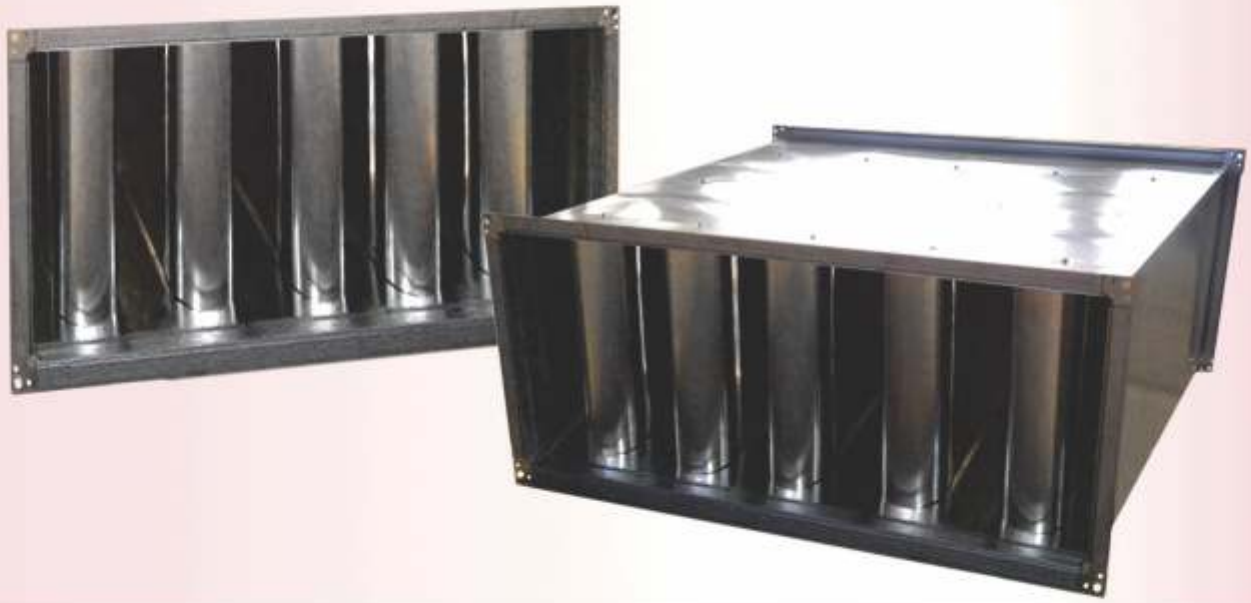
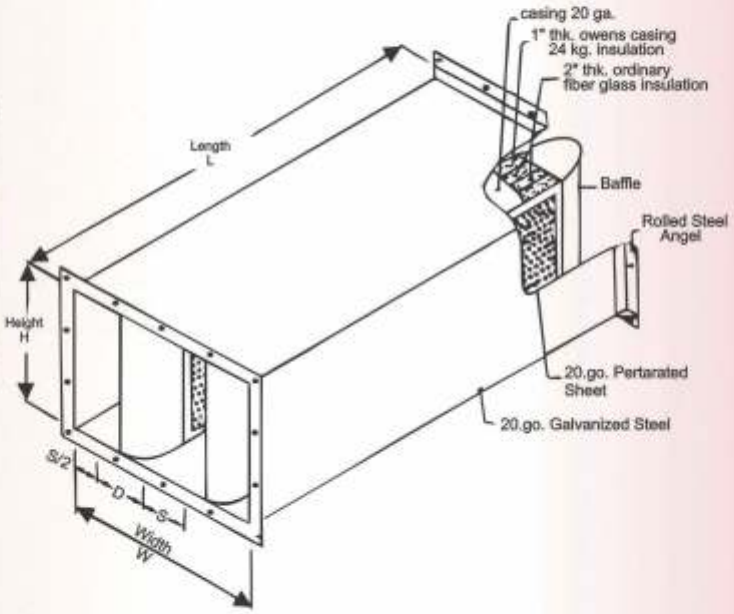
MASTER GRILLE

ماستر غريل



Silencer

SILENCER



PRODUC DESCRIPTION

-Outer Casing : Lock formed, 20 gauge galvanized sheet steel constructed to the relevant 'HVAC' duct work specification where applicable. All fixing are by rivets for strength and rigidity.

-Baffles: They are made of 20 gauge perforated galvanized steel filled with an inorganic sound absorbing material that is resistant to vermin and moisture.

-Flanges: Rolled steel angle flanges securely welded to the attenuator casing. Flanges are predrilled, See page for flange sizes and drilling details.

-Finish: Galvanized mild steel with flanges finished in one coat of primer paint.

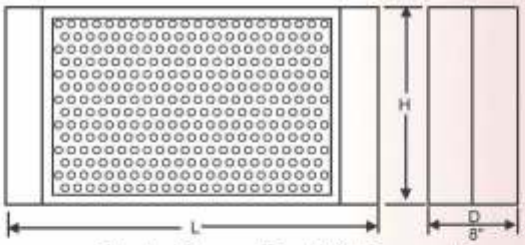
-NOTES:

Standard Pressure Drop: D = 8"
S = 3" to 8"

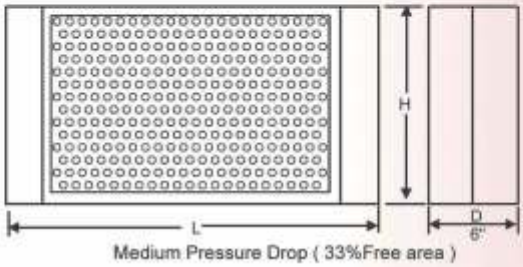
Medium Pressure Drop: D = 6"
S = 2.5" to 6"

Low Pressure Drop: D = 4"
S = 1.5" to 4"

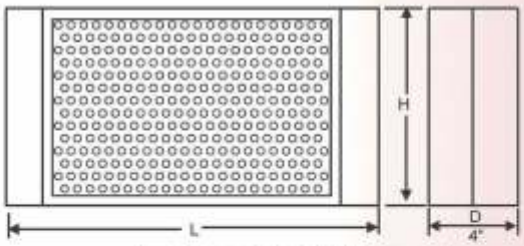
BAFFLE DETAIL (With Perforated)



Standard Pressure Drop (25% Free area)



Medium Pressure Drop (33%Free area)



Low Pressure Drop (50% Free area)

AERODYNAMIC PERFORMANCE

Standard Pressure Drop

Length (Inches)		Static Pressure Drop (in. w.g.)									
36		0.12	0.18	0.28	0.34	0.40	0.48	0.65	0.74	0.83	0.93
60		0.14	0.22	0.35	0.42	0.50	0.59	0.78	0.89	1.00	1.13
84		0.17	0.25	0.39	0.48	0.57	0.67	0.89	1.01	1.12	1.29
Sizes	Face	Face Velocity (fpm)									
WxH	Area	650	800	1000	1100	1200	1300	1500	1600	1700	1800
(in.)	(Sq.ft)	Air Volume (cfm)									
12x6	0.5	325	400	500	550	600	650	750	800	850	900
12x12	1.0	650	800	1000	1100	1200	1300	1500	1600	1700	1800
12x18	1.5	975	1200	1500	1650	1800	1950	2250	2400	2550	2700
12x24	2.0	1300	1600	2000	2200	2400	2600	3000	3200	3400	3600
12x30	2.5	1625	2000	2500	2750	3000	3250	3750	4000	4250	4500
24x18	3.0	1950	2400	3000	3300	3600	3900	4500	4800	5100	5400
24x24	4.0	2600	3200	4000	4400	4800	5200	6000	6400	6800	7200
24x30	5.0	3250	4000	5000	5500	6000	6500	7500	8000	8500	9000
24x36	6.0	3900	4800	6000	6600	7200	7800	9000	9600	10200	10800

Medium Pressure Drop

Length(Inches)		Static Pressure Drop (in. w.g.)									
36		0.04	0.08	0.13	0.20	0.27	0.34	0.43	0.52	0.61	0.67
60		0.04	0.11	0.16	0.26	0.34	0.44	0.54	0.65	0.78	0.84
84		0.06	0.12	0.18	0.29	0.37	0.47	0.59	0.71	0.85	0.92
Sizes	Face	Face Velocity (fpm)									
WxH	Area	650	900	1100	1400	1600	1800	2000	2200	2400	2500
(in.)	(sq.ft.)	Air Volume (cfm)									
12x6	0.5	325	450	550	700	800	900	1000	1100	1200	1250
12x12	1.0	650	900	1100	1400	1600	1800	2000	2200	2400	2500
12x18	1.5	975	1350	1650	2100	2400	2700	3000	3300	3600	3750
12x24	2.0	1300	1800	2200	2800	3200	3600	4000	4400	4800	5000
12x30	2.5	1625	2250	2750	3500	4000	4500	5000	5500	6000	6250
24x18	3.0	1950	2700	3300	4200	4800	5400	6000	6600	7200	7500
24x24	4.0	2600	3600	4400	5600	6400	7200	8000	8800	9600	10000
24x30	5.0	3250	4500	5500	7000	8000	9000	10000	11000	12000	12500
24x36	6.0	3900	5400	6600	8400	9600	10800	12000	13200	14400	15000

Low Pressure Drop

Length(Inches)		Static Pressure Drop (in. w.g.)									
36		0.05	0.08	0.12	0.17	0.21	0.26	0.30	0.35	0.41	0.46
60		0.06	0.10	0.15	0.22	0.27	.32	0.38	0.45	0.51	0.59
84		0.07	0.12	0.18	0.26	0.31	0.38	0.45	0.52	0.60	0.69
Sizes	Face	Face Velocity (fpm)									
WxH	Area	900	1200	1500	1800	2000	2200	2400	2600	2800	3000
(in.)	(Sq.ft.)	Air Volume (cfm)									
12x6	0.5	450	600	750	900	1000	1100	1200	1300	1400	1500
12x12	1.0	900	1200	1500	1800	2000	2200	2400	2600	2800	3000
12x18	1.5	1350	1800	2250	2700	3000	3300	3600	3900	4200	4500
12x24	2.0	1800	2400	3000	3600	4000	4400	4800	5200	5600	6000
12x30	2.5	2250	3000	3750	4500	5000	5500	6000	6500	7000	7500
24x18	3.0	2700	3600	4500	5400	6000	6600	7200	7800	8400	9000
24x24	4.0	3600	4800	6000	7200	8000	8800	9600	10400	11200	12000
24x30	5.0	4500	6000	7500	9000	10000	11000	12000	13000	14000	15000
24x36	6.0	5400	7200	9000	10800	12000	13200	14400	15600	16800	18000

Air Pressure Drop Calculations:

1- Determine the face velocity in feet Per minute through the silencer (s) By dividing cfm by the silencer Face area in square feet.

2- Enter the table for the appropriate silencer model at the above face velocity and read up to the pressure drop at the required length.

Example:- A Medium model Rectangular silencer is 24" wide x 36" high x 60" length and it handles 10,000 cfm.
Determine the static pressure drop.
Solution : The face area is

$$\frac{24 \times 36}{144} = 6 \text{ Sq. ft.}$$

$$\frac{10{,}000 \text{ cfm}}{6 \text{ Sq. ft.}} = 1667 \text{ fpm face velocity.}$$

In the Model SA40-LPD Table Below, interpolating between 1500 and 1800 fpm, the static pressure drop is approximately 0.18" w.g.

DYNAMIC INSERTION LOSS (dB)

Standard Pressure Drop

Length (inches)	Face Velocity (fpm)	Octave Band Center Frequency (Hz)							
		1	2	3	4	5	6	7	8
		63	125	250	500	1k	2k	4k	8k
36	0	5	8	18	29	33	33	22	15
	1000	5	7	17	27	33	32	22	14
	2000	3	7	16	26	33	32	22	14
60	0	6	12	24	40	54	53	34	20
	1000	6	11	24	40	54	50	34	20
	2000	5	10	23	38	50	48	32	20
84	0	8	17	37	46	57	60	51	28
	1000	7	16	33	45	57	58	50	29
	2000	5	14	33	45	54	54	50	29
120	0	9	24	44	48	59	65	63	40
	1000	8	23	44	48	59	65	62	42
	2000	7	21	41	46	56	62	58	42

Medium Pressure Drop

Length (inches)	Face Velocity (fpm)	Octave Band and Center Frequency (Hz)							
		1	2	3	4	5	6	7	8
		63	125	250	500	1k	2k	4k	8k
36	0	3	7	12	22	30	28	18	14
	1000	3	6	12	20	30	28	18	14
	2500	2	4	11	20	28	27	17	13
60	0	5	9	18	35	50	47	28	17
	1000	5	9	18	34	49	47	27	18
	2500	4	8	17	32	46	47	27	20
84	0	6	12	26	44	58	60	34	20
	1000	6	11	26	43	58	60	35	22
	2500	5	10	24	42	56	54	36	24
120	0	7	20	39	48	60	65	58	28
	1000	7	20	38	47	59	63	58	32
	2500	6	18	34	47	56	58	56	37

Low Pressure Drop

Length (inches)	Face Velocity (fpm)	Octave Band and Center Frequency (Hz)							
		1	2	3	4	5	6	7	8
		63	125	250	500	1k	2k	4k	8k
36	0	2	7	12	17	25	20	14	10
	1000	2	7	11	16	24	19	13	10
	2500	1	5	10	15	22	19	12	9
60	0	3	8	15	28	43	34	20	12
	1000	2	7	14	27	42	33	20	12
	2500	2	7	13	25	41	33	20	12
84	0	6	10	21	37	56	46	25	15
	1000	5	9	20	37	56	46	25	15
	2500	4	8	19	33	54	47	26	16
120	0	6	15	29	47	57	61	38	19
	1000	5	14	27	46	57	61	40	22
	2500	5	13	25	45	55	55	42	24

AIR FLOW GENERATED NOISE (dB re 10 -12 Watts)

Standard Pressure Drop

Face Velocity (fpm)	Octave Band and Center Frequency							
	1	2	3	4	5	6	7	8
	63	125	250	500	1k	2k	4k	8k
1000	50	45	39	35	39	39	35	35
1500	59	55	48	45	45	49	47	46
2000	65	63	55	52	50	56	56	54
2500	72	68	63	60	54	60	62	60

Medium Pressure Drop

Face Velocity (fpm)	Octave Band and Center Frequency (Hz)							
	1	2	3	4	5	6	7	8
	63	125	250	500	1k	2k	4k	8k
1000	50	42	33	32	34	30	25	26
1500	56	51	43	41	41	42	40	36
2000	60	57	51	47	46	51	50	44
2500	67	63	56	52	50	56	57	52

Low Pressure Drop

Face Velocity (fpm)	Octave Band and Center Frequency (Hz)							
	1	2	3	4	5	6	7	8
	63	125	250	500	1k	2k	4k	8k
1000	52	38	29	30	30	26	20	27
1500	55	48	41	39	39	39	34	33
2000	57	55	49	45	45	48	44	37
2500	65	60	54	50	50	54	52	45

Correction Factors*

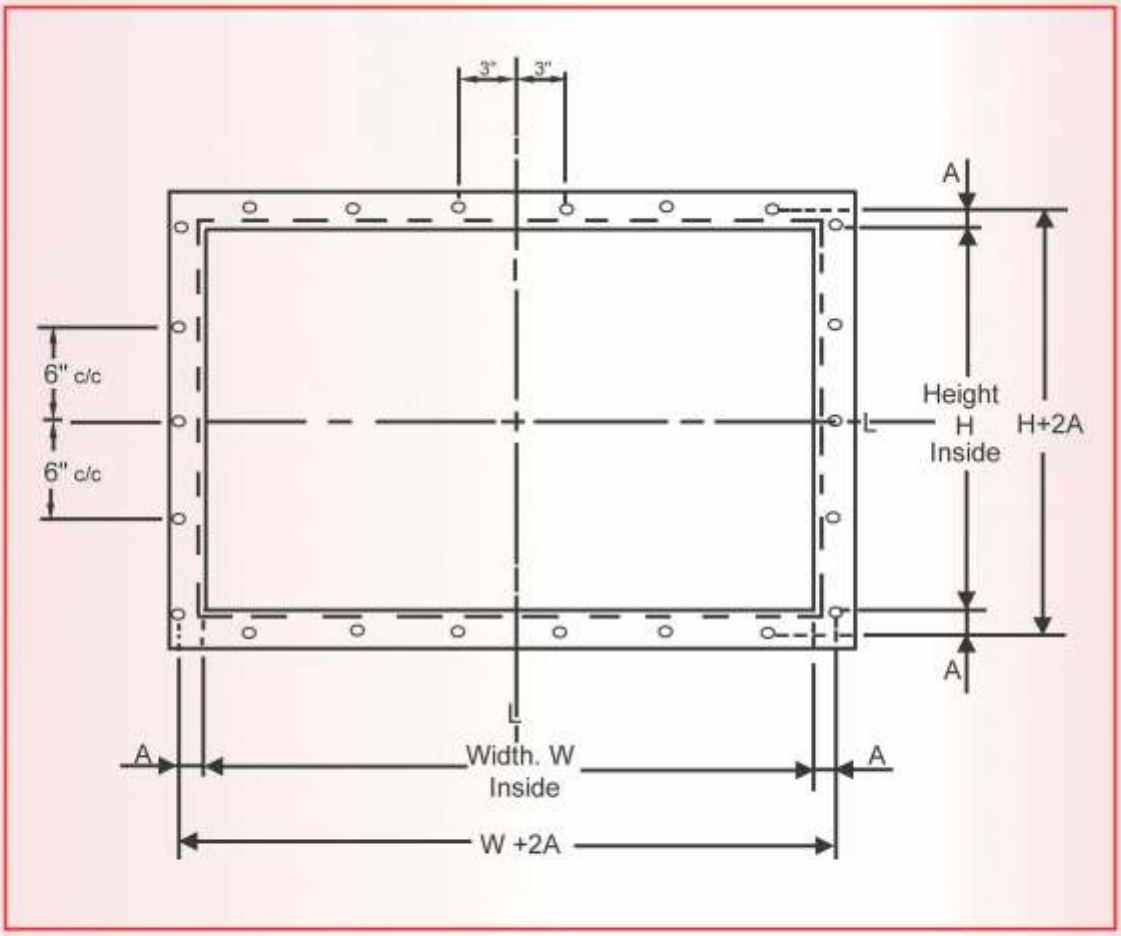
Face area (sq. ft.)	0.5	1	2	2.5	3	4	5	6	8	10	13	16	28	64	132
Correction (dB)	-9	-6	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+9	+12	+15

* The listed air flow generated noise data apply to a face area of 4 square feet. For silencers with other face areas, or for multiple silencers, the above values must be added to the listed air flow generated noise data.

Note : It is imperative to examine both dynamic insertion loss and air flow generated noise when comparing silencer performance data's. Failure to do so may result in incorrect conclusions regarding overall silencer performance, with a consequent undersign of the system.

Depending upon air velocity and source sound power levels, the air flow generated noise may actually become the predominant noise in certain octave bands. In the calculation, lines 10, 12, 13, 14 and 15 are easily calculated and the result will enable the Engineer to accurately assess the overall performance of the silencer.

Standard Drillings and Angle Frame Sizes



Attenuator Perimeter (Inches)	Angle Size (Inches)	Hole Diameter (Inches)	A' (Inches)
36-83	1 x 1 x 1/8	5/16	9/16
84-Up	1-1/2 x 1-1/2 x 3/16	3/8	7/8

Selecting a silencer to meet a room design NC.

Calculation Form

Calculation	Source	Octave Band and CENTER Frequency							
		1 63	2 125	3 250	4 500	5 1k	6 2k	7 4k	8 8k
1. Room design goal NC_____	Table 1								
2. Room attenuation	Table 2								
3. Multiple outlet effect	Table 3	-	-	-	-	-	-	-	-
4. End reflection attenuation	Table 4								
5. Branch power division	Table 5								
6. Elbow attenuation. Noise source to outlet	Table 6								
7. Duct attenuation. Noise source to outlet	Table 7								
8. Terminal unit correction.		-3	-3	-3	-3	-3	-3	-3	-3
9. Allowable Lw at fan discharge	Total lines 1-8								
10. Actual Lw at fan discharge	Fan manu-factures data								
11. Dynamic Insertion Loss (DIL) required	Subtract line 9 form line 10								
12. DIL of selected silencer Our Model ——— Face Velocity ——— fpm.	Our Performance Tables.								
13. Silencer air flow generated noise Lw at ----------fpm. Include air flow generated noise correction factor where required.	Our Performance Tables.								
14. Attenuated fan Lw at silencer discharge.	Subtract line 12 from line 10								
15. Resultant Lw at silencer discharge (compare with line 9)	Combine lines 13 & 14 table8								

Step-by-step outline of calculating procedure:

Line 1 : The specification will usually give a criterion (NC); where one is not given, table - 1 can be used.

The required or selected criterion is inserted in line 1.

Line 2 : calculate the room volume in cubic feet. In table 2 find the attenuation in each octave band, Based on whether the overall surface characteristic of the room is judged to be hard, average or soft.
These attenuation are inserted in line 2.

Line 3 : Multiple outlets in a room will increase the sound level and so must be taken Into account. Insert the correction from table 3 in all 8 octave bands in line 3. This is always negative Quantity.

Line 4 : When low frequency plane sound waves interact with a small diffuser or grille that discharges into a large room, a significant amount of the sound energy incident on this interface is reflected back into the duct (end reflection). In table 4 find the amount of end reflection and enter it in line 4. Use the duct size at connection to the grille or diffuser.

Table-1: NC. (Noise Criterion) Vs. Sound Pressure.

NC Index	Mid - Frequency Octave Band - HZ							
	1 63	2 125	3 250	4 500	5 1k	6 2k	7 4k	8 8k
NC 65	80	75	71	68	66	64	63	62
NC 60	77	72	67	63	61	59	58	57
NC 55	74	67	62	58	56	54	53	52
NC 50	71	64	59	54	51	49	48	47
NC 45	67	60	54	49	46	44	43	42
NC 40	64	57	50	45	41	39	38	37
NC 35	60	52	45	40	36	34	33	32
NC 30	57	48	41	35	31	29	28	27
NC 25	54	44	37	31	27	24	22	21
NC 20	51	40	33	26	22	19	17	16

Table-2: Room Attenuation-Hard, Average and Soft Surfaces

Room Volume in Cubic Feet.	Mid - Frequency Octave Band - HZ							
	1 63 H-A-S	2 125 H-A-S	3 250 H-A-S	4 500 H-A-S	5 1k H-A-S	6 2k H-A-S	7 4k H-A-S	8 8k H-A-S
500	0-1-1	0-2-2	0-3-3	1-3-3	2-4-4	3-5-5	4-6-6	5-7-7
1000	0-2-2	1-3-3	1-4-4	2-5-5	3-6-6	4-7-7	5-8-8	6-9-9
2000	1-4-4	2-5-5	3-6-6	4-7-7	5-7-7	6-8-8	7-9-9	8-10-10
4000	3-5-5	4-6-6	5-7-7	5-8-8	6-9-9	7-10-10	8-11-11	9-12-12
8000	4-7-7	5-8-8	6-9-9	7-10-10	8-10-10	9-11-11	10-12-12	11-13-13
16000	5-8-8	7-9-9	8-10-10	8-11-11	9-12-12	10-13-13	11-14-14	12-15-15

Table -3: Multiple Outlet Effect

No. of outlets	1	2	3	4	5	8	10	20
Gain (Db).	0	3	5	6	7	9	10	13

Table -4: End Reflection Attenuation.

Round duct diameter or greatest dimension of rectangular duct (inches).	Mid - Frequency Octave Band - HZ							
	1 63	2 125	3 250	4 500	5 1k	6 2k	7 4k	8 8k
6	12	6	2	0	0	0	0	0
12	7	2	0	0	0	0	0	0
24	1	0	0	0	0	0	0	0
48 or greater	0	0	0	0	0	0	0	0

Line 5 : When sound travelling in a Duct encounters a junction, the Sound power contained in the Incident sound waves in the main Duct is distributed between the Branch associated with the junction.

Calculate the branch duct area as a Percentage of the main duct. Enter The correction from table 5 at each Octave band in line 5.

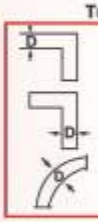
Line 6 : Table 6 displays attenuation In each octave band and for unlined hard duct elbows. The fist figure in each group is for round elbows, second for square elbows with turning vanes, third for square elbows without turning vanes and enter them in line 6.

Line 7 : As with unlined rectangular Ducts, unlined round ducts provide A degree of attenuation. This is Frequency dependent and varies with the duct dimension and duct length, whish should be taken into Account. So, determine the lengths and sizes of all sections of duct. Use table 7 to calculate the attenuation per foot of duct size. Total of these figures are inserted in line 7.

Table -5: Branch Sound Power Division

Branch duct area as % of main duct area	0.2	0.5	1	2	3	5	10	15	20	30	40	50	60
Branch Attenuation (dB)	27	23	20	17	15	13	10	8	7	5	4	3	2

Table -6: The Attenuation of Square Elbows with, Without Air Turns and Round Elbows -dB.



Duct Diameter or Width (D) (inches)	Mid - Frequency Octave Band - HZ							
	1 63	2 125	3 250	4 500	5 1k	6 2k	7 4k	8 8k
5 - 10	0-0-0	0-0-0	0-0-0	0-0-1	1-3-5	2-4-7	3-4-5	3-3-3
11 - 20	0-0-0	0-0-0	0-0-1	1-3-5	2-4-7	3-4-5	3-3-3	3-3-3
21 - 40	0-0-0	0-0-1	1-3-5	2-4-7	3-4-5	3-3-3	3-3-3	3-3-3
41 - 80	0-0-1	1-3-5	2-4-7	3-4-5	3-3-3	3-3-3	3-3-3	3-3-3

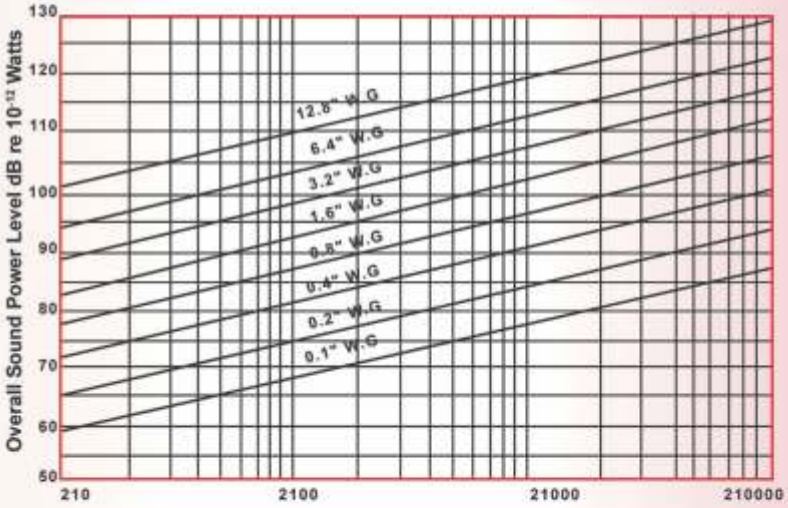
Table -7: The Attenuation of Unlined Duct - dB per Foot.

Rectangular Duct Size (D) (inches)	Mid - Frequency Octave Band - HZ							
	1 63	2 125	3 250	4 500	5 1k	6 2k	7 4k	8 8k
6x6	0.30	0.20	0.10	0.10	0.10	0.10	0.10	0.10
12x24	0.40	0.20	0.10	0.05	0.05	0.05	0.05	0.05
24x24	0.25	0.20	0.10	0.03	0.03	0.03	0.03	0.03
48x48	0.15	0.10	0.07	0.02	0.02	0.02	0.02	0.02
72x72	0.10	0.10	0.05	0.02	0.02	0.02	0.02	0.02
Round Duct Diameter (D) (inches)								
D ≤ 7	0.03	0.03	0.05	0.05	0.10	0.10	0.10	0.10
7 ≤ D ≤ 15	0.03	0.03	0.03	0.05	0.07	0.07	0.07	0.07
15 ≤ D ≤ 30	0.02	0.02	0.02	0.03	0.05	0.05	0.05	0.05
30 ≤ D ≤ 60	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02

Line 8 : The terminal unit correction is a built-in allowance for air noise added to the system by the terminal units. (not fan powered).

Line 9 : Total lines 1 through 8 and insert the amounts in line 9. These are the sound power levels allowable at the fan discharge, if design goal criteria (NC) is to be met with no additional attenuation.

Table -8: In-duct Lw of the Fan



Line 10 : Using the fan manufacturer's Catalogue information, obtain the actual in-duct sound power level at the mid frequency octave bands of interest. Or calculate the approximate in-duct sound power level from table 8. In both cases the approximate duty of the fan needs to be known. These figures are inserted in line 10.

Some manufacturers present noise Data as a sound pressure level which Needs to be converted by applying the Relevant correction factor.

Line 11 : Subtract line 9 from line 10 And insert in line 11. This is the Amount of additional attenuation needed to meet the design goal criteria (NC) level. If line 9 is greater Than line 10, insert 0.

Spectrum Correction								
Frequency Hz	63	125	250	500	1k	2k	4k	8k
Forward Curved Centrifugal	-2	-7	-12	-17	-22	-27	-32	-37
Backward Curved Centrifugal	-7	-8	-7	-12	-17	-22	-27	-32
Axial	-8	-7	-6	-7	-8	-11	-14	-17

Line 12 : If line 11 indicates that additional attenuation needed, select our silencer with dynamic insertion loss (DIL) values that meet or exceed those in line 11. Use static (no-flow) ratings if the sound travels counter to the direction of air flow.

Line 13 : From our performance tables, determine the air flow generated noise for the selected silencer model and face velocity. Include the correction allowance for silencer face area where applicable. These figures are inserted in line 13.

Line 14 : Calculate the attenuated fan sound power level at the silencer discharge by subtracting line 12 from line 10.

Line 15 : To obtain the resultant sound power level (Lw) at the discharge of the silencers. Line 13 and 14 must be combined.

Note : To arrive at the combined sound power level, it is necessary to logarithmically. This can be simplified by using table 9, as shown in the following example.

Table -9: Adding Lws

Difference in dB	Amount added to higher value
0.1	+3db
2.3	+2db
4.5.6.7.8	+1db
9 or more	+0db

Add 40 dB to 38 dB, the difference between these values is 2. From table 9, 2 dB to be added to 40, for a resultant sound power level of 42 dB.

Selecting a Silencer to meet a room design goal NC – Example

- A conference room has 700 square feet of floor space with a 10 foot ceiling.
- The room absorption characteristic is average condition.
- The supply fan capacity (total air flow for the system) is 9000 cfm at 3" SP.
- The duct work is sized and laid out as shown in the figure below.
- The branch duct serving the conference room terminates in 2 diffusers supplying a total of 830 CFM.

Straight Ducts - Values from Table 7.

Qty.	Description	Octave Band & Center Frequency (Hz)							
		1 63	2 125	3 250	4 500	5 1k	6 2k	7 4k	8 8k
1	36" with turning vanes	10	10	5	2	2	2	2	2
1	12" without turning vanes	4	4	2	1	1	1	1	1
1	10" without turning vanes	1	1	1	0	0	0	0	0
	Total	15	15	8	3	3	3	3	3

Elbows - Values from Table 6.

Qty.	Size	Octave Band & Center Frequency (Hz)							
		1 63	2 125	3 250	4 500	5 1k	6 2k	7 4k	8 8k
1	36"x36"x50'	10	10	5	2	2	2	2	2
1	12"x10"x20'	4	4	2	1	1	1	1	1
1	10"x8"x7 1/2'	1	1	1	0	0	0	0	0
	Total	15	15	8	3	3	3	3	3

Calculation	Source	Octave Band & Center Frequency (Hz)							
		1 63	2 125	3 250	4 500	5 1k	6 2k	7 4k	8 8k
1. Room design goal NC 35	Table 1	61	53	45	40	36	34	33	32
2. Room attenuation	Table 2	7	8	9	10	10	11	12	13
3. Multiple outlet effect	Table 3	-3	-3	-3	-3	-3	-3	-3	-3
4. End reflection attenuation	Table 4	9	3	1	0	0	0	0	0
5. Branch power division	Table 5	10	10	10	10	10	10	10	10
6. Elbow attenuation, noise source to outlet	Table 6	0	0	4	10	16	15	11	9
7. Duct attenuation, noise source to outlet	Table 7	15	15	8	3	3	3	3	3
8. Terminal unit correction.		-3	-3	-3	-3	-3	-3	-3	-3
9. Allowable Lw at fan discharge	Total lines 1-8	96	83	71	67	69	67	63	61
10. Actual Lw at fan discharge	Fan manu-factures data	78	80	91	90	89	86	81	75
11. Dynamic Insertion Loss (DIL) required	Subtract line 9 form line 10	0	0	20	23	20	19	18	14
12. DIL of selected silencer Our Model SA 40- SPD 60" Face Velocity 1000 fpm.	Our performance Tables.	6	11	24	40	54	50	34	20
13. Silencer air flow generated noise Lw at 1000 fpm Include air flow generated noise correction factor where required.	Our performance Tables.	50	45	39	35	39	39	35	35
14. Attenuated fan Lw at silencer discharge.	Subtract line 12 form line 10	72	69	67	50	35	36	47	55
15. Resultant Lw at silencer discharge (compare with line 9)	Combine lines 13 & 14 table 6	72	69	67	50	40	41	47	55