant sound pressure (Use Figure 17 to add noise levels together logarithmically)

Enter total sound pressure level for system. Calculate difference in sound pressure level between k. and n. and add correction from Fig 17.

Ref p.

Total Sound Pressure for Multiple Systems.

If a room is served by more than one system e.g. supply system and exhaust system, the two systems should be worked out separately.

Enter total sound pressure level of all systems. Calculate o. for both systems and add correction from Fig 17.

Ref q.

Required NR/PNC level.

The NR curves are designed to predict community reaction to noise in general areas and also give us a good representation as to how the ear actually assesses noise.

Determine the desired NR level using page G-32.

Enter required NR level from Fig 18.

If PNC curves are being used, enter required PNC level from Fig 19.

Ref r.

Attenuation required to achieve required NR level.

This is the extra attenuation required to achieve the required noise criteria (NR).

Therefore if we select an attenuator with the insertion loss required, we should achieve the criteria specified.

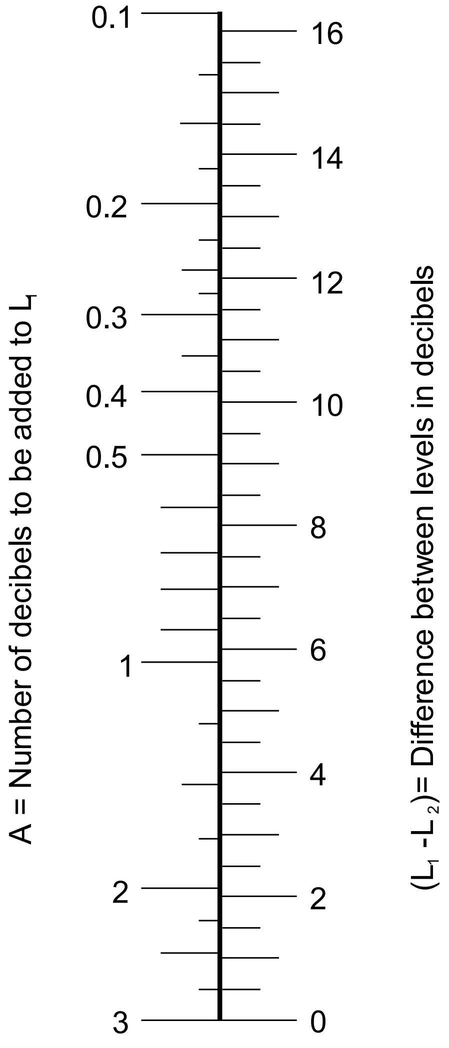
Required performance of attenuator is Ref p. - q.

Ref s.

Attenuator selection

Select a attenuator from the AMS catalogue.
Enter insertion loss of attenuator.

Figure 17



Ref t.

Resultant Sound Pressure level at Distance.

This is the total sound pressure level after the attenuator has been added to the system.

Enter resultant sound pressure in room Ref p. - s.

Ref u.

Criteria achieved.

The resultant NR/PNC level after the attenuator has been inserted into the system.

Compare resultant sound pressure in room to NR/PNC curve and enter achieved criteria.

Environment		NR Curve	Recommended design sound level, dB(A) Satisfactory	Maximum
Office Buildings	General open Offices, reception areas	40	40	45
	Conference rooms	30	30	40
	Executive Offices	35	35	40
	Foyers	45		
	Public Areas	45	40	50
	Computer rooms	45	45	50
	Undercover Carparks	50-60*	55	65
Hospital	Hospital wards	35	35	40
	Intensive care wards, operating theatres	30	40	45
	Laboratories	40	45	50
	Casualty areas	40	40	45
	Kitchens, sterilising and service areas	45	50	55
	Surgery, dental clinics and consulting rooms	40	40	45
	Waiting rooms and reception areas	45	40	50
Schools	Classrooms	35	35	45
	Lecture theatres without speech reinforcement	30	30	35
	Lecture theatres with speech reinforcement	-	35	45
	Conference rooms	30	35	40
	Assembly halls up to 250 seats	30	30	40
	Assembly halls over 250 seats	30	30	35
	Recreation halls	40	-	-
	Gymnasiums	40	45	55
	Laboratories (Working)	45	40	50
	Engineering workshops	45	50	60
	Music practice rooms / office areas	40	40	45
	Toilets, changing rooms and showers	45	45	55
Radio and T.V. studios	T.V. recording studios	20-25	Note 1*	Note 1*
	Audience studios	30	-	-
Auditoriums and Music Halls	Concert and opera halls	25	Note 1	Note 1
	Music practice rooms	30	-	-
	Cabarets and theatre restaurants	-	35	40
	Lecture Halls	30	-	-
	Lobbies	40	-	-
Hotels / Motels	Dining rooms	40	40	45
	Restaurants	40	45	50
	Sleeping areas near major roads	35	35	40
	Sleeping areas near minor roads	35	30	35
	Kitchens and laundries	45	45	55
	Bars and lounges	45	45	50
Shop Buildings	Supermarkets	50	50	55
	Shopping malls	45	45	55
Public buildings	Municipal building administrative offices	35	35	40
	Library reading areas	35	40	45
Indoor sports buildings	Billiards and snooker rooms	45	40	45
	All other indoor sports with coaching	-	45	50
	All other indoor sports without coaching	-	50	55
	Gymnasiums, squash courts and bowling alleys	50	-	-
	Swimming pools	55	-	-
General Service areas for all buildings	Toilets	45	50	55
	Corridors	45	45	50
	Plant rooms	70	-	-

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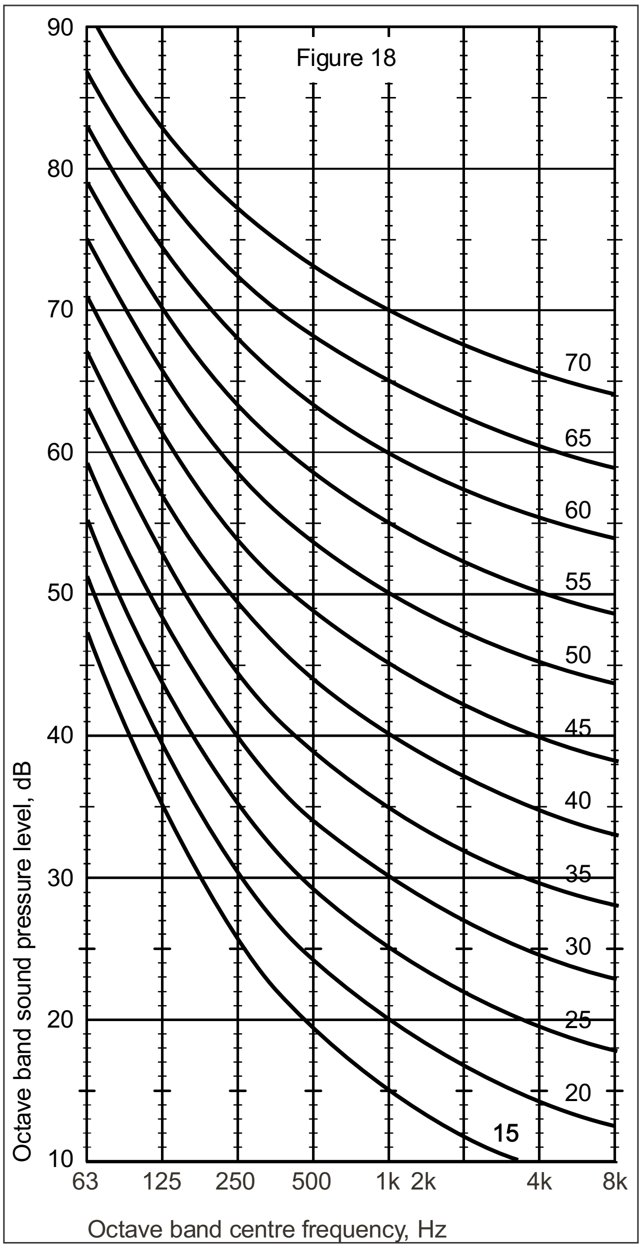
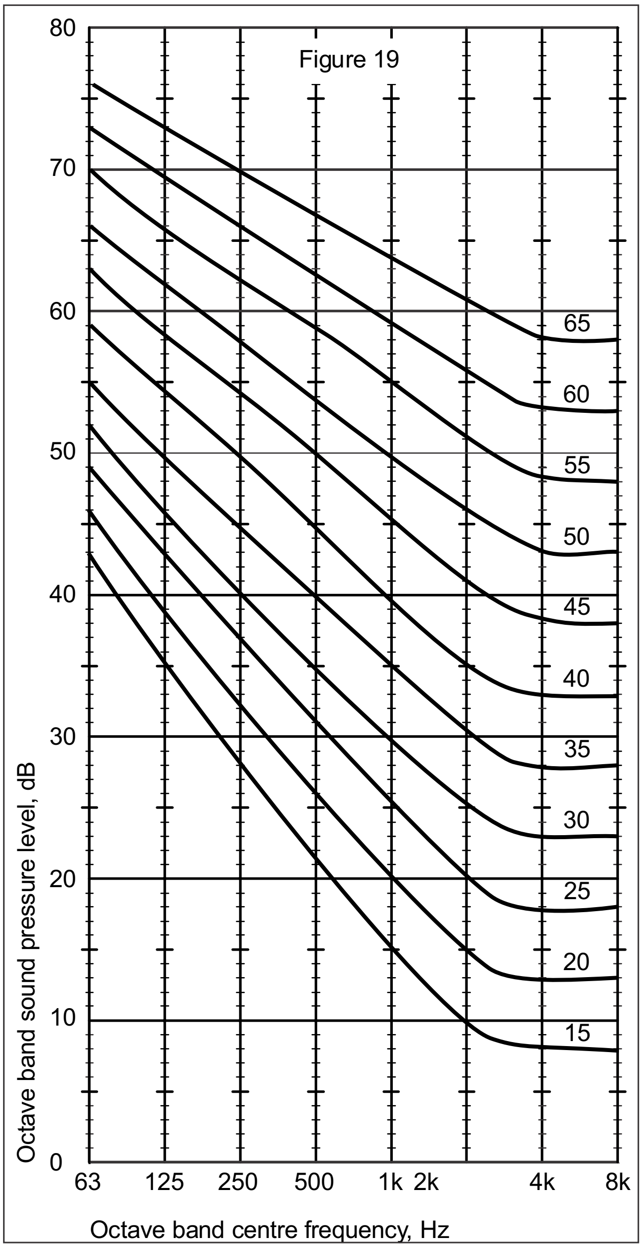
The NR data is extracted from the Handbook which is available from the AIRAH Office at Level 7. 1 Elizabeth Street, Melbourne, Victoria, 3000.
More complete dB(A) data is available from AS/SNX 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors
Note 1: Specialist advice should be sought for these spaces * Added by Fantech.

Noise Rating Curves



Preferred Noise Criterion Curves



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.

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 (e.g. motors, engines), and do not allow for the increased annoyance associated with tonal, or pulsating noises.

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.

Acknowledgment

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