FAN NOISE

Type of fan	4	*4, Centrifugal – Forward Curved*
Q	4760	CMH
P	500	Pa
Q	2800	CFM
P	2.01	" H20
eff	0.8	
Cn	4.0	

Octave Band	2	3	4	5	6	7
Mid Frequency (Hz)	125	250	500	1000	2000	4000
Cn	*38*	*38*	*34*	*28*	*24*	*21*
Lw (dB)	**83**	**83**	**79**	**73**	**69**	**66**

Lw = Kw + 10 log(Q) + 20 Log(P) + BFI + Cn

Lw= sound power level (dB)
Kw = specific sound power level depending on the type of fan (see Fig 9-3), from empirical data provided by fan manufacturer
Q = volume flow rate (cfm)
P = total pressure (inches of H20)
BFI = Blade Frequency Increment = correction for pure tone produced by the blade passing frequency (bpf) from Fig 9-3, add this correction only to the octave band whose center frequency is closest to the blade passing frequency.
bpf= blade passing frequency = #of blades × RPM/60 (Hz)
Cn = efficiency correction (because fans that are operated off their optimum flow conditions get noisier)

PLENUM INSERTION LOSS – S (ASHRAE Applications, 48.2.4)

Type of lining	3	*3, 25 mm, 48 kg/m3*	
l	4.3	m	*(Plenum length)*
w	0.8	m	*(Plenum width)*
h	0.8	m	*(Plenum height)*
V	2.8	cum.m	*(Plenum volume)*
a	0.5	m	*(Inlet width)*
b	0.5	m	*(Inlet height)*
fc	343		*(Critical frequency)*
r	1.3	m	*(Distance between inlet and outlet)*
Sout	0.175	sq.m	*(Area of plenum outlet)*
S	14.44	sq.m	*(Total area of duct minus openings)*
Q	2		*(Directionality factor: 2 for opening near center, 4 for opening near corner)*
Offset angle	4	*4, 30*	*(Sound absorbtion coefficient)*

Octave Band	2	3	4	5	6	7
Mid Frequency (Hz)	125	250	500	1000	2000	4000
αa	*0.11*	*0.28*	*0.68*	*0.9*	*0.93*	*0.96*
OAE	*-2*	*3*	*2*	*4*	*4*	*5*
Af	*0.4*	*0.4*	*0.2*	*0*	*0*	*0*
We	*2*	*5*	*9*	*0*	*0*	*0*
TL (dB)	**20**	**20**	**16**	**19**	**19**	**20**

PLENUM INSERTION LOSS – R1 (ASHRAE Applications, 48.2.4)

Type of lining	3	*3, 25 mm, 48 kg/m3*	
l	4	m	*(Plenum length)*
w	2.4	m	*(Plenum width)*
h	1	m	*(Plenum height)*
V	9.6	cum.m	*(Plenum volume)*
a	0.6	m	*(Inlet width)*
b	0.6	m	*(Inlet height)*
fc	286		*(Critical frequency)*
r	3.3	m	*(Distance between inlet and outlet)*
Sout	0.48	sq.m	*(Area of plenum outlet)*
S	31.16	sq.m	*(Total area of duct minus openings)*
Q	2		*(Directionality factor: 2 for opening near center, 4 for opening near corner)*
Offset angle	7	*7, 90*	*(Sound absorbtion coefficient)*

Octave Band	2	3	4	5	6	7
Mid Frequency (Hz)	125	250	500	1000	2000	4000
αa	*0.11*	*0.28*	*0.68*	*0.9*	*0.93*	*0.96*
OAE	*0*	*0*	*0*	*0*	*0*	*0*
Af	*0.4*	*0.4*	*0.2*	*0*	*0*	*0*
We	*2*	*5*	*9*	*0*	*0*	*0*
TL (dB)	**20**	**20**	**16**	**19**	**20**	**20**

PLENUM INSERTION LOSS – R2 (ASHRAE Applications, 48.2.4)

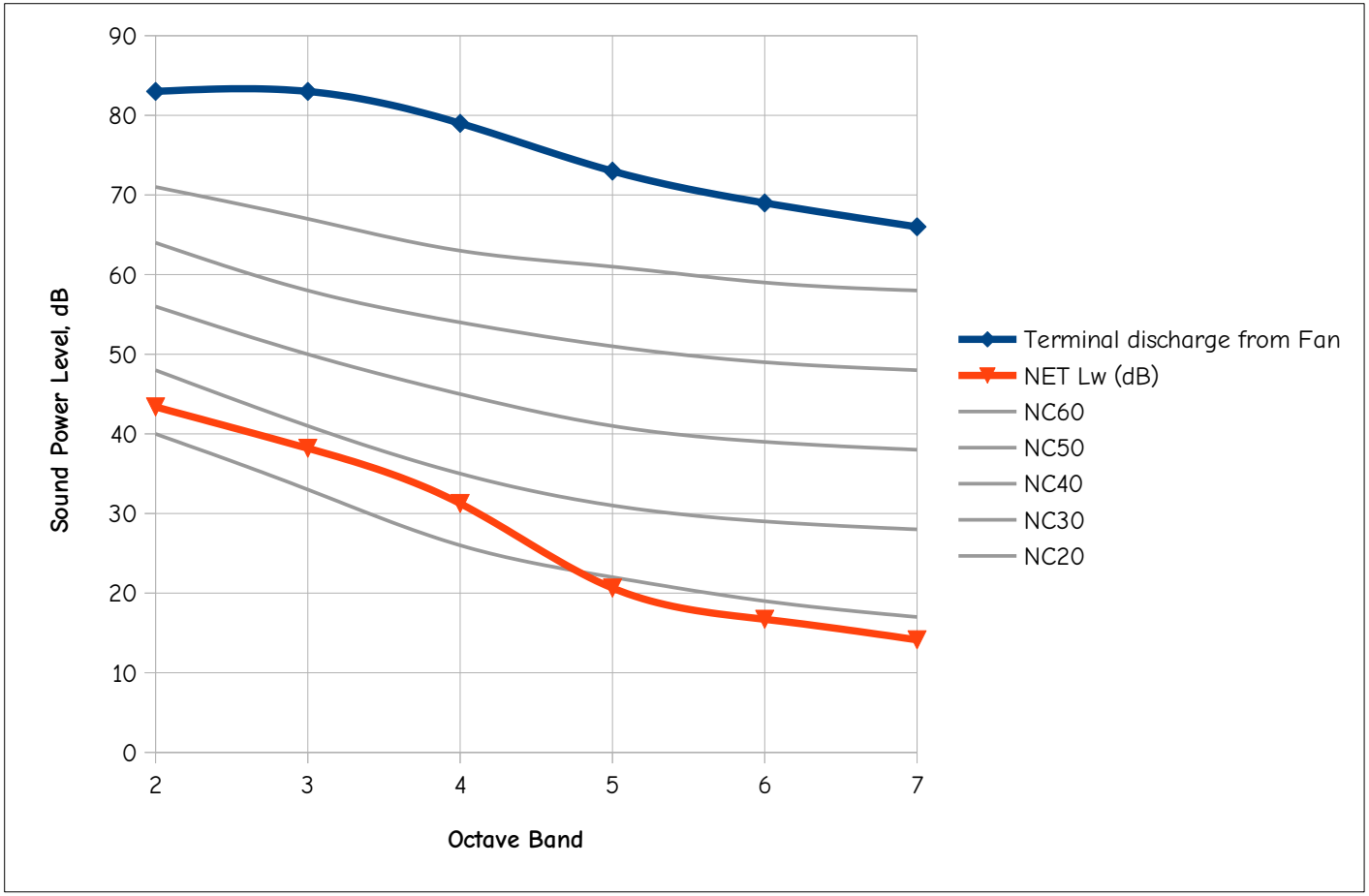
Type of lining	3	*3, 25 mm, 48 kg/m3*	
l	7	m	*(Plenum length)*
w	1.8	m	*(Plenum width)*
h	1.3	m	*(Plenum height)*
V	16.4	cum.m	*(Plenum volume)*
a	1.2	m	*(Inlet width)*
b	0.4	m	*(Inlet height)*
fc	143		*(Critical frequency)*
r	6.2	m	*(Distance between inlet and outlet)*
Sout	0.48	sq.m	*(Area of plenum outlet)*
S	47.12	sq.m	*(Total area of duct minus openings)*
Q	4		*(Directionality factor: 2 for opening near center, 4 for opening near corner)*
Offset angle	6	*6, 45*	*(Sound absorbtion coefficient)*

Octave Band	2	3	4	5	6	7
Mid Frequency (Hz)	125	250	500	1000	2000	4000
αa	*0.11*	*0.28*	*0.68*	*0.9*	*0.93*	*0.96*
OAE	*-6*	*19*	*5*	*9*	*10*	*12*
Af	*0.4*	*0.4*	*0.2*	*0*	*0*	*0*
We	*2*	*5*	*9*	*0*	*0*	*0*
TL (dB)	**20**	**31**	**24**	**32**	**34**	**37**

ROOM ACCOUSTIC CALCULATIONS

	Octave Band	Dia	W	H	t	L/#	2	3	4	5	6	7
	Mid Frequency (Hz)	**(m)**	**(m)**	**(m)**	**(mm)**	**(m)**	**125**	**250**	**500**	**1000**	**2000**	**4000**
I	***Supply discharge path***											
	Terminal discharge from Fan						83	83	79	73	69	66
	Environmental Adjustment Factor						2	1	0	0	0	0
	Lined rectangular duct		0.5	0.5	25	1	0.0	0.0	0.0	0.0	8.7	6.7
	Plenum – S						20.0	20.0	15.8	18.9	19.0	20.1
	Branch power division	0.5	1				3.0	3.0	3.0	3.0	3.0	3.0
	Lined rectangular duct		0.7	0.25	25	2	2.1	4.5	11.3	24.0	22.6	16.2
	Branch power division	0.33	1				4.8	4.8	4.8	4.8	4.8	4.8
	Lined square elbow		0.5	0.3	25	1	1	6	11	10	10	10
	End reflection loss (Flush terminated)	0.339	0.3	0.3			6.3	2.6	0.8	0.2	0.1	0.0
	Space Effect (Multiple outlets)	12	2.8	6			4.1	5.0	5.9	6.8	7.7	8.6
	Lw (dB)						**40**	**36**	**26**	**5**	**0**	**0**
II	***Supply duct breakout path***											
	Terminal discharge from Fan						83	83	79	73	69	66
	Environmental Adjustment Factor						2	1	0	0	0	0
	Lined rectangular duct		0.5	0.5	25	1	0.0	0.0	0.0	0.0	8.7	6.7
	Plenum						20.0	20.0	15.8	18.9	19.0	20.1
	Branch power division	0.5	1				3.0	3.0	3.0	3.0	3.0	3.0
	Lined rectangular duct		0.7	0.25	25	2	2.1	4.5	11.3	24.0	22.6	16.2
	Rectangular duct breakout		0.7	0.25		3.2	6.6	9.6	12.6	15.6	19.6	25.6
	Ceiling Effect (Gypsum board tiles)						16	18	18	21	22	22
	Lw (dB)						**33**	**27**	**18**	**0**	**0**	**0**
III	***Outlet Generated***											

	Diffuser generated noise (NC15)						46	39	32	27	24	22
	Environmental Adjustment Factor						2	1	0	0	0	0
	Space Effect (Multiple outlets)	12	2.8	6			4.1	5.0	5.9	6.8	7.7	8.6
	Lw (dB)						**40**	**33**	**26**	**20**	**16**	**13**
IV	***Return air discharge path***											
	Terminal discharge from Fan						83	83	79	73	69	66
	Environmental Adjustment Factor						2	1	0	0	0	0
	Plenum – R1						20.0	20.0	16.1	19.2	19.7	20.2
	Plenum – R2						20.0	31.3	24.2	32.3	33.9	36.6
	Branch power division	0.20	1				7.0	7.0	7.0	7.0	7.0	7.0
	End reflection loss (Flush terminated)	0.339	0.3	0.3			6.3	2.6	0.8	0.2	0.1	0.0
	Space Effect (Multiple outlets)	15	2.8	5			4.4	5.3	6.2	7.1	8.0	8.9
	Lw (dB)						**23**	**16**	**25**	**7**	**0**	**0**
V	***Return air radiated path***											
	Terminal discharge from Fan						83	83	79	73	69	66
	Environmental Adjustment Factor						2	1	0	0	0	0
	Plenum – R1						20.0	20.0	16.1	19.2	19.7	20.2
	Plenum – R2						20.0	31.3	24.2	32.3	33.9	36.6
	Ceiling Effect (Gypsum board tiles)						16	18	18	21	22	22
	Lw (dB)						**25**	**13**	**21**	**0**	**0**	**0**
Σ	**NET Lw (dB)**						**43**	**38**	**31**	**21**	**17**	**14**
	NC						**26**					


90
80
70
60
50
40
30
20
10
0
2
3
4
5
6
7
Sound Power Level, dB
Octave Band
Terminal discharge from Fan
NET Lw (dB)
NC60
NC50
NC40
NC30
NC20