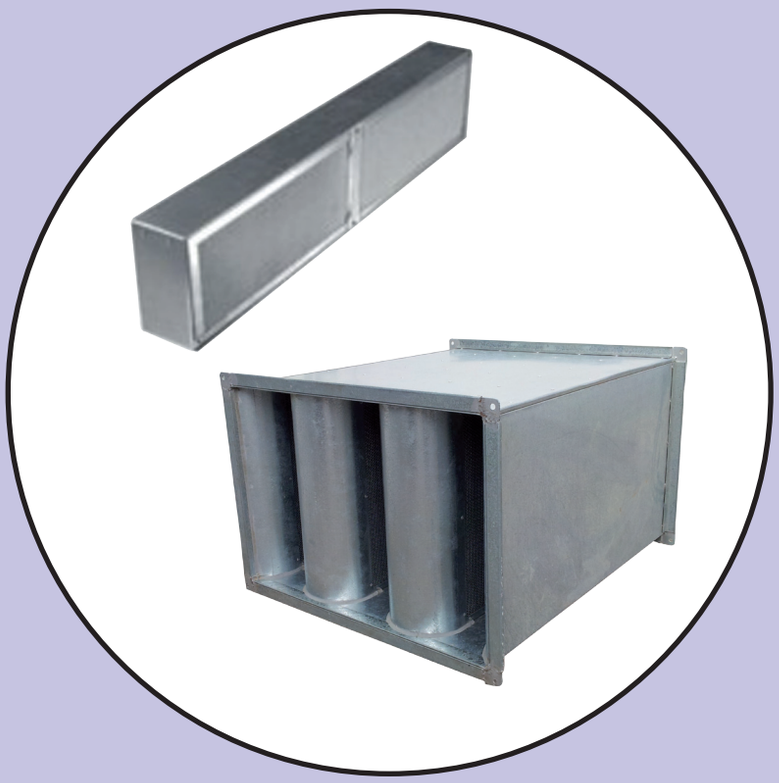
جي جي سي

GGC

شركة الخليج لفتحات التكييف المركزي

GULF GRILLES CO.



SOUND ATTENUATORS

All Fans/Impeller used in Air Conditioning system produce noise, relevant to the amount of work they do to move the air, much of the noise is generated by the fluctuations of radiated pressure and these pressure waves are distributed approximately equally in all directions, causing "ductborn noise" and "breakout" or "flanking noise". Our silencers is the reliable answer for these noise problems.

After approximately determining the sound reduction requirements of the concerned area select suitable silencer to match, or reduce noise to the target level, while selecting silencer following parameters are to be considered :-

1. **Insertion Loss.**

2. **Air Flow Regenerated Noise.**

3. **Static Pressure Drop.**

4. **Forward or Reverse Flow.**

Our sound attenuator (silencer) are carefully designed to combat noise problems. Galvanized steel outer casing of the silencer is designed to "HVAC" standard, perforated baffles is filled with an odourless, incombustible, vermin proof and moisture proof inorganic sound absorbing material. Primary function of this unit is to reduce noise, operated smoothly, efficiently and trouble free service.

In the following catalog pages, each item of equipment is clearly described for quick and accurate understanding of its construction, dimensions and performance. Also presented in simple and concise form are procedures for selecting silencers and calculating the sound attenuation requirements for the overall system.

ACOUSTIC TERMS AND DEFINITIONS

Absorption: The properties of a material composition to convert sound energy into heat thereby reducing the amount of energy that can be reflected

Attenuation: The reduction of sound energy as a function of distance travelled

Attenuator: A device or equipment that prevents, reduces or absorbs sound often colloquially known as silencer

A-weighting: An electronic filtering system in a sound meter that allows meter to largely ignore lower frequency sounds in a similar fashion to the way our ears do.

Background Noise: The existing noise associated with a given environment, could be sound from many sources, near and far

Breakout Noise: The transmission or radiation of noise through some part of the duct system to an occupied space in the building

Decibel (dB): One tenth of a BEL; a BEL being a unit of amplification corresponding to a tenfold increase. In terms of sound level measurements it is related to datum levels as follows.

- For sound pressure levels(SPL) datum=$2x10^{-5}$ Pa
- For Sound Power Level (SWL) datum = $1x\ 10^{-12}$ Watts
- SPL(dB)= $20\ \log[p/(1x10^{-5})]$, where P is the amplitude of the sound pressure waves concerned, measured in Pascal.

Decibel, A- Weighted (dBA): Unit representing the sound level measured with the A-weighting network on a sound level meter

Decibel, C-Weighted (dBC) : Unit representing the sound level measured with the C-weighting network on a sound level meter.

Directivity Factor: When sound level radiates from any source levels can be higher in certain direction than others. This is called 'Directivity'. Directivity factor is the ration of the increased level to the average value.

Directivity Index: It is the directivity factor expressed in decibels (dB)

Dynamic Insertion Loss (DIL) : It is a measure of the acoustic performance of an attenuator when handling the rated air flow. Not necessarily the same as static insertion loss because it may include regeneration and or other velocity effects and will account for the effects of the actual fluid and fluid conditions for which the silencer is designed

End Reflection: End reflection occurs when sound energy radiated from a hole. The sudden expansion to atmosphere causes some low frequency noise to be reflected back towards the source, expressed in decibels (dB). The effect dependent on hole size and frequency. Maximum at lowest frequency from smallest hole.

Hertz (Hz): Frequency of sound expressed by cycles per second

Insulation (Sound): It is the property of a material or partition to oppose sound transfer through its thickness.

Loudness: A listeners' auditory impression of the strength of a sound. Te average deviation above and below the static value due to sound wave is called sound pressure. The energy expended during the sound wave vibration is called intensity and is measured in intensity units. Loudness is the physical resonance to sound pressure and intensity

Noise Criteria Curves(NC): Curve that define the limits which the octave band spectrum of a noise source must not exceed if a certain level of occupant acceptance is to be achieved

Noise Criterion (NC) Curves: Established 1/1 octave band noise spectra for rating the amount of noise of an occupied space with a single number.

Noise Rating Curves: A set of curves based on the sensitivity of the human ear. They are used to give a single figure rating for a broadband of frequencies. They have greater decibel range than NC curves

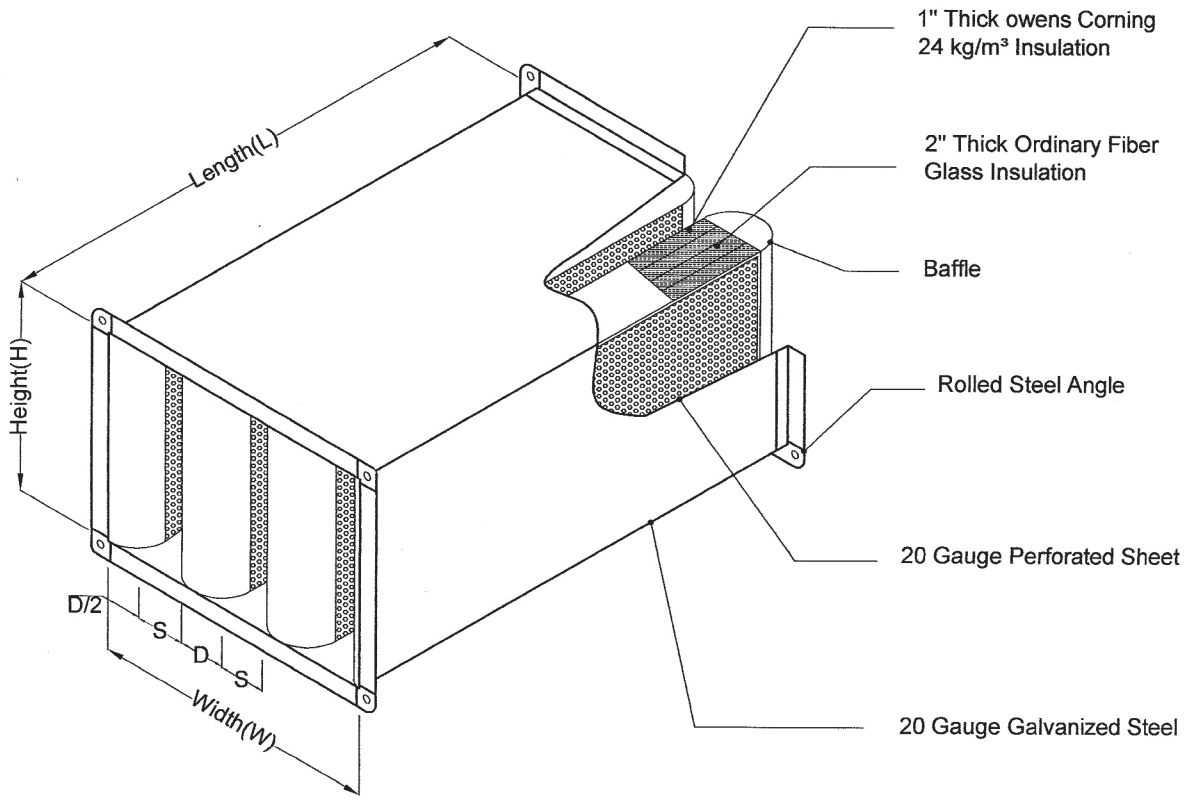
Octave Band: A range of frequencies where the highest frequency of the band is double the lowest frequency of the band. The band is usually specified by the center frequency.

Reverberation Time: The reverberation time of an enclosed space is the time required, or that would be required were the decay rate to remain constant, for the sound pressure level to decrease by 60 decibels.

Sound power Level of a Source (Lw): The ratio expressed in decibels, of its sound power to the reference sound power which by divided agreement, is either 10^{-13} or 10^{-12} watts.

Sound Power of a Source(W): The rate at which sound energy is radiated by the source.

Sound Pressure Level (Lp): A measure of the air pressure change caused by a sound wave expressed on a decibel scale reference to a reference sound pressure of $2x10^{-5}$ Pa or 0.0002 microbar.



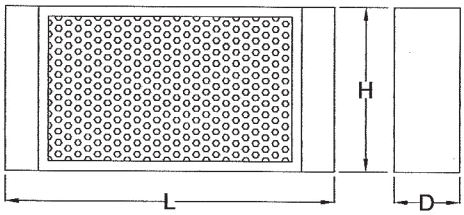
PRODUCT DESCRIPTION

- **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.

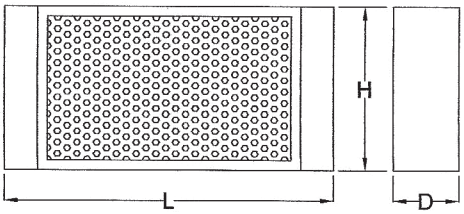
- **Baffles:** They are made of 20 gauge perforated galvanized steel filled with inorganic sound absorbing material that is resistant to vermin and moisture.

- **Flanges:** Rolled steel angle flanges securely welded to the attenuator casing. flanges are pre-drilled.

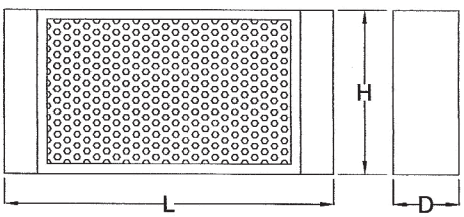
- **Finish :** galvanized mild steel with flanges finished in one coat of primer paint.



STANDARD PRESSURE DROP(25% FREE AREA)
(SA40-SPD)



MEDIUM PRESSURE DROP(33-42% FREE AREA)
(SA40-MPD1 & SA40-MPD2)



LOW PRESSURE DROP(50% FREE AREA)
(SA40-LPD)

NOTES:

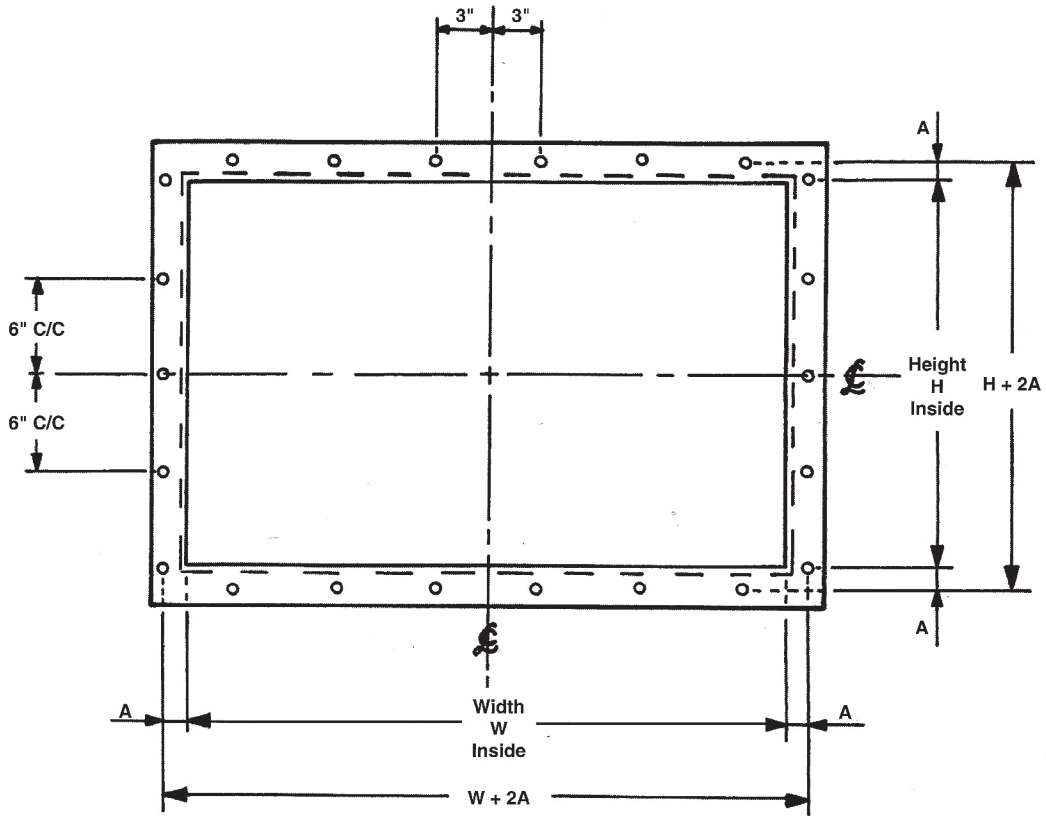
MODEL SA 40 SPD : D=8" S=3"

MODEL SA 40 MPD1 : D=8" S=4"

MODEL SA 40 MPD2 : D=8" S=6"

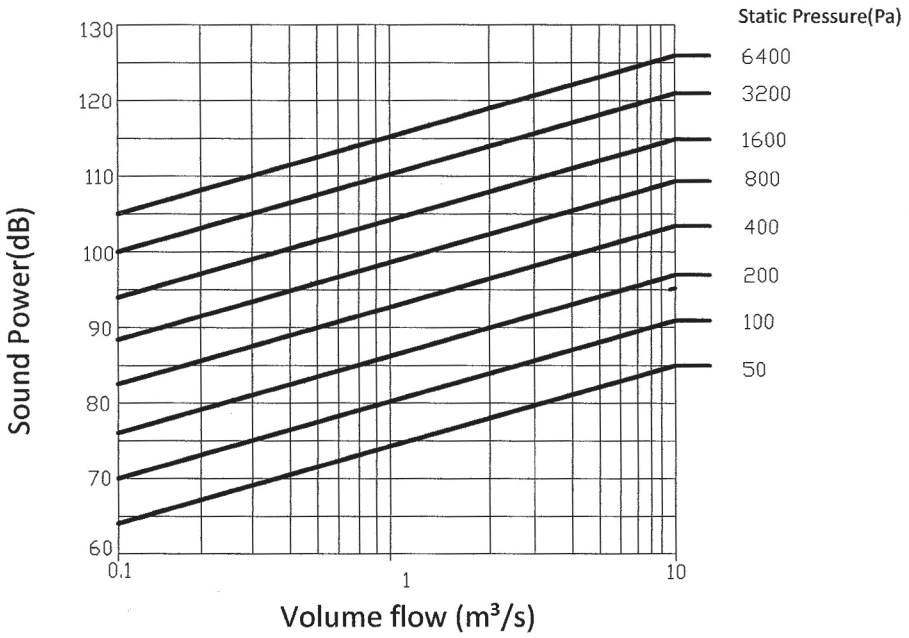
MODEL SA 40 LPD : D=8" S=8"

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	1-½ x 1-½ x 3/16	3/8	7/8

Table 1: In duct Sound Power Level of the Fan

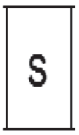


Spectrum Correction

Fan type	Octave							
	63	125	250	500	1000	2000	4000	8000
centrifugal fan, backward-curved blades	-4	-6	-9	-11	-13	-16	-19	-22
Centrifugal fan, forward curved blades	-2	-6	-13	-18	-19	-22	-25	-30
Centrifugal fan, straight radial blades	-3	-5	-7	-7	-8	-11	-16	-18
Axial fan	-7	-9	-7	-7	-8	-11	-16	-18

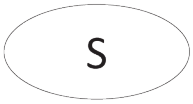
TABLE 2

Attenuation of straight unlined rectangular sheet metal ducts -dB/m



Minimum Duct Dimensions S in mm	Mid-frequency Octave Bands,Hz							
	63	125	250	500	1000	2000	4000	8000
000-200	0.6	0.6	0.45	0.3	0.3	0.3	0.3	0.3
201-400	0.6	0.6	0.45	0.3	0.2	0.2	0.2	0.2
401-800	0.6	0.6	0.3	0.15	0.15	0.15	0.15	0.15
801-1600	0.3	0.15	0.15	0.1	0.06	0.06	0.06	0.06

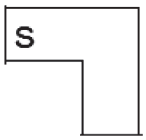
Attenuation of straight unlined circular or round sheet metal ducts-dB/m



Minimum Duct Dimensions S in mm	Mid-frequency Octave Bands,Hz							
	63	125	250	500	1000	2000	4000	8000
000-180	0.03	0.03	0.05	0.05	0.1	0.1	0.1	0.1
181-380	0.03	0.03	0.03	0.05	0.007	0.007	0.007	0.007
381-760	0.02	0.02	0.02	0.03	0.05	0.05	0.05	0.05
761-1520	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02

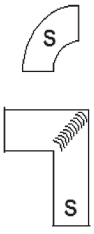
TABLE 3

Attenuation of mitred bends without turning vanes or with short chord turning vanes (rectangular ducts)-dB



Minimum Duct Dimensions S in mm	Mid-frequency Octave Bands,Hz							
	63	125	250	500	1000	2000	4000	8000
000-200	0	0	0	0	6	8	4	3
201-400	0	0	0	6	8	4	3	3
401-800	0	0	6	8	4	3	3	3
801-2000	0	6	8	4	3	3	3	3

Attenuation of radiussed bends or mitred bends with long chord turning vanes (circular or rectangular ducts)-dB



Minimum Duct Dimensions S in mm	Mid-frequency Octave Bands,Hz							
	63	125	250	500	1000	2000	4000	8000
000-250	0	0	0	0	1	2	3	3
251-500	0	0	0	1	2	3	3	3
501-1000	0	0	1	2	3	3	3	3
1001-2000	0	1	2	3	3	3	3	3

TABLE 4

End Reflection Attenuation(dB)						
Duct Dimensions(mm)	Octave Band Centre Frequency(Hz)					
	63.5	125	250	500	1000	2000 and higher
125	17	12	8	4	1	0
250	12	8	4	1	0	0
500	8	4	1	0	0	0
1000	4	1	0	0	0	0
2000	1	0	0	0	0	0

TABLE 5

Percentage of total sound factors,dB	
Volume of air(%)	Attenuation in dB
1%	-20
2%	-17
3%	-15
4%	-14
5%	-13
10%	-10
20%	-7
50%	-3
100%	0

TABLE 7

Directivity Factor,dB						
Junction of two room Surfaces						
Mid-Frequency octave band(Hz)	Outlet Area,cm²					
	10-50	50-100	100-500	500-1000	1000-5000	5000-10000
63	6	6	6	7	7	8
125	6	6	7	7	8	8
250	6	6	7	7	8	9
500	6	6	7	7	8	9
1000	7	7	8	8	9	9
2000	7	8	8	8	9	9
4000	7	8	8	8	9	9
8000	8	8	8	8	9	9

Centre of one room surface						
Mid-Frequency octave band(Hz)	Outlet Area,cm²					
	10-50	50-100	100-500	500-1000	1000-5000	5000-10000
63	3	3	3	4	4	6
125	3	3	3	5	5	7
250	3	4	5	6	6	8
500	4	5	6	7	7	9
1000	5	7	7	8	8	9
2000	7	8	8	9	9	9
4000	8	8	8	9	9	9
8000	8	8	8	9	9	9

TABLE 6

Distance Factors,dB	
Distance in meter	Attenuation in dB
1	-11
1.5	-14
2	-17
3	-20
4	-23
5	-25
6	-26
7	-28
8	-29
9	-30

TABLE 8

Percentage of total sound factor	
volume of air reaching the room(%)	dB reduction
1	-20
2	-17
3	-15
4	-14
5	-13
10	-10
20	-7
50	-3
100	0

TABLE 9

Room volume factor,dB	
Volume in mt^3	Room Volume Correction
3	9
5	7
10	4
20	1
50	-3
100	-6
200	-9
500	-13
1000	-16
2000	-19
5000	-23
10000	-26

TABLE 10

Reverberation time factor,dB	
Average Furnishing	-3
Limited Furnshing	0
No Furnishing	3
Very hard surface ceiling	6

TABLE 11

Addition of Sound Pressure Levels, dB	
Difference in dB	Amount added to higher value
0,1	3 dB
2,3	2dB
4,5,6,7,8	1dB
9 or more	0 dB

Radiation Fileds of a Spherical Sound Source

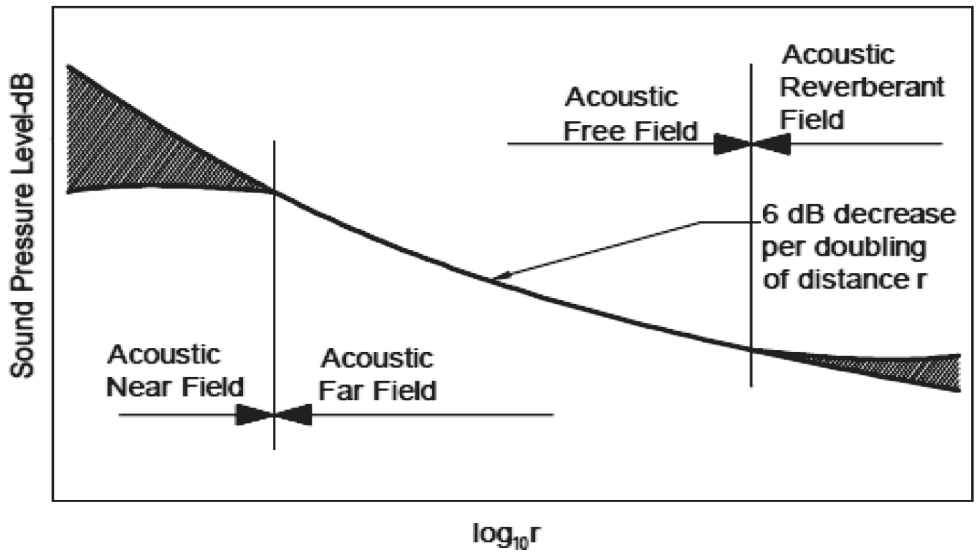


TABLE 12

Recommended Noise Criterion-NC		
Type of Room-Space Type	**Recommended NC Level**	**Equivalent Sound Level dBA**
Residences		
Apartment Houses	U	35
Assembly Halls	25	35
Churches	30	40
Courtrooms	30	40
Factories	40	50
Private Homes,rural and suburban	20	30
Private Homes, urban	25	34
Hotels/Motels		
individual rooms or suites	25	35
Meeting or banquet rooms	25	35
sevice and support areas	40	45
Halls, corridors, lobbies	35	50
Offices		
Conference rooms	25	35
Private	30	40
Open plan areas	35	45
Business machines/computers	40	50
Hospitals and clinics		
Private rooms	25	35
Operating rooms	25	35
wards	30	40
Laboratories	35	45
Corridors	30	40
Public Areas	35	45
Schools		
Lecture and Classrooms	25	35
open plan classrooms	35	45
Movie motion prictures theaters	30	40
Libraries	35	40
Legitimate theaters	20	30
Private Residences	25	35
Restaurants	40	50
TV broadcast Studies	15	25
Recording Studios	15	25
Concert and recital halls	15	25
Sport Coliseums	45	55
Sound broadcasting	15	25

TABLE 13

Dynamic Insertion Loss in dB

SA40-SPD		Mid-frequency Octave Bands,Hz							
MODEL	LENGTH IN MM	63	125	250	500	1000	2000	4000	8000
SA75-SPD	600	9	13	22	36	45	39	33	29
SA75-SPD	900	10	16	27	41	49	47	38	33
SA75-SPD	1200	11	18	31	46	50	50	43	38
SA75-SPD	1500	12	21	36	50	50	50	48	42
SA75-SPD	1800	13	24	41	50	50	50	50	46
SA75-SPD	2100	13	26	45	50	50	50	50	50
SA75-SPD	2400	13	29	50	50	50	50	50	50

SA40-MPD1		Mid-frequency Octave Bands,Hz							
MODEL	LENGTH IN MM	63	125	250	500	1000	2000	4000	8000
SA100-MPD	600	7	10	18	34	46	40	33	29
SA100-MPD	900	8	12	22	37	50	46	36	31
SA100-MPD	1200	9	14	26	40	50	50	39	33
SA100-MPD	1500	9	17	30	44	50	50	41	35
SA100-MPD	1800	10	19	34	47	50	50	44	37
SA100-MPD	2100	11	21	38	50	50	50	47	39
SA100-MPD	2400	11	24	42	50	50	50	49	41

SA40-MPD2		Mid-frequency Octave Bands,Hz							
MODEL	LENGTH IN MM	63	125	250	500	1000	2000	4000	8000
SA150-MPD	600	8	12	17	34	44	28	23	22
SA150-MPD	900	8	14	20	37	47	32	26	24
SA150-MPD	1200	9	15	23	40	50	36	29	26
SA150-MPD	1500	10	17	26	43	53	40	32	28
SA150-MPD	1800	11	18	29	46	57	44	35	31
SA150-MPD	2100	11	20	32	49	40	48	38	33
SA150-MPD	2400	12	21	35	50	50	50	41	35

SA40-LPD		Mid-frequency Octave Bands,Hz							
MODEL	LENGTH IN MM	63	125	250	500	1000	2000	4000	8000
SA200-LPD	600	7	11	16	25	27	23	21	20
SA200-LPD	900	8	12	18	30	33	26	23	21
SA200-LPD	1200	8	14	21	35	39	30	25	23
SA200-LPD	1500	9	15	23	40	44	33	28	24
SA200-LPD	1800	9	17	26	45	50	37	30	26
SA200-LPD	2100	10	18	28	50	50	40	32	27
SA200-LPD	2400	11	19	30	50	50	43	34	28

MODEL SA40-SPD(Standard Pressure Drop)

Pressure loss ▲P , inches of w.g		0.06	0.1	0.14	0.2	0.24	0.3	0.34	0.4	0.44	0.5
Face Velocity V fpm		315	412	472	725	629	688	747	786	855	904
Attenuator self noiseguide against face velocity V				**NC 25**		**NC30**	**NC35**		**NC40**		
Width (inches)	Height (inches)	Volume flow rate V l/s									
11	6	138	180	212	254	275	307	328	350	371	403
	12	275	360	424	509	551	614	657	699	742	805
ONE	18	424	551	636	763	848	911	996	1059	1123	1208
BAFFLE	24	551	742	848	1017	1123	1229	1335	1398	1504	1610
	30	699	911	1059	1271	1398	1526	1653	1759	1886	2013
	36	848	1102	1250	1526	1674	1843	1992	2098	2246	2416
22	12	551	742	848	1017	1123	1229	1335	1398	1504	1610
	18	848	1102	1250	1526	1674	1843	1992	2098	2246	2416
TWO	24	1123	1462	1674	2034	2246	2458	2649	2797	3009	3221
BAFFLES	30	1398	1843	2098	2543	2797	3051	3327	3496	3750	4026
	36	1674	2204	2521	3051	3348	3666	3984	4195	4513	4831
	42	1949	2564	2945	3539	3920	4280	4640	4895	5255	5636
33	18	1250	1653	1886	2288	2521	2755	2988	3157	3390	3623
	24	1674	2204	2521	3051	3348	3666	3984	4195	4513	4831
THREE	30	2098	2755	3157	3793	4195	4598	4979	5255	5636	6039
BAFFLES	36	2521	3305	3772	4556	5043	5509	5975	6293	6759	7247
	42	2945	3856	4407	5318	5869	6420	6971	7353	7882	8433
	48	3348	4407	5043	6081	6717	7353	7967	8391	9027	9641
44	24	2246	2945	3348	4047	4471	4895	5318	5594	6018	6441
	30	2797	3666	4195	5064	5594	6124	6653	6992	7522	8052
FOUR	36	3348	4407	5043	6081	6717	7353	7967	8391	9027	9641
BAFFLES	42	3920	5149	5869	7098	7840	8560	9302	9789	10531	11251
	48	4471	5869	6717	8115	8942	9789	10637	11188	12035	12862
	54	5043	6611	7543	9132	10065	11018	11951	12586	13540	14472
55	30	3496	4598	5255	6336	6992	7649	8306	8751	9387	10044
	36	4195	5509	6293	7607	8391	9175	9959	10489	11273	12057
FIVE	42	4895	6420	7331	8878	9789	10700	11633	12247	13158	14069
BAFFLES	48	5594	7353	8391	10150	11188	12247	13286	13985	15044	16082
	54	6293	8264	9450	11400	12586	13773	14938	15743	16909	18095
	60	6992	9175	10489	12671	13985	15298	16612	17481	18795	20108
66	36	5043	6611	7543	9132	10065	11018	11951	12586	13540	14472
	42	5869	7713	8815	10637	11739	12841	13964	14684	15786	16888
SIX	48	6717	8815	10065	12162	13434	14684	15934	16782	18032	19303
BAFFLES	54	7543	9916	11336	13688	15108	16527	17926	18879	20299	21719
	60	8391	11018	12586	15214	16782	18350	19918	20977	22545	24134
	66	9238	12120	13836	16739	18456	20193	21931	23075	24812	26529
	72	10065	13222	15108	18244	20130	22037	23922	25173	27058	28944
77	42	6844	8984	10277	12417	13709	14981	1610	17142	18413	19706
	48	7840	10277	11739	14197	15659	17142	18604	19579	21041	22524
SEVEN	54	8815	11569	13222	15977	17629	19282	20935	22037	23668	25321
BAFFLES	60	9789	12841	14684	17735	19579	21422	23244	24473	26317	28139
	66	10764	14133	16146	19515	21528	23562	25575	26910	28944	30957
	72	11739	15426	17629	21295	23499	25702	27906	29368	31572	33775
	78	12735	16697	19091	23075	25448	27842	30216	31826	34199	36593
	84	13709	17989	20553	24834	27419	29982	32546	34263	36826	39412
88	48	8942	11739	13434	16231	17905	19579	21253	22376	24050	25723
	54	10065	13222	15108	18244	20130	22037	23922	25173	27058	28944
EIGHT	60	11188	14684	16782	20278	22376	24473	26571	27969	30067	32165
BAFFLES	66	12311	16167	18456	22312	24622	26931	29220	30766	33076	35386
	72	13434	17629	2013	24325	26846	29368	31889	33563	36085	38606
	78	14536	19091	21825	26359	29092	31826	34538	36360	39094	41806
	84	15659	20553	23499	28605	31317	34263	37208	39157	42103	45027
	90	16782	22037	25173	30427	33563	36721	39857	41954	45111	48247
99	54	11336	14875	16994	20532	22651	25342	26910	28330	30449	333451
	60	12586	16527	18879	22821	25173	27525	29898	31466	33818	36191
NINE	66	13836	18180	20765	25088	27694	30279	32885	34602	37208	39814
BAFFLES	72	15108	19833	22651	27376	30216	33034	35873	37759	40598	43416
	78	16358	21486	24537	29665	32716	35788	38861	40895	43967	47040
	84	17629	23117	26423	31932	35237	38543	41848	44052	47357	50663
	90	18879	24770	28330	34220	37759	41297	44836	47209	508430	54286
	96	20130	26423	30216	36509	40280	44052	47824	50345	54117	57888

The pressure loss data above relates to a straight attenuator 1200mm long. The following factors are applicable to other lengths:

Length L in mm	600	900	1200	1500	1800	2100	2400
▲P factor	x0.90	x0.95	0	x1.05	x1.1	x1.15	x1.20

MODEL: SA40-MPD1(Medium Pressure Drop)

Pressure Loss - Cross Section Sizing

Pressure loss ▲P,inches of w.g		0.08	0.13	0.18	0.25	0.31	0.38	0.43	0.51	0.56	0.64
Face velocity V fpm		413	531	629	747	825	924	983	1061	1120	1179
Attenuator self noise guide against face velocity V				NC 25		NC30		NC 35		NC 40	
Width(inches)	Height(inches)	VOLUME FLOW RATE V(cfm)									
12	6	201	254	307	360	403	445	477	519	540	572
	12	403	509	614	720	805	890	954	1038	1081	1144
ONE	18	593	763	911	1081	1208	1335	1441	1547	1632	1716
BAFFLE	24	805	1038	1229	1441	1610	1801	1907	2055	2182	2288
	30	996	1293	1526	1822	2013	2246	2394	2585	2712	2861
	36	1208	1547	1822	2182	2394	2691	2861	3094	3263	3433
24	12	805	1038	1229	1441	1610	1801	1907	2055	2182	2288
	18	1208	1547	1822	2182	2394	2691	2861	3094	3263	3433
TWO	24	1610	2055	2437	2903	3200	3581	3814	4111	4344	4577
BAFFLES	30	2013	2543	3051	3623	4005	4492	4768	5149	5446	5721
	36	2394	3094	3666	4344	4810	5382	5721	6187	6526	6865
	42	2797	3602	4280	5064	5615	6272	6675	7204	7607	8009
	48	3200	4111	4873	5806	6399	7162	7628	8115	8687	9154
36	18	1801	2310	2755	3263	3602	4026	4301	4640	4895	5149
	24	2394	3094	3666	4344	4810	5382	5721	6187	6526	6865
THREE	30	3009	3856	4577	5446	6018	6717	7162	7734	8158	8582
BAFFLES	36	3602	4640	5488	6526	7204	8073	8582	9260	9789	10298
	42	4217	5403	6399	7607	8348	9408	10022	10806	11421	12014
	48	4810	6187	7331	8687	9620	10764	11442	12353	13052	13730
	54	5403	6950	8243	9789	10806	12099	12883	13900	14684	15447
48	24	3200	4111	4873	5806	6399	7162	7628	8115	8687	9154
	30	4005	5149	6102	7247	8009	8963	9535	10298	10870	11442
FOUR	36	4810	6187	7331	8687	9620	10764	11442	12353	13052	13730
BAFFLES	42	5615	7204	8539	10150	11209	12544	13349	14409	15214	16019
	48	6399	8243	9768	11590	12819	14387	15256	16485	17396	18307
	54	7204	9260	10976	13052	14409	16125	17163	18540	19557	20596
	24	8009	10298	12205	14493	16019	18138	1907	20596	21740	22884
60	30	5001	6441	7628	9069	10022	11209	11929	12883	13582	14303
	36	6018	7734	9154	10870	12014	13455	14303	15447	16316	17163
FIVE	42	7014	9005	10679	12692	14027	15680	16697	18032	19028	20024
BAFFLES	48	8009	10298	12205	14493	16019	17926	19070	20596	21740	22884
	54	9005	11590	13730	16316	18032	20172	21464	23181	24452	25745
	60	10022	12883	15256	18117	20024	22418	23838	25745	27185	28605
	66	11018	14154	16782	19939	22037	24643	26232	28330	29898	31466
	72	12014	15447	18307	21740	24028	26889	28605	30894	32610	34326
72	36	7204	9260	10976	13052	14409	16125	17163	18540	19557	20596
	42	8412	10806	12819	15214	16824	18816	20024	21634	22821	24028
SIX	48	9620	12353	14642	17396	19218	21507	22884	24706	26084	27461
BAFFLES	54	10806	13900	16485	19557	21634	24198	25745	27800	29347	30894
	60	12014	15447	18307	21740	24028	26889	28605	30894	32610	34326
	66	13222	16994	20130	23922	26423	29580	31466	33987	35873	37759
	72	14409	18540	21973	26084	28838	32271	34326	37081	39708	41191
	78	15616	20087	23795	28266	31233	34962	37187	40153	42399	44624
84	42	9811	12607	14959	17756	19621	21952	23371	25236	26635	28033
	48	11209	14409	17078	20299	22418	25088	26698	28838	30427	32038
SEVEN	54	12607	16210	19218	22821	25236	26105	30046	32440	34241	36042
BAFFLES	60	14027	18032	21359	25363	28033	31381	33373	36042	38055	40047
	66	15426	19833	23499	27906	30830	34517	36721	39645	41848	44052
	72	16824	21634	25639	30427	33648	37653	40047	43247	45662	48057
	78	18223	23435	27758	32970	36445	40789	43395	46849	49455	52061
	84	19621	25236	29898	35513	39242	43925	46722	50451	53269	56066
	90	21019	27037	32038	38055	42060	47061	50070	54074	57062	60071
96	48	12819	16485	19536	23181	25639	28690	3051	32949	34835	36615
	54	14409	18540	21973	26084	28838	32271	34326	37081	39136	41191
EIGHT	60	16019	20596	24410	28987	32038	35852	38140	41191	43480	45768
BAFFLES	66	17629	22651	26846	31889	35237	39433	41954	45302	47824	50345
	72	19218	24728	29283	34792	38437	45768	45768	49434	52167	54922
	78	20829	26783	31741	37674	41658	49582	49582	53545	56532	59499
	84	22418	28838	34178	40577	44857	53396	53396	57676	60876	64076
	90	24028	30894	36615	43480	48057	57210	57210	61787	65220	68652
	96	25639	32970	39051	46383	51256	61024	61024	65898	69563	73229

The pressure loss data above relates to a straight attenuator 1200mm long. The following factors are applicable to other lengths:

Length L in mm	600	900	1200	1500	1800	2100	2400
▲P factor	x0.90	x0.95	0	x1.05	x1.10	x1.15	x1.20

MODEL : SA40-MPD2(Medium Pressure Drop)

Pressure Loss - Cross Section Sizing

Pressure loss ▲P, inches of w.g		0.06	0.10	0.14	0.20	0.24	0.30	0.34	0.40	0.44	0.50
Face velocity V (fpm)		590	766	904	1081	1179	1317	1395	1513	1592	1690
Attenuator self noise guide against face velocity V				NC 25	NC30		NC 35	NC 40		NC 45	
Width(inches)	Height(inches)	VOLUME FLOW RATE V (cfm)									
14	6	339	434	509	614	667	742	795	858	901	954
	12	678	869	1017	1229	1335	1483	1589	1716	1801	1907
	18	996	1293	1526	1843	2013	2246	2373	2564	2712	2861
ONE	24	1335	1737	2055	2458	2670	2988	3157	3433	3602	3835
BAFFLE	30	1674	2161	2564	3051	3348	3729	3941	4280	4513	4789
	36	2013	2606	3072	3666	4005	4471	4746	5149	5403	5742
28	18	2013	2606	3072	3666	4005	4471	4746	5149	5403	5742
	24	2670	3475	4089	4895	5340	5954	6314	6844	7204	7649
TWO	30	3348	4344	5128	6124	6675	7459	7882	8560	9005	9577
BAFFLE	36	4005	5212	6145	7353	8009	8942	9471	10277	10806	11484
	42	4683	6081	7162	8560	9344	10425	11061	11993	12607	13391
	48	5340	6950	8179	9789	10679	11929	12629	13709	14409	15298
42	24	4005	5212	6145	7353	8009	8942	9471	10277	10806	11484
	30	5001	6505	7670	9175	10022	11188	11845	12841	13519	14345
THREE	36	6018	7819	9217	11018	12014	13413	14218	15426	16210	17227
BAFFLE	42	7014	9111	10743	12841	14027	15659	16591	17989	18922	20087
	48	8009	10404	12290	14684	160380	17884	18964	20553	21634	22969
	54	9005	11718	13815	16527	18032	20130	21316	23117	24325	25829
	60	10022	13010	15341	18350	20024	22354	23689	25702	27037	28711
56	30	6675	8603	10234	12247	13349	14917	15807	17142	18032	19134
	36	8009	10404	12290	14684	16019	17884	18964	20553	21634	22969
FOUR	42	9344	12141	14324	17142	18689	20871	22121	23986	23541	26783
BAFFLE	48	10679	13879	16379	19579	21359	23859	25278	27419	28838	30618
	54	12014	15616	18413	22037	24028	26825	28436	30830	32440	34432
	60	13349	17354	20469	24473	26698	29813	31593	34263	36042	38267
	66	14684	19091	22524	26931	29368	32801	34750	37695	39645	42103
	72	16019	20829	24558	29368	32038	35767	37907	41107	43247	45917
70	36	10022	13010	15362	18350	20024	22354	23689	25702	27037	28711
	42	11675	15193	17905	21422	23371	26084	27652	29982	31529	33479
FIVE	48	13349	17354	20469	24473	26698	29813	31593	34263	36042	38267
BAFFLE	54	15023	19685	23032	27525	30046	33542	35534	38543	40556	43056
	60	16697	21698	25596	30597	33373	37271	39496	42823	45048	47845
	66	18350	23859	28139	33648	36721	41001	43437	47103	49561	52612
	72	20024	26041	30703	36721	40047	44730	47400	51405	54074	57401
	78	21698	28203	33267	39772	43395	48438	51341	55685	58566	62190
	84	23371	30364	35831	42823	46722	52167	55282	59965	63080	66978
84	42	14027	18223	21486	25702	28033	31296	33182	35979	37844	40174
SIX	48	16019	20829	24558	29368	32038	35767	37907	41107	43247	45917
BAFFLE	54	18032	23435	27630	33034	36042	40259	42653	46256	48650	51659
	60	20024	26041	306796	36721	40047	44730	47400	51405	54074	57401
	66	22037	28626	33775	40386	44052	49201	52125	56532	59478	63143
	72	24028	31233	36848	44052	48057	53672	56871	61681	64881	68885
	78	26041	33839	39920	47718	51934	58143	61596	66809	70284	74585
	84	28033	36445	42992	51405	56066	62613	66343	71958	75645	80306
	90	30046	39051	46065	55070	60071	67084	71089	77086	81090	86112
98	48	18689	24304	28648	34263	37377	41742	44221	47972	50451	53566
	54	21019	27122	32228	38543	42060	46955	49752	53968	56765	60262
	60	23371	30364	35831	42823	46722	52167	55282	59965	63080	66978
SEVEN	66	25702	33415	39412	47103	51405	57380	60812	65961	69373	73674
BAFFLES	72	28033	36445	42992	51405	56066	62613	66343	71958	75645	80306
	78	30364	39475	46573	55685	60749	67805	71915	77976	82001	87087
	84	32716	42526	50154	59965	65410	73038	77340	83908	88358	93867
	90	35047	45556	53735	64245	70093	78187	82849	90053	94503	100436
	96	37377	48586	57316	68525	74797	83485	88358	95986	100860	107004

The pressure loss data above relates to a straight attenuator 1200mm long. The following factors are applicable to other lengths:

Length L in mm	600	900	1200	1500	1800	2100	2400
▲P factor	x0.90	x0.95	0	x1.05	x1.10	x1.15	x1.20

MODEL: SA40-LPD(Low Pressure Drop)

Pressure Loss - Cross Section Sizing

Pressure loss ▲P, inches of w.g		0.06	0.1	0.14	0.2	0.24	0.3	0.34	0.4	0.44	0.5
Face velocity V fpm		786	983	1218	1454	1572	1749	1886	2044	2162	2279
Attenuator self noise guide against face velocity V			NC 25	NC30	NC 35	NC 40		NC 45		NC50	
Width(inches)	Height(inches)	VOLUME FLOW RATE V cfm									
16	6	509	636	784	943	1017	1134	1218	1324	1398	1473
	12	1017	1271	1568	1886	2034	2267	2437	2649	2797	2945
ONE	18	1526	1907	2373	2818	3051	3390	3666	3962	4195	4429
BAFFLE	24	2034	2543	3157	3772	4068	4534	4873	5297	5594	5891
	30	2543	3178	3941	4704	5085	5657	6102	6611	6992	7374
	36	3051	3814	4725	5636	6102	6780	7331	7925	8391	8857
	42	3560	4450	5509	6590	7120	7925	8539	9260	9789	10319
	48	4068	5085	6314	7522	8137	9048	9768	10573	11188	11802
32	18	3051	3814	4725	5636	6102	6780	7331	7925	8391	8857
	24	4068	5085	6314	7522	8137	9048	9768	10573	11188	11802
TWO	30	2966	6357	7882	9408	10171	11315	12205	13222	13985	14748
BAFFLES	36	3984	7628	9450	11294	12205	13582	14642	15871	16782	17693
	42	7755	8899	11039	13180	14239	15849	17078	18519	19579	20638
	48	8137	10171	12607	15044	16273	18095	19536	21147	22376	23605
	54	9154	11442	14197	16930	18307	20363	21973	23795	25173	26550
	60	10171	12713	15765	18816	20341	22630	24410	26444	27969	29495
48	24	6102	7628	9450	11294	12205	13582	14642	15871	16782	17693
	30	7628	9535	11823	14112	15256	16972	18307	19833	20977	22121
THREE	36	9154	11442	14197	16930	18307	20363	21973	23795	25173	26550
BAFFLES	42	10679	13349	16549	19748	21359	23753	25630	27758	29368	30978
	48	12205	15256	18922	22587	24410	27164	29283	31741	33563	35386
	54	13730	17163	21274	25406	27461	30555	32949	35703	37759	39814
	60	15256	19070	23647	28224	30512	33945	36615	39666	41954	44243
	66	16782	20977	26020	31042	33563	37335	40280	43628	46150	48671
	72	18307	22884	28372	33860	36615	40725	43946	47590	50345	53100
64	36	12205	15256	18922	22587	24410	27164	29283	31741	33563	35386
	42	14239	17799	22079	26338	28478	31678	34178	37017	39157	41297
FOUR	48	16273	20341	25215	30110	32546	36212	39051	42314	44751	47188
BAFFLES	54	18307	22884	28372	33860	36615	40725	43946	47590	50345	53100
	60	20341	25427	31529	37632	40683	45260	48819	52888	55939	58990
	66	22376	27969	34686	41403	44751	51913	53693	58185	61533	64902
	72	24410	30512	37844	45154	48819	54307	58588	63461	67127	70792
	78	26444	33055	40980	48925	52888	58842	63461	68758	72721	76683
	84	28478	35598	44137	52676	56956	63355	68356	74034	78315	82595
80	42	17799	22248	27588	32928	35598	39602	42717	46277	48947	51616
	48	20341	25427	31529	37632	40683	45260	48819	52888	55939	58990
FIVE	54	22884	28605	35470	42336	45768	50917	54922	59499	62931	66364
BAFFLES	60	25427	31784	39412	47040	50854	56575	61024	66110	69924	73738
	66	27969	34962	43353	51744	55939	62232	67127	72721	76916	81111
	72	30512	38140	47294	56447	61024	67890	73229	79332	83908	88485
	78	33055	41319	51235	61151	66110	73547	79332	85943	90901	95859
	84	35598	44497	55176	65855	71195	79204	85434	92554	97893	103233
	90	38140	47675	59117	70559	76280	84862	91536	99165	104886	110607
	96	40683	50854	63058	75263	81366	90519	97639	105775	111878	117980
96	48	24410	30512	37844	45154	48819	54307	58588	63461	67127	70771
	54	27461	34326	42569	50811	54922	61109	65898	71343	75518	79628
SIX	60	30512	38140	47294	56447	61024	67890	73229	79332	83908	88485
BAFFLES	66	33563	41954	52019	62084	67127	74670	8094	87256	92299	97342
	72	36615	45768	56744	67741	73229	81472	87871	95202	100690	106178
	78	39666	49582	61490	73378	79332	88252	95202	103127	109081	115035
	84	42717	53396	66216	79035	85434	95054	102512	111073	117472	123871
	96	48819	61024	75666	90308	97639	108615	117175	126922	134254	141585

The pressure loss data above relates to a straight attenuator 1200mm long. The following factors are applicable to other lengths:

Length L mm	600	900	1200	1500	1800	2100	2400
▲P factor	x0.90	x0.95	0	x1.05	x1.10	x1.15	x1.20

SILENCER SELECTION SHEET

GULF GRILLES COMPANY

DESIGN & SELECTION OF SOUND ATTENUATOR

PROJECT	

Unit No:					
Air Flow(cfm)				Model	
SA Size(mm)	W	H		Length(mm)	
				Pressure Drop(Pa)	
Velocity(m/s)					

					Octave Centre Frequency								
					63	125	250	500	1000	2000	4000	8000	
Source sound power level													Line 1
Minimum Duct Dimension(mm)		Length(m)		-									Line 2
Radiussed Elbows Width(mm)		Qty (Nos)		-									Line 3
Additional Attenuation				-									Line 4
Outlet Reflection	Length(cm)	Width(cm)		-									Line 5
SWL Leaving System													Line 6
percentage of air leaving outlet	cfm			-									Line 7
Distance from outlet to listener(m)				-									Line 8
Directivity		centre of ceiling		+									Line 9
Direct(SPL)													Line 10
Percentage of air reaching				-									Line 11
Room volume	LxW(m²)	Height(m)		-									Line 12
Reverberation time(sec)				+									Line 13
Reverberant SPL													Line 14
Combined SPL													Line 15
Criterion	NC												Line 16
Add decibel safety factor													Line 17
Required insertion loss													Line 18
Dynamic insertion loss of selected silencer													Line 19

Line 1 : Using the fan manufactures catalog information, obtain the actual in-duct sound power level at the mid frequency octave band of interest, or calculate the approximate in-duct sound power level from table. In both cases approximate duty of the fan needs to be known. These data are inserted in the line 1 for source sound power level data.

Some manufactures present noise data as a sound pressure level which needs to be converted by applying the relevant correction factor.

Line 2 : Straight unlined rectangular sheet metal ducts and unlined circular duct provide a certain amount of attenuation throughout the discrete frequency range. In rectangular ducts, at low frequencies the attenuation is significant and it tends to decrease as frequency increases. Table 2 can be used to calculate the attenuation per meter for straight rectangular and circular ducts

Line 3 : Table 3 displays data for attenuation of various types of elbows at each octave. The degree of attenuation provided by the straight mitered bends are greater than the radiussed elbows.

Line 4 : Attenuation when main duct branches. Depend on the amount of air carried by each duct

Line 5 : 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). Table 4 can be used to find out the end reflection attenuation of different duct dimensions.

Line 6 : Calculate the sound power level leaving the system by subtracting line 2 to 5 from line 1.

Line 7 : Sound pressure level associated with the discharge air from a single outlet depend on the percentage of the amount of air being supplied by the outlet to total quality of air being supplied by the blower fan. Table 5 can be used to obtain the data corresponding to percentage leaving outlet.

Line 8 : As the distance from the source to the listener increases, the sound level perceived by the listener decrease. Table 6 displays the possible attenuation as the distance from the source increase.

Line 9 : Due to directivity, the position of the outlet in relation to the wall affect the sound level. Table 7 can be used to find out the directivity of the outlet.

Line 10: calculate the direct sound pressure level by subtracting and adding line 7,8 and 9 respectively from SWL leaving system.

Line 11: Table 8 displays values corresponding to percentage of air reaching the room.

Line 12 : Table 9 displays values corresponding to different room volume

Line 13 : The time taken for the sound to decay 60 dB of its original sound level after the sound source is ceased. It depends on the volume of the space and amount of absorptive surface. Reverberation time is directly related to the room volume. In general, large space will require more absorption to achieve the same reverberation time as a smaller space.

Highly absorbent surfaces shorten the reverberation time whereas highly reflective surfaces prolong the reverberation time. Table 10 displays values corresponding to different type of rooms.

Line 14 : Calculate the reverberant SPL by subtracting and adding line 11, 12 and 13 respectively from SWL leaving system.

Line 15 : Combined SPL can be calculated by logarithmically adding direct and reverberant SPL. Table 11 displays decibel addition factors.

Line 16 : The noise criteria(NC) is a single numerical index commonly used to define goal for the maximum allowable noise in a given space. The specification will usually provide a criterion (NC) where one is not given, table 12 can be used.

Line 17 : A decibel safety factor of 3 dB should be added.

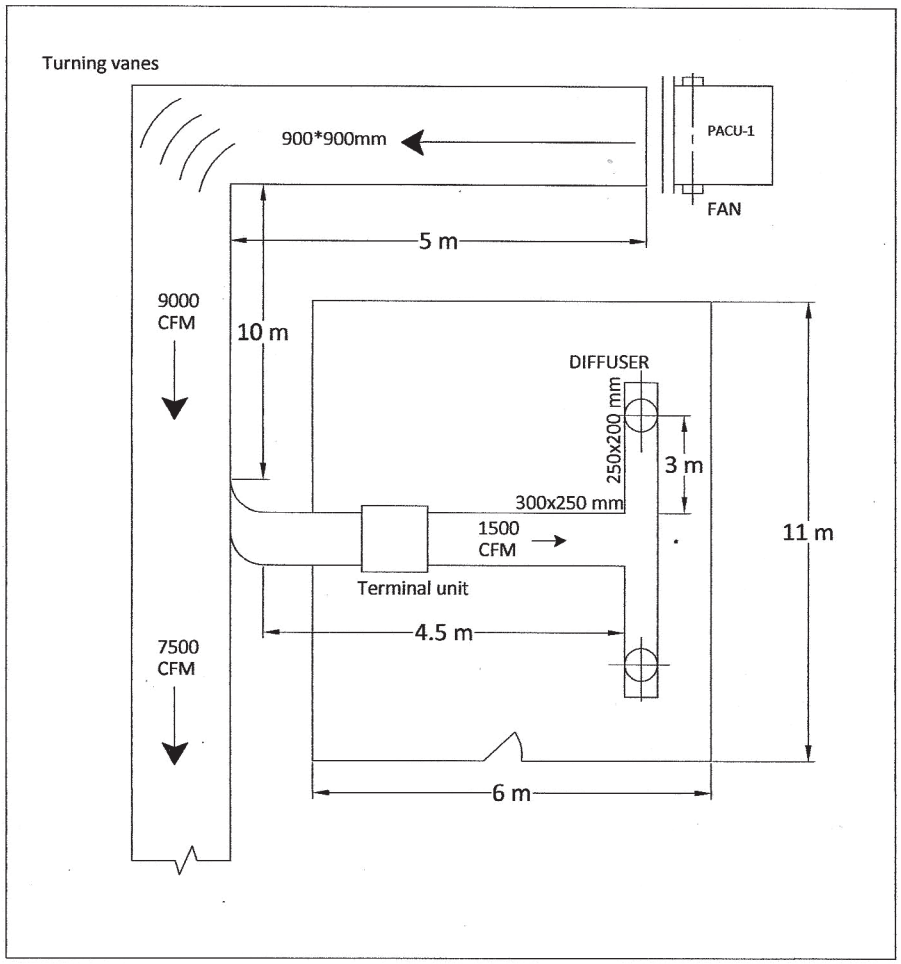
Line 18 : Obtained is the surplus level of noised after considering all the above parameters and the criterion. By selecting an appropriate silencer, the excess noise can be combated.

Line 19 : In order to attain the desirable goal and to effectively abate the undesirable noise that persist, select a suitable silencer from table 13.

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 of the system) is 9000 cm 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 750 cfm
- Sound power level of the package unit as follows

Sound Power Level of the Machine								
Octave Band Center Frequencies								
Hz	63	125	250	500	1000	2000	4000	8000
dB	92	84	78	77	73	72	68	59



SILENCER SELECTION(ILLUSTRATION)

GULF GRILLES COMPANY

DESIGN & SELECTION OF SOUND ATTENUATOR

PROJECT	

Unit No	PACU 1		SUPPLY	
Air Flow(cfm)	9000		Model	MPD
SA Size(mm)	W	H	Length(mm)	900
	900	900	Pressure Drop(Pa)	46
Velocity(m/s)	5.25			

					Octave Centre Frequency								
					63	125	250	500	1000	2000	4000	8000	
Source sound power level					92	84	78	77	73	72	68	59	Line 1
Minimum Duct Dimension(mm)	900	Length(m)	15	-	4.5	4.5	2.25	1.5	0.9	0.9	0.9	0.9	Line 2
	250		4.5	-	2.7	2.7	2.03	1.35	0.9	0.9	0.9	0.9	
	200		3	-	1.8	1.8	1.35	0.9	0.9	0.9	0.9	0.9	
				-									
				-									
Radiussed Elbows Width(mm)	900	Qty	1	-	0	0	1	2	3	3	3	3	Line 3
	250		1	-	0	0	0	0	1	2	3	3	
				-									
				-									
				-									
Additional Attenuation				-									Line 4
Outlet Reflection	Length(cm) 25	Width(cm)	20	-	12	8	4	1	0	0	0	0	Line 5
SWL Leaving System					71	67	67.4	70.3	66.3	64.3	59.3	50.3	Line 6
percentage of air leaving outlet	cfm 750			-	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	Line 7
Distance from outlet to listener(m)	1.5			-	14	14	14	14	14	14	14	14	Line 8
Directivity				+	4	5	6	7	8	9	9	9	Line 9
Direct(SPL)					50	47	49	52	49	48	43	34	Line 10
Percentage of air reaching room	1500		16.67%	-	7.78	7.78	7.78	7.78	7.78	7.78	7.78	7.78	Line 11
Room volume	LxW(m²) 66		Height(m) 3	-	8.99	8.99	8.99	8.99	8.99	8.99	8.99	8.99	Line 12
Reverberation time			1	+	0	0	0	0	0	0	0	0	Line 13
Reverberant SPL					54.2	50.2	50.6	53.5	49.5	47.5	42.5	33.5	Line 14
Combined SPL					55.7	52	52.7	56	52.5	51.1	46.1	37.1	Line 15
Criterion NC			25		54	44	37	31	27	24	22	21	Line 16
Add decibel safety factor	3				3	3	3	3	3	3	3	3	Line 17
Required insertion loss					5	11	19	28	29	30	27	19	Line 18
Dynamic insertion loss of selected silencer					8	14	20	37	47	32	26	24	Line 19